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Food Neophobia among Brazilian Children: Prevalence and Questionnaire Score Development

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Abstract: This study aims to create and validate a score to classify food neophobia among Brazilian children (from the ages of 4 to 11 years) and investigate the prevalence of food neophobia. This descriptive cross-sectional population-based study is conducted following three steps: (i) the application of an instrument to identify food neophobia in Brazilian children by their caregivers; (ii) the instrument's score definition; and (iii) the evaluation and characterization of the national prevalence of food neophobia among Brazilian children. The scores were categorized into three levels, based on the tertial approximation: low, moderate, and high. The study had 1112 participants, and the prevalence of high food neophobia was observed in 33.4% of Brazilian children. The prevalence of food neophobia allowed us to identify this behavior in Brazilian children and better understand the population. Boys were significantly more neophobic than girls. The general neophobia score and domains did not significantly differ between Brazilian regions and age groups. It is worrying that food neophobia did not decrease with advancing age. The score for the complete instrument with 25 items, or the 3 domains, makes its use practical. It can be used to assess neophobia with more caution, evaluate the most neophobic children, and enable more targeted professional interventions to promote healthier and sustainable eating habits.

Keywords: food neophobia; prevalence; child; caregiver perception

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1. Introduction

Diet and nutrition are essential throughout life to promote and maintain good health, protecting the individual from diseases as well as sustainable consumption being an essential condition for sustainable development [1,2]. Environmental degradation and its negative impacts on human health are significant concerns for populations and governments, generated mainly by industrialization, which caused over-consumption. These negative impacts and ecological imbalances alert consumers about the consequences of their actions, showing the need for changing their food consumption patterns [3–5]. Since birth, there is a concern about the child's food habits because diets evolve, being influenced by many factors, such as food availability, culture, globalization, and individual preferences [2]. Additionally, food habits influence the main aspects of environmental

sustainability since they may be linked to food waste, ingestion of industrialized or natural and local food, among others [4,6]. Children's food rejection can be caused by multiple cognitive and social/environmental factors and has been referred to as food neophobia, an unwillingness, reluctance to eat and/or avoidance of novel foods [7–9].

There are several factors influencing food neophobia, such as heredity [10,11], genes and prenatal experiences [7], parental influence on the child's eating habits [12,13], parental pressure for the child to eat [12], lack of encouragement, and/or parental affectivity during meals [12], childhood anxiety [8,12], feelings and emotions [12], sensory preferences [7], and an innate preference for sweet and savory flavors [12]. Food neophobia affects overall diet quality, resulting in less food variety and unhealthy food choices by children, which can lead to unsustainable consumption [4,6,12–15]. In addition, a higher food neophobia level is associated with lower fruit and vegetable intake [16], as well as eggs [17], fish [18], chicken, and cheese intake [14], most of them from local production. Neophobic children like to eat more sweets and snacks frequently [18], which are considered unhealthy and unsustainable food.

Although neophobia is a well-defined condition, the prevalence of food neophobia among children diverges in studies, mainly due to the application of different instruments and scales [15]. A recent systematic review to identify the factors associated with food neophobia in children showed a prevalence ranging from 12.8 to 100% in studies from 2000 to 2019 and levels of neophobia classified as medium and high [15].

Furthermore, there are few instruments to assess it, especially those validated for the specific sample to be studied [19]. Pliner and Hobden created the first instrument to assess food neophobia in humans in 1992 [9]. Based on a review of 13 designs to assess food neophobia and the willingness to try unfamiliar foods, Damsbo-Svendsen et al. developed a food neophobia test tool. They found it necessary due to the time that had elapsed since the creation of the first instrument to assess food neophobia, and the perception and availability of new food change with the world changes [20]. To measure student attitudes toward new fruits and vegetables, the fruit and vegetable neophobia instrument was developed by Hollar et al. as part of an effort to evaluate farm to school programs [21].

