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NUTRITIONAL PROFILE OF CHILDREN BEARING AUTISM SPECTRUM DISORDER

Perfil nutricional de crianças portadoras do transtorno do espectro autista

Perfil nutricional de niños portadores de trastorno del espectro autista

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ABSTRACT

Objective: To evaluate the nutritional status and dietary intake of children bearing the autism spectrum disorder (ASD). **Methods:** The study had a quantitative, descriptive, exploratory and cross-sectional approach. Twenty-six children aged 3 to 10 years, with diagnosis of ASD, of both sexes, attended to in the city of Limoeiro do Norte, Ceará State, Brazil, participated in the study. Data was collected through interviews, guided by a socioeconomic questionnaire (age, family income, participants' level of education, psychopharmacological treatment, age at diagnosis of ASD, ICD-10 coding, and clinical history); dietary history, application of three 24-hour recalls, and anthropometric measurements (body weight, height, arm circumference and tricipital and subscapular skinfolds), with a subsequent calculation of the body mass index (BMI). Descriptive analysis was used and continuous variables were expressed as mean $\pm$ standard deviation and coefficient of variation. **Results:** Of the children evaluated, 10 (38.5%) were overweight (23.1%, n=6) or obese (15.38%, n=4) according to the BMI-for-age, and a further 10 children (38.5%) were at risk of overweight. The estimated energy requirement (EER) was above that recommended in 14 (53.85%) of the autistic patients. The intake of vitamins A (77%, n=20) and B6 (58%, n=15) and calcium intake (50%, n=13) were inadequate. **Conclusion:** Children with ASD evidence high overweight and obesity rates, and high inadequacy in vitamins and minerals intake.

Descriptors: Nutrition Assessment; Food Consumption; Autistic Disorder.

RESUMO

Objetivo: Avaliar o estado nutricional e o consumo alimentar de crianças portadoras do transtorno do espectro autista (TEA). **Métodos:** O estudo teve abordagem de natureza quantitativa, descritiva, exploratória e transversal. Participaram 26 crianças, de 3 a 10 anos de idade, com diagnóstico do TEA, de ambos os sexos, atendidas no município de Limoeiro do Norte, Ceará. Os dados foram coletados através de entrevistas, ordenadas por um questionário sociodemográfico (idade, renda familiar, escolaridade dos participantes, tratamento psicofarmacológico, idade recebida do diagnóstico do TEA, classificação da CID-10 e histórico clínico); histórico nutricional; aplicação de 3 recordatórios de 24 horas; e medidas antropométricas (peso, altura, circunferência do braço e as dobras cutâneas tricipital e subescapular), com posterior cálculo do índice de massa corporal (IMC). Utilizou-se análise descritiva e as variáveis contínuas foram expressas em média $\pm$ desvio padrão e coeficiente de variação. **Resultados:** Das crianças avaliadas, 10 (38,5%) apresentaram sobrepeso (23,1%, n=6) e obesidade (15,38%, n=4) pelo IMC/I (Índice de Massa Corporal para Idade), bem como 10 crianças (38,5%) apresentaram risco de sobrepeso. O consumo de energia (EER) esteve acima do recomendado para 14 (53,85%) dos autistas. Identificou-se inadequação no consumo de vitamina A (77%, n=20), vitamina B₆ (58%, n=15) e cálcio (50%, n=13). **Conclusão:** As crianças com o TEA demonstram elevados índices de sobrepeso, obesidade e elevada inadequação na ingestão de vitaminas e minerais.

Descritores: Avaliação Nutricional; Consumo de Alimentos; Transtorno Autístico.



