

Consumption of Ultra-Processed by Children with Obesity: Validation of the NOVA Score in the Context of PHC

Consumo de Ultraprocessados por Crianças com Obesidade: Validação do Escore NOVA no Contexto da APS
Consumo de Ultraprocesados por Niños con Obesidad: Validación de la Puntuación NOVA en el Contexto de la APS

RESUMO

Objetivo: Descrever o escore NOVA de consumo de alimentos ultraprocessados (AUP) e avaliar seu desempenho em refletir sua participação na dieta de crianças com obesidade atendidas na Atenção Primária à Saúde (APS). **Métodos:** Estudo de validação com dados de um ensaio clínico randomizado realizado em Betim (MG), com 167 crianças com obesidade atendidas na APS. Foram aplicados um recordatório alimentar de 24 horas e um questionário de consumo de AUP. O escore NOVA foi calculado para estimar o consumo de AUP, e sua associação com a participação desses alimentos na dieta foi analisada por regressão linear e pelo índice de concordância Pabak. **Resultados:** Observou-se associação linear significativa entre o escore NOVA e a participação de AUP no valor calórico total da dieta, com concordância substancial entre as classificações. **Conclusão:** O escore NOVA é uma ferramenta prática e válida para qualificar a vigilância alimentar e apoiar o manejo da obesidade infantil.

DESCRIPTORES: Obesidade infantil; Alimentos ultraprocessados; Consumo alimentar; Atenção primária à saúde; Estudo de validação.

ABSTRACT

Objective: To describe the NOVA score for ultra-processed food (UPF) consumption and to evaluate its performance in reflecting their participation in the diet of children with obesity receiving care in Primary Health Care (PHC). **Methods:** Validation study using data from a randomized clinical trial conducted in Betim (MG), involving 167 children with obesity receiving care in PHC. A 24-hour dietary recall and a UPF consumption questionnaire were applied. The NOVA score was calculated to estimate UPF consumption, and its association with the participation of these foods in the diet was analyzed using linear regression and the Pabak agreement index. **Results:** A significant linear association was observed between the NOVA score and the participation of UPF in the total caloric value of the diet, with substantial agreement between classifications. **Conclusion:** The NOVA score is a practical and valid tool to enhance food surveillance and support the management of childhood obesity.

DESCRIPTORS: Childhood obesity; Ultra-processed foods; food consumption; Primary health care; Validation study.

RESUMEN

Objetivo: Describir el escore NOVA de consumo de alimentos ultraprocesados (AUP) y evaluar su desempeño en reflejar su participación en la dieta de niños con obesidad atendidos en la Atención Primaria de Salud (APS). **Métodos:** Estudio de validación con datos de ensayo clínico aleatorizado realizado en Betim (MG), con 167 niños con obesidad atendidos en APS. Se aplicaron un recordatorio alimentario de 24 horas y un cuestionario de consumo de AUP. El consumo de AUP y su asociación con la participación de estos alimentos en la dieta se estimaron mediante regresión lineal e índice de concordancia Pabak. **Resultados:** Se observó una asociación lineal significativa entre el escore NOVA y la participación de AUP en el valor calórico total de la dieta, con concordancia sustancial entre las clasificaciones. **Conclusión:** El escore NOVA es una herramienta práctica y válida para fortalecer la vigilancia alimentaria y apoyar el manejo de la obesidad infantil.

DESCRIPTORES: Obesidad infantil; Alimentos ultraprocesados; Consumo alimentario; Atención Primaria de Salud; Estudio de validación.

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INTRODUCTION

Childhood obesity is a global public health problem, with a consistent increase in its prevalence across different countries and regions of the world⁽¹⁾. In Brazil, between 1974–1975 and 2008–2009, the prevalence of childhood obesity increased by 13.7% among boys and 10% among girls⁽²⁾. Children with obesity are more likely to remain overweight throughout their lives, which increases the risk of chronic diseases in adulthood⁽³⁾.

In this context, the role of ultra-processed food consumption stands out as one of the key determinants of this condition. These products have been associated with poorer overall diet quality, characterized by

higher energy density and lower fiber and micronutrient content, in addition to contributing to the replacement of fresh or minimally processed foods⁽⁴⁾. Such characteristics favor dietary patterns that can contribute to the development and maintenance of excess weight starting in childhood.

