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RELATIONSHIP BETWEEN NUTRITIONAL STATUS AND METABOLIC SYNDROME IN TEENAGERS IN THE PIAUÍ SEMIARID[1]

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ABSTRACT
This is a descriptive, quantitative-type study carried out at nine schools of the private network of the municipality of Picos-PI. The objective was to analyze the relationship between nutritional status and metabolic syndrome in adolescents from Piauí semiarid region. The sample consisted of 289 adolescents aged between 10 and 19 years. Data were collected through a form containing socioeconomic data, anthropometric data and hemodynamic measurements. In the definition of metabolic syndrome, the following variables were considered: central obesity; dyslipidemia; high blood pressure; and altered fasting glycemia. For statistical analysis, the Statistical Package for the Social Sciences version 20.0 for Windows® was used. There was an excess body weight in both sexes, in relation to the components of the metabolic syndrome, the adolescents presented alterations in the TG (9.7%), Total Cholesterol (20.7%), LDL-C (22.2%), with decreased glucose tolerance (2.4%), HDL-C below desirable (34.6%), with high blood pressure (12.2%) and with cardiovascular risk (28%). Overweight adolescents had higher probability (OR=0.083) to develop the metabolic syndrome. The study concluded that overweight related to the presence of the metabolic syndrome among the surveyed adolescents.

Keywords: Metabolic syndrome. Adolescent. Nutritional status.

INTRODUCTION

With modernity and change in eating habits combined with the sedentary lifestyle, diseases related to the lifestyle of the people have been emerging, especially among teenagers. One of them is the metabolic syndrome, which, in turn, form a set of risk factors for the emergence of chronic diseases, and, until recently, was still ignored.

Metabolic syndrome (MS) is a set of risk factors that together increase the likelihood of developing cardiovascular disease usually related to central deposition of fat and insulin resistance. It is of great importance to highlight the association between MS and cardiovascular disease, increasing the overall mortality in about 1.5 times and cardiovascular in about 2.5 times[1].

According to the Ministry of Health (MS), adolescence corresponds to the age group between 10 and 19 years, and is the period of life characterized by intense growth and development, manifested by anatomical, physiological, psychological and social changes[2].

In Brazil, there is still few scientific evidence on the prevalence of the MS among youngsters, even though overweight is consistent to elevate cardiovascular risk and change the metabolic factors in child and adolescent organisms. There are considerations that the emergence of the MS in young individuals associates with excess body weight. Therefore, as childhood obesity has increased in recent years, the number of adolescents diagnosed with MS should also increase[3].

In adults, the cut-off values for the different components of the MS are already well defined, but for teenagers there is still no consensus in the

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literature, which hinders the diagnosis for this age group. However, this study used the criteria of Cook et al.[4] for definition of the syndrome in the adolescent audience.

The occurrence of the MS in adolescents is linked to increased risk of cardiovascular disease, obesity, psychosocial problems, abnormal glucose metabolism, hepatic and gastrointestinal disorders, sleep apnea, orthopedic complications and disorders in motor development. In addition, the MS, when acquired during the youth, as well as its risks to health, tends to endure into adulthood[3].

In view of the difficult diagnosis in children and adolescents and the suggestions that associate the increase of MS in young individuals in proportion to the excess body weight, this study aims to analyze the relationship between nutritional status and MS in adolescents from the Piauí semiarid.

METHODOLOGY

Descriptive, quantitative-type study developed in Picos-PI. Of the 19 private schools of the city, eight of them constituted the sampling data. These schools have grades/years intended for the age group (10 to 19 years of age) and have agreed to participate in the study by granting institutional authorization.

The data were collected in the period from April to November 2014. The population consisted of all teenagers from 10 to 19 years enrolled in private schools in the Picos urban area.

For the calculation of the sample size, we used the formula for cross-sectional studies with finite population[5]. The study considered as parameters the coefficient of 95% confidence (1.96), the sampling error of 3% and population of 4,500 adolescents (10 to 19 years) (N=4,500), regularly enrolled in private schools in the urban area. The prevalence considered was the least expected among the variables chosen for study (7% for hypertension) (P=0.07) (6,7). After applying the formula, the sample resulted in 289 participants.

The participants were selected proportionally according to the number of students enrolled in each school. The inclusion criterion was age between 10 and 19 years. There was exclusion of the students who were absent on the day for the collection and those who were not fasting.

The study used a form that contemplated information on socio-economic and anthropometric data, and hemodynamic measurements, adapted from another study[5,8]. The weight-related information were processed in kg, accuracy of 100g, Family BWF-model scales; the height was measured in cm, 1 mm precision, in portable stadiometer posted to smooth wall and no footer. The waist circumference (WC) was measured with inelastic and flexible 150cm-long measuring tape, with an accuracy of one decimal place and placed in horizontal plane. The measurement was performed with the patient standing on flat and smooth surface, in upright position, relaxed abdomen, arms arranged throughout the body and feet together.