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RESUMEN

Objetivo: Evaluar el estado nutricional y el consumo de alimentos de niños portadores de trastorno del espectro autista (TEA). **Métodos:** Estudio de abordaje cuantitativo, descriptivo, exploratorio y transversal. Participaron 26 niños entre 3 y 10 años de edad, de ambos los sexos y con el diagnóstico de TEA que eran asistidos en el municipio de Limoeiro de Norte, Ceará. Se recogieron los datos a través de entrevistas ordenadas por un cuestionario sociodemográfico (edad, renta familiar, escolaridad de los participantes, tratamiento psicofarmacológico, edad que recibió el diagnóstico de TEA, clasificación de la CID-10 e historia clínica); el histórico nutricional; la aplicación de 3 recordatorios de 24 horas; y las medidas antropométricas (el peso, la altura, la circunferencia del brazo y los pliegues cutáneos tricipital y subescapular) con posterior cálculo del índice de masa corporal (IMC). Se utilizó el análisis descriptivo y las variables continuas se expresaron en media $\pm$ desviación típica y coeficiente de variación. **Resultados:** De entre los niños evaluados, 10 (38,5%) presentaron sobrepeso (23,1%, $n=6$) y obesidad (15,38%, $n=4$) a partir del IMC/E (Índice de Masa Corporal para la edad), así como 10 niños (38,5%) presentaron riesgo de sobrepeso. El consumo de energía (EER) estuvo por encima del recomendado para 14 (53,85%) de los autistas. Se identificó como inadecuado el consumo de vitamina A (77%, $n=20$), vitamina B₆ (58%, $n=15$) y calcio (50%, $n=13$). **Conclusión:** Los niños con TEA han demostrado elevados índices de sobrepeso y obesidad e inadecuada ingesta de vitaminas y minerales.

Descriptores: Evaluación Nutricional; Consumo de Alimentos; Trastorno Autístico.

INTRODUCTION

Autism Spectrum Disorder (ASD) is a developmental disorder characterized by changes in cognitive ability and social interactions that may lead to food selectivity. This disorder presents a variety of high-complexity clinical manifestations, which may be related to innumerable interactions between genes, epigenetic factors and exposure to environmental factors⁽¹⁾. The ASD etiology is still unknown, despite the existence of countless hypotheses and the fact that more than 70 years have passed since the first studies and publications on the subject⁽²⁾.

In the 1980s and 1990s, its prevalence was estimated at 4-5/10,000 inhabitants, increasing to 30-60/10,000 in the 1990-2000 decade. According to the Centers for Disease Control and Prevention (CDC), in 2015, there was a prevalence of the disorder of 14.7 per 1000 (1 in 45) in 8-year-old children, affecting 1 in every 42 boys and 1 in every 189 girls⁽³⁾.

According to the 2010 census of the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística - IBGE*)⁽⁴⁾, it is estimated that there are 454,706 children with autism spectrum disorder (ASD) in Brazil, with a prevalence rate of one to 150, in a proportion of 3 men to 1 woman. In Ceará, the data is inaccurate.

Given this scenario, the different levels of care could outline health promotion strategies for ASD patients and their families, with the aim of providing comprehensive health care and promoting quality of life. To that end, the participation of health professionals and public policy managers is necessary, offering primary health care related to diagnosis, prevention of health conditions, and the availability of rehabilitation and continuous care⁽⁵⁾.

The main health promotion interventions pointed out in the literature, related to the autistic people, consider important aspects of their context (motor, cognitive, communication, expression, socialization, psychic and nutritional), aiming at preventing the deficiency disease and favoring social competences for their autonomy and independence, which are intended to improve their lives in general⁽⁶⁾.

In addition to the most striking features perceived in individuals bearing the Autism Spectrum Disorder (ASD), which are mainly related to poor language development and social interaction, there are also several gastrointestinal disorders that can affect the autistic people, such as the reduced production of digestive enzymes, inflammation of the intestinal wall and altered intestinal permeability, and all these factors aggravate the symptoms of patients with the disease⁽⁷⁾.

Inadequate diet and energy imbalance are of particular concern because micronutrient intake is closely related to the energy intake and it is likely that children with lower energy consumption will also suffer from vitamin and mineral deficiencies⁽⁸⁾. Data suggest that autistic children are two to three times more likely to become obese than the adolescents in the general population⁽⁹⁾. Therefore, physical activity and nutritional care are valuable elements in the prevention of diseases such as childhood obesity, for maintenance of functional independence, social participation and quality of life. Inadequate nutritional status, limited food variety and severity of symptoms associated with ASD can have a significant impact on the quality of life of patients, parents and caregivers⁽¹⁰⁾.

Thus, one can see that the relationship between the ASD and nutritional aspects, such as nutritional status and eating behavior, is still inconclusive. Therefore, research that improves this relationship can directly contribute to the construction of quality evidence and, consequently, provide proper intervention strategies for patients and families. In this context, the aim of the study was to evaluate the nutritional status and food consumption of children bearing the autism spectrum disorder (ASD).

METHODS

This is a quantitative, descriptive, exploratory and cross-sectional study carried out in the parents' association named *Diamante Azul*, in the municipality of Limoeiro do Norte, Ceará, Brazil, from March to June 2017.

