

RESEARCH  
ARTICLE

# Visual and textual prompts as a nudge to promote the selection of healthy dairy products among adolescent and young adult students

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**Context:**

The dairy industry is strategically important in providing and promoting healthier foods among adolescents and young adults, a critical stage for consolidating long-term habits. Products such as yoghurt and cheese combine nutritional value, convenience and sensory appeal, making them suitable alternatives to ultra-processed foods commonly found in school cafeterias. In this context, nudge strategies—particularly the combination of visual and textual prompts—stand out as scalable and low-cost interventions to influence food choices.

**Aim:**

This study investigated whether exposure to an educational nudge could promote healthier food choices focused on dairy products.

**Methods:**

A total of 826 students (ages 13 to 23) were randomly assigned to an intervention group exposed to the nudge or to a control group. They then completed a structured questionnaire (including sociodemographic, behavioural and attitudinal questions) and performed three food choice tasks (sandwich, beverage and spreads) in a simulated school cafeteria environment. Data were analysed using logistic regression with marginal effects to estimate the intervention's impact on student choices.

**Major Findings:**

Nudging significantly increased the likelihood of choosing yoghurt over soda (+11%,  $P < 0.001$ ) and white cheese over processed meats (+19.9%,  $P < 0.001$ ), but had no effect on the choice of ricotta spread over ham spread ( $P = 0.617$ ). Among the attitudes, higher levels of health consciousness were associated with an increased likelihood of choosing yoghurt (+3.3%,  $P = 0.017$ ) and ricotta (+3.4%,  $P = 0.008$ ). Exposure to the nudge increased the likelihood of choosing two out of the three healthier dairy options assessed.

**Scientific or Industrial Implications:**

Dairy companies can incorporate nudging strategies—especially in school environments, digital media or packaging—to encourage healthier choices. Aligning product communication with health

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*goals may strengthen brand trust and appeal to health-conscious youth. Tailored strategies by product type are recommended given the varying effectiveness across dairy categories.*

**Keywords** Health marketing, Consumer behaviour, Adolescents, Product positioning, Nudging strategies.

## INTRODUCTION

Diet is a modifiable risk factor for malnutrition and non-communicable chronic diseases, such as type 2 diabetes, cardiovascular diseases and obesity (Li *et al.* 2023). In this context, making healthy food choices during adolescence (ages 10–19) and early adulthood (ages 19–23) (World Health Organization, 2024) is highly relevant, given that it is during these life stages that behaviours and habits are established and carried throughout life (Neufeld *et al.* 2022). Furthermore, adolescents undergo higher growth rates, which in turn require adequate nutritional intake and a balanced diet.

Thus, it is recommended that adolescents and young adults regularly consume nutritionally balanced foods, such as vegetables, fruits, whole grains, low-fat dairy products, lean meats, fish, eggs, nuts, seeds and soy-based products (USDA and HHS 2020). Nutrients, such as iron, calcium and vitamin D, are particularly important, while excessive consumption of foods rich in saturated fats, sugars, salt and energy drinks should be avoided (Nidirect Government Services 2024). More specifically, in the context of more complex food categories, such as dairy products, differentiated recommendations are observed, as milk, yoghurt and fresh cheeses are encouraged, while processed cheeses, ice creams, dairy desserts and sweetened dairy beverages are frequently discouraged (Siu and Drewnowski 2023).

Regarding common meal settings, adolescents and young adults often frequent school and university cafeterias, environments in which less healthy food choices tend to predominate (Ryan *et al.* 2020; Whatnall *et al.* 2021). Therefore, in these settings, the incorporation of healthy dairy products into cafeteria menus emerges as a viable strategy to improve dietary balance—especially in countries like Brazil, where dairy products are widely produced and well accepted by the population (Martinelli *et al.* 2022). However, the food choice process is modulated by factors, such as product attributes, the intrinsic individual characteristics of consumers and products, and the consumption environment shaped by its social norms (Hoffmann *et al.* 2020). The processing of these factors can be understood through the dual-process theory, which posits that decisions are shaped by two types of mental processes in the individual: one more automatic and heuristic and another more reflective and deliberative (dos Santos *et al.* 2020).

In these scenarios, ‘nudge’ strategies have gained prominence (Trafford and de la Hunty 2021) as means of

modifying the choice architecture, influencing behaviour in a predictable manner without restricting options or offering significant financial incentives (van der Laan and Orchołska 2022). In other words, the concept of nudge is based on the idea that, due to the high number of decisions individuals must make in their daily routines, many of these decisions are not made in a slow, rational and deliberative manner, but rather intuitively, and therefore can be influenced in subtle ways (Almeida *et al.* 2024). That said, a nudge can be understood as any element of the choice architecture that modifies people’s behaviour in a predictable way, without, however, enforcing this change through the prohibition of options or the provision of economic incentives (Thaler and Sunstein 2008). In this context, nudging strategies are understood as means of subtly influencing the choice architecture without excluding options or offering financial incentives. When used to influence choices, this concept is grounded in a framework of libertarian paternalism, which aims to integrate a paternalistic dimension (e.g. helping people make decisions that may benefit their lives) with a libertarian dimension (ensuring that freedom of choice is preserved and that no options are excluded or prohibited) (Almeida *et al.* 2024).

From a food science perspective, nudges have been explored as a way to promote healthier or more environmentally sustainable choices. The most common nudges include availability and placement interventions—the first type aims to increase the presence of healthy foods in a given setting, while the second seeks to alter the physical location of foods in that setting, for example, by placing healthy foods in prominent or easily accessible positions, such as at eye level or at the entrance. There are also descriptive nudges, which use symbols and texts to provide positive or negative information about foods (through deliberative processing) (Sapio and Vecchio 2024).