In Brazil, there is an instrument by Previato and Behrens to assess food neophobia in adults [22] developed from the first instrument to assess food neophobia in humans [9]. However, there are no population-based studies for Brazilian children assessing the condition, as there was no specific instrument [23]. De Almeida et al. [23] recently developed and validated a specific instrument for Brazilian children to be answered by the child's caregivers. The instrument evaluates food neophobia in general and neophobia for fruits and vegetables, but still, it does not allow the classification of neophobia due to the lack of scores. Therefore, this study aims to create and validate a score to classify neophobia among Brazilian children and investigate and classify the prevalence of food neophobia among Brazilian children from the ages of 4 to 11 years. Potentially, the knowledge on the children's food neophobia (general and for fruits and vegetables) may allow specific public policies to promote healthier and sustainable eating habits.

2. Materials and Methods

This descriptive cross-sectional population-based study was conducted following three steps: (i) the application of the instrument to identify food neophobia in Brazilian children by their caregivers [23]; (ii) the instrument's score definition; and (iii) the evaluation and characterization of the national prevalence of food neophobia in Brazilian children from the ages of 4 to 11 years old. The study was approved by the Health Sciences Ethics Committee, University of Brasilia, No. 4.407.816, and followed the guidelines established by the Declaration of Helsinki.

2.1. Participants

Brazil is divided into five regions (North, Northeast, South, Southeast, and Midwest). In the score validation, we opted to follow Hair et al. [24] that states that the validation

process requires 20 respondents per item. In this sense, the minimum sample size was estimated at 500 participants to validate a questionnaire composed of 25 items. The expected minimum sample was at least 100 parents or caregivers of children aged between 4 and 11 years, proportionally divided by the 5 Brazilian regions. As this is a nationally external validation study, the probabilistic sample of the study was based on the "Pesquisa Nacional por Amostra de Domicílios Contínua" [25] about general characteristics of households and residents. According to the Brazilian regions, the research indicates the resident population by age in Brazil, with an adequacy greater than or equal to 70% of the sample distribution.

The sample included caregivers of Brazilian children who agreed to participate in the research and knew about the child's eating behavior, that is, who often follow their meals. Such condition for participation in the research was previously informed in the consent form. Incomplete questionnaires were excluded.

Caregivers were instructed that only one of them should respond to the instrument. After filling it in, they would notify the other caregiver about having already participated in the research to avoid duplicating the child's answer. Caregivers with more than one child in the age group of the research could fill in the questionnaire once for each child, as many times as necessary according to the number of children. A convenience non-probability sampling method was used by snowball recruitment.

2.2. Instruments and Application

The previously validated instrument [23] was available through the online platform Google forms®, and widely disseminated on social networks (such as Facebook®,Ttwitter®, and Instagram®), messaging apps, and by email. The data collection phase spanned a year, from November 2020 to November 2021.

The first part of the instrument collected data on sociodemographic aspects: resident Brazilian region, place of residence (urban area, rural area, indigenous area, and quilombola area), caregiver's profile (age, sex, degree of kinship, marital status, and educational level) and, finally, child's profile (nationality, gender, age, diagnoses, and family income). The instrument was self-administered and answered by caregivers. It was divided into three domains: neophobia in general, neophobia for fruits, and neophobia for vegetables. Each domain had a similar number of items, allowing a better analysis of the scores of the entire instrument (25 items) and each domain [23]. Such items distribution allowed the assessment of the neophobic traits of each domain separately or through the complete instrument.

2.3. Scores Construction

For the construction of the scores, the answers were coded to assume values from 0 to 4 for each question. Thus, the general domain score (with 9 items) ranges from 0 to 36; the score for the fruit domain (8 items) ranges from 0 to 32; the score for the vegetable domain (8 items) ranges from 0 to 32; and the total score (25 items) ranges from 0 to 100. By summing the values of each answer, researchers defined the general neophobia score and each domain score. Therefore, the higher the values, the greater the food neophobia of the evaluated children. The scores were categorized into three levels: low, moderate, and high. This categorization was based on the scores calculated for this study sample. Based on the tertial approximation, the cutoff points were considered to separate the sample into three groups of similar sizes.

