Industry and individuals: branding, labelling, and marketing of food products

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Industry and individuals: branding, labelling, and marketing of food products

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Editorial: Industry and individuals: branding, labelling, and marketing of food products

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Editorial on the Research Topic
Industry and individuals: branding, labelling, and marketing of food products

Some of the most important changes nowadays are those that concern our eating behavior. In this decision-making process, a whole series of factors shape our perceptions, attitudes and behavior. These factors are in turn the expression of radical transformations based on the advance of technologies, changes caused by the post-pandemic crisis, environmental challenges and substantive changes in the global economy. Our Research Topic proposed to take a look from various perspectives and various scientific backgrounds into these factors and the way in which consumers are responding to certain stimulus. Studies have shown that consumers are sensitive to sustainable labeling and trusted sources such as governments or public authorities that can back up the labeling process (1). Labeling that uses different simple and intuitive cues is more efficient and elicits a faster response in terms of consumers' decisions. We observe efforts made in the legislative field to help food consumers to make more informed and healthier choices based on the food products front labeling (2, 3). A sustainability labeling framework (that can include regulatory measures for green claims, managing efficiently origin labeling, etc.) is needed and seen as an essential solution for the optimization of food consumers perceptions (2, 4). Consumers are often sensitive to information and stimuli that can raise their level of self-awareness and positive self-image. Food and packaging-related eco-labels have been highlighted as extrinsic cues able to affect consumers' perception of food quality and safety (5). There is a need to investigate reading labels in fine-grained models, adapted to different types of labels and different contexts of reading (6). The level of consumers' trust, and by extension, their positive decisions toward healthier food products, can be optimized through a substantial effort to inform them about the new smart packaging technology and its benefits (7). This effort is educational in its nature—consumers being taught how to recognize proper nutritional information and how to combine it in order to maximize their consumption (along with budgetary concerns and other consumption barriers that can prevail in certain situations).

In our complex global environment, dietary choices are more and more influenced by factors like nutritional information, brand values, package design etc. The papers from the "*Industry and Individuals: Branding, Labelling, and Marketing of Food Products*" Research Topic are exploring these factors from a diversified perspective. The aim of the Research Topic was to highlight the complexity of these effects on food consumers, unraveling the interplay between industries and consumer behaviors, their food choices, and purchasing decisions. The papers within the Research Topic proposed new insights from various scientific backgrounds. Seyedhamzeh et al. explore the degree of effectiveness associated with new labeling strategies that are pointing toward the promotion of healthier dietary choices. The paper is referring to an important theme that can be found also in subsequent papers—the importance of transparent and innovative labeling from the point of view of the effect upon consumer behavior. In the paper by Mulligan et al., the focus shifts to a very interesting topic—the influence of cartoon characters used on food packaging upon the children's food choices. This article complements the first by highlighting the specific impact of marketing strategies on young consumers, in the field of food products, highlighting also the need for regulation and ethical marketing practices, when it comes to products addressed to children. Paştiu et al. expand the discussion toward the problems of accessibility in terms of food choices exploring how economic and availability factors in rural settings may influence or affect dietary decisions. Results of their research emphasize once more the importance of informative labeling and ethical marketing in ensuring fair access to nutritional information.

Kikuta et al. further investigates the complex process of building trust in food products through the use and promotion of proper accredited food labels. Authors are emphasizing the role of governmental and organizational oversight to maintain these standards that are important factors capable of influencing consumer decision-making. Trustworthy food labels are seen as perfect tools to optimize consumers' choices over time. Kelly et al. present the critical role that visual design can have in enhancing the effectiveness of nutritional labels. Food products consumers' perceptions can be influenced in a clear manner by the effort to offer easy to understand visual elements, adapted to the communication context of specific food products. Huang et al. propose exploratory research that shed light on consumer psychology—specifically, how nutrition claims can affect Chinese consumers' purchasing decisions. The consumers' need for clear nutritional information is in line with global trends that characterize today's consumers. Modern consumers have become more selective because of the greater access to diversified information sources and literacy, and food products consumption is not an exception. Chilón-Troncos et al. complete these findings with their own research that shows the impact of nutritional literacy on food choices. The study highlighted in a clear manner that informed consumers are more likely to make healthier choices. More and more consumers, from different social and cultural backgrounds are becoming interested in knowing how their food products related decisions can affect their general wellbeing and health status. García-Salirrosas et al. bring a fresh approach to our Research Topic, proposing a

research that investigates how perceived value influences brand loyalty. Marketing effectiveness can be reached only through a clear strategy capable of aligning food products brands perception and consumer core values. With the help of clear positioning attributes, brands are capable of differentiation and the promotion of a clear value proposition. Finally, Zaharia and Gonţa discuss the significant impact of social media on body image and dietary behaviors. This paper shows how digital marketing and social media trends can profoundly affect consumer health perceptions and behaviors. Their research brings into our attention the complexity of psychological factors that are determining certain food consumption behavior and interaction with food products, showing the link with important psychological constructs like self-image, body image and social pressure.

Collectively, these articles provide a comprehensive view of how branding, labeling, and marketing influence consumer dietary choices and behaviors, which was the aim of this Research Topic. Further, they explore the way in which perceptions of the value of healthy foods, nutrition labels and health claims influence purchasing decisions and brand loyalty. Factors such as the psychological effects of promoting healthy foods on social media, the importance of label design and visual product promotion as well as the nutritional literacy and the impact of visual messages on consumers are examined. The role of nutritional literacy is highlighted in emerging markets and rural contexts, the role of label design and visual promotion in facilitating or inhibiting the adoption of healthy eating habits being highlighted also. Gathering information and evidence from various research and scientific backgrounds, readers can reach the conclusion that integrating strategic marketing with nutritional literacy and ethical considerations to promote healthier consumer choices and enhance public health outcomes has the outmost importance.

Author contributions

Conflict of interest

Publisher's note

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Designing a new physical activity calorie equivalent food label and comparing its effect on caloric choices to that of the traffic light label among mothers: a mixed-method study

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Objective: We designed a new type of 'physical activity calorie equivalent' (PACE) food label in Iran to compare its effect with that of the traffic light food label (TLL) on caloric choices.

Design: Mixed-method study.

Participants: Mothers of school children between the ages of 6–12 years.

Setting: In the qualitative phase, 10 focus group discussions (FGDs) were conducted with various groups of mothers, and two FGDs were conducted with food science and nutrition experts to design a new PACE label. In the quantitative phase, 496 mothers were randomly assigned to five groups: (1) no nutrition label, (2) current TLL, (3) current TLL + educational brochure, (4) PACE label, and (5) PACE label + brochure. Samples of dairy products, beverages, cakes, and biscuits were presented. ANOVA and multiple linear regressions were applied to examine the association between label types and calories of the selected products as our main outcome.

Results: The mothers' perspectives were classified into two sub-themes, the PACE label's facilitators and barriers. The new PACE label's characteristics were divided into two subcategories: (a) appearance, and (b) nutritional information, including 14 codes. In the quantitative section, mean calories of the selected foods were lowest in the TLL + brochure group (831.77 kcal; 95% CI: 794.23–869.32), and highest in the PACE label group (971.61; 95% CI: 926.37–1016.84).

Conclusion: The new PACE label was a combination of PACE, TLL, and warning labels. It did not significantly affect lower caloric choice, however, the TLL + brochure option was effective in choosing foods with fewer calories.

1 Introduction

The increasing prevalence of obesity has been, and remains, a major global challenge, where rapid changes in dietary and food behaviors –and as a consequence, excess energy intake- are the main causes of this rising trend (1). According to recent studies, the rates of mortality caused by non-communicable diseases (NCD) are higher in low and middle-income countries (2, 3).

Energy imbalances and physical inactivity in children and adolescents are of particular concern (4). Member states of the World Health Organization (WHO) agreed to reduce physical inactivity by 10% by 2025, and operational policies are underway in 56% of these states (5); Iran also aims to reduce its physical inactivity by 20% by 2025 (6). Therefore, in order to mitigate this harmful trend, an effective policy must be developed to target both unhealthy diets and physical inactivity (4). However, these policies may be implemented differently in various countries or in different populations, e.g., children (7, 8).

Nutrition labels, taxes, and subsidies on healthy foods are examples of policy interventions that can target public behavior and the environment. Food labeling, in particular, has attracted the interest of researchers and policymakers, since it is considered as a nudging strategy that can encourage healthier eating (9). However, the main limitation of food labels' effectiveness is the difficulty in understanding their information (10). Various types of numerical and interpretive labels, such as nutrition fact, traffic light, and star rating labels exist in different countries (11–13). However, there is no consensus among investigators on the impact of nutrition labels on food behavior (14–16).

Traffic light labels (TLL) were first invented by non-governmental organizations in the United Kingdom in the early 1990s (17). After multiple researches, it was agreed to announce the amounts of four nutrients including, sugar, sodium, fat and saturated fatty acids using green, yellow and red colors, the colors of traffic lights. Each of these colors indicates low, medium, and high, respectively (17). Numerous studies have assessed the impact of TLL on healthier food selection (18–21); most of them have indicated TLL as an effective tool in healthier food choices. The results of a systematic review and meta-analysis study showed that TLL was marginally more effective than the Guideline Daily Amount (GDA) and other food labels in increasing the selection of healthier options (22). An important point about the studies on TLL effectiveness is that many of these studies have been done on food products such as pizza, sandwiches, popcorn and breakfast cereals.

Recently, a new type of label that takes physical activity into consideration has been examined in different studies in high-income countries (23–29) that shows the amount of physical activity needed to 'burn off' calories. Thus, this label employs a multi-disciplinary strategy that combines both caloric content and physical activity. Therefore, it can help to improve public awareness about the importance of physical activity in reducing the trend of obesity; it can also lead to a healthier lifestyle among the general population (30, 31) A recent systematic review and meta-analysis of randomized controlled trials and experimental studies revealed that, compared to other food labels, using physical activity calorie equivalent (PACE) labeling can be helpful in consuming significantly fewer calories by the public (32). Nonetheless, perceptions about PACE labels have not been sufficiently investigated, and the existing literature has been restricted to high-income countries (33).

Although food labels have been used in Iran for many years, studies show that consumers' usage rates are low (34, 35). Among the reasons behind food labels' inefficacy are their incomprehensibility and the high load of information presented in them. In recent years, the use of traffic light labels in packaging products has become mandatory in Iran, but many challenges have been raised in the use and interpretation of its colors by consumers and experts. To this end, for the first time in Iran, we sought to design a food label that includes the level of physical activity, by considering the viewpoints of mothers, who overwhelmingly represent Iranian households, alongside food science and nutrition experts (PhD graduates of nutrition and food industry sciences). By doing so, we intended to convey the most important information (in addition to the amount of physical activity needed to burn off calories), as well as the best appearance features to consumers in the shortest possible time, and to encourage them toward choices with fewer calories. To our knowledge, this is the first randomized study to compare the effect of PACE and TLL on packaged food products in Iran.

2 Methods

This study was part of a larger mixed method research in which the strengths, weaknesses, and strategies of improving the use of nutrition labels were discussed (36). Subsequently, a new PACE label was designed based on findings from a qualitative study, and examined in a trial to assess its impact on food choices (quantitative phase). The study's protocol has been published elsewhere, where the method has been discussed in detail (37). Specifically, we investigated whether a label that has been designed based on recommendations made by

Abbreviations: ANOVA, analysis of variance; BMI, body mass index; COREQ, consolidated criteria for reporting research; CONSORT, consolidated standards of reporting trials flow diagram; FGDs, focus group discussions; Kcal, kilo calorie; PhD, doctor of philosophy; PACE, physical activity calorie equivalent; NCD, non-communicable diseases; SRQR, standards for reporting qualitative research; SSBs, sugar sweetened beverages; TLL, traffic light label; WHO, World Health Organization.

mothers (household representatives) and professionals (scientific representatives), could guide consumers to healthier food choices in terms of calories compared to TLL as a mandatory label on food packaging in Iran.

For the qualitative phase, the participants were informed of the research objectives before the interviews. Furthermore, participants were assured that the information would be used only for research purposes, and would not be accessible to those who were not in the research team. For the quantitative phase, written informed consent was obtained from all participants.

2.1 Qualitative phase

A flowchart showing the study's processes is presented in Figure 1. All the sessions were conducted with an investigator (first author, who was a PhD graduate of 'Food and Nutrition Policy') and a note taker trained in qualitative research, using a questionnaire guide (Supplementary File 1). Moreover, all the focus group discussions (FGDs) were transcribed. The Consolidated Criteria for Reporting Research (COREQ) (38) and the Standards for Reporting Qualitative Research (SRQR) (39) were followed in the conducting of this research.

2.1.1 FGDs with mothers as household representatives

Sixty-three mothers participated in our study. The mothers' general characteristics have been presented in Supplementary File 2: Table S1. We chose mothers because women are responsible for the purchase and preparation of foods in most Iranian households (40–42).

Ten FGDs were conducted with mothers of school children aged 6–12 years in ten primary schools from southern, northern, eastern, western, and central Tehran. Two primary schools were randomly selected from each district. This way, we achieved homogenous sampling with respect to the participants' socioeconomic status. Primary school children's mothers were chosen due to the importance of childhood obesity and their role as gatekeepers and choosing food. Primary schools in Iran include 6–12-year-old children. As mentioned earlier, 2 schools were randomly selected from the northern, eastern, western, central and southern areas of Tehran. All participants were literate and willing to participate. Mothers who were nutritionists or food technologists were excluded from the study; however, there were no limitations on their age. Mothers were invited to the respective schools by phone, and we continued recruitment until at least 6 mothers –who met our selection criteria- agreed to participate. All sessions were recorded with a voice recorder, after obtaining the participants' consent. FGDs consisted of two parts: in the first part, the existing labels were discussed, and in the second part, the mothers were asked, for an average of 75 min, about the new PACE label. The researcher used a guide for asking questions (Supplementary File 1: Table S2). The concept of a PACE label was introduced to the mothers through products such as cakes with different calories, and as these products had different amounts of calories, the suggested physical activity for each label was different. Several initial layouts of the PACE labels were designed by a graphic designer based on the mothers' points of view for further discussion in the experts' FGDs. Interviews continued until data saturation was reached.

2.1.2 FGDs with experts

Two FGDs were held with 'food science and nutrition experts' (hereinafter referred to as 'FSN experts' for the sake of brevity). For this group, the sampling method was purposeful and FSN experts from two universities of Tehran participated in the FGDs. First, official letters were sent to the Heads of Departments of Nutritional Sciences and Dietetics and the study objective was explained. Then, a day was

FIGURE 1
Study flowchart.
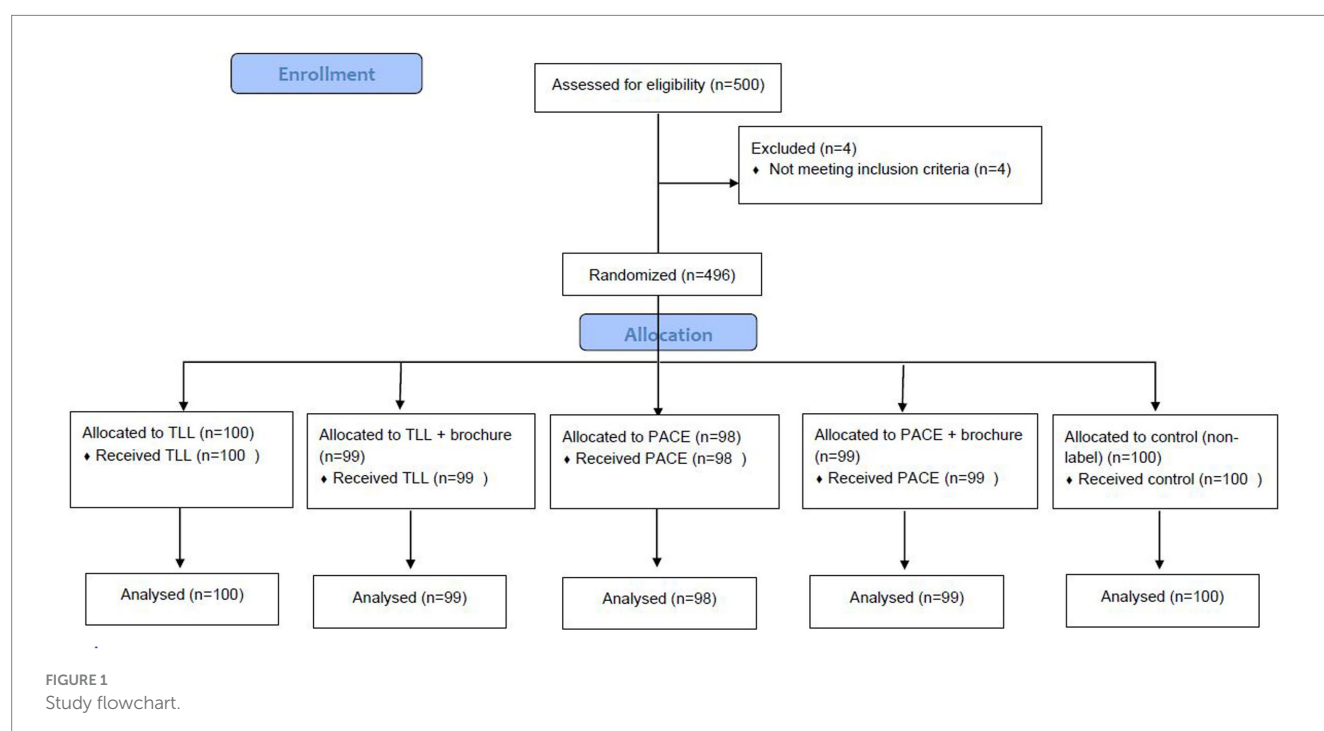
coordinated to hold the FGD with the aforementioned professionals. The FGDs with FSN experts were conducted with 6 PhD graduates of nutrition and 8 PhD graduates of food sciences from universities in Tehran.

The mothers' expectations regarding the PACE labels were discussed and the FSN experts' comments were collected in two separate FGDs. The average duration of each FGD was about 1 h. The labels were then amended upon consensus among the researchers and sent to the mothers to outline the final format of the PACE labels. Most of the changes the mothers requested pertained to the appearance of the new PACE label. Ultimately, the final versions of the new labels were designed.

2.1.3 Label printing

After confirming the label image for print, we had to determine the size and definitions on each label. For this purpose, the information on the purchased products, such as definitions of serving, weight of each serving, total weight of the product, and the label size were entered into Excel 2010 software, and understandable serving, label size, energy, sugar, salt, fat, physical activity level per minute, required number of labels, and color were added to the information of each product. According to the size of various food labels on the products, the 2×3 cm size was applicable to all dairy products, cakes, biscuits and sugar-sweetened beverages. After print, the readability of the labels was confirmed by the researchers.

2.1.4 Qualitative phase data analysis

The conventional content qualitative analysis approach was applied to determine the main themes (43). This method is used when there is insufficient evidence and inaccurate data on a specific topic or phenomenon.

All the FGDs were transcribed verbatim and typed in Microsoft Word. Notes taken by the note taker were added to the transcription to ensure accuracy and clarity of any instances which might not have been recognized by the transcriber. The MAXQDA 10 software was used to help qualitatively analyze the interviews. We identified the themes after systematically coding the data by reading and re-reading (43). In this technique, the text was read like a novel and key words or sentences that addressed the concepts and perspectives were marked. Thereafter, the text was re-read several times and codes relevant to one or several topics were recorded. Similar codes were then presented as themes. After reaching consensus, investigators developed a codebook with detailed transcriptions. To ensure validity and reliability, after the initial analysis of the interviews, approximately half of them were sent to the interviewees and were analyzed after their approval was obtained. Upon analyzing the transcriptions, approximately 40% of them were sent to the co-investigator and re-examined for consistency of coding (inter-coder agreement: 91%). The analysis results were approved by a quality-assurance supervisor.

2.2 Quantitative phase

Similar to the qualitative phase, the participants were mothers of 6-12-year-old schoolchildren. Ten schools were randomly selected from the same regions used in the qualitative phase, but the schools were different this time, so the mothers would be blinded toward the study goal regarding their caloric choices. The inclusion criteria were the same as those in the qualitative phase.

2.2.1 Sample size calculation and randomization

Using G*Power software, sample size was calculated based on caloric choices –which is the primary outcome of our study. A sample size of 481 was calculated considering the expected effect size of 0.15, $\alpha = 0.05$, and power$= 90\%$ (44). To account for potential attrition, a sample size of 500 was estimated (100 in each arm).

We applied stratified block randomization, using STATA software, where stratums were schools, and each stratum contained five blocks of ten.

2.2.2 Study procedure

First, a pilot study was conducted in one school (on 50 mothers) to assess the likely problems, practicality, and feasibility of the study. In the second phase, mothers were randomized into five arms, including the traffic light label (TLL)- which is currently mandatory in Iran-, TLL plus the educational brochure (Supplementary File 2), PACE, PACE plus the educational brochure, and without the label arm, using a randomization list. PACE was initially designed by a graphic designer and changes were made based on recommendations made by mothers and specialists. The demographic questionnaire and international physical activity questionnaire (IPAQ) were filled before the participants were offered different food choices (Supplementary File 3). The Consolidated Standards of Reporting Trials (CONSORT) flow diagram is presented in Figure 2. The participants were blinded to the primary objective of the study and were told the objective was to identify "factors affecting a family's food choices and their impacts on children's nutritional status and anthropometrics." Food selection was performed among 42 dairy products, 29 beverages, and 38 cakes and cookies (Figure 3). Each participant was allowed to select 8 food products from 8 food groups including 1-milk, 2-flavored milk, 3-cheese, 4- yogurt, 5-juice, 6-carbonated drinks, 7-cakes, and 8-biscuits and wafers. In each group, food products had different calories and so there were options with fewer calories. The food products were provided from a chain store and were from well-known brands. Participants were requested to suppose they were in a supermarket and to choose their preferred products among the provided foods. They were also requested to read a brochure before they began to purchase the products.

2.2.3 Quantitative phase data analysis

Continuous variables were analyzed by analysis of variance (ANOVA) (comparing mean calories of selected foods between the groups), and categorical variables by chi-square tests [comparing general characteristics including marital status, education, economic status, satiety status, BMI (normal/overweight/obese), and physical activity]. Linear regression was used to assess the relationship between the types of labels and the primary outcome, which was the caloric choice of select products. To adjust for the effect of potential confounders (age, economic status, education, job, BMI, and physical activity), multivariable linear regression was used. The potential confounders were assessed using a demographic questionnaire (Supplementary File 3). All tests were conducted using STATA 16, and type I error was considered as 0.05.

FIGURE 2
The food products used for the study.

FIGURE 3
The food products used for the study. **(A)** Shows energy (Cal), Serving size (g)/(mL), sugar (g), fat (g), salt (g), *trans* fatty acids (g) (green: low, amber: medium, red: high). **(B)** The first PACE label designed: first row represents the salt, fat and sugar content in different colors; energy (Cal), the amount of physical activity. Second and third rows are similar to the first row but different in image design due to the participants' viewpoints (green: low, amber: medium, red: high). **(C)** The second PACE label designed with the clause "low amount and high amount of salt/fat/sugar," energy and the duration of physical activity required to burn off calories (green: low, amber: medium, red: high). **(D1)** One packet (200 mL), energy: 150 Kcal, sugar: high (red), 22 min brisk walking. **(D2)** One packet (200 mL), energy: 92 Kcal (green), 14 min brisk walking.

3 Results

3.1 Qualitative phase: designing a new PACE label

In this section, two main themes were defined. First, the mothers' perspectives on PACE were examined, and then the new label's expectations were drafted upon taking into account the viewpoints of mothers and FSN experts. The aforementioned are presented in Supplementary File 1: Table S3.

3.1.1 Mothers' perspectives as household representatives

Mothers' perspectives were classified into two sub-themes, the physical activity label's facilitators and barriers. The facilitators were categorized into four codes: 1- healthier food choices, 2-easy to understand, 3-suitable solution, 4-creating incentives to lose weight and be physically active. The barriers were categorized into the following four codes: 1-no impact on level of activity, 2-lack of significance, 3-economic problems, 4-lack of time.

3.1.1.1 Facilitators

Most mothers' perspectives on PACE labeling were positive.

> *"It's very good to know how many calories you are receiving and how much activity you must have to burn them off"* (35-year-old mother).

The most important facilitator of the PACE label, according to the mothers, was choosing healthier foods. Some mothers believed that such a label did not require any specialist knowledge of nutrition. Furthermore, since the concept of physical activity –such as walking- is more comprehensible than calories, it can be easier to understand for the general public. Others stated that physical activity could be a suitable solution for certain food items of interest. If weight reduction was an important consideration for the individual, it could motivate them to increase their physical activities.

3.1.1.2 Barriers

Economic problems were mentioned as a major barrier for using the label. However, this was not mentioned for the PACE label alone. Lack of time was also mentioned as a probable barrier. Some mothers believed that PACE would change their food choices but not their physical activity habits, thus lack of impact on level of activity was another mentioned barrier. Based on their opinions, PACE primarily affected their food choices, but physical activity would gradually change over time, or be used more often by athletes or people actively concerned about their fitness.

Very few mothers (two) said that even if the label was very simple, it would still have no significant impact on their food choices. Therefore, even if the label were simple in its design or appearance, it still may not affect their choice of food selection.

Not all mothers agreed on how these labels would affect their children's choices. Some mothers were certain that they would improve their children's food behavior, while others considered them as ineffective. The reasons given for these dissimilar opinions were, the children or their family habits and, the influence of their peers. Indeed, some participants were certain that this type of label could change

their children and their own behavior toward eating foods, leading to healthier food choices in the family.

> *"When a child sees that his or her parents care about everything, that child too, will learn to do so."* (30-year-old mother).

3.1.2 Mothers' expectations of the new PACE label

The participants unanimously agreed that graphics were more understandable than digits. They also said that walking was the most feasible form of physical activity, as compared to other exercises, such as swimming. Colorful labels were highly recommended, especially for children. In addition, most of the mothers believed that using both PACE and TLL (Figure 3A) would be more effective. Another point raised by the mothers was the location of the label. They said that nutrition labels were mostly positioned at the back of packages, at inappropriate locations, and that they were mostly illegible; they had to spend a lot of time finding and reading the labels, thus, they might be overlooked. Many suggested that the nutrition label should be near the production/expiry date, where it would be noticed, or near the brand name, on the front of the package. The participants believed "walking duration" in minutes was a more appropriate term than "walking distance" in kilometers. In their opinion, every single nutritional fact was important, such as the general and detailed information about fat, sugar, salt, vitamins and minerals, calorie content and understandable portion size. However, this may not be possible, because printing all of this data in the form of colorful graphics can affect the labels' legibility.

Taking the mothers' viewpoints into consideration, with the help of our graphic designer we designed three different PACE labels by the end of the FGDs (Figure 3B). We simplified the images by excluding certain variables, such as age and gender, to produce an applicable label. In order to convert calories into physical activity, walking at 5.6 km/h, an average energy consumption of 6.7 kcal/min, and an average weight of 70 kg were considered for the calculations. For example, a pack of cake with 228 calories required 34 min brisk walking to burn off. The investigators collectively agreed on the second image; however, the walking image was changed to brisk walking in order to better represent the information (Figure 3C).

3.1.3 Experts' expectations of the new PACE label

The food science and nutrition (FSN) experts approved the graphic design of the new label, and believed it to be easily understood by the public. However, some of them suggested the PACE information to be included in the nutrition fact table.

All the experts believed that using a single color instead of three would simplify matters for the consumer. They believed that consumers ought to be provided with vital, yet concise information. Drawing from our results, we decided to use one of the green or red colors on the labels to highlight the high amount of fat, sugar, and/ or salt. Based on Iran's Food and Drug Administration guidelines (45), if any of the fat, sodium, or sugar contents of a product are in the red zone (high), the red label should be used (the cutoff points used for allocating a color to a food product based on the values of fat, sugar and sodium have been listed in Supplementary File 1: Tables S4A,B). In addition, the clause "high in fat/sugar/sodium," along with calorie content, serving size, and

recommended physical activity will be included in the label. However, if the abovementioned content levels are in the amber (medium) or green (low) zones, only the green label will be used along with calorie content, serving size, and recommended physical activity. Regardless of the label's color, the minutes of physical activity required to burn off the calories must be provided. Thus, the second format of the picture (Figure 3B) was selected. Finally, the new labels were designed in red and green. The red label provides extra information on the high amount of fat and/or salt and/or sugar. After taking into account the FSN experts' opinions, and a consensus among the investigators, the labels were sent to the mothers. They were asked to select their preferred label(s) and/or make changes that would improve their food choices. They believed that walking was a more popular activity, so people may find the information more applicable to their lives.

> "*The picture suggests running instead of walking, which is a limitation and may not be possible for many women in Iran.*" (45-year-old mother).

Thus, the figurative label was slightly amended based on the mothers' opinions (Figure 3D) and the new PACE label was designed after considering all the stakeholders' viewpoints.

3.2 Quantitative phase: assessing the effect of the new PACE and TLL

The general characteristics of participants of different groups are presented in Table 1. A total of 496 mothers participated in the study. There were significant differences between the groups in terms of the participants' age, education, and physical activity. Moreover, the blocks were matched according to gender and location.

3.2.1 Calories of selected foods

The mean calories of all the selected foods, based on the food groups, including dairy, sugar-sweetened beverages, cakes, and cookies have been listed in Table 2. The calories of the selected foods ranged from 334 to 1,425 kcal. The PACE label did not have a significant effect on choosing products with fewer calories compared to other groups. The total calories of the foods selected in the TLL + brochure group were significantly fewer compared to the other groups. Furthermore, the calories of dairy, sugar-sweetened beverages, cakes, and biscuits in the TLL + brochure were also lower than the others; however, the difference was statistically significant only for cakes and biscuits.

Comparison of the intervention groups with the control group indicated that after adjusting for the confounders, only the TLL + brochure group's selected calories were significantly lower than the control group (caloric diff = −76 Kcal; $p = 0.01$). Conversely, the PACE label's calories were significantly higher than the control group's (caloric diff = 61 kcal; $p = 0.04$). The differences between TLL as well as PACE+brochure and the control groups were insignificant (Table 3).

With regards to the confounders' effects, each year increase in maternal age was associated with a decrease of 1.41 kcal in the selected calories, however it was not statistically significant. Improvement of the economic status was associated with a decrease in the selected calories by 2 kcal, but it was not significant. A rise in the education

level yeilded an insignificant decrease of 10 kcal in the seclected calories. Employed mothers chose about 38 kcal more than housewives, but it was not significant. In obese individuals, each unit increase in BMI yeilded an increase of 104 kcal in the selected calories, and was statistically significant ($p = 0.001$). Finally, each metabolic equivalent/min/week increase in physical activity level was associated with a non-significant decrease of about 13 kcal in the selected calories ($p = 0.48$) (Supplementary File 1: Table S5).

After adjusting for the other confounders (age, economic status, education, BMI, and physical activity), only BMI was significantly effective, such that obese individuals selected more calories (~114 Kcal).

4 Discussion

4.1 Qualitative phase

We designed a new label which is a combination of the traffic light, warning (46), and physical activity labels (47). It provided information about caloric content, serving size, and recommended physical activity with the clause "*high in* sugar/salt/fat." As a result, the consumer will see either one of the green or red colors, and will be warned of the potentially harmful content/s. Therefore, this type of label can easily be understood, regardless of the consumer's level of education. The color amber, which represents TLL's medium level, was omitted to make its printing easier for manufacturers.

The PACE label was first designed by Swartz et al. (47) and was examined in various studies on a variety of foods, such as fast foods (23, 24, 27), snacks, and beverages (26, 27, 48) to discern its effectiveness. However, these studies' findings were inconsistent (49–51).

In one study, a warning label was assessed for certain products that were high in sugar, sodium, and saturated fats (52, 53). The warning label was designed to prevent the rising trend of obesity; however, it only provided details about the high amounts of nutrients that had adverse effects on consumers' health using the color black, which is associated with reduced perceptions of food healthiness. In our new label, not only are high amounts of the abovementioned nutrients presented, but consumers are also warned about the unhealthiness of the nutrients' levels by presenting them in red color. Further information, such as caloric content, serving size, and recommended physical activity help provide customers with sufficient details to decide whether or not to purchase a product.

The findings of our study were concordant with the studies in which environmental and individual factors were assessed in menu labeling utilization. In Schindler et al.'s study, the most frequently cited barriers to menu label utilization were price and time constraints (54). The result of another study showed that parents' decisions on what fast food items to order for their children might be affected by PACE labeling. Thus, this labeling could encourage them to get their children to exercise (27).

4.2 Quantitative phase

The PACE label failed to influence food choices in terms of caloric content. The lowest calories of the foods selected were seen in the TLL + brochure group in the pairwise comparison of the intervention

TABLE 1 General characteristics of participants in the quantitative phase.

Variables	Total N (%)[a]	Groups					p-value[b]
		Without label N (%)	TLL N (%)	TLL + brochure N (%)	PACE N (%)	PACE + brochure N (%)	
Participants	496 (100)	100 (20.2)	100 (20.2)	99 (20)	98 (19.8)	99 (20)	
Marital status (married)	480 (96.86)	97 (97)	98 (98)	94 (94.9)	95 (96.9)	96 (97)	0.30
Education (academic education)	189 (38.1)	53 (53)	29 (29)	19 (19.2)	50 (51)	38 (38.4)	<0.001
Family members ≤4	436 (87.9)	84 (84)	90 (90)	83 (82.3)	91 (82.6)	89 (89.9)	0.06
BMI (kg/m²)[d]							
Normal (18–24.9)	154 (31.17)	30 (30)	32 (32)	36 (36.7)	32 (32.7)	24 (24.5)	0.65
Overweight (25–29.9)	211 (42.71)	44 (44)	40 (40)	37 (378)	37 (37.8)	49 (50)	
Obese (>30)	129 (26.11)	26 (26)	28 (28)	29 (29.6)	29 (29.6)	25 (25.5)	
Economic status based on assets							
Highest	100 (20.2)	19 (19)	23 (23)	26 (26.3)	19 (19.4)	13 (13.1)	0.37
High	99 (20)	22 (22)	23 (23)	24 (24.2)	17 (17.3)	13 (13.1)	
Moderate	99 (19.4)	19 (19)	20 (20)	14 (14.1)	22 (22.4)	24 (24.2)	
Low	100 (20.2)	23 (23)	15 (15)	17 (17.2)	19 (19.4)	26 (26.30)	
Lowest	98 (19.8)	17 (17)	19 (19)	23 (23.2)	21 (21.4)	23 (23.2)	
Occupation							
Housewife	395 (79.64)	83 (83)	80 (80)	83 (83.8)	75 (76.5)	74 (74.7)	0.08
Worker	6 (1.21)	1 (1)	1 (1)	3 (3)	1 (1)	–	
Farmer	14 (2.82)	3 (3)	4 (4)	–	2 (2)	5 (5.1)	
Employed	14 (2.82)	4 (4)	1 (1)	–	6 (6.1)	3 (3)	
Administrative staff	19 (3.83)	2 (2)	6 (6)	6 (6.1)	4 (4.1)	1 (1)	
Retired	2 (0.4)	1 (1)	–	1 (1)	–	–	
Self-employed	45 (9.7)	6 (6)	7 (7)	6 (6.1)	10 (10.2)	16 (16.2)	
Satiety status using visual analog scale							
Very hungry	35 (7.06)	11 (11)	8 (8)	6 (6.1)	6 (6.1)	4 (4)	0.8
Quite hungry	72 (14.52)	11 (11)	17 (17)	18 (18.2)	13 (13.3)	13 (13.1)	
Not hungry or full	135 (27.22)	24 (24)	28 (28)	28 (28.3)	24 (24.5)	31 (31.3)	
Quite full	119 (23.92)	25 (25)	22 (22)	20 (20.2)	26 (26.5)	26 (26.2)	
Full	134 (27.02)	29 (29)	27 (27)	25 (25.3)	29 (29.6)	25 (25.2)	
Physical activity score (ME/min/weak)[c]							
Light	344 (71.67)	80 (87.9)	71 (74.7)	69 (71.1)	61 (62.6)	63 (63.6)	0.007
Moderate	122 (25.42)	11 (12.1)	22 (23.2)	25 (25.8)	33 (33.7)	31 (31.3)	
Vigorous	14 (2.92)	-	2 (2.1)	3 (3.1)	4 (4.1)	5 (5.1)	
Age, years [Mean (SD)]	38.5 (6.87)	38.2 (4.82)	36.77 (4.86)	36.87 (5.63)	39.5 (4.84)	40.80 (13.10)	0.002

[a]The values are numbers (percentages) for all variables except for 'age', where the values are means (standard deviations). [b]Values were obtained from one-way analysis of variance for quantitative variables and chi-square test for qualitative variables. [c]Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ). [d]BMI: body mass index; ME: metabolic equivalent; PACE: physical activity calorie equivalent; TLL: traffic light label.

vs. control group. The calories of the selected foods in the TLL+ brochure were 76 kcal less than the control; however, this value was lower than the minimally clinically significant difference of −115.2 (55). Although when compared to the control, without the brochure, the TLL and PACE labels did not lead to reductions in the selected calories, the addition of an educational brochure led to reductions in the selected calories. The selected calories of the TLL + brochure group were 90 kcal lower than in the TLL group, and in the PACE+brochure

TABLE 2 Mean calories (kcal) and 95% confidence intervals of all the selected foods, based on the food groups, including dairy, sugar-sweetened beverages, cakes and biscuits.

Food products	Without the label (n = 100)	TLL (n = 100)	TLL + brochure (n = 99)	PACE (n = 98)[a]	PACE + brochure (n = 99)	p-value
All products	918.21 (877.367,959.05)	921.29 (880.16, 962.41)	831.77 (794.23, 869.32)	971.61 (926.37,1016.84)	916.73 (875.19, 958.28)	0.0001
Dairy	508.69 (478.34, 539.03)	493.2 (462.95, 524.44)	475.51 (449.01, 502.01)	531.1 (496.70, 565.49)	505.68 (473.59, 537.77)	0.15
Sugar-Sweetened beverages	109.65 (94.02, 125.27)	118.63 (104.13, 133.12)	99.96 (82.83, 117.10)	112.55 (96.90, 128.19)	108.13 (92.41, 123.85)	0.57
Cakes and biscuits	299.87 (277.01, 322.72)	309.46 (284.27, 334.64)	256.29 (10.91) (234.84, 277.74)	327.95 (300.01, 355.90)	302.91 (276.03, 329.80)	0.002

The mean calories of all food products were significantly fewer in TLL + brochure than in the other groups (without label, TLL, PACE, PACE + brochure). For the food groups, the calories of cakes and biscuits were significantly fewer in the TLL + brochure compared to the other groups. No significant relationship was found between the groups for other food groups. The reported values are means (standard deviations). P value was obtained using the ANOVA method. [a]PACE: physical activity calorie equivalent; TLL: traffic light label.

TABLE 3 Comparing the effects of PACE and TLL on calories of selected foods – bearing in mind the confounders'[1] effects.

Comparisons	β Coefficients (95% CI)	p-value
Calorie intake (kcal, PACE / TL)	23.31 (−9.28, 55.91)	0.16
Mothers' age (year)	0.91 (−5.66, 7.50)	0.78
Economic status based on assets[2]	−8.85 (−30.76, 13.06)	0.42
Education level (academic, non-academic)[3]	16.13 (−86.69, 118.96)	0.75
Occupation (employed, housewife)	55.80 (−21.33, 132.93)	0.15
BMI[4]		
Normal	Ref	
Overweight	8.12 (−66.32, 82.57)	0.83
Obese	114.27 (34.18, 194.36)	0.005
Physical activity[5]	16.24 (−42.06, 74.55)	0.58

[1]The confounders were age, economic status, education, occupation, BMI, and physical activity. [2]Assets were categorized into quintiles from lowest to highest (The reference category was the lowest economic status). [3]The reference category was non-academic education. [4]Physical activity was categorized into tertiles (light, moderate, vigorous). [5]Multivariable regression was used to compare the effect of the PACE label to TLL on the calories of selected foods. PACE: physical activity calorie equivalent; TLL: traffic light label.

they were 55 kcal less than the PACE group. After adjusting for all the confounders, no change was observed in the primary outcome, and, yet, the TLL + brochure group selected the lowest calories.

We may explain why the TLL + brochure combination was more effective than the PACE+brochure one. The first hypothesis is that participants were unfamiliar with the PACE labeling, and although the addition of an educational brochure reduced the amount of selected calories, the reduction was not significant. This hypothesis maybe to some extent reinforced by a study condcuted in poland to identify predictors of food label use (56). They found only one predictor which was self-rated knowledge about nutrition healthiness for label reading. The second probable reason could be that the participants were already familiar with the TLL, but did not know how to use it; indeed, they were guided to a better choice

with the help of an educational brochure. The last putative explanation is that the TLL label is simpler than the PACE label, however, more studies are needed to compare the two types of labels. In their study on 172 adults, Blackham et al. assessed the comprehensibility of calorie labels, TLL, and PACE for fast-foods using a questionnaire (57). Consistent with our results, 66% of the participants chose TLL as the most comprehnsible, 18% chose PACE, and 11% chose the calorie label. Two recent studies examined the effects of PACE labels on consumer preferences for healthy and unhealthy foods. In an online survey conducted on 570 Chinese men and women (29), walnut stuffed red dates were considered as the healthy and potato chips as the unhealthy food choices. The participants were randomized into walnut stuffed red dates and potato chips groups, and each group had four choices (1. standard kcal label; 2. a label showing the minutes of walking; 3. running needed to burn off the calories; and 4. a condition without a label). The results indicated that labels enhance the utilization of healthy foods. Moreover, the most positive attitudes were expressed toward the PACE labels rather than the kcal label. One explanation behind the conflicting results of our study and Yang's may be that their respondents had higher levels of healthy behaviors than the societal average. Elsewhere, another study was conducted on 91 students at a German university to assess the visual attention of PACE labels using eye-tracking technology (28). Participants made choices among 162 snacks –all of which had PACE labels, and 22.91% viewed the PACE label, at least once, for a total mean view time of 3.51 s. However, in the questionnaire administered to the participants, only 8% mentioned noticing the PACE label when purchasing the snacks, and although the general choices they made were healthy, they declared having no specific 'health' goal.

Upon comparing the food categories (dairy, sugar-sweetened beverages, cakes, and biscuits) between the study groups, TLL + brochure yeilded the best choices for all the food groups. The maximum difference, which was about 72 kcal, was seen between the TLL + brochure and PACE groups for cakes and biscuits. For dairy products, the largest difference was observed between the TLL + brochure and PACE groups (55 kcal). Finally, in the sugar-sweetened beverages category, the maximum difference was found between the TLL + brochure and TLL groups (19 Kcal).

An earlier study (58) indicated that being female, having a higher educational status and physical activity were associated with higher

rates of utilization of nutrition labels, which is consistent with the current study. Based on our findings, individuals with a higher level of education chose fewer calories in all the intervention groups compared to the control. However, in the pairwise comparison of TLL with PACE, and TLL + brochure with the PACE+brochure, for each unit increase in the level of education, higher calories were chosen by the mothers, although it was not statistically significant. Perhaps, more importance should be placed on nutritional knowledge, not on educational level alone. Indeed, results of a review study indicated that nutritional knowledge or nutrition education can have a direct impact on the use of nutrition labels (59).

4.3 Policy implications

Based on our findings, it seems that traffic light labels, when accompanied by a brochure, can lead consumers toward food choices with fewer calories.

4.4 Limitations

Certain inevitable limitations always exist in qualitative studies, and must be considered when interpreting the findings. Usually, mothers are responsible for the purchase of foodstuff in Iranian households. Therefore, we chose to only interview the schoolchildren's mothers, and not their fathers, who may have held entirely different opinions. Indeed, with the changing landscape of societal expectations around the roles of males and females, it would be pragmatic to evaluate fathers' perspectives as well in future research. Additionally, we used a variety of dairy products with familiar brands. We'd recommend examining the impact of the PACE label on both familiar and unfamiliar products in future studies.

We endeavored to consider every viewpoint presented by the mothers when designing the new label. However, certain ideas, such as the use of all-macro fonts, and/or the inclusion of micronutrients in the labels were not feasible. However, we covered more important and comprehensible details regarding the FSN experts' opinions. In the new label, we simplified our design, by excluding variables such as age and gender. The primary purpose of this study was to design a label which would help people make healthier food choices. We have facilitated this by using a legible font on a colored label that provides consumers with explicit and concise information.

In the quantitative phase, each of the TLL and PACE labels were examined alone and in combination with an educational brochure. To the best of our knowledge, to date, no study has compared PACE and TLL labels in such a way. The main limitation of our study was the one-time exposure to labels, which, particularly in the case of physical activity labels, could have led to its reduced effectiveness as opposed to the TLL. However, the multiplicity of groups, limited time and finances, and difficulty of implementation (lack of school facilities - food spoilage) did not allow us to expose the participants to the labels more than once. Moreover, because the mothers were blind to the purpose of the study, it was practically impossible to expose them several times. Here, the mothers' education was assessed alone, and their nutritional knowledge was not examined. We therefore recommend evaluating nutritional knowledge in future studies as well. Additionally, it should be noted that physical activity does not eliminate the negative metabolic effects of the food eaten, although our new label also

reported higher levels of salt, sugar and fat. Another limitation was that in this study, sampling was done from Tehran. The city accounts for about 10% of the total population of Iran, and due to budget limitations, we could not do it in other cities, but future studies can be done in other provinces as well to ensure the generalizability of results.

Finally, we wanted to design a new PACE label. Though we could not predict what the new label would look like at the beginning of the study, we wanted to make sure it was based on the physical activity information needed to burn calories. This new PACE label also contains information on the amount of sugar/sodium/fat (if present), which is shown in red color and the clause "high in sugar/sodium/fat." Since both the traffic light label and the new label were colored, we think that the color effect was present in both types of labels.

5 Conclusion

The new label presented in this study is a combination of the physical activity, traffic light symbols, and warning labels. According to the mothers in the qualitative phase, the new label helped them make lower caloric choices, even in those with the lowest level of nutritional knowledge. In the quantitative phase, we failed to find any effect of PACE and PACE+brochure on healthier food choices. However, we may arrive at different results if we examine its effect on the selection of restaurant food in future studies, where participants have already been taught about the label. Moreover, according to the findings of this study, training is an important and necessary tool in the utilization of nutrition labels.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Research Ethics Committee of Tehran University of Medical Sciences (96-03-161-37037). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

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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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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1280532/full#supplementary-material

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The impact of characters like Tony the Tiger and other child-targeted techniques used in food and beverage marketing

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Introduction: Food marketing's impact is a function of exposure and power, both of which contribute to children's poor diet quality and obesity risk. Children's exposure to food marketing is well documented, however, few studies have assessed the impact of specific persuasive marketing techniques or aspects of 'power' on children.

Methods: This study administered an online survey to 1,341 Canadian children (9–12 years) aiming to determine the impact of: (1) child-targeted vs. adult-targeted marketing, and (2) licensed characters vs. spokes characters on children's food preferences and behavioral intentions. Participants were randomized to a single condition in each survey part and viewed 3 static food advertisements displaying the features of that condition (e.g., child-targeted advertising or licensed characters), and answered 3 Likert-scale (5-point) questions after each exposure. For each condition within each research question, there were four outcome variables related to the impact of marketing on children: food preference, purchase intent, pester power, and total impact. ANOVA tested the difference in impact (Likert scores) between conditions overall and for each outcome, with Bonferroni *post-hoc* tests where necessary.