Nudges are mostly designed to facilitate decisions quickly and intuitively, with low cognitive effort. On the contrary, educational materials are usually designed to induce deeper reflection, presenting more detailed information aimed at stimulating reflective thinking, but requiring greater effort and cognitive processing (Garcia *et al.* 2010; Gomes-Fonseca *et al.* 2019; Mete *et al.* 2019; Mallick *et al.* 2024). To address this challenge, integrating nudge elements—such as visual and textual stimuli—into educational materials may simplify the decision-making process by activating automatic cognitive processes and reducing

cognitive load (Weijers *et al.* 2021). Additionally, combining these elements with reflective stimuli may foster greater engagement and behavioural change that benefits from deliberation (Hansen and Jespersen 2013).

Among adolescents and young adults, approaches with negative framing and general suggestions have helped reduce risky online behaviours (Masaki *et al.* 2020), just as personalised text message programs have been used to encourage physical activity (Cushing *et al.* 2021), and the 'dish of the day' strategy has been used to increase vegetable consumption among university students aged 17 to 19 years (Mistura *et al.* 2019). Zumthum and Stämpfli (2024) demonstrated the effectiveness of nudges in promoting healthier food choices, such as the preference for meatless meals. However, this type of approach involving food choices and healthy dairy products has not yet been widely tested among students, especially Brazilian adolescents and young adults aged between 13 and 23 years. Considering that younger individuals may respond well to visual stimuli (Niu *et al.* 2020; Benito-Ostolaza *et al.* 2021), exploring this strategy may provide new insights into how to positively influence eating habits.

Moreover, understanding the underlying factors related to food choice is also essential, as the effect of interventions may vary across different demographic groups. In studies focused on healthier food choices, consumer health consciousness is often assessed using attitudinal scales (Sob *et al.* 2023).

This study evaluated how an intervention using a nudge involving educational materials that combine visual and textual stimuli influences the process of choosing healthy dairy products among students from a federal institute in a simulated cafeteria environment.

## MATERIALS AND METHODS

### Conceptual framework

In Brazil, the expression 'white cheeses' is widely used to refer to fresh or minimally matured cheeses, characterised by lower fat and cholesterol content compared with yellow cheeses. The main examples include Minas Frescal cheese, ricotta, coalho, cottage and buffalo mozzarella (dos Santos *et al.* 2023). These cheeses are frequently recommended in healthy diets and for individuals focused on reducing fat intake, as they are important sources of calcium and phosphorus (Rozenberg *et al.* 2016). Similarly, yoghurts are also highly nutritious and associated with balanced diets (Fiore *et al.* 2022; Hasegawa and Bolling 2023). Thus, considering the potential effectiveness of the intervention, the following hypothesis was formulated:

**H1a:** *Exposure to educational material combining visual and textual stimuli about balanced diet increases the likelihood of choosing healthier dairy products.*

Additionally, it was evaluated whether individuals' attitudes related to their own health modulated choices in the cafeteria. For this, an adapted version of the Health Consciousness Scale (HCS) (Gould 1990) was used to test the hypothesis:

**H1b:** *Higher levels of health consciousness increase the likelihood of choosing options with healthy dairy products.*

The econometric theory underpinning discrete choice experiments postulates that explanatory variables capable of capturing individual heterogeneity help to explain variations in preferences and, consequently, in the food choice process. In this context, screen time can be considered a contemporary behavioural marker and also a relevant proxy for lifestyle patterns associated with less healthy food choices (Tambalis *et al.* 2020; Viola PC de *et al.* 2023; Rodríguez-Barniol *et al.* 2024). In this line, Riehm *et al.* (2019) recommend limiting recreational screen time to a maximum of 2–3 h per day for children and adolescents in order to promote a healthier lifestyle. Based on this evidence, the following hypothesis was tested:

**H1c:** *Spending more than 3 hours per day in recreational screen time increases the likelihood of choosing less healthy options.*

The frequency of physical activity practice has also been associated with healthier food choices (Manz *et al.* 2019; Tozo *et al.* 2023), and therefore, the following hypothesis was tested:

