



CONSUMPTION OF ULTRA-PROCESSED FOODS AND NUTRITIONAL STATUS OF CHILDREN WITH AUTISM SPECTRUM DISORDER

Consumo de ultraprocessados e estado nutricional de crianças com transtorno do espectro do autismo

Consumo de ultraprocessados y estado nutricional de niños con trastorno del espectro autista

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ABSTRACT

Objective: To analyze the consumption of ultra-processed foods among children with autism spectrum disorder (ASD) and its association with nutritional status. **Methods:** Cross-sectional study of 29 children conducted in 2017 in São Luís, Maranhão, Brazil. A semistructured questionnaire was used with parents or caregivers to obtain sociodemographic information. The nutritional status was assessed based on body mass index/age and height/age. The food consumption was assessed using a 24h recall, which was used to estimate the percentage of caloric contribution and the mean of the foods consumed according to the level of processing. Student's t test with a significance level of 5% was used to compare the consumption of ultra-processed foods in relation to the nutritional status. **Results:** Overweight was observed in 55.2% (n=16) of the children and the consumption of ultra-processed foods was responsible for 28% (560 kcal/day) of caloric contribution. Overweight children consumed a higher mean percentage of ultra-processed foods than those who were not overweight (34.2% vs. 19.4%, p=0.009). Fruit consumption represented only 4.3% (74.6 kcal) of total caloric contribution and vegetables were the least consumed whole foods among children. **Conclusion:** Whole foods or minimally processed foods were the most consumed food among the analyzed children. However, the higher consumption of ultra-processed foods was associated with overweight in children with ASD.

Descriptors: Autistic Disorder; Food Consumption; Nutritional Status; Children.

RESUMO

Objetivo: Analisar o consumo de alimentos ultraprocessados entre crianças com transtorno do espectro do autismo (TEA) e sua associação com o estado nutricional. **Métodos:** Realizou-se um estudo transversal, em São Luís, Maranhão, Brasil, com amostra de 29 crianças, em 2017. Utilizou-se um questionário semiestruturado, aplicado aos pais ou responsáveis, para obtenção de



variáveis sociodemográficas. O estado nutricional foi avaliado pelos indicadores de índice de massa corporal/idade e estatura/idade. Obteve-se o consumo alimentar por meio de recordatório de 24h, a partir do qual foi calculado o percentual de contribuição calórica e a média dos alimentos consumidos de acordo com o nível de processamento. Para comparação do consumo dos ultraprocessados de acordo com o estado nutricional, utilizou-se o teste t de Student, com nível de significância de 5%. **Resultados:** Verificou-se o excesso de peso em 55,2% (n=16) das crianças e o consumo de alimentos ultraprocessados foi responsável por 28% (560 kcal/dia) da contribuição calórica. Crianças com excesso de peso consumiram maior média percentual de alimentos ultraprocessados do que as sem excesso de peso (34,2% versus 19,4%, p=0,009). O consumo de frutas representou apenas 4,3% (74,6 kcal) da contribuição calórica total, e as hortaliças foram os alimentos in natura menos consumidos pelas crianças. **Conclusão:** Alimentos in natura ou minimamente processados foram a base da alimentação das crianças estudadas. Apesar disso, o maior consumo de alimentos ultraprocessados foi associado ao excesso de peso nas crianças com TEA.

Descritores: Transtorno Autístico; Consumo de Alimentos; Estado Nutricional; Criança.