The survey included children aged 3 to 10 years, of both sexes, diagnosed with ASD according to the ICD-10 disease coding⁽¹¹⁾, in agreement with the Diagnostic and Statistical Manual of Mental Disorders of the American Academy of Psychiatry (DSM-IV-TR)⁽¹²⁾, and whose parent or guardian allowed participation by signing the informed consent form.

Data was collected by means of a home visit held during the months from March to June 2017, in which the interviews were conducted, ordered by a sociodemographic questionnaire comprising objective and subjective questions, dietary history, three 24-hour recalls (two days referring to the week, and the other one, to the weekend), and anthropometric measurements were also carried out.

The interview was applied after obtaining the Minors' Assent Form and having the Informed Consent Form signed by the parents of the children participating in the research, emphasizing the aspects pertinent to the autonomy, nondisclosurement and confidentiality of the data.

The sociodemographic questionnaire was applied in order to identify age, family income, schooling, psychopharmacological treatment, age at ASD diagnosis, ICD-10 classification⁽¹¹⁾ and clinical history of the patients.

The food consumption estimation was assessed by means of a three-day 24-hour dietary recall, all applied in person at the participant's residence. This method consists of obtaining verbal information, referring to the food intake of the last 24 hours, containing data on food and beverages, as well as the weight/size of portions consumed⁽¹³⁾. It should be noted that the survey applied was answered by those responsible for the children. The total energy value (TEV) was identified, and the carbohydrate, protein and lipid contents were calculated according to the recommendation of 45% to 65%, 10% to 30%, and 25% to 35%, respectively⁽¹⁴⁾. In this study, it was considered an intake margin of 10% of the recommended intake, that is, the intake between 90% and 110% of the recommended value was considered adequate; less than 90%, intake less than recommended; and, above 110%, intake above recommended.

The Brazilian Food Composition Table⁽¹⁵⁾ was used as reference to obtain the nutritional composition of the foods. After the calculations, the values were compared with the dietary reference intakes (DRI) according to the estimated average requirement (EAR), or adequate intake (AI), and tolerable upper intake limit (UL)⁽¹⁶⁾, considering sex and age of each patient. The following micronutrients were evaluated: calcium (Ca), magnesium (Mg), phosphorus (P), iron (Fe), potassium (K), sodium (Na), vitamin A (A), vitamin B1 (B1), vitamin B2 (B2), niacin, vitamin B6 (B6), vitamin C (C) and also fibers and cholesterol.

The anthropometric parameters used were weight, height, arm circumference, and triceps and subscapular skinfolds. The weight was measured on a digital platform-type electronic scale (Toledo®), with a capacity of 200 kg. Height and arm circumference (AC) were measured using inextensible metric tape (Cescor®) with an accuracy of 1mm. For measurement of height, the participants were leaning against a wall, barefoot, with their feet parallel, their ankles together, standing erect, their arms along their body, with their head positioned so that the lower part of the eye socket would be in the same plane of the outer ear hole⁽¹⁷⁾. Mid-upper arm circumference (MUAC) was measured at the midpoint between the acromion and the olecranon⁽¹⁸⁾. A clinical adipometer (Cescor®), which exerts a pressure of 10g/mm² with an accuracy of 1 mm, was used to collect the skinfolds (triceps and subscapular) measures.

From these parameters, the nutritional status of each participant was then classified according to weight-for-age (W/A), height-for-age (H/A), weight-for-height (W/H) and body mass index for age (BMI/A) as described by SISVAM⁽¹⁹⁾, according to the Z score. For arm circumference measurement, the percentages of adequacy were calculated for: arm circumference (% MUAC), arm muscle circumference (% AMC), corrected arm muscle circumference (% cAMC) and triceps skinfold (% TSF)⁽²⁰⁾. In order to classify the adiposity reserve, the percentiles of triceps skinfold (TSF), subscapular skinfold (SSF) and the sum of triceps and subscapular skinfolds (STSSF) were used⁽¹⁸⁾.

The software Statistical Package for Social Sciences, version 21.0 (SPSS® Inc, Chicago, IL) was used for descriptive analysis, and the continuous variables were expressed as mean $\pm$ standard deviation and coefficient of variation.

The study was approved by the Research Ethics Committee of the Federal Institute of Education, Science and Technology of Ceará (IFCE), according to Approval no. 2.160.713.