2.4. Statistical Analysis

For analysis purposes, the ages were grouped into two groups (4–7 and 8–11), and gender (male and female) was analyzed separately. The age groups were defined based on a study [26] that stated the cutoff point of neophobia intervention in children should start before eight y/o since younger children are more likely to change their food behavior than older ones. The instrument's internal consistency and domains were verified using Cronbach's alpha coefficient. Values greater than or equal to 0.7 indicate good consistency [27]. Neophobia scores were described as mean and standard deviation for quantitative variables

and as frequencies and percentages for categorical variables. These scores were compared among Brazil regions using a one-way analysis of variance followed by Tukey's post hoc test. The comparison of neophobia scores according to gender and age was performed using Student's *t*-test. The neophobia scores were categorized into three levels (low, medium, and high neophobia). The Pearson's Chi-square test was used to compare the neophobia levels among regions, gender, and age. Student's *t*-test was used to verify for each age if there was a statistically significant difference between the scores of general neophobia and the other domains according to gender. All tests considered two-tailed hypotheses and a significance level of 5%. For the analysis, the data were extracted from the Google Forms® platform in a Google® spreadsheet and analyzed using the SPSS® 20.0 software, using descriptive statistics and presented as mean and standard deviation, frequencies, and percentages.

3. Results

The final sample was composed of 1112 participants after excluding 5 subjects that refused to sign the consent form; 2 children were not Brazilian and 97 responses referred to children outside the age range of this study (response rate 91.5%). The national distribution of the participants among the Brazilian regions is in Table 1. Participants were mostly from the Southeast region (n = 425; 38.2%) and the Northeast (n = 299; 26.9%). They were followed by the South (n = 172; 15.5%), the Midwest (n = 116; 10.4%), and the North (n = 100; 9%). The sample did not diverge more than 30% from the distribution of children aged 4 to 11 years in the large regions of Brazil. Furthermore, the sample distribution according to sex and age was also balanced (Table 2). Therefore, it is a representative sample of children aged 4 to 11 years in Brazil.

Table 1. Sample distribution according to the Brazilian regions, with a maximum divergence of up to 30%. Brazil, 2020–2021. n = 1112.

	PNAD IBGE 2019 *	Sample		Divergence
	%	Frequency (n)	%	
Midwest	8.1%	116	10.4%	29.1%
Northeast	29.6%	299	26.9%	−9.2%
North	10.9%	100	9.0%	−17.3%
Southeast	38.3%	425	38.2%	−0.2%
South	13.1%	172	15.5%	17.9%
BRAZIL	100%	1112	100%	—

* Estimate the population of children aged 4 to 11 years, considering a uniform age distribution within each age group.

Caregivers were mostly mothers (n = 956; 86%). Fathers (n = 75; 6.7%) and others (family members, babysitters, etc.) (n = 81; 7.3%) were represented in a smaller proportion. Most were female (n = 1028; 92.4%); married or in a stable relationship (n = 904; 81.3%); lived in urban areas (n = 1072; 96.4%); and the mean age was 39.01 ± 7.2. Most caregivers had a first university degree (n = 381; 34.3%); the others had Master's through postdoctoral studies (n = 289; 25.9%), complete higher education (n = 219; 19.7%), complete high school (n = 191; 17.2%), and no study beyond complete elementary school (n = 32; 2.9%).

The children's gender was balanced (558 girls, 50.2%; 554 boys, 49.8%), with a mean age of 7.2 ± 2.304. A total of 889 of the children (79.9%) had no medically diagnosed conditions, but 223 (20.1%) presented one or more medical diagnoses (such as food allergies/intolerance; eating disorders; autism spectrum disorder; Down's syndrome; and others) (Table 2).

The complete instrument with all 25 items showed excellent internal consistency, $\alpha \geq 0.9$. The same pattern was also seen in its three domains separately (Table 3).

Table 2. Sociodemographic data and children profile (n = 1112). Brazil, 2020–2021.