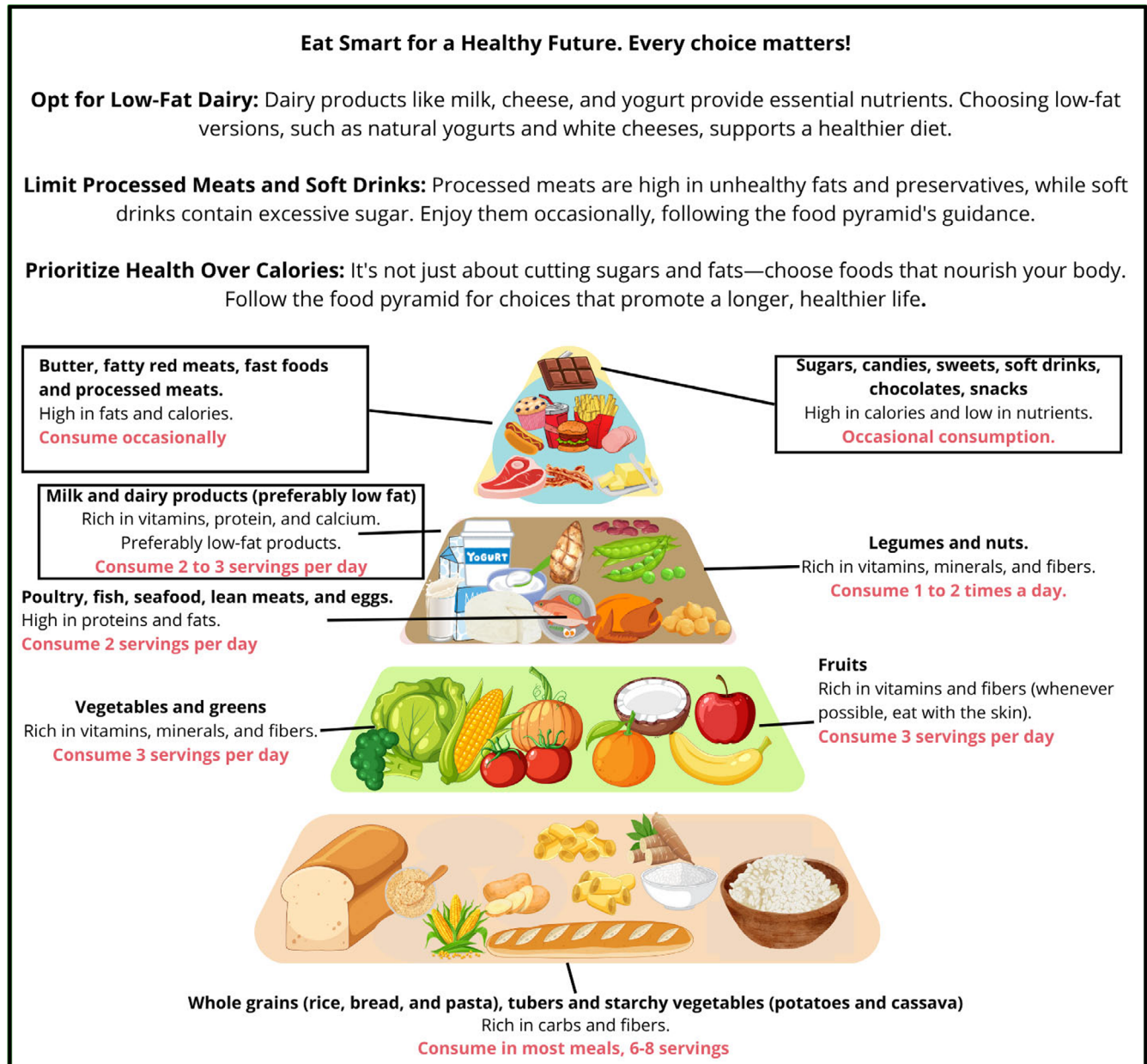
**H1d:** *Higher frequency of physical activity increases the likelihood of choosing healthier products.*

### Data collection

This study was conducted as a stated preference experiment involving choice tasks structured in a virtual questionnaire on the Compusense platform. Data collection took place from 22 April 2024 to 21 June 2024. The study was approved by the Ethics Committee of the Federal Institute of Education, Science, and Technology of Rio de Janeiro under protocol 82564924.7.0000.5268.

### Participants

Nine hundred and eighty-four students from federal institutes participated in the study, of which 826 were included in the analysis. Participants who did not fully complete the questionnaire were excluded from the analysis. Thus, the study included students ( $n = 826$ ) who were adolescents (aged between 13 and 19 years) and young adults (aged between 20 and 23 years). Participants were recruited through convenience sampling using the snowball sampling technique. The study was publicised through an invitation letter shared on social media and posted in printed form



**Figure 1** Structure of the nudge used in the experiment.

within the institutes, with QR codes provided to facilitate access to the online experiment.

### Experimental design

Participants were randomly assigned to either the control group or the intervention group, automatically allocated upon accessing the research questionnaire via QR code or link. In the control group, participants completed three choice tasks without any prior intervention. In the intervention group, participants were exposed to the educational material (Figure 1) emphasising balanced food choices before completing the choice tasks.

The content of the textual prompts was developed based on five essential characteristics for an effective stimulus: specification of the target behaviour, provision of detailed instructions, simplicity and intuitiveness of the task, delivery of the message close to the critical decision moment, and the use of polite language so as not to compromise the perception of freedom of choice (Zumthurm and Stämpfli 2024).

The combination of visual and textual stimuli was chosen due to the higher effectiveness of this format compared with isolated use (Zumthurm and Stämpfli 2024). Both stimuli were based on the second edition of the Dietary Guidelines

for the Brazilian Population, the Healthy Consumer Guide, and the Healthy Eating Guide for Adolescents (ANVISA 2008; Brasil 2014; de Castro and Brião 2020).

### Questionnaire structure

Initially, participants were presented with a brief introductory text about the school cafeteria with which they were familiar. Next, the intervention group was presented with the nudge and then the choice tasks (Figure 2), while the control group proceeded directly to the choice tasks. The choice task was preceded by the prompt: 'Imagine that you are in the school cafeteria choosing something to eat among the available options. In the next step of this study, you will see different snack options and indicate which one you would choose'. There was no time limit for inspecting the nudge, nor for completing the choice tasks.

The sandwich task included one option with processed meat (mortadella or cooked ham) and another with white cheese (Minas or cottage). In the beverage task, the options were plain or fruit-flavoured yoghurt and cola- or fruit-flavoured soda. In the spread task, participants could choose between ham pâté or ricotta pâté. The order of tasks and alternatives was randomised across participants. In all tasks, there was a 'I would not choose any of the options' choice, in order to simulate a real cafeteria environment where the individual may decide not to consume any of the available items. The options were selected based on foods commonly offered or brought from home to be consumed in school cafeterias, to ensure the relevance and familiarity of the context for participants. The evaluated foods were also chosen based on the Dietary Guidelines for the Brazilian Population (2nd edition), using NOVA classification criteria, which recommend replacing ultra-processed foods with less processed alternatives (Brasil 2014). This system classifies foods into four groups, according to the degree of processing and their potential impact on the risk of obesity and other diseases.