RESULTS

The mean age of the research participants (n=26) was 7 years ($\pm$ 2), with no participant younger than three years old. The present study identified that 24 (92.31%) children in the sample were boys and only 2 (7.69%) were girls. All the children participating in the study had a settled diagnosis with ICD-10 classification⁽¹¹⁾. Of these, 24 (92.4%) were coded as F84.0 (infant autism) and 2 (7.6%) were classified as F84.0 with associations F71.0 (moderate mental retardation) and F90.0 (hyperkinetic disorders). Data showed that 50% (n=13) of families have family income between 1 and 1.5 minimum wages.

The results showed that 69.2% of the participants (n=18) were under psychopharmacological treatment. Among the most consumed drugs is risperidone, in 42.3% (n=11). In addition to the psychopharmacological treatment, 21 (80.8%) children undergo multiprofessional therapies with psychologists, occupational therapists and speech therapists at least once a week, and the whole sample attends schools or day care centers. (Table I).

Table I - Description of socioeconomic data of children aged 3 to 10 years with diagnosis of autism spectrum disorder. Limoeiro do Norte, Ceará, 2017.

Variables	Categories	n	%
Sex	Female	2	7.69
	Male	24	92.31
Age	From 3 to 4 years old	4	15.4%
	From 5 to 6 years old	8	30.8%
	From 7 to 8 years old	8	30.8%
	From 9 to 10 years old	6	23.1%
Family income	< 1 minimum wage	1	3.8%
	1 minimum wage	13	50.0%
	From 1.5 up to 2 minimum wages	8	30.8%
	More than 2 minimum wages	4	15.4%
With a medical diagnosis report	Yes	26	100.0%
	No	0	0.0%
Age at diagnosis	<3 years	5	19.2%
	From 3 to 4 years old	16	61.5%
	From 5 to 6 years old	2	7.7%
	From 7 to 8 years old	2	7.7%
	From 9 to 10 years old	1	3.8%
ICD-10 Coding	F84.0	24	92.4%
	F84.0/F71.0	1	3.8%
	F84.0/F90.0	1	3.8%
Use of medication	Yes	18	69.2%
	No	8	30.8%
Medication used	Risperidone	11	42.3%
	Ritalin	4	15.4%
	Neuleptil	3	11.5%
	Depaquer	3	11.5%
	Others	5	19.2%
Attending school	Yes	26	100%
	No	0	0%
Multiprofessional therapy	Yes	21	80.8%
	No	5	19.2%

Legend: F84.0: Childhood autism; F71.0: Moderate mental retardation; F90.0: Hyperkinetic disorders.

In the evaluation of energy consumption, classification bands were established. Values lower than 90% of the recommendation were considered below-recommended consumption; from 90% to 110%, suitable; and above recommendation, when higher than 110%. The values found can be observed in Figure 1.