According to the Nova classification⁽⁵⁾, ultra-processed foods are industrial formulations composed of substances extracted or modified from foods, with the addition of cosmetic additives. They are durable, low-cost, hyperpalatable products often promoted through intense marketing strategies⁽⁶⁾.

In the context of food surveillance, the Food and Nutrition Surveillance System (SISVAN) collects data on the consumption of fruits, vegetables, ul-

tra-processed foods, and sugary beverages, serving as an important tool to inform actions in Primary Health Care (PHC), the primary level of care for managing childhood obesity⁽⁷⁾. However, because it relies on simplified markers, the system has limitations for a more detailed assessment of dietary intake, especially regarding the measurement of the proportion of ultra-processed foods in the diet. In this context, the routine in PHC, often characterized by brief consultations, further hinders the use of more complex instruments, such as 24-hour dietary recalls, which require time, training, and are subject to memory biases⁽⁸⁾. Given this, there is a growing need for simple, quick, and effective tools that allow healthcare professionals to improve the assessment of

food consumption without increasing the workload of teams or users⁽⁹⁾.

The NOVA score for ultra-processed food consumption, applied through the NovaScreener instrument, presents itself as a practical alternative for estimating the intake of these foods based on a simplified list of food subgroups. The NovaScreener is a structured self-report questionnaire developed in the context of Brazilian population studies, such as Vigitel and the NutriNet Brasil cohort, based on the most commonly consumed ultra-processed foods in the country, identified through national surveys such as the Family Budget Survey (POF)⁽¹⁰⁾. The instrument assesses the previous day's consumption of different subgroups of ultra-processed foods, with the score calculated by summing the consumed items, which allows for a concise estimation of the degree of exposure to these products.

The score was validated in adults⁽¹⁰⁾ and, more recently, tested in children aged 6 to 7 years in a subsample of the 2015 Pelotas Birth Cohort, demonstrating its ability to reflect the presence of ultra-processed foods in the diet⁽¹¹⁾. However, evidence regarding its performance in specific contexts, such as among obese children receiving primary care, remains limited. Assessing its performance in this group may help consolidate its use in clinical practice and in food and nutrition surveillance. Thus, the objective of this study was to describe the NOVA score for ultra-processed food consumption and evaluate its performance in reflecting the presence of these foods in the diets of children with obesity treated in primary care.

METHOD

Study Design and Setting

A validation study that analyzed data derived from the parent study "Management of childhood obesi-

ty in the context of primary health care: an approach based on intensive multi-component intervention," approved by the ethics and research committee of the Federal University of Minas Gerais, (CAAE 39508720.6.0000.5149), registered in ClinicalTrials.gov (NCT05966259). In summary, this is a randomized controlled clinical trial conducted with children living with obesity who are treated at Basic Health Units (UBS) in Betim, Minas Gerais. Further details on the parent study are described in a previous publication⁽¹²⁾.

Study Sample

It involved 167 children followed at the baseline of the parent study. Participants were recruited through two complementary strategies: (i) identification of children with obesity based on SISVAN records for children aged 6 to 11 years treated in primary care in 2019; and (ii) open dissemination of the study at health units and through local media. Children diagnosed with obesity (z-score $\geq +2$ for Body Mass Index/Age)^(13,14) were included, according to individual consultation records. Exclusion criteria included children with mental disorders that prevented participation in consultations or groups, children using weight-loss medications, those with obesity-related comorbidities, and those whose parents or caregivers did not agree to participate or did not sign the Informed Consent Form.

Data Collection

The data used for this study were derived from the baseline of the parent study, collected between August 2022 and October 2022. Individual consultations were conducted at the UBS by five nutritionists trained exclusively to care for the children included in the study. During the consultation, a questionnaire was administered, answered by the guardians together with the children, consisting

of questions regarding socioeconomic characteristics, the child's anthropometric variables, the mother's or guardian's nutritional profile, and the child's dietary intake.