RESUMEN

Objetivo: Analizar el consumo de alimentos ultraprocesados entre los niños con trastorno del espectro autista (TEA) y su asociación con el estado nutricional. **Métodos:** Se realizó un estudio transversal, en São Luís, Maranhão, Brasil, con una muestra de 29 niños en 2017. Se utilizó un cuestionario semi-estructurado que ha sido aplicado a los padres o responsables para obtener las variables sociodemográficas. El estado nutricional ha sido evaluado por los indicadores del índice de masa corporal/edad y estatura/edad. Se obtuvo el consumo alimentario a través del recordatorio de 24 horas del cual ha sido calculado el porcentaje de la contribución calórica y la media de los alimentos consumidos según el nivel de procesamiento. Para comparar el consumo de los ultraprocesados según el estado nutricional se utilizó la prueba t de Student con el nivel de significación del 5%. **Resultados:** Se verificó el exceso de peso en el 55,2% (n=16) de los niños y el consumo de alimentos ultraprocesados ha sido responsable por el 28% (560 kcal/día) de la contribución calórica. Niños con exceso de peso han consumido la mayor media percentual de alimentos ultraprocesados que los sin el exceso de peso (34,2% versus 19,4%, p=0,009). El consumo de frutas ha representado solamente el 4,3% (74,6 kcal) de la contribución calórica total y las hortalizas han sido los alimentos in natura menos consumidos por los niños. **Conclusión:** Alimentos in natura o los muy poco procesados fueron la base de la alimentación de los niños estudiados. Sin embargo, el mayor consumo de alimentos ultraprocesados se asoció con el exceso de peso de los niños con TEA.

Descriptorios: Trastorno Autístico; Consumo de Alimentos; Estado Nutricional; Niño.

INTRODUCTION

Autism Spectrum Disorder (ASD) is characterized by a set of atypical neurodevelopmental changes in the child. Children with ASD have difficulties in social interaction, cognitive delays in language and communication deficits, and repetitive and restricted behaviors⁽¹⁾.

In recent years, the prevalence rate of ASD has increased significantly. Latest estimates from the Centers for Disease Control and Prevention (CDC) based on 2014 data show a prevalence rate in the United States of 16.8 per 1000, i.e., one in 59 children aged eight years has ASD⁽²⁾.

In addition to perceived characteristics related to behavior, language and social interaction, children with ASD also present gastrointestinal comorbidities, such as: chronic constipation, diarrhea, and abdominal pain. Although often neglected, there is evidence of an association between the presence of gastrointestinal symptoms and the severity of the disorder – individuals with ASD and gastrointestinal symptoms tend to present with increased irritability, anxiety and social isolation⁽³⁾.

With regard to the dietary habits of these children, food selectivity is the most common concern due to its negative impact on nutritional status and growth⁽⁴⁾. Therefore, attention should be paid to the intake of unhealthy foods and to dietary restrictions and monotony among these children. Because of these peculiarities in eating behavior, children with ASD tend to have some nutritional deficiencies. The most common deficiencies in this population group are related to calcium, zinc, magnesium, antioxidants, omega 3, and increased copper. Therefore, planning and caring for the diet of these children should be reinforced in order to ensure good nutrition⁽⁵⁾.

Currently, the strong presence of ultra-processed foods in children's diet has been much discussed. A cross-sectional study⁽⁶⁾ carried out in a Primary Health Care Center in Southern Brazil with 204 children aged 2 to 10 years revealed that the caloric contribution of ultra-processed foods to children's diet is high. The average energy consumption was 1,672.3 kcal/day, with 47% of these calories coming from ultra-processed foods.

Other studies have also pointed to the high caloric contribution of ultra-processed foods to children's diet⁽⁷⁻⁹⁾. It is known that ultra-processed foods have high energy density, excess of saturated and total fats, low fiber content and are rich in sugar and sodium and poor in vitamins and minerals, which are essential for the control of nutritional deficiencies presented by autistic children^(10,11).

The consumption of ultra-processed foods has been associated with overweight in adolescents and adults without ASD⁽¹²⁻¹⁴⁾. This association is explained by the poor nutritional quality of ultra-processed foods. To date, we have not found published studies on food consumption according to the purpose and extent of processing in children with ASD and studies that have associated this consumption with nutritional status.

In view of the complex nature of ASD and considering that these children are at increased risk for developing nutritional deviations, the assessment of the profile of the foods consumed by them and its association with nutritional status is a tool for the diagnosis and prevention of health problems. This assessment allows the implementation of specific multidisciplinary strategies to promote the comprehensive care of this population group. Therefore, the objective of this study was to analyze the consumption of ultra-processed foods among children with autism spectrum disorder (ASD) and its association with nutritional status.

METHODS

A descriptive cross-sectional study was carried out with data collected from children diagnosed with autism spectrum disorder (ASD) from May to September 2017 in São Luís, Maranhão, Brazil.