Categories		Sample	
		n	%
Gender	Male	554	49.8%
	Female	558	50.2%
Age	4 years old	177	15.9%
	5 years old	169	15.2%
	6 years old	144	12.9%
	7 years old	102	9.2%
	8 years old	136	12.2%
	9 years old	155	13.9%
	10 years old	127	11.4%
	11 years old	102	9.2%
Diagnoses [a]	No disease	889	79.9%
	Food allergies	60	5.4%
	Food intolerance	53	4.76%
	Eating disorders [b]	6	0.53%
	Autism spectrum disorder	33	2.96%
	Down's syndrome	23	2.06%
	Attention deficit hyperactivity Disorder/Anxiety and/or Oppositional defiant disorder	20	1.79%
	Other diagnoses [c]	56	5.03%

[a] Children may have one or more diagnoses. [b] Anorexia/bulimia/pediatric eating disorder. [c] Such as insect allergies, respiratory diseases, heart disease, and others.

Table 3. Internal consistency of the neophobia instrument in each domain (n = 1112).

	Number of Items	Cronbach's Alpha (IC 95%)
General Neophobia	9	0.935 (0.930; 0.941)
Fruit Neophobia	8	0.927 (0.920; 0.933)
Vegetables Neophobia	8	0.947 (0.942; 0.951)
TOTAL	25	0.973 (0.971; 0.975)

From the sample results, the categorization of food neophobia using the total number of items of the instrument was defined by 3 scores: (i) up to 40 points: low neophobia (n = 333; 39.9%); (ii) from 41 to 65 points: moderate neophobia (n = 408; 36.7%); and (iii) 66 points or more: high neophobia (n = 371; 33.4%), as shown in Table 4. Based on the total score of the instrument for the classification of food neophobia and the distribution in the sample, the score for each domain was created using the same criteria. Therefore, for each domain, a low food neophobia is up to 13 points, moderate food neophobia is between 14 and 21 points, and a high neophobia is from 22 points. The cutoff point and the scores for each of the three domains allow the use of the instrument in parts or as a whole. A prevalence of high food neophobia was observed in 33.4% of Brazilian children.

Table 4. Distribution of the sample according to neophobia classification. Brazil, 2020–2021.

	Food Neophobia		
	Low	Moderate	High
Domain of neophobia in general *	301 (27.1%)	354 (31.8%)	457 (41.1%)
Domain of neophobia for fruits *	451 (40.6%)	325 (29.2%)	336 (30.2%)
Domain of neophobia for vegetables *	296 (26.6%)	352 (31.7%)	464 (41.7%)
TOTAL INSTRUMENT SCORE **	333 (39.9%)	408 (36.7%)	371 (33.4%)

* Domain score cutoff points: low—up to 13 points; moderate—from 14 to 21 points; high—22 points or more.
** Total score cutoff points: low—up to 40 points; moderate—from 41 to 65 points; high—66 points or more.

There was no significant difference for the general neophobia score and its domains for the Brazilian regions ($p > 0.05$). The Student's *t*-test was performed to verify of there was a difference between genders for each of the domains. In general, boys were more neophobic in all domains that assessed food neophobia, $p < 0.05$. In the domain of neophobia in general and neophobia for fruits, boys were significantly more neophobic, $p < 0.05$. In the vegetable domain, there was no difference in neophobia between genders. The ages were disaggregated and analyzed to see if there was a difference between them. The Student's *t*-test was performed, and there were no differences between ages. They remained grouped for the analyses. There was no difference for the age groups when analyzing neophobia in domains and general. The first group (4 to 7 y/o) and the second (8 to 11 y/o) presented similar neophobia. It was also verified whether the differences in the values of general neophobia and other domains according to sex were significant at each age. Among 4–7 y/o children, there were not significant differences between sexes in all domains and the general instrument. Among 8 y/o children in the vegetable domain, girls had the highest mean ($p = 0.045$). Considering the 9 y/o group, boys had a higher mean for the domain of fruits ($p = 0.010$), vegetables ($p = 0.033$) and the general instrument ($p = 0.023$) than girls. In the 10 y/o group, boys also presented a higher mean for the general domain ($p = 0.049$) and fruit domain than girls ($p = 0.031$). Finally, in the 11 y/o group, boys had higher scores for the general domain ($p = 0.015$), the fruit domain ($p = 0.015$), the vegetable domain ($p = 0.008$), and for the general instrument ($p = 0.009$) than girls.