Food intake was assessed using a 24-hour dietary recall and the Ultra-Processed Foods Questionnaire. For the dietary recall, which was completed by the child with the assistance of the guardian present at the time of the consultation, the Automated Multiple-Pass Method was used, ensuring greater accuracy, reliability, and standardization of the process, thereby minimizing potential errors. The method involves five steps: 1- a quick list of foods and beverages consumed in the last 24 hours; 2- questioning about foods and beverages that are often forgotten; 3- identification of the location, time, and type of each meal; 4- detailing each food item, including portion sizes, units of measurement, preparation methods, or brands used, and the addition of culinary ingredients; and 5- a final review to verify all reported data and check for omissions. The Automated Multiple-Pass Method for administering the 24-hour dietary recall has previously been shown to be effective in obese populations⁽¹⁵⁾.

The data collected from the 24-hour dietary recall were tabulated using the Brasil Nutri® software, created by the Ministry of Health in partnership with the Institute of Social Medicine at the Federal University of Rio de Janeiro, for the use of data from the Family Budget Survey conducted by the Brazilian Institute of Geography and Statistics. Based on the recall, food and beverage consumption data obtained in household measures were converted into units of weight (in grams) and volume (milliliters) using the software, and linked to the respective nutritional composition information, in accordance with the methodology proposed by the Brazilian Institute of Geography and Sta-

tistics for processing food consumption data from the 2008/2009 Family Budget Survey⁽¹⁶⁾.

Caloric and food intake was analyzed and classified according to the NOVA classification system, based on the extent and purpose of food processing^(6,17). To calculate the contribution of ultra-processed foods to the previous day's food consumption, each item reported by the participant in the 24-hour dietary recall was classified as ultra-processed or non-ultra-processed, according to the NOVA classification^(5,6,17). Finally, the total calories consumed (in kcal), calories from ultra-processed foods (in kcal), the percentage of total calories from these foods, and the percentage of these calories relative to the total daily calorie intake were calculated⁽¹⁰⁾.

The Ultra-Processed Foods Questionnaire was developed through a design process based on secondary sources and previously validated instruments. Initially, the food consumption marker forms from SIS-VAN⁽¹⁴⁾ were considered, with the aim of ensuring alignment with primary health care practices. Next, the most commonly consumed ultra-processed

foods and beverages in the Brazilian population were selected, based on data from the 2008–2009 POF⁽¹⁶⁾. From this selection, an initial list of food items was constructed, subsequently organized into subgroups based on similarities among the foods and on groupings already described in the literature^(7,10,18). The final instrument included 36 food items distributed across 10 subgroups, aiming to facilitate administration and understanding by respondents while maintaining representativeness of the main ultra-processed foods consumed in the Brazilian context. The Ultra-Processed Foods Questionnaire was completed by the children, with the assistance of their parents or guardians, using the list of available ultra-processed foods. Children were encouraged to mark the foods they had consumed on the day prior to the consultation. Ultimately, the Ultra-Processed Foods Questionnaire generated a database of the foods consumed—or not consumed—by the children on the previous day. Responses were entered via the nutritionists' cell phones using the Epi-collect5 Data Collection software, which stores participants' responses

in a database.

Data Analysis

Descriptive analyses were performed using absolute and relative frequency measures. The NOVA score for ultra-processed food consumption for each participant was calculated as described in a previous study⁽¹⁰⁾, based on the reporting of at least one item from each of the 10 subgroups of ultra-processed foods, resulting in a score ranging from 0 to 10, where 10 represents the maximum amount of ultra-processed foods consumed the previous day, based on the food items in the questionnaire. Based on this score, a classification into consumption quintiles (0–1, 2, 3, 4, 5, or more) was performed, based on the NOVA score⁽¹⁰⁾. The Ultra-Processed Foods Questionnaire was used to calculate the NOVA score for ultra-processed food consumption and its applicability in children with obesity, based on the final classification (Table 1).

Table 1. Final classification of the ultra-processed foods and beverages that comprised the Ultra-Processed Foods Questionnaire used in the study. Betim, Minas Gerais, 2022.