Results: A greater average total impact was observed among children exposed to child-targeted ads (mean Likert score 3.36) vs. adult-targeted ads (mean score 2.75; $p < 0.001$) or no marketing (mean score 2.81; $p < 0.001$). Children exposed to ads featuring spokes characters had a higher average total impact (mean score 3.98) vs. licensed characters (mean score 3.80; $p < 0.001$) and the control (i.e., no characters) (mean score 3.19; $p < 0.001$), and the total impact of licensed characters was greater than that of no characters. Similar trends were observed for all other outcomes.

Discussion: Overall, this study showed that child-targeted ads and those using characters - especially spokes characters - have a strong overall impact on children's food preferences, purchase intents, and pester power, and support the implementation of comprehensive marketing restrictions to protect children.

1 Introduction

The burden of childhood overweight, obesity and non-communicable diseases (NCDs) remains high globally, and in Canada (1–6). There is a well-established link between diet and nutrition-related chronic diseases such as obesity and in Canada, dietary risk is the top behavioral risk factor for death and disability following tobacco (7–11). Canadian children's diets are consistently found to fall short of meeting national dietary guidelines; research shows that child diets are high in ultra-processed foods and low in fruits and vegetables putting them at risk for nutrition-related chronic disease (12–15).

Food marketing has been highlighted as an important causal factor contributing to poor diet quality in children, and to childhood obesity (16–20). Canadian children are exposed to a high volume of food marketing across various media platforms and settings, including television, digital and social media, at school, and in recreational centers, among others (21–26). Recent data from Canada has shown that there were 54 million food and beverage ads on the top 10 child-preferred websites alone over a one-year period, and that children aged 2–11 years in Toronto were exposed to 2,234 food ads in 2019 on television across 36 stations (27). This exposure was propelled by the estimated 628 million dollars in food and beverage advertising expenditures that occurred in Canada in 2019, most of which occurred on television (68%) and digital media (12%) (28). There is also a plethora of evidence indicating that the vast majority of marketing children are exposed to promotes food and beverage products that are of poor nutritional quality that are often high in sodium, sugars and fat (18, 29, 30). Children are particularly vulnerable to the effects of marketing and a series of systematic reviews have documented that unhealthy food marketing impacts children's food preferences, intakes, and requests (16, 18–20). As a result, the World Health Organization (WHO) has recommended that countries develop policies to restrict these marketing practices (30, 31).

The overall impact of food marketing is a function of both children's exposure to food marketing, and the power of such marketing (31). While "exposure" refers to the reach, and frequency of the marketing, "power" refers to its content and design (31). While the bulk of the scientific literature has focused on child exposure to food marketing, research has also documented the power of food and beverage marketing. Although, the types of techniques that are used varies between media (e.g., print media vs. digital), there are many techniques that are consistent across all marketing platforms, such as the use of: promotional characters or brand spokes-characters (like Tony the Tiger), nutrition or health appeals, taste appeals, celebrity endorsements, colorful or eye-catching visual imagery, appeals to fun or humor, emotional appeals, child-appealing themes (e.g., fantasy, adventure), games, toys, giveaways, contests, and more (18, 32–35). Research from Canada studying the power of marketing has elucidated similar trends in the types of strategies manufacturers are employing to appeal to children (25, 26, 36–40).

While there is a growing body of literature describing the power of food marketing, fewer studies have assessed the impact of specific persuasive marketing techniques or aspects of 'power' on children. The use of advergames, for example, have been found to impact children's food choice and intakes (41–44). While some studies have examined and highlighted the impact of various characters on children's attention, recall, preferences, and choice of products (16, 41,

45–53), there are many gaps regarding the impact of specific techniques compared to others. For instance, despite characters being a frequently displayed and generally impactful marketing technique, it is unknown how various types of characters, such as brand spokes characters or licensed characters (i.e., from popular movies or television shows) differentially impact children.

There has also been recent research indicating that children are drawn to marketing techniques that are not typically considered to be targeted at youth, such as appeals to health and nutrition or giveaways and promotions for adult-targeted products (e.g., prepaid gas cards) (54). This is important as children are also heavily exposed to food and beverage marketing targeting older demographics, within child-focused media or settings (e.g., adult-targeted ad featured on a children's television channel), while frequenting mixed-audience settings (e.g., professional sports games) or while consuming mixed-audience media (e.g., prime time television). To date, however, there have been no studies to our knowledge which have specifically studied the impact of adult-targeted food marketing (i.e., with the absence of marketing techniques specifically targeting children) on children's preferences or made comparisons to child-targeted marketing.

Assessing these nuances in impact between different aspects of marketing power is essential to understanding how the specific content and features of food and beverage marketing play a role in children's food preferences and food-related behaviors. These questions have yet to be investigated in the Canadian context and such evidence is critical to informing the development of comprehensive marketing policies that are in line with WHO guidance and ensuring all types of marketing that impact children are being restricted (30, 55, 56). As such, this study aimed to answer two research questions: (1) what is the impact of adult-targeted food and beverage advertisements compared to child-targeted food beverage advertisements on children's food preferences and behavioral intentions; and (2) What is the impact of spokes-characters vs. licensed characters used in food and beverage advertisements on children's food preferences and behavioral intentions? The authors hypothesize that child-targeted advertisements will have a stronger impact on children than adult-targeted advertisements, and that there will be no difference in impact between advertisements featuring spokes-characters and licensed characters.

2 Materials and methods

This study was a cross-sectional study; an online survey was administered to over 1,000 Canadian children to determine the impact of (1) child-targeted vs. adult-targeted food and beverage ads, and (2) ads featuring licensed characters vs. spokes characters. This study was approved by the University of Ottawa Research Ethics Board (H-11-22-8517).

2.1 Participants and recruitment

Participants were recruited for this study by the market research company, Leger. Leger targeted (via email) adult panelists who identify as being parents of children within the intended study demographic by email. For this study, recruitment was aimed at children aged 9–12 years old living in Canada, speaking English or French and

having the ability to complete an online survey. Parents were asked a series of screening questions to determine eligibility and those who met the inclusion criteria were asked to provide informed consent for their child to participate in the survey; children also provided informed assent. Participants were able to complete the survey either in English or in French. Participants were compensated per Leger's usual incentive structure.

Given the study design required to answer the research questions, we aimed to recruit 1,000 children for this study. Based on a recent systematic review and meta-analysis, we anticipated a small effect size (i.e., standard mean difference of 0.3) of food marketing on children's preferences (16). To detect a significant difference of that magnitude between 2 groups in a 2-tailed T test with 80% power, the minimum sample size required per study group was 175 participants. With a sample size of 1,000 children, all conditions for all parts of the study would have at minimum 250 participants, providing adequate power for any given comparison. This number of participants also aligned with budgetary limitations and recruiting feasibility as assessed by Leger. Recruitment was conducted as to be nationally representative (based on provincial population), and quota sampling was used to obtain equal numbers of males/females and children aged 9–10 and 11–12 years. Participants were compensated according to Leger's usual incentive structure. In total, $n = 1,341$ children completed the survey administered by Leger.

2.2 Experimental design

To test the research questions, a survey was administered online to participants by Leger. The first part of the survey consisted of a short demographic questionnaire that was completed by parents on behalf of their child, which asked questions about the child's age, sex, ethnicity, and perceived income adequacy. Children then completed the remainder of the survey on their own.

The children's portion of the survey consisted of 2 parts, each corresponding to one of the research questions on the impact of food and beverage ads: (1) child-targeted vs. adult-targeted (RQ1), and (2) licensed characters vs. spokes characters (RQ2). A summary of the survey parts and conditions is presented in Table 1. Participants were randomized to a single condition within each part of the survey, for which they were asked to view 3 static food advertisements (in random order) displaying the features of that condition (e.g., child-targeted advertising or licensed characters). The order of the survey parts was also randomized. In total, children viewed and responded to 6 advertisements over the course of the whole survey. It is important to note that the present study was conducted as part of a larger study on the impact of food marketing on children. There were thus additional survey parts that were administered to participants to address other research questions, however, only those relevant to the current research will be discussed here.

TABLE 1 Summary of survey parts and conditions.

Conditions	Part 1: RQ 1	Part 2: RQ 2
	Child-targeted ad	Licensed characters
	Adult-targeted ad	Spokes characters
	No marketing (control)	No characters (control)

Following each ad exposure, participants were asked to answer the following Likert-scale questions (5-points, indicated by emojis ranging from sad (1) to happy (5) faces; Figure 1) related to their preference, purchase intent and pester power, respectively: (1) How much would you like to eat/drink this product; (2) Would you choose to buy this product in a store, and (3) Would you ask an adult to buy this product for you?

The ad images children were exposed to were designed specifically for this study. The 3 ads within an individual condition were designed to display similar features relevant to that condition, but differed in terms of the product shown and the specific design of the ad. For instance, within the "child-targeted ads" condition, all images would display a variety of child-targeted marketing techniques (e.g., bright colors, fun themes, child language, cartoons, etc.), but would feature different food products (e.g., yogurt, cereal or granola bars). Similarly, in the "licensed character" and "spokes-character" conditions, different characters (of the same type) were featured in each of the 3 images presented in both conditions. All ads were designed to be gender-neutral (e.g., avoiding stereotypical gendered advertising techniques or characters such as princesses or race cars) and appropriate for children within the study age range. Where possible, ads were for products from brands unfamiliar to children in Canada (i.e., brands from the United Kingdom or Australia) to reduce bias due to pre-existing brand or product preferences. In some cases (e.g., RQ2 – spokes character condition), this was not feasible given the nature of the condition. Additionally, where possible, products featured in the ad images were from "health-neutral" food categories (i.e., not 'junk foods', e.g., yogurt, cereal, granola bars) to avoid bias based on children's known preference for junk-foods (57).

2.3 Outcomes and analysis

Demographic variables were analyzed descriptively. For each condition within each research question, there were four outcome variables of interest related to the impact of marketing on children: (1) Food preference (score from Likert question 1); (2) Purchase intent (Likert question 2); (3) Pester power (Likert question 3); (4) Total impact (average of all Likert scores). These outcome variables are key components of the commonly referenced hierarchy of unhealthy food promotion effects on children proposed by Kelly et al. (58). These outcomes have also been highlighted in most recent WHO-commissioned systematic review and meta-analysis on the impacts of food marketing on children (16). In this survey, a Likert score of 3 was represented by a "neutral face" emoji, so for the purposes of these analyses, an average Likert score greater than 3 (i.e., happy faces) can be interpreted as a positive impact on children, and any score lower than 3 (i.e., sad faces) can be interpreted as a negative impact.

To evaluate the difference in impact between each condition on preference, purchase intent, pester power, and total impact, for each RQ analysis of variance (ANOVA) models were fitted with Likert scores for food preference, purchase intent, pester power and total impact as outcomes; sex (male/female), age (9–10 years/11–12 years), ethnicity (majority, minority), perceived income adequacy (low/high), and condition as fixed factors/independent variables. There was no interaction between condition, age, and sex, so further subgroup analyses were not conducted. In cases where the ANOVA yielded
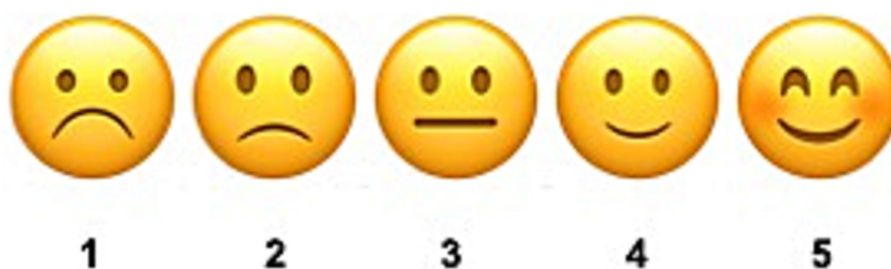
FIGURE 1
Likert scale scores and emojis.

TABLE 2 Demographic characteristics of the study sample ($n = 1,341$).

	n	% of total
Total sample	1,341	100.0
Sex		
Female	679	50.6
Male	660	49.2
Prefer not to say	2	0.1
Age		
11–12 years	706	52.6
9–10 years	635	47.4
Mean Age (SD)	10.6 (1.1) years	
Ethnicity[1]		
Majority	869	64.8
Minority	457	34.1
Did not answer	15	1.1
Perceived income adequacy[2]		
High	804	60.0
Low	530	39.5
Did not answer	7	0.5
Province/Region of residence		
West (British Columbia, Alberta)	323	22.6
Prairies (Saskatchewan, Manitoba)	91	6.4
Ontario	523	36.5
Quebec	318	22.2
East (Newfoundland and Labrador, Nova Scotia, New Brunswisk, Prince Edward Island)	85	5.9
North (Yukon, Northwest Territories, Nunavut)	1	0.1

[1]Ethnicity was categorized as "majority" (i.e., only "White (European descent)" was selected) and "minority" (i.e., any other ethnicity group(s) were selected, including when in addition to "White (European descent)" being selected).
[2]Perceived income adequacy was categorized as "high" (Reponses of either very easy, easy, and neither easy nor difficult when asked how difficult or easy it is for you to make ends meet?) or "low" (responses of difficult or very difficult).

significant results, Bonferroni post-hoc tests were conducted. Results were considered statistically significant when $p < 0.05$. All data was analyzed using Microsoft Excel and SPSS 27.0 (IBM, 2020).

3 Results

Sociodemographic characteristics of the participants ($n = 1,341$) are presented in Table 2. A total of 49.2% of the sample was male and 50.6% was female and the average age of participants was 10.6 years (47.4% 9–10 years and 52.6% 11–12 years). Most participants identified as being in the ethnic majority group (i.e., White, 64.5%) and high perceived income adequacy (60%). An expanded summary of all collected sociodemographic data can be found in Supplementary Table S1.

3.1 RQ1: child-targeted vs. adult-targeted ads

The effects of exposure to adult vs. child-targeted ads, and exposure to child-targeted ads vs. the control (no marketing) on total impact, were significantly different (Figure 2). A significantly greater average total impact was observed among children exposed to child-targeted ads (mean Likert score 3.36) compared to those exposed to adult-targeted ads (mean score 2.75; $p < 0.001$) or no marketing (mean score 2.81; $p < 0.001$).

As shown in Table 3, average preference, purchase intent, and pester responses differed significantly by ad exposure condition, overall and by ethnicity. Average food preference was significantly higher among participants exposed to child-targeted ads (mean score 3.38) compared to both adult-targeted ads (mean score 2.83; $p < 0.001$) or control (mean score 2.87; $p < 0.001$). Similarly, average purchase intent and pester power responses were also significantly higher among those exposed to child-targeted ads (mean scores 3.33 and 3.38, respectively) compared to adult (2.72 and 2.70; $p < 0.001$) or control conditions (2.79 and 2.78; $p < 0.001$). Among ethnic minorities and majorities, preference, purchase, and pester were significantly higher among those exposed to child-targeted ads compared to those exposed to adult-targeted or no marketing (control), with majority ethnicity participants reporting stronger impact. There was no significant interaction effect between sex, age, perceived income adequacy,
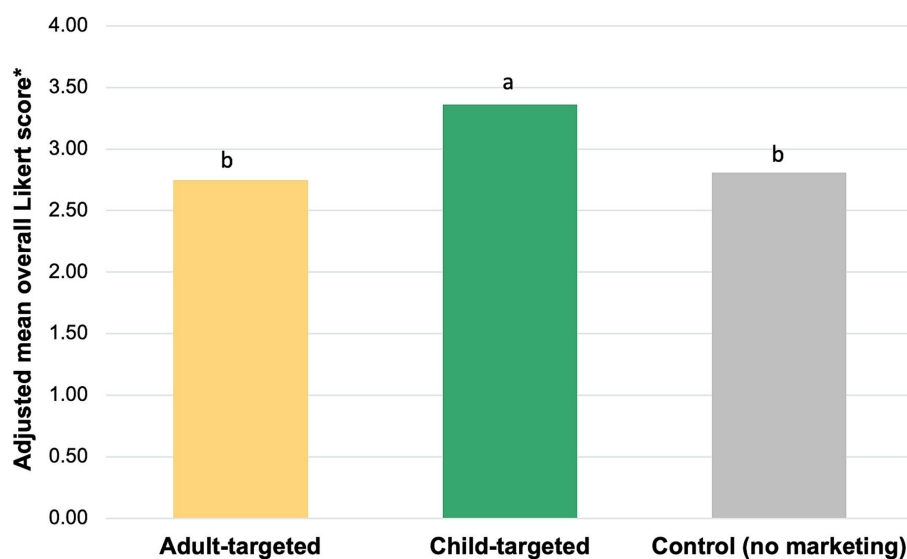
FIGURE 2
Total impact of child-targeted vs. adult targeted ads on children's food preferences and behavioral intentions. Bars that do not share subscripts have means that differ by $p < 0.05$ according to Bonferroni multiple comparisons.

and ad exposure condition on preference, purchase, pester, or total impact responses.

3.2 RQ2: licensed characters vs. spokes characters

The average total impact significantly differed per condition (Figure 3). Children exposed to ads featuring spokes characters had a significantly higher average total impact (mean score 3.98) compared to those exposed to licensed characters (mean score 3.80; $p < 0.001$) and the control (i.e., no characters) (mean score 3.19; $p < 0.001$).

The effect of exposure to spokes characters on food preference (mean score 4.02), purchase (3.93), and pester power (4.00) responses was greater compared to those exposed to licensed characters (mean scores 3.84, 3.79, 3.78, respectively; $p < 0.001$) or no characters (3.25, 3.16, 3.17, respectively; $p < 0.001$) while exposure to licensed characters was significantly different to no characters ($p < 0.001$) (Table 4). The response outcomes did not significantly differ by the interaction effect between ad exposure condition, sex, age, ethnicity, or perceived income adequacy.

4 Discussion

The overarching objective of this study was to determine how various aspects of marketing power (i.e., the design, content, and overall impression) impact children's food preferences and behavioral intentions. Two research questions examined the differential impact of child-targeted vs. adult-targeted ads, and licensed characters vs. spokes characters.

This study found that child-targeted ads had a positive impact on children's preferences, purchase intents, pester power and total impact. These results differed significantly from the impact of adult-targeted

ads, and ads with no marketing (control condition), both of which had negative impacts on all examined outcomes. This indicates that when children are exposed to food and beverage marketing, the ads that display features of child-targeted marketing are most likely to trigger children's desire to consume, purchase or pester parents about those products, especially in comparison to ads targeting adults or those with little to no marketing power. These findings are supported by previous literature on the impact of child-targeted food and beverage marketing on children's food preferences and food-related behaviors (16, 19, 20, 59, 60). For instance, the most recent systematic review and meta-analysis on this topic reported that exposure to food marketing was associated with increases in children's food intakes, food choices and purchase requests of marketed products (16). However, this review did not delineate between the impact of marketing that employed child-targeted techniques and marketing that did not; the present study contributes evidence to fill this gap. Our results are concerning, when considered in conjunction with the evidence speaking to the volume of child-targeted marketing Canadian children are exposed to and the consistently poor nutritional quality of the products being promoted by this marketing (18, 29, 30). Advertisements featuring powerful, child-targeted marketing techniques are likely increasing children's desire to consume, purchase and pester for products that will negatively impact their diet quality and health outcomes, and must be restricted.

The adult-targeted ads had a slightly negative impact on children in our study and this result is discordant with other studies that have spoken to the appeal of marketing techniques that are not explicitly child-targeted or that are aimed at older demographics (54). However, this research question was aiming to evaluate the overall impression of the ad, rather than the specific marketing techniques that were used, meaning that while, overall, adult-targeted ads were less impactful on children in our study, it is still possible that specific adult-targeted marketing techniques are appealing to children. It is worth noting that to date, there have still been few studies aiming to elucidate the impacts

TABLE 3 Total impact and impact of child-targeted vs. adult-targeted ads on children's food preference, purchase intent and pester power.

Condition	Adult-targeted marketing	Child-targeted marketing	Control (no marketing)	
Food preference				
	Adjusted mean[1]	Adjusted mean[1]	Adjusted mean[1]	p value[2]
Overall	2.83[b]	3.38[a]	2.87[b]	p < 0.01
Sex				0.57
Male	2.84	3.35	2.91	
Female	2.83	3.41	2.83	
Age				0.74
9–10 years	2.9	3.44	2.89	
11–12 years	2.77	3.33	2.85	
Ethnicity[3]				0.02
Minority	2.85[b]	3.30[a]	2.97[b]	
Majority	2.82[b]	3.46[a]	2.77[b]	
Perceived income adequacy[4]				0.27
Low	2.82	3.4	2.79	
High	2.84	3.36	2.96	
Purchase intent				
	Adjusted mean	Adjusted mean	Adjusted mean	p value
Overall	2.72[b]	3.33[a]	2.79[b]	p < 0.01
Sex				0.67
Male	2.74	3.31	2.83	
Female	2.71	3.35	2.76	
Age				0.66
9–10 years	2.79	3.38	2.8	
11–12 years	2.66	3.28	2.79	
Ethnicity				0.01
Minority	2.76[b]	3.26[a]	2.92[b]	
Majority	2.69[b]	3.40[a]	2.67[b]	
Perceived income adequacy				0.09
Low	2.73	3.36	2.68	
High	2.72	3.3	2.9	
Pester power				
	Adjusted mean	Adjusted mean	Adjusted mean	p value
Overall	2.70[b]	3.38[a]	2.78[b]	p < 0.01
Sex				0.51
Male	2.71	3.34	2.82	
Female	2.69	3.42	2.74	
Age				0.29
9–10 years	2.77	3.44	2.75	
11–12 years	2.63	3.32	2.81	
Ethnicity				0.03
Minority	2.73[b]	3.33[a]	2.91[b]	
Majority	2.67[b]	3.42[a]	2.64[b]	
Perceived income adequacy				0.21
Low	2.69	3.4	2.68	

(Continued)

TABLE 3 (Continued)

Condition	Adult-targeted marketing	Child-targeted marketing	Control (no marketing)	
High	2.71	3.36	2.88	
Total impact				
	Adjusted mean	Adjusted mean	Adjusted mean	p value
Overall	2.75[b]	3.36[a]	2.81[b]	$p < 0.01$
Sex				0.56
Male	2.76	3.33	2.85	
Female	2.74	3.4	2.78	
Age				0.52
9–10 years	2.82	3.42	2.81	
11–12 years	2.68	3.31	2.82	
Ethnicity				0.02
Minority	2.78[b]	3.30[a]	2.94[b]	
Majority	2.73[b]	3.43[a]	2.69[b]	
Perceived income adequacy				0.16
Low	2.75	3.39	2.72	
High	2.76	3.34	2.91	

[1]Adjusted means based on ANOVA models fitted with Likert scores for food preference, purchase intent, pester power and total impact as outcomes; sex (male/female), age (9–10 years/11–12 years), ethnicity (majority, minority), perceived income adequacy (low/high), and condition as fixed factors/independent variables.

[2]p values <0.05 were considered to be statistically significant, with differences between conditions indicated by differing superscript letters.

[3]Ethnicity was categorized as "majority" (i.e., only "White (European descent)" was selected) and "minority" (i.e., any other ethnicity group(s) were selected, including when in addition to "White (European descent)" being selected).

[4]Perceived income adequacy was categorized as "high" (Reponses of either very easy, easy, and neither easy nor difficult when asked how difficult or easy it is for you to make ends meet?) or "low" (responses of difficult or very difficult).

[a,b]Means that do not share subscripts have means that differ by $p < 0.05$ according to Bonferroni multiple comparisons.
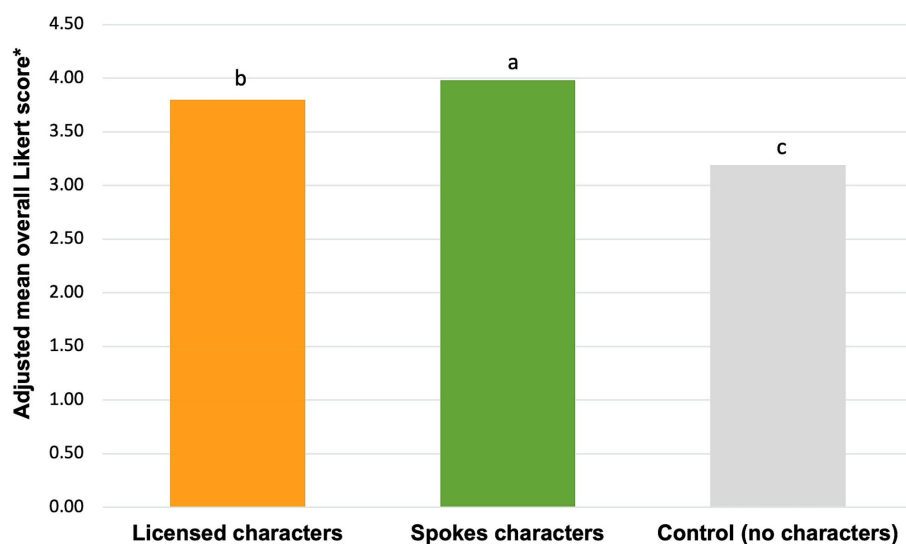
FIGURE 3
Total impact of licensed characters vs. spokes characters on children's food preferences and behavioral intentions. Bars that do not share subscripts have means that differ by $p < 0.05$ according to Bonferroni multiple comparisons.

of marketing techniques beyond those implicitly targeting children, and further research should aim to determine which adult-targeted techniques (such as health claims and giveaways or price promotions targeting adults) are most impactful to children, or how the use of these techniques in conjunction with child-targeted marketing techniques influences the overall impact of the marketing on children.

TABLE 4 Total impact and impact of licensed characters vs. spokes characters on children's food preference, purchase intent and pester power.

Condition	Licensed characters	Spokes characters	Control (no characters)	
Food preference				
	Adjusted mean[1]	Adjusted mean[1]	Adjusted mean[1]	*p* value[2]
Overall	3.84[b]	4.02[a]	3.25[c]	*p* < 0.001
Sex				0.22
Male	3.84	3.97	3.3	
Female	3.84	4.07	3.19	
Age				0.12
9–10 years	3.91	4.17	3.27	
11–12 years	3.77	3.87	3.22	
Ethnicity[3]				0.37
Minority	3.81	3.96	3.27	
Majority	3.87	4.08	3.22	
Perceived income adequacy[4]				0.11
Low	3.84	4.03	3.14	
High	3.84	4.02	3.35	
Purchase intent				
	Adjusted mean	Adjusted mean	Adjusted mean	*p* value
Overall	3.79[b]	3.93[a]	3.16[c]	*p* < 0.001
Sex				0.44
Male	3.78	3.89	3.2	
Female	3.81	3.98	3.12	
Age				0.3
9–10 years	3.87	4.07	3.19	
11–12 years	3.71	3.8	3.13	
Ethnicity				0.4
Minority	3.78	3.87	3.18	
Majority	3.8	4	3.14	
Perceived income adequacy				0.07
Low	3.84	3.97	3.07	
High	3.75	3.9	3.25	
Pester power				
	Adjusted mean	Adjusted mean	Adjusted mean	*p* value
Overall	3.78[b]	4.00[a]	3.17[c]	*p* < 0.001
Sex				0.54
Male	3.75	4.01	3.21	
Female	3.81	3.99	3.13	
Age				0.43
9–10 years	3.84	4.13	3.23	
11–12 years	3.72	3.87	3.12	
Ethnicity				0.18
Minority	3.75	3.94	3.23	
Majority	3.82	4.06	3.12	
Perceived income adequacy				0.2
Low	3.84	4.02	3.12	

(Continued)

TABLE 4 (Continued)

Condition	Licensed characters	Spokes characters	Control (no characters)	
High	3.72	3.98	3.23	
Total impact				
	Adjusted mean	Adjusted mean	Adjusted mean	p value
Overall	3.80[b]	3.98[a]	3.19[c]	p < 0.001
Sex				0.44
Male	3.79	3.96	3.24	
Female	3.82	4.01	3.15	
Age				0.24
9–10 years	3.87	4.12	3.23	
11–12 years	3.74	3.84	3.16	
Ethnicity				0.28
Minority	3.78	3.92	3.23	
Majority	3.83	4.05	3.16	
Perceived income adequacy				0.11
Low	3.84	4.01	3.11	
High	3.77	3.96	3.28	

[1]Adjusted means based on ANOVA models fitted with Likert scores for food preference, purchase intent, pester power and total impact as outcomes; sex (male/female), age (9–10 years/11–12 years), ethnicity (majority, minority), perceived income adequacy (low/high), and condition as fixed factors/independent variables.

[2]p values <0.05 were considered to be statistically significant, with differences between conditions indicated by differing superscript letters.

[3]Ethnicity was categorized as "majority" (i.e., only "White (European descent)" was selected) and "minority" (i.e., any other ethnicity group(s) were selected, including when in addition to "White (European descent)" being selected).

[4]Perceived income adequacy was categorized as "high" (Reponses of either very easy, easy, and neither easy nor difficult when asked how difficult or easy it is for you to make ends meet?) or "low" (responses of difficult or very difficult).

[a–c]Means that do not share subscripts have means that differ by p < 0.05 according to Bonferroni multiple comparisons.

Some literature has noted potential differences in marketing impact based on demographic characteristics (e.g., age, sex, gender, weight status, socioeconomic status) (18, 61–63). For instance, a study from the UK found that following exposure to food marketing, children with obesity or excess weight had larger increases in snack intake compared to children with normal weight status (61). A recent Canadian study found that older youth (aged 13–17) reported higher exposure to food marketing online, females reported higher marketing exposure online and in retail settings, while males were exposed more frequently in video games; and that youth from minority ethnic groups and households with lower income adequacy reported higher exposure to marketing (63). This study, however, did not assess the impact of this exposure on differing demographics. The present study found no effect of age, sex, or perceived income adequacy on marketing impact of child- or adult-targeted ads. This can likely be explained in part by the fact that the static ad images used in this experiment were designed to be gender -neutral and appealing to a broad age-range of children to reduce bias. In real world settings, however, children's personal characteristics almost certainly play a role in the impact of the food marketing they see. One recent study has attempted to elucidate how characteristics of Canadian children (e.g., sociodemographic, behavioral, and dietary intake factors) impact the appeal of real-world instances of digital food marketing (64). The authors report that there was large variability in what children found appealing and that the power of marketing instances varied even within groups of children with similar characteristics, suggesting that children's marketing preference may largely be personal and not

linked to sociodemographic group membership (64). Interestingly, our results indicated that child-targeted ads had a stronger total impact and impact on preference, purchase intent and pester power in the majority (i.e., White) ethnic group. While there has been some recent evidence documenting potential inequities in marketing exposure, whereby children's exposure to food and beverage marketing seems to be higher in lower socioeconomic status (SES) and racialized communities (18, 65), there is a paucity of evidence examining the impact of food marketing across sociodemographic strata especially in Canada, and further research is needed in this area to consolidate these findings and ensure that any future marketing policies are equitable.

The second research question addressed by this study delved into one specific child-targeted marketing technique: the display of characters. Results showed that spokes characters had the strongest total impact on children compared to licensed characters and the control condition. While not as strong of an impact, licensed characters still had a positive impact on children, which was significantly greater the impact of marketing that did not display any characters (control condition). In line with previous literature speaking to the powerful impact of characters (16, 41, 45–48), this study found that ads featuring spokes characters and licensed characters increased children's desire to consume, purchase or pester parents about products in comparison to ads that did not feature these marketing techniques, with spokes characters being the most powerful of the two examined character types. Research has shown that children's characters are one of the marketing techniques that children

are most exposed to on many different media platforms and settings where children live and play (18, 32–35). Manufacturers are evidently choosing to employ this marketing technique frequently, likely because they have found it to be valuable for building brand equity and effective at increasing purchasing and therefore, profits. The ethics of using characters to promote foods and beverages to children has been questioned, and some have called for greater accountability from companies regarding their use of spokes and licensed characters in order to protect children's health (66). However, given that major food and beverage companies have a fiduciary duty to their shareholders that conflict with prioritizing public health (e.g., generating profit), governments should take responsibility for ensuring children are not unduly exposed to harmful food and beverage marketing by introducing federally mandated policies.

Findings from RQ1 indicated that child-targeted marketing is impactful to children, and these results add nuance to these findings by highlighting a specific marketing technique that is contributing to the overall child-targeted impression of the ad and boosting its impact. Findings such as these, examining the impact of individual marketing techniques, are important, as they provide a strong rationale for including these aspects of power within marketing restrictions in order to most effectively protect children from the aspects of food marketing that are having the strongest impacts on them and consequently, their dietary health. As such, additional research should aim to examine the impact of other marketing techniques, especially emergent marketing techniques such as user-generated content on social media, which has been found to be increasingly prevalent in Canada (67). For instance, some research has focused on examining the impact of social media, influencers and advergaming, on children's food-related behaviors, and have found this type of marketing to be incredibly powerful (68, 69). Data such as these should absolutely be considered by policymakers when aiming to develop effective marketing regulations. In terms of developing marketing policies, the WHO recommends a mandatory, comprehensive approach that restricts all forms of marketing to children of foods which are high in saturated fats, trans-fatty acids, free sugars, or salt (56). Their guidelines further indicate that along with reducing exposure, policies should also aim to reduce the power of food marketing. The results of this work support this guidance as characters and other elements of child-targeted marketing were found to impact children's food behaviors. Importantly, this study highlights the need for broad definitions of what constitutes "child-targeted" marketing within the scope of marketing policies (i.e., including multiple aspects of marketing power), in order to ensure that children are adequately protected from the persuasive power of food marketing.

This study presented the first Canadian examination of the impact of (1) child-targeted vs. adult-targeted food and beverage marketing, (2) marketing featuring licensed characters vs. spokes characters on children's food preference, purchase intent, and pester power, strengthened by the use of a large and nationally representative sample of Canadian children. Strong efforts were made to reduce bias from pre-existing preferences and brand attitudes, or random error, namely by using multiple ad exposures per condition, as well the intentional design of the survey ad images to be gender-neutral and display unfamiliar products/brands and health-neutral food categories when possible. Randomization was also employed in several ways. Study participants were randomly assigned to an ad exposure condition within each research question, and this helped to achieve a relatively equal distribution of participants within each condition based on

sociodemographic variables (i.e., sex and age). Participants also viewed each ad exposure within their assigned condition in randomized order to further protect against bias. The order of which participants were exposed to each part of the survey (i.e., each RQ) was also random. Finally, the strengths of the analytical approach employed in this study, in particular the use of ANOVA analysis, allowed for results to be compared between conditions, while adjusting for relevant sociodemographic variables. Moreover, *post hoc* Bonferroni tests enabled the identification of significant pairwise comparisons and providing additional depth to the analysis. This study was, however, not without limitations, some inherent to survey study design, such as survey fatigue, which may have impacted the quality and accuracy of responses. Next, the study sample primarily consisted of participants identifying as ethnic majority and of higher income which may have reduced the generalizability of the results, however this is a skew is commonly observed when recruiting participants from online/online survey panels (70). Additionally, the effect of BMI or weight-status on the response outcomes could not be assessed in this study due to inconsistent or incomplete self-reporting of participants' height and weight observed in this survey. Finally, it is necessary to acknowledge that children have individualized preferences (e.g., naturally prefer one character over another) and were only exposed to 3 images per condition for feasibility reasons and to limit participant fatigue. While the marketing images used in this study were designed with the intention of being as universally appealing as possible, it is plausible that this may have somewhat neutralized the overall impact of the ads on some children, or that the selected images did not capture the interest of some children at all. As well, our results may not be generalizable to all food advertising (e.g., other food categories), and other unmeasured factors may explain differences in responses to different types of advertising conditions (e.g., familiarity of characters). In an expanded study or a real-world setting, greater variability or strength in the response outcomes could be expected, especially on an individual level, given that children are exposed to a large volume and variety of marketing on a daily basis that may better align with their personal preferences and therefore increase its impact.

This study showed that child-targeted ads and those using characters - especially spokes characters - have a strong overall impact on children's food preferences, purchase intents, and pester power. Taken together, the results of this research provide timely evidence to support and inform the development and implementation of federally mandated marketing restrictions in Canada and highlight the importance of carefully considering aspects of marketing power within the regulatory approach to best protect children from the harmful effects of food marketing.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by University of Ottawa Research Ethics Board. The studies were conducted in accordance with the local legislation and institutional requirements.

Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

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Conflict of interest

EP received an honorarium from the Stop Marketing to Kids Coalition (2018) and Heart and Stroke (2023) for policy work related to food and beverage marketing to kids. She is currently employed by Heart and Stroke on a part-time basis (as of September 2023) to do work related to this topic area but unrelated to this research study.

The remaining 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.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fnut.2023.1287473/full#supplementary-material

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Food insecurity among consumers from rural areas in Romania

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Food security has a special relevance in nowadays economies, due to the current crisis, characterized by multiple layers on a social, political, economic, and individual biological level. The present study aims to identify relevant aspects of food insecurity for consumers in rural Romania and the main factors that significantly influence it (food availability, food access, and food consumption). The data were collected from a sample of 875 consumers from rural areas in Romania. The results show that food insecurity is perceived by the consumers of Romanian rural households as being strongly influenced by food availability, but less influenced by food consumption and access. The results have an essential relevance in the development of agri-food marketing strategies and public policies in the field of sustainable development.

KEYWORDS
food insecurity, consumers, food consumption, food availability, food access

1 Introduction

Food security is a global concern given global population growth, climate change that can affect agricultural production, globalization, international trade and dependence on food imports for more vulnerable countries, difficult access to food due to economic and social inequalities, the international political environment and the global trend toward changes in food preferences and lifestyle.

According to the Food and Agriculture Organization (1, 2), these factors influencing food security can be grouped into four categories: availability—related to food supply, and access to available food products, consumption and stability—the constant availability, access, and use of food resources over time.

Shaw (3) pointed out that: "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life".

For rural consumers in Romania, this trend of globalization and the development of the global economy have led to an increased homogeneity of diets, with food products being disconnected from their source. This has resulted in increased uncertainty in the supply chain, making it susceptible to disruptions and causing food insecurity (4, 5).

In agri-food marketing, the identification of vulnerable groups of consumers is essential to satisfy their needs, regardless of the country's level of development. First of all, agricultural products are intended to satisfy a physiological need (survival), according to

Maslow's pyramid of needs (6). The most basic need is for physical survival, and this will be the first thing that motivates consumer behavior.

In Romania, according to data provided by the National Institute of Statistics in 2018 (7), approximately 47% of the country's population lives in rural areas, and a significant part of them produce their food in their households. The access of this category of consumers to food can be limited by various economic and social barriers.

Food insecurity differs among consumers in rural and urban areas in Romania. The existing research shows that there are important differences in food diversity between actual consumption and purchased food quantities, but these differences are not influenced by the residence area (urban vs. rural) (8). However, the analysis of food consumption patterns reveals that there is a higher consumption of main food products in urban areas compared to rural areas (9). Additionally, the study highlights that the rural population has higher expenditure elasticities for food demand compared to the urban population, mainly due to lower cash incomes (10). These findings suggest that food insecurity may be more prevalent in rural areas due to lower food diversity and lower cash incomes, which can affect access to food and threaten food security.

Food insecurity among consumers in rural areas of Romania is an important research topic. Analyzing how food consumption, food availability and food access relate to food insecurity among consumers from rural areas in Romania can help identify areas for improvement in food quality and living standards.

2 Materials and methods

2.1 Literature review. Theoretical framework and hypothesis development

Regarding food consumption, there are significant differences between rural and urban consumers. Food consumption patterns in rural and urban areas can differ significantly due to various factors, including lifestyle, access to resources, economic conditions, agricultural practices and cultural influences. The latter produce their food, while urban consumers buy it. Also, urban consumers have access to a greater diversity of food. Food consumption among rural consumers can be explained through several factors: price, as a key driver for purchasing behavior, social context and habits of food purchase and consumption, health concerns, awareness of the environmental impact, trends in food such as currents of vegetarianism and veganism, consumption of local products agricultural practices. A complex interplay of various factors influences the determinants of food and non-food consumption. According to Savadogo and Brandt (11), income, education, household size and structure are important determinants of food and non-food consumption.

Furthermore, studies have shown the relevance and the relations between food access and consumption as well as the important relationships between neighborhood food environment and consumption measures (12, 13). Consequently, based on the above opinions, the following hypothesis has been established:

H1: *There is a strong correlation between food consumption and food access.*

Food consumption in rural areas is closely tied to food security, as these areas often rely on local agricultural practices and the availability of homegrown or regionally produced food.

In his research, Skeratt (14), demonstrates that "place" has a significant impact on food consumption, as it influences the type of food available that affects consumer choices, and this can be observed by comparing consumers who live in the environment rural and those who live in the urban environment.

In 1986, Swaminathan presented the idea of "Nutrition Security", which was defined as "physical, economic, and social access to a balanced diet, clean drinking water, environmental hygiene, primary health care, and nutritional literacy," which has been emphasized. The term has three dimensions: availability, access, and absorption (15).

Availability describes the actual availability of food supplies in the appropriate amounts. Using food grains as a stand-in for food (fair enough in a situation where food grains make up a significant portion of caloric intake), the availability of food grains is determined by net domestic production plus net imports plus stock drawdown, net of feed, seed, and waste. Market integration within the borders of a country and storage and transportation infrastructure are prerequisites for physical availability in any given area.

The bundle of entitlements that relate to people's starting points, what they can obtain (particularly in terms of physical and financial access to food), and the opportunities that are available to them to attain entitlement sets with sufficient food—either through their efforts, through state intervention, or both—all determine *access*.

The capacity to use the food ingested for biological purposes is known as absorption. This in turn is closely tied to the availability of clean water for drinking, sanitation, a sanitary environment, primary healthcare, as well as suitable eating habits and information (16).

Even though during harvest time there usually are no problems with the availability of food, all around the globe, in each country some institutions work on ensuring food availability for their citizens. It focuses on the availability of enough food in acceptable quantities, whether it comes from imports or home production (17).

Additionally, scholars have outlined the status and the relations between food access and food availability among different types of consumers, as well as the influence of other factors (e.g., cost disparity, food price, etc.) (18, 19). Accordingly, based on the above views, the following hypothesis has been settled:

H2: *There is a strong correlation between food access and food availability.*

In its most basic form, food availability refers to the state in which food is produced to be consumed at local levels, where local people or households can easily find the food they need. It illustrates how different types of food are produced and supplied. Furthermore, the process of food availability is taken into account, mainly focusing on the dietary preferences

of the consumer. These important variables are convenience, cost, taste, and cultural norms. In addition to these, there exist additional variables such as socioeconomic status and food accessibility, which essentially impact food purchases and nutrient quality (20).

According to other authors, food availability, food accessibility, and food consumption are critical to achieving food security (21).

Consumer decisions have a direct impact on nutrition and sustainability results, both of which are impacted by the type and amount of money spent and the diversity of food available (22). Also, consumers are developing more and more different behaviors as a direct consequence of technology impact and social media communications (23).

Since the availability of food is dependent upon both naturally occurring and sustainably farmed land systems, it is generally accepted that long-term food security requires an ecosystem-aware food security policy. Governments that practice sustainable land use and prudent resource management can support long-term, productive agriculture. In the same time, farmers should become more aware and adopt a green based design for the production process, along with green marketing techniques capable to generate a favorable mentality among consumers, highlighting their health benefits based on sustainable farming products consumption (24).

Allocating land tenure rights and access to natural resources, preserving soil and pollinators that are essential to crop growth, preserving forests that provide food sources and aid in water regulation, and permitting ecosystem restoration services to maintain healthy ecosystems are some of the specific policies that will help achieve these goals (25).

The food availability reduction can cause a reduction of food per capita supply, which is usually caused by natural disasters, wars or pandemics. The insufficient production and availability of food represent the main causes of famines and starvation (26).

At the same time, the availability of food is so important as it influences people by adjusting the pace at which they consume calories. An individual needs to sustain a positive or at least equilibrium energy balance over an extended period to stay healthy, even though their energy intake rates will constantly fluctuate across different time scales (27).

Moreover, the rising prevalence of food insecurity, in the last decade, has become a growing concern for many low- and middle-income countries (28). This issue has been exacerbated by natural disasters and socioeconomic instability (29), various factors are contributing to this alarming trend (e.g., conflict, global health matters, inflation), (30, 31). According to FAO (32), a situation where people lack adequate access (e.g., physical, social or economic) to nutritious food is referred to as food insecurity and it occurs when individuals do not have the necessary resources to meet their daily needs. Hence, based on the above understandings, the following three hypotheses have been determined:

H3: *Inadequate food consumption positively affects food insecurity.*

H4: *Inadequate food access positively affects food insecurity.*

H5: *Inadequate food positively affects food insecurity.*

Strategies should strive to reduce the environmental effect of the agricultural sector and adapt farming systems to the impacts of extreme climate change to manage the availability dilemma

and achieve food security. High-yielding crop varieties, sustainable soil management techniques, the use of irrigation technology that improves water usage efficiency (like drip irrigation), and farmer training can all help farming systems adapt to climate change (17). Using integrated farming techniques could result in less reliance on outside inputs, which would benefit the environment (33).

In this sense, agroecological intensification can be quite beneficial. Agroecological intensification, for instance, can entail replacing chemical fertilizers with legumes and pesticides with biological pest control, such as employing predators (34). Precision farming techniques can lower waste and pollution in the environment in industrialized nations (35). These methods can lower the detrimental environmental externalities of agricultural farming systems, boost yields over time, and save significant production costs. Low-income nations lack sophisticated farm input markets, therefore utilizing biological processes and relying as little as possible on outside inputs could increase local productivity and guarantee food availability (33). As a trend, bio-economy has a strong pace due to the importance of the outcomes that are dealing with the preservation of bio-resources and the possibility to have a high degree of efficiency for environment related activities like farming (36).

"The access of all people, on a permanent basis, to the necessary food for an active and healthy life" is the definition of food security (37). Although there are several levels at which food security can be assessed, the majority of references are made to the global, national, and microeconomic—that is, to the family and individual—levels. One or more of the four components of food security—food availability, supply stability, economic access, and the individual's need for wholesome, nutrient-dense food—are highlighted, depending on the level of reference. Therefore, the ability of nations to offer an adequate agricultural supply to meet the population's food and nutritional demands is the main focus when applying the idea of food security at the global or national level (38). Simultaneously, newer strategies (39) emphasize "food autonomy" as a component of stable food security, which lessens susceptibility to changes in both domestic and international agricultural markets.

2.1.1 Reviews related to food insecurity, food availability and food access among Romanian rural consumers

Food availability in the countryside is a crucial concern, not only in Romania but also in the whole world. The rural environment plays a critical role in food production, but there are still significant challenges in ensuring access to adequate food for rural communities.

In the European Union, Romania has the most subsistence farms per capita. Practically speaking, 3.3 million of Romania's 3.7 million farms can be classified as subsistence farms due to the incredibly low value of the produced goods. Despite playing a smaller part in the marketplace, these small farms are crucial to the rural community because they provide food and social security while also helping to preserve the environment by using conventional production techniques (40).