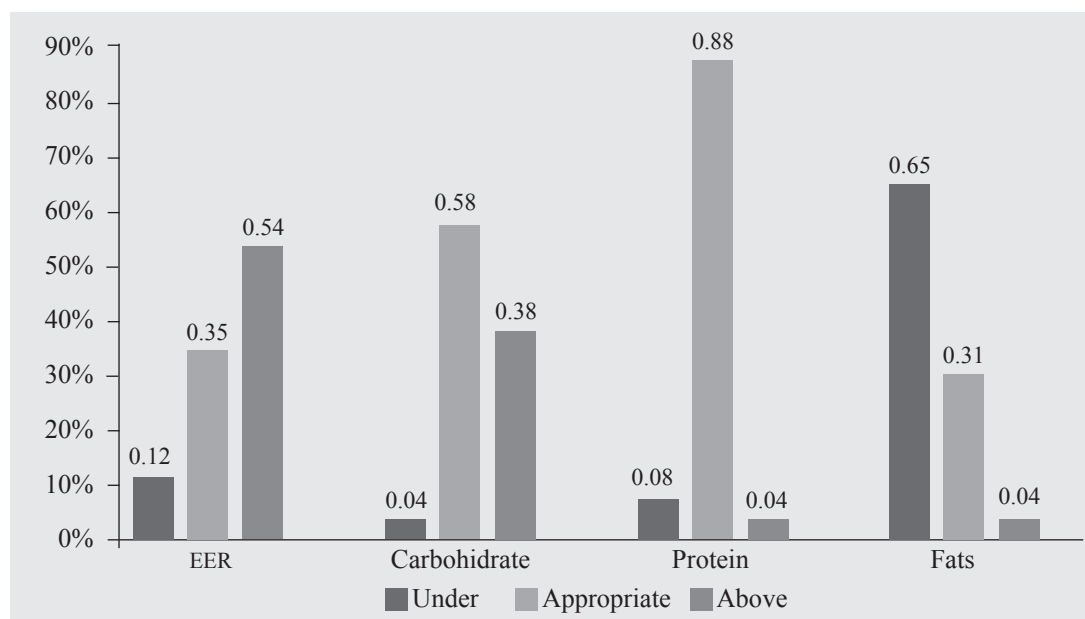


Figure 1 - Description of the percentage of adequacy of Estimated Energy Requirement (EER) and macronutrient consumption in autistic children. Limoeiro do Norte, Ceará, 2017.

Legend: EER: Estimated Energy Requirement

To evaluate the adequacy of the macronutrients, the IOM⁽¹⁴⁾ recommendation was used, which indicates: 45% to 65% for carbohydrate, 10% to 30% for protein, and 25% to 35% for lipids, with age ranging from 4 to 18 years.

The results for carbohydrate (57.69%, n=15) and proteins (88.46%, n=23) were adequate, differing from the value for lipids (65%, n=17), which was below recommended. However, the results found for the Estimated Energy Requirement (EER) are above the recommended level for 14 (53.85%) research participants.

Next, Table II demonstrates the adequacy of minerals and vitamins, respectively, found based on recommendations regarding the DRIs⁽¹⁶⁾.

Table II - Description of the results of the consumption of minerals and vitamins in autistic children according to the dietary reference intakes (DRIs). Limoeiro do Norte, Ceará, 2017.

Consumption	Minerals						Vitamins					
	Ca (mg)	Mg (mg)	P (mg)	Fe (mg)	K (mg)	Na (mg)	A (mcg)	B1 (mg)	B2 (mg)	Niac. (mg)	B6 (mg)	C (mg)
POS ADE	46.15% (n=12)	0.00% (n=0)	80.77% (n=21)	88.46% (n=23)	100.00% (n=26)	26.92% (n=7)	23.08% (n=6)	84.62% (n=22)	69.23% (n=18)	26.92% (n=7)	42.31% (n=11)	69.23% (n=18)
POS INAD	50.00% (n=13)	42.31% (n=11)	19.23% (n=5)	7.69% (n=2)	0.00% (n=0)	69.23% (n=18)	76.92% (n=20)	15.38% (n=4)	30.77% (n=8)	19.23% (n=5)	57.69% (n=15)	30.77% (n=8)
POS HARM	3.85% (n=1)	57.69% (n=15)	0.00% (n=0)	3.85% (n=1)	0.00% (n=0)	3.85% (n=1)	0.00% (n=0)	0.00% (n=0)	0.00% (n=0)	53.85% (n=14)	0.00% (n=0)	0.00% (n=0)

Legend: POS ADE: possibly adequate; POS INAD: possibly inadequate; POS HARM: possibly harmful; Ca: calcium; Mg: magnesium; P: phosphorus; Fe: iron; K: potassium; Na: sodium; mg: milligram; A: vitamin A; B1: vitamin B1; B2: vitamin B2; Niac: niacin; B6: vitamin B6; C: vitamin C; mcg: microgram

Among the minerals, a possible inadequacy was identified in the intake of calcium (50%, n=13) and sodium (69.23%, n=18). Magnesium obtained a possibly harmful result (57.69%, n=15). Phosphorus, iron and potassium were found to be possibly adequate, with 80.77% (n=21), 88.46% (n=23) and 100% (n=26), respectively.

The data presented for vitamin consumption showed an inadequacy for vitamin A (77%, n=20) and B6 (58%, n=15), being below recommendations.

The consumption was within the recommended range for vitamins B1 (84.62%, n=22), B2 (69.23%, n=18) and C (69.23%, n=18); only niacin was at a possibly harmful level.

The results found for the percentage of fibers consumed by the children were 10 (38%) adequate; however, 9 (35%) were harmful and 7 (27%) were inadequate. Consumption of dietary fiber may be associated with the bowel habits of the participants inasmuch as 20 (77%) performed the defecation at least once every day, being rated as 2 or 3 on the Bristol Scale.