First Group	Final Classification
Diet/light dairy beverages	Milk drink
Dairy beverages without yogurt	
Yogurt with fruit	
Crackers and snacks	Crackers and chips
Diet/light cookies	Sweet cookies
Sweet cookies	
Breakfast cereals	
Margarine	Margarine
Light margarine	
Sauces	
Bread	Breads
Light/diet breads	
Sweet breads	
Sweet breads/light/diet cakes	

Ham	Sausages
Reconstituted meats	
Light sausages	
Ready-to-eat meat meals	
Instant noodles	Ready-to-eat meals
Diet/light instant noodles	
Ready-to-eat meals (to-go)	
Ready-to-eat pasta meals	
Pizza	
Soups and pre-packaged mixes	Sweets
Chocolates	
Ice cream	
Diet/light sweets	
Other sweets	
Soft drinks	Soft drinks
Diet/light soft drinks	
Boxed juices (powdered or to be diluted)	Juices
Diet/light ready-to-drink fruit juices or teas	

To assess the association between the NOVA score for ultra-processed food consumption and the proportion of these foods in children's diets (as measured by R24h), the mean percentage of calories derived from ultra-processed foods was analyzed both continuously and in quintiles of its distribution. Linear regression models were used to test for a linear trend, with the mean percentage of calories from ultra-processed foods as the dependent variable. Next, agreement was assessed between the classification based on quintiles of the percentage of calories from ultra-pro-

cessed foods and the quintiles of the NOVA score for ultra-processed food consumption. Agreement was assessed using the Pabak index (Prevalence-adjusted and bias-adjusted kappa), which adjusts the Kappa for prevalence and bias⁽¹⁰⁾. The Pabak index indicates near-perfect agreement when greater than 0.80, substantial agreement between 0.61 and 0.80, moderate agreement between 0.41 and 0.60, fair agreement between 0.21 and 0.40, and poor agreement when equal to or less than 0.20.

The analyses were performed using STATA® software version 16.1, and

the Pabak index was calculated using WINPEPI (PEPI-for-Windows) software version 11.65b.

RESULTS

Table 2 presents the characteristics of the children participating in the study. Most were female (52.69%), of mixed-race/brown skin color (59.28%), and had an income greater than R\$1,818 (55.69%) (Table 2). The mean z-score for the Body Mass Index/Age was 3.33 (95% CI: 3.18–3.47) (data not shown in the table).

Table 2. Characteristics of the children included in the study who were treated at Basic Health Units. Betim, Minas Gerais, 2022 (n=167).

Variables	n (%)
Gender	
Male	79 (47.31)
Women	88 (52.69)
Age (years)	
6	18 (10.78)
7	23 (13.77)
8	35 (20.96)
9	43 (25.75)

Original Article

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10	43 (25.75)
11	5 (2.99)
Race/skin color	
Yellow	4 (2.40)
White	33 (19.76)
Indigenous	1 (0.60)
Mixed	99 (59.28)
Black	30 (17.96)
Family income	
The family has no income	2 (1.20)
Up to R\$606.0	7 (4.19)
From R\$606.0 to R\$1,212.0	24 (14.37)
From R\$1,212.0 to R\$1,818.0	39 (23.35)
Over R\$1,818.0	93 (55.69)
Don't know	2 (1.20)

Table 3 describes the frequency of ultra-processed food consumption on the day prior to the interview for each of the 10 subgroups included in the NOVA score for ultra-processed food

consumption. More than half of the children reported consuming sweets (54.94%) and bread (53.29%) the previous day. About 36% consumed margarine, 44.91% consumed processed

meats, 44.31% consumed soft drinks, 44.31% consumed dairy products, and 44.31% consumed powdered juice.

Table 3. Frequency (%) of consumption by children, on the day prior to the interview, of foods included in the Nova score for ultra-processed food consumption. Betim, Minas Gerais, 2022 (n=167).

Foods	Relative Frequency (%)
Sweets	54.49
Bread (loaf, hot dog bun, hamburger bun, or other)	53.29
Sausages	44.91
Dairy products	44.31
Soft drinks	44.31
Powdered juice	44.31
Sweet cookies	40.12
Margarine	36.53
Snacks	26.95
Ready-made meals	13.17

Table 4 describes the distribution of ultra-processed food consumption based on the NOVA score, calculated from the 10 food subgroups consumed on the day prior to the inter-

view. Scores of 2, 3, 4, and 5 were the most common, with frequencies of 16.7%, 23.3%, 20.4%, and 14.4%, respectively. Zero scores were observed in 0.6% of participants, and scores of

5 or higher were observed in 35.3% of participants.