Romania has a varied pattern of food consumption because of the large proportion of its population living in rural areas.

Thus, there are two patterns of food consumption: one for the urban population, where access to food is primarily determined by the purchasing power of the households, and another for the rural population, which consists of land-owning families whose purchasing power is determined by the ratio of the prices of goods sold on the farm to the prices of goods purchased on the market. It is clear that these consumption patterns are not pure forms because even the urban population exhibits high levels of self-consumption that are either directly or indirectly related to the household members' farming activities.

However, the availability of food does not ensure that it will be accessible, as issues with economic distribution in society can have a significant negative influence on both food security and access to food at the home level. Food security is therefore seen as a family or individual issue in the last instance. Generally speaking, hunger and food insecurity are a direct effect of poverty. Poor households will be able to afford and probably want to eat a sufficient diet as a result of economic growth and income increases (41). At the same time, periods of food deprivation (like historical well-known events – Dutch Hunger Winter, etc) can have undesired effects in a long run on the future generations' capacity to manage a healthy diet (42).

Access to food for rural households in Romania is contingent not just on household incomes but also on the agricultural resources these households possess initially. This is because the majority of Romanian peasant farms are small-scale households, that have inadequate market connections, and mostly use their produce for self-consumption.

Based on current estimates, 82% of Romanian farms produce mostly for their own consumption (43), whereas just 16.5% produce primarily for direct sales (44). In this way, subsistence agriculture, which makes up for the lack of monetary income and provides a nutritional standard for survival, appears to be a safety net for the impoverished population residing in rural areas as well as for certain urban households that own agricultural land. This occurs under the circumstances that our nation's families continue to consume food at relatively high percentages of their consumption expenditures, demonstrating how vulnerable all households are to agriculture—more specifically, to the prices of agricultural products on both the local and international markets.

Factors influencing the availability of food in rural areas, according to Vávra et al. (45), are as follows:

(1) Agricultural infrastructure—The availability of food in rural areas is closely related to agricultural infrastructure. Access to resources such as quality seeds, and modern and appropriate agricultural machinery can significantly increase the production of food technologies. Climate change: Climate change can negatively affect agricultural production, with significant consequences for food availability. Extreme events such as drought or flooding can disrupt food supply chains.
(2) Access to markets—For rural producers to sell their products, it is essential to have efficient transport systems and road infrastructure to facilitate access to markets.
(3) Agricultural education—An agriculturally educated rural community can benefit from better farming and resource management techniques, thereby contributing to increased food production.

(4) Agricultural policies—Government policies on agriculture can have a significant impact on food availability. Subsidies, financial support and regulations can influence how rural farmers operate and grow their businesses.

The specific context of Romania, according to the National Institute of Statistics is described by the following characteristics:

(1) Traditional agricultural structure—Romania has a long agricultural tradition, and many rural communities continue to depend on agriculture for subsistence and income. However, there are some challenges related to the modernization of the agricultural sector.
(2) Small producers—A large part of agricultural production in Romania comes from small agricultural producers. They may experience difficulties in accessing modern technologies and markets, thus affecting the availability of food.
(3) Demographic changes—Population migration to cities can lead to aging rural communities and a decline in the agricultural workforce, which can affect food availability.
(4) Rural development program—The Romanian government implements programs for rural development, with an emphasis on the modernization of agricultural infrastructure, the stimulation of ecological agriculture and the support of small producers.
(5) Access to credits—Limited access to credits for farmers can be a barrier to the development of agricultural businesses and, implicitly, to ensuring an adequate availability of food in the countryside.

One of the most reliable sources of information about the factors influencing global food security is the Global Food Security Index (GFSI) (46). It assesses food security in 113 countries using four main criteria: price, availability, quality and safety, and sustainability and adaptation. It was created by Economist Impact with assistance from Corteva AgroSciences. A dynamic benchmarking model built from 68 qualitative and quantitative drivers of food security serves as the foundation for the index. Economist Impact chose the 113 countries in the index with consideration for regional variety, economic significance, population size (bigger countries were picked to reflect a larger proportion of the world's population), and the intention of incorporating all regions of the world.

According to GFSI, in 2022, in the overall ranking table, Romania was in the 45th position with a score of 68.8 out of 100, after all the EU countries. The first position in the ranking is held by Finland with a score of 83.7 points. While comparing its' position with the year 2012, Romania maintained the 45th position but improved the score with 5.8 points (47).

Still, the food consumption patterns of Romanians still reflect poverty, but the effects of poverty on population nutrition are more pronounced in urban areas than in rural ones.

More stable food availability results from the contact between agriculture and rural homes, despite the inferior quality features of the food (higher levels of alcohol, less animal protein, and a higher prevalence of fats of animal origin and high cholesterol).

Simultaneously, a reduced intake of meat, fresh vegetables, and fruit indicates an even less diverse food consumption in rural areas

when we compare consumption by residential areas. The rural area's food intake is seasonal, with virtually little fruit and vegetable eating occurring outside of season (40).

The rising prevalence of food insecurity, in the last decade, has become a growing concern for many low- and middle-income countries (28). This issue has been exacerbated by natural disasters and socioeconomic instability (29), various factors are contributing to this alarming trend (e.g., conflict, global health matters, inflation), (30, 31). According to FAO (32), a situation where people lack adequate access (e.g., physical, social or economic) to nutritious food is referred to as food insecurity and it occurs when individuals do not have the necessary resources to meet their daily needs.

Even though farmers (i.e., small-scale farmers) are primarily responsible for ensuring food security in the national framework, they are still susceptible to the risk of food insecurity at home (48).

Previous researchers have considered the emergence of COVID-19 can worsen the diet quality and increase the intake of various food products. This could lead to future health problems and the promotion of nutritional awareness is needed (49, 50). Scholars from Romania noted the behavior of consumers prompted consumers to pay more attention to where their food comes from and also shifted their focus to buying local products and issues related to food waste (8, 40, 51–54).

Similarly, other Romanian authors, pointed out that for people residing in rural areas/small farms, the manifest attributes of food choice are classified into several constructs: price, quality, sustainable food, the impact of products on their health, the quantity of thrown food, accessibility of organic food, or Romanian traditional food (55–61).

Therefore, from the aspects previously described, it is noted that Romanian researchers treated less the effects of anxiety regarding the quality and quantity of food, caused by access to food of rural consumers in Romania.

Previous research from different sources has pointed out that easier access to supermarkets, measured in different settings, was associated with food consumption, particularly improved fruit or vegetable intakes or overall diet quality (12).

Likewise, previous research has indicated the relationship between food consumption and food availability at the local and national levels (62, 63). Thus, based on the above judgements, the following hypothesis has been established:

H6: *There is a strong correlation between food consumption and food availability.*

After analyzing the literature, we considered the appropriate relationships among food consumption, food access, food availability and food insecurity in the form of the model proposed in Figure 1 (proposed conceptual model).

According to our conceptual model, we can outline that the negative balance of any of the three indicators (i.e., food consumption, food access, and food availability) leads to food insecurity. Therefore, the concept of food insecurity is based on three fundamental elements: (1) Inadequate food consumption, (2) Inadequate food availability; (3) Inadequate access to food.

2.2 Research methodology

The data collection was carried out by using the survey based on a questionnaire on a sample of 875 inhabitants from rural areas in Romania. The scales used in measuring the variables of this study were adapted from previous research and adjusted to fit the specific context of our study.

The surveys were conducted in Romania during 2021–2022. The sample included 900 people from rural areas from Transylvania, Moldova, and Dobrogea regions in Romania. The selection of the sample was random. In the selection of farms, the representativeness of the sample was followed. This representation was achieved by dividing the population evenly by region/sub-regions. Research data were collected in the form of direct interviews by interview operators.

The interview based on the questionnaire administered by the operators was a complex one including economic, social, sustainability, market links and job satisfaction aspects.

Regarding ethical approval, we highlight the fact that the questionnaire text mentioned the guarantee that technical and procedural measures have been taken to protect and ensure the confidentiality, integrity and accessibility of processed personal data and also that unauthorized use or access and personal data breach will be prevented, in accordance with the legislation in force.

Incomplete and invalid questionnaires were removed from the sample and 875 valid questionnaires were obtained.

According to USAID Title II and Child Survival and Health Grant indicators of the access component of household food insecurity [hereafter referred to as household food insecurity (access)] can be used to guide, monitor and evaluate in distinction countries. Over the past several years, USAID's Food and Nutrition Technical Assistance (FANTA) project has supported a series of research initiatives to explore and test different options for meeting this need (64).

The Household Food Insecurity Access Scale (HFIAS), is an adaptation of the approach used to estimate the prevalence of food insecurity in the United States (U.S.) annually. The method is based on the idea that the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey and summarized in a scale. Version 3 of the guide, the HFIAS questions have been refined to address the recommendations of the Nutrition and Consumer Protection Division, Food and Agriculture Organization of the United Nations (FAO) (64).

U.S. Household Food Security Survey Module (US HFSSM) asks respondents to describe behaviors and attitudes that relate to these various aspects of the food insecurity experience (65). A question relating to perceptions of insufficient *quantity* asks whether any adults had to eat less than they thought they should. The US HFSSM are summarized in a scale to provide a continuous indicator of the degree of a household's food insecurity.

FANTA and its partners they defined a set of questions (Household Food Insecurity Access Scale Generic Questions) that have been used in several countries and appear to distinguish the food secure from the insecure households across different cultural contexts (64).
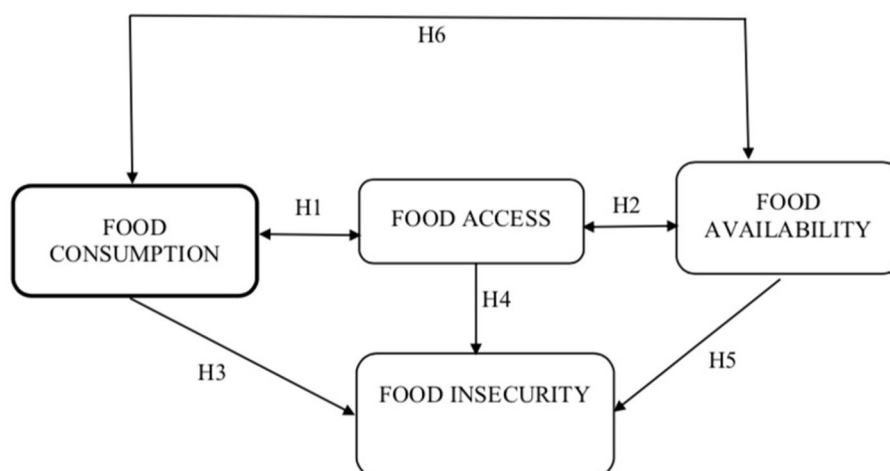
FIGURE 1
The proposed conceptual model.

TABLE 1 Variable measures.

Model construct	Exogenous variables	Items	Sources
Food access	Anxiety and uncertainty about the household food supply: (FAA)	Did you worry that your household would not have enough food?	(64)
	Insufficient quality, which includes food variety, and preferences (FAV)	Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	
	Insufficient food quantity (FAQ)	Did you or any household member have to eat fewer meals in a day because there was not enough food?	
Food consumption	Income (FCI)	Level of income	(66)
	Production of food (FCPF)	Production, purchasing power, social	
	Health, social safety nets (FCS)	Safety nets, community support	
Food availability	Resources for food (ARF)	Natural, human, and physical	(66, 69)
	Availability Production of food (APF)	Food production, market integration	

The categorical variables are used in separate questions to describe the structure of the sample and to explain the correlations between the independent variables and the dependent ones. The responses were assessed on a 3-point Likert-type scale ranging from 1 = rarely (once or twice in the past four weeks) 2 = sometimes (three to ten times in the past four weeks) 3 = often (more than ten times in the past four weeks) in accord with HFIAS scale (64). The measured variables were food consumption, food access, food availability and food insecurity. The proposed model is based on the HFIAS scale and the proposed items to measure food availability and food consumption by Pandey and Bardsley (66).

In our research, food access, was measured using: (i) Anxiety about the household food supply (FAA); (ii) Perceptions that food is of insufficient quality, which includes food variety, and preferences (FAV); (iii) Perception that food is of insufficient food quantity, which includes food supply (FAQ).

For analyzing food consumption were used: (i) Income (FCI); (ii) Production of food (FCPF) and (iii) health, social safety nets (FCS) (66).

Food availability was measured with the variables: (i) Resources for food—natural, human, and physical, (ARF) and (ii) availability Production of food—production, food imports, market integration (APF).

The HFIAS questions relate to three different domains of food insecurity (access) found to be common to the cultures examined in a cross-country literature review (67, 68).

The questionnaire includes 15 questions with specific content for the three constructs of the model (Table 1).

The structure of the sample is described using data represented in Table 2.

Therefore, a model was created with the following dimensions: food consumption, food access, food availability, and food insecurity.

TABLE 2 Sample structure.

Variable	Category	Frequency	Percentage
Gender	Male	633	72.3%
	Female	242	27.7%
Agricultural Education	Yes	484	55.3%
	No	391	44.7%
Age	18–35	138	15.77%
	36–45	327	37.37%
	46–55	189	21.60%
	56–65	137	15.66%
	Over 66	84	9.6%
Number of household members	2–4	548	62.63%
	4–8	284	32.46%
	Over 8	43	4.91%

The components of the model were analyzed using the exploratory factor analysis method. This method ensures accuracy and contributes to defining the model as correctly as possible and identifying the component variables that could be removed from the analysis to reduce the information that must be analyzed without affecting the accuracy of the final result. The Cronbach's Alpha test is used to assess the reliability of the scales. For each factor, Cronbach's alpha coefficient was calculated to measure the internal consistency. It measures the sum of observed variables associated with the overall variable to eliminate low correlation coefficient observation variables to the overall variable. For exploratory analysis, it is essential to conduct a test of the scale's reliability using Cronbach's Alpha. Although it is not possible to discuss a specific value that Cronbach's alpha coefficient can have to guarantee a high degree of fidelity of the measurements, several researchers suggest that values that are ≥0.90 can be considered excellent, while values ≥0.80 may be considered good and those ≥0.70 are acceptable (70, 71).

3 Results

According to the results, Cronbach's alpha coefficient values are above 0.90, for each component measurement (a value of 0.993 for food utilization, a value of 0.998 for food access, a value of 0.995 for food availability 0.995) which means that the fidelity (consistency) of the scales in case of latent variables is confirmed (71, 72).

In the case of The Kaiser–Meyer–Olkin (KMO) test for measuring the suitability of the sample, it must have a minimum workload of 0.5 to consider that the sample size is appropriate for performing the factor analysis and over 0.7 data adequacy is considered very good. According to the results Kaiser–Meyer–Olkin (KMO) for food consumption is 0.776, food access 0.771 and food availability 0.5 for the latter, the suitability is moderate (73).

Another condition to be able to apply exploratory type factorial analysis and the main components analysis procedure deals with homoscedasticity verification or homogeneity of variances by the Bartlett test. This test is sensitive to abnormalities. The Bartlett Test is used for the null hypothesis test that implies all population variations are equal, compared to the alternative hypothesis that assumes at least two are different. In other words, the Bartlett Test examines whether the correlation matrix of the investigated population is similar to the identity matrix. If the population correlation matrix resembles the identity matrix, then it means that each variable correlates poorly with all other variables. This test is considered significant and the null hypothesis is rejected if $p < 0.001$ (Table 3). Values regarding exploratory factor analysis (values of Bartlett's Test of Sphericity, Kaiser–Meyer–Olkin test and Cronbach's alpha coefficient, for each dimension of the model, extracted and retained based on the considered items).

In conclusion, it can be stated that factor analysis can be used because the latent variables determined to start from the initial items are valid in terms of item commonality (Kaiser–Meyer–Olkin test), item sphericity (Bartlett Test) and measurement scale consistency (Cronbach's alpha). A confirmatory factor analysis was conducted using version 28.0 of the IBM-SPSS AMOS program.

Table 4 presents the goodness of fit and we point out that indices of the structural model were satisfactory for the variables of food consumption, food access, food availability and food insecurity (Chi-square–CMIN = 59.659, df = 22; p = 0.00; GFI = 0.934; IFI = 0.996, NFI = 0.995, TLI = 0.993, CFI = 0.996, RMSEA = 0.063).

Comparing the values obtained in Table 4 with the limit values of each index, it can be stated that the proposed model is satisfactory in terms of statistical consistency (Table 5).

One can notice from Table 4 that $p < 0.01$; the statistical significance of the parameter estimates test of the critical ratio (C.R.) needs to be >1.96 (75, 76, p. 494–505).

The general analysis of the model results shows that food consumption, food accessibility and food availability it influences directly food insecurity.

Hypotheses H1 - Food consumption has a direct positive and significant effect on food access β = 0.91, $p < 0.01$, Critical Ratio test = 20.811 > 1.96 is accepted. Income level, purchasing power, safety nets, and community support had a direct and significant effect on Anxiety and uncertainty about the household food supply, insufficient quality, which includes food variety, and preferences and insufficient food quantity.

Also, there is a strong correlation between food access and food availability (β = 0.91, $p < 0.01$, CR test = 20.786 > 1.96), and the H2 hypothesis is supported. Food availability has a direct positive and significant effect on food access. Resources for the food and the availability and production of food have a direct influence on food acces.

Hypothesis H3 Inadequate food consumption has a direct positive and significant effect on food insecurity, β = 0.33, $p < 0.01$, and Critical Ratio test = 8.684. The correlation is not very strong, but according to the data, the hypothesis is supported.

Hypothesis H4 Inadequate food access has a direct positive and significant effect on food insecurity perception, β = 0.40, $p < 0.01$,

TABLE 3 Values regarding exploratory factor analysis.

Test statistic	Food consumption	Food access	Food availability	Food insecurity
Cronbach's Alpha	0.993	0.998	0.995	0.973
Bartlett's test of sphericity*	6,128.625	8,175.134	3,382.031	7.350
Approx. Chi-Square df Sig.	3.000	3.000	1.000	1.000
Kaiser–Meyer–Olkin Measure of Sampling Adequacy	0.776	0.771	0.500	0.760

*Extraction method Principal component analysis.

TABLE 4 Fit indices for the model.

Model	P	GFI	AGFI	NFI	RFI	IFI
Research obtained values	0.000	0.934	0.912	0.995	0.992	0.996
Theoretical statistical values*	< 0.05	>0.90	>0.90	>0.95	>0.90	>0.90
Model	TLI	CFI	PNFI	PCFI	RMSEA	PCLOSE
Research obtained values	0.993	0.996	0.608	0.609	0.063	0.00
Theoretical statistical values	>0.95	>0.95	>0.50	>0.50	<0.1	<0.05

*Statistical theoretical values are considered according to Hooper et al. (74).

and CR =11.764. Even though the correlation is not very strong, H3 is supported.

Hypothesis H5 Inadequate food availability has a direct positive and significant effect on food insecurity perception $\beta = 1.07$, $p <$ 0.01, and Critical Ratio test =3.870. Similarly, the correlation is very strong and H5 is supported.

For hypothesis H6 we noticed that Adequate food availability has a direct positive and significant effect on food consumption $\beta = 0.92$, p < 0.01, and CR =20.872.

4 Discussion

The different types of households, complex social structures and the inequitable distribution of resources among its members reinforce the idea that the concept of "household food security" has political relevance. The research carried out to date has not yet provided an adequate perspective on individual food insecurity. The measurement of different experiences of insecurity within the household should be continued and the implications of these results discussed.

One of the greatest challenges for specialists has been to develop a set of criteria that can be used to assess the validity of adapted scales of experiential food insecurity in different cultures without complete data sets.

This research has identified highly variable food insecurity situations in Romania.

According to USAID, three distinct variables are essential to the attainment of food insecurity: (1) Food Availability: if there are insufficient quantities of appropriate, necessary types of food from domestic production; (2) Food Access: individuals have inadequate incomes or other resources to purchase or barter to obtain levels of appropriate food needed to maintain consumption

of an adequate diet/nutrition level; and (3) Food Consumption: food is improperly used, improper food processing and storage techniques are employed, inadequate knowledge of nutrition and child care techniques exist and is applied, and adequate health and sanitation services.

Having as a model the household food insecurity access scale (i.e., HFIAS) used in the USA to measure food insecurity, we created a model that can be used at the level of rural households in Romania.

The investigated population were small farms, households that deal with agriculture and that produce their basic food. In the case of the small farmer, the indicators from the HFIAS model were adapted. For small households, food diversification is a problem for the population and limited access to other foods than those in the household.

Dimensions of food insecurity were measured with items from the scale HFIAS (67, 68) combined with the model proposed by Pandey and Bardsley (66) and FAO and SAARC (69). With the HFIAS scale, we measured the food access and food availability and food consumption the proposed models were adapted.

Likewise, we discover that the perception of *uncertainty* or *anxiety* over food is less in the case of the investigated population from Romania compared to the studies done in the USA, or other countries (77).

The food consumption decisions are influenced in a great measure by different factors among them being the perception of food products labels that can elicit a positive impact in the long run in case of subsequent loyal behavior (78, 79).

The specialized literature analyzed refers to the use of food insecurity measurement scales in a comparative way in different time intervals. The research carried out at the level of consumers in rural areas in Romania requires a reiteration of the study to be able to analyse and compare the results.

TABLE 5   Standardized direct effect coefficient.

Hypotheses	Correlations	β	P	Std. error	C.R.	Decision
H1	FC → FACC	0.91	0.000	0.044	20.811	Supported*
H2	FACC → FA	0.91	0.000	0.044	20.786	Supported*
H3	FC → FIN	0.33	0.000	0.038	8.684	Supported*
H4	FACC → FIN	0.40	0.000	0.034	11.764	Supported*
H5	FA → FIN	1.07	0.000	0.276	3.870	Supported*
H6	FC → FA	0.92	0.000	0.047	20.878	Supported*

*Significant at CR > 1.96, p < 0.01.

5 Conclusions

In agreement with USAID studies and partially using the HFIAS scale, we consider that food insecurity is perceived by the inhabitants of Romanian rural households as being strongly negatively influenced by food availability, but less influenced by food consumption and access.

The rural population has direct access to basic foods, to food subject to production and valorisation in their small farms. Inadequate access to food is due to infrastructure. The level of anxiety about the quality or quantity of food is closely related to the geographical area, being influenced by crops and access to imported products.

Food must be available for households to have access to, and a household must have access to food for individual household members to have appropriate food utilization/consumption. All three elements of food security must be achieved for food security to be attained (77).

That situation has increased local dependencies on food supplied from distant locations, with households having little control over prices received for their produce or paid for food, whereas risks increase as the diversity of their food production and consumption systems decline (80). Changing environmental and socio-economic conditions could worsen that situation (66, 81).

Data availability statement

The datasets presented in this article are not readily available because confidentiality restrictions. Requests to access the datasets should be directed to bologandreea@gmail.com.

Author contributions

CP: Formal analysis, Methodology, Writing – original draft, Writing – review & editing. SM: Investigation, Writing – review & editing. ID: Investigation, Methodology, Writing – original draft, Writing – review & editing. AM: Conceptualization, Investigation, Writing – original draft. CH: Writing – original draft, Writing – review & editing.

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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Monitoring health and nutrition claims on food labels in Brazil

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Introduction: The monitoring of nutrition and health claims on food and beverage labels has been proposed by international and national organizations because it can collaborate with the development of public policies to regulate food labeling and marketing strategies. One way of carrying out this monitoring is by using data collected by private companies.

Objective: To compare information on nutrition and health claims available in a commercial database of a private company that monitors the launch of new foods and beverages in Brazilian food retailers with information on those same claims manually coded by trained research assistants.

Methods: This is a cross-sectional observational study using a data sample of newly launched food and beverages available at a commercial database from 2018 to 2021. We compared the information on health and nutrition claims available on the commercial dataset with reliable information on the same nutrition and health claims manually coded by trained research assistants using a tested taxonomy to classify such claims. We used Gwet's Kappa AC1 with 95% CI and percentage agreement to compare both data sources and calculated sensitivity and specificity of the compared data.

Results: A total of 6,722 foods and beverages were analyzed. Mintel-GNPD presented 36.28% ($n = 2,439$) of nutrition claims, while in the trained researchers' coding, it was 33.73% ($n = 2,267$). We found a prevalence of 5.4% ($n = 362$) for health claims in Mintel-GNPD and 10.8% ($n = 723$) in the researchers' coding. All subcategories of nutrition and health claims showed high agreement (Kappa >0.81). Health claims presented kappa = 0.89 with 33.7% sensitivity and 98.0% specificity while nutrition claims showed kappa = 0.86 with 92.9% sensitivity and 92.5% specificity.

Conclusion: Nutrition and health claims showed high agreement, with great results in nutrition claims, indicating that Mintel-GPND is suitable for monitoring such claims on food and beverage packaging in Brazil. Additionally, our findings show a high prevalence of nutrition and health claims on food packages launched in the Brazilian food retail, highlighting the need to monitor these to develop public policies to regulate food marketing on packaging in Brazil.

1 Introduction

According to the World Health Organization, marketing to promote food and non-alcoholic beverages can be defined as any form of commercial communication or message that is designed to or has the effect of increasing the recognition, appeal, or consumption of specific food products (1). Marketing strategies can be made in different ways and using different marketing techniques, such as industry-sponsored advertisements, actions at points of sale, product design, and packaging (1). These strategies often include health and nutrition claims that highlight the nutritional content of the product, focusing on macronutrients and micronutrients and their potential health benefits in different age groups (2–4). The presence of nutrition and health claims on food packages can create a 'health halo' (5, 6), which is when an aspect of the product is highlighted as healthy and leads the consumer to understand the whole product as healthy, generalizing the one positive attribute and resulting in misconceptions and increasing the perceived healthiness of the food resulting in the consumption of ultra-processed foods that are harmful to health (7).

There are increasing sales of ultra-processed foods around the world, especially in low-and middle-income countries such as Latin America (8, 9). Food and beverages sold in retail outlets around the world, especially ultra-processed foods (10, 11), contain different types of marketing strategies to attract consumer attention and encourage purchase and consumption (2). Marketing strategies, such as health and nutrition claims, on unhealthy food packages high in added sugar, saturated fat, and sodium can influence and modify eating patterns leading to an unhealthy lifestyle, especially among children (12–15), which can be related to the development of non-communicable diseases (NCD) and obesity (16, 17).

Regarding the variety of strategies used by the food industry, according to INFORMAS (International Network for Food and Obesity/Non-communicable Diseases (NCDs) Research, Monitoring and Action Support), we can define nutrition and health claims as those that represent that there is a relationship between the food or ingredient and health and those that represent that food has a nutritional property due to its macro or micronutrient content, respectively (4). Some examples of health claims are 'contains calcium which helps prevent osteoporosis' or 'helps lower cholesterol'. Nutrition claims can be represented by 'source of vitamins and minerals', 'low in sugar', and 'high in protein'.

In Brazil, nutrition and health claims have been found on food packages of different types of food categories with different nutritional compositions. In a study carried out in Brazil (18), more than 80% of products including breakfast cereals and granola bars, fruit juices and nectars, and flavored drinks groups had claims on the package, with 28.5% having nutrition claims, followed by 22.1% having health claims. Another study also carried out in Brazil (11), found a prevalence of 33.3% of health claims on food packages and 32.1% of nutrition claims, 59.8% of which were ultra-processed products with at least one promotional strategy.

Public policies to regulate food marketing have been identified as one effective strategy that governments should invest in to promote healthier food environments and food choices that promote health, especially for children (19, 20). Evidence-based public policies are proving to be more effective in promoting long-term changes in the food environment, especially for the control and prevention of obesity and changes in eating patterns (21).

Monitoring strategies such as nutrition and health claims on food packages used by the food industry in a wide variety of environments (television, social media, internet, games, labels) has been proposed by international (22, 23) and national (24) organizations to support the development and improvement of public policies related to food labeling and marketing of foods considered unhealthy. Despite the great importance of monitoring these strategies, studies point to the difficulty of collecting data and generating up-to-date and reliable databases (25). In Brazil, there are no public databases on food and beverage packages to enable the monitoring of health and nutrition claims and their changes over time. One possibility to monitor and evaluate nutrition and health claims is through primary data collection that already has been made in Brazil (11, 18) and Chile (26), for example, collecting data through photos of food packages in supermarkets using a validated method (27). However, this process generally involves the use of multiple high-quality equipment, requires trained human resources to recognize package claims, and uses a large amount of financial resources and, it takes a lot of time to do the process (27). Considering that the food industry incorporates new products into the market in a very quick way, using different technologies and sources to do this kind of research is a possibility. One resource that has been used to monitor food labeling information is commercial databases developed by intelligence data companies and used by retailers and the food industry. The databases contain historical data on product launches of different countries, such as data from Mintel (28–30), Kantar, and others.

However, the databases of food packages from these types of companies contain hundreds of attributes that are not always organized for use in research and public policy. Especially in Latin America, where different countries are implementing labeling regulations to make healthier choices easier, it is important to have food labeling data to evaluate the regulation's attributes and its impacts (31), such as product reformulation (32) and changes in sales of unhealthy foods (33). Therefore, this study aims to compare information on nutrition and health claims available in a commercial database of a private company that monitors the launch of new foods and beverages in Brazilian food retailers with information on those same claims manually coded by trained research assistants.

2 Materials and methods

2.1 Study design and sampling

This is a cross-sectional observational study using a data sample of newly launched food and beverages available at a commercial database from 2018 to 2021. We compared the information on health and nutrition claims available on the commercial dataset with reliable information on nutrition and health claims manually coded by trained research assistants using a tested taxonomy to classify such claims. The commercial database used is the Global New Products Database (Mintel-GNPD). Mintel is a private company that monitors the launch of new retail products in more than 80 countries around the world. The company also has information on other products such as cleaning and hygiene products among others (34).

In the Mintel-GNPD, the variable "*product description*" (e.g.: Creamy Chocolate Dessert has been repackaged, featuring an offer

to pay less for more products. This gluten-free product has been inspected by the Brazilian Ministry of Agriculture, and retails in a 720 g pack with two 360 g units, each containing four 90 g tubs) and the variable "*claims*" (e.g.: "Economical, Gluten-Free, Allergens (Low/Reduced/No)") hold much of the label's possible nutrition and health claims. So, we selected these variables to compare. We downloaded the food images from the Mintel web platform to help us in identifying health and nutrition claims by trained researchers with a taxonomy method. Data collection, treatment, and coding of Mintel's GNPD data will be detailed in the next sections.

We used data on foods and beverages available in the Mintel-GNPD database between 1 January 2018 to 31 December 2021. For sampling, we selected foods and beverages that represented the best-selling brands in Brazil according to the information provided by Euromonitor in the market share of foods and beverages sold in Brazil in the same period of the data available in Mintel (35). We included all foods and beverages from brands that together share up to 80% of sales in each of the available food categories in the Euromonitor data totaling 5,601 items. We also selected food brands owned by the largest Brazilian food retailers as Casino, Carrefour, WMB, Supermercados Cencosud, Supermercados BH, Cia Zaffari, and Supermercado Dia resulting in 1,456 products. Imported products or products with illegible images ($n = 256$), products from 2022 ($n = 89$), and infant formulas ($n = 34$) were excluded from the analysis. In the end, we had 6,722 food and beverage products evaluated. Using this sample, we analyzed Mintel's GNPD variables of nutrition and health claims and package images.

2.2 Organization and coding of nutrition and health claims variables from Mintel-GNPD

The "*product description*" and "*claims*" variables are available in textual formats in the Mintel-GNPD database. The extraction of information about health and nutrition claims was done by developing a code in Stata that created dichotomous variables identifying the presence (1) or absence (0) of terms and expressions characterizing nutrition and health claims through quantitative content analysis (36). Quantitative content analysis is a research technique most used in communication research that examines symbols of communication and assigns them to numeric values according to valid measurements (35, 36).

To characterize and classify the nutrition and health claims in subcategories and subtypes, we used the protocol developed by the International Network for Food and Obesity/Non-communicable Diseases (NCDs) Research, Monitoring and Action Support (INFORMAS) (4), as shown in Table 1.

A conference analysis was carried out to evaluate the developed code in Stata that identified claims in Mintel's GNPD database. For this analysis, a sample of package images was evaluated individually to check whether the claim identified by the code was present on the label or not. For subtypes that resulted in up to 50 products identified in Mintel's GNPD database, all images were evaluated, and for subtypes with more than 50 products identified, a sample of at least 20% of the products was evaluated.

TABLE 1 Classification of health and nutrition claims according to INFORMAS "Food Labeling" protocol.

Claim categories	Subcategories	Subtypes
Health claims	General health claims	General, super, healthy Low GI/energy density Digestive health Bones health Oral health
	Reduction of disease risk	Heart-related claims Cardiology Society Nutrient absorption Cholesterol absorption Diabetes/Glycemic impact Osteoporosis Digestive health
	Nutrient and other function claim	Nutrient and muscle Nutrient and bone Nutrient and digestion Nutrient and immunity Nutrient and brain Nutrient and general health Nutrient and growth Nutrient and energy Nutrient and absorption Nutrient and strength
Nutrition claims	Health-related ingredient claim	
	Nutrient content claim	Fiber Energy Antioxidants/vitamins/minerals Fats Saturated fats Trans fats Omega 3 Omega 6 Sugar Protein Salt Cholesterol Taurine/guanine Caffeine
	Nutrient comparative claim	Reduced fat Reduced saturated fat Reduced trans fat More calcium Less salt Reduced sugar Reduced calories More fiber Reduced carbohydrates More protein Reduced cholesterol

2.3 Organization and coding of nutrition and health claim variables from food images

Mintel's GNPD also contains images of all the sides of food packages. These images were used to code the nutrition and health claims by five nutritionists, who were trained to identify and code this information in a standardized way and the data were used for comparison with the data from Mintel-GNPD. This process occurred between December 2021 and July 2022. We developed a coding manual specially for this coding, also based on the INFORMAS protocol. The researchers did a one-month training before the coding and weekly meetings with the coordinator and supervisor of the research to clarify any doubts. We did an inter-and intra-rater analysis before starting the coding process to assess the reliability of the protocol questions and after finishing the coding process, both using 10% of the sample. Health claims showed Kappa = 0.96 on test–retest analysis and Kappa = 0.98 on inter-rater reliability and nutrition claims showed Kappa = 0.96 on test–retest and inter-rater analysis, which shows high agreement and high reliability of data coded by our researchers' team.

2.4 Statistical analyzes

For the descriptive analyzes, absolute and relative distribution tables of the categories and subcategories of nutrition and health claims were created for both the data coded by the researchers and the data available in the variables proposed in Mintel's GNPD database. We also described the food categories in which nutrition and health claims were most frequent for both sources of data.

To study the nutrition and health claims we compared the coding of Mintel's GNPD variables with the coding done by our team of researchers using the images of all sides of the packages also available on Mintel-GNPD. For each category of claims and its subcategory and subtype, the agreement between both data sources was analyzed using Gwet's Kappa AC1 and 95% Confidence Interval. Gwet's measure was chosen because we are working with dichotomous variables and the measure it's suitable for the analyzes. Additionally, it tends to be more stable dealing with substantial prevalence differences between the values of 0 and 1 (37, 38). We also calculated the percentage of agreement and 95% confidence interval. To interpret the Gwet's Kappa AC1 values obtained, we used the scale proposed by Landis and Koch (39), where: less than 0.0, poor agreement; from 0 to 0.20, slight agreement; from 0.21 to 0.40, fair agreement; from 0.41 to 0.60, moderate agreement; from 0.61 to 0.80, substantial agreement; and from 0.81 to 1.00, high agreement. To help interpret the agreement between the datasets evaluated, Gwet's Kappa AC1 and percent of agreement are presented with sensitivity and specificity.

To report sensitivity and specificity another analysis was carried out for summary statistics in a 2 × 2 table. We calculated sensitivity as the fraction of products identified with claims by the researchers and found on Mintel's GNPD database and specificity as the fraction of products identified with no claims by the researchers and corrected identified with no claims on Mintel's GNPD database. All statistical analyzes were carried out using Stata software version 15.

3 Results

A total of 6,722 foods and beverages available in Mintel's GNPD database were analyzed from 2018 to 2021. Table 2 shows the comparison between the prevalence of nutrition claims by food groups present on Mintel's GNPD database and coded by researchers using the food images, in these case we showed that the dairy products presented the higher prevalence of nutrition claims, with 24.03% ($n = 586$ vs. 23.03% $n = 522$ in researcher's coding), followed by baked goods with 13.78% ($n = 336$ vs. 14.12% $n = 320$) and juices and fruit drinks with 10.25% ($n = 250$ vs. 10.94% $n = 248$) j. Table 2 also shows the prevalence of health claims by food groups. In Mintel's GNPD database were found in 23.71% ($n = 87$) of the dairy products group (vs. 22.68% $n = 164$ in Researcher's coding), followed by 14.44% ($n = 53$ vs. 11.62% $n = 84$ in Researcher's coding) in baked goods and breakfast cereals (13.35% $n = 49$ vs. 8.44% $n = 61$ in Researcher's coding). In the researchers' coding, we also found a high prevalence of health claims of 10.24% ($n = 74$) in chocolates.

Table 3 shows the prevalence of claims found by category, subcategories, and subtypes of health claims. Health claims were classified in 5.46% ($n = 367$ vs. 10.76% $n = 723$ in Researchers' coding) of the products in the Mintel-GNPD database. There was a higher prevalence of general health claims, with 72.75% ($n = 267$ vs. 90.73% $n = 656$ in Researchers' coding), with a higher prevalence of the 'general, super, healthy' subtype (67.13% $n = 243$ vs. 86.03% $n = 622$ in Researchers' coding). The reduction of disease risk claims (18.51% $n = 67$ vs. 4.56% $n = 33$ in Researchers' coding) presented a higher prevalence of diabetes claims (12.98% $n = 47$ vs. 2.07% $n = 15$ in Researchers' coding) and the nutrient and other function claims (33.15% $n = 120$ vs. 11.76% $n = 85$ in Researchers' coding) showed a higher prevalence of nutrient and digestive health claims (12.43% $n = 45$ vs. 1.24% $n = 9$ in Researchers' coding).

Table 3 also shows the results obtained for the analyzes of the agreement of health claims. The three subcategories – general health claims, reduction of risk disease, and nutrient and other functions – showed a Gwet's Kappa ≥0.90 as well as all their subtypes. The sensitivity for the category was 33.75% and the specificity was 98.03%. Claims of reduction of disease risk about osteoporosis showed perfect agreement (Gwet's Kappa = 1.00), with 100% sensitivity. The lowest sensitivity was observed for general health claims about low glycemic index (16.67%) presenting 100% specificity. Claims about the Cardiology Society, nutrient absorption, and digestive health from the subcategory of reduction of disease risk did not present sufficient data for sensitivity and specificity analysis but these last two subtypes showed high agreement.

Table 4 shows the prevalence of claims found by category, subcategories, and subtypes of nutrition claims in the Mintel-GNPD database and researchers' coding, in Mintel's GNPD database we found 36.28% ($n = 2,439$ vs. 33.73% $n = 2,267$ in Researcher's coding) of nutrition claims. Nutrient content claims were the most frequent claims in the Mintel-GNPD data, with a prevalence of 78.88% ($n = 1924$ vs. 76.56% $n = 1735$ in Researcher's coding) and there was a higher prevalence of vitamin and minerals claims (31.61% vs. 30.26% $n = 686$ in Researcher's coding) in this subcategory. In the nutrient comparative claim (12.30% $n = 300$ vs. 17.16% $n = 389$ in Researcher's coding), the highest prevalence was for reduced sugar claims (3.81% $n = 93$ vs. 3.79% $n = 89$ in Researcher's coding) and reduced sodium

TABLE 2 Characterization (*n* and %) of the nutrition and health claims available on Mintel-GNPD and data coded by trained researchers according to different food groups.

Food groups	Nutrition claims				Health claims			
	Mintel-GNPD		Researchers' coding		Mintel GNPD database		Researchers' coding	
	n	%	*n*	%	*n*	%	*n*	%
Side dishes	54	2.21	39	1.72	9	2.45	15	2.07
Sweeteners and sugar	1	0.04	0	0.00	0	0.00	1	0.14
Baby food	55	2.26	45	1.99	16	4.36	38	5.26
Snacks	128	5.25	123	5.43	13	3.54	37	5.12
Sweets and chewing gum	55	2.26	53	2.34	20	5.45	25	3.46
Isotonic and energy drinks	32	1.31	28	1.24	30	8.17	9	1.24
Meal substitutes beverages	74	3.03	67	2.96	3	0.82	11	1.52
Ready-to-drink beverages	33	1.35	32	1.41	2	0.54	5	0.69
Hot drinks	13	0.53	11	0.49	7	1.91	19	2.63
Breakfast cereals	101	4.14	96	4.23	49	13.35	61	8.44
Fruits and vegetables	49	2.01	49	2.16	11	3.00	18	2.49
Processed fish. Meat and egg products	130	5.33	105	4.63	10	2.72	26	3.60
Dairy products	586	24.03	522	23.03	87	23.71	164	22.68
Sauces and condiments	206	8.45	187	8.25	4	1.09	33	4.56
Chocolates	133	5.45	155	6.84	8	2.18	74	10.24
Baked goods	336	13.78	320	14.12	53	14.44	84	11.62
Sweet breads fillings	42	1.72	48	2.12	23	6.27	11	1.52
Savory bread fillings	2	0.08	2	0.09	0	0.00	0	0.00
Meals	28	1.15	29	1.28	8	2.18	12	1.66
Soft drinks	56	2.30	47	2.07	0	0.00	0	0.00
Desserts and ice cream	56	2.30	47	2.07	5	1.36	25	3.46
Soups	7	0.29	8	0.35	0	0.00	12	1.66
Juices and fruit drinks	250	10.25	248	10.94	9	2.45	43	5.95
Water	12	0.49	6	0.26	0	0.00	0	0.00
Total	2,439	100	2,267	100	367	100.00	723	100.00

claims (3.61% *n* = 88 vs. 4.81% *n* = 109 in Researcher's coding). For the last subcategory, health-related ingredient claims (28.82% *n* = 703 vs. 35.42 *n* = 803 in Researcher's coding), we found a higher prevalence for whole grain claims (12.96% *n* = 316 vs. 12.44% *n* = 282 in Researcher's coding).

Table 4 also shows the agreement results of nutrition claims, which also showed high agreement with Gwet's Kappa above 0.81 in the category. The category showed a Gwet's Kappa of 0.86, classified as high agreement and all the subcategories also showed high agreement (≥ 0.90), as well as all the subtypes. The category had a sensitivity of 92.90% and a specificity of 92.53%. The nutrient content claims for saturated fats showed 100% sensitivity, as well as the nutrient claims for cholesterol and taurine and guanine. The nutrient comparative claims of higher protein also showed 100% sensitivity, on the other hand, comparative claims about reduced trans-fat and higher calcium showed 0% sensitivity although both resulted in Gwet's Kappa =0,99 (high agreement). Among all categories, health-related ingredient claims about honey showed the lowest sensitivity (13.33%) but with 99.97%

specificity. Comparative claims of reduction of carbohydrates did not present sufficient data for analyzes.

4 Discussion

This study provided a deep characterization of the nutrition and health claims present on packaged foods and beverages launched in Brazilian food retail between 2018 and 2021 and found in the Mintel-GNPD. We showed that this dataset could be a reliable alternative when the purpose is to monitor health and nutrition claims on food labels in Brazil. Nutrition claims were the most prevalent, with 35–40% of the claims in both data sources. We found that some food groups, as dairy products, baked goods, breakfast cereals, and isotonic and energy drinks had a higher prevalence of nutrition claims, and other food groups as dairy products, baked goods, juices and fruit drinks, and sauces and condiments had a higher prevalence of health claims, and in general the prevalence is higher in the Mintel-GNPD than data codified by trained researchers. We found high agreement

TABLE 3 Sensitivity, specificity, percentage of agreement and kappa for verifying the agreement of health claims in the Mintel-GNPD.

Claims	Mintel's GNPD database (%)	Researcher's coding (%)	Sensitivity (CI 95%)*	Specificity (CI 95%)*	Percent of agreement*	Gwet's AC1 (CI 95%)*
Health claims	5.39	10.76	34.44% (32.62–34.88)	98.03% (97.70–98.36)	91.12	0.89 (0.88–0.90)
General health claims	77.62	90.73	26.83% (25.77–27.89)	98.27% (97.96–98.58)	91.3	0.90 (0.89–0.90)
General, super, healthy	67.13	86.03	23.95% (22.93–24.98)	98.38% (98.07–98.68)	91.49	0.90 (0.89–0.91)
Digestive health	3.31	1.80	76.92% (75.92–77.93)	99.97% (99.93–100.00)	99.93	0.99 (0.99–0.99)
Bones health	1.10	0.41	66.67% (65.54–67.79)	99.97% (99.93–100.00)	99.96	0.99 (0.99–1.00)
Oral health	1.66	2.21	31.25% (30.14–32.36)	99.99% (99.96–100.00)	99.82	0.99 (0.99–0.99)
Low GI/energy density	0.55	1.66	16.67% (15.78–17.56)	100.00% (100.00–100.00)	99.85	0.99 (0.99–0.99)
Reduction of disease risk	18.51	4.56	90.91% (90.22–91.60)	99.45% (99.27–99.62)	99.4	0.99 (0.99–0.99)
Heart-related claims	2.21	0.97	57.14% (55.96–58.33)	99.94% (99.88–100.00)	99.9	0.99 (0.99–0.99)
Cardiology Society	0.00	0.00	– (−)	– (−)	–	– (−)
Nutrient absorption	0.28	0.00	– (−)	– (−)	99.99	0.99 (0.99–1.00)
Cholesterol absorption	3.59	1.80	92.31% (91.67–92.94)	99.99% (99.96–100.00)	99.97	0.99 (0.99–1.00)
Digestive health	0.00	0.14	– (−)	– (−)	99.99	0.99 (0.99–1.00)
Osteoporosis	0.55	0.28	100.00% (100.00–100.00)	100.00% (100.00–100.00)	100.00	1.00 (1.00–1.00)
Diabetes/Glycemic impact	12.98	2.07	93.33% (92.74–93.93)	99.51% (99.34–99.68)	99.49	0.99 (0.99–0.99)
Nutrient and other function claim	33.15	11.76	72.94% (71.88–74.00)	99.13% (98.90–99.35)	99.8	0.98 (0.98–0.99)
Nutrient and energy	5.25	2.07	60.00% (58.83–61.17)	99.85% (99.76–99.94)	99.76	0.99 (0.99–0.99)
Nutrient and strength	4.70	1.38	80.00% (79.04–80.96)	99.87% (99.78–99.95)	99.84	0.99 (0.99–0.99)
Nutrient and general health	4.97	2.07	46.67% (45.47–47.86)	99.84% (99.74–99.93)	99.72	0.99 (0.99–0.99)
Nutrient and muscle	6.63	2.35	88.24% (87.47–89.01)	99.87% (99.78–99.95)	99.84	0.99 (0.99–0.99)
Nutrient and bone	5.8	1.94	92.86% (92.24–93.47)	99.88% (99.80–99.96)	99.87	0.99 (0.99–0.99)
Nutrient and growth	4.14	1.38	70.00% (68.90–71.10)	99.88% (99.80–99.96)	99.84	0.99 (0.99–0.99)
Nutrient and brain	1.10	0.28	100.00% (100.00–100.00)	99.97% (99.93–100.00)	99.97	0.99 (0.99–1.00)
Nutrient and digestion	12.43	1.24	100.00% (100.00–100.00)	99.46% (99.29–99.64)	99.46	0.99 (0.99–0.99)
Nutrient and immunity	2.76	1.66	83.33% (82.44–84.22)	100.00% (100.00–100.00)	99.97	0.99 (0.99–1.00)
Nutrient and absorption	0.83	0.14	0.00% (0.00–0.00)	99.96% (99.90–100.00)	99.94	0.99 (0.99–1.00)

*Data compared between Mintel's GNPD database and trained researchers' coding.

in the information available in Mintel-GNPD for all categories and subcategories of nutrition and health claims evaluated, showing a high potential for using Mintel-GNPD to monitor these strategies on food packages. The high prevalence of nutrition claims on food packaging is concerning because it can influence and modify eating patterns, especially in children, and contribute to the development of non-communicable diseases (13, 16). Since Brazil does not yet have representative and up-to-date public data on the information on food and drink packaging sold in supermarkets, this study provides an alternative source of reliable data for monitoring and characterizing health and nutrition claims in the country.