At the end of the choice tasks, participants answered sociodemographic and behavioural questions involving the average daily time spent using electronic devices for leisure (TV, cell phone, tablet) and physical activity practice (frequency). Regarding habits, they were asked about the consumption of cheese, processed meats, yoghurt, pâtés and soft drinks. Finally, they responded to attitudinal questions related to health consciousness, using a reduced version of the HCS in a 7-point Likert format, ranging from 'Strongly Disagree' to 'Strongly Agree'. The validity of the HCS was confirmed using Cronbach's Alpha (0.809) and the KMO test (0.88), demonstrating its reliability and suitability for the analysis.

### Data analysis

The three choice tasks (sandwich, beverage and spread) were analysed separately using the `glm()` function with binomial family and logit link function. The modelling was

based on the Random Utility Model (McFadden 1973), which assumes that individuals choose the alternative that provides the highest perceived utility, such that the utility  $U_{ij}$  of a choice alternative  $j$  for individual  $i$  can be expressed as:

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

where  $V_{ij}$  represents the systematic utility, that is, the part of the utility explained by observed variables, modelled as a linear combination for each individual, and  $\varepsilon_{ij}$  is the unobservable random term, assumed to be independently and identically distributed among individuals following a Gumbel distribution (type I extreme value).

In our coding, for each task we assumed two alternatives: the choice of the healthy dairy product versus the choice of the unhealthy option or the choice of 'I do not prefer either product'. Therefore, the choice was modelled using the binary form of the logit model, with the probability that individual  $i$  chooses the healthy alternative given by:

$$P(Y_i = 1) = \frac{1}{1 + \exp(-X_i\beta)}$$

where  $Y_i \in \{0,1\}$  represented the choice, assuming the value 1 for choosing the healthy dairy and 0 for the other options; while  $X_i$  is the vector of explanatory variables for individual  $i$ , for example sociodemographic characteristics (age and sex), behavioural (screen time and physical activity) and attitudinal (HCS).

Additionally, marginal effects were calculated to better visualise the variation in the probability of choosing a healthy alternative as a function of small changes in the explanatory variables, given that the coefficients from isolated glm logit models are not highly explanatory in terms of probability changes. The marginal effect of an explanatory variable on the probability that individual  $i$  chooses alternative  $j$  is given by the following expression:

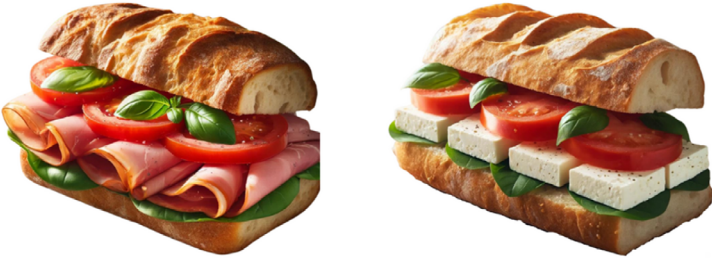
$$\frac{\partial P_{ij}}{\partial x_{mk}} = P_{ij}[1(j=m) - P_{im}]\beta_k$$

where  $P_{ij}$  is the probability that individual  $i$  chooses alternative  $j$ ;  $x_{mk}$  represents the value of the  $k$ -th explanatory variable associated with alternative  $m$ ;  $1(j=m)$  is an indicator function that equals 1 if  $j=m$ , and 0 otherwise;  $P_{im}$  is the probability that individual  $i$  chooses alternative  $m$ ; and  $\beta_k$  is the coefficient associated with the explanatory variable  $x_{mk}$ .

To improve parsimony and avoid overfitting, variable selection in the final model was performed using Akaike information criterion (AIC) and stepwise backward and forward procedures. The validity of the HCS was confirmed by Cronbach's alpha (0.809) and KMO (0.88), ensuring the reliability of the attitudinal measure.

The variables included in the LOGIT model, along with their definitions, are presented in Table 1.

**Which would you choose in the canteen?**



Ham Sandwich with tomato and basil  
or  
Mortadella Sandwich with tomato and basil

Minas Cheese Sandwich with tomato and basil  
or  
Cottage Sandwich with tomato and basil


**I choose the sandwich on the left (ham or mortadella)**

**I choose the sandwich on the right (Minas cheese or cottage)**

**I don't choose either of them**

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**Which would you choose in the canteen?**



Natural yogurt  
or  
Yogurt with fruit

Cola soft drink  
or  
Fruit-flavored soft drink


**I choose the yogurt (natural or fruit-flavored)**

**I choose the soft drink (cola-flavored or fruit-flavored)**

**I don't choose either of them**

---

**Which would you choose in the canteen?**



Ricotta spread

Ham spread

**I choose the ricotta spread**

**I choose the ham spread**

**I don't choose either of them**

Figure 2 Choice tasks used in this study.

**Table 1** Variables included in the multinomial logit model.

Variable	Definition
NUDGE	Binary. Whether the consumer received an educational nudge.
SEX	Binary. Sex of the participant.
AGE	Continuous. Age of the participant.
PHYSACT_NO	Binary*. Does not engage in physical activity.
PHYSACT_IRRE	Binary*. Engages in physical activity one to three times a week.
PHYSACT_ACTI	Binary*. Engages in physical activity more than three times a week.
SCREEN<3H	Binary*. Spends 3 h or less per day on electronic devices.
SCREEN>3H	Binary*. Spends more than 3 h per day on electronic devices.
CHEESE_NO	Binary*. Does not consume white cheese.
CHEESE_MON	Binary*. Consumes white cheese one to three times per month.
CHEESE_WEEK	Binary*. Consumes white cheese at least once a week.
PRO_MEAT_NO	Binary*. Does not consume processed meats.
PRO_MEAT_MON	Binary*. Consumes processed meats one to three times per month.
PRO_MEAT_WEEK	Binary*. Consumes processed meats at least once a week.
YOG_NO	Binary*. Does not consume yoghurt.
YOG_MON	Binary*. Consumes yoghurt one to three times per month.
YOG_WEEK	Binary*. Consumes yoghurt at least once a week.
SODA_NO	Binary*. Does not consume soda.
SODA_MON	Binary*. Consumes soda one to three times per month.
SODA_WEEK	Binary*. Consumes soda at least once a week.
HCS	Continuous. Average of Health Consciousness Scale.