The classification of neophobia into low, moderate and high was evaluated for each Brazilian region, gender, and age group (Table 5). There was no significant difference between the Brazilian regions, and there was no statistically significant difference between the age groups. Therefore, in our sample, older children present similar results for neophobia as younger children.

Table 5. The distribution of the neophobia classification by Brazilian region, gender, and age group (n = 1112). Brazil, 2020–2021.

	Brazilian Regions						Gender			Age Group		
	Midwest	**Northeast**	**North**	**Southeast**	**South**	***p*** *	**Girls**	**Boys**	***p*** *	**4–7 y**	**8–11 y**	***p*** *
Tertial Approximation	**116**	**299**	**100**	**425**	**172**		**558**	**554**		**592**	**520**	
General neophobia												
Low (≤13)	28 (24.1%)	64 (21.4%)	29 (29.0%)	129 (30.4%)	51 (29.7%)	0.060	161 (28.9%)	140 (25.3%)	0.029	156 (26.4%)	145 (27.9%)	0.146
Moderate (14 to 21)	36 (31.1%)	114 (38.1%)	36 (36.0%)	116 (27.2%)	51 (29.6%)		189 (33.8%)	164 (29.6%)		203 (34.2%)	150 (28.8%)	
High (≥22)	52 (44.8%)	121 (40.5%)	35 (35.0%)	180 (42.4%)	70 (40.7%)		208 (37.3%)	250 (45.1%)		233 (39.4%)	225 (43.3%)	
Fruit neophobia												
Low (≤13)	43 (37.1%)	118 (39.5%)	48 (48.0%)	168 (39.5%)	74 (43.0%)	0.567	239 (42.8%)	212 (38.3%)	0.004	247 (41.7%)	204 (39.2%)	0.109
Moderate (14 to 21)	32 (27.6%)	98 (32.7%)	26 (26.0%)	122 (28.7%)	47 (27.3%)		176 (31.6%)	149 (26.9%)		182 (30.8%)	143 (27.5%)	
High (≥22)	41 (35.3%)	83 (27.8%)	26 (26.0%)	135 (31.8%)	51 (29.7%)		143 (25.6%)	193 (34.8%)		163 (27.5%)	173 (33.3%)	
Vegetable Neophobia												
Low (≤13)	28 (24.1%)	73 (24.4%)	34 (34.0%)	114 (26.8%)	47 (27.3%)	0.563	152 (27.2%)	144 (26.0%)	0.707	158 (26.7%)	138 (26.5%)	0.629
Moderate (14 to 21)	32 (27.6%)	96 (32.1%)	28 (28.0%)	143 (33.7%)	53 (30.8%)		180 (32.3%)	172 (31.0%)		194 (32.8%)	158 (30.4%)	
High (≥22)	56 (48.3%)	130 (43.5%)	38 (38.0%)	168 (39.5%)	72 (41.9%)		226 (40.5%)	238 (43.0%)		240 (40.5%)	224 (43.1%)	
TOTAL												
Low (up to 40)	31 (26.7%)	80 (26.8%)	36 (36.0%)	132 (31.1%)	54 (31.4%)	0.407	165 (29.6%)	168 (30.3%)	0.006	182 (30.7%)	151 (29.0%)	0.101
Moderate (41 to 65)	39 (33.6%)	125 (41.8%)	35 (35.0%)	148 (34.8%)	61 (35.5%)		228 (40.8%)	180 (32.5%)		229 (38.7%)	179 (34.5%)	
High (66 or more)	46 (39.7%)	94 (31.4%)	29 (29.0%)	145 (34.1%)	57 (33.1%)		165 (29.6%)	206 (37.2%)		181 (30.6%)	190 (36.5%)	

* Pearson's Chi-square test.

There was no significant difference in the neophobia classification in general and the domains among the large regions of Brazil ($p > 0.05$). Boys' neophobia was significantly

higher ($p < 0.05$), except for the vegetable domain. There was no significant difference in neophobia with age.