The data evaluated in Mintel's GNPD database showed a prevalence of 36.28% of nutrition claims on food packaging. Regarding the high prevalence of nutrition claims found in this study, other previous studies that have analyzed food and drink labels with data collected from supermarket shelves have also shown something similar, finding 28.5% of nutrition claims on food packaging (18).

Another study that evaluated claims and marketing strategies in Brazil found 32.8% of nutrition claims and health claims and revealed a high prevalence of these claims on dairy products (40). Breakfast cereals, bakery products, and dairy products were also food groups found with the highest prevalences of promotional strategies (11), including nutrition and health claims, which corroborates our results. This shows that, in a way, the data available from Mintel-GNPD represents what Brazilians have been finding on supermarket shelves.

We found two times more health claims in the information collected and coded by trained researchers using food images and INFORMAS taxonomy than the variables extracted from Mintel-GNPD, and this difference had an impact on agreement and sensitivity measures. One possible reason is that the INFORMAS protocol used to classify health claims considers brand names, phrases below the brand name, and slogans as health claims, and in the Mintel-GNPD we did not use the variable "brand" to identify the claims (e.g., a product with the name Naturale was considered as a health claim).

TABLE 4 Sensitivity, specificity, percentage of agreement and kappa for verifying the agreement of nutrition claims in the Mintel-GNPD.

Claims	Mintel's GNPD database (%)	Researcher's coding (%)	Sensitivity (CI 95%)*	Specificity (CI 95%)*	Percent of agreement*	Gwet's AC1 (CI 95%)*
Nutrition claims	36.28	33.73	92.9% (92.28–93.51)	92.53% (91.90–93.15)	92.65	0.86 (0.85–0.87)
Nutrient content claim	78.88	76.53	95.5% (95.01–96.00)	94.65% (94.11–95.18)	94.87	0.91 (0.90–0.92)
Fiber	13.37	13.28	97.01% (96.60–97.42)	99.47% (99.30–99.64)	99.36	0.99 (0.99–0.99)
Energy	13.78	11.69	76.60% (75.59–77.62)	97.94% (97.60–98.28)	97.1	0.96 (0.96–0.97)
Antioxidants/vitamins/minerals	31.61	30.26	97.67% (97.31–98.03)	98.33% (98.02–98.63)	98.26	0.97 (0.97–0.98)
Fats	9.35	6.97	82.91% (82.01–83.81)	98.52% (98.23–98.81)	98.16	0.98 (0.97–0.98)
Saturated fats	1.72	1.46	100.00% (100.00–100.00)	99.87% (99.78–99.95)	99.87	0.99 (0.99–0.99)
Trans fats	6.15	6.40	95.86% (95.39–96.34)	99.83% (99.74–99.93)	99.75	0.99 (0.99–0.99)
Omega 3	2.09	2.16	95.92% (95.45–96.39)	99.94% (99.88–100.00)	99.91	0.99 (0.99–0.99)
Omega 6	0.86	1.01	86.96% (86.15–87.76)	99.99% (99.96–100.01)	99.94	0.99 (0.99–1.00)
Sugar	24.03	23.78	95.73% (95.25–96.22)	98.87% (98.61–99.12)	98.62	0.98 (0.98–0.98)
Protein	11.03	10.94	95.16% (94.65–95.67)	99.49% (99.32–99.66)	99.33	0.99 (0.99–0.99)
Salt	7.71	5.73	90.77% (90.08–91.46)	98.94% (98.69–99.18)	98.78	0.98 (0.98–0.99)
Cholesterol	4.63	4.19	100.00% (100.00–100.00)	99.73% (99.60–99.85)	99.73	0.99 (0.99–0.99)
Taurine/guanine	1.15	1.10	100.00% (100.00–100.00)	99.96% (99.90–100.00)	99.96	0.99 (0.99–1.00)
Caffeine	0.74	0.53	83.33% (82.44–84.22)	99.88% (99.80–99.96)	99.85	0.99 (0.99–0.99)
Nutrient comparative claim	12.30	17.16	62.98% (61.83–64.14)	99.13% (98.91–99.35)	97.04	0.96 (0.96–0.97)
Reduced fat	3.40	3.40	89.61% (88.88–90.34)	99.79% (99.68–99.90)	99.67	0.99 (0.99–0.99)
Reduced saturated fat	0.04	0.22	20.00% (19.04–20.96)	100.00% (100.00–100.00)	99.94	0.99 (0.99–1.00)
Reduced trans fat	0.08	0.09	0 (0.00–0.00)	99.97% (99.93–100.00)	99.94	0.99 (0.99–1.00)
More calcium	0.21	0.04	0 (0.00–0.00)	99.93% (99.86–99.99)	99.94	0.99 (0.99–1.00)
Less salt	3.61	4.81	75.23% (74.20–76.26)	99.91% (99.84–99.98)	99.91	0.99 (0.99–0.99)
Reduced sugar	3.81	3.79	82.56% (81.65–83.47)	99.67% (99.53–99.81)	99.51	0.99 (0.99–0.99)
Reduced calories	3.12	3.26	89.19% (88.45–89.93)	99.85% (99.76–99.94)	99.45	0.99 (0.99–0.99)
More fiber	0.25	0.13	33.33% (32.21–34.46)	99.93% (99.86–99.99)	99.73	0.99 (0.99–0.99)
Reduced carbohydrates	0.00	0.00	– (–)	– (–)	–	– (–)
More protein	0.16	0.04	100.00% (100.00–100.00)	99.96% (99.90–100.00)	99.96	0.99 (0.99–1.00)
Reduced cholesterol	0.00	0.09	– (–)	– (–)	99.97	0.99 (0.99–1.00)
Health-related ingredient claim	28.82	35.42	70.61% (69.52–71.70)	97.63% (97.27–98.00)	94.41	0.93 (0.92–0.93)
Wholegrain	12.96	12.44	97.16% (96.77–97.56)	99.35% (99.16–99.54)	99.26	0.99 (0.98–0.99)
Bacteria/culture/probiotics/prebiotics	1.15	4.72	96.26% (95.81–96.72)	99.37% (99.18–99.55)	99.32	0.99 (0.99–0.99)
Fruits	5.95	5.51	31.20% (30.09–32.31)	99.68% (99.55–99.82)	98.41	0.98 (0.98–0.98)
Nuts	0.08	0.44	20.00% (19.04–20.96)	100.00% (100.00–100.00)	99.88	0.99 (0.99–0.99)
Honey	0.16	0.66	13.33% (12.52–14.15)	99.97% (99.93–100.01)	99.78	0.99 (0.99–0.99)
Grains/seeds	2.09	4.32	28.57% (27.49–29.65)	99.65% (99.51–99.79)	98.62	0.98 (0.98–0.98)
Vegetables/plants	4.22	3.62	56.10% (54.91–57.28)	99.14% (98.92–99.36)	98.62	0.98 (0.98–0.98)
Milk/cream	5.82	3.00	39.71% (38.54–40.88)	98.27% (97.96–98.58)	97.68	0.97 (0.97–0.97)
Oils	3.65	1.54	60.00% (58.83–61.17)	99.90% (99.82–99.97)	99.69	0.99 (0.99–0.99)
Cocoa	2.46	4.46	71.29% (70.21–72.37)	99.74% (99.62–99.86)	99.32	0.99 (0.99–0.99)

*Data compared between Mintel's GNPD database and trained researchers' coding.

However, nutrition and health claims that most impact consumers and influence their food choices are highlighted on the front of the package (18, 41) and on other sides of the package as well (11, 42) and are not necessarily present in brand logos and slogans.

Studies evaluating the validity and reliability of the information available on secondary databases have been made through the years in epidemiology (43), as a way of certifying that variables, measures, or information collected by third parties can be used to generate good results in quantitative studies that associate health outcomes with risk factors, for example. Some examples of these studies are related to the food environment, comparing it to primary data collected, as made in the United States (44) and United Kingdom (45). A systematic review (46) evaluated the use of commercial databases in public health studies, including companies such as Euromonitor and Kantar, and concluded that these data can be useful tools with great potential for public health nutrition studies if used according to their limitations.

The inadequate use of nutrition and health claims on food packaging is concerning because these claims are used to persuade consumers to buy products, especially children (47). When there is no effective regulation the use of marketing strategies targeted at children can increase and mislead the consumers' understanding (48). In addition, the lack of regulation makes it difficult to check the veracity of the claims, as has happened in Brazil where a brand of biscuits claimed to have honey on the package but none of them had honey on the ingredient list (49). The high frequency of nutrition and health claims on packages is concerning and highlights the need to monitor these strategies in a faster way, considering that the food industry incorporates new products into the market very quickly. These results emphasize the need to improve regulations and inspections on the use of nutrition and health claims to reduce the health halo effect on consumers and not be present in foods that are high in sugar, sodium, and fats. Besides these types of claims being regulated in Brazil (50–52), they are used as a form to promote the product, increasing the perception of healthiness by consumers, but are often present on foods that have poor nutritional quality (11, 18).

Therefore, by monitoring these strategies using a commercial database we can characterize the types of products that contain this health and nutrition claims, which types of claims are most prevalent, the target audience, the brands involved, and other factors that are key to developing and evolving regulatory aspects in Brazil. However, this characterization of health and nutrition through the Mintel database first needs an evaluation of its data, as a first step, since Brazil does not yet regulate marketing, we can explore the types of products and types of claims most used by ultra-processed food manufacturers.

This study has some limitations. Mintel's GNPD database is updated with every launch or update – reformulation, packaging design, or any other modification – and for that reason, it is not possible to know if any product present in the database and analyzed in this research has been discontinued from the market. Nevertheless, the sample is large and includes approximately 20% of the products available for the period from 2018 to 2021. We included products from the best-selling brands in Brazil, which together hold an 80% market share of sales, as well as all private-label foods from seven Brazilian retail markets. To categorize the claims, we classified them into categories and subcategories. When classifying into subcategories, we found a very low prevalence of some claims, for example, the 'nuts' subcategory of health-related ingredients (below 0.5% in both datasets) that could have affected the sensitivity measure. Despite the limitations, this is the first study to compare

information of nutrition and health claims present in Mintel-GNPD with manually coded claims by trained researchers. Another strength of the study is the use of the INFORMAS protocol to evaluate the nutrition and health claims. As it is a standardized international protocol, it makes it easier to compare results with other countries (4). Also, Mintel-GNPD has data from more than 80 countries and the coding that we developed in Stata can be applied to analyze nutrition and health claims from other countries too.

5 Conclusion

The results found in this study indicate that the information on health and nutrition claims available at Mintel-GPND is suitable for monitoring such claims on food and beverage packaging in Brazil. Monitoring the use of nutrition and health claims on food packages is central to developing and improving public policies to regulate food labeling, especially when it comes to children and adolescents. The considerable expenses and frequently extended timelines associated with gathering primary data, compounded by the absence of publicly accessible databases containing this information, present challenges in effectively surveilling these claims. Thus, verifying whether Mintel-GNDP is suitable for monitoring health and nutrition claims in Brazil will allow us to take advantage of available datasets to facilitate policy monitoring.

The development and improvement of public nutrition and health policies depend on the production of scientific evidence through monitoring the marketing strategies, such as health and nutrition claims, used by the food industry so they can act effectively to improve the diet of the Brazilian population, reducing the consumption of low nutritional quality foods and preventing the development of related diseases such as obesity and diabetes. Public policies aimed at regulating marketing strategies are a fundamental part of protecting the population's health, as they aim to protect consumers from abusive marketing practices, provide clearer and better-quality information about the food they are buying, and offer tools for healthier food choices.

Having established that the information on health and nutrition claims available at Mintel-GNPD for Brazil allows for future research endeavors. These data can provide valuable information for monitoring and enforcement of the labeling legislation in Brazil.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

CK: Conceptualization, Formal analysis, Writing – original draft. CAB: Methodology, Writing – review & editing, Supervision. ACD: Methodology, Writing – review & editing, Supervision.

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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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Check for updates

Visual communication design: a neglected factor in nutrition promotion via packaged food labels

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Packaging design is a communication device and a critical component in branding strategy, and has relevance for food policy. Presently, packaging-related nutrition policy initiatives focus on the role of regulated claims, nutrition information panels and front-of-pack nutrition labels to help guide consumer food choices and address high prevalences of discretionary and ultra-processed food consumption in many countries. However, these nutrition labelling systems are not optimized as public health policy tools as many consumers do not use them to inform their food choices. Visual communication design theory posits that a designer orders the elements and principles of design into hierarchies that prioritize certain elements over others, and that some of these elements are more dominant and given more emphasis than others. The overall design of the package thereby directs consumer attention to some aspects of pack design (e.g., characters, contents of the package) and away from others (e.g., nutrition details). Dual processing frameworks propose that food decisions are made with the interplay between automatic and rational thinking processes. Packaging designs affect whether consumers rely predominantly on automatic or rational thinking to select a food. This narrative review outlines the role of food packaging design and how it impacts the clear communication of nutrition aspects of food products and how the use of nutrition information by consumers to make decisions may depend upon design structures in packaging. This article attests that nutrition scientists and policy makers should incorporate visual communication design into research on the food packaging as a public health promotion tool. A stronger focus on the communication of regulated front-of-pack nutrition information can be made with a re-evaluation of the hierarchy of elements in the front-of-pack design enabling consumers to make healthier decisions.

KEYWORDS

public health, nutrition policy, food packaging, communication, design, food labeling, claims, consumer behavior

Introduction

Discretionary and ultra-processed foods form a large proportion of contemporary diets (1–5). These foods are often consumed as packaged foods, typically purchased relatively cheaply from grocery stores/supermarkets (6, 7), thereby contributing to the high prevalence of low-quality diets and attendant elevated non-communicable disease

risk (8, 9). Food packaging designs motivate purchase and consumption, and are therefore one way by which food environments influence food choice and consumption and may be an important reason why consumers make unhealthy food choices (10). Considering the overall pack design, including both the use of mandatory or voluntary nutrition labels along with other design elements, and how these influence consumer decision making processes, could provide new avenues for optimizing the use of nutrition labels by consumers.

For nutrition labelling to be effective it is pertinent that the complete nutrition and health properties of the product are clearly available on food packages so consumers notice and use this information to make informed decisions. Dual-processing frameworks provide a useful way to understand consumer responses to food labelling and packaging designs (11–16). According to these frameworks two interacting processes are involved in decision making: System 1 (or bottom-up) and System 2 (or top-down) processes. System 1 processes are fast, intuitive, emotive and informed by learned associations and emotions. In contrast, System 2 processes are slower, reflective, controlled, and conscious, typically linked to goal-directed behaviors (12, 17). According to these frameworks, packaging attributes interact with consumer characteristics and contexts to determine whether the packaging is effective at promoting healthier food choices. The mechanism by which this occurs is whether System 1 or System 2 processing is more dominant during the choice process. For food packaging, the use of emotive claims, mascots/celebrities, attractiveness of the overall visual design, colors and images of products or other visual cues can evoke System 1 processing. Conversely, nutrition information panels and nutrition and health claims would be expected to require effortful System 2 processing.

Contextual factors, level of involvement in making the decision, goals, and individual characteristics play important roles in determining whether System 1 or System 2 is more dominant in decision making. In circumstances where level of involvement is lower due to reduced cognitive resources (e.g., time pressure, consumers are fatigued), or consumers are not motivated to select a healthier option (e.g., instead seeking a food reward), they may be less likely to rely upon System 2 (and therefore on-pack nutrition information) (15). In current regulatory contexts where consumers must disentangle regulated nutrition information from the other elements of packaging design (including voluntary nutrition claims), and where marketing cues can be incongruent with the product's nutrition profile (18), it is expected that consumers need to engage System 2 processing to use on-pack nutrition information and make healthy food choices (14). However, for on-pack nutrition information to be a more effective health promotion policy tool, packs need to be designed in ways that recognize dual processing perspectives of consumer decision making. Packs should be designed in ways that either promote System 2 processing by directing consumer attention to regulated nutrition information, or System 1 processing whereby marketing and other design elements are congruent with the product's nutrition profile and therefore can inform choices. Understanding of the various elements on food packages, including nutrition labels and marketing elements, as well as visual communication design principles that encompasses what, where and how these elements are arranged, can provide new

avenues for promoting healthy diets through on pack nutrition labeling.

There is a long-standing history in the use of both mandatory and voluntary nutrition labelling practices to promote healthier diets, with the World Health Organization (19) and United Nations (20) and a range of other more localized bodies including Food Standards Australia New Zealand (21, 22) and the European Union (23) recognizing the important role of food labelling in affecting food environments and therefore diets. Historically, nutrition information/facts panels, which typically provide information on average energy, total fats, saturated fats, carbohydrates, protein and sodium per 100 grams and/or serve of product, were the main method to provide nutrition information on products. However, this information requires knowledge, time, and effort to use, and is typically not on the front of a package, meaning it requires effort to locate and use. This led to the introduction of simpler, more interpretive, front-of-pack labels (e.g., Health Star Rating (HSR) in Australasia, Nutri-Score in parts of Europe or warning statements in South America) designed to summarize nutrition information about the products and make it readily visible and understandable to a wider range of consumers. Product manufacturers also use voluntary nutrient and health claims on the front of packages to communicate nutrition and health information. In this regard, product manufacturers promote products through the exclusive use of positive statements (claims) and do not make transparent potentially problematic nutrients such as high levels of added sugar or salt (24–27).

A large body of work has investigated how these various nutrition or health labels influence consumer perceptions, awareness, understanding, and use. This primarily includes front-of-pack labels, nutrition, health and related claims, and nutrition information panels (28), including, more recently, warning labels (29–31) and "high in" labeling (32). This work has been extensively reviewed elsewhere [see (30, 33–39)]. Empirical findings on the efficacy of these elements to influence perceptions and choice are mixed (29–31, 34, 35, 37–43): it appears that the effects of nutrition information on food packages may depend upon a range of factors including the type of information presented on the pack, the way in which the information is presented (e.g., numerically, visually, using particular colors), and how these interact with the characteristics of the consumer, the context in which the food decisions are being made the type and what other information is present Therefore, although nutrition labels have promise as a policy tool to influence consumer behaviors, they are not yet optimized for use by all consumers across a range of foods and contexts.

There is also a collection of somewhat disparate other research studies related to understanding how packaging designs influence consumer food choices. This body of work has considered the effects of simultaneous presentation of various claims as part of an over pack design, the combined/interacting effects of claims and nutrition information (44, 45), or the role of claims in biasing health perceptions (46). Further research has examined the impact of food package graphic design on consumers, with these studies showing the utility of graphic design for being a useful tool in communicating consumer benefits (47), that the positioning of packaging elements influences consumer attention (48), and that a relationship between packaging design and willingness to pay exists

(49). Additionally, food pack design research has shown that consumers are able to process multiple packaging messages concurrently (47), that visual design cues are an important influence on consumer choices (10, 50, 51), and that brand and other visual cues such as colors and images can influence choices (52–55). There is also a recognition that other aspects of packaging design including auditory, haptic, and olfactory characteristics influence consumers (56) and that physical features (e.g., shape) influence attention in crowded marketplaces (56, 57). There are also studies (18, 58) examining implicit and explicit packaging design elements as heuristics, showing that these influence consumers differently. Taken together, these studies demonstrate the important role of design in influencing consumers in a range of ways. However, extant nutrition research on food packaging has neglected to sufficiently acknowledge the important role that visual communication design has on consumer-packaged food/drink choices and consumption behaviors. The aim of the present review is therefore to outline how design, including design hierarchy can be considered in food packaging research to promote healthy diets. This review does not aim to interrogate each of the elements or propose an alternative way to construct the arrangement of the visual elements of each package, nor will it seek to critique or alter the nutrition information already present on the package.

Visual communication design's role in consumer decision making

Packaging design, as a communication device, is a critical component in a branding strategy, one where the focus of a designer is to develop a positive relationship in a saturated retail environment, enticing consumers to make a purchase. As a specific area of design practice, food packaging design has become a communication device, offering information, and assuring consumers of their choice. The package becomes the living embodiment of a brand's attributes, traits and personality establishing an inherent promise in the design of the package (59). "Packaging design is one of the key elements of a marketing strategy for a product as it is the visual face that will be promoted, recognized and sought out by the consumer" (60, p. 15). However, unlike manufacturers who use design to effectively market their products to consumers, the possibilities offered by design have not been exploited by nutrition scientists and policy makers. Therefore, it is vital to interrogate the many attributes present on food packages (e.g., claims, marketing images, brand names) and how packaging design is codified using design elements and principles to communicate to consumers. These are the tools that can be manipulated to promote healthier choices.

Visual communication design [i.e., the process of bringing a functional, esthetic, and organized structure to a group of diverse elements (61)] on food packaging can influence consumers at the point of purchase and impact whether on-pack nutrition information is used by consumers to make decisions (50, 62). Pack designs that capture attention and evoke emotions, generate product perceptions and expectations using color, fonts, imagery, and branding strategies can be used to direct consumers toward healthier alternatives (18). This could be via disrupting automatic (System 1) decision making to rely predominantly on rational (System 2) processes if designs direct

attention to nutrition information. Alternatively, if nutrition information is designed and presented in ways that require little cognitive effort, then healthy decisions could be made by relying upon System 1 processes. The fundamental premise is that design is important to enhance the effectiveness of communication, increasing the capacity of the recipient to engage with the information and learn from the communication to make healthier choices.

Design elements and principles

Design elements and principles are the foundations of the language of design. Offering a definition of design elements and principles, Evans and Thomas (63) explain that the elements of design are the components that constitute the content of a graphic design composition while the principles of design are the way the components are placed together and the unseen forces that create interaction between the elements. Design elements are defined by Barnum et al. (64) as dot, line, shape, space, texture, value, size and scale, color, and typography whereas design principles are defined as balance, hierarchy, rhythm, pattern, unity, proportion, emphasis, and contrast. This list is not definitive, and a review of online resources and books will demonstrate different groupings and additional words defining design elements and principles; each are also correct and valid (65).

Visual design hierarchy

Design as a discipline uses signs, conventional and experiential, to communicate concepts to consumers (66). Visual communication designers work with codification of the visual to communicate and impart meaning in a very precise way. The consumer is an active participant in the exchange of information, entering a discourse (67). The purpose of design is to clearly communicate through visual information which involves choosing the right elements and crafting them in a way they communicate efficiently and effectively (68). Designers work with clearly defined design elements and principles that are organized into a system and placed within a context. It is by association to surrounding signs that meaning is created as the elements and principles work collectively to guide the viewer through the communication. Although the field of design continues to evolve with social change and rapid technological developments, and the growing need for market impact, the basic elements that are used to create the communication strategy remain the same (64).

Of relevance to nutrition information on food packages is the principle of hierarchy (the arranged order of elements) and the dominance (the relationship and influence of one element over another) or emphasis (the prioritizing of one element over another) in a design used to establish the path the viewer's eye will take when they are presented with a food package (67). Once the consumer has looked at the dominant elements, and has become familiar with them, they seek the next level of communication and consider other elements that support the dominant elements (63). Designing with a clear emphasis on the dominant elements, followed by the secondary and subsequent support elements, reveals a meaning for the consumer. By managing the visual hierarchy, the designer controls how the design is read (63). The place of nutrition information in the visual hierarchy may impact whether it is used by consumers in System 1 and System 2 based decision making. That is, if nutrition information is placed low in the hierarchy, then it is unlikely that consumers will use

this information when making decisions or forming impressions of products.

However, the overall design, its elements and their interrelations has not been examined as an influence upon attention to, and use of nutrition information in relation to food choices and intakes. We were unable to identify any papers that examined the way in which design structures, specifically design hierarchies, influence packaged food choices. This is problematic because for food packaging to be effective in promoting healthy diets, and ultimately good health, it needs to be able to influence the decision making of diverse consumers who purchase different foods in different contexts. We argue that design hierarchies are fundamental to doing this effectively by prioritizing clear and trustworthy nutrition information in pack designs.

Prioritizing clear and trustworthy nutrition information

It is apparent that by considering front of pack design hierarchy, novel ways of capturing and directing attention to nutrition information on food packages can be developed and tested as new avenues for improving public health. We propose this would generate new ways of designing front of packs that extend from focusing on what nutrition information is on the pack, toward a greater emphasis on where and how it is displayed, relative to other elements, and how this impacts consumers' decision making as understood by dual processing models. Reducing the competition for attention (e.g., by reducing the prominence of marketing imagery) and strengthening those packaging elements that can promote health (such as nutrition information) is fundamental to improving health through packaged food choices. Designing food packages that effectively communicate nutrition information by using an understanding of the elements and principles of design can be generated and tested. In designing these packages, combining design principles with advances in understanding consumer decision making [e.g., dual processing theories (14), neural models (15)], to impact decision making could lead to novel approaches. Empirical research could test the effects of these new designs using existing methods (e.g., experiments, discrete choice studies, eye tracking) on packages both on consumer perception, attention, understanding, health inferences and choices, but also about packaging design appeal and brand strength as outcomes of interest to designers. Designs that

enable consumers to make more accurate decisions with less cognitive effort (i.e., relying upon system 1) compared to current pack designs could be identified. As part of this, there is also an opportunity to address the need for the communication of both positive and negative nutrition information (e.g., via warning labels), in relation to other visual cues (e.g., marketing images), building on the comprehensive research on nutrition labels. The effects of these types of changes on different consumers and product categories needs to be tested.

Recognizing there are structural implications with the current approaches to packaging design, we propose that packaging designs should (i) increase the hierarchy of nutrition information and secondly, (ii) establish a consistent location for the information, and (iii) present objective information (both positive and negative). This could be addressed by removing most of the marketing information on packs (plain packaging approach). However, an alternative approach that allows for the preservation of branding and marketing information is to place a larger (e.g., 25% of packaging) panel of nutrition information on the front-of-pack design, moving existing design elements slightly to the left, right, up or down according to the package. Figure 1 below, demonstrates how this could be achieved using a typical snack bar found on Australian supermarket shelves. The nutrition panel has been located on the left of the package occupying approximately one quarter of the front panel. Each of the elements previously identified still appear on the package but have been pushed to the right. Figure 2 demonstrates how the nutrition information appears at the top of the pack, again taking one quarter of the front-of-pack space, moving the other elements lower in the packing design. Lastly, Figure 3 demonstrates one quarter of the front-of-pack hosting the nutritional information at the bottom of the package, moving the other elements higher. The principle of increasing the hierarchical impact and establishing a consistent location of the nutrition information is achievable in the examples below (Figures 1–3). For consumers, the benefits of considering design in this way is the increased capacity to identify healthier products with limited cognitive effort (i.e., by relying upon System 1).

Due to the consistencies in design approaches within a food category, it is not difficult to see how this approach could be applied across the range of each food category (Figure 4). The children's
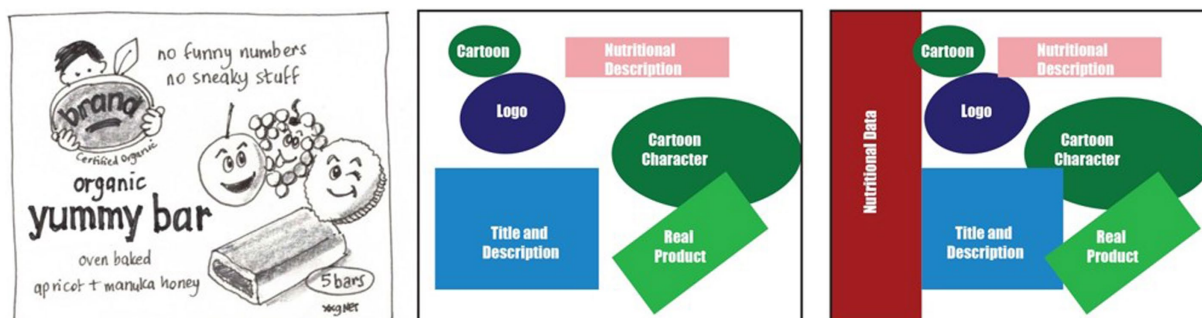
FIGURE 1
Illustrated image of child snack bar product (L) with elements highlighted with color (C) and proposed 25% of the pack dedicated to nutrition information (R).
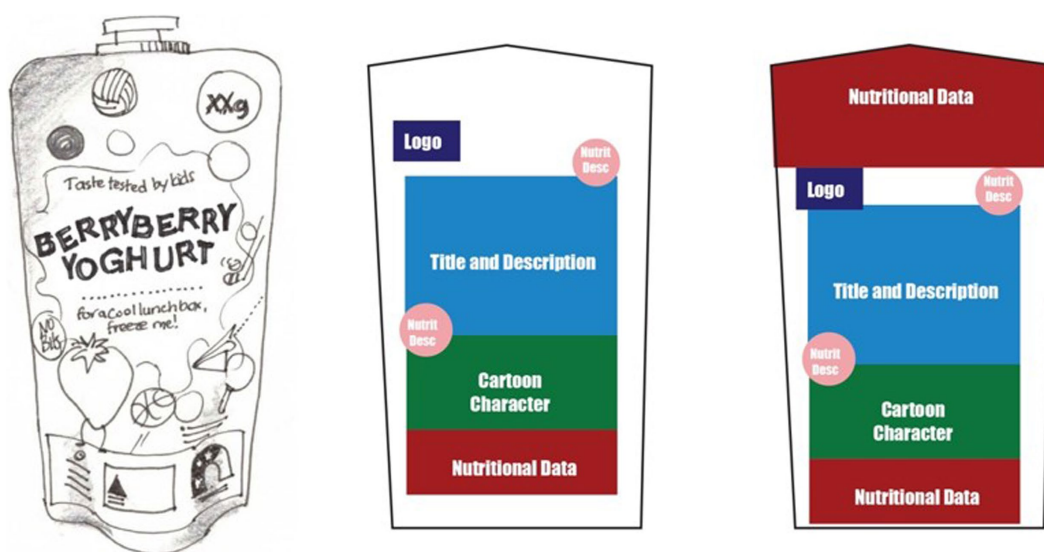
FIGURE 2
Illustrated image of pouch yoghurt product (L) with elements highlighted with color (C) and proposed 25% of the pack dedicated to nutrition information (R).
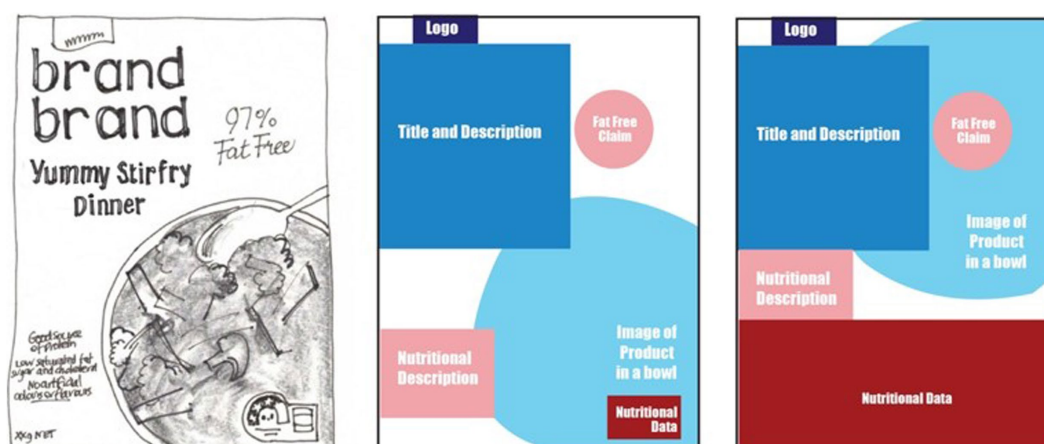
FIGURE 3
Illustrated image of readymade meal product (L) with elements highlighted with color (M) and proposed 25% of the pack dedicated to nutrition information (R).

yogurt range shows six designs where the left-hand image highlights the existing design elements, and the right-hand image highlights an increased focus on the essential nutritional information for consumer to make an informed decision. In each instance, the front-of-pack design was not altered with the revised design and instead the existing front-of-pack elements have been moved lower in the package, compacted together in some instances, allowing for an increased visual emphasis, equivalent to one quarter of the package, dedicated to nutrition information. This elevates the nutrition data for the consumer to first in the hierarchy of elements, due to the size and consistent location of the panel of information. Reliably, across all six children's yogurt range designs, the nutrition panel becomes the first focal point for the consumer, followed by the either the cartoon characters or the title and description.

The ready-made meals achieve the same outcome when the nutrition panel is elevated in the hierarchy to one quarter of the front-of-pack design. The six designs demonstrated below offer, on the left, the original hierarchical arrangement of elements and on the right the revised design, with a focus on allocating 25 % of the package to nutrition information consistently located at the bottom of the front-of-pack design. This is followed by three designs from the fruit bar range where the nutrition information is placed on the left-hand side of the front-of-pack design. With increase of the nutrition element in design hierarchy, the consumer's ability to identify and read nutrition information should be increased.
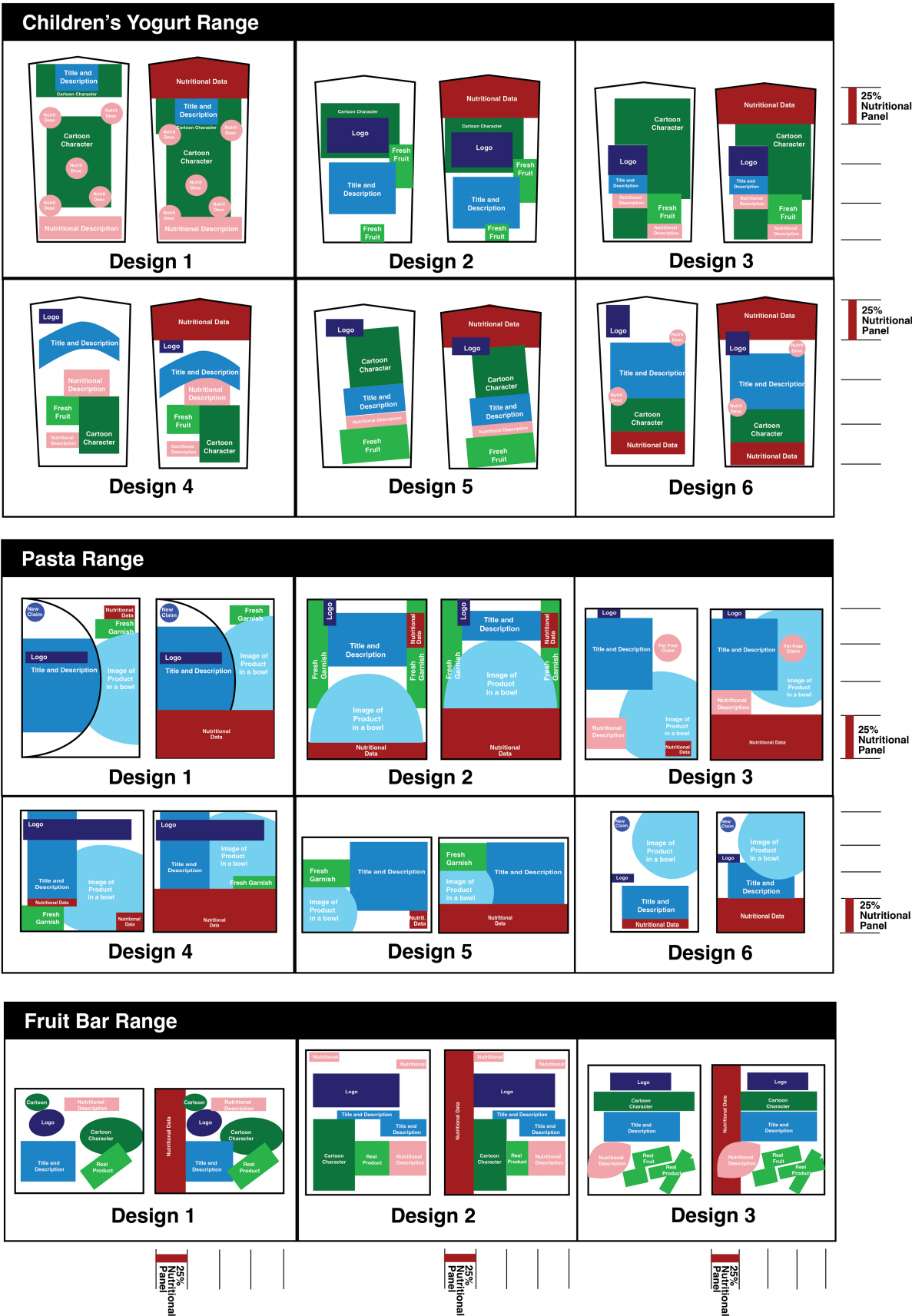
FIGURE 4
Example of application of a nutrition panel comprising 25% of the pack across different food products within a category using three food categories as exemplars.

Discussion

In this article we have outlined the significant role that design has in consumer responses to food packaging. Creating a hierarchy of elements visually on a package that prioritizes objective, regulated nutrition information would increase awareness of this content and assist consumers with the visual reading of the information. This would result in stronger consumer awareness and the ability for consumers to make informed decisions. It could lead to new ways of enhancing the impact of regulated nutrition information without compromising the need for visual design to entice consumers. It is important that research demonstrates that designs not only impact consumer attention to nutrition information, but also choice (69). However, the role of hierarchy in design impacting the reading of nutrition information, and influencing decisions and decision-making processes, has not been explored. It is unknown where nutrition information is placed in visual communication hierarchies currently, and whether it is given dominance and emphasis on different types of healthy or unhealthy foods.

There is a need to understand how nutrition information, as an element in a package design, competes with other elements on the package including the title, description of the product and any imagery on current food packages, and how this affects consumer decision making. If nutrition information is given a higher priority compared with other information seen on a front-of-pack (e.g., title, description, images), the hierarchy of elements created visually on a package would increase awareness of the nutrition content and assist consumers with the visual reading of this information. This may disrupt automatic decision-making processes (System 1) and promote the use of rational decision making (System 2) (58). Alternatively, if nutrition information is presented in easy, intuitive ways, then System 1 decision processes could be an effective way to promote healthier choices. This could therefore assist consumers in making informed, accurate decisions based on trustworthy nutrition information. Increasing the impact of nutrition information using a design hierarchy could lead to new ways of enhancing the impact of regulated nutrition information without compromising the need for visual design to entice consumers.

This is not an insurmountable task. As demonstrated above, generalizations can be made in a review of food product categories, one of which is similar packaging and commonly known visual communication strategies are used across a category of food. Although packages look distinctly different across food categories, there are many elements used in a packaging design such as the choice of font, color, and shape of the package that lead to consistency in the design approach within the same food category. This makes the comparative evaluation of food packaging possible. By considering packaging design we can develop novel ways of capturing and directing attention to nutrition information on food packages and thus new approaches for influencing food choices.

Design is not currently considered in a comprehensive way in food/nutrition regulatory frameworks. In Australia, there are currently only regulations that mandate the size and position of some words and elements on a food package, as well as the requirement for a proscribed nutrition information panel (70). However, if evidence accumulates demonstrating how design

affects consumption and can be used to promote consumption of healthier foods, this could form the basis of regulatory change. An advantage of this approach is that it is easier to enforce packaging regulation than other domains of food advertising (e.g., digital marketing) (71). Manufacturers who take advantage of this approach could develop a new marketing strategy that may differentiate their product in a saturated market. Companies that are moving toward broader benefits including healthy eating options can maximize their communication strategy through front of pack design. This may generate new ways of addressing the intractable problems of high consumption rates of unhealthy, ultra-processed packaged foods, as part of a wider set of strategies.

Conclusion

Packaging visual communication design is a neglected health promotion tool. We argue that considering the hierarchy of elements on food packaging designs is likely to enhance the importance of nutritional information by increasing its profile so it may assist consumers in making decisions. Visual communication design hierarchies can therefore help address the fundamental challenge associated with nutrition labelling at present – that many decisions are made without using on-pack nutrition information. Packaging designs that prioritize trustworthy nutrition elements therefore have potential to influence healthy food decisions and improve diet quality and health outcomes for the population.

Author contributions

MK: Conceptualization, Project administration, Writing – original draft, Writing – review & editing. JM: Writing – review & editing. CC: Writing – review & editing. JW: Writing – review & editing. CR: Conceptualization, Writing – original draft, Writing – review & editing.

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Chinese consumers' psychology and behavior of the foods with nutrition claims based on AISAS model

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Objective: We analyzed the impact of nutrition claims on Chinese consumer psychology and behavior process based on the theoretical framework of AISAS (Attention-Interest-Search-Action-Share) model.

Design: To adopt questionnaires to collect gender, age, income and other basic information of adult residents and a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) to collect data on residents' attention to nutrition claims, interest in nutrition claims, search on nutrition claim information, purchasing behavior on food with nutrition claims, sharing information on food with nutrition claims. Then to study the relationship between the basic situation of residents and their attention, interest, search, food purchase behavior and sharing of nutrition claims by using exploratory factor analysis, reliability and validity test, structural equation modeling estimation and hypothesis testing.

Participants: Chinese adults.

Setting: Multi-stage stratified random sampling method was used to collect the valid online questionnaire of 630 Chinese adults from Central, North, East, South, Northwest, Southwest, and Northeast China.

Results: Younger adults and those with higher household incomes exhibited heightened attention to nutrition claims. Furthermore, consumers' attention to nutrition claims could be transformed into food information sharing through interest, information search, and food purchase. Consumers' interest in food with nutrition claims could be transformed directly into food purchase. Consumers' search for related information could be directly transformed into food information sharing.

Conclusion: Chinese consumers' age and household income could be included in the AISAS model for the foods with nutrition claims, and the consumers' action and share could transform from their interest and search.

KEYWORDS

nutrition claim, food consumption, AISAS model, structural equation model, nutrition labeling

1 Introduction

At present, the dietary habits of Chinese adults are characterized by elevated consumption of oil and salt, accompanied by inadequate intake of whole grains, dark vegetables, fruits, milk, fish, shrimp, and beans. This dietary pattern leads to excessive sodium and saturated fatty acid intake and insufficient consumption of calcium, dietary fiber, and vitamin C (1). Therefore, the supply of food with low sodium, low fat, high calcium, rich dietary fiber, and rich vitamin C can effectively cater to residents' requirements for a nutritious and healthy diet. The nutrition claim is a nutrition labeling that describes the positive nutritional and health properties of the foods. Marking methods and content requirements for nutrition claims on prepackaged foods have been regulated in *the National Food Safety Standard of General Rules for Nutrition Labeling of Prepackaged Foods* (GB 28050—2011) since 2011 (2). Therefore, there has been a growing number of prepackaged foods labeled with such claims in the marketplace.

Although the nutrition claim is a policy tool developed by the Chinese government for consumers to make nutritious and healthy food choices (3). However, whether and how consumers react to nutrition claims on foods is not only the basis for public authorities to evaluate nutrition policies, but also one of the indicators for manufacturers to test the market share of nutritious and healthy foods. In addition, China's nutrition claims are introduced during the mobile Internet era when people are willing to search and share information (4). In this context, consumer responses to nutrition claims may also include the active search and sharing of nutrition claim information. However, the current research mainly focuses on consumers' attention, interest, cognition and purchasing behavior of nutrition claims, but has not yet studied how consumers search and share nutrition claims information in the era of mobile Internet. Therefore, it is innovative to carry out research on consumers' psychological and behavioral processes of food nutrition claims, including search and information sharing, which could understand the nutritional needs and consumption behaviors of consumers in the new era, expanding and strengthening the explanatory power of consumer behavior theories with China experience, and providing decision-making basis for governments in other countries to adjust and improve supporting measures for nutrition claims. It also provides persuasive evidence for food manufacturers to produce nutritious and healthy foods.

The remaining parts of this study are as follows: the second part summarized the research progress of the impact of nutrition claims on consumers' psychology and behavior process; the third part proposed research hypotheses; the fourth part introduced the data sources and research methods; the fifth part implemented reliability and validity test and structural equation model estimation; the sixth part discussed the results; the final part is the conclusion and inspiration.

2 Literature review

At present, the behavior pattern of consumers in the era of mobile Internet was studied mainly with the Attention-Interest-Search-Action-Share (AISAS) model proposed by Dentsu Co.,

LTD in 2005 based on the Attention-Interest-Desire-Memory-Action (AIDMA) model which aims to explore consumers' psychology and behavior in the Internet era (5). As shown in **Figure 1**, the AISAS model consists of attention, interest, information search, action, and experience sharing. AISAS model was widely used in online and offline marketing effectiveness evaluation of Fast Moving Consumer Goods (FMCG), durable goods and services, involving coffee, seafood, intelligent pension products, hotel accommodation, tourism service, the Augmented Reality (AR) wedding invitation app, AI-generated cultural and creative products, advertising on social networking site and organic food sold on social media. Among them, some studies extended the AISAS model according to characteristics of the products and service (6–15). For example, the social latent variables were added to the AISAS model to construct the Attention-Interest-Search-Social-Action-Share (AISSAS) model to analyze consumers' usage behavior of the AR wedding invitation app (8). Most studies have proved that AISAS model and its extended model could effectively explain consumer psychology and behavior to products and service marketing (6–9).

There have been a number of studies on the impact of nutrition claims on consumer psychology and behavior. Through questionnaire design, scholars mainly investigated consumers' preference, health perception, interest, willingness to pay and attention, brand loyalty, purchase decision and food choices (16–31). There also existed a few studies on the relationship between individuals' psychology and behavior such as interest in foods with nutrition claims and purchase decision (21, 32). Studies have consistently concluded that nutrition claims had a "health halo", which could improve consumers' cognition of food quality, consumption confidence (17, 18, 24, 27, 28).

The existing studies on the impact of nutrition claims on consumers' psychology and behavior were not systematic and in-depth enough to fully reveal the consumers' reactions to nutrition claims, which failed to effectively design the promotion and marketing strategy of nutrition claims. By referring to the former studies on AISAS model and its application, we aimed to analyze the impact of nutrition claims on consumer psychology and behavior process by expanding the AISAS model and using the questionnaire survey data of Chinese consumers.