Table 4. Proportion of ultra-processed foods in the diets of children included in the study who were treated at Basic Health Units, calculated using a 24-hour dietary recall, according to the NOVA score for ultra-processed food consumption. Betim, Minas Gerais, 2022 (n=167).

NOVA score for ultra-processed food consumption	Sample n (%)	Share of ultra-processed foods in the diet (% of total energy) Mean (95% CI)
0	1 (0.6)	33.1 (-)
1	6 (3.6)	27.4 (12.8 – 42.1)
2	28 (16.7)	30.0 (22.4 – 37.7)
3	39 (23.3)	39.7 (32.0 – 47.3)
4	34 (20.4)	38.7 (28.7 – 48.7)
5	24 (14.4)	49.3 (40.5 – 58.0)
6	16 (9.6)	44.2 (28.2 – 60.3)
7	14 (8.4)	54.8 (40.5 – 69.2)
8	3 (1.8)	52.5 (45.2 – 59.8)
9	1 (0.6)	34.7 (-)
10	1 (0.6)	31.4 (-)
Categorization		
0–1	7 (4.2)	28.3 (15.8 – 40.8)
2	28 (16.8)	30.1 (22.4 – 37.7)
3	39 (23.3)	39.7 (32.0 – 47.3)
4	34 (20.4)	38.7 (28.7 – 48.7)
5 or more	59 (35.3)	48.8 (42.3 – 55.4)

Note: 95% CI: 95% Confidence Interval.

Furthermore, it was observed that the mean percentage of ultra-processed foods in the total caloric intake of the diet, calculated from the 24-hour dietary recall, increases linearly and significantly with an increase in the ultra-processed food consumption score. The linear regression analysis indicated that, for each unit increase in the ultra-processed food

consumption score, the percentage contribution of ultra-processed foods to total caloric intake increased by 3.44 units (p-value < 0.05) when the score was evaluated on a scale of 0 to 10 (Table 4), and increased by 5.41 units (p-value = 0.001) when evaluated using quintile categorization of the score (data not shown in the table), demonstrating a positive and statistically significant relationship between

these variables.

Participants were simultaneously stratified according to quintiles of ultra-processed food intake in the diet, estimated by the 24-hour dietary recall, and approximate quintiles of the NOVA score (0–1, 2, 3, 4, and 5 or more). Table 5 indicates substantial agreement between the two parameters used (Pabak index of 0.62).

Table 5. Distribution (%) by quintiles of ultra-processed food intake in the diet and (approximate) quintiles of the NOVA score for ultra-processed food consumption among children included in the study who were treated at the Basic Health Units in Betim (n=167), Minas Gerais, 2022.

Quintiles of ultra-processed food share in the diet	Quintiles of the NOVA score for ultra-processed food consumption					Total
	0–1	2	3	4	5 or more	
Q1 (≤ 17.5)	0.6	6.0	3.6	6.0	3.6	19.8
Q2 (17.6–31.4)	1.8	3.6	7.2	2.4	5.4	20.4
Q3 (31.41–44.0)	1.2	3.0	4.8	4.2	7.2	20.4
Q4 (44.1–61.9)	0.6	2.4	3.6	3.6	9.6	19.8
Q5 (≥ 62.0)	0.0	1.8	4.2	4.2	9.6	19.8
Total	4.2	16.8	23.4	20.4	35.3	100.0

DISCUSSION

This study described and evaluated the performance of the NOVA score for ultra-processed food consumption in obese children treated in primary care, showing a significant linear association between the score obtained from the Ultra-Processed Food Questionnaire and the caloric proportion of ultra-processed foods estimated by the 24-hour dietary recall. Furthermore, substantial agreement was observed between the quintiles of caloric contribution from ultra-processed foods and the approximate quintiles of the NOVA score distribution, reinforcing the validity of the tool for this population group.

To the best of our knowledge, this is the first study to validate the performance of the NOVA score specifically in obese children in the primary care setting. This contribution is particularly relevant given the scarcity of practical and validated tools for assessing dietary intake in this age group and in a primary care setting.