4. Discussion

Improving diet quality while reducing environmental impact and achieving sustainable development outcomes is critical from a global perspective [28]. However, the first step to achieve it is stimulating healthier diets, generally lower in environmental impact [28]. Healthier diets present various barriers, such as physical and economic access to food, eating habits, lack of knowledge, lack of encouragement to consume healthy foods, practicality in preparation and access that can promote the rejection of unfamiliar and healthy foods. Therefore, it is important to promote healthier eating habits since birth and have knowledge about children's food neophobia to improve diet quality throughout life.

Although there are some available instruments to evaluate food neophobia, the most appropriate questionnaire is considered to be the one developed in the country and written in the language where the study will take place [22] due to ethnic, social, and cultural aspects. In Brazil, the instrument to identify food neophobia in children by their caregivers was developed and validated in 2020 [23]. However, this is the first study in Brazil to estimate nationwide the prevalence of food neophobia among children aged 4 to 11 years old and to classify the neophobia into scores. The knowledge on the prevalence and classification of neophobia may be promising to stimulate specific public policies that promote healthier and sustainable eating habits.

The development of the score was similar to that from other studies, including categorizing neophobia into low, moderate, and high. Scores were based on the studied population to simplify its identification and classification [15,17,29,30]. Our study showed that only 27% (n = 301) of the children were classified with low neophobia and most (n = 458; 42%) as high neophobia. These data are essential to identify food neophobia among children and search for an adequate approach to face neophobia. Additionally, the score created to groups of fruits and vegetables is important to identify the main groups that affect food neophobia, allowing more targeted interventions based on children's food rejections and preferences. The score categorization is vital since the lack of diversity in food caused by food neophobia restricts the intake of nutrients necessary for health maintenance and promotion. When food restriction is high, it can affect health and the children's cognitive and motor abilities [12].

Our results showed that boys were more neophobic than girls ($p < 0.05$), from 9 to 11 years old. Similar results were observed in Swedish children (n = 722) and showed that nine-year-old boys had higher food neophobia scores than nine-year-old girls [31]. Results in Italy, in a study developed in 2014 with 560 children aged 6 to 9 years, showed that boys were more neophobic than girls in all age groups [26]. Another study with Swedish children (n = 57) aged 2 to 17 y/o showed that boys presented higher scores to food neophobia than girls [32]. In Pennsylvania (U.S.A.), a study with children aged 4–5 y/o (n = 82) showed that boys had higher levels of neophobia than girls [33]. One potential explanation for the gender difference is that boys have less healthful food preferences than girls at almost every age [34] and the environmental effects, such as personality [35]. In London, researchers observed that boys scored higher than girls in food neophobia in children aged 4–5 years old (n = 109), but this difference was not statistically significant [14]. Additionally, other studies found no differences in neophobia scores among gender [17,36]. Therefore, more studies need to be conducted to assess the difference in neophobia between the gender and determining factors. Additionally, we asked about different health conditions but did not exclude the participants since we aimed to target Brazilian children in general. We used the information about health conditions to verify if the participants presented differences depending on different health conditions and it was not significantly different ($p > 0.05$).

There was no difference in neophobia between age groups in our study as occurred in other studies [37,38]. However, different from our results, some studies showed that the older children had lower scores on the neophobia scales than the younger children [26,31,32].

A review about food neophobia mentioned that neophobia tends to decrease with age throughout childhood, adolescence, and adulthood. A general decrease happens until early adulthood and stabilizes in adulthood [39]. A potential reason is that children have different experiences as they grow up, learn about new foods, and interact more with their environment. Therefore, fewer things and foods are new for older children [39]. Factors, such as pressure to eat, parental practices, and social influences, can affect the magnitude and duration of the expression of food neophobia [39], children's innate preference for sweet and savory flavors, parents' lack of encouragement and/or affection at mealtime [12].