Table III demonstrates the nutritional status of ASD patients and highlights that 10 (38.5%) presented excess weight (23.1%, n=6) and obesity (15.38%, n=4) according to the BMI/A (Body Mass Index for age); a further 10 children (38.5%) presented risk of excess weight and 20 children (76.98%), risk of obesity. The weight-for-height index (W/H) was similar to the BMI/A parameter, in which the sum of the percentage of children presenting risk of excess weight (15.38%, n=4), excess weight (9%, n=7) and obesity (19.23%, n=5) exceeded the percentage of children diagnosed with eutrophy (38.46%, n=10).

The W/A index showed that the majority of the children (57.69%, n=15) were adequately weighed for age; nevertheless, the values referring to children who presented a high weight for age (38.5%, n=10) were also relevant. The H/A was found adequate in the whole sample evaluated.

Table III - Classification of the nutritional status of autistic children. Limoeiro do Norte, Ceará, 2017.

Classification of nutritional status				
BMI for age (BMI/A)				
Thinness 3,85% (n=1)	Eutrophy 19,23% (n=5)	Risk of excess weight 38,46% (n=10)	Risk of excess weight 23,08% (n=6)	Obesity 15,38% (n=4)
Weight for age (W/A)				
	Low weight for age 3.8% (n=1)	Appropriate weight for age 57.69% (n=15)	High weight for age 38.51% 9 (n=10)	
Weight for height (W/H)				
	Eutrophy 38.46% (n=10)	Risk of excess weight 15.38% (n=4)	Risk of excess weight 26.93% (n=7)	Obesity 19.23% (n=5)
Height for age (H/A)				
		Appropriate height for age 100% (n=26)		

Legend: n: number of children; BMI: Body Mass Index

The nutritional profile of the evaluated public, according to the percentages % MUAC, % AMC, % cAMC and % TSF, and values of TSF, SSF and STSSF, is shown in Table IV. The nutritional classification by % MUAC indicates that 38.46% (n=10) presented a eutrophic classification. However, this cannot be considered a positive value if associated with 42.31% (n=11) for excess weight and obesity, as well as 19.23% (n=5) for moderate and mild malnutrition. As for fat reserve, according to TSF, SSF and STSSF, the findings show that a majority of the patients present excess fat (obesity), 65.38% (n=17), 76.92% (n=20) and 76.92% (n=20), respectively.

These results emphasize the importance of nutritional assessment (anthropometric measurements, body composition) within the clinical routine of patients with ASD and their families, always considering the unique characteristics of each patient.

Table IV - Classification of the body composition of autistic children. Limoeiro do Norte, Ceará, 2017.

Classification of body composition				
Mid-upper arm circumference (% MUAC)				
Severe malnutrition 7.69% (n=2)	Mild malnutrition 11.54% (n=3)	Eutrophy 38.46% (n=10)	Excess weight 19.23% (n=5)	Obesity 23.08% (n=6)
Arm muscle circumference (% AMC)				
Severe malnutrition 11.54% (n=3)	Moderate malnutrition 7.69% (n=2)		Mild malnutrition 26.92% (n=7)	Eutrophy 53.85% (n=14)
Corrected arm muscle circumference (% cAMC)				
	Normal 73.08% (n=19)		Mild moderate malnutrition 26.92% (n=7)	
Triceps skinfold percentage (% TSF)				
Severe malnutrition 7.69% (n=2)	Mild malnutrition 3.85% (n=1)	Eutrophy 7.69% (n=2)	Excess weight 7.69% (n=2)	Obesity 73.08% (n=19)
Triceps skinfold (TSF)				
	Undernourished 3.85% (n=1)	Eutrophy 30.77% (n=8)	Obesity 65.38% (n=17)	
Subscapular skinfold (SKF)				
	Eutrophy 23.08% (n=6)		Obesity 76.92% (n=20)	
Sum of tricipital and subscapular skinfolds (STSSF)				
	Undernourished 3.85% (n=1)	Eutrophy 19.23% (n=5)	Obesity 76.92% (n=20)	

Legend: n: number of children

DISCUSSION

In the present study, the analyzed sample (n=26) presented a higher prevalence for the male sex, corroborating the findings of previous studies^(13,21), which report a higher incidence in epidemiological surveys of autism, with an average of 3.5 to 4 boys for every 1 girl; also highlighting autism as being 4 times more common in boys than in girls, on a scale of 5/10,000. The mean age at which the children received the diagnosis was at 4 years, with no children younger than three years in the present study, a fact that is associated with the difficulty in confirming the early diagnosis of this disorder⁽¹³⁾. The ASD diagnosis is eminently clinical, and should be performed with use of ICD-10 criteria⁽¹¹⁾, by means of the medical history with parents, legal guardians and/or caregivers, as well as the clinical observation of behavior⁽³⁾.