3 Hypotheses

The **Figure 2** shows that the AISAS hypothesis model is proposed based on the framework of the AISAS model and the characteristics of foods with nutrition claims. The AISAS model does not include consumers' socio-economic characteristics, rendering it incapable of discerning which demographic segments are more likely to pay attention to product marketing advertisements. Most studies have found that consumers who were female, younger or had higher household income paid attention to nutrition claims (33–36). It could be seen that gender, age and annual household income were the individual characteristics that significantly affected consumers' attention to nutrition claims.

FIGURE 1
AISAS model. Source: Dentsu Inc (5).
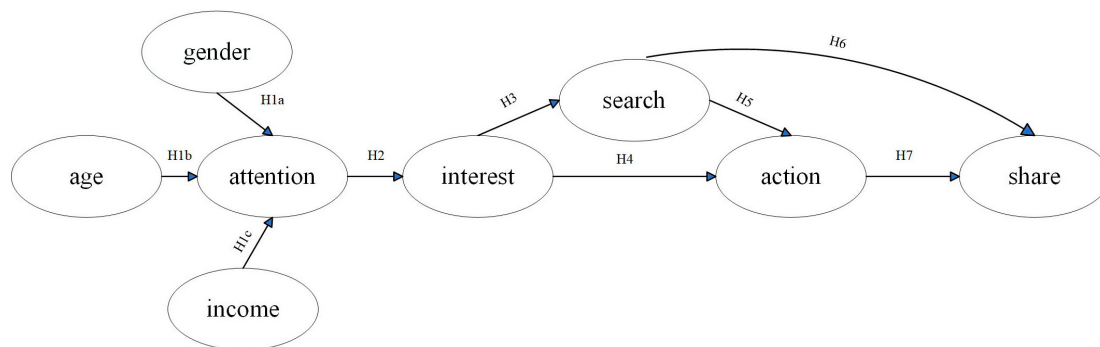
FIGURE 2
The AISAS hypothesis model. Authors' own illustration.

Therefore, this study aims to incorporate these three individual characteristics to formulate the following research hypotheses:

H1a: Consumers' attention to food nutrition claims is directly and negatively influenced by their gender.

H1b: Consumers' attention to food nutrition claims is directly and negatively influenced by their age.

H1c: Consumers' attention to food nutrition claims is directly and positively influenced by their annual household income.

The AISAS model clarifies that consumers' interest in products is directly and positively affected by their attention to product advertising (5). Moreover, European consumers' interest in nutrition labeling were found to be derived from attention (37, 38). It is inferred that consumers who pay attention to food nutrition claims are likely to be interested in foods with nutrition claims, so the following research hypothesis is proposed:

H2: Consumers' interest in foods with nutrition claims is directly and positively influenced by their attention to food nutrition claims.

The AISAS model clarifies that consumers' search for product-related information is directly and positively affected by their interest in products (5). It is also found that if nutrition labeling raised consumers' interest, consumers would search more information about the product (39, 40). It is inferred that consumers who are interested in foods with nutrition claims are

likely to search for information about those foods. Therefore, the following research hypothesis is proposed:

H3: Consumers' search for information about foods with nutrition claims is directly and positively influenced by their interest in the food.

The AISAS model illustrates that consumers' interest in products could only be transformed into product purchase through information search (5). Given the more affordable nature of food products featuring nutrition claims compared to items related to personal development and enjoyment (e.g., education, healthcare, entertainment, and cultural services), some consumers may be inclined to expedite their purchase decisions without extensive information search (21, 32). Consequently, the research hypothesis is as follows:

H4: Consumers' food purchase behavior is directly and positively influenced by their interest in the foods with nutrition claims.

The AISAS model clarifies that consumers' product purchase is directly and positively affected by their search for product-related information (5). And consumers' search for information about foods with nutrition and health claims was found the final step that translated into foods purchasing (38). So it is inferred that consumers who search for information about foods with nutrition claims are likely to buy the foods with nutrition claims and the following research hypothesis is proposed:

H5: Consumers' food purchase behavior is directly and positively influenced by their search for information about the foods with nutrition claims.

TABLE 1 Scale items for each latent variable.

Latent variables	Scale items	Scale items code
Attention	The food nutrition claims have attracted your attention.	a1
	Manufacturers running ads highlighting food nutrition claims have attracted your attention.	a2
	Compared to other identical foods, the food with nutrition claims has attracted your attention.	a3
	You have paid attention to food nutrition claims in daily life.	a4
Interest	You have been interested in the foods with nutrition claims.	b1
	Nutrition claims have aroused your interest.	b2
	The foods with nutrition claims has made you feel better than the food without such claims.	b3
	You are eager to try the foods with nutrition claims.	b4
	You are more interested in the foods with nutrition claims than those without.	b5
Search	You have searched for the relevant information about the foods with nutrition claims before purchasing.	c1
	You have dispelled doubts about the foods with nutrition claims through some channels before purchasing.	c2
	You have verified the accuracy of the food nutrition claims through some channels before purchasing.	c3
	You have searched for more information about the foods with nutrition claims before purchasing.	c4
	You have sought other people's evaluations of the foods with nutrition claims before purchasing.	c5
Action	You have purchased the foods with nutrition claims.	d1
	You have purchased the foods with nutrition claims for your friends and family members.	d2
	You have made the purchase plan for the foods with nutrition claims.	d3
	You often buy the foods with nutrition claims.	d4
Share	You have shared the consumption experience of the foods with nutrition claims with your friends and family members.	e1
	You have given a positive evaluation for the foods with nutrition claims.	e2
	You have shared your positive experience of the foods with nutrition claims on the Internet.	e3
	You have recommended the foods with nutrition claims to strangers.	e4
	You have shared information about the foods with nutrition claims on your social media, such as WeChat Moments or Weibo.	e5

The scale items on consumers' attention, interest and search referred to Fannani and Najib (10) while the scale items on consumers' action and share referred to Javed et al. (13).

The AISAS model clarifies that the influence of consumers' product information search on product information sharing goes through the food purchase process (5). In reality, some consumers without product purchase experience still share their product evaluations through we-media platforms (41). The former study proved that consumers who searched information about foods with nutrition and health claims were likely to share the relevant information (21). Therefore, the following research hypothesis is proposed:

> H6: Consumers' product information sharing is directly and positively influenced by their search for information about the foods with nutrition claims.

The AISAS model clarifies that consumers' sharing of products is directly and positively influenced by their food purchase behavior (5). Furthermore, there was a high probability that consumers who purchased the foods with nutrition claims shared their experience (39, 42). It is inferred that consumers who have bought the foods with nutrition claims tend to share the food information. Therefore, the following research hypothesis is proposed:

> H7: Consumers' inclination to share information about foods with nutrition claims is directly and positively influenced by their purchase behavior related to these foods.

4 Materials and methods

4.1 Data collection

As indicated in Table 1, the five latent variables in the AISAS model could be measured by scale items, with respondents providing their answers on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Our questionnaire (see Supplementary material) was refined based on feedback from a pre-survey involving 30 adults in Beijing, China. We utilized a paid online survey service of Wenjuanxing,[1] a reputable online survey platform in China with a database of 6.2 million registered members of different ages across 31 provinces/autonomous regions/municipalities (referred to as 'province' hereafter).

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1 https://www.wjx.cn

TABLE 2 Samples' characteristics.

Characteristics	Items	Samples	Percentage (%)	The 2020 Population Census Data[b] (%)
Gender	Male	315	50	51.24
	Female	315	50	48.76
Age	18∼59 years old	616	97.78	86.30
	60 years old and above	14	2.22	13.70
Education level	Junior school or below	27	4.28	17.6
	Senior school	428	67.94	55.03
	Junior college	154	24.44	24.61
	Postgraduate	21	3.33	2.76
Residence	Urban area	378	60	63.89
	Rural area	252	40	36.11
Annual household disposable income (Chinese Yuan[a])	<10,000	31	4.92	–
	10,000∼49,999	114	18.10	–
	50,000∼99,999	123	19.52	–
	100,000∼149,999	143	22.70	–
	150,000∼199,999	116	18.41	–
	≥200,000	103	16.35	–

Authors' own calculation.[a]One US dollar equals 6.980 Chinese Yuan, and one Euro equals 6.900 Chinese Yuan from September 8th to September 22th, 2022.[b]Annual household disposable income was not measured in the *Population Census in 2020*.

This study adopted multi-stage stratified random sampling method. Due to the fact that people in Northeast China, North China, Northwest China, East China, Central China, Southwest China, and South China have different eating habits, China was divided into the above seven regions in the first stage, and then one province was randomly selected from these regions (43). The seven provinces were Jilin, Inner Mongolia, Shaanxi, Shandong, Henan, Sichuan, and Guangdong. Finally, according to the minimal number of representative, random samples (N = 600) in China was determined with an allowable error of 4% and a confidence level of 95%, at least 86 samples collected from each selected province on average. Therefore, we commissioned Wenjuanxing to collect target sample size from its member database. From September 8th to September 22nd, 2022, Wenjuanxing emailed the questionnaire link to 130 adults randomly selected from each province, and about 88.13% participated in the online survey. Before data collection, informed written consent was obtained from all participants. Eight Chinese Yuan as cash incentives were offered to each respondent if their responses were careful and complete. Finally, after data validity was checked, 630 valid samples were used for analysis.

4.2 Methods

Although the linear regression model could be used to analyze consumer behavior based on AISAS model (12), most previous studies adopted the structural equation model to analyze the internal relationship between consumers' attention, interest, search, action and sharing (11, 15). Therefore, we intended to use this method. Structural equation modeling allows the creation of observable variables per construct, which does not require split

analysis and yields valid and clear inferences (44). Thus, the results of the relationships among variables were reliable and neutral (45). In addition, structural equation modeling is capable of scrutinizing complex correlations and a range of hypotheses by immediately incorporating mean structures and group estimation (46).

According to the influence paths in **Figure 2**, the hypotheses proposed above were made out by the structural equation modeling which consists of a structural model and a measurement model.

$$\eta = B\eta + \Gamma\xi + \zeta \qquad (1)$$

The formula above is a structural model. η are the latent variables of the AISAS model. *B* are the relationships between latent variables. *ξ* are exogenous variables such as gender, age and annual household income. Γ is the influence of exogenous variables on individuals' attention to nutrition claims. ζ is the residual term.

$$Y = \hat{y}\eta + \epsilon \qquad (2)$$

The formula above is a measurement model. *Y* are explicit variables. $\hat{y}$ is the correlation coefficient matrix of latent variables (*i.e.,* attention, interest, search, action, share) and their explicit variables. ϵ is measurement error.

Then the built model estimation was conducted in two steps. Firstly, the reliability and validity test was performed to evaluate the stability and consistency of measured items in the measurement model with the SPSS Statistics 24.0 and AMOS Statistics 26.0. Secondly, the evaluation of goodness-of-fit indices for the proposed structural equation modeling and tests of hypotheses were made by means of moment structure analysis with Stata Statistics17.0 to obtain the direct effect, indirect effect and total effect among latent variables.

TABLE 3 Description of latent variables and summary statistics.

Latent variables	Scale items code	Centralized and discrete statistics				Stronglydisagree		Disagree		Neither agree nor disagree		Agree		Strongly agree	
		Mean	Std dev	Skewnes	Kurtosis	N	%	N	%	N	%	N	%	N	%
Attention	a1	4.00	0.67	−0.53	3.77	0	0	17	2.70	92	14.60	395	62.70	126	20.00
	a2	4.02	0.76	−0.74	3.85	2	0.32	25	3.97	91	14.44	353	56.03	159	25.24
	a3	4.17	0.72	−0.77	4.01	1	0.16	16	2.54	65	10.32	344	54.60	204	32.38
	a4	3.98	0.79	−0.63	3.33	1	0.16	30	4.76	106	16.83	338	53.65	155	24.60
	a5	3.91	0.80	−0.78	3.82	3	0.48	38	6.03	98	15.56	363	57.62	128	20.32
Interest	b1	4.06	0.78	−0.65	3.34	1	0.16	23	3.65	98	15.56	324	51.43	184	29.21
	b2	4.06	0.76	−0.68	3.42	0	0	27	4.29	84	13.33	341	54.13	178	28.25
	b3	4.20	0.78	−0.97	4.06	2	0.32	22	3.49	64	10.16	300	47.62	242	38.41
	b4	4.08	0.76	−0.78	4.07	3	0.48	18	2.86	87	13.81	340	53.97	182	28.89
	b5	3.98	0.79	−0.73	3.67	2	0.32	31	4.92	96	15.24	348	55.24	153	24.29
Search	c1	4.07	0.78	−0.86	4.20	4	0.63	21	3.33	85	13.49	336	53.33	184	29.21
	c2	3.81	0.82	−0.49	2.97	1	0.16	45	7.14	141	22.38	329	52.22	114	18.10
	c3	3.94	0.87	−0.57	2.89	2	0.32	39	6.19	127	20.16	289	45.87	173	27.46
	c4	3.86	0.94	−0.86	3.61	13	2.06	46	7.30	110	17.46	309	49.05	152	24.13
	c5	3.62	0.98	−0.55	2.84	15	2.38	75	11.90	152	24.13	280	44.44	108	17.14
Action	d1	4.02	0.70	−0.67	4.31	2	0.32	15	2.38	90	14.29	385	61.11	138	21.90
	d2	4.04	0.85	−0.88	3.89	6	0.95	27	4.29	96	15.24	305	48.41	196	31.11
	d3	4.02	0.90	−1.06	4.31	12	1.90	29	4.60	88	13.97	305	48.41	196	31.11
	d4	3.87	0.84	−0.75	3.80	8	1.27	31	4.92	130	20.63	328	52.06	133	21.11
Share	e1	3.91	0.83	−1.09	4.90	11	1.75	30	4.76	88	13.97	374	59.37	127	20.16
	e2	3.74	0.93	−0.53	2.99	10	1.59	49	7.78	167	26.51	272	43.17	132	20.95
	e3	3.60	1.05	−0.55	2.67	21	3.33	84	13.33	142	22.54	262	41.59	121	19.21
	e4	2.93	1.12	−0.05	2.22	74	11.75	150	23.81	197	31.27	162	25.71	47	7.46
	e5	3.56	1.04	−0.64	3.00	31	4.92	62	9.84	165	26.19	266	42.22	106	16.83

Authors' own calculation.

TABLE 4   Factor loading matrix after rotation.

Scale items code	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	KMO	Bartlett value
a1	0.693	−0.104	0.528	0.508	0.564	0.932	
							459.595***
a2	0.602	−0.209	0.473	−0.158	0.065	0.941	
a3	0.706	−0.126	0.512	0.413	−0.058	0.940	
a4	0.602	−0.070	0.458	0.343	0.137	0.959	
a5	0.558	−0.155	0.228	0.202	0.678	0.938	
b1	0.727	−0.173	0.202	−0.061	−0.209	0.944	
							658.631***
b2	0.697	−0.197	0.183	−0.131	−0.213	0.949	
b3	0.582	−0.232	0.111	0.458	−0.217	0.939	
b4	0.510	−0.132	0.215	−0.068	−0.074	0.954	
b5	0.615	−0.161	0.161	−0.078	−0.078	0.957	
c1	0.600	0.535	0.053	0.531	−0.221	0.946	
							621.254***
c2	0.777	0.440	0.163	0.753	0.185	0.918	
c3	0.672	0.642	0.142	0.349	−0.133	0.894	
c4	0.505	0.507	0.216	0.531	−0.179	0.925	
c5	0.672	0.315	0.115	0.332	0.216	0.924	
d1	0.528	−0.105	0.310	0.258	0.095	0.958	
							1637.266***
d2	0.615	−0.184	−0.143	0.209	−0.061	0.759	
d3	0.616	−0.158	−0.259	0.302	−0.101	0.757	
d4	0.532	−0.100	−0.084	−0.113	0.265	0.955	
e1	0.608	0.733	−0.160	−0.180	−0.185	0.949	
							920.893***
e2	0.623	0.612	−0.122	−0.350	0.015	0.944	
e3	0.512	0.677	−0.103	−0.273	−0.005	0.929	
e4	0.595	0.704	−0.193	−0.270	0.166	0.917	
e5	0.529	0.636	−0.057	−0.290	−0.074	0.925	
Cumulative variance%	43.612	54.941	66.780	71.864	84.206	91.562	

Authors' own calculation; Overall Bartlett's Test of Sphericity: $\chi 2 = 5986.933$, ***$p < 0.01$; Overall KMO was 0.915.

5 Results

5.1 Descriptive statistics

As shown in Table 2, the distribution of samples' gender and residence closely resembled the *Main data of the 7th National Population Census in 2020* (47). This validates the representativeness of the overall sample despite of low proportion of the population aged 60 and above and with junior high school education and below.

Based on the information provided in the Table 3, several conclusions can be drawn regarding respondents' perceptions and behaviors in relation to the marketing of foods with nutrition claims.

As for attention, the majority of respondents (62.70%) agreed that the food nutrition claims attracted their attention. There existed variability, indicated by the standard deviation of 0.67.

As for interest, there was significant interest from respondents in foods with nutrition claims, with around 86.03% of them agreeing that these foods made them feel better than those without such claims. Variability in responses existed, suggested by the standard deviation of 0.78. As for search, respondents appeared to search for information about foods with nutrition claims, but there was significant variation in the level of search, indicated by the standard deviation of 0.87. A few people (3.33%) indicated that they completely agreed with actively seeking information. As for action, most respondents (83.01%) agreed or strongly agreed that they bought foods with nutrition claims, but there was variability, suggested by the standard deviation of 0.70. As for share, there was a variety of attitudes regarding sharing information about foods with nutrition claims, and the lowest percentage was associated with recommending these foods to strangers (20.16%). There was significant variation in the level of sharing, indicated by the standard deviation of 0.83.

TABLE 5 Corrected item-total correlation results.

Scale items code	Corrected item-total correlation	Cronbach's α if item deleted
a1	0.660	0.818
a2	0.556	0.846
a3	0.566	0.801
a4	0.582	0.811
a5	0.577	0.906
b1	0.568	0.811
b2	0.649	0.825
b3	0.593	0.840
b4	0.588	0.882
b5	0.535	0.857
c1	0.645	0.842
c2	0.563	0.813
c3	0.683	0.855
c4	0.556	0.845
c5	0.568	0.876
d1	0.556	0.806
d2	0.592	0.801
d3	0.578	0.879
d4	0.637	0.856
e1	0.574	0.804
e2	0.583	0.812
e3	0.601	0.874
e4	0.591	0.852
e5	0.574	0.845

Authors' own calculation.

5.2 Exploratory factor analysis

As was shown in **Table 4**, the Kaiser-Meyer-Olkin (KMO) statistics of scale items and overall KMO statistics were above 0.7 and the approximate chi-square value of Barlett's sphericity test of five latent variables and overall Bartlett value were statistically significant. It means that the samples were suitable for exploratory factor analysis. The results of factor loading after rotation indicated that eigenvalue of 5 factors were greater than 1, and the cumulative contribution rate was more than 80%.

5.3 Reliability and validity test

As seen from **Table 5**, the corrected item-total correlation coefficients of all scale items were greater than 0.5, indicating a strong correlation between scale items. All the Cronbach's α were above 0.8 if any item was deleted. However, the Cronbach's α was highest (0.906) if a5 was deleted.

Table 6 shows that Cronbach's α of each latent variable was greater than 0.7 when deleting a5, indicating that the scale reliability was good.

TABLE 6 Reliability test results.

Latent variables	Scale items code	Cronbach's α
Attention	a1	0.712
	a2	
	a3	
	a4	
Interest	b1	0.757
	b2	
	b3	
	b4	
	b5	
Search	c1	0.742
	c2	
	c3	
	c4	
	c5	
Action	d1	0.806
	d2	
	d3	
	d4	
Share	e1	0.804
	e2	
	e3	
	e4	
	e5	

Authors' own calculation.

As shown in **Table 7**, Average Variance Extracted (AVE) of all constructs were more than 0.7. It means that constructs had high reliability and convergence validity. The discriminant validity among constructs were assessed with Maximum of shared squared variance (MSV) and Average of shared squared variance (ASV), and **Table 8** showed that the scale could distinguish different dimensions or concepts to a high degree.

5.4 Structural equation modeling estimation and hypothesis testing

Table 9 displays the goodness-of-fit indices for the initial and modified models. None of the fitting indexes of the initial model reached the threshold value. The initial model was modified by adding the residual correlation path between explicit variables (i.e., d2 and d3). The fitting index values such as Standardized Residual Mean Root (SRMR), Root Mean Square Error of Approximation (RMSEA), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Parsimony Goodness-of-Fit Index (PGFI), Parsimony Normed Fit Index (PNFI) and Parsimony Comparative Fit Index (PCFI) outperformed the respective threshold values, signifying that the model was able to fit all data satisfactorily. Likelihood ratio χ^2_ms, χ^2/df, Akaike Information Criterion (AIC)

TABLE 7 Correlation coefficient matrix.

Latent variables	Attention	Interest	Search	Action	Share
Attention	[0.972]				
Interest	0.968***	[0.759]			
Search	0.664***	0.648***	[0.792]		
Action	0.677***	0.500***	0.387***	[0.822]	
Share	0.695***	0.647***	0.752***	0.752***	[0.879]

Authors' own calculation; ***p < 0.01. AVE of all latent variables in parentheses.

TABLE 8 Discriminative validity test.

Latent variables	CR	MSV	ASV
Attention	0.924	0.386	0.352
Interest	0.919	0.309	0.257
Search	0.967	0.275	0.223
Action	0.971	0.186	0.189
Share	0.902	0.428	0.276

Authors' own calculation.

and Bayesian Information Criterion (BIC) in the modified model were smaller than those in the initial model.

Figure 3 shows the estimation result of the modified model. All hypotheses were supported at the statistical significance level except for the influence of gender (Table 10). To be more specific, consumers' attention to food nutrition claims were negatively influenced by their age and positively influenced by their annual household income so H1b and H1c were supported. However, consumers' gender took insignificant effect and H1a was not accepted. As expected, consumers' attention posed positive influence on their interest which had positive influenced their search for information about foods with nutrition claims and food purchase behavior. Therefore, H2, H3, H4 were accepted. Furthermore, consumers' search for the information positively affected their food purchase and sharing, supporting H5 and H6. H7 was also supported because consumers' product information sharing was influenced by their food purchase behavior.

As shown in Table 11, among the influence paths, the effect of respondents' attention to food nutrition claims on their interest in the food with such claims had the most significant total effect (1.372). It was followed by the influence of attention on food purchase (1.042), the influence of attention on information sharing (0.869), the influence of interest on food purchase (0.760), and the influence of attention on search for information about such foods (0.719).

6 Discussion

6.1 Association between Individuals' socio-economic status and attention

Respondents' gender did not have a direct and significant impact on their attention to food nutrition claims. It is inconsistent with previous studies that female groups were likely to pay attention to nutrition claims (33, 34). This may be due to the fact that

food nutrition claims in China conveyed information that appealed to both men and women, so there were not significant gender differences in consumers' attention to nutrition claims. In addition, respondents' age and annual household income significantly and directly affected their attention to food nutrition claims. Specifically, the increase in age significantly decreased respondents' attention to such claims, while the increase in annual household income raised respondents' attention to the claims. This finding was in accordance with the studies of Klopčič et al. (36) and Vyth et al. (48) Compared with relevant studies on the improved AISAS model by incorporating latent variables (9, 13), the AISAS model in our study, which incorporated external variables including age and annual household income, represented an innovative and valuable approach for identifying the characteristics of consumers who were attentive to food nutrition claims.

6.2 Association between attention and interest

Respondents who paid attention to food nutrition claims increased interest in such claims, consistent with the theoretical prediction of the AISAS model (5) and relevant empirical studies that confirmed consumers' interest was determined by their attention (11, 13). In our study, attention had the most significant influence on interest (1.372), indicating that respondents' attention to nutrition claims was most likely to transform into interest compared to other influence paths. However, other studies argued that, of all the paths, interest had the greatest impact on search or search had the greatest impact on purchase (12, 14). This is because our study took food nutrition claims as the research object. Only when nutrition claims were paid attention could consumers become interested, and then other behaviors such as searching, buying and sharing would be carried out.

6.3 Association between interest and search

Respondents interested in foods with nutrition claims tended to search for information about such foods, which was consistent with the expected theoretical predictions of the AISAS model (5) and the studies' results (14, 15). However, the difference is that the limited effect of respondents' interest on their information search (0.524) in our study suggested a low probability of transforming interest in foods with nutrition claims into information search. Perhaps

Goodness-of-fit indices	Threshold value	Fitting index values in the initial model	Fitted	Fitting index values in the modified model	Fitted
Likelihood ratio χ^2_ms	the smaller, the better	956.658	No	620.736	Yes
Chi-square (χ^2/df)	the smaller, the better	153.22	No	114.51	Yes
SRMR	<0.05	0.083	No	0.042	Yes
RMSEA	<0.05	0.060	No	0.043	Yes
TLI	>0.9	0.874	No	0.937	Yes
CFI	>0.9	0.886	No	0.943	Yes
PGFI	>0.5	0.498	No	0.787	Yes
PNFI	>0.5	0.487	No	0.890	Yes
PCFI	>0.5	0.489	No	0.869	Yes
AIC	the smaller, the better	38936.977	No	38603.055	Yes
BIC	the smaller, the better	39283.743	No	38954.267	Yes

Authors' own calculation.

FIGURE 3
Modified structural equation modeling results. e1~e25 are the residuals of explicit variables. e26~e30 are the measurement errors of latent variables, Source: Authors' own illustration.
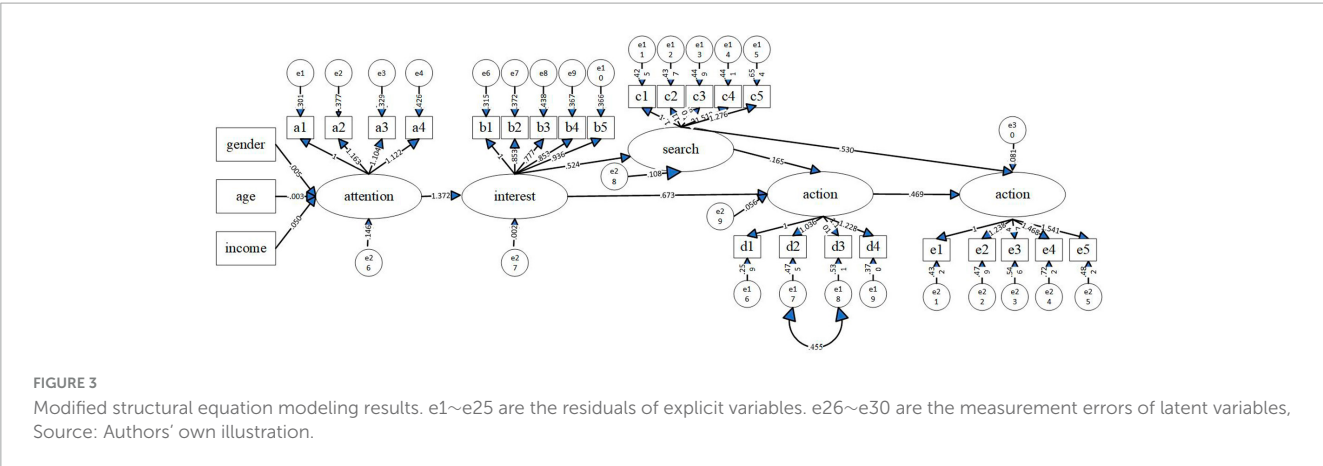
this is due to that China's nutrition claims was authoritative and enforced by the government. Consumers who were interested in nutrition claims were generally less likely to search for information and convert it directly into buying behavior.

6.4 Association between interest and action

Respondents' interest in foods with nutrition claims directly and positively influenced their purchase behavior of those foods. It indicates that emotionally driven consumers tended to consume impulsively without searching for information despite the convenience of information access in the mobile Internet era. This finding differed from the theoretical prediction of the AISAS model that represented the one-way progressive progress of interest → search → action, but was in accordance with the previous studies' results that consumers who were interested in food nutrition claims had high probability in purchasing foods labeled with nutrition claims (21, 32). Like other studies (12, 14), this study also found that in practice, consumers did not strictly follow the theoretical model of the AISAS model, which provided Chinese experience for expanding the AISAS model.

6.5 Association between search and action

Respondents who searched for information about the foods with nutrition claims tended to buy food, which was consistent with the theoretical prediction of the AISAS model (5) and other studies (13, 15). However, among the many influence paths, food information search had the smallest influence on food purchasing (0.165). It implied a limited motivation for food information searchers to buy the food with nutrition claims. This is because Chinese respondents interested in the foods with nutrition claims may search for information to fully understand the food before shopping, or they may make consumption decision without searching for relevant information.

6.6 Association between search and share

Respondents who actively searched for information about the foods with nutrition claims were likely to share food consumption experience and information, which was not same with the

TABLE 10   Test results of the hypothesis.

Hypothesis	Hypothesized paths	Coefficient	OIM std. err	Accepted
H1a: Consumers' attention to food nutrition claims is directly and negatively influenced by their gender.	Gender → attention	0.005	0.033	No
H1b: Consumers' attention to food nutrition claims is directly and negatively influenced by their age.	Age → attention	−0.003**	0.001	Yes
H1c: Consumers' attention to food nutrition claims is directly and positively influenced by their annual household income.	income → attention	0.050***	0.012	Yes
H2: Consumers' interest in foods with nutrition claims is directly and positively influenced by their attention to food nutrition claims.	attention → interest	1.372***	0.115	Yes
H3: Consumers' search for information about foods with nutrition claims is directly and positively influenced by their interest in the food.	interest → search	0.524***	0.055	Yes
H4: Consumers' food purchase behavior is directly and positively influenced by their interest in the foods with nutrition claims.	interest → action	0.760***	0.057	Yes
H5: Consumers' food purchase behavior is directly and positively influenced by their search for information about the foods with nutrition claims.	search → action	0.165**	0.067	Yes
H6: Consumers' product information sharing is directly and positively influenced by their search for information about the foods with nutrition claims.	search → share	0.607***	0.082	Yes
H7: Consumers' inclination to share information about foods with nutrition claims is directly and positively influenced by their purchase behavior related to these foods.	action → share	0.469***	0.071	Yes

**$P < 0.05$, ***$p < 0.01$. OIM std. err stands for observed information matrix standard error.

TABLE 11   Paths effect decomposition.

Paths	Direct effect	Indirect effect	Total effect
Attention → Interest	1.372***	–	1.372***
Attention → Search	–	0.719***	0.719***
Attention → Action	–	1.042***	1.042***
Attention → Share	–	0.869***	0.869***
Interest → Search	0.524***	–	0.524***
Interest → Action	0.673***	0.087**	0.760***
Interest → Share	–	0.634***	0.634***
Search → Action	0.165**	–	0.165**
Search → Share	0.530***	0.077**	0.607***
Action → Share	0.469***	–	0.469***

**$P < 0.05$, ***$p < 0.01$.

theoretical prediction of the AISAS model that represents the one-way progressive progress of search → action → share (5), but was consistent with the former findings that search could have a direct impact on sharing (12, 21). It was possibly because that certain consumers who engaged in information search but lacked actual shopping experience were still willing to share the information of food with nutrition claims on we-media platforms due to the low cost of online information search.

6.7 Association between action and share

Respondents who bought the foods with nutrition claims tended to share food shopping experiences and information, consistent with the theoretical prediction of the AISAS model (5)

and the relevant studies' conclusion (13, 14). This confirmed that in the era of mobile Internet, many consumers had mobile devices such as cell phones. Consumers who had a good experience in buying food with nutrition claims tended to share their purchasing experience on social media to attract potential consumers to pay attention to the food with nutrition claims. In this way, a virtuous circle would be formed. Through word-of-mouth marketing, more people would be encouraged to buy nutrition and health food, and finally the nutrition and health level of the whole society could be improved.

7 Conclusion

This study aimed to investigate consumers' psychology and behavior of foods with nutrition claims using questionnaire data collected from 630 adults across representative regions in China, employing the AISAS model. The findings suggested that the AISAS model with individual socio-economic characteristics and non-unidirectional progression was suitable for analyzing the reaction of Chinese adults to foods with nutrition claims. Younger adults and those with high annual household income were likely to pay attention to food nutrition claims. Consumers' attention and interest in food nutrition claims were transformed into information search, food purchase, and experience sharing.

Our results proved that nutrition claims were able to guide specific Chinese consumer groups to make purchase decision especially share their opinion about the foods with nutrition claims, thus there were perhaps some theoretical and practical contributions of this study. Firstly, the expansion of AISAS model theory was supported by the present empirical study in China, highlighting that individuals' socio-economic characteristics could

be included in the model, and the people's action and share could also transform from interest and search, respectively, so the updated model may have high efficiency of explanation and prediction for more forms of products' advertising marketing. Secondly, our study was likely to provide the basis for the public sector to continue promoting nutrition claims to implement the national dietary nutrition health interventions and for enterprises to actively label nutrient-rich foods with nutrition claims which was sold in subdivided groups.

This study is subject to certain limitations which will be solved in future research. Firstly, our sample size is relatively small in comparison with China's large population, which may restrict the generalizability of our findings to broader studies. Secondly, the model did not regard the social environment as an external factor, despite the proven role of social and economic factors in shaping individuals' psychology and behavior. Thirdly, scale items measuring consumption process of the foods with nutrition claims with self-report questionnaires are biased toward subjectivity. However, self-report questionnaires are vulnerable to social desirability bias due to respondents tendencies to answer in a more socially acceptable way. Therefore, for accurate research results, more attempts are needed, involving a larger sample, adding social environment variables and employing indirect questioning methods such as the list experiment.

The following implications are offered: Firstly, manufacturers may focus on younger demographics and groups with higher household incomes when developing marketing strategies for food products with nutrition claims to promote the broader consumption of nutritious and healthy foods. Secondly, consumers could be encouraged to share their consumption experience and food evaluation online to guide more consumers to purchase food. Thirdly, public sectors could formulate favorable policies and incentive measures to encourage enterprises to supply more foods with nutrition claims, ultimately contributing to enhancing balanced nutrition and promoting healthy diets nationwide.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

Ethics statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Institute of Food and Nutrition Development, Ministry of Agriculture and Rural Affairs for studies involving humans. Informed consent was obtained from all subjects involved in the study.

Author contributions

ZH: Conceptualization, Funding acquisition, Methodology, Project administration, Writing—original draft. HL: Data curation, Writing—review and editing. JH: Writing—review and editing.

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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Predicting willingness to consume healthy brand foods using the theory of planned behavior: the role of nutritional literacy

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Introduction: The willingness to consume healthy foods has highlighted the growing importance of health, even more so when it comes to food choice, and predicting the willingness to consume foods of a healthy brand represents an action that leads to the practice of conscious eating habits, but what is behind this willingness? To answer this question and based on previous studies such as the theory of planned behavior and nutritional literacy, this study aimed to build a predictive model through an empirical study to examine the influence of nutritional literacy (NL) on attitude (ATT), subjective norm (SN) and perceived behavioral control (PBC), as well as to determine the influence of the three variables of the theory of planned behavior (TPB) on the willingness to consume healthy brand foods (WCHBF) in the Peruvian market.

Methods: The research focused on the population that stated that they were consumers of the Unión brand (a brand whose value proposition is the sale of healthy foods), obtaining 482 consumers. The study was conducted under a quantitative, non-experimental, cross-sectional design approach.

Results: The results support the existence of a positive and significant effect of NL on ATT, SN, and PBC, finding the exact behavior of SN and PBC in WCHBF; however, in the proposed model, it is observed that ATT has no impact on WCHBF.

Conclusion: Applying strategies that lead to a change in consumer behavior towards healthy brands is a matter of time and will. In this context, the findings indicate that nutritional literacy plays an essential role in the willingness to consume healthy foods, which sheds more light on the design of educational interventions and awareness campaigns that independently inform about nutritional benefits and empower consumers, allowing them to make informed and healthy choices.

1 Introduction

Over time, there have been significant changes in food consumption patterns. Health has become one of the most critical factors influencing food choices (1–4). However, individuals have varying attitudes toward food and dietary behaviors, resulting in different food patterns and preferences (5–7).

People's willingness to consume healthy brand-name foods can vary widely due to some factors, including personal preferences, purchasing power, health awareness, nutritional information and labeling, lifestyle, and dietary choices, price and availability, brand reputation, and cultural and social trends (8). Previous literature recognized a significant association between the willingness to consume foods from healthy brands with nutritional information and labeling since having clear and transparent information about the ingredients and nutrition of the product or food can influence purchasing decisions (9, 10). Brands that emphasize health attributes can attract health-conscious consumers (11, 12). In this sense, the intention to consume healthy branded products is a complex and multifaceted phenomenon involving personal and contextual factors. Food companies often adapt to these trends and adjust their marketing strategies to attract consumers looking for healthier options since studies ensure that social influence affects food intake and choice (13).

On the other hand, it is worth mentioning that nutritional literacy is considered one factor contributing to good practices in maintaining an adequate diet; that is, it provides the community with valuable information about the risks associated with malnutrition (14). Nutrition literacy is essential to promote health and well-being at individual and societal levels. Promotes disease prevention, weight control, healthy eating habits, and consumer empowerment, thus creating a healthier society that recognizes the importance of a balanced diet (15, 16).

Therefore, the willingness to consume foods from healthy brands and nutritional literacy are key aspects that are vital in promoting a balanced and healthy diet (11, 17, 18). Together, they are committed to building a healthier society where consumers can make informed decisions that benefit their well-being and society (8, 16).

Continuing education on healthy eating is critical to addressing nutrition-related public health issues and promoting healthier lifestyles. However, very little has been written about the willingness to consume foods from healthy brands (5, 19–21). One of their studies refers to how emotional regulation influences food choice. When people reduce incidental negative emotions caused by reappraisal, they prefer foods from healthier brands more than when they let their feelings decide (21).

The theory of planned behavior (TPB) has been widely used to examine various aspects of people, such as to predict organic food adoption behavior (22), dietary behaviors (23), also to predict sugar intake (24), the intention to adopt a healthy diet (25) and fast food consumption (26); furthermore, its application has also been transferred to other contexts such as oral health behaviors (27),

improving medication adherence (28), teaching complementary medicine (29), pro-environmental behavioral intention (30) and understanding Facebook user behavior (31). In this sense, the TPB is used to understand and predict human behavior, particularly in decision-making associated with planned actions or behaviors (22). TPB has been used in various fields, including health, psychology, marketing, and management. The application of the TPB is crucial because it provides a solid and practical theoretical framework for understanding, predicting, and changing people's behavior (32). By understanding the motivations and perceptions of decisions, professionals can develop more effective strategies to encourage desired behaviors and increase the effectiveness of interventions in different fields of action (25).

After a diligent review of the background above, there has been a growing interest in continuing to study these topics for academics and professionals in the business and health sectors. Although scientific evidence validates that among the topics of study, the theory of planned behavior has caused the most significant interest. However, bibliometric indicators reveal the ten countries that most disclose their scientific results: the USA, China, United Kingdom, Australia, Iran, Malaysia, Canada, Taiwan, Indonesia, and South Korea. The same ones have applied their study to various areas, sectors, and populations, such as business, social sciences, medicine, psychology, environmental science, and engineering. When discerning the scientific dissemination by country, the studies carried out in the Peruvian population have been found to be very limited. That is, very little scientific literature can provide support and guidance for future studies in this context. Given the prevalence of diseases and poor eating practices related to nutrition, this research aims to fill the knowledge gap and provide a valuable contribution to the academic community and professionals of the sectors involved. In this sense, the purpose of the research is to build a predictive model through an empirical study to examine the influence of Nutritional Literacy (NL) on attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC), as well as determine the influence of three variables of the theory of planned behavior (TPB) on the willingness to consume (WCHBF) for healthy products in the Peruvian market.

2 Theoretical background

2.1 Research variables

2.1.1 Nutritional literacy

Nutritional literacy was first established in 1995 to assess awareness of nutrition labels among healthy individuals in Canada (14, 33, 34). Nutrition literacy is an individual's ability to understand, evaluate, and effectively use nutritional information (35, 36). It involves gaining knowledge about the principles of healthy eating, interpreting nutritional information in foods, and making informed decisions about diet and nutrition (37, 38). Nutritional literacy is

crucial in promoting the health and well-being of consumers and can help prevent diet-related diseases such as obesity and diabetes. Furthermore, it can foster healthy eating habits and make informed dietary decisions (14, 37).

Critical nutrition literacy involves skillfully evaluating and scrutinizing nutrition information and guidance and being motivated to address nutritional obstacles from individual, societal, and global perspectives (17). In this context, there has been a noticeable increase in the interest and focus on nutritional literacy (33). Nutritional educational programs have been proven essential in formal and informal settings such as schools, universities, and communities. These programs aim to educate consumers about a balanced and healthy diet. The programs also teach them how to interpret nutritional information and make informed decisions about their diet and nutrition (34, 39, 40). Clear and understandable food labeling is essential. It helps consumers understand nutritional information and make better choices about their diet. Promoting healthy foods is also crucial (41, 42). Marketing campaigns, strategic discounts in stores and supermarkets, and offering nutritious options in restaurants and cafes all encourage healthier eating habits (43, 44). Quick access to healthy foods is also important. This strategy ensures that fruits, vegetables, whole grains, and lean proteins are available and accessible in stores and supermarkets (45, 46). It also encourages the creation of community gardens and farmers markets to promote a nutritious eating environment (47). Finally, collaboration with the food industry is essential. This cooperation seeks to develop and promote healthy foods, reduce the sugar, salt, and fat content in processed foods, and promote transparent and responsible food marketing (38, 48).

2.1.2 Willingness to consume healthy brand food

In today's context, consumer behavior strongly favors foods that contribute to health and well-being, driven by consumers' enhanced access to tools empowering informed decisions about their nutritional choices (49, 50). Consumers' willingness to choose and consume healthy branded foods is related to their attitude toward foods perceived as healthy or beneficial to their health (51–53). Numerous elements, including brand perception, nutritional information, cost, and personal preferences, can affect one's attitude toward preferring this food (54–57). According to previous studies, a brand's perceived healthiness, product quality, and understandable nutritional information availability all impact consumers' willingness to buy and consume healthy branded foods (42, 58–60). Additionally, socio-economic factors like income level, education, and occupation can also impact the willingness to consume brand-name healthy foods (61, 62).

In addition, it is advisable to use nudge marketing tools to promote consumers' willingness to choose and consume healthier brand foods (63–65). Nudge marketing tools refer to marketing strategies influencing consumers' readiness to select and consume more nutritious food products from specific brands. These tools may include visually appealing and informative nutritional labels, strategic product placement in retail environments, and promotional offers or discounts for healthier options (66, 67). The aim is to encourage consumers to make healthier food choices willingly, positively impacting their overall dietary habits (63, 68). This concept is particularly relevant in increasing awareness and concern about health and nutrition, where marketers seek effective and ethical ways to

promote healthier brand foods without infringing upon consumers' freedom of choice (65, 69).

2.1.3 Theory of planned behavior

The Theory of Planned Behavior (TPB) is a psychological framework that helps predict and understand human behavior (70). It is commonly used to predict purchasing and consumption behaviors (70–73). TPB proposes three main factors influencing a person's behavior: attitude toward the behavior, subjective norm, and perceived behavioral control (70, 74).

First, consumer attitude towards the behavior refers to how a person evaluates the behavior they are considering (52, 75). According to Ajzen and Madden (76) "attitude" denotes the degree to which a person has a favorable or unfavorable opinion or evaluation of an action or behavior. People who hold a better attitude towards a particular behavior are more likely to have the intention to perform that action (77).

Subjective norms refer to a person's social pressure to perform or not perform a behavior (70, 75, 78). According to Madden et al. (79), an individual's close friends are the primary reference group influencing subjective norms. Subjective norms also refer to the positive or negative judgments and perceptions of individuals or groups that believe the individual should perform a particular action (78).

Lastly, perceived behavioral control is a term used to refer to the ease or difficulty with which an individual can carry out a behavior (74, 79). A combination of control beliefs and an individual's perceived power significantly predict their intention (80). In other words, PBC refers to an individual's ability to control and perform a specific action. This concept is crucial as it ensures that individuals can easily carry out their intended actions, leading to successful behavior change (74).

2.2 Conceptual model and research hypothesis

2.2.1 Influence of nutritional literacy on the theory of planned behavior

Previous studies have indicated that higher nutritional literacy influences consumers to have more positive attitudes towards healthy eating (49). According to Ramdam et al. (81) having more excellent nutrition knowledge is directly linked to more positive attitudes toward selecting healthy foods. Furthermore, Tian et al. (82) point out that labels such as educational materials and food promotions provide objective information to consumers when purchasing a healthy diet. This situation is attributed to the fact that individuals with better nutritional literacy tend to understand the benefits of a balanced diet, which positively influences their attitudes toward healthy eating and, therefore, towards healthy food brands. Similarly, Miller and Cassidy (83) understand nutritional information might be crucial in making dietary decisions through various means. This influence may extend beyond reliance on explicit food label details, encompassing direct impacts on food choices or shaping attitudes and beliefs. Considering these precedents, the hypothesis posits that:

> *H1*: Nutritional Literacy (NL) positively influences consumer attitudes toward healthy brand food consumption.

According to previous research, people's understanding of nutrition can affect their personal beliefs about eating habits (84, 85). Nutritional labels impact the consumer and the social environment, especially when consuming healthy products. For instance, when dining out, the people who matter to the consumer prefer to select a menu item that provides nutritional information (86). Similarly, Sousa et al. (87) found that customers' intentions to purchase products with nutritional labels were significantly related to their subjective norms, indicating that consumers are influenced by their peers when using food labels to select healthy foods. Considering these antecedents arises the hypothesis that:

> *H2*: Nutritional Literacy (NL) positively influences Subjective Norms (SN) for healthy brand food consumption.

Previous studies highlight the significant impact of food literacy on consumers' perceived control and informed decision-making regarding their dietary choices. Sousa et al. (87) revealed a strong correlation between food literacy and perceived behavioral control, indicating that understanding nutrition information on food labels empowers individuals, amplifying their control over food choices. Similarly, Trieste et al. (88) observed that individuals knowledgeable about nutrition exhibit heightened attention toward nutritional aspects in products, facilitating informed decisions in food consumption. Begley et al. (89) further supported these findings, proposing that promoting food literacy programs can instigate positive shifts in eating behavior and facilitate well-informed decision-making in dietary choices. Taking into account these antecedents, the hypothesis proposes that:

> *H3*: Nutritional Literacy (NL) positively influences Perceived Behavioral Control (PBC) for healthy brand food consumption.

2.2.2 Influence of the theory of planned behavior on willingness to consume healthy food

The theory of planned behavior has been fundamental in understanding consumer food decisions (90–92). Based on the idea that attitudes, perceived social norms, and perceived behavioral control influence a person's intentions and behaviors, this psychological theory has been successfully applied in numerous studies focused on consumers' food choices (91–97).