The COVID-19 pandemic forced social isolation in Brazil and affected foods habits [40]. Overworking and inadequate divisions of chores at home threatened the quality of food consumption [41], changed dietary behaviors, increased food intake, and unhealthy food choices during the pandemic, affecting everyone [42]. A study with Brazilian adults (n = 312) about their perceptions of food habits in this period shows that they changed their food consumption and purchases. They reduced their shopping trips to markets and started using delivery services and shopping platforms [40]. During the social isolation, a study [43] with Brazilian children (n = 589) between 2 y/o and 9y/o and adolescents (n = 720) also identified changes in eating habits. The overload of household tasks and homework during the pandemic may have influenced them to eat more practical food and snacks, as shown by the replacement of large meals with unhealthy and unsustainable foods [43]. The changes in children's routines also showed effects. A study [44] conducted during the COVID-19 pandemic with Brazilian children (n = 530) 6y/o to 11y/o shows that 52.3% (n = 277) presented anxiety, 35.7% (n = 189) agitation, 41.9% (n = 222) irritability, 23.2% (n = 123) fear, and 22.1% (n = 117) presented discouragement, which influenced sleep and appetite patterns [44].

In our sample, there was no difference among age, probably because of parental practices, since the analysis of personal food consumption in Brazil [45] showed that the food consumption of Brazilians is composed of food with reduced nutrient content and high-calorie content. The traditional Brazilian diet, such as rice and beans, has decreased and lost its space among the preferences of Brazilians. The consumption of fruits and vegetables has decreased in recent years. It is below the recommended level, leading to a reduction in fiber consumption, which may indicate a decline in the quality of the diet. In addition, there was an increase in sugar consumption [45], which may indicate that this nutritional transition with dietary changes affects the variety and consumption of the new and different foods that children are exposed.

A study [46] about the perceptions and choices of Brazilian children as consumers of food products shows a similar tendency. Children aged 8–10 years (n = 71) were students in public schools where energy-dense and nutrient-poor food consumption was severely restricted. However, these foods were shopped independently in local minimarts near the children's homes and schools and influenced their parents' purchases at the supermarket. The study revealed children's active role in influencing family food choices and making independent food purchases [46]. A study that performed translation and validation of the food neophobia scale (FNS) in Brazilian adults found that most respondents were classified as neutral (72.5%) and 17.5% were neophobic [22]. However, this study [22] used a limited number of participants (n = 40), and there are no studies with a sufficient sample evaluating the national prevalence of neophobia (general and in the fruit and vegetable domain) in Brazil.

A systematic review investigated the relationship between picky eating and/or food neophobia with childhood weight status in studies performed from 1990 to 2015. Among the 41 studies included in the systematic review, the prevalence of food neophobia varied between 40% and 60% [47]. In Pennsylvania (U.S.A.), 7-year-old girls (n = 192) participated in a study investigating food neophobia. It was observed that 33% (n = 63) of the girls had medium-to-high neophobia scores [8], different from our study in which 71% of the girls (n = 397) presented moderate and high neophobia scores (Table 5). Among 2–5 y/o Australian children (n = 371), overall, they were moderately food neophobic [48], which is

different from our study in which 32% (n = 353) were considered moderate neophobic. In southern Poland, a study with children aged 2.5–7 y/o (n = 325) showed that the prevalence of a high level of food neophobia was found in 10.8% of the children (differently from our results that showed 41% of the sample with high neophobia). A medium level of neophobia was found in 76.9% of the children [17]. In Jeddah, Saudi Arabia, the study [37] included 216 children aged 3 to 7 years old. Most children, 98.6%, had moderate-to-severe food neophobia [37], higher than our findings that showed a 73% moderate/high food neophobia among our sample.

In Brazil, the most common, even for elites, are part-time schools, studying one period and staying at home the other. Only recently has the offer of full-time teaching increased, mainly in private schools. Full-time also meets a demand related to the daily interests of the practical life of families, as guardians who work all day end up delegating the child's care to the school [49]. In 2020, 29.5% of public basic education schools had full-time enrollment in Brazil [50]. The National School Feeding Program (PNAE) is considered one of the most comprehensive and long-lasting programs in school feeding globally. It includes students in the public school system and involves food and nutrition education actions for all students. However, it is sometimes performed with low frequency [51]. These two aspects of the reality in Brazil can explain our findings of 73% of moderate/high food neophobia [52]. Additionally, foods consumed in Brazil are more varied than those in the rest of the world [52]. Several feelings can influence food neophobia, such as fear, anxiety, pleasure, fun, access to food, food preferences [7,53], and sensory preferences [12], and must be considered.