\*1 = yes, 0 = no.

## RESULTS

Regarding the sociodemographic and consumption characteristics (Table 2), the sample consisted of 52.18% male and 47.82% female participants. In terms of age groups, 81.23% were adolescents aged 13 to 19 years, and 18.77% were young adults aged 20 to 23 years. Concerning physical activity, 34.26% of participants were classified as sedentary, 33.17% as irregularly active and 32.57% as physically active. The use of electronic devices for leisure revealed that 85.35% of participants spend more than 3 h per day using these devices, while 14.65% use them for <3 h.

**Table 2** Characteristics of the sample.

Variable	Percentage (%)
<b>Sex</b>	
Male	52.18
Female	47.82
<b>Age group</b>	
Adolescents (13–19)	81.23
Young Adults (20–23)	18.77
<b>Physical activity practice</b>	
Sedentary	34.26
Irregularly Active	33.17
Active	32.57
<b>Time spent on electronic devices for leisure</b>	
Less than 3 h	14.65
More than 3 h	85.35
<b>White cheese consumption</b>	
Does not consume	19.49
Monthly consumption	51.82
Weekly consumption	28.69
<b>Processed meat consumption</b>	
Does not consume	11.14
Monthly consumption	53.03
Weekly consumption	35.83
<b>Yoghurt consumption</b>	
Does not consume	24.33
Monthly consumption	48.31
Weekly consumption	27.36
<b>Soft drink consumption</b>	
Does not consume	16.59
Monthly consumption	39.83
Weekly consumption	43.58
<b>Spreads consumption</b>	
Does not consume	52.06
Monthly consumption	42.98
Weekly consumption	4.96

Concerning eating habits, 19.49% of participants do not consume white cheese, 51.82% consume it monthly, and 28.69% consume it weekly. In terms of processed meat consumption, 11.14% do not consume it, 53.03% consume it monthly, and 35.83% consume it weekly. For yoghurt, 24.33% of participants do not consume it, 48.31% consume it monthly, and 27.36% consume it weekly. Regarding soda consumption, 16.59% do not consume it, 39.83% consume it monthly, and 43.58% consume it weekly. Finally, spreads consumption revealed that 52.06% do not consume it, 42.98% consume it monthly, and 4.96% consume it weekly.

The results from the logit model (Table 3) indicated that the educational material had a significant positive impact on the choice of the white cheese sandwich ( $P < 0.001$ ). Exposure to the intervention was associated with a 19.9% higher probability of choosing the white cheese sandwich (Cottage

**Table 3** Estimates of the coefficients of the logit model and respective marginal effects.

Variables	Coefficients	SE	z value	Pr(> z )	Marginal effects (dy/dx)
<b>White cheese sandwich</b>					
INTERCEPT	-1.028	0.281	-3.646	< <b>0.001</b>	-
NUDGE	0.876	0.136	6.401	< <b>0.001</b>	0.199
AGE	0.031	0.008	3.833	< <b>0.001</b>	0.007
CHEESE_WEEK	0.660	0.192	3.434	< <b>0.001</b>	0.150
CHEESE_MON	0.340	0.163	2.089	<b>0.036</b>	0.077
PRO_MEAT_WEEK	-0.661	0.230	-2.867	<b>0.004</b>	-0.150
PRO_MEAT_MON	-0.488	0.210	-2.319	<b>0.020</b>	-0.111
SODA_WEEK	-0.293	0.141	-2.073	<b>0.038</b>	-0.066
<b>Yoghurt</b>					
INTERCEPT	-0.531	0.457	-1.162	0.245	-
NUDGE	0.534	0.149	3.571	< <b>0.001</b>	0.110
AGE	0.016	0.008	1.815	0.069	0.003
SCREEN>3H	-0.213	0.148	-1.434	0.151	-0.044
CHEESE_WEEK	-0.345	0.176	-1.954	<b>0.050</b>	-0.071
PRO_MEAT_WEEK	-0.847	0.261	-3.245	<b>0.001</b>	-0.175
PRO_MEAT_MON	-0.517	0.237	-2.175	<b>0.029</b>	-0.106
YOG_WEEK	1.213	0.220	5.510	< <b>0.001</b>	0.250
YOG_MON	0.732	0.178	4.102	< <b>0.001</b>	0.151
SODA_WEEK	-1.677	0.213	-7.838	< <b>0.001</b>	-0.346
SODA_MON	-0.881	0.204	-4.313	< <b>0.001</b>	-0.182
HCS	0.162	0.068	2.382	<b>0.017</b>	0.033
<b>Ricotta spread</b>					
INTERCEPT	-0.456	0.346	-1.317	0.187	-
NUDGE	<b>0.216</b>	<b>0.111</b>	<b>2.514</b>	<b>0.617</b>	<b>0.214</b>
AGE	0.018	0.008	2.114	<b>0.038</b>	0.004
PHYSACT_ACTI	0.218	0.146	1.488	0.136	0.052
CHEESE_WEEK	0.254	0.175	1.452	0.146	0.053
CHEESE_MON	0.223	0.147	1.51	0.131	0.061
PRO_MEAT_WEEK	-0.748	0.222	-3.363	< <b>0.001</b>	-0.114
PRO_MEAT_MON	-0.476	0.211	-2.26	<b>0.023</b>	-0.179
HCS	0.144	0.055	2.619	<b>0.008</b>	0.034

Values in bold indicate significance with a  $P$ -value <0.05.

or Minas cheese) over the processed meat sandwich or choosing no sandwich at all. Age also had a positive effect ( $P < 0.001$ ), suggesting that each additional year is associated with a 0.7% increase in the likelihood of choosing the white cheese sandwich. As expected, regular consumption of white cheese was a key predictor of this choice: participants who consumed it weekly had a 15% higher probability of choosing this option ( $P < 0.001$ ), while monthly consumers showed an increase of 7.7% ( $P = 0.036$ ).