The nutritional status was classified according to the criteria proposed by the World Heatlh Organization, using indicators of BMI/age, second percentile[9,10].

The blood pressure was checked in accordance with the classic auscultation method, in an instrument validated for the research, following the procedures recommended in the VI Brazilian Guidelines of Hypertension[11].

The sleeve used was appropriate for the circumference size of the adolescents' arms. Two measures were used: systolic blood pressure (SBP) and diastolic blood pressure (DBP), measured after 5 minutes of rest. In case there was a difference between the first and second measures of SBP or DBP of more than 5mmHg, there was a third measurement, considering the average between the 2nd and the 3rd measures of SBP and DBP[8]. The classification considered the curves to determine the percentile of the stature of the child/adolescent according to age and gender, according to the National High Blood Pressure Education Program of the United States[9], complying with the percentile table of arterial blood pressure referenced by the VI Brazilian Guidelines of Hypertension[11]. Teenagers with SBP and/or DBP equal to or above the 95 percentile for gender, age and stature were classified in the condition of high blood pressure. All measurements were carried out at the visited schools.

For analysis of serum dosage of glucose, triglycerides, insulin, total cholesterol, LDL-cholesterol and HDL-cholesterol, the material was collected after fasting of 12 hours, using laboratory techniques for analysis of enzymes and conventional colorimetric determinations respecting the V Brazilian guidelines of Dyslipidemias and Atherosclerosis prevention[10].

Following the same guideline, its results were classified according to the reference values for

adolescents, i.e., the values considered desirable for the lipid profile were: triglycerides (TG) values <100mg/dl; borderline of 100-129mg/dl and high ≥130mg/dl; desirable total cholesterol (TC) <150mg/dl, borderline 150-169mg/dl and high ≥170mg/dl; LDL-C desirable <100mg/dl, borderline 100-129mg/dl and high ≥130mg/dl and desirable HDL-C ≥45mg/dl. For the determination of glycemic and insulin the considered values were <100mg/dl, decreased glucose tolerance >100 to <126mg/dl and diabetes mellitus ≥126mg/dl.

The MS was identified when three or more of the following criteria occurred: central obesity (waist circumference ≥ 90 percentile for age and gender); dyslipidemia (triglycerides > 130 mg/dl; HDL cholesterol < 40 mg/dl); high blood pressure (blood pressure ≥ 95 percentile for gender, age and height); and fasting glucose changed (blood glucose ≥ 110 mg/dl)[4].

There was cardiovascular risk when CC > 90 percentile for gender and age[12]. Overweight and obeses adolescents were grouped together and referred to as overweight (BMI ≥ P85), since they constitute risk groups for use of specific statistical tests.

For statistical analysis, we used the SPSS statistical package, version 20.0 for Windows® (Statistical Package for the Social Sciences), whose analysis was made by means of descriptive and inferential statistics. For the association between dichotomous variables and continuous variables, the Mann-Whitney tests were used for nonnormal variables and the Student's t test for independent samples was used for variables with normal distribution. For the analysis of two independent samples, the Fisher exact test and Odds Ratio were used to determine the estimated probability for the sampling risk with 95% confidence interval.

As for the ethical principles, the study respected Resolution 466/12 (13), governing researches involving human beings. The Research Ethics Committee of the Federal University of Piauí approved the project (Opinion: 352,372). The adolescents' parents and/or tutors and the adolescents themselves received information on the objectives of the study and agreed to participate, signed the informed consent form - ICF and the informed assent form - IAF.

RESULTS AND DISCUSSION

In the results found, the sample distribution (n=289) was in accordance with the identification of adolescents, relating variables, gender and age group, being 57.4% male, 63.0% were in the age group 10-14 years and 37.0% in the 15-19 years, with median of 14 years.

There are many studies about the prevalence of the MS in adolescents. These numbers vary greatly, since different criteria are used for the definition of this diagnosis[14,15]. This study used Cook et al.[4] for reference values, which showed that an association between MS and the variables sex and age was not sufficiently influenced to change the metabolic status of the adolescent's organism.

When analyzing the relationship of these variables with the SM, there was statistical insignificance when obtaining values of p=0.908 for gender and p=0.074 for age.

Table 1. Distribution of the adolescentes by nutritional classification based on the BMI. Picos, 2014. n=289.

BMI	Boys		Girl	
	F	%	F	%
Extreme thinness	-	-	1	6
Thinness	5	4.1	7	4.2
Eutrophy	59	48.0	98	59.0
Overweight	38	30.9	41	24.7
Obesity	21	17.1	19	11.4
Total	123	100.0	166	100.0

The data in table 1 show an excess body weight in more than 36% of girls and 48% of boys.

The National Statute of Family Expenditure (ENDEF) confirmed that the overweight prevailed in the age group from 10 to 19 years, being 7.5% in girls and 3.9% in boys. The growth of these indicators was detected more than a decade after the survey of Family Budgets (POF), which revealed more 18% among boys and 15.4% among girls[3].