Although previous studies, such as NutriNet Brasil⁽¹⁰⁾, have confirmed the NOVA score's effectiveness in adults, this study broadens its applicability by demonstrating its usefulness in a pediatric population with distinct dietary characteristics. A comparative analysis of the most frequently consumed foods revealed a different pattern between adults and children: while margarine (38%), sliced bread (33%), and soft drinks (32.8%) predominated among adults, the most consumed ultra-processed foods among obese children were sweets (54.5%), industrialized breads (53.3%), and processed meats (44.9%). Furthermore, considering similar criteria for grouping ultra-processed foods between the aforementioned study and the present study, it is observed that such differences in food preferences reinforce the importance of age-appropriate dietary assessment strategies, given that the preference for sweet foods with strong sensory appeal tends to be higher

in childhood⁽¹⁹⁾.

In this regard, the results obtained in this study are consistent with the findings of a Brazilian study that proposed and evaluated a tracker for the consumption of ultra-processed foods in early childhood (6–7 years), based on data from the 2015 Pelotas Birth Cohort, demonstrating that the generated score has a good ability to reflect the presence of these foods in the diet⁽¹¹⁾. There was similarity among the most frequently consumed ultra-processed foods, although differences exist both in the exact frequency of consumption and in the grouping of ultra-processed foods. However, these methodological distinctions do not prevent the identification of a consistent pattern of ultra-processed food consumption, reinforcing the validity of the findings and the relevance of the NOVA score's applicability in different population contexts.

In the context of food and nutrition surveillance, the markers of the Food and Nutrition Surveillance System constitute an essential tool for monitoring diet in Primary Health Care, with a focus on the frequency of consumption of food groups, including ultra-processed foods. However, because they are based on dichotomous consumption indicators (yes/no) and a limited set of items, these markers may not allow for estimating the actual quantity of ultra-processed foods consumed, limiting their sensitivity in assessing the share of these foods in the diet and the overall quality of the diet. The NOVA score, in turn, emerges as a valuable complement, offering a quantitative and more refined estimate of exposure to ultra-processed foods⁽⁵⁾.

Given its simplicity and compatibility with routine primary care settings, the NOVA score proves to be a promising tool for monitoring food consumption among children with childhood obesity. Its application allows for the rapid identification of exposure to ultra-processed foods and supports clin-

ical decision-making, particularly in dietary counseling and longitudinal follow-up. The findings of this study suggest that even the presence of just a few subgroups of ultra-processed foods may already be associated with a higher proportion of these foods in the diet, which reinforces the instrument's potential as a screening tool for the early identification of inadequate dietary patterns.

In this sense, its application can support targeted educational interventions, individualized dietary counseling, and monitoring of the response to implemented actions. Furthermore, its integration into nutritional surveillance systems can strengthen the implementation of the recommendations of the Dietary Guidelines for the Brazilian Population and inform public policies aimed at promoting adequate and healthy nutrition in childhood.

Among the study's limitations, the exclusive focus on children with obesity stands out, which restricts the generalizability of the results to pediatric populations with different nutritional statuses. As a strength, the innovative nature of the study stands out for testing the performance of a tool with the potential to be incorporated into the routine of Primary Health Care. Further studies with more diverse samples, covering different age groups and nutritional statuses, are recommended, as well as longitudinal investigations that can assess the impact of the NOVA score on medium- and long-term health outcomes. The validation and expanded use of this tool could make a significant contribution to improving the assessment of ultra-processed food consumption in the context of food and nutrition surveillance in Primary Health Care.

CONCLUSION

The findings of this study show that the NOVA score for ultra-processed food consumption performs well in estimating the proportion of ultra-processed foods in the diets of

obese children seen in Primary Health Care. The significant association with data obtained from the 24-hour dietary recall and the agreement between the classification criteria indicate that this is a valid, practical, and easy-to-apply tool in this context. Thus, the NOVA

score proves to be a promising strategy to complement the instruments already used in food and nutrition surveillance, such as the markers of the Food and Nutrition Surveillance System, allowing for a quantitative and more accurate assessment of ultra-processed food consump-

tion. Its adoption in routine Primary Health Care can strengthen actions for the prevention and management of childhood obesity, aligning with the recommendations of the Dietary Guidelines for the Brazilian Population.

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