On the contrary, regular consumption of processed meats significantly reduced the probability of choosing the white cheese sandwich. Weekly consumers experienced a 15% reduction ( $P = 0.004$ ), while monthly consumers exhibited a decrease of 11.1% ( $P = 0.020$ ). Weekly consumption of soft

drinks also had a negative impact ( $P = 0.038$ ), reducing the likelihood of choosing the white cheese sandwich by 6.6%.

In the beverage task (yoghurt versus soft drink), exposure to the educational material also showed a significant positive effect ( $P < 0.001$ ), increasing the probability of choosing yoghurt by 11% compared with the soft drink or choosing no product at all. Regular consumption of yoghurt was the primary determinant, with weekly consumers having a 25% higher probability of choosing yoghurt ( $P < 0.001$ ), while monthly consumers showed an increase of 15.1% ( $P < 0.001$ ). In contrast, weekly consumption of soft drinks had a strong negative effect ( $P < 0.001$ ), reducing the probability of choosing yoghurt by 34.6%, while monthly consumption reduced it by 18.2% ( $P < 0.001$ ). Unlike the

sandwich choice task, in the beverage choice task, the level of health consciousness (HCS) had a significant positive impact ( $P = 0.017$ ), indicating that a one-unit increase in the HCS, reflecting higher levels of health concern, was associated with a 3.3% increase in the probability of choosing yoghurt.

In the spread task (between ricotta and ham spread), exposure to the educational material did not have a significant effect ( $P = 0.617$ ), meaning that exposure to the educational material did not alter the probabilities of choosing either pâté. However, age positively influenced the choice of ricotta spread ( $P = 0.038$ ), with each additional year being associated with a 0.4% increase in the likelihood of choosing it. Regular consumption of processed meats had a significant negative impact: weekly consumers exhibited an 11.4% reduction ( $P < 0.001$ ), while monthly consumers showed a 17.9% reduction ( $P = 0.023$ ). Finally, health consciousness (HCS) was also a significant positive factor ( $P = 0.008$ ), with a one-unit increase in HCS raising the probability of choosing ricotta spread by 3.4%.

## DISCUSSION

In this study, the three categories of food involved in the choice tasks represent part of the dietary routine of Brazilian adolescents and young adults, both at home and in school settings (da Costa *et al.* 2022). Sandwiches, sweetened beverages and pâtés are examples of foods that commonly include ultra-processed components. For instance, sandwiches often contain processed meats, pâtés are usually industrially produced, and sweetened beverages typically refer to soft drinks. According to the Brazilian Dietary Guidelines (2nd edition), which adopts the NOVA classification system, ultra-processed foods should be consumed only occasionally, due to their negative impact on health when consumed excessively (Brasil 2014; Menezes *et al.* 2023). However, the frequent consumption of these foods is common among adolescents and is concerning, as they are easily accessible, widely accepted in school environments and often replace foods that provide important nutrients (Mesas *et al.* 2022; Gombi-Vaca *et al.* 2024).

The present study is unprecedented in evaluating how Brazilian students can choose healthier options involving dairy products in canteens when exposed to simple and low-cost stimuli, such as the combination of visual and textual educational prompts structured as a 'nudge'. Evaluating this type of intervention is necessary because the consolidation of eating habits is a complex and important process for the individual, and being able to promote healthier choices in a simple and inexpensive way is in line with the recommendations of the main national health agencies. Furthermore, by exploring the adaptation of an online choice experiment simultaneously evaluating different categories of dairy products and attitudinal and sociodemographic aspects, this study

showed for the first time in the Brazilian context the possibility of conducting research with a large number of students, offering concrete support for the development of interventions applicable to public policies and strategies of the productive sector aimed at promoting healthier food choices involving the reduction of ultra-processed food consumption.

Various strategies can be used to reduce the consumption of ultra-processed foods, such as encouraging substitution in recipes and presentations or opting for healthier choices. Dairy products represent a diverse category of foods associated with a healthy diet, particularly those that are more whole and without excessive added sugar and salt. When related to processed meats, substitution with dairy products can reduce health risks and lower mortality rates (Kießwetter *et al.* 2024). Additionally, dairy products present great potential for the inclusion of functional ingredients, making them even more suitable for a healthy diet (Ali *et al.* 2022). Despite Brazil being a major dairy producer, per capita consumption of dairy products remains relatively low, contributing to insufficient calcium intake, especially among adolescents (Guiné *et al.* 2020).

Regarding beverages consumed with meals, reducing the frequency of soft drink consumption among adolescents has been linked to positive impacts on physical and mental health, minimising aggressive behaviours, depressive symptoms and obesity risk (Mrug *et al.* 2021; Gketsios *et al.* 2023). Neves *et al.* (2022) demonstrated that daily soft drink consumption is associated with an increased risk of obesity and hypertension, particularly among boys, which may lead to chronic complications, such as cardiovascular diseases, in adulthood.