The nonprobability sample included 29 children aged 3-12 years diagnosed with ASD by a neuropediatrician. Data were collected through interviews with the parents or guardians of each child in the teaching clinic of a private university in São Luís.

A semi-structured questionnaire was constructed by the researchers and it included questions on socioeconomic conditions (monthly household income, parents'/guardians' education, marital status and occupation) and questions on food selectivity or children's difficulty in accepting new foods.

Anthropometric data were obtained by measuring the height and weight of the children using the techniques recommended by the World Health Organization⁽¹⁵⁾. Height (in centimeters) was measured using a stadiometer with a maximum capacity of 215 cm. The stadiometer was attached to a Filizola® digital scale that was used to measure weight. The scale had a capacity of two hundred kilograms and a fifty-gram accuracy. After measurements, the body mass index (BMI) was calculated using the formula $BMI = \text{weight (kg)}/\text{height (m)}^2$.

The nutritional diagnosis considered the BMI z-score for age and height according to the reference values proposed by the World Health Organization⁽¹⁵⁾.

Information on food consumption was obtained from a 24-hour dietary recall (24HR) applied by a properly trained researcher. A single 24HR was used to collect information on the child's food consumption on the previous day. All foods and beverages consumed by the child were recorded, including details of preparation, amount and brands. After that, the foods were classified according to the level of processing as proposed by Dietary Guidelines for the Brazilian Population⁽¹⁶⁾, which classifies food into three categories: natural or minimally processed foods, processed foods and ultra-processed foods.

The natural or minimally processed foods category includes foods obtained directly from plants or animals that do not undergo any alteration after leaving nature. Minimally processed foods correspond to natural foods that have undergone processes of cleaning and removal of inedible or undesirable parts.

Processed foods include products made by the industry, which essentially adds salt or sugar, or other substances used in cooking, to natural foods to make them durable and more palatable.

The ultra-processed foods category includes industrial formulations made entirely or predominantly of substances derived from food or food constituents or synthesized in the laboratory using organic matters such as coloring agents, flavorings, flavor enhancers and other types of additives used to endow products with sensory properties.

The 24HR was analyzed using the AvaNutri® Revolution software (Rio de Janeiro, Brazil) to calculate the number of calories provided by the foods. After that, data were exported to Stata® version 14.0 (College Station, Texas, USA), which was used to calculate the percentage of caloric contribution and the mean of the foods consumed according to the level of processing. To characterize the sample, the percentages of variables related to socioeconomic status, nutritional status and eating behavior were calculated.

The association between the consumption of ultra-processed foods and overweight was checked by the Student's t-test with a significance level set at 5%.

The present study was approved by the Research Ethics Committee of the CEUMA Higher Education under Approval No. 2.042.597. The authorization for the participation of the children in the research was obtained by means of the signing of the Free and Informed Consent Form by the parents or guardians.

RESULTS

Parents' and guardians' mean age was 37 years and the majority had a monthly income of one or more minimum wages (89.7%; n=26) and incomplete or complete secondary education (72.5%; n=21). Children's mean age was 8 years and 96.6% (n=28) of them were boys. In all, 69.0% (n=20) of the children with ASD presented food selectivity and difficulties to accept new foods (Table I).

Table II shows the high percentage of autistic children who were overweight (55.2%; n=16). In addition, the prevalence rates of underweight (20.7%; n=6) and short stature (13.8%; n= 4) were also high.

Table I - General characteristics of parents or guardians of children with ASD. São Luís, Maranhão, 2017.

Variables	n	%
Interviewee's age		
20-34 years	7	24.1
>35 years	22	75.9
Interviewee's degree of kinship		
Mother or father	28	96.6
Grandmother or another relative	1	3.4
Monthly income		
< 1 Minimum wage	3	10.3
≥1 Minimum wage	26	89.7
Interviewee's education		
Incomplete or complete primary education	3	10.3
Incomplete or complete secondary education	21	72.5
Incomplete or complete higher education	5	17.2
Child's sex		
Female	1	3.4
Male	28	96.6
Child's age		
< 5 years	4	13.8
5-12 years	25	86.2
Food selectivity and/or difficulty to accept new foods		
Yes	20	69.0
No	9	31.0
TOTAL	29	100

Table II - Nutritional status of children with autism spectrum disorder according to body mass index for age (BMI/A) and height for age (H/A). São Luís, Maranhão, 2017.