Children with food neophobia tend to eat fewer fruits and vegetables [21,39,54], and sometimes the greater the neophobia, the lower the consumption of these foods [16,18,55,56]. The recommendation of the World Health Organization is to consume at least 400 g of fruits and vegetables a day. Adequate consumption of these foods is essential for children's growth and development. It prevents different diseases and promotes quality of life. The little variability of fruits and vegetables and their low consumption can contribute to a nutrient-poor diet, generating nutritional deficiencies [2,57]. Therefore, it is crucial to identify the neophobia considering fruit and vegetable groups to allow effective interventions since food neophobia affects overall diet quality and children's health [8,12,14,15].

Despite the continental dimension of Brazil with different characteristics among the five main regions, there was no significant difference in the neophobia score (and in the domain scores) between the Brazilian regions ($p > 0.05$). A study in Brazil analyzed the characteristics of food consumption outside the home. The individuals evaluated (n = 34,003) were older than 10 years. It was observed that the food groups with the highest prevalence of out-of-home consumption were fried and baked snacks, pizza, soft drinks, and sandwiches, and in all regions of Brazil, in urban and rural areas, in both genders and all age groups evaluated [58]. The expansion of social policies reduced social inequalities and allowed the country to grow inclusively [59]. There were no nationwide studies evaluating neophobia in Brazil that could enable us to discuss and compare our results.

It is important to emphasize that the data collection occurred during the COVID-19 pandemic and began months after it started in Brazil. The pandemic influenced Brazil's families' income and employment, with severe impacts for many people [60,61]. This very unusual moment in the world affected food access and food behavior, but it is now our reality since we are still facing the pandemic. Additionally, the COVID-19 pandemic influenced children's food priorities and eating behaviors since they experience moderate-to-severe anxiety symptoms due to increased hunger, emotional over-eating, and food and satiety responsiveness, which decreased the enjoyment of food [62]. Thus, food neophobia may also be modified, and it is important to evaluate it during the COVID-19 pandemic and after it. Moreover, as it is impossible to predict the end of the pandemic, more studies should be conducted during this period.

Our study has strengths, such as the representativeness of all Brazilian regions and the large sample that makes us confident about the adequate power of the study design.

Our study's potential limitations should be mentioned. The type of sampling used in this study may lead to selection bias, as the sample was obtained non-randomly. This bias was assumed because access to the study population on a national level was challenging due to the COVID-19 pandemic situation and the existing mobility restrictions during data collection. The pandemic period might influence food neophobia in children, but we cannot measure this or compare it with pre-pandemic data, as that data does not exist. The pandemic (with greater parental involvement and increased behavioral problems caused by prolonged confinement) may have influenced the children's diet, as they spent more time at home and probably with a different routine than usual. However, because parents or caregivers were working remotely during the period, it may have helped them to have a closer perception of reality about their children's diet, as they began to monitor almost all meals.

The high response rates from female caregivers could lead to a gender bias. However, more female respondents are expected since females tend to be more concerned about health and children's health and participate more often in the studies [63–67]. The research was disseminated on social networks and in universities across Brazil, which may be reflected in the sample since most caregivers had completed a first university degree.

5. Conclusions

This study developed a score definition to classify food neophobia in Brazilian children that was considered satisfactory. Even in the case of such an extensive and populous country, there was no difference among the country regions, which allows it to be used widely, correctly classifying all children in the age group for which the instrument is intended. The score for the complete instrument with 25 items, or the 3 domains, makes it of practical use and can be used to assess neophobia with more caution, evaluating in which domain the child is more neophobic. It will enable more targeted professional interventions and bring satisfactory results in the future.

The prevalence of food neophobia allowed us to identify this behavior in Brazilian children and better understand the population. It is worrying that there was no difference between ages in food neophobia, indicating that it did not tend to decrease with advancing age, which could cause nutritional damage for children. Boys being more neophobic than girls is a point of attention that deserves to be further studied to explain the reasons. Increasing knowledge about food neophobia is the first step toward reducing it, stimulating debates on the theme to construct public policies in this direction.

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