The data evaluated in the present study shows that 50% of families had family income between 1 and 1.5 minimum wages. This result is similar to that observed in another study⁽²²⁾, in which 56% of the families interviewed had similar family income.

There was a high prevalence of autistic patients (69.2%) who underwent psychopharmacological treatment in the current research. Risperidone is among the most commonly used drugs, with 42.3%, and showing positive results, which include the reduction in aggressiveness, irritability and isolation; however, its most common adverse effects are drowsiness, dizziness, sialorrhea and weight gain. The use of risperidone is also associated with metabolic alterations, such as increased insulin resistance, hyperglycemia, arterial hypertension and dyslipidemia⁽²³⁾. Medicines with action in the central nervous system are not used for healing, but rather for relief of symptoms. The participation of 100% of the sample in schools or day care centers helps to create alternatives for social inclusion, since the contact with multiprofessional therapies increases their ways of expressing themselves and communicating⁽²⁴⁾.

The results of the present study were adequate for carbohydrate (57.69%) and proteins (88.46%), in contrast with the value for lipids (65%), which was below recommended levels. It is worth mentioning that diets with insufficient amounts of fat can lead to reduced absorption of some micronutrients, such as fat-soluble vitamins⁽²⁵⁾. Nevertheless, the results found for Estimated Energy Requirement (EER) were above the recommended level for 53.85% of the autistic patients. Such findings are possibly associated with frequent eating errors that characterize the disorder, such as selectivity and binge eating. Food selectivity varies from child to child, constituting a problem when it interferes with daily and social routine⁽²⁶⁾. Reports and testimonies of people with ASD suggest that the sensory characteristics of foods, such as odor, texture, color and temperature, may contribute to food selectivity^(27,28).

It is very common for autistic children to have nutritional deficiencies, since most have a monotonous diet. However, even if the child has a varied and nutritionally adequate diet, they must be able to perform three basic functions which, unfortunately, are not done by the majority: digesting and properly breaking food into an absorbable form, absorbing nutrients through the gastrointestinal tract (GIT), and converting the nutrients into a usable form at the cellular level⁽²⁵⁾.

The most common micronutrient deficiencies in ASDs are of vitamins B1, B3, B5, B6, B9, B12, A and the minerals calcium (Ca), zinc (Zn), selenium (S) and magnesium (Mg)⁽²⁹⁾. In the current work, a possible inadequacy (50%) of calcium (Ca) can be observed, which is directly associated with several organic functions, such as modulation of transduction signals, energy production metabolism and cellular proliferation, with the resulting symptoms of its deficiency associated with: anxiety, depression, hyperactivity, agitation, hallucinations, irritability, nervousness, aggression, chronic stress, learning difficulties and memory loss⁽³⁰⁾. As concerns the vitamin A intake, the result of the current investigation pointed out a possible inadequacy. Such deficiency in children can cause growth failure and ocular damage, such as xerophthalmia⁽³⁰⁾.

Nutrients such as vitamin B6 are of major importance for methylation, transsulfonation and sulfation, which represent a set of biochemical activities that do not function properly in patients with ASD. When such metabolic transformations are limited, the neurotransmitters are not properly activated, causing symptoms of anxiety, depression, attention deficit and sleep disorder. This, in association with increased intake of aluminum, mercury, glutamate and various artificial substances ingested in the diet, favor accumulation in the body and give rise to cerebral alterations that lead to irritability, aggressiveness, hyperactivity⁽¹³⁾. Limitation in the consumption of those nutrients, together with the conversion of enzymes, seems to be one of the reasons for the deficiency of components that are essential to the organism of autistic children, such as: sulfate, cysteine, taurine and glutathione, thus hindering a majority of the metabolic processes found⁽²⁵⁾.

Adequate intake of other vitamins, such as B1 and niacin, is of great importance for autistic children, as their deficiency is characterized by neurological signs and may intensify the symptoms related to the disorder, since it prevents the conversion of acetaldehyde (neurotoxic substance) in autistic children, impairing its elimination by the organism. This can affect brain structures and eventually interfere with the neural development of the autistic individual⁽²³⁾.