Previous studies have established a strong association between consumers' attitudes and their intention to consume healthy food (93–95, 98–100). For instance, Roseman et al. (101) highlight the importance of the connection between consumers' attitudes toward food and their intention to buy it. Creating a positive perception among consumers is crucial, as it can significantly affect their buying and consumption behavior (102–104). Küster-Boluda and Vidal-Capilla (98) stated that consumers' favorable attitudes toward functional foods significantly impact their likelihood of consuming them. Similarly, Khan et al. (105) emphasize that a positive consumer attitude toward an organic product can generate purchase intentions and result in an actual purchase. There is a correlation between consumer attitude and the intention to consume health-oriented products. Grounded in these precedents, the hypothesis posits that:

> *H4*: Attitude (ATT) positively influences the consumers' willingness to consume healthy brand food (WCHBF).

Prior research has established that consumers' subjective perceptions of the social environment and expectations significantly impact their purchasing and consuming healthy brand foods (94, 96, 106–108). This is mainly because societal trends toward healthier eating and increased individual responsibility for personal well-being have strongly impacted consumers' choices to buy organic foods (90, 109). For example, Lim and Goh (93) emphasized how social norms and the reference opinions of other individuals positively impact the consumer's inclination toward purchasing healthy drinks. This finding highlights the relevance of considering social influences in formulating effective strategies to encourage the acquisition of organic products. According to Teng and Wang (108) people who are significant in a consumer's life can influence their intention to purchase organic products. If consumers perceive that those important to them have a favorable or unfavorable view of organic food, it can affect their purchase intentions towards organic food. Similarly, Agnoli et al. (97) affirmed a high association between wine consumption and social referents. They observed that close friends and partners considerably influenced subjective influence, implying that they are essential in controlling drink consumption. Based on these backgrounds, the hypothesis suggests that:

> *H5*: Subjective Norms (SN) positively influence the consumers' willingness to consume healthy brand food (WCHBF).

Previous research has shown that people are more likely to consume healthy brand foods when they control their behavior (53, 90, 92, 96). A study conducted by Ham et al. (96) found a significant correlation between an individual's intention to purchase organic food products and their sense of control over their actions. This emphasizes the importance of an individual's confidence in making informed choices regarding their food preferences. Another study by Giampietri et al. (110) revealed that consumers are more likely to buy their preferred food items when they feel they have greater control over their behavior. However, people's perceptions of control over their actions may vary in different circumstances. This could be linked to how much power a consumer has over what they choose to purchase and consume. As a result, it can affect a consumer's willingness to buy organic food (53). Based on these antecedents, the hypothesis suggests that:

> *H6*: Perceived Behavioral Control (PBC) positively influences the consumers' willingness to consume healthy brand food (WCHBF).

Considering the hypotheses mentioned above, the ensuing conceptual model of the study can be visualized, as depicted in Figure 1. Additionally, the advanced hypotheses and their associated constructs have been briefly outlined in tabular form and are available for reference in Appendix A.

3 Methods

3.1 Context and method

This article aimed to build a predictive model through an empirical study to examine the influence of Nutrition Literacy (NL) on attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC), as well as determine the influence of the three variables
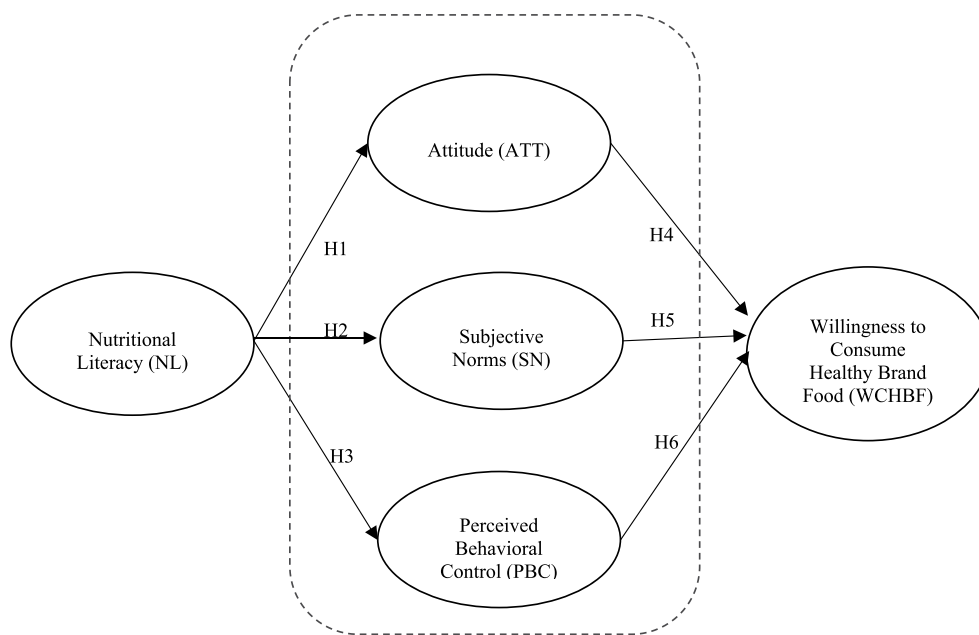
FIGURE 1
Conceptual model.

of the theory of planned behavior (TPB) on the willingness to consume (WCHF) for healthy products in the Peruvian market. The study used a quantitative, non-experimental, and cross-sectional design approach, using a self-administered questionnaire (111).

3.2 Sample and procedure

Different authors recommend different sample sizes. The optimal sample size recommended by some authors should be more than 100 subjects, and the minimum acceptable is at least five times the number of items to be analyzed; however, they suggest that ten times the number of items to be interpreted would be more acceptable (112, 113). Considering these recommendations and given that the instrument of the present study is composed of 27 essential items and three socio-demographic items, a minimum sample of 300 subjects was established. In the end, a sample of 482 participants was obtained, which is above the minimum required sample.

Taking into account that, according to the last Peruvian census, the Lima population is made up of 9,485,405, where women predominate (114) and under the support established by the researchers by stating that young people (5, 115–118) are the ones who tend to consume healthy products compared to adults, considered more traditional, the sample was based on university students. Non-probabilistic convenience sampling was applied to collect data for this research (119). It should be noted that this study was approved by the Ethics Committee of the EPG of the Universidad Peruana Unión (2023-CE-EPG-00043) and was conducted in accordance with the ethical standards of the Declaration of Helsinki. An online survey was carried out through the Google form, the link of which was shared through the official social networks of a private university, an institution where an adequate lifestyle is promoted through healthy eating and which

also has the Unión industry within its facilities, applied during the period from July to December 2023 in the city of Lima, Peru. The investigation focused on consumers who stated they were consumers of the Unión brand (whose value proposition is the sale of healthy foods). Participants had to be of legal age, from 18 years onwards. Men and women were invited to participate in the survey; however, the response rate differed (see Table 1). To participate in the survey, each consumer must provide informed consent (Under the premise: '*I acknowledge that by completing this questionnaire, I am giving my consent to participate in the study*'). To do so, they were previously informed that their participation was voluntary, that the data collected would be analyzed anonymously, and that they would be used exclusively for academic and research purposes. Nearly 800 Peruvian consumers were invited to this survey, 482 correctly completed questionnaires were answered, and they were considered suitable to be considered in the analysis of this document. Of them, the most significant number of participants were between 18 and 24 years old (84%), were female (65.1%), and their civil status was single (95.2%) (see Table 1).

3.3 Measures

To evaluate the Nutritional Literacy (NL) variable, this study applied the short 11-item scale developed by Vrinten et al. (120). To evaluate the variables of the theory of planned behavior, adaptation was proposed by Kumar et al. (121), where Attitude, Subjective Norm, and Perceived Behavioral Control have three items each, and the willingness to consume foods from healthy brands has seven items (Appendix B). All items are evaluated using a 5-point Likert-type scale, where "1" means "Strongly disagree" and "5" means "Strongly agree." The digital questionnaire was divided into two sections. The

TABLE 1 Socio-demographic data of the sample (*n* = 482).

Category		Frequency	Percentage
Age range	18–24	405	84.0
	25–34	62	12.9
	35–58	15	3.1
Sex	Male	168	34.9
	Female	314	65.1
Civil status	Married	23	4.8
	Single	459	95.2

first section presented the 27 items already mentioned, and the second section was composed of questions related to socio-demographic data such as age, sex, and civil status.

3.4 Analysis of data

Two statistical software packages were used to analyze the data: IBM SPSS version 22 was used to analyze the respondents' demographic data, shown in Table 1. Tests for discriminant validity, convergent validity, and reliability were carried out to assess the measurement model (122). Smart-PLS version 4.0 was used to test the conceptual model (see Figure 1) using a two-step approach involving measurement model evaluation and structural model evaluation (122). The PLS-SEM partial least squares method was used to test the hypotheses. PLS-SEM is a comprehensive multivariate statistical analysis approach that includes structural and measurement components to simultaneously examine the relationships between each of the variables in a conceptual model, which has the characteristic of multivariate analysis, i.e., it involves a number of variables equal to or greater than three (119). In addition, PLS-SEM was used in the present study because it facilitates the construction of theories (123).

The significance of the path coefficients (*p*-value and *t*-value) was sought to evaluate the structural model. The coefficient of determination (R^2) was used to measure the predictive relevance of the structural model. Finally, the overall model fit was measured using the root mean square residual (SRMR). It is noteworthy that behavioral scholars have praised the application of PLS-SEM in interdisciplinary research (124).

4 Results

Before carrying out the model analyses, the exploratory data analysis was previously carried out with the SPSS-22 software and it was detected that there were no inconsistencies and no outliers, so there was no need to transform the data. Furthermore, according to the contributions of Professor Gaskin, since it is a Likert scale, there are no atypical values, since the participant responds at the extreme (1 or 5), which is why it does not represent a representative atypical component (125).

The application of the PLS-SEM software is carried out through two stages: (1) evaluation of the measurement model and (2)

evaluation of the structural model. The first stage evaluates the validity and reliability of the measurement model, and the second evaluates the structural model, which addresses the relationships between the constructs (126, 127).

4.1 Evaluation of the structural model

To evaluate the internal consistency of the measurement model, it is necessary to evaluate the convergent validity and reliability of the construct. Convergent validity is acceptable if the loading of each indicator is greater than 0.7 (123). The composite reliability (CR) should be above 0.70, and the average variance extracted (AVE) should be above 0.5 (126, 127). Cronbach's alpha coefficient should be greater than 0.7. The factor tends to be similar to CR values when factor-based algorithms are used (128). Table 2 shows that all the loadings of the 27 items of this construct had a value greater than 0.7 (except NL10 and NL11; however, together, they meet the reliability). Likewise, all the constructs' Alpha and CR values were more significant than 0.80, and all the AVE values were more significant than 0.50. Therefore, the convergent validity of the measurement model was excellent. The skewness and kurtosis of the data distribution are also shown, and it is noted that all values are below +/−1.5, which indicates slight variations from the normal and, consequently, results suitable for carrying out factor analysis (129). Although the method used for statistical analysis in this study does not require compliance with normality, these data provide information about the distribution of the data.

The Fornell–Larker criterion was used to evaluate discriminant validity, so the square root of the AVE of each construct was calculated, which had to be greater than the highest correlation between the construct and other constructs in the model (126, 127). Table 3 shows that all bold diagonal values are more significant than the correlations. Therefore, the measurement model meets all the necessary assumptions to continue evaluating the structural model.

4.2 Evaluation of the structural model

After completing the discriminant, convergent, and reliability tests, the structural model was evaluated using the PLS bootstrapping algorithm with a complete result, a subsample of 5,000, and a one-tailed *t*-test at a significance level of 0.05%. The outcomes of the structural model with the path coefficient, which ought to be a value between −1 and +1 (111), are displayed in Figure 2.

Chin (130) suggests values of 0.67, 0.33, and 0.19 as substantial, moderate, and weak measures of *R*, respectively. In behavioral studies, a value of 0.2 for R^2 is acceptable (127, 131). The present work's R^2 coefficients for ATT, SN, PBC, and WCHBF were 0.160, 0.200, 0.273, and 0.403, respectively. That is, the R^2 values were acceptable, except for ATT, which is weak. Therefore, the values show that the variables in the present study explain an acceptable percentage of the variance of the WCHB. The overall model fit was measured by the root mean square residual (SRMR), resulting in a value of 0.054 for this indicator, which was below the recommended threshold value of 0.080 (126, 127), thus confirming the model fit.

TABLE 2 Results of the measurement model.

Construct	Items	Skewness	Kurtosis	loadings	(α)	C.R.	AVE
Attitude (ATT)	ATT1	−1.025	0.943	0.961	0.965	0.965	0.934
	ATT2	−1.068	1.068	0.970			
	ATT3	−1.127	1.086	0.969			
Nutritional Literacy (NL)	NL1	−0.608	0.503	0.742	0.926	0.933	0.576
	NL10	−0.571	0.012	0.659			
	NL11	−0.595	0.209	0.682			
	NL2	−0.580	0.290	0.815			
	NL3	−0.576	0.116	0.788			
	NL4	−0.544	0.264	0.817			
	NL5	−0.589	−0.073	0.752			
	NL6	−0.506	0.101	0.800			
	NL7	−0.511	0.224	0.720			
	NL8	−0.297	−0.442	0.786			
	NL9	−0.226	−0.357	0.766			
Perceived Behavioral Control (PBC)	PBC1	−0.635	0.370	0.898	0.852	0.857	0.772
	PBC2	−0.504	−0.135	0.878			
	PBC3	−0.421	−0.216	0.859			
Subjective Norms (SN)	SN1	−0.724	0.549	0.926	0.931	0.931	0.878
	SN2	−0.884	0.937	0.942			
	SN3	−0.850	0.649	0.944			
Willingness to Consume Healthy Brand Food (WCHBF)	WCHB1	−0.764	0.358	0.813	0.931	0.935	0.706
	WCHB2	−0.574	−0.183	0.861			
	WCHB3	−0.748	−0.020	0.801			
	WCHB4	−0.771	0.214	0.868			
	WCHB5	−0.701	0.033	0.874			
	WCHB6	−0.723	−0.038	0.843			
	WCHB7	−0.712	−0.110	0.817			

Cronbach's alpha (α) for all variables is >0.8, the composite reliability (CR) is >0.70, and the mean–variance extracted (AVE) is >0.50, indicating the model's significant validity.

TABLE 3 Discriminant validity (Fornell–Lacker criterion).

	ATT	NL	PBC	SN	WCHBF
Attitude (ATT)	**0.967**				
Nutritional Literacy (NL)	0.400	**0.759**			
Perceived Behavioral Control (PBC)	0.687	0.522	**0.879**		
Subjective Norm (SN)	0.824	0.447	0.696	**0.937**	
Willingness to Consume Healthy Brand Food (WCHBF)	0.555	0.458	0.562	0.599	**0.840**

The square root of AVEs is shown diagonally in bold.

The hypothesis tests and the evaluation of the path coefficients can be seen in Table 4. The results show that NL has a positive and significant effect on ATT, SN, and CBP, which supports hypotheses H1, H2, and H3. The results show that SN and PBC positively and significantly affect WCHBF, which supports hypotheses H5 and H6. This model indicates that ATT does not impact the WCHBF, so H4 is not accepted.

4.3 Invariance analysis and moderating effects: sex

To determine whether there is a difference in the willingness to consume healthy brand foods between male (34.9%, $n = 168$) and female (65.1%, $n = 314$) consumers, it is necessary first to perform the invariance analysis. In Table 5, the MICOM-STEP2 analysis is shown, which allows

FIGURE 2
Structural model. PBC, perceived behavioral control; NL, nutritional literacy; ATT, attitude; WCHBF, willingness to consume healthy brand food; SN, subjective norms.
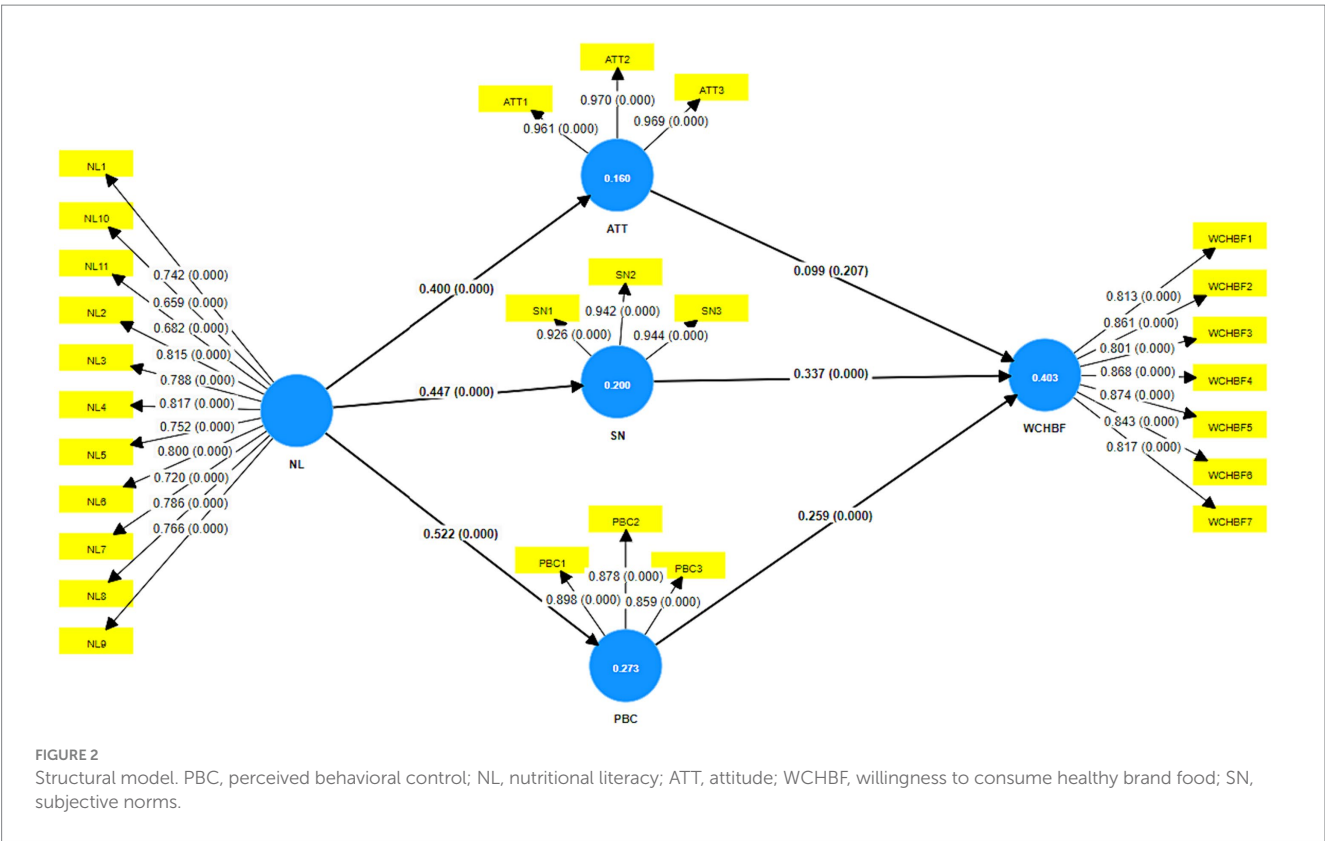
TABLE 4 Hypothesis testing.

Hypothesis		Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	p-values	Decision
H1	NL > ATT	0.400	0.401	0.046	8.661	0.000	Supported
H2	NL > SN	0.447	0.448	0.046	9.805	0.000	Supported
H3	NL > PBC	0.522	0.524	0.041	12.863	0.000	Supported
H4	ATT > WCHBF	0.099	0.100	0.078	1.262	0.207	Rejected
H5	SN > WCHBF	0.337	0.334	0.083	4.089	0.000	Supported
H6	PBC > WCHBF	0.259	0.262	0.060	4.286	0.000	Supported

for the verification that there is no construct difference between men and women; that is, it allows for the verification of the construct invariance between both groups. In this sense, since the p-values are not significant ($p > 0.5$), it is concluded that there is invariance in the data collection of both groups, both men and women (132), so it is possible to continue with the analysis of the differences between both groups.

Using the Multigroup Bootstrap Analysis (Bootstrap MGA), we proceeded to verify the difference in the results of the contrast of the hypotheses between men and women, after performing an analysis of 5,000 samples, the results show that none of the p values is less than 0.05, therefore (132), There is no significant difference between men and women in the contrasts of the hypotheses raised in this study (see Table 6).

5 Discussions and conclusions

Nutritional literacy is a topic that has gained significant momentum within the scientific community, and research involving health care has aroused a high interest in contributing to a healthy lifestyle (133, 134). Although applying strategies that allow a change in consumer purchasing behavior toward healthy brands is a challenge, there is research that supports the findings of this study by supporting that there is a fundamental element that allows a positive change in consumer attitudes regarding the consumption of foods from healthy brands, this being nutritional literacy (135). Another study that defends the results of this research is based on the health behavior model, which states that human beings can change their habits that involve health as long as they are influenced by support for medical care. When people feel this support, they experience positive results that lead to maintaining good health behavior (135). However, the lack of nutritional information could generate severe health problems since consumers with this deficiency tend to minimize the value of healthy brands; therefore, it is necessary to use assertive measures so that consumers choose to purchase foods from healthy brands (136, 137). In general terms, antecedents that support this investigation have been found. Regardless of acquiring knowledge regarding a daily diet, nutritional

TABLE 5 Invariance analysis.

Construct	Original correlation	Correlation permutation means	5.0%	Permutation p-value
ATT	1.000	1.000	1.000	0.892
NL	0.999	0.999	0.998	0.339
PBC	0.999	1.000	0.999	0.215
SN	1.000	1.000	1.000	0.988
WCHBF	1.000	1.000	0.999	0.457

TABLE 6 Bootstrap MGA.

Hypothesis		Difference (Female − Male)	1-tailed (Female vs Male) p value	2-tailed (Female vs Male) p value
H1	NL > ATT	−0.081	0.816	0.368
H2	NL > SN	−0.093	0.850	0.300
H3	NL > PBC	−0.045	0.715	0.571
H4	ATT > WCHBF	0.121	0.251	0.501
H5	SN > WCHBF	−0.229	0.883	0.234
H6	PBC > WCHBF	0.051	0.349	0.698

literacy triggers an essential influence for a consumer to adopt healthy food consumption habits.

Furthermore, another result of this research proves that nutritional literacy exerts an essential influence on subjective norms for the consumption of healthy foods. Makiabadi (138) establishes that a person's knowledge shapes the behavior of human life. That is to say, the greater the understanding of information, the more subjective norms point to a better decision when purchasing their food. Another antecedent that gives essential support to these findings is the theory of planned behavior. According to the research, this theory describes eating behavior, where subjective norms are influenced by nutritional literacy (139). Furthermore, it has been identified that the intention to change behaviors linked to nutrition is significantly influenced by subjective norms, with personal perceptions being a response to the consumer's prior knowledge, translating this fact into further support that affirms that nutritional literacy influences subjective norms (140). In this context, the results of this study are reinforced, specifying that nutritional literacy influences subjective norms, constituting this fact as an opportunity to provide further strength to interventions aimed at promoting the consumption of healthy brand foods.

The third hypothesis that proposed investigating whether nutritional literacy positively influences the perceived behavioral control for consuming healthy brand foods has been rejected. To further support this finding, research has found that in the event of an inadequate state of health, nutritional literacy allows an individual to understand and raise awareness to follow nutritional advice, representing a change in perceived behavior (34, 141). A similar study addressed this behavior in adolescents, stating that this population has greater ease and access to nutritional information when required; thus, when an individual maintains a higher level of nutritional literacy, he or she maintains better control of perceived behavior (141). This means that every individual with a level of nutrition knowledge has a more fantastic option of making informed decisions and ratifying his or her decision, even when external pressures seek to be against healthy food choices. Furthermore, other research that

supports this study indicates that nutritional literacy is an indicator that influences behavior and decisions regarding food consumption (142, 143).

Within the findings, it has been identified that attitude does not influence the willingness of consumers to consume healthy branded foods. It is that even though traditionally, it has been considered that attitude plays a determining role in the formation of individual behaviors and consumption decisions (144, 145). Within the study population, the choice of healthy foods is not a determinant in predicting the willingness to consume healthy branded foods, so it is claimed that other factors may have a more marked influence. While Renwick and Smith (146) refer that the attitudes of individuals can address a series of decisions, the same that with repetition becomes a habit, in the case of the Peruvian population, beyond the choice of a healthy brand, other factors intervene in the final decision. Under this context, Perry (147) states that beyond attitudes, knowledge, and skills can influence the final decision.

This study sheds light on the influence of subjective norms on consumers' willingness to consume healthy branded foods. To better explain this finding, it is necessary to clarify that subjective norms involve "perceived social pressure to perform a particular behavior" (148). In this context, Oktavianus and Bautista (149) support the idea that subjective norms have a high potential to improve an individual's behavioral intention. For its part, Chen and Fu (150) and Bautista et al. (151) declare that when people harbor bad practices due to some erroneous information, subjective norms are part of an ideal component to correct them. When an individual considers that his environment expects him to perform some specific behavior, the possibility of him opting increases. For addressing the expectations of others. Another result that coincides with the evidence established that the perception of a third person increases the intention for an individual to correct their actions, even more so if they are actions that can correct habits that damage health (152, 153). This means that subjective norms are a point of support since the participation of third parties and the social environment build positive attitudes regarding the consumption of

healthy brand foods, which represents forming solid habits regarding a diet from healthy brands. Finally, the results suggest that the influence of nutritional literacy on attitude, subjective norm, and perceived behavioral control is similar between men and women. This indicates that both groups may similarly perceive the importance of nutritional literacy in their purchasing decisions for healthy products.

5.1 Implications

This study has addressed consumer behavior from the planned behavior perspective within the theoretical implications. Thus, the proposed theoretical model is part of a robust conceptual structure that allows a clear understanding of the factors involved in decision shopping. Based on the theory, specific strategies that aim to correct consumer behavior regarding the consumption of healthy foods can be addressed. Statistics make an essential contribution to the literature on these topics. Therefore, more research is needed to evaluate the data obtained in this study more broadly.

Now, the results lead to discovering specific practical implications that have to do with technology. In a digitalized world, allowing consumers to be well-informed and achieve nutritional literacy is not an impossible task. Still, it does require that the media disseminate information about it. On the other hand, it is necessary to increase nutritional literacy to ensure a healthier diet in the population; therefore, new government policies on health must be developed to achieve these standards. When analyzing projects and programs related to nutrition in underdeveloped countries, some of these successful programs include multiple behavioral development initiatives that could last over time but require a progressive lifestyle change. In this sense, the results of this study can be translated into recommendations to improve nutritional literacy, nutrition, and the development of good eating habits to avoid health risks and complications (poor quality of life, malnutrition, dietary intake, diabetes, among others).

On the other hand, the Ministries of Health and Education should show a more significant commitment to cooperating for this national purpose. Some practical courses, such as healthy eating and lifestyle programs, are necessary to educate a new generation with a broader vision. Currently, some private educational institutions, in their attempt to join this movement, could be spreading less-than-appropriate eating practices. For this reason, these issues should be addressed with permanent guidance from experts in the field.

This study deepens knowledge about nutritional literacy and the consumption of foods from healthy brands, which would allow the senior management of any organization, the academic community, those responsible for the Ministry of Health, and other public and private organizations to consider reforming food policies and designing strategies to improve the health of more citizens.

Finally, given that there are no significant differences between men and women, marketing strategies related to promoting healthy products could be designed more unisex. Campaigns that highlight the importance of nutritional literacy could effectively target both sexes.

5.2 Limitations and future research

The size of the sample and the type of sampling (non-probability by convenience) used in the study do not allow the results to be projected onto the composition of the base population. The study sample was observed to have a significant disproportion in terms of civil status, sex, and age range. Due to this, the study's findings may not be applicable to other populations or contexts since the sample was biased toward specific socio-demographic characteristics. It is suggested that future studies should attempt to obtain more homogeneous samples to avoid this issue.

On the other hand, the study did not consider some essential socio-economic determinants to describe the profile of the participants, such as educational level, health conditions, occupation, and economic income. This fact is part of one of the limitations of this study, so this research could not be generalized. In this way, it is proposed that future research address the differences in perception of the study variables in a different cultural context to measure the gaps. The study was also limited by the time it took to complete the survey, making some prone to abandoning the questionnaire. Furthermore, another limitation of this research is that it has not been considered whether the sample has received or possesses any level of nutritional literacy since the difference between them may be a research bias, so future research should address the level of nutritional literacy to carry out an analysis that measures the strength of influence of one variable on another.

Finally, although there are no significant differences between men and women in the results of this study, it could be beneficial to explore external factors such as culture, advertising, or social events that may influence men and women differently in relation to eating and health. These factors must be considered for future research, in this way to understand the context fully.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Universidad Peruana Unión Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

RC-T: Conceptualization, Data curation, Funding acquisition, Investigation, Resources, Validation, Visualization, Writing – original draft. EG-S: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. ME-F: Conceptualization, Funding acquisition, Resources, Visualization, Writing – original draft, Writing – review & editing. DM-L: Conceptualization, Funding acquisition, Investigation, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. MV-G:

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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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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fnut.2024.1353569/full#supplementary-material

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The impact of perceived value on brand image and loyalty: a study of healthy food brands in emerging markets

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Introduction: Food brands that promote a healthy lifestyle are gaining more followers. Healthy food consumers are a conscious and demanding segment that values the quality and benefits they receive from a product and the ethical, environmental, and social impact of their purchasing decisions. The objective of the research is to evaluate the influence of perceived value components on health food brand image and brand loyalty in an emerging market.

Methods: A cross-sectional and explanatory study was conducted considering 612 consumers of a healthy brand in Peru. The participants included women (65.2%) and men (34.8%), with ages between 18 and 56 (M = 22.56; SD = 5.95). Data were collected using a self-report form and statistically analyzed using PLS-SEM.

Results: The study hypotheses confirmed the impact of perceived emotional value, perceived social value, perceived financial value, and perceived quality on brand image and loyalty. However, the proposed model observes that perceived social value has no impact on brand loyalty.

Conclusion: Implementing strategies that help build stronger, healthy brands is part of effective management for business leaders. In this context, the findings indicate that brands should effectively communicate their attributes and offer them that meet and exceed consumer expectations to achieve consumer loyalty. This is a mechanism to consolidate a strong and positive image that facilitates customer loyalty based on perceived value. The results obtained can help marketers and decision-makers in the healthy food industry to design more effective brand strategies, which could increase demand for their healthy products.

KEYWORDS

perceived value, brand image, loyalty, healthy foods, food industry

1 Introduction

Food brands and companies struggle to have the attention of their consumers in a market that is challenged to be increasingly sustainable (1–4). Today, consumers are more aware of a more balanced and healthy diet, which has been considered an essential factor in the inclination towards healthy brands over conventional ones. Brands that offer healthy options can appeal to this growing group of health-conscious consumers. For a food to be considered healthy, it must provide minimal amounts of vegetables, fruits, and whole grains, with strict limits on sodium, added sugar, and saturated fat (4). In this context, consumers of healthy brands have expressed their interest in consuming them and even paying 20% more because they translate it to protect their family's health and optimize their well-being (5–8).

After the COVID-19 pandemic, the population leaned toward consuming healthy foods that contain solid nutrients capable of preventing diseases. Thus, interest in the consumption of healthy foods was growing due to consumer inclinations, so it has represented a key factor of business growth in the Peruvian market, allowing many brands to awaken new business ideas around healthy foods (9, 10). When issuing an opinion or judgment, these consumers connect the brand they are most familiar with to their feelings (5, 11). Therefore, one of the primary purposes of a marketing campaign is to establish loyalty in its consumers (12–14). Brand loyalty involves the development of a unique and emotional bond with a company through its name, logo, symbols, characters, and slogans throughout the life of consumers (12, 15–17).

The current study recognizes that perceived value has been associated with a substantial nexus between brand loyalty (18–23) and brand image (24–27). The importance of its exploration lies in several factors, one of them being that the market for healthy products is constantly developing (2, 28), with an increasing number of companies competing for the attention of health-conscious consumers. In a competitive market, perceived value becomes a key differentiator. Brands that project superior value can build a solid and unique brand image to stand out in the market. When consumers perceive that a product offers high value compared to its alternatives, consumers are likelier to remain loyal to that brand. Loyalty and preference are critical in healthy products because brand loyalty ensures repeat sales and encourages positive word of mouth and consumer brand advocacy (18, 29–31).

In this context, research on healthy foods has been associated with confidence in purchasing decisions (32), exposure to nature (33), intuitive nutritional labeling (34), health messages (35), willingness to pay (36), emotions (37), culture and health awareness (3), positive emotions (38), price consciousness (39), and mainly with the perceived value (9, 10), loyalty (9, 15, 31, 40) and brand image (41). The importance and interest in these topics have led to previous studies (24, 27, 42–47). However, the impact that the components of perceived value may generate in the context of healthy brands has yet to be explored. Therefore, studying perceived value, brand image, and brand loyalty in an environment of healthy product consumers is a multidisciplinary topic that can provide a more comprehensive approach.

Consequently, after reviewing the background above, a growing interest is revealed in continuing to discern these topics among business leaders, the food industry, and specialists in marketing, consumer psychology, consumer economics, and business strategy.

The bibliometric indicators reveal the 10 countries that most disclose scientific results: The United States, China, Indonesia, Taiwan, India, Malaysia, the United Kingdom, South Korea, Australia, and Spain. The same ones have mainly applied their studies to various areas, sectors, and populations, such as business, management and accounting, social sciences, computer sciences, economics, econometrics, and finance. On the other hand, when discerning scientific dissemination by country, research has yet to be found that has evaluated the behavior of these topics in the context of healthy brands in the Peruvian market. In this sense, the objective of the research was to evaluate whether the components of perceived value impact brand image and loyalty.

2 Theoretical background

2.1 Variable research

2.1.1 Healthy food brand image

Healthy food brand image has gained significant importance in the current context of the food market, where the growing concern for health and well-being has led consumers to seek healthier options in their diet (41). This trend has accelerated in recent years, driven by factors such as the increase in diet-related chronic diseases, increased awareness about nutrition, and the environmental impact of food (48). Keller (49) defines brand image as "the perceptions about a brand reflected by the brand associations retained in the consumer's memory." In the context of healthy foods, these associations are strongly linked to nutritional attributes, health benefits, and values related to well-being (50, 51). Healthy food brands must balance the perception of quality and health benefits with affordability to build a positive and sustainable brand image (52).

2.1.2 Healthy food brand loyalty

Brand loyalty refers to a consumer's deep commitment to consistently repurchase and support a preferred brand of healthy foods (53, 54). Loyalty is characterized by positive brand attitudes and repetitive purchasing behaviours driven by the perception of health and well-being benefits (49, 55, 56). In the health food market, brand loyalty is influenced by factors such as perceived quality, brand trust, perceived authenticity, and alignment with personal values related to health and sustainability (57). Furthermore, brand loyalty is strengthened when consumers perceive that the brand consistently offers functional and experiential benefits, such as taste and satisfaction (58). Importantly, loyalty to healthy food brands may be more resistant to price fluctuations and competition, as consumers value health benefits over purely economic considerations (50, 52). However, this loyalty can also be more demanding since healthy food consumers are more informed and critical of health claims and brand authenticity (28, 59).

2.1.3 Perceived quality

Perceived quality refers to the consumer's overall evaluation of the excellence or superiority of a product or service (60). Parasuraman et al. (61) state that perceived quality is a consumer judgment about an entity's overall excellence or superiority. This concept is subjective and can vary significantly between different consumers based on their previous experiences, expectations, and individual contexts. In the

context of health food brands, perceived quality refers to the consumer's overall evaluation of food products' nutritional excellence, freshness, and purity (62–64). According to Konuk (52), the perceived quality of organic and healthy foods is closely related to the perception of food safety and health benefits. From an economic perspective, perceived quality can justify higher prices, as consumers are willing to pay a premium price for foods they perceive to be of high nutritional quality and free of artificial ingredients (57).

2.1.4 Perceived social value

Perceived social value refers to the utility derived from the product's ability to enhance the consumer's social self-concept (65, 66). This concept relates to how consumers perceive that a product or service can improve their social status or image within a group (67–69). Perceived social value in the context of healthy food brands refers to how consuming these products can improve an individual's social image. Hansen et al. (70) argue that consuming healthy and organic foods has become a form of expression of identity and social status. This implies that consumers may be willing to pay more for products that improve their social image as health and environmentally conscious people (68, 71).

2.1.5 Perceived emotional value

Perceived emotional value is defined as the utility derived from the feelings or affective states that a product generates. Therefore, purchasing decisions are not purely rational but also influenced by emotional factors (65, 66). In the context of healthy foods, the perceived emotional value is related to the positive feelings associated with consuming these products. This can include well-being, satisfaction from caring for one's health and the planet, and a sense of belonging to a group of conscious consumers. These factors are crucial in shaping food purchase intention (72–74). Organic, since healthy food brands can generate customer loyalty. Kushwah et al. (75) argue that emotional value is closely related to self-actualization and the feeling of doing the right thing. This suggests that brands can leverage these feelings in their communication strategies.

2.1.6 Perceived financial value

Perceived financial value refers to the consumer's perception of the relationship between the price paid and the value received (10, 60). In economic terms, this concept is closely related to utility and consumer theory. Perceived financial value in the context of healthy foods refers to the consumer's evaluation of whether the price paid for these products is justified by the benefits received. This includes the direct monetary cost and the potential long-term savings on health expenses. Apaolaza et al. (62) affirmed that consumers who perceive high financial value in organic and healthy foods have higher purchase intentions despite higher prices. This suggests that, in economic terms, health food brands can compete effectively in the market if they can effectively communicate the long-term value of their products (10).

2.2 Conceptual model and research hypothesis

According to Keller (49), a positive brand image contributes to the formation of favorable attitudes toward the brand, which fosters loyalty. Furthermore, Batra et al. (55) argue that brand image can

evoke positive emotional responses, which is essential for developing brand loyalty. In this context, brand image is a critical factor for loyalty (76, 77). Thus, a strong and positive brand image in healthy foods increases loyalty directly and consumers' willingness to pay more for products from that brand, thus reinforcing the link between image and loyalty (78). Additionally, Watson et al. (79) proposed that a green brand image mediates the relationship between environmental concern and brand loyalty. Based on the mentioned above, the following hypothesis is proposed:

> **H1:** Health food brand image directly and positively influences healthy food brand loyalty.

Environmental values influence attitudes and behaviors (79). Cuesta-Valiño et al. (80) demonstrated the importance of green satisfaction and brand image as antecedents of the green brand value of organic agri-food products. In the same way, Sheth et al. (65) argued that emotional value is one of the five values that influence consumption choices, and in the case of healthy foods, it may be related to feelings of pride in taking care of one's health and that of one's family. For example, in the restaurant context, customers' positive emotional experiences with satisfactory food and service contribute significantly to the formation of loyalty toward these establishments. The study reveals that when diners experience positive emotions such as joy, satisfaction, or enthusiasm during their visit to a restaurant, they are more likely to develop a favorable and lasting attitude towards it.

Singh et al. (81) indicated that emotional value and brand satisfaction are positively related, and both act as significant predictors of brand loyalty for premium and non-premium footwear brands. The brand is the vehicle that leads to establishing and strengthening that emotional, even spiritual, bond that companies must have with their customers (82). Functional value was shown to be more important than emotional value, and information usefulness had relatively greater value compared to other quality dimensions used to determine customer loyalty to the brand (83). Based on the previous context, the following hypotheses are proposed:

> **H2:** Perceived emotional value directly and positively influences healthy food brand image.

> **H3:** Perceived emotional value directly and positively influences healthy food brand loyalty.

The stronger the brand is, that is, the more recognition and loyalty it has on the part of the customer, or the longer the customer has lived better and more intense experiences with the brand, the brand will have greater brand equity, and consequently will provide greater profitability to the brand (82). In the same way, perceived value is a judgment or evaluation made by the customer comparing the benefits or utility obtained from a product, service, or relationship and the perceived sacrifices or costs (84) Perceived value is the evaluation variable by the consumer. The variable on which companies can work, since later, together with other factors, will result in loyalty behavior on the part of the consumer (85). In this scenario, the perceived value is subordinated to the evaluation judgments of the results obtained, involving pre-purchase information, the quality of services, and brand loyalty (86). Thus, the following hypotheses are proposed:

H4: Perceived financial value directly and positively influences healthy food brand image.

H5: Perceived financial value directly and positively influences healthy food brand loyalty.

In the context of healthy foods, perceived quality is a critical point that can change a consumer's general perception of a product. In this way, research supports that a positive perceived quality can build a trustworthy brand image in the minds of consumers (87, 88). The perception of quality is a subjective quality based on belief, knowledge, and experience that could modify the perception of the brand image. That is, when a consumer perceives positive attributes of a brand, he responds by creating a positive image that leads to favorable attitudes such as loyalty (89, 90).On the other hand, previous studies have suggested that perceived quality is a factor that influences brand loyalty positively and directly (91, 92). To explain this association, (147) state that every time a customer experiences a high level of specific expectations and standards for a product, perceived quality assumes a catalytic role in resulting in brand loyalty (93, 94). In this framework, when consumers perceive the excellent quality of a product, their commitment is strengthened, and the tendency to be loyal to the brand increases since it has been proven that quality is crucial in consumers' purchasing decisions (95).

Service quality is also understood as a precursor to brand loyalty (96) Customer loyalty has become a strategic imperative for most companies. Previous studies conducted in different industries have empirically shown that the overall perception of service quality is one of the essential factors in establishing customer loyalty (96) Customer loyalty has emerged as an essential element of strategy for many firms because strengthening customer loyalty is expected to increase sales results, service quality, and greater profits (97). The importance of measuring loyalty is that the general perception of service quality has been established as one of the factors promoting customer loyalty toward the brand (97) Based on what was mentioned above, the following hypotheses are proposed:

H6: Perceived quality directly and positively influences healthy food brand image.

H7: Perceived quality directly and positively influences healthy food brand loyalty.

Perceived social value refers to the utility that consumers derive from a product's ability to enhance their social self-image within a group. In the context of healthy food brands, consuming these products is often associated with a positive social identity since these foods are perceived as responsible and conscious options for personal well-being and the environment. This association can significantly improve brand image, as consumers value brands that allow them to project a positive image in their social circles. Furthermore, previous studies have shown that consumers are willing to pay a higher price for products that improve their social status, reinforcing the relationship between perceived social value and brand image (70). Brand loyalty in the context of healthy foods is influenced by functional factors such as quality or price and social factors. When consumers perceive that a healthy food brand helps them maintain or improve their social status, they are more

likely to develop lasting brand loyalty (65). This is particularly relevant in markets where the social image associated with the consumption of healthy products is highly valued (98). Brand loyalty is reinforced when consumers feel that supporting a brand is aligned with its social values, increasing their willingness to make a repeat purchase (98). In this context, the following hypothesis is proposed:

H8: Perceived social value directly and positively influences healthy food brand image.

H9: Perceived social value directly and positively influences healthy food brand loyalty.

Previous research has shown that brand image is a component that plays an important role in perceived value and loyalty, which is why it deserves to be evaluated exhaustively (99, 100). When accentuating a bond of loyalty between the brand and the consumer, the perceived value assumes a fundamental role that can be strengthened with the intervention of the brand image successful marketing strategy (101, 102). A critical debate on the effect of brand image on increasing consumer loyalty indicates that consumers no longer rely solely on brand image to make repetitive purchases. However, it also evaluates the perceived value. When a consumer believes in a product, has high expectations, and maintains a positive brand image, purchasing behavior becomes repetitive, which translates into loyalty (103, 104).

Likewise, some studies have attributed a special connection between a good brand image and consumer loyalty (101, 105, 106). Other studies have used perceived value (economic, social, emotional value, and quality (9, 107) to drive consumer loyalty (108, 109). In both cases, research has focused on understanding consumer loyalty to deepen and better understand the link between the study variables. Other research reveals that this general evaluation of the consumer (perceived value) precedes loyalty, becoming even more consolidated when the brand image is in the consumer's mind (110). To explain this, brand image can affect consumer preferences and expectations regarding specific product attributes, driving purchases and repurchases, which translates into loyalty (111).

Likewise, perceived quality is a critical determinant of brand image, especially in the health food market, where consumers associate quality with attributes such as freshness, purity, and nutritional benefits (50, 52). A positive brand image mediated by high perceived quality can lead to greater brand loyalty, as consumers trust that the brand will consistently meet their quality expectations. This mediation process strengthens loyalty through brand trust and continued consumer satisfaction (52). Also, extending the perceived social value as a variable affects brand loyalty through brand image. Consumers who perceive that a brand improves their social status tend to have a more favorable image of the brand, strengthening their loyalty (70). In this sense, brand image bridges social value and loyalty, ensuring consumers continue to prefer the brand that allows them to project a desired social identity. Based on what was mentioned above, the following hypothesis is proposed:

H10: Healthy food brand image plays a mediating role in the influence of perceived emotional value on healthy food brand loyalty.

H11: Healthy food brand image plays a mediating role in the influence of perceived financial value on healthy food brand loyalty.

H12: Healthy food brand image plays a mediating role in the influence of perceived quality on healthy food brand loyalty.

H13: Healthy food brand image plays a mediating role in the influence of perceived social value on healthy food brand loyalty.

Considering the hypotheses mentioned above, the conceptual model resulting from the study can be visualized, as represented in Figure 1.

3 Materials and methods

3.1 Study design and participants

The present investigation has been considered within a cross-sectional and explanatory study (112). The study population comprised Peruvian residents who consumed products from a healthy brand (Marca Unión). The brand that was considered for this study has an essential representativeness in the Peruvian market and currently has a presence in Ecuador, Chile, and the United States; it is valued as a healthy brand that looks after the well-being of its

consumers and that manufactures its products based on whole or whole grains. Within the inclusion criteria, participants had to be of legal age (minimum 18 years) and consumers of a healthy brand, excluding all participants who did not meet these requirements.

Non-probabilistic sampling was applied to establish the sample size (113) and the electronic tool Soper was used (114). This online tool considers the number of observed and latent variables in the Structural Equation Model (SEM), along with the anticipated effect size ($\lambda = 0.20$), the desired level of statistical significance ($\alpha = 0.05$), and the power required statistic ($1 - \beta = 0.80$). Based on these standards, the need to include a minimum of 296 consumers in the sample was determined. However, a total of 612 people participated, including women (65.2%) and men (34.8%), with ages ranging between 18 and 56 years (M = 22.56; SD = 5.95). Most of the participants were female consumers (65.2%), with an age range between 18 and 22 years (66.3%), single (93.3%), and who declared that they had a higher university education (95.8%), as shown in Table 1.