Variables	%	n
Body mass index for age (BMI/A)		
Underweight	20.7	6
Normal	24.1	7
Overweight	34.5	10
Obesity	20.7	6
Height for age (H/A)		
Short stature	13.8	4
Normal	82.8	24
Tall stature	3.4	1

The highest caloric contribution was from natural or minimally processed foods and corresponded to 61.5% (1249.7 kcal/day). The consumption of ultra-processed foods represented 27.6% of the caloric contribution, corresponding to an average of 560.0 kcal per day (Table III).

The natural foods with the highest caloric contribution included white meat and eggs, corresponding to 15.5% (326.8 kcal / day), followed by rice, which corresponded to 12.1% (264 kcal / day) of the percentage of total calories consumed. Fruit consumption represented only 4.3% (74.6 kcal) of the total caloric contribution. Vegetables were the natural or minimally processed foods less consumed by the children, with a percentage corresponding to only 0.3% (7.3 kcal / day) of the total caloric contribution (Table IV).

The highest caloric contribution of processed foods came from bread rolls, with an average of 125.2 kcal/day, representing 6.3% of total caloric intake. The processed food with the lowest caloric contribution was canned sardines (0.2%) (Table IV).

Among ultra-processed foods, biscuits (salty and sweet) were responsible for the highest caloric contribution, representing 13.5% (247.7 kcal/day). The flour used to prepare porridge was the second most consumed ultra-processed food, with an average of 112.4 kcal/day, corresponding to 4.6% of total caloric intake. The least consumed ultra-processed food was margarine, with an average of 7.5 kcal/day, representing 0.4% of total caloric intake (Table IV).

The analysis of the association between the average consumption of ultra-processed foods and overweight revealed that ultra-processed foods contributed to 19.4% of the diet in children who were not overweight and to 34.2% of the diet in children who were overweight ($p=0.009$).

Table III - Mean and percentage of calories from natural or minimally processed foods, processed foods and ultra-processed foods among children with autism spectrum disorder. São Luís, Maranhão, 2017.

Food groups	Mean±SD	Consumption of TCI (%)
Natural or minimally processed foods	1249.7±517.0	61.5
Processed foods	140.6±149.2	7.1
Ultra-processed foods	560.0 ±357.1	27.6
Total	1950.3	100.0

SD: Standard deviation; TCI: Total caloric intake

Table IV - Mean and percentage of consumption of natural or minimally processed foods, processed foods and ultra-processed foods among children with autism spectrum disorder. São Luís, Maranhão, 2017.

Variables	Mean	Consumption of TCI (%)
Vegetables	7.2	0.3
Toasted Flour	17.6	1.0
Coffee (sweetened)	26.0	1.4
Legume Soup	30.3	2.1
Spaghetti	72.8	3.2
Beans	78.6	3.8
Red Meat	75.5	3.9
Fruits (Apple, Watermelon, Banana, Orange and Açai Berry)	74.6	4.3
Fruit Juice	99.7	4.5
Milk	207.3	9.4
Rice	264.0	12.1
White Meat and Eggs	326.8	15.5
Processed Foods		
Sardine	2.8	0.2
Cheese	12.6	0.6
Bread Rolls	125.2	6.3
Ultra-processed Foods		
Margarine	7.5	0.4
Yogurt	23.2	1.0
Artificial Juice	31.0	1.5
Fast food (Pizza and Coxinha)	31.3	1.5
Bread (Loaf and Sweet)	56.0	3.0
Flour for Porridge	112.4	4.6
Biscuits (Sweet and Salty)	247.7	13.5

TCI: Total caloric intake

DISCUSSION

Natural or minimally processed foods accounted for 61% of total caloric intake; therefore, they were the main foods in the diet of the children with ASD analyzed in the present research. Despite that, the high consumption of ultra-processed foods was associated with overweight. The consumption of ultra-processed foods corresponded to 27.6% of total consumption. This percentage cannot be considered low as the consumption of these foods is not recommended by the Dietary Guidelines for the Brazilian Population⁽¹⁶⁾. In addition, the frequency of nutritional deviations was high among children with ASD, which is a worrying finding in the present study.