The growing need to promote dietary improvements among children, adolescents and young adults has driven research into strategies that encourage healthier eating habits. In this context, the exploration of nudges as a strategy to influence food choices has gained prominence due to its simplicity and low cost of implementation (Harbers *et al.* 2020), by manipulating choice architecture to make healthier decisions more likely (Lindstrom *et al.* 2022). In this study, the use of simple textual prompts associated with the pictorial structure of the food pyramid altered the probability of food choices, increasing the likelihood of choosing a healthier food option. Recent studies show that nudges, such as the strategic placement of foods and the use of prompts, have yielded positive results in real-world consumption contexts, especially in environments where unhealthy foods are widely available (Gillebaart *et al.* 2023).

Yi *et al.* (2022) demonstrated that combining different types of nudges, such as manipulating food proximity and using visual and textual prompts, can significantly increase the choice of healthier food options in collective consumption environments. Zumthurn and Stämpfli (2024) also

observed that the combination of visual and textual prompts was more effective than using prompts in isolation. Similarly, the present study revealed that the combination of visual and textual prompts had different effects across the various categories evaluated in the choice tasks. For example, it increased the likelihood of choosing sandwiches with white cheese compared with sandwiches with processed meats, increased the probability of selecting yoghurt, but did not affect the choice of pâtés. This finding suggests a link between intervention and consumer preferences, which aligns with observations that increasing the number of healthy options can favour the selection of such products.

Broers *et al.* (2019) support this observation by demonstrating that specific nudges, such as the use of 'chef's suggestion' for a salsify soup dish, can increase the choice of a particular product without altering the preference for the broader category (in this case, soups). This phenomenon may be related to the individual nature of products within a category. In our study, despite yoghurt, white cheese and ricotta spread all being dairy products, their sensory differences or individual consumer perceptions may have influenced choice decisions differently.

These findings reinforce the importance of designing nudges that take into account the specific characteristics of each product, even when they belong to the same food category. For example, the absence of a nudge effect in the task involving spreads may be related to the participants' lower familiarity with this food category, given that among the evaluated categories (sandwiches and beverages), spreads were reported as the least consumed by the students. This condition may have reduced participants' engagement with this specific task. The limiting role of familiarity in the effectiveness of nudges was reported by Broers *et al.* (2019), who highlighted that nudges tend to be more effective when applied to familiar foods. Furthermore, Zumthurm and Stämpfli (2024) show that the effects of nudges can vary significantly across different food categories, even when the intervention is the same, leading to the interpretation that the effectiveness of the stimulus also depends on the type of product and the consumption context.

This supports the idea that the effectiveness of nudges is directly related to the alignment between the stimuli provided and the desired behaviours, and that just as the variety of food options can undermine healthy choices when most products are focused on palatability rather than nutritional quality, offering different healthy products increases the likelihood of making a healthier choice (Pechey and Marteau 2018; Langfield *et al.* 2023). Yi *et al.* (2022) emphasise that the effectiveness of nudges depends on their ability to capture consumers' attention at the moment of choice and facilitate automatic decision-making.

However, the effectiveness of nudges seems to be closely linked to additional factors beyond preferences, such as

consumers' attention and their pre-existing health goals. A recent study examining the relationship between nudges and attention indicated that consumers with clearly established healthy eating goals were more likely to respond positively to a nudge. In contrast, those with weak or nonexistent goals were not affected (Gillebaart *et al.* 2023). The HCS is a reliable way to understand how auxiliary dimensions, such as health concerns, may relate to the choice of healthier food versions. The results of this study show that the level of health consciousness (measured via HCS) has a significant impact on food choice, with individuals with higher health consciousness being more likely to choose the yoghurt and ricotta spread. This finding suggests that nudges may work better when aligned with individuals' personal goals, supporting the importance of personalised and multifaceted interventions to maximise outcomes.

Another study conducted in sports canteens in the Netherlands showed that while nudges can increase the sales of healthy foods, the impact of these interventions tends to be moderate in environments where adherence to interventions is inconsistent, such as in football club canteens. Factors, such as staff motivation and consistency in implementing the intervention, were identified as crucial influences for the success of nudges in promoting healthier food choices (Van Rookhuijzen and De Vet 2021).

In an Italian university cafeteria, nudges to promote healthier choices also demonstrated varying effectiveness with different foods. In the specific case of Italy, nudges had different effects depending on the meal course, showing a positive impact on the second course, side dish and bread, but not significantly affecting choices related to the first course or fruit (Cesareo *et al.* 2022).

A systematic review conducted by Marcano-Olivier *et al.* (2020) analysed 25 studies that investigated the use of nudges to promote healthier food choices in school cafeterias, primarily focusing on children and adolescents aged 6 to 18 years. The authors highlighted that simple interventions, such as changing the order in which foods are presented or making healthier options more accessible and visually appealing, have shown positive results in increasing the selection and consumption of fruits and vegetables. In particular, the study suggested that techniques like repositioning healthy foods at the front of buffets and using attractive labels for these items can significantly influence the food choices of children and adolescents.

The results reveal that nudges were especially effective when applied to younger age groups, where eating habits are still developing, allowing for greater flexibility in food choices. Marcano-Olivier *et al.* (2020) also reported that children between 6 and 12 years old tended to respond more immediately to visual and environmental stimuli, such as food arrangement, while adolescents between 13 and 18 years, though more resistant to behavioural changes, could also be influenced by appropriate interventions,

especially when these involved appealing elements associated with their food choices. In this context, consistent with the findings of this study, textual prompts containing statements proved effective in promoting some healthier options.

An example of a nudge that was not effective is the study conducted by dos Santos *et al.* (2018), which investigated the use of the ‘dish of the day’ strategy for a plant-based option to stimulate its consumption among Danish adolescents. The study found no significant difference in choices between the control and intervention groups for both age groups, using only the simple approach of labelling the dish as the dish of the day.