3.2 Measurement scales

An online questionnaire was designed and divided into three parts to collect the data. In the first section, filling instructions were given. In the second section, the sociodemographic information of the participants was requested, and in the last section, the measurement scales were presented. This research used three reliable
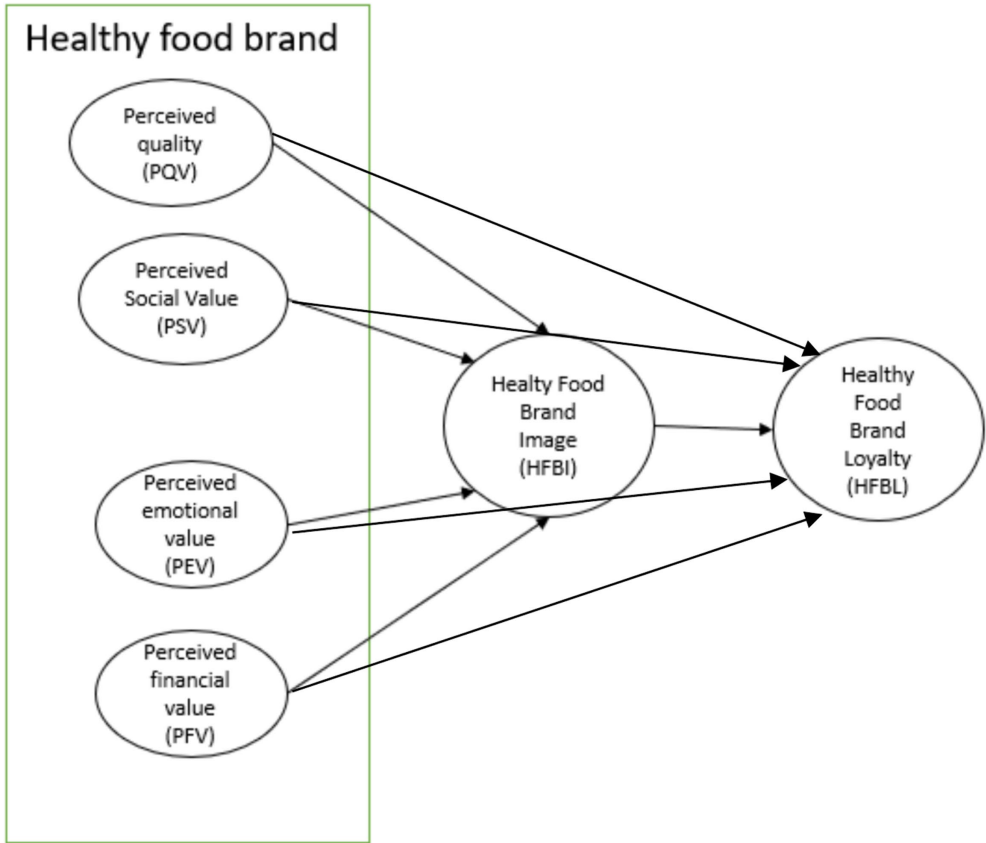

FIGURE 1
Proposed model.

TABLE 1 Profile sociodemographic of the participants (*n* = 612).

Feature	Category	Frequency	%
Age range	18–22 years	406	66.3
	23–56 years	206	33.7
Sex	Male	213	34.8
	Female	399	65.2
Marital status	Single	571	93.3
	Married	35	5.7
	Cohabitant	2	0.3
	Divorced	4	0.7
Academic training	Regular Basic Education (EBR)	19	3.1
	Technical Superior	7	1.1
	University Higher	586	95.8

measurement scales, which evaluated each item using a 5-point Likert-type scale, rated from 1 (strongly disagree) to 5 (strongly agree). To evaluate the perceived value, a short scale was used (115), which assessed four components: perceived quality value (PQV), perceived social value (PSV), perceived emotional value (PEV), and perceived financial value (PFV). Three items were used for each construct. A short 3-item scale adapted from previous studies was used to measure brand image (89, 116, 117), and brand loyalty was measured in 2 items adapted from previously published studies (89, 117, 118). Each of the items of the questionnaire can be found at the end of the document in Appendix A.

3.3 Ethical considerations

The research was approved by the Ethics Committee of the Graduate School of a private university (2023-CE-EPG-00043). Subsequently, between July and December 2023, participants were invited to complete an online questionnaire shared by WhatsApp and Telegram through Google Forms. Before data collection, the study made sure to follow the confidentiality rules and the principles of the Declaration of Helsinki (119, 120), informing the participants about the study's objective, and obtaining informed consent from each person involved through the following statement: "I agree to participate in this study."

3.4 Statistical analysis

The partial least squares structural equation model (PLS-SEM) was used to perform the statistical analysis of the data. Two stages were carried out to evaluate the PLS-SEM: evaluating the psychometric properties of the measurement scale, such as reliability, convergent, and discriminant validity, and testing hypotheses through the system of structural equations. The choice of PLS-SEM is due to its usefulness when analyzing several dependent, independent and latent variables, in addition, it has the key advantage of simultaneously analyzing the structural model, providing a complete view of the interaction of the variables (121).

TABLE 2 Convergent validity results.

Construct	Items	Factor loading	Alpha	CR	AVE
Healthy Food Brand Image (BI)	BI1	0.953	0.946	0.946	0.902
	BI2	0.943			
	BI3	0.953			
Healthy Food Brand Loyalty (BL)	BL1	0.949	0.892	0.892	0.902
	BL2	0.951			
Perceived Emotional Value (PEV)	PEV1	0.952	0.945	0.947	0.900
	PEV2	0.957			
	PEV3	0.937			
Perceived Financial Value (PFV)	PFV1	0.927	0.926	0.927	0.871
	PFV2	0.940			
	PFV3	0.932			
Perceived Quality (PQV)	PQV1	0.958	0.953	0.953	0.914
	PQV2	0.950			
	PQV3	0.961			
Perceived Social Value (PSV)	PSV1	0.958	0.950	0.954	0.909
	PSV2	0.957			
	PSV3	0.945			

The convergent validity results ensured acceptable values [Factor loading, Cronbach's Alpha, and composite reliability (CR) ≥ 0.70 and Average Variance Extracted (AVE) > 0.5].

4 Results

4.1 Convergent validity

According to Hair et al. (122), to evaluate the measurement model, an estimate of the reliability of the constructs (composite reliability and Cronbach's alpha) and validity (discriminant and convergent validity) was proposed. Cronbach's alpha values are between 0.892 and 0.953, and the threshold value of 0.7 falls below these values (122). Likewise, the composite reliability (CR) shows values between 0.892 and 0.954, which were above the suggested value of 0.7 (123). Based on these findings, all constructs were considered error-free, and construct reliability was established (Table 2).

Average variance extracted (AVE) and factor loading should be tested for convergent validity (122). According to Table 1, all factor loadings had values above the suggested value of 0.7. Furthermore, Table 2 shows that the AVE returns have values between 0.871 and 0.914 and are above the threshold value of 0.5. With these results, convergent validity for all constructs is adequately satisfied.

4.2 Discriminant validity

Two criteria were considered to determine discriminant validity: (1) The Fornell-Larker criterion and (2) the Heterotrait-Monotrait (HTMT) relationship (122). Table 3 confirms the requirements by the Fornell-Larker condition since all AVEs and their square roots are more significant than their correlations with other constructs (124).

Table 4 provides the results of the HTMT relationship, which shows that the threshold value of 0.85 is greater than the value of each

TABLE 3 Fornell-Larcker scale.

	BI	BL	PEV	PFV	PQV	PSV
BI	**0.950**					
BL	0.683	**0.950**				
PEV	0.640	0.693	**0.949**			
PFV	0.677	0.714	0.730	**0.933**		
PQV	0.756	0.735	0.692	0.705	**0.956**	
PSV	0.351	0.440	0.605	0.564	0.405	**0.953**

The diagonal values in bold represent the square of the average variance extracted (AVE).

TABLE 4 Heterotrait-monotrait (HTMT) relationship.

	BI	BL	PEV	PFV	PQV	PSV
BI						
BL	0.743					
PEV	0.676	0.755				
PFV	0.722	0.785	0.779			
PQV	0.796	0.797	0.728	0.749		
PSV	0.369	0.478	0.638	0.600	0.424	

construct (125). These findings determine discriminant validity. These results confirm the validity and reliability of the measurement model, allowing the evaluation of the structural model to continue.

4.3 Structural model analysis

The PLS-SEM method was used to compare the suggested hypotheses. For model fitting, predictive relevance values were employed. The predictive relevance of the model is represented by cross-validated redundancy values (R2). For a model to be accurate, its R2 values need to exceed "0" (125, 126). Using the blindfolding method, R2 values were calculated. All endogenous construct values were more significant than 0, indicating the correctness of the model. Table 5 displays the endogenous latent variables together with corresponding R2.

As seen in Figure 2 and Table 6, the path coefficient values, *p*-value, and *t*-statistics were utilized to accept and reject the hypotheses. The strength of the association between the variables can be examined using the coefficient values. Path. Strong relationships are indicated by path coefficient values near +1, and vice versa (127). The acceptance and rejection of the put forward hypotheses are shown by the *p* values and the *t* statistics. In this study, the conceptual model contains 13 hypotheses. The results of the tested hypotheses have been summarized in Table 6. H1 is accepted, which proposed that healthy food brand image (BI) has a positive impact on healthy food brand loyalty (BL) ($\beta = 0.158$, $p = 0.000$, $t = 3.496$); H2 was accepted, which proposed that perceived emotional value (PEV) has a positive impact on healthy food brand image (BI) ($\beta = 0.164$, $p = 0.001$, $t = 3.215$); H3 is accepted, which proposed that perceived emotional value (PEV) has a positive impact on healthy food brand loyalty (BL) ($\beta = 0.205$, $p = 0.000$, $t = 4.008$).

H4 is accepted, which proposed that perceived financial value (PFV) has a positive impact on healthy food brand image (BI) ($\beta = 0.259$, $p = 0.000$, $t = 5.507$); H5 is accepted, which proposed that

TABLE 5 R2 of the endogenous latent variables.

Construct	R2
Healthy Food Brand Image (BI)	0.623
Healthy Food Brand Loyalty (BL)	0.645

perceived financial value (PFV) has a positive impact on healthy food (BL) brand loyalty ($\beta = 0.245$, $p = 0.000$, $t = 4.935$); H6 is accepted, which proposed that perceived quality (PQV) has a positive impact on healthy food brand image (BI) ($\beta = 0.499$, $p = 0.000$, $t = 10.293$); H7 is accepted, which proposed that perceived quality (PQV) has a positive impact on healthy food brand loyalty (BL) ($\beta = 0.300$, $p = 0.000$, $t = 6.085$); H8 is accepted, which proposed that perceived social value (PSV) has an impact positive in the image of the healthy food brand (BI) ($\beta = -0.096$, $p = 0.010$, $t = 2.564$); H9 is not accepted, which proposed that perceived social value (PSV) has a positive impact on healthy food (BL) brand loyalty ($\beta = 0.001$, $p = 0.973$, $t = 0.034$); H10 is accepted, which proposed that healthy food brand image (BI) has a mediating role in the influence of perceived emotional value (PEV) on healthy food brand loyalty (BL) ($\beta = 0.026$, $p = 0.013$, $t = 2.480$); H11 is accepted, which proposed that healthy food brand image (BI) has a mediating role in the influence of perceived financial value (PFV) on healthy food brand loyalty (BL) ($\beta = 0.041$, $p = 0.006$, $t = 2.761$); H12 is accepted, which proposed that healthy food brand image (BI) has a mediating role in the influence of perceived quality (PQV) on healthy food brand loyalty (BL) ($\beta = 0.079$, $p = 0.001$, $t = 3.257$) and H13 is accepted, which proposed that healthy food brand image (BI) has a mediating role in the influence of perceived social value (PSV) on healthy food brand loyalty (BL) ($\beta = -0.015$, $p = 0.031$, $t = 2.155$).

5 Discussions

Peruvian macroeconomic stability has led to its classification as a country with an emerging economy. This means that the economy is going through a phase of accelerated growth and development (128), this fact is attributed, in part, to the emergence of innovative businesses within the healthy food sector and that after the arrival of the pandemic, trends in the consumption of healthy foods have been increasing (10, 28, 129). The increase mentioned above has prompted the commercial sector to make decisions to satisfy demand, a demand that promotes public health, an aspect increasingly valued by consumers (98, 130). This entire scenario has become an opportunity for companies in this sector to focus their strategies on promoting consumer loyalty. Consequently, it improves your brand image and reinforces the value consumers perceive.

In this context, this study focused on analyzing the factors of perceived value and the intervention of brand image to achieve consumer loyalty. In this context, it has been demonstrated in the first instance that perceived value influences the brand image of healthy foods. To support this result, the background establishes that a better perception of a brand is attributed to the one that generates benefits and sustainability, such is the case of healthy foods that have a special value for their impact on the lifestyle and well-being of individuals (109). Other research that supports the results found is focused on antecedents that support that healthy food brands maintain an optimal perceived value, this is due to the ideological barriers that significantly
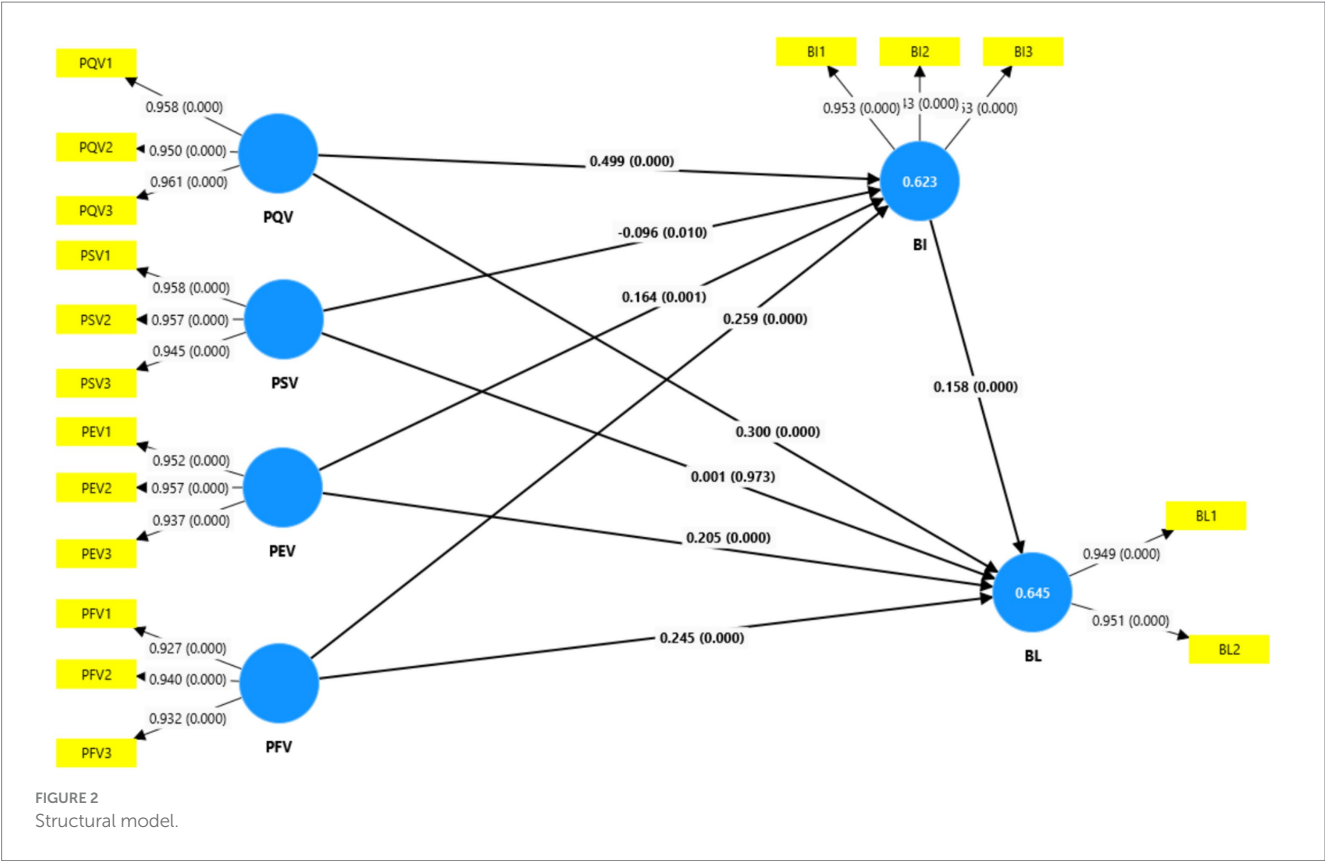
FIGURE 2
Structural model.

TABLE 6 Structural model results.

h	Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	p-values	Decision
H1	BI—BL	0.158	0.160	0.045	3,496	0.000	Supported
H2	PEV—BI	0.164	0.164	0.051	3,215	0.001	Supported
H3	PEV—BL	0.205	0.206	0.051	4,008	0.000	Supported
H4	PFV—BI	0.259	0.261	0.047	5,507	0.000	Supported
H5	PFV—BL	0.245	0.243	0.050	4,935	0.000	Supported
H6	PQV—BI	0.499	0.497	0.049	10,293	0.000	Supported
H7	PQV—BL	0.300	0.299	0.049	6,085	0.000	Supported
H8	PSV—BI	−0.096	−0.096	0.038	2,564	0.010	Supported
H9	PSV—BL	0.001	0.000	0.037	0.034	0.973	Not supported
H10	PEV—BI—BL	0.026	0.026	0.010	2,480	0.013	Supported
H11	PFV—BI—BL	0.041	0.042	0.015	2,761	0.006	Supported
H12	PQV—BI—BL	0.079	0.080	0.024	3,257	0.001	Supported
H13	PSV—BI—BL	−0.015	−0.015	0.007	2,155	0.031	Supported

contribute to the consumption of natural foods, traditional products to which a higher perceived value is attributed compared to processed products; Under this scenario, it is demonstrated that, despite the time that has passed, healthy foods continue to occupy an essential place in the consumer's life, thus generating a positive image, which is crucial to encourage repurchase intentions (131, 132).

Furthermore, the results of this research are further supported by the statement that establishes the importance of the contribution of

the general evaluation that a consumer makes towards a brand's products in economic, social, emotional, and quality terms towards the brand image, which gives rise to its lasting interaction between the consumer and the brand, thus causing the feeling of trust and commitment that allows a brand to maintain a positive reputation in the market (133–135). In other words, it is stated that brand image tends to improve when the perceived value is greater (136, 137); therefore, disseminating positive and authentic consumer experiences

through social platforms and word-of-mouth marketing becomes a favorable strategy to mobilize brand image through perceived value (30).

Likewise, the findings reflect that perceived value influences brand loyalty to healthy foods. One of the supports that support this result is that every brand must offer authentic value to consumers to generate benefits that generate positive behavioral results, taking into account that every perception of a product or brand is built based on quality, price, and emotional attachment and when this is positive and goes beyond the consumer's expectations, loyalty behavior is developed. Lasting, translating this into repetitive purchases and recommendations of the product and/or brand (138, 139). In addition, another idea that supports the results establishes that consumer demand for healthy foods has allowed consumers to maintain a positive perception, which becomes an opportunity to strengthen the bond of the brand with the consumer, giving openness to a solid and lasting loyalty (108). Likewise, it supports that a reasonable adjustment of consumer perceptions enhances constant purchase intention until consolidating long-term loyalty (13, 140).

Another of the results obtained establishes that in the population of the study, perceived social value does not influence brand loyalty to healthy foods. A study that supports this finding makes it clear that affective factors and purchase intention are more determining factors than rational thinking when promoting consumer loyalty, this suggests that emotions, quality, and price have a high contribution in consumer loyalty, in contrast to social value that does not seem to have an essential link in loyalty (13, 140). When it comes to consuming healthy foods, the most important thing is the tangible benefit it generates (prevention of diseases), and the social value or social status falls behind the priorities (10, 141).

Based on the results found in this study, it is stated that brand image assumes a mediating role in the influence of perceived value toward brand loyalty. A study that supports these results supports that brand image is a factor that can alter consumer behavior, which means that every company must dedicate its efforts to improve the brand image to reduce dilemmas and stimulate consumer loyalty and that the brand image, beyond transmitting information and experience, represents an important factor in the connection between perceived value and consumer loyalty (142, 143). Likewise, previous studies that support the results indicate that companies should analyze other factors, such as the customer's perceived value, beyond focusing on satisfaction as a predictor of loyalty, to obtain an explanation. More updated on how to get more loyal customers, also taking into account another factor such as brand image, the one in charge of mediating this association (144, 145), so it is conclusive that brand image strengthens the effect of perceived value on consumer loyalty (17, 146). Consequently, to achieve consumer loyalty, brands should effectively communicate their attributes and offer them by covering and exceeding consumer expectations. This is a mechanism to consolidate a strong and positive image that serves as a facilitator in customer loyalty based on perceived value.

5.1 Theoretical and practical implications

Analyzing the impact of perceived value and brand loyalty in the health food industry in emerging markets has significant theoretical and practical implications. Theoretically, this study enriches the existing literature on consumer behavior and healthy food marketing by highlighting the influence that brand image has on purchase intention for nutritious products in developing countries. Incorporating perceived emotional value, perceived quality, and brand image in this context opens new horizons in food marketing research, focusing on aspects such as brand personality. This provides a novel perspective on how consumers perceive and emotionally connect with healthy food brands.

In practical terms, this research's results provide valuable information and have concrete applications. The insights gained can help marketers and decision-makers in the healthy food industry design more effective brand strategies, which could increase demand for their healthy products. By better understanding how consumers emotionally value and perceive quality and brand image, marketers can adapt their strategy to strengthen brand loyalty in emerging markets.

5.2 Management implications

The implications for management in the context of healthy food purchase intention and the crucial role of brand image are of great relevance. Managers must recognize the importance of cultivating a favorable brand image when formulating marketing strategies to increase consumer preference for healthy foods. In this context, managers must invest in developing a strong and positive brand image. This can be achieved through various strategies, such as effective advertising campaigns, public relations initiatives, sponsorship of events that promote health, and the participation of brand ambassadors who highlight the benefits of the products. Through these actions, consumers can perceive healthy foods as more beneficial options for their well-being and lifestyle.

Likewise, the permanent monitoring that managers must carry out of how consumers perceive the brand image becomes more relevant to adapting their marketing strategies in response to timely market changes. This continuous monitoring will allow strategies to be adjusted to maintain the relevance and attractiveness of the brand among consumers. In addition, managers must consider specific market characteristics in developing countries, such as health consciousness, local taste preferences, and consumer purchasing power. Adapting marketing strategies to these characteristics can facilitate the creation of a greater preference for healthy foods and avoid consumer rejection.

Finally, the Ministries of Health and Education can play a fundamental role in promoting healthy lifestyles. Implementing practical courses and programs promoting healthy eating and lifestyle can inspire and motivate new generations to have a broader perspective and prefer healthy food brands. Collaboration between the public and private sectors on these initiatives can amplify the impact of marketing efforts and contribute to a cultural shift toward a preference for more nutritious foods. In summary, managing healthy food purchase intention and promoting a positive brand image requires a strategic and adaptive approach. By investing in building a solid brand image, monitoring consumer perceptions, and adapting strategies to market characteristics, managers can increase consumer preference for healthy foods. Furthermore, collaboration with public institutions can enhance these efforts, contributing to a significant change in consumer habits and the general well-being of the population.

5.3 Limitations of the study

The study used a cross-sectional design, which limits the ability to establish definitive causal relationships between perceived value, brand image, and loyalty. Future studies could consider a longitudinal design to observe how these relationships evolve. The sample focused on specific emerging markets. Although relevant to the study context, the results may not be fully generalizable to other markets or regions with different socioeconomic and cultural characteristics. It is suggested that future studies replicate the study in other geographies to evaluate the generalizability of the findings.

Data collection was based on self-administered surveys, which could have introduced response biases, such as social desirability or recall bias. Future research could benefit from triangulation of methods, including in-depth interviews or observational data, to mitigate these biases. Although the study addressed several dimensions of perceived value, other relevant variables were not considered, such as the influence of competition, product characteristics, or the economic context. This could have influenced the results, and future research could have included these variables to obtain a more complete picture.

Finally, despite the high participation of the study population, no differences have been analyzed with respect to their perspectives on the topic under investigation, since no homogeneous characteristic was achieved to measure gaps between different groups, so it is proposed as future research to deepen the comparative analysis between the various subpopulations in order to identify possible discrepancies and factors that influence their perceptions.

5.4 Future research

As mentioned above, it is recommended that future studies use a longitudinal design to investigate how brand value perception and brand image evolve and how this affects consumer loyalty. While this study focused on healthy food brands, it would be valuable to explore whether the same patterns are observed in other sectors, such as technology or financial services, to evaluate the applicability of the results in different industries. Future studies could explore how contextual variables, such as economic conditions, marketing campaigns, or market competition, affect the relationship between perceived value, brand image, and loyalty.

Expanding the research to include multicultural analysis could shed light on how cultural differences influence value perception, brand image, and loyalty. This would be especially relevant in an increasingly globalized world. The role of possible mediating and moderating variables that were not addressed in this study could be further explored. For example, investigate whether brand trust or emotional commitment mediate between perceived value and loyalty.

6 Conclusion

The present study has provided a comprehensive view of how different components of perceived value influence brand image and consumer loyalty towards health food brands in emerging markets. The findings underline the importance of emotional, financial, and quality value as determining factors in building a solid brand image and generating customer loyalty.

In particular, perceived quality and financial value were confirmed to be the biggest drivers of positive brand image and brand loyalty, indicating that consumers value product quality and value for money in their decision-making. On the other hand, although emotional value also shows a significant influence, its effect is smaller than the other two components, suggesting that, although emotions play a relevant role, economic rationality and product quality are more determinants in customer loyalty.

A noteworthy aspect of this study is that, unlike the other dimensions of perceived value, social value did not show a direct impact on brand loyalty, which could indicate that, in the context of health food brands in Peru, social perceptions are not a critical factor in the decision to continue buying a particular brand. However, its influence on brand image suggests that it could be relevant to the brand's overall perception, although not necessarily in direct loyalty.

The mediating role of brand image was also confirmed, especially in the relationship between perceived emotional, financial, and quality value and loyalty. This reinforces that a strong brand image is essential for translating perceived values into loyalty behaviors, functioning as a bridge between consumer perception and action.

The results of this research can guide brand managers in the health food industry to develop strategies that improve the quality and perceived value of their products and strengthen brand image to ensure consumer loyalty. It also suggests the need to focus marketing strategies on highlighting product quality and value for money without neglecting the emotional component to consolidate a lasting relationship with consumers. Finally, although social value does not appear to be a direct factor in loyalty, it should not be ignored entirely, as it contributes to the brand's overall perception.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethics Committee of the Peruvian Union University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

EG-S: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. ME-F: Conceptualization, Funding acquisition, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. JE-P: Conceptualization, Investigation, Resources, Visualization,

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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.

Publisher's note

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Appendix A

TABLE A1 Questionnaire used for the study.

Healthy Food Brand Image (BI)		The Union brand.
	BI1	Has a good reputation
	BI2	Addresses my health concerns
	BI3	Is reliable
Healthy Food Brand Loyalty (BL)		Personally I …
	BL1	Prefer the Union brand over other brands of healthful products
	BL2	Recommend the Union brand to my friends and family
Perceived Emotional Value (PEV)		Consuming Union brand products…
	PEV1	Gives me satisfaction
	PEV2	Makes me feel good
	PEV3	It gives me peace of mind
Perceived Financial Value (PFV)		Buying Union brand products…
	PFV1	Offer good value for money
	PFV2	They are worth the price
	PFV3	Are reasonably priced
Perceived Quality (PQV)		Union brand products…
	PQV1	Are always of good quality
	PQV2	Have a good presentation
	PQV3	Have an adequate shelf life
Perceived Financial Value (PFV)		Consuming Union brand products…
	PEV1	Gives me satisfaction
	PEV2	Makes me feel good
	PEV3	Gives me peace of mind
Perceived Social Value (PSV)		Consuming Union brand products…
	PSV1	Helps me feel accepted by others
	PSV2	Improves the way I am perceived
	PSV3	Gives me social approval

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The healthy eating movement on social media and its psychological effects on body image

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Introduction: The present study aims to investigate the relationship between social-media pressure, the tendency to internalize standards of beauty and attractiveness associated with thin bodies, which subsequently leads to distortion of body shape perceptions, and restrictive and emotional eating behavior disorders.

Methods: A survey-based research design was employed, utilizing an online questionnaire to collect data. The study sample consisted of 614 students, selected from the most prestigious universities in Bucharest. The questionnaire incorporated validated scales measuring Socio-Media Pressure for a Thin Body Image (SMPTB), Body Appreciation (BA), Body Shape Perception (BSP), Restrained Eating Behavior (REB), and Emotional Eating Behavior (EEB).

Results: The results confirmed the hypotheses of the research, meaning food restrictions are a way to diminish the level of dissatisfaction with body shape, to reduce the difference between the ideal body shape and the real one. Food restrictions are perceived as natural behaviors, appropriate to support the standards of beauty and attractiveness specific to this historical stage. Emotional eating disorders emerge as a way to compensate for the discomfort generated by low body esteem.

Discussion: The results underscore the pervasive influence of social media in shaping eating behaviors and body image perceptions. Food restrictions, framed as natural responses to societal pressures, highlight the need for interventions addressing the normalization of harmful beauty standards. Emotional eating behaviors reveal the psychological toll of body dissatisfaction, emphasizing the importance of strategies to foster positive body image and mental well-being. These findings provide a foundation for developing educational campaigns and therapeutic approaches targeting the psychological impact of social media on eating behaviors.

KEYWORDS

social media pressure, body image, emotional eating behavior, thin body, beauty standards, thinspiration, fitspiration

1 Introduction

In contemporary society, we are witnessing an increasing tendency in people to function, relate, work using technology, build benchmarks and follow models promoted on social networks. Also, individuals tend more and more to rely on information provided by different modern means of communication at the level of their social groups (1). Covid-19 pandemic has created a favorable context for the intensive use of technology in order to maintain interpersonal relationships, to have entertainment and relaxation, and to carry out professional activities (2–5). The cost that people pay in order to ease their work, to get informed quickly or to relax refer to the internalization of the messages underlying the content of social media. A significant category of these messages refers to aspects related to the need of having a slim body (6, 7), or adopting eating behaviors conducive to

these standards. Exposure to images of thin bodies, bodies worked in the gym, does not produce the expected effects: adopting a healthy lifestyle, involving sports, movement, appropriate eating behaviors, but on the contrary, deepens the discordance between the desired body image, inoculated through social media, and the real image. The constant exposure to idealized body images on social media platforms can lead to increased body dissatisfaction and a low level of self-esteem among users. Studies have shown that this phenomenon is particularly prevalent among adolescents and young adults, who are more susceptible to peer influence and social comparison (8, 9). Moreover, the pressure to conform to these unrealistic body standards can result in the adoption of unhealthy behaviors, such as extreme dieting, over-exercising, and even eating disorders (10, 11). These behaviors are often fueled by the desire to achieve the "perfect" body image that is frequently portrayed on social media. Interestingly, while social media can have detrimental effects on body image and behavior, it also has the potential to promote positive health behaviors. For instance, some social media campaigns and influencers advocate for body positivity and healthy living, which can inspire individuals to adopt healthier lifestyles (12, 13). Furthermore, the use of social media for health promotion is becoming increasingly popular. Health professionals and organizations leverage social media platforms to disseminate information about healthy eating, physical activity, and mental well-being, aiming to counteract the negative effects of exposure to idealized body images (14, 15). It is crucial for individuals to develop critical media literacy skills to navigate the complex landscape of social media. By understanding the constructed nature of the content they consume, individuals can better resist the pressure to conform to unrealistic body standards and make more informed decisions about their health and well-being (9, 16). In the light of the above considerations, the research data brought by this study is useful for understanding the issues associated with social reflection mechanisms, relevant in the approach of building perceptions of body form (17, 18), in order to outline educational strategies for children, adolescents and young people, customized, depending on the age category, but also the specifics of the media content. The present study aims to present the psychological implications of association relationships between social-media pressure regarding ideal body image, internalization of a standard of beauty and attractiveness of thin bodies, quality of body shape perceptions, level of body appreciation, and the presence of restrictive and emotional eating behavior disorders. The paper is structured as follows: introduction makes a brief presentation of the paper emphasizing the novelty and the methodology of research, second part presents a literature review designed to substantiate the six working hypotheses and to propose our theoretical model. The third part presents the research methodology and materials, followed by the fourth part witch, presents the research findings to the readers. The fifth and sixth parts are revealing the discussions and conclusions of the paper, pointing out the main ideas and contributions in the field.

2 Literature review and hypotheses development

The present study aims to present the psychological implications of the body image construction approach, considering the aspects associated with the pressure to display an appearance that corresponds to the beauty model, specific to the era, promoted on social media platforms. This leads to the internalization of a standard of beauty associated with thin bodies and favors the tendency to evaluate and appreciate one's own body based

on comparison with thin and attractive bodies exhibited on social media. The consequences of these actions are materialized in the adoption of problematic eating behaviors.

In order to conceptualize these relations, we may focus our attention on the possible correlations between the high level of social media pressure and the tendency to internalize thin bodies standards. Social media platforms are powerful agents of influence in the process of building body image, with simple exposure to images and videos of thin, attractive bodies easily leading to the assimilation of beauty standards (19). The feeling of this influence by consumers can be defined as social media pressure. Young women prefer Facebook and Instagram to traditional forms of media such as television or magazines (20). This preference is explained by the nature of the content found on these platforms with some of them (e.g., Instagram) that allow photo and video editing (21), having also a high degree of addictiveness. Dependence on SNS (social networking service) is supported by multiple research data (22–25), studies that report the psychological, social and behavioral implications of social media content consumption, focusing mostly on the negative effects, through the unrealistic standards imposed by social media platforms regarding appearance. To highlight the impact of social media, a new concept is outlined, the construct of appearance-related social media consciousness, described "as the extent to which individuals' thoughts and behaviors reflect ongoing awareness of whether they might look attractive to a social media audience" (26, p. 164). Thus, the analysis of one's own body starts from what could be considered attractive in the social media space, from the physiological aspects validated at the social level. The tendency to internalize standards associated with thin bodies requires acceptance of socially valid models of beauty and attractiveness and pressure to follow those standards. SMPTB (27). In a study conducted on 259 women, aged between 18 and 29, it was observed that preoccupation with social media content related to appearance, materialized by activity involving photos on Facebook and Instagram, was associated with concerns about body image, the internalization of an ideal of the slim body that intensifies the desire for a slim body, aspects that were not found in the case of those who did not show interest in the issue of appearance on social media (28). Internalizing a standard of a slim body, following exposure to social media content related to appearance, and installing the need to follow that standard, are reported also in recent studies (29, 30). In another study, 193 college students, aged 17 to 46, were exposed to conventional images associated with the ideal of beauty by using Facebook, in order to highlight, the role, that social media platforms, play in comparing appearance, body image quality and intensity of eating disorders. Compared to the control group, people in the experimental group showed higher values in terms of the tendency to relate to images on social media, consequently an increase in the tendency to compare, which favors the degree of body image deformation and higher chances of adopting eating disorders (31). The intensification of the comparison based on appearance involves a strong internalization of social media content, which becomes a benchmark for how one's own body is perceived and analyzed. The intense activity of sharing pictures of one's own body on social networks, frequent especially among adolescent girls, is associated with greater control for weight and body shape, which is based on the internalization of a standard of beauty associated with thin bodies triggered by the use of social media platforms (32). Another study of 103 teenage girls reported results along the same lines. Adolescent girls were tested in terms of using the Facebook platform, aspects related to internalizing a slim body standard, appearance comparison, desire for a slim body, weight problems, tendency to be noticed and evaluated based on appearance, research data indicating

significant correlations between psychological variables (33). The strong association between social media consumption and pressure to follow a pattern of ideal appearance is shown in a study (34) aimed at investigating 1,552 Norwegian adolescents, 827 girls and 725 boys. Adolescents reported consistent exposure to social media, most of them spending more than 2–3 h in the media space (28.5% – 2–3 h, 25.1% – 3–4 h, 25.3%–over 4 h). In terms of gender differences, girls spend much more time on social media space (30.7%–over 4 h) compared to boys (19.0%–over 4 h), which led to differences in other variables as well, so girls were more susceptible to social media pressure to adopt a standard associated with slim and attractive bodies and to internalize this model. Male adolescents showed higher averages only on the variable associated with the tendency to internalize a muscle body standard, which is explained by the presence of a greater number of images and videos on social media showing the bodies of men with muscles. The power that social media holds in creating trends related to physical appearance is illustrated by the trends of this historical milestone –"thinspiration and fitspiration" (7). Thinspiration involves presenting motivating messages and images that support lean bodies, and fitspiration supports the association between physical activity, health, and attractive bodies (35). Although representatives of these movements presented and promoted them in order to inoculate healthy body image cues, many studies report the opposite, creating the context for internalizing unhealthy patterns of beauty (36). These movements are defined as "classes of social media content characterized by idealized depictions of excessively thin and overtly fit/lean bodies" (37, p. 187). To investigate the effects that thinspiration and fitspiration, can generate in real life, 108 participants were asked to use their smartphones for a week to track measurements of them as well as body satisfaction. Women reported a considerably higher number of exposures to both material-related materials Thinspiration and Fitspiration, the average duration of exposure being 2–3 min, with no differences reported between the two content categories (38). Exposure to thinspiration and fitspiration content was associated with lower body satisfaction and overall functioning in both women and men. Thinspiration and Fitspiration are contemporary ways in which social media builds and promotes standard beauty images. In this regard, a descriptive study, which was based on the content analysis of images that were appreciated as a source of inspiration in the social media space, being considered three social networks: Instagram, Twitter and WeHeartIt, given their popularity, as well as the possibility of sharing photos (39). The study introduced into the analysis, in addition to thinspiration (promoting slim bodies with little body fat) and fitspiration (promoting toned bodies), a new construct—Bonespiration, movement similar to thinspiration, that promotes extremely thin bodies, whose bones are pronounced. The results illustrate significant differences in Thinspiration and Bonespiration content compared to Fitspiration content, with many more thin bodies present in the first two categories than in the third category. Fitspiration is perceived as the inspirational variant in social media that leads to the creation of healthier landmarks in terms of appearance, although some participants have associated Thinspiration with Fitspiration, which draws attention to the psychological and behavioral risks that can occur under the motto of messages such as Fitspiration. The aspects highlighted above, allow us to formulate the first hypothesis of our study (H1).

> *H1:* A high level of social media pressure that individuals feel about ideal body image is associated with a high level of tendency to internalize the standard of beauty and attractiveness of slim bodies.

Considering the role that social media platforms play in shaping the perception of what constitutes an attractive body, we present aspects associated with the process of self-image formation specific to the current period.

Self-image includes a combination of perceptions, attitudes and impressions about oneself (40). Self-image is a construct that can take on positive or negative valences (41). A significant component of self-image is body image, especially at this historical stage, where we identify a growing pressure to follow the benchmarks promoted on social media, associated with thin, athletic bodies, models of beauty and attractiveness (42–45). Social media content is a powerful agent of influence in shaping the ideal of beauty. Body image illustrates the subjective perception of physical aspects, which is based on self-evaluation and social reflection (46). On the one hand, we identify the role of internal factors, such as personality structure and personal experiences, as well as external social factors, on the other hand. Family, groups of friends, and social media constitute a consistent facet of how a person perceives themselves (7). Forming a positive body image involves acceptance and respect for appearance. People with a positive self-image accept their body as it is, regardless of its shape. Thus, there is a differentiation between satisfaction with one's own body and the perception formed in this sense (47). Dissatisfaction with one's own body sets in when people describe their body in negative terms and there is a disharmony between real and ideal body image (48). Body shape perception distortion not only refers to a deformation of body perception, but also includes body-associated attitude and cognitive impairment (49). Thus, people who have sketched a distorted perception of their appearance, relate inappropriately to themselves, and emit thoughts of denigration towards themselves. It is not only a matter of measuring body shape perception, but also of self-discredit. The tendency to internalize a standard of beauty and attractiveness of thin bodies (TBISI—Thin Body Image Standard Internalization), a concept presented in the previous section, starting from unrealistic benchmarks in social media, will considerably influence the evaluation of one's own body, in the sense of increasing the level of dissatisfaction. Research data supports the first hypothesis of our study, according to which social media pressure has a significant contribution to the process of internalizing the image of a thin body, and internalizing the image of a thin body guides the way in which the body image is built. And the pressure is even greater at this historical stage, when appearance is valued more at the expense of other capacities, skills, and Self-objectivation intensifies, especially among girls and women. More and more people consider it necessary to allocate time and resources to have a look that meets the criteria of the people they interact with, people in the online communities to which they belong, as evidenced by a study that investigated 1,983 adolescents (Mean age = 14.41 years), female and male, among Austrian, Belgian, Spanish, and South Korean, and that looked at aspects of media exposure in relation to body-image, moderated by self-objectivation (50). Because of social media pressure, especially for teenagers and young people, the natural process of social comparison is intensified. In order to define themselves, people evaluate their appearance in relation to the appearance of others (51). This mechanism has always had a role in evaluating one's own body (52), people taking as a benchmark the images of other bodies to decide if they have a beautiful, attractive body, but nowadays, the standards associated with beautiful and attractive bodies are not only very high, they are unrealistic, impossible to achieve under natural conditions, with a healthy eating approach and dietary restrictions that do not pose a health risk. Women who resort to comparison in assessing body shape, considering more attractive

appearances, are also those who are dissatisfied with their own bodies, are driven by the need to lose weight, and engage in restrictive eating behaviors, as observed in a study conducted on 321 women aged 19–25 years (53). The comparison itself, whether upward or downward, instills the need to have a slim body and the need to resort to diets. They are differentiated by the way the body is perceived; the first category of assessments is also associated with body dysfunction, negative attitudes, and thoughts related to appearance—issues not found in the second category. These aspects highlight that people who focus on attractive images on social media, considering them relevant, are more demanding with their own bodies. Also, the ability to manage negative emotions associated with comparison depends on both the quality of body image and eating behaviors. As reported in a study of 628 female college students, adaptive coping was associated with lower levels of body image deformity and behavioral disorders than maladaptive coping (54). Another study in this regard reports that social comparison, based on bodily aspects, produces much more intense effects than other comparison criteria, for example comparison based on intelligence (55). This highlights the role that aspects of appearance play in the process of building and reconstructing self-image, which are a defining facet. Given that more and more people are choosing social media platforms to spend their time (56), and considering that social media content often promotes images of thin bodies (57–59), as well as an intense concern for appearance, we can conclude that mass media is a powerful agent of influence. It significantly shapes the standards of appearance, attractiveness, and beauty, leading to a distorted perception of one's own body (44, 60). These aspects, as well as those related above, allow us to formulate the second hypothesis of our study (H2).

H2: A high level of tendency to internalize certain standards of beauty and attractiveness of thin bodies is associated with a negative body image.

And this relationship impacts the quality of behavior, below we will highlight the effects it generates in terms of eating behavior. Self-denigrating attitudes lead to restrictive eating behaviors, a problem presented in other studies (61–63). According to DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition), we mention the most common forms of eating behavior disorder of this period: restrictive or avoidance eating behavior, anorexia nervosa, bulimia nervosa, excessive eating behavior (64). Restrictive eating behavior is the tendency to reduce the consumption of some foods or even eliminate others (65). Dietary restrictions are associated with cognitive factors, rather than physiological ones, associated with state of satiety or hunger (66). Thus, restrictive eating behavior is specific to people who are trying to control their physiological needs. Restrictive eating behavior is also found in people who are of normal weight, especially in women who appreciate that they have weight problems even when they do not have them (67, 68). The deformation of the perception of body shape leads to the deformation of the perception of weight, and which favors the installation of restrictive eating behavior. Over the past 30 years, there has been a lot of controversy surrounding the concept of diet or food restriction, highlighting both positive (weight loss makes greater contributions to diet risks) and negative (dietary restrictions favor food excesses; replacing diets with other techniques has led to inconsistent weight loss in people experiencing weight problems) (69, 70). In the current society, we are witnessing a concern regarding body image, guided by

the need to correspond to landmarks of bodies' attractiveness, but also by the repercussions of a consumer society, so we consider that the adoption of restrictive eating behaviors is indirectly encouraged. By social comparison, forming a negative self-image increases the tendency to adopt a diet, which is associated with the development of eating disorders (71, 72). In the study conducted by Soni et al. (73) on a population of 298 students, women and men, correlations between body image, self-esteem, media influence and attitudes towards food are highlighted. Young people who had inappropriate attitudes towards food were those who were more receptive to media influence, who had lower levels of self-esteem and a higher level of dissatisfaction with body image. The link between dietary restrictions, interest in diets and control over calories consumed and body image is present in both women and men, which highlights the role of society-imposed attractiveness benchmarks associated with slim bodies. Inappropriate attitudes towards food are a generating agent of young people's tendency to form a distorted body opinion. Exposure to media related to weight loss has an impact on the correlation between body image and the presence of eating disorders (73). In the study conducted by Sanzari et al. (42) on a student population, the role of social media platforms (Snapchat, TikTok, and YouTube) at two points in time, 2015 and 2022, is analyzed, including aspects associated with the COVID-19 pandemic, on the relationship between the two psychological variables. The results point to more obvious disturbances in body image and eating behavior for 2022, due to the higher number of accounts held by young people. The study highlights the moderating role of the media content variable, the problems associated with body perception and those related to adopting an appropriate eating behavior being related to the quality of media materials, not to the time spent on these platforms, as initially expected. Simple exposure to media content that highlights the need to lose weight leads to the development of distorted body images, correlated with eating disorders, including the use of laxatives, invoking vomiting. To investigate how aspects of the relationship between body image and diet evolved, Ingolfsdottir et al. (74) conducted a study on Icelandic schoolchildren aged 16–19 years between 2000 and 2010. The study allowed the collection of data on 33,801 students, of both sexes, in order to draw a perspective on the psychological variables specific to this community, but also to capture the aspects related to overweight of Icelandic adolescents in relation to those of adolescents belonging to other cultural areas. The results indicated a higher level of overweight among Icelandic adolescents than Scandinavian adolescents, but lower than American adolescents. Negative body image is a strong predictor of the tendency to adopt a diet, both for women and men. The predisposition to acquire a diet is increasing among women and decreasing among men. In terms of body image, more women formed a negative perception compared to the male population. With age, the chances of following a diet increase, indicating that body image standards are likely to rise, leading to higher levels of dissatisfaction. Another conclusion of the study refers to the role that social media platforms have in terms of the landmarks they promote, so that messages that lead to the internalization of an ideal athletic body produce fewer negative effects on body image, consequently, reduce the possibility of adopting a diet, compared to those that lead to the internalization of an ideal slim body. Another study looking at body image, self-awareness and diet aspects was conducted on a population of 531 adolescents, aged 15–17, selected from Ankara schools. The internalization of an ideal slim body model,

low levels of body appreciation, personal value are associated with dysfunctional body image and the presence of diets. We find lower scores in self-awareness, body image for dieting adolescents compared to those without dietary restrictions (75). The relationship between aspects of body image, self-esteem and eating behavior disorders is also highlighted in the population study of female students at Delhi University (76). The overall objective of the research was to identify predictors of eating behavior. Most of the participants showed dissatisfaction with their body shape (76.7%). Concern for body image and aspects related to social reflection, including how they were evaluated by family members, were the main factors generating eating disorders. A significant component of the predisposition to manifest dissatisfaction with physical aspects originates from the opinions that close people manifest, opinions that are internalized and generate inappropriate eating behaviors. Body perception is a predictor of eating behavior, people with a positive body image are less likely to have eating disorders. People with a positive body image have a high level of self-esteem, which contributes to well-being and quality of life. They also exhibit high self-acceptance, are less receptive to social media pressure to have a slim body, and adopt healthy lifestyles and appropriate eating behaviors (44). A population study of German adolescents, aged 11–17 years, presents data supporting the relationship between body shape distortions and the presence of restrictive behavior (77). Thus, adolescent girls who underestimated themselves in terms of appearance said they skipped meals, tried to control their weight through food, had dietary restrictions, manifested negative states after eating and states of annoyance associated with weight, the averages being much higher than those of adolescents who had a better perception of their own body. The study aimed at a comparative analysis of early-adolescents and adolescents, as well as gender differences. Early-adolescent girls showed a strong tendency to internalize an ideal image associated with slim bodies. Eating disorders, a tendency to deform body image, and negative moods associated with diet, body, and weight issues were much more prevalent in girls. Other studies also emphasize the association between body image, desire for a slim body, and eating behavior disorders (78, 79). The studies presented support the presence of a relationship between body shape perception and eating behavior disorders in different societies, including those with higher obesity rates, such as the USA, and those with lower incidence, like Japan (80). Attitudes and evaluations towards body shape, in association with the need to have a slim body, lead to the installation of appropriate eating behavior or problematic behavior, in both individuals with weight problems and those with a normal body mass index. Considering all the aspects presented above, we can formulate the third hypothesis of our study (H3).