In addition to the great importance associated with the assessment of micronutrients, attention should be given to the role of dietary fibers in modulating intestinal health. Adequate fiber intake should provide normal bowel function, prevent diet-related cancer, and reduce serum cholesterol for a decreased risk of cardiovascular disease. Its inadequacy may affect neurological functions by means of several mechanisms, reflecting many of the symptoms seen in ASD⁽²⁵⁾. Studies^(25,31) have demonstrated that the digestion of foods by autistic children is usually impaired due to low sulfation and transsulfonation, digestion processes that are essential for intestinal mucosal integrity, detoxification and microbiota balance, and this may interfere with the absorption of micronutrients and lead to low levels of minerals and vitamins, among other compounds.

Along with the parameters related to dietary intake, adequate physical and anthropometric assessment may contribute to a better understanding of the clinical picture of autistic people. Thus, in regard to the nutritional status of children with ASD, studies^(13,32) have been performed aiming to evaluate the nutritional profile of this population.

Clinical observations show that these children are at greater risk of being overweight, since they have great difficulties in practicing physical exercises in a structured way, besides the social isolation, which makes it possible the increase of sedentarism and corroborates the data of this research, in which none of the participants are engaged in any physical activity. However, excess weight and obesity are public health problems in the general population, since the incidence of many chronic diseases in adulthood is directly related to childhood obesity⁽³³⁾.

In the child, obesity increases the risk of short- and long-term problems, such as diabetes, cardiovascular and psychosocial diseases. International study indicates that children and adolescents with ASD may be particularly vulnerable to these weight changes⁽¹⁰⁾. Thirty children attending a special school in Campo Grande, Brazil, were evaluated, and the results showed that four (13.3%) were obese and seven (23.3%) were underweight. Similarly, the evaluation of 23 autistic children and adolescents observed that three (13%) were underweight, five (21.7%) were overweight and six (26.1%) were obese⁽⁷⁾. Although the evaluation methods presented establish an overall nutritional profile of patients with ASD, it is necessary to associate methods of body composition assessment, since these enable a more accurate nutritional diagnosis.

The MUAC percentage adequacy is an anthropometric nutritional parameter recommended by the WHO to estimate the total musculoskeletal protein, providing index of fat deposition and local muscle mass, and can be considered an independent measure, being one of the most used measures in nutritional assessment⁽³⁴⁾. The MUAC adequacy percentage evaluates the reserve of muscle tissue without correction related to the bone area (not taking into account the bone diameter). The diagnosis found for this parameter indicates that 53.85% of the children with ASD in the current study were eutrophic. On the other hand, 46.15% presented mild to severe malnutrition. Using this formula to calculate the adequacy of AMC may underestimate muscle loss by up to 20 to 25%, since the bone area is included in the calculation, thus masking the body loss.

The diagnosis presented for the percentage of cAMC adequacy, which evaluates the reserve of muscle tissue after correcting the bone area (taking the bone diameter into consideration), was normal for 78.03% (n=19) of the children, reflecting more adequately the actual magnitude of changes in muscle tissue than the percentage of AMC adequacy⁽²⁰⁾. The nutritional status, according to the percentage of TSF adequacy, reveals a higher prevalence of obesity, with 73.08% (n=19). This is the most

used skinfold for monitoring the nutritional status in clinical practice because it is more representative of body fat distribution, regardless of age and sex, since it correlates significantly with body weight and fat mass^(18,20). According to the WHO⁽¹¹⁾, there has been an increase in the prevalence of obesity in childhood and adolescence, regardless of the method used in anthropometric classification.

This fact demands that interventions be aimed for health promotion, such as a healthy eating policy, actions that encourage regular physical activity and cultural leisure activities. The studies have not yet determined the ideal treatment that encompasses the nutritional context, behavioral control, medication, physical and educational aspects⁽²⁹⁾. The dietary intervention is aimed at improving the physical health and well-being of these individuals, and it is essential to provide autistic children with nutritional support, contributing to correct eating errors, as well as to promote health and quality of life. Early diagnosis is the only consensus worldwide with regard to autism⁽³⁵⁾.

The development of further research and the continuation of new studies is important to improve the professional approach in its form and, consequently, these patients' quality of life and health as well. The present study has some limitations, since the sample is from a limited area in the northeast of the country and may not represent the same characteristics for other groups of children with ASD.

CONCLUSION

The children with autism spectrum disorder evaluated showed high rates of excess weight and obesity, limited food repertoire, high inadequacy regarding the intakes of vitamins (A and B6) and mineral calcium, which may be associated with high consumption of high-calorie foods with poor micronutrient content.

CONFLICT OF INTERESTS

There was no conflict of interests in the present study.

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