The high consumption of ultra-processed foods among adolescents has been associated with the metabolic syndrome⁽¹⁴⁾. Studies carried out with youth and adults in Brazil also found an association between the consumption of ultra-processed foods and overweight^(12,13). Even though there are no studies carried out with children with ASD to check for this association, the recommendations of the Dietary Guidelines for the Brazilian Population point out that ultra-processed foods are nutritionally unbalanced and contribute to the development of nutrient excesses or deficits⁽¹⁶⁾, which is in line with the results of the present study.

The percentage of consumption of natural or minimally processed foods in this study can be considered a positive finding; however, the fact that fruits, legumes and vegetables account for only a small part of this consumption is worrisome. A comparative study of children with and without ASD treated at a hospital in Northern India found that children with ASD had aversion to fruits and vegetables⁽¹⁷⁾. Studies have shown that children with ASD prefer snacks and starchy and ultra-processed foods and are reluctant to eat fruits and vegetables⁽¹⁸⁻²⁰⁾.

It is known that fruits and vegetables are foods of great importance for the supply of micronutrients essential for the growth and development of the child. In addition, they help prevent and control diseases and strengthen the immune system⁽²¹⁾. There is a significant correlation between micronutrient deficiencies and worsening of autistic symptoms⁽²⁰⁾. Therefore, the low consumption of fruits and vegetables represents a risk to the health of children with ASD as it can lead to nutritional deficiencies and negatively affect the symptomatology of the disease.

A study carried out with children with ASD in Curitiba, Paraná, found that the analyzed children presented a high frequency of consumption of ultra-processed foods such as encased meats, soft drinks, artificial juices and sweets, and that artificial juice was consumed two or more times a day⁽²²⁾.

The ultra-processed foods most consumed by the children analyzed were salty and sweet biscuits, followed by flour used to prepare porridge. A study of secondary data from the National Demographic and Health Survey showed that the consumption of biscuits and crackers by children is high. About 50% of children aged 6-59 months from all regions (except the Northern Region) consumed these foods on a daily basis⁽²³⁾. Another study carried out with children with ASD and children with typical development aged 7-10 years showed that 63% of children with ASD were selective with regard to food texture and preferred crunchy foods such as pizza, biscuits and sweets⁽²⁴⁾.

Studies that assessed the consumption of ultra-processed foods in children with typical development found a calorific contribution of ultra-processed foods higher than that found in the present study. In a study of dietary intake of children aged 2-10 years, the caloric contribution was found to be 47%⁽⁶⁾. Another study carried out with children aged 7-8 years found a caloric contribution from processed and ultra-processed foods of 48.6%⁽²⁵⁾. In the present study, the caloric contribution from ultra-processed foods was 27.6%; therefore, it was lower than those found in the aforementioned studies.

The assessment of the nutritional status of children with ASD revealed a double burden of nutritional deviations, thus suggesting that the diet of these children is unbalanced. However, although the prevalence of overweight among these children was high, affecting more than half of the sample, the percentages of children with underweight (20.7%) and short stature for age (13.8%) were also significant.

This finding is worrisome because overweight has increased among children and is related to the development of noncommunicable diseases in adult life⁽²⁶⁾. In addition, exposure to malnutrition can have serious consequences for children's health, making normal growth and development impossible, compromising their immunity, and interfering with their quality of life⁽²¹⁾. Food selectivity and rejection of novel foods were highly prevalent problems in the sample of the present study. These factors may affect the intake of nutrients and calories and may possibly be in the genesis of the nutritional deviations observed in the present study⁽²⁷⁾.