> *H3:* Negative perception of body shape is associated with a high intensity of restrictive eating behavior.

Considering the role of external social factors in the process of assessing body shape, as well as the association between it and restrictive eating behavior, we illustrate associated aspects of internalization of body imagery considered to be attractive in the social media space. Different scholars have studied the concept of body image over years in multiple contexts, highlighting positive or negative perceptions over it. The body appreciation has been considered one of the key elements capable to operationalize the

positive body image, being defined as the ability to form a set of positive attitudes towards one's own body, which is associated with its appreciation and acceptance, without validating the beauty models present on social media (13, 81). In a general view, a positive body image involves respecting, honoring, loving, and displaying gratitude towards the features, functionality, and health of the body (82). According to different studies, there is a positive connection between body appreciation and different other constructs like: favorable appearance evaluation, self-esteem, optimism, proactive coping, positive affect, life satisfaction, and self-compassion (81, 83–86). In the same time, body appreciation is inversely related to body dissatisfaction, social physique anxiety, body image avoidance, body shame, body surveillance, body checking behaviors, and internalization of societal appearance ideals (87–92). In addition, an inversed relationship was found between body appreciation and different pathologies like eating disorder symptomatology, neuroticism and maladaptive perfectionism (90, 93, 94). Body appreciation as it is measured with the help of Body Appreciation Scale (BAS) does not rely simply on the absence of negative body image or the experience of self-perceived attractiveness, but a kind of valuation of individuals body image and manifestation of criticism about unrealistic body images promoted by the media (95, 96). Actually, within the scientific literature there are many studies that are demonstrating the link between internalization of thin body or other cultural models promoted over the media and body appreciation. Thus, body appreciation is involved in the development of the ability to deconstruct unrealistic media images (97, 98). In a study made in 2013, Halliwell observed that the protective effect of high body appreciation is extended to women known to be vulnerable to media exposure-those who have internalized the thin ideal (99). Specifically, women subjects, that have endorsed the thin ideal and had low body appreciation after they have been exposed to thin female model images, reported larger appearance discrepancies and placed more importance on their appearance discrepancies. In the same time, women that have endorsed the thin ideal but had high levels of body appreciation do not give the same importance to their appearance discrepancies. On another line of research, a study made on a sample of 228 black college women from USA has shown that levels of higher body appreciation were linked to less history of weight related teasing, lower eating, weight and shape concerns, and lower Western beauty ideal internalization (100). So, it become clear, that the link between body appreciation and internalization of different cultural predefined standards relating with thin bodies, fit appearance etc. goes in both ways – higher internalization means lower body appreciation, higher body appreciation means lower internalization. The results of research conducted by Bordo in 2003, show that individuals who internalize the perception that excess body weight and the appearance of a fat body are linked with lower morality, lack of willpower and control, and personal inadequacy find it difficult to accept, love, and respect their bodies (101, 102).

So, again, it seems that higher internalization of such perception about "must have thin body" standards is connected with lower levels of body appreciation. Other studies like the research conducted by Alleva, Veldhuis, and Martijn in 2016, on a sample of Dutch female respondents with ages between 18 and 28 years, are showing that women that are focusing on their body functionality and as a consequence manifesting body appreciation have been able to buffer any potentially negative effects of media exposure (103). Finally, a

study made on 266 women respondents from Australia showed that greater perceived body acceptance by others and self-compassion, and lower appearance media consumption, self-objectification, social comparison, and thin-ideal internalization were related to greater body appreciation (104). Another study conducted by the same authors showed that body appreciation predicted less change in body dissatisfaction following exposure. Participants with low body appreciation experienced increased body dissatisfaction, while those with high body appreciation did not (105). Taking account of all of the above, we can issue the fourth hypothesis of our study (H4).

H4: A high level of the tendency to internalize standards of beauty and attractiveness of thin bodies is associated with a lower level of Body Appreciation.

The tendency of depreciation of body image associated with restrictive eating disorders, aspects supported by previous studies, which we have reported in the previous sections, leads us to turn our attention to aspects related to emotional eating disorder. The complexity of the concept of emotional eating disorder is given by the combination of perspectives from which it can be explained and described, meaning social psychology, clinical psychology, psychotherapy, medical psychology and nutrition (106–109). We can define emotional eating behavior as "as eating in response to negative emotions" or as the tendency to overeat due to the inability to manage emotions (110, p. 290). Food is not only consumed to satisfy physiological needs, but also to respond to emotional, psychological needs, aspects related in research aimed at investigating psychological aspects in relation to obesity. Of the 256 obese patients evaluated, 49% had depression and 56% had anxiety, which explains the role of psychological comorbidities in explaining eating behavior (111). The relationships between negative emotions, anxiety, depression, and the presence of emotional eating behavior led to the creation of the Emotional Eating Scale (EES) by Arnow et al. (112), which includes three subscales: Anger/Frustration, Anxiety, and Depression. The Dutch Eating Behavior Questionnaire (DEBQ) allows the examination of aspects related to eating disorders, presenting information on three categories: restrained, emotional, and external eating (113). The onset of emotional eating behavior is based on both negative and positive emotions support both variants (114–116). Binge eating is more commonly determined by negative emotions compared to positive ones (117). Binge eating disorders involve abnormally high food consumption in a very short time and is associated with psychological and non-psychological factors (118). Research data supports the idea that binge eating is an unhealthy way to compensate for negative emotions and promote emotional behavior disorder (119). The data presented above point to the link between emotions and the quality of eating behavior, aspects that are also related to the quality of body appreciation (BA), a variable described in the section dedicated to the fourth hypothesis of our study. Thus, in a recent study, 301 participants, women and men, without declared pathologies, physical (chronic conditions) or mental (including eating disorders), were evaluated in terms of body appreciation, eating behaviors, depression, anxiety, and stress. The results indicate that high anxiety, depression, and stress (distress) scores and low body appreciation scores were associated with eating behavior disorders (110). Women had higher scores on levels of anxiety, stress, and a tendency to develop eating disorders, and lower levels of body appreciation than men. A

longitudinal study, within the University of North Carolina Greensboro, NC, United States, started from the investigation of 445 participants, selected from childcare centers and care centers for mothers with children, analyzing aspects related to emotional eating, emotion regulation and negative body image (120). Measurement of psychological variables began at age 2 and continued into adolescence. The analysis of 138 adolescents indicated that there were no significant differences in eating behavior, depending on weight, and the presence of differences in body appreciation, depending on gender, with girls showing lower levels of body appreciation. Differences in body appreciation were also observed, depending on weight. In the case of adolescents who negatively appreciated their body, the regulation of emotions led to a decrease in the tendency to adopt emotional eating behavior. Thus, we highlight the role that body appreciation has in relation to the tendency to adopt emotional behaviors from the first years of life, tendencies that are preserved in adolescence, and later in adulthood, and that have an impact on public health. As observed in the study conducted by Bucchianeri (121), problems with appearance are predictors of mental health and eating behaviors. Another study highlighting the impact that problems associated with emotional eating and those associated with body appreciation, in relation to attachment type, have on the manner in which quality of life is assessed, is the one conducted by Laporta-Herrero et al. (122). Data collected from 260 adolescents, including 129 participants without clinical problems and 131 participants with eating disorders, receiving treatment in a specialized center in Spain. Secure attachment is associated with a positive appreciation for both categories of adolescents, and a good body appreciation correlates with body image quality of life. Adolescents with eating disorders showed a better quality of life relative to body image when they had favorable relationships with fathers, the same bound was observed for adolescents without eating problems, only in relation to mothers. In order to form an adequate body image, as well as healthy attitudes towards it, adolescents need a quality relationship with their parents, based on trust, which will propagate on how they perceive and evaluate their life. Quality interpersonal relationships are based on people's ability to provide social and emotional support, so people who benefit from compassion and/or practice self-compassion will evaluate themselves by using positive terms (123), and will be less tempted to develop eating disorders (124). The compassion that mothers showed in relation to their daughters led to a good appreciation of the body, as well as lower chances of adopting emotional eating (125). The data of the studies presented highlight the role of social factors in building body appreciation, as well as managing emotions related to eating behavior. Thus, strategies aimed at reducing the frequency of eating behavior disorders have as a starting point the improvement of the way in which the body is perceived. In this regard, a study was conducted on a population of obese women (mean age = 41.4 years) who received treatment for obesity. The results indicated that managing aspects of body satisfaction to improve it in those who manifested the highest scores in the emotional eating variable led to better results compared to obese women who exhibited normal levels of emotional eating (126). The aspects presented above allow us to formulate the fifth hypothesis of our study (H5).

H5: A lower level of Body Appreciation is associated with a high level of intensity of Emotional Eating Behavior.

Studies conducted in Europe (74, 77, 103), Asia (76, 80, 127, 128), and US (100, 120) report the trend of increasing numbers of people, from increasingly younger ages, who develop distorted body image and low levels of body appreciation, as well as eating disorders, as presented in the sections above of this paper. The data is worrying given the impact that the quality of body appreciation has on the quality of mental health (129). The perception and evaluation of the body being strongly correlated with physical health and the quality of behaviors (130, 131). If in the past, problems related to body shape were rather associated with adolescence, being related to physiological and hormonal changes, nowadays we witness a generalization of these disorders, being encountered including in mature adults, and the causes are, this time, external—the need to face standards promoted on social media or family pressure, friends (27). Although we do not identify the same causes, more and more people, from children to adults, define themselves in negative terms, devalue and denigrate themselves (95, 96, 120, 122). A population study of women highlights differences in this regard. Women aged 25–68 showed concern for weight control and a higher level of inappropriate eating behaviors, even in the absence of issues associated with body shame, compared to those aged 18–24, whose concern for weight was associated with high levels of body shame and the presence of disordered eating behaviors (132). The high level of body shame indicates the presence of negative attitudes towards one's own body, a negative evaluation of body shape, lack of body appreciation. As evidenced by studies reporting the association between high levels of body shame, low levels of body appreciation and the presence of bulimia nervosa (131, 133, 134). The presence of bodily shame will negatively influence the level of mental health, expressed by the valence of attitudes towards oneself, the manner of reporting towards physical appearance, the quality of eating habits and actions (135). Another explanation for the intensification of body dissatisfactions, which are also associated with body shame, and body surveillance, is self-objectification, a bound, validated by data reported in the study of 371 people, licensed in Psychology from University of Turin (136). Self-objectification is specific to people who use the term object when they relate to themselves, instead of subject, an object to be observed and analyzed by others (137), an object whose existence depends on the pleasure of others (138). Thus, there is a division of intrinsic human value from corporeal value, the emphasis being placed on the second component, an intensification of self-objectification being associated with a high level of need for body supervision and a low level of body appreciation (139). Self-objectification originates from the women sexual objectification, a perspective that presents the woman only as a sexual object or associated with social functions, cancelling out the aspects of personality that give her specificity (140). In the absence of self-objectification, we notice a lower tendency of people to evaluate their body, taking into account the opinions about their own appearance, with negative content, that are expressed by others. Data from a qualitative study indicate that adolescents, girls and boys, who have a positive self-image, did not consider messages with negative connotations (97). A good body appreciation is a healthy way to cope with external factors, such as media exposure, to diminish the possibility of developing body dissatisfactions (85, 99). In terms of gender differentiation, men exhibit higher levels of body appreciation (105, 141), but with age, women begin to value their bodies more, compared to men, whose assessment remains constant with age (85).

In the light of all of the above we can issue our sixth hypothesis of our study (H6).

> *H6:* A lower level of Body Shape Appreciation is associated with a lower level of Body Appreciation.

The presentation of the relationships between psychological variables, consequently the hypotheses underlying our study can be found in Figure 1 in the form of a theoretical proposed model.

3 Research design and methodology

3.1 Research design

In the following section we will present the main aspects regarding the research design and methodology used. The present study has as main characteristic the fact that allows the research of relationships. Within the research we may highlight the following psychological variables: Socio-Media Pressure for a Thin Body Image (SMPTB), Body Appreciation (BA), Body Shape Perception (BSP), Restrained Eating Behavior (REB), and Emotional Eating Behavior (EEB). The demographic variables taken into consideration were: age and gender. From this point of view, we have to highlight the fact that we have constructed our sample starting from a statistical population made of students coming from a number of four higher education institutions.

The sampling method used in the case of present research is convenience sampling. This method involves selecting participants based on their accessibility and willingness to respond. The questionnaire was distributed online, making it accessible to students from the four universities. Only students from the specified universities were targeted. Participation was voluntary, meaning only those who were interested and available completed the questionnaire.

The final sample has 38.8% male respondents and 61.2% female respondents, with ages between 18 and 21 years (52% of the respondents), 22–25 years (22% of the respondents) and 26–50 years (26% of the respondents). The differences between the number of female and male respondents is due to the fact that the majority of students came from social sciences and humanities specializations, and the higher proportion of women within the student population in Romania (according to Romanian Ministry of Education reports, in the year 2020/2021 there has been 43.3% female students in comparison with only 33.9% male students – numbers calculated by relating the number of students in the country (excluding foreign students) to the population in the 19–23 age group) (142). The establishment of association relationships was based on specialized literature relevant to the investigated topic, as it can be seen within the theoretical model proposed.

3.2 Measuring instruments

To measure Socio-Media Pressure for a Thin Body Image (SMPTB) and Thin Body Image Standard Internalization (TBISI) we applied the Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4) scale (27). The questionnaire includes the following subscales: Internalization: Thin/Low Body Fat, Internalization: Muscular, Internalization: General Attractiveness,
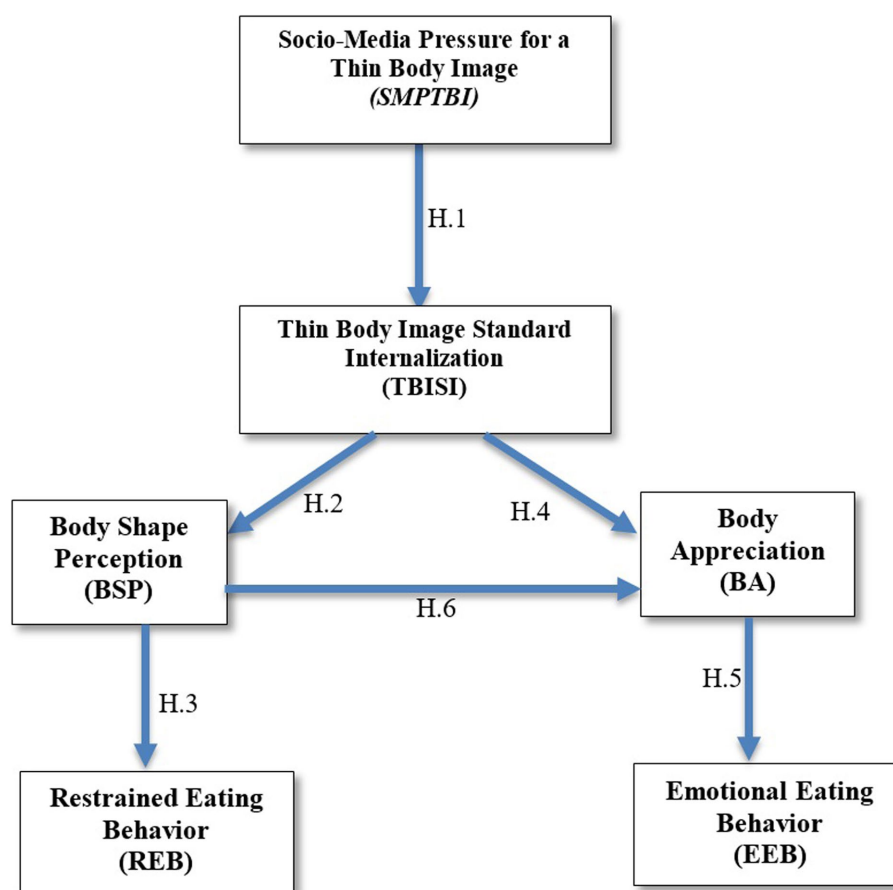
FIGURE 1
Theoretical model proposed, highlighting the relationship between identified variables.

Pressures: Family, Pressures: Media, Pressures: Peers, and Pressures: Significant Others. To assess the social media pressure, young people feel regarding beauty and attractiveness standards, we used the Pressures: Media subscale, and to assess the tendency to internalize beauty and attractiveness standards of slim bodies, we used Internalization: Thin/Low Body Fat subscales. The scale shows five response steps as follows: Definitely Disagree = 1; Mostly Disagree = 2; Neither Agree No Disagree = 3; Mostly Agree = 4; Definitely Agree = 5. The assessment of the Body Shape Perception (BSP) variable was performed using the Body Shape Questionnaire. The scale contains 16 items aimed at self-assessing aspects associated with body shape in the last 4 weeks (143). The participants opted for one of the answer options with step: 1 = never, up to 6 = always. A high score is associated with a tendency to worry and dissatisfaction with body shape. We used the Body Appreciation Scale-2, developed by Tylka and Wood-Barcalow (13), to measure body appreciation (BA). The scale comprises 10 items and presents five response steps, where the value 1 = never and 5 = always. A high score indicates a high level of body appreciation. The variables Restrained Eating Behavior (REB) and Emotional Eating Behavior (EEB) were measured using The Dutch Eating Behavior Questionnaire (DEBQ) for Assessment of Restrained, Emotional, and External Eating Behavior (113). The questionnaire includes scales for restrained, emotional, and external eating. We only used items associated with restrictive and emotional

behavior. The answer was Likert, from 1 = never, to 5 = very often. High scores indicate the presence of restrictive or emotional behavior. Annex number one presents the variables, items and their corresponding sources.

3.3 Procedure

Data were collected using an online survey form (Google Forms) between January and April 2024. The students were assured of confidentiality in accordance with the provisions in force of the Regulation on the protection of individuals with regard to the processing of personal data and on the free movement of such data. Clicking onto the questionnaire indicated consent to participate.

4 Results

The collected data was processed using IBM SPSS Statistics version 29.0. The program allowed both descriptive data analysis (testing the internal consistency of all psychological variables and distribution) and inferential analysis (correlation analysis and comparative analysis by gender of respondents of F and t Tests for Independent Samples). In the first phase, the internal consistency of

psychological variables was analyzed. In Table 1, information for each variable is provided, with Cronbach's Alpha coefficient values being relatively high. This indicates good to excellent internal consistency for the analyzed variables, demonstrating that the measurement scales have suitable internal consistency for use in data analysis.

To assess the shape of the distribution we used the asymmetry coefficient and the vaulting or flattening coefficient—Skewness and Kurtosis (144). Skewness acceptable range for values is [−2, +2] and Kurtosis acceptable range for values is [−3, +3] (145, 146). Thus, the values of the two indicators in Table 1 indicates that the data is normally distributed. It can be found that in the case of the analyzed variables there are no extreme values that distort the mean (Figure 2).

For variable testing, the Pearson correlation analysis was used, which allowed testing the intensity of the connection between psychological variables (Figure 2).

In the light of the obtained results we can present the theoretical model proposed, validated by the values for each relationship between the concerned variables, as it can be seen in Figure 3.

In the following we will present the results corresponding to each advanced hypothesis, in order to assess their validation. Thus, hypothesis H.1 stated that there is a direct, positive and strong relationship, statistically significant between the social media pressure young people feel about ideal body image and the tendency to internalize standards of beauty and attractiveness of slim bodies ($r = 0.787$, $p < 0.001$). The materiality value allows us to validate the research hypothesis. A high level of pressure that young people feel about the ideal of body image leads to the internalization of this standard of beauty. Thus, exposure to images and videos of thin and attractive bodies is perceived as a compulsion to follow those benchmarks, a unique standard of beauty. Social media content dictates the process of forming an ideal body image. Targeting consists of indicating aspects related to appearance that need to be relevant, meaningful, showing the way forward to have a beautiful and attractive body. People who attach considerable importance to these messages will be more vulnerable to assimilate passively, without subjecting them to evaluation, critical thinking and without relating them to the particularities of their own body. The second hypothesis stated that a high level of tendency to internalize certain standards of beauty and attractiveness of thin bodies is associated with a negative body image. From this point of view our results helps us to identify a direct, positive, medium intensity, statistically significant relationship between the tendency to internalize standards of beauty and attractiveness of thin bodies and the negative perception of body shape ($r = 0.662$, $p < 0.001$). The hypothesis is

confirmed, which is confirmed by the materiality value. A high level of internalization of beauty and attractiveness standards promoted in social media causes a negative perception of body shape. The approach of internalizing a model of beauty and attractiveness changes the personal indicators of body analysis, thus creating new evaluation criteria, much more demanding, high demands appear in relation to one's own body. The comparison process is carried out between the image created by social media, which is embellished to match marketing strategies and the real body image, which does not benefit from improvement programs or filters. This leads, in most cases, to the formation of a negative perception of body shape. The third hypothesis stated that negative perception of body shape is associated with a high intensity of restrictive eating behavior. We found that there is a direct, positive, strong, and statistically significant relationship between negative body shape perception and intensity of restrictive eating behavior ($r = 0.755$, $p < 0.001$). The materiality value allows the initial assumption to be confirmed. A high level of negative perception of body shape leads to dietary restrictions or avoidance of certain categories of food. Reducing the level of dissatisfaction with one's own body is achieved by trying to control body weight. The eating disorder is installed as a repercussion of the need to restore an inner balance, by modifying aspects related to appearance. The trend is even more obvious in today's society, given the price placed on the manner in which a person looks, the manner in which the body is displayed illustrates a marketing strategy in itself, of promoting oneself. And, while in the past these tendencies were found among public figures or those associated with political, artistic, or beauty fields, today it is common and considerably more concerning, as personal value is increasingly associated with the ability to meet certain beauty standards, even at younger ages. The fourth hypothesis stated that a lower level of Body Appreciation is associated with a high level of intensity of Emotional Eating Behavior. We identify an inversely proportional relationship, of medium intensity, but statistically significant between the two variables ($r = -0.557$, $p < 0.001$). The hypothesis is confirmed, given the value of p. A high level of internalization of a standard of beauty and attractiveness associated with a slim body leads to negative body appraisals. The assimilation of an unrealistic model, given the fact that images and videos on social media promote thin bodies, worked at the gym, and in reality, there are a variety of types of silhouettes, favors the appearance of negative attitudes and thoughts in relation to one's own body. The inability to match a standard translates into self-discredit, contempt for one's appearance. The large discrepancy between the ideal image and the real image creates discomfort,

TABLE 1 Cronbach's Alpha coefficient values and descriptive statistics for the analyzed variables.

Variables	Cronbach's Alpha	Mean	Minim and maxim possible variables values	Std. Dev.	Skewness	Kurtosis
Socio-Media Pressure for a Thin Body Image (SMPTB)	0.910	16.666	4–20	4.460	−0.130	−1.242
Thin Body Image Standard Internalization (TBISI)	0.832	20.581	5–25	5.223	−0.286	−0.821
Body Appreciation (BA)	0.966	44.358	10–50	13.012	0.566	−0.999
Body Shape Perception (BSP)	0.960	36.915	16–96	9.496	−0.176	−1.118
Restrained Eating Behavior (REB)	0.954	26.259	10–50	7.120	0.279	−0.954
Emotional Eating Behavior (EEB)	0.974	42.795	13–65	11.108	0.410	−1.032
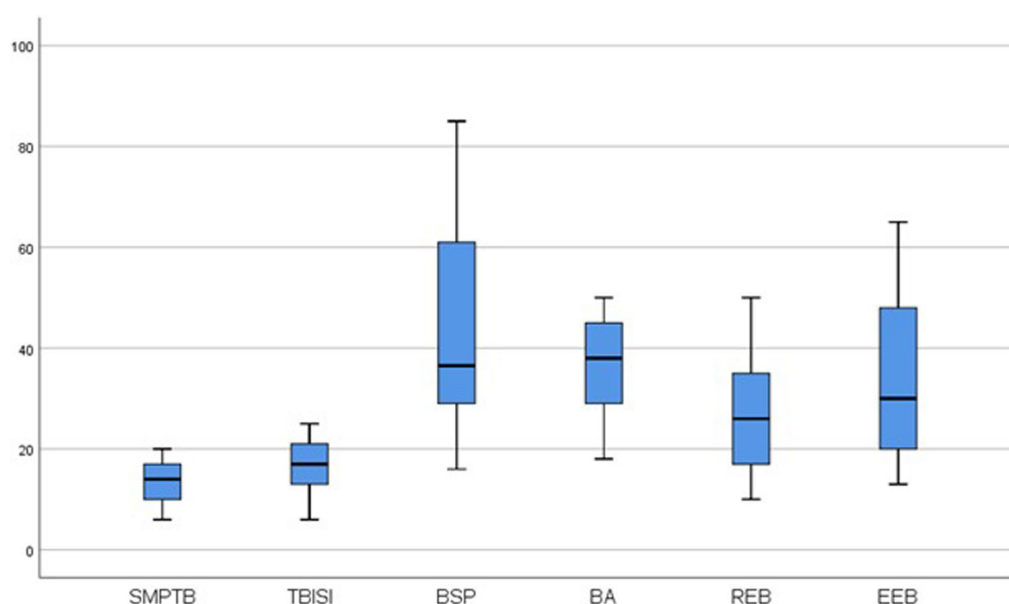
FIGURE 2
Box plot graphs related to the analyzed variables. SMPTB, socio-media pressure for a thin body image; TBISI, thin body image standard internalization; BSP, body shape perception; BA, body appreciation; REB, restrained eating behavior; EEB, emotional eating behavior.
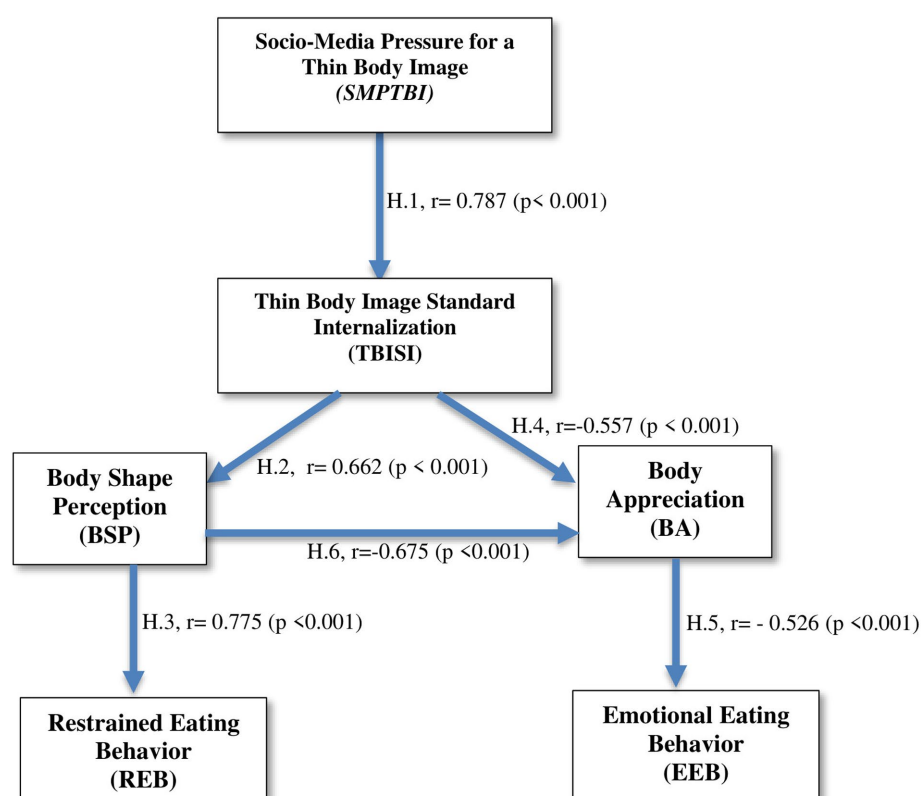
FIGURE 3
The empirical model validated by the relationship between considered variables.

tension that reflects the valence of body evaluation. The fifth hypothesis stated that a lower level of body appreciation is associated with a high level of intensity of emotional eating behavior. We identify an inversely proportional relationship, of medium intensity, statistically significant, between body appreciation and intensity of emotional eating behavior ($r = -0.526$, $p < 0.001$). The materiality

value indicates that the hypothesis is confirmed. A low level of body appreciation leads to the onset of emotional eating behavior. Negative emotional states associated with low body esteem are removed with the help of food. Eating is the way to lessen negative emotions. Food is a handy option, an easily available resource, which is consumed in order to compensate for the tension felt, anxiety, anger or anger in relation to the body. A positive body image means accepting and respecting the body, regardless of the changes it is going through, with less chance of changing perceptions and attitudes in relation to external factors. The sixth hypothesis stated that a lower level of body shape appreciation is associated with a lower level of body appreciation. From this respect, we found that there is an inverse proportional relationship of medium intensity between Body Shape Perception and Body Appreciation ($r = -0.675$, $p < 0.001$). A high level on the BSP scale indicates dissatisfaction with one's own body, and a high BA score is associated with the ability to judge one's appearance. Thus, a high level of bodily appreciation is associated with appropriate perceptions related to physical aspects. Materiality validation allows validation of the initial hypothesis. Negative assessment of body shape is associated with self-devaluation attitudes in relation to the body. People who do not have a good opinion of their own body also develop inappropriate attitudes towards it, of disgust and discredit. A positive body image means accepting and respecting the body, regardless of the changes it is going through, with less chance of changing perceptions and attitudes in relation to external factors (Table 2).

It can be found that there are statistically significant differences between women and men in all variables in the model, with women having a higher average for all variables analyzed except the score for BA where men have a higher average than women. Statistically significant differences in body appreciation between women and men are also reported in previous studies (147, 148). Women averaged SMPTB, TBISI, BSP, REB and EEB given the higher share of materials exhibited in the social media space for them, on the one hand, and the female population is more interested in topics associated with body shape, diets, areas of activity associated with beauty (149–151), compared to the male population. Thus, the pressure that women feel

to have a body that meets social media standards is greater than the pressure that men feel (121, 152), consequently the internalization of beauty standards associated with thin bodies is greater, which favors the development of body dissatisfaction and food restrictions or emotional eating. The strong tendency of women to internalize an image of slim bodies also occurs in societies where there are no weight problems, an aspect reported in a population study of women in Japan (153). Another aspect that highlights gender differences in internalizing a standard of beauty and attractiveness refers to the fact that women are more concerned about having a slim body, adhere to models of appearance like this, while men are concerned about body muscle (78). The content of the materials promoted in social media being customized in this sense, we find several images and videos with women whose bodies are thin and with men whose bodies are worked out at the gym.

5 Discussion

The images exposed in social media become benchmarks in terms of the standard of attractiveness and beauty, viewing images and videos showing thin bodies intensifies the comparison process, becoming more interested in the shape of their own body and manifesting a high degree of internalization of beauty standards (154–158). The pressure of social media is all the stronger because of the increasing role of social media platforms in people's lives, and because of unrealistic standards related to the appearance and promotion through them. Viewing photos or videos showing attractive bodies creates discomfort among both men and women. The discrepancy between the images in social media and the real image is large and frustration sets in, given that the images are generally valid, are not customized, do not take into account all physical typologies. Aspects that we also find in the study conducted by Pritchard and Button (159), whose results indicate that both women and men expressed feelings of dissatisfaction with weight, when they were exposed to images related to the ideal of appearance, and these were more intense than when they looked at

TABLE 2 Comparative analysis of psychological variables by respondent gender using independent samples t-test and Levene's test.

	Independent samples test								
	Levene's test for equality of variances		t-test for equality of means						
	F	p (Sig.)	t	df	p (Sig. 2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference	
								Lower	Upper
Socio-Media Pressure for a Thin Body Image (SMPTB)	4.733	0.030	−3.239	612	0.001	−1.27726	0.39431	−2.05163	−0.50290
Thin Body Image Standard Internalization (TBISI)	28.020	0.000	−2.534	612	0.012	−1.17415	0.46332	−2.08403	−0.26426
Body Shape Perception (BSP)	81.655	0.000	−7.540	612	0.000	−12.87091	1.70694	−16.22308	−9.51873
Body Appreciation (BA)	19.416	0.000	3.668	612	0.000	3.07195	0.83760	1.42704	4.71686
Restrained Eating Behavior (REB)	13.454	0.000	−5.339	612	0.000	−5.17430	0.96920	−7.07766	−3.27094
Emotional Eating Behavior (EEB)	32.783	0.000	−7.068	612	0.000	−9.76124	1.38109	−12.47348	−7.04899

body-positive imagery. Genetically, each person has a minimum of weight that they can reach, so there are greater or lesser chances of corresponding to a standard of beauty, but which cannot be fully controlled. In a study conducted on the population of women, it is observed that they cannot get to have an appearance associated with the ideal image, which implies a minimum in terms of weight, and at the same time maintain their health (160). There are data that confirm our perspective, the need to present images that support diversity, multiple forms of beauty. Some studies (161, 162) show that exposure to positive body images is associated with high levels of body satisfaction in both women and men. One of the explanations why we are witnessing a strong tendency, especially of adolescents and young people, to assimilate unrealistic standards of beauty and attractiveness, are movements such as thinspiration, or fitspiration. Although they aim to motivate followers to get a body similar to images on social media, they only increase the level of dissatisfaction with their own body (163–165). The intense tendency to internalize a standard of attractiveness and beauty associated with thin bodies is associated with a negative evaluation of body shape. The desire to have a slim body, the ideal facet of body image, compared to the real facet of body shape perception leads to increased levels of dissatisfaction. Especially in contemporary society, when more emphasis is placed on external facets at the expense of inner resources. Pictures uploaded to social networks are edited beforehand, which is explained by the internalization of beauty stereotypes and the need to conform to high standards (166). Internalizing an ideal of the slim body implies from the start an excessive preoccupation with body shape, weight (167), but also a greater attention paid to the manner in which the body is portrayed in the social-media space (168). And the exaggerated preoccupation with body shape is associated with the creation of a body ideal by constantly referring to the standards related to appearance in the social media space, which leads to body dissatisfaction The interest in displaying a body image that corresponds to the ideal of beauty and attractiveness of this historical stage is materialized in the act of processing and editing the photos that are displayed in the social media space (169, 170). A consistent component of self-presentation refers to the impression that young people create in the social media space, by selecting and posting photos that correspond to cultural and historical standards. In recent studies, young people worried about their body shape will edit the pictures they upload on social media platforms (171, 172), to display the ideal body facet, the one they want, the facet that is appreciated and validated by their community. Editing programs and filters are used to mask imperfections in appearance (163), in the case of those who are dissatisfied with body shape, and exposure to these edited photos leads to body dissatisfaction. A study of 144 teenage girls reports that simply examining edited photos posted on social media leads to a negative assessment of body shape (173). Students are more vulnerable to the need to make a good impression through the profile created on social media platforms. One possible explanation is that appearance is associated with popularity, young people who receive positive reviews for uploaded photos have a higher status in their community and better chances to integrate socially. Another explanation starts from the social representation of femininity, which is associated with the need to have a lean body, and the social representation of masculinity, which indicates the need to have a fit body (174, 175). The internalization of an ideal of

the slim and fit body is associated with high standards of appearance, but also with harsh criteria of comparison. Studies indicate an increased level of body dissatisfaction based on comparison with famous people in the media, popular on social networks, especially those associated with the field of beauty (44, 154, 176). The negative evaluation of body shape favors restrictive eating behaviors. People dissatisfied with physical aspects resort to dietary restrictions, prohibitions or diminishing the consumption of prohibited foods in order to improve their body shape, to reduce the discrepancy between the way they perceive themselves and the way they would like to look. Negative body shape perception is a strong predictor of dietary restrictions (76), for both women and men, the chances of dieting increase with age, which is explained by rising beauty standards (74). The approach of assessing body shape is doubled by that of forming attitudes in this sense. Thus, positive attitudes occur in relation to the image of thin bodies and negative attitudes in relation to fat bodies (177). And the valence of attitudes towards body shape directs the valence of attitudes towards food. Thoughts and beliefs about one's own body lead people to appreciate what categories of foods can be eaten, because they allow maintaining a body shape, and those that need to be eliminated because they prevent them from reaching the desired body shape. As a result, negative attitudes towards high-calorie foods and positive attitudes towards those with a low caloric index develop (178). Body shape is evaluated according to how close or far it moves away from the desired image, and this assessment influences attitudes towards food, which are divided into two categories, those allowed and those prohibited. The deformation of body shape accentuates the tendency to restrict eating behavior (66, 131, 153, 179). The strong internalization of certain standards of beauty and attractiveness of slim bodies is associated with a negative appreciation of the body. The stronger the desire to have thin bodies as a model, the stronger the tendency to depreciate one's own body. The approval of beauty models associated with thin bodies promoted on social media increases vulnerability when exposed to these images, as well as the degree of deformation of aspects (99). Creating an ideal of beauty that does not correspond to the personal physiological structure will lead to unrealistic body appraisals. Studies indicate that social beauty standards influence one's personal ideal of beauty, impacting one's level of self-esteem (180). Exposure to images and videos with attractive, beautiful bodies, usually of public figures, models or artists, causes the onset of negative emotions in relation to one's own appearance, shame, guilt, disgust. Comparing one's own body with the one in the images that appear in the social media space creates distress, especially since the standards are unrealistic, the materials are processed, the photos are filtered, they are edited. In this regard, a study conducted by Harvey et al. (181) highlight an increased sensitivity to disgust towards one's own body and food in people with eating disorders. Thus, it is observed that the improvement of problems associated with eating disorders is associated with lower score of disgust towards one's own body (181). The relationship between the presence of disgust and the adoption of dysfunctional eating behaviors can also be found in the more recent study (182), which presents data on 2,317 Italian participants, 57% of whom are women, aged 17–69 years. The data suggests that among the non-obese population, restrictive eating behaviors occur in those with a high body mass index, as a result of a high level of sensitivity to disgust,

which is associated with a high level of self-disgust. When people overestimate their weight, especially women, starting from the model of a slim body image, there is also a tendency to increase the level of disgust with appearance, as well as the need to find a quick solution to improve appearance. As evidenced by the study conducted by Anna Brytek-Matera et al. (183), people who had eating disorders were also those who had developed a dysfunctional image of what the ideal body illustrates, as well as a distorted perception of the body. In the same direction, another negative emotion expressed in relation to one's own body, shame, is associated with the presence of eating disorders, the anticipation of body shame representing a deficient way to diminish the chances of eating problems (184). Thus, we can specify that reducing the time spent on social media platforms can have contributions in terms of attitudes and emotions that are conceived in relation to appearance, with beneficial effects on food decisions and behaviors. Respect for one's own body leads to positive attitudes towards food, consequently also to adequate, healthy eating behaviors, a low level of body appreciation is associated with eating behavior disorders, body image deformity, the presence of anxiety and depression (81). Eating behavior disorders are specific to both adolescents and young adults (120, 185). The data is worrying, given that problems associated with eating behavior in childhood persist into adolescence and then continue into adulthood (186). At this historic stage an increasing number of children and adolescents are experiencing mental health problems (187–190) anxiety, depression, suicide attempts, eating disorders, obesity, alcohol addictions and prohibited substances. A possible explanation for this phenomenon is given by the pressure placed on the younger generation, the level of demands being higher and higher, which can be associated with perfectionism, the need to be perfect, to act perfectly (191). Another explanation is offered by exposure to social media content from a very young age, which on the one hand influences their benchmarks, including those related to appearance, guides their behaviors and decisions. Given the fact that images and videos of slim bodies are found on social media platforms, people who do not have a proper constitution or body shape that agrees with them, will face weight stigma, thus developing negative attitudes associated with weight, devaluation (192). A high level of body appreciation will allow counteracting ideal images of beauty on social media, by keeping a proper image of the body, respecting and valuing it (95, 96). People who value their bodies do not just describe themselves in positive terms, they value themselves for who they are, without having to relate to unrealistic standards made up by social media influencers. The results of our study indicate that exposure to social media content, more specifically, images and videos, of thin bodies, considered to be benchmarks in terms of the ideal of beauty and attractiveness, leads to the internalization of unrealistic standards regarding appearance, and the process of comparing these images of ideal bodies to the real image increases the level of dissatisfaction with one's own body. As well as the tendency to self-devaluation, aspects that will favor the adoption of unhealthy, restrictive or emotional eating behaviors. We consider that there is an interconnection relationship between the psychological variables mentioned above, which produces effects at psychological, behavioral and health level, and these have an impact on the level of public health. Regarding the psychological implications, we will refer to the consequences felt at an emotional, cognitive and motivational level. Thus, viewing photos and videos with attractive bodies will trigger the appearance of negative emotions, such as anger, shame towards one's own body, guilt, disgust, which can later turn into generalized anxiety or even depression (157). Regarding the cognitive plan, the negative evaluation of the body, consequently the formation of attitudes with the same valence, starts from the set of ways in which lean and fat bodies are perceived. A higher value is given to all elements related to what constitutes a slim body, and by comparison, a negative connotation to elements related to the representation of fat bodies. The onset of unhappy thoughts about one's body turns into behavioral intention, the desire to improve appearance, to have and display a body that is worthy of consideration, appreciated by others, because it corresponds to generally valid standards for this historical stage. And subsequently, this desire, which becomes a primary need, affects how food and food decisions are valued. Food categories will be categorized according to their ability to maintain, keep a slim body, for those who have a normal body mass index, or a body mass index below average, including people with eating disorders, such as bulimia, anorexia, or those that will lead to weight loss, especially for people who have an above-average body mass index, overweight people. In a study conducted on a group of 1,200 participants, which aimed to investigate attitudes towards food according to body mass index, we notice that there are no significant differences in the category of those who had a normal body mass index compared to overweight people (193). Thus, at the behavioral level, we are witnessing an increasing tendency of people to eat because of the need to get an ideal appearance, which is based on unrealistic standards, and not having a healthy body, associated with a healthy lifestyle. The increasing number of people with an eating disorder report public health-related problems involving mental health and physiological health. Between the two there are interdependence relationships, a low level of mental health will lead to physiological disorders, and the presence of diseases produces repercussions on the human psyche. A recent study (194) presents research data confirming increasing rates of the number of eating disorders among children and adolescents, with Covid-19 pandemic making a major contribution to this phenomenon.

6 Conclusion

The present research highlights the role that mass media plays in developing a positive body image and healthy body appreciation, as well as in setting benchmarks associated with beauty and attractiveness standards, social representations of eating behavior, perceptions of dietary restrictions, and diets. Although social media representatives, representatives of the fit-inspiration and thin-inspiration movement (7, 195) start from the premise that they will send messages with a role in improving body shape by correcting healthy eating behavior, the effects are not as expected, so most young people and young adults tend to evaluate themselves rather negatively, comparing (196, 197) unrealistic benchmark images with the real image, restrictions and food prohibitions emerge as a way to improve the perception of body shape, to diminish the level of dissatisfaction. The results of a population study of young women indicate that a one-week break from social media leads to improved aspects of body satisfaction and body image (198, 199). Thus, we highlight the impact that the

consumption of social media content has on the quality of body perceptions and body appreciation.

6.1 Research limits

The main limitation of the research refers to the fact that the group was predominantly made up of women, who are more open to participate in studies (200, 201) involving the disclosure of personal information (202), gender differences also imply the valence of information, men being less willing to share negative information (203) and more interested in aspects related to body shape, beauty (74). Misconceptions about eating behavior disorders, e.g., eating problems are associated with the need for attention, vanity, food choices are personal choices, and diets are part of life (204, 205). The men are more satisfied with their bodies than women, if we take into account adolescence, subsequently, with age, we witness an improvement in these aspects, only among women. Given that the participants in our study were young people and young adults, we identified a higher level of body appreciation among men than among women (85). A possible explanation could be related to the fact that mature women, with life experience, learn to focus on the qualities they have (206, 207), to the detriment of those that are exposed on social media, and men, because they are not so influenced by media content, keep the same criteria for evaluating appearance (121, 198). Thus, women are forced throughout their lives to manage the discrepancies between what social media promotes, the appearance they must have, and the one they own, the discrepancy between the ideal facet of the body and the real one. Another explanation refers to the fact that mature women have a lower level of self-objectivation, but also of sexual-objectivation, which is due to the social media content that is created for other age groups, thus, naturally decreases the pressure that mature women feel regarding appearance, the need to have a slim body to be considered valuable.

A possible limitation of the research is the specificity of the approached topic, in the sense that it limits the research area to a very specific issue for which specific variables are available. The researches that could optimally complement the results of the current approach could benefit from statistical analyses that explicitly validate the advanced model.

6.2 Future research directions

In order to capture the issues related to social-media pressure on the tendency to internalize standards of beauty and attractiveness of thin bodies, which leads to distortion of perception about body shape, affects the extent to which individuals appreciate their body, as well as repercussions on eating behavior, the study can be continued by expanding the group of participants, including people from other age groups, starting from childhood, but also drawing longitudinal research designs. Studies (120, 208) indicate that these aspects are evident from the first years of life, on the one hand, and their presence is then maintained, until adulthood, on the other hand. Given that the number of people suffering from anxiety and depression (2, 209, 210) is becoming greater, from

increasingly young ages, and the quality of mental and physical health suffers, and the effects are associated with the quality of eating behaviors, especially the emotional one, designing a research design to evaluate the moderating role of anxiety and depression on the relationship between the perception of body shape and the presence of eating behavior disorders will allow the collection of useful results in developing strategies aimed at developing a healthy self-image by inoculating appropriate models.

6.3 Practical implications

The present study can be a starting point for drawing up a national strategy necessary to attract an alarm signal regarding the influence that social media has on the design of beauty and attractiveness models, as well as on the quality of eating behaviors, implicitly on mental and physical health. The outcome of the research contributes to the existing specialized literature by presenting results that highlight some of the defining characteristics for this historical stage: the strong technology and its impact on the approach of building body shape perceptions, the tendency to internalize media content, which affects the manner of relating to oneself and influences the valence of attitudes and eating behaviors.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Review Committee of the Faculty of Psychology, Titu Maiorescu University from Bucharest. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

AZ: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. IG: Writing – review & editing, Funding acquisition, Investigation, Conceptualization, Writing – original draft.

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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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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fnut.2024.1474729/full#supplementary-material

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