In this context, approaches combining different strategies and interventions based on social norms have also been successfully tested, particularly in increasing vegetable purchases and reducing the consumption of unhealthy foods, such as soft drinks. However, the effects of these interventions vary depending on the social context and consumers’ predisposition to adopt healthier behaviours (Schlinkert *et al.* 2020).

From a market perspective, the dairy industry can employ low-complexity nudge strategies, such as negotiating the placement of healthier dairy products in prominent positions at points of sale, along with the use of posters, flyers and display stands featuring pro-consumption prompts in product selection areas (e.g. gondolas) and checkout zones (Chapman *et al.* 2023). Furthermore, although the use of artificial intelligence—particularly machine learning algorithms that analyse purchasing profiles and facial recognition technologies—has been criticised for enabling ‘dark nudges’ that may encourage less healthy choices (Brooks *et al.* 2022), these technologies can also be ethically employed by manufacturers in their marketing campaigns to identify consumers’ sociodemographic and behavioural profiles. Such characteristics appear to be latent in product choice and, given the association between individual traits and the effectiveness of applied stimuli, may guide the personalisation of nudges.

## LIMITATIONS

The main limitations of this study should be acknowledged. Firstly, the use of convenience sampling through the snowball technique may have introduced selection bias, limiting the representativeness of the sample. However, given the school environment in which the study was conducted, the homogeneity of the sample may have minimised the impact of nonprobability sampling. This study assessed the immediate impact of the intervention without investigating its long-term effects on participants’ food choices. The absence of follow-up to evaluate the sustainability of behavioural changes limits the conclusions regarding the ongoing effectiveness of the intervention with educational material using textual and visual prompts. Future studies that track participants over time would be important to

determine whether the changes in food choices persist after the intervention.

Additionally, the experiment was conducted online, which limited control over the environment in which participants completed the questionnaire. While the use of virtual surveys facilitated data collection, it is possible that external factors, such as distractions or variations in the physical setting, may have influenced the reported food choices, differing from what could be observed in a controlled environment, such as a real school canteen. Moreover, this study did not assess the role of social norms in influencing food choices, which constitutes an important limitation. Social norms, such as peer behaviour or shared beliefs about healthy eating within a group, have been shown to impact decision-making processes significantly. By not accounting for these factors, the study may have overlooked a key driver of food choice behaviour, particularly in environments like school canteens, where peer influence can play a crucial role. Future research incorporating measures of social norms could provide a more comprehensive understanding of how nudges interact with social dynamics to shape food choices.

Another limitation is the absence of information regarding participants’ dietary restrictions, such as vegetarianism or lactose intolerance. However, considering the sample size ( $n = 826$ ), it is likely that these effects were diluted in the overall results. Future research may deepen the analysis by incorporating these variables to explore interactions with specific dietary subgroups.

Other potential limitation of this study is the relatively lower familiarity of participants with the spread category, which may have reduced engagement or influenced choice behaviour in the corresponding task. However, it is important to note that nearly half of the participants still reported consuming these products, which supports their inclusion in the experiment despite their lower overall frequency compared with other food categories.

Despite these limitations, this study is pioneering in its approach and offers several advantages. It is one of the few studies to examine the combined effect of visual and textual prompts as nudges in promoting healthier food choices among adolescents and young adults within the context of the school canteen. Also, the study employed a large sample size, enhancing the robustness of the findings despite the nonprobabilistic sampling method. Lastly, the study’s focus on a vulnerable age group—adolescents and young adults—makes the findings particularly relevant for designing interventions aimed at fostering long-term healthy eating habits. These strengths underscore the innovative nature of the research and highlight its potential contribution to public health strategies.

## CONCLUSION

The use of the ‘nudge’ strategy combining textual prompts about a balanced diet and visual elements with a food

pyramid was effective in promoting the choice of healthy dairy products among adolescent and young adult students in school cafeteria settings, especially for products, such as fresh white cheeses and yoghurts, in contrast to processed meats and soft drinks, respectively. The choice of ricotta spread over ham spread was not affected by exposure to the nudge. In addition to nudge exposure, underlying factors, such as the individual's age positively modulated the choice, albeit subtly, with increases in age associated with a higher probability of choosing the sandwich with white cheese and the ricotta spread. Behavioural factors such as the frequency of physical activity and screen time did not modulate choice, whereas attitudinal factors such as health consciousness did, with higher levels of health concern being associated with greater probabilities of choosing yoghurt and ricotta pâté. Among consumption habits, different patterns were found, notably the habit of consuming processed meats and soft drinks, such that individuals who consume processed meats and soft drinks more frequently were less likely to choose the healthy dairy options. In summary, the results found in this study reinforce the relevance of nudges as supportive tools in policies aimed at promoting balanced eating among young individuals, favouring the substitution of less healthy options with healthier dairy-based alternatives.

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## AUTHOR CONTRIBUTIONS

**Elson Rogerio Tavares Filho:** Conceptualization; methodology; data curation; investigation; formal analysis; software; writing – original draft; visualization. **Ramon Silva:** Conceptualization; methodology; data curation; investigation. **Tatiana C Pimentel:** Writing – original draft; validation. **Maria Terezinha S L Neta:** Conceptualization; methodology; data curation; investigation; formal analysis. **Elane S Prudencio:** Conceptualization; supervision; investigation; methodology. **Neila S P S Richards:** Methodology; software; investigation. **Eliane T Marsico:** Conceptualization; supervision; project administration; investigation; methodology. **Mônica Q Freitas:** Conceptualization; resources;

supervision; project administration; funding acquisition; investigation. **Erick A Esmerino:** Conceptualization; resources; supervision; project administration; investigation; methodology. **Adriano Gomes Cruz:** Conceptualization; resources; supervision; project administration; funding acquisition; investigation; methodology.

## CONFLICT OF INTEREST STATEMENT

None.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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