A comparative cohort study carried out in the United States with children with ASD and a control group of children with typical development found that children with ASD aged 2-5 years were more likely to be overweight. On the other hand, the prevalence rate of underweight was higher in children with ASD compared with the control group for the 6-11 years age range. These results also agree with the double burden of nutritional deviations observed in the

present research. According to the authors of the American study, this result can be explained by the fact that children aged 2-5 years spend more time in therapy sessions in which snacks are used to improve children's participation and also because they have less physical activity opportunities. The high prevalence rate of underweight among children with ASD aged 6-11 years was explained by the autonomy in food choices and access to foods at that age⁽²⁸⁾.

The rates of overweight in children with ASD found in the present research are similar to those reported in a study carried out with children with ASD aged 2-6 years in Curitiba, Paraná, in which the rate of overweight was 41.2%⁽²²⁾. High percentages of overweight were also found in children aged 3-10 years diagnosed with ASD in the city of Limoeiro do Norte, Ceará. The results showed high rates of overweight (23.1%) and obesity (15.38%)⁽²⁹⁾. On the other hand, a study carried out in Khartoum State, Sudan, found lower frequencies, with about 20% of children and adolescents (3-13 years old) being overweight⁽³⁰⁾.

The assessment of food consumption and the nutritional diagnosis of children with ASD contribute to food and nutritional surveillance, which is one of the guidelines of the National Food and Nutrition Policy (*Política Nacional de Alimentação e Nutrição – PNAN*). The objective of this guideline is to monitor the food and nutritional status in order to improve the population's dietary conditions⁽³¹⁾. Furthermore, considering that diet is one of the priorities of the National Health Promotion Policy (*Política Nacional de Promoção da Saúde – PNPS*), assessing and identifying the food and nutritional aspects of these children has been an important tool for health promotion⁽³²⁾.

Thus, checking for the presence of disorders and identifying the most consumed foods are key to developing and implementing specific strategies to protect and promote the health of children with ASD and their families at all levels care.

It is known that ASD has a strong influence on family dynamics – hence the need to promote comprehensive and longitudinal care⁽³³⁾. In the context of care and health promotion, it is important to include the nutritionist in the multidisciplinary team that serves the child with ASD in order to manage the eating problems typically developed by them. The nutritionist should encourage parents to include healthy foods instead of ultra-processed foods, which, in addition to being associated with overweight, have a significant impact on the general health of the child⁽⁶⁾. Thus, nutritional strategies should aim at creating a link between the child and the food, especially those foods mostly rejected by the child. In addition, the improvement in food consumption and a balanced and healthy diet can have positive impacts on nutritional status, growth and development, and on typical signs and symptoms of ASD.

The reduced sample size and the use of only one 24HR may be considered limitations of the present study. However, because it is a low-frequency outcome in children, obtaining a large sample size is difficult. In addition, the limitations of analyzing only one day of dietary recall are attenuated by the fact that children with ASD tend to have a monotonous diet and a limited food repertoire^(34,35).

One of the strengths of this study is its novelty in assessing food consumption in children with ASD based on the new classification of foods according to the level and purpose of processing and its association with overweight. The diagnosis of ASD based on the report issued by the neuropsychiatrist as a criterion for inclusion in the study is a factor that strengthens the quality of the selection of the sample.

CONCLUSION

Natural or minimally processed foods were the basis of the diet of the analyzed children. Despite that, the high consumption of ultra-processed foods was associated with overweight in children with ASD. Therefore, these children and their families should be included in nutrition education programs to raise awareness of the importance of an adequate and healthy diet and to prevent nutritional disorders.

CONTRIBUTIONS

Ana Karla de Araújo Almeida contributed to conception, development, statistical analysis and drafting of the manuscript; **Poliana Cristina de Almeida Fonseca, Leila Alves Oliveira** and **Wylliane Rayana Chaves Carvalho Santos** contributed to conception, statistical analysis and final revision of the manuscript. **Adrielle Zagnignan** contributed to conception, development and final revision of the manuscript. **Bianca Rodrigues de Oliveira** contributed to statistical analysis, drafting and final revision of the manuscript. **Virgínia Nunes Lima** contributed to conception, development, statistical analysis and final revision of the manuscript. **Carolina Abreu de Carvalho** contributed to conception, development, statistical analysis, drafting and final revision of the manuscript.

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