The accelerated growth of body weight among teenagers has become a national reality and a global public health problem. Many investigations suggest that the favorable conditions for the development of the MS are associated with nutritional status[16].

A study conducted in the State of Paraná with public school students found that, among the 582 adolescents aged between 12 and 18 years, 6.7% were diagnosed with MS, prevailing in boys (9.4%), while in girls, (4.1%)(6). In this research, the variables: excess body weight and MS can be a troubling relationship when considering the increased numbers of adolescents with the syndrome.

Table 2. Distribution of the sample accoridng to the cardiovascular risk and metabolic changes. Picos, 2015.

Variables	F	%
Cardiovascular risk		
Yes	81	28.0
No	208	72.0
Arterial Blood Pressur		
Normal	214	74.0
Borderline	40	13.8
High	35	12.2
Metabolic Syndrome		
Yes	9	3.1
No	280	96.9
Amount of MS components		
None	166	57.4
1	91	31.5
2	23	8.0
3	8	2.8
4	1	0.3
Total	289	100.0

As table 2 shows, 28% of the studied adolescents have cardiovascular risk, 12.2% showed high blood pressure, 3.1% possess a sufficient number of risk factors for the identification of the MS and, in addition, 42.6% of them present at least one risk factor for developing it.

Table 3. Characterization of the lipid and glucose profile of the sample. 2014.

Variables	N	%
Triglycerides (TG)		
Desirable	216	74.7
Borderline	45	15.6
Increased	28	9.7
Glycemia		
Normal	282	97.6
Decreased glucose tolerance	7	2.4
Total cholesterol		
Desirable	159	57.8
Borderline	59	21.5
Increased	57	20.7
LDL-C		
Desirable	169	62.6
Borderline	41	15.2
Increased	60	22.2
HDL-C		
Desirable	189	65.4
Low	100	34.6
Total	289	100.0

The overweight and obesity correlated significantly with the significant increase of risk factors for cardiovascular disease among adolescents. A study found that high blood pressure is one of them, estimating an increase of 5.4 times in relation to children, a risk of eutrophic 3.6 times greater for systolic blood pressure and 2.7 times greater for diastolic blood pressure when compared to the same audience[16]. This study showed that 28% of schoolchildren showed cardiovascular risks, 12.2% amounted only to high blood pressure levels.

According to the WHO (World Health Organization), 1/3 of deaths worldwide are related to circulatory diseases and 1/5 of deaths caused by cardiovascular disease occurs in developed countries and, in developing countries, this value is four times higher[3].

The lipid and glucose profile of the adolescents indicated in table 3 show that 9.7% of them had increased triglycerides (TG), 15.6% border values, and 2.4% had decreased glucose tolerance. In relation to dyslipidemia, 20.7% and 22.2% hadincreased total cholesterol and LDL-C, respectively, and 34.6%, HDL-C levels below the desirable.

The glucose and lipid profile found in this study are worrisome, because approximately 25% of the assessed students present TG rates at least in borderline conditions, while 2.4% already have decreased glucose tolerance.

During puberty, at around 13 years old, fasting insulin levels are high and the obese bodies, in particular the android fats, concentrate increased amounts of insulin in the body, a process initiated by the decrease in insulin sensitivity to cells to stimulate them later, triggering adverse reactions, reflected by the decrease of 30% of the insulin action and facilitating development of DM2[15,11,17]. Insulin resistance in adipose tissue leads to the increase of free fatty acids and, if not intervened, these substances increase hepatic production of low density lipoprotein (LDL-C), raising plasma TG concentrations, as well as decrease HDL concentrations[15]. Insulin resistance happens when cells of the human body need more and more of this hormone to absorb the glucose present in the blood[18].

Accordingly, the high TG rates are usually answers to lower HDL-C rates and higher LDL-C rates[10]. These associations, which correspond to this investigation, demonstrate risks for cardiovascular disease and fit as factors of MS.

Table 4. Relationship between lipid and glucose profile and MS in the sample. 2014.

Variables	MS	N	Average number of posts	Mean	Standard Deviation	p-value
Waist circumference	Yes	9	236.83	-	-	0.001**†
	No	280	142.05	-	-	
Triglycerides	Yes	9	242.61	-	-	0.000**†
	No	280	141.86	-	-	
HDL-C	Yes	9	40.72	-	-	0.000**†
	No	280	148.35	-	-	
TC	Yes	7	146.36	-	-	0.806†
	No	270	138.81	-	-	
LDL-C	Yes	7	138.14	-	-	0.977†
	No	270	139.02	-	-	
Glycemia	Yes	9	-	85.74	15.81	0.027**‡
	No	280	-	76.74	11.80	

†Mann-Whitney Test; ‡T-test for independent samples

According to the data displayed in table 4, there was a statistically significant relationship between MS and waist circumference (p=0.001), triglycerides (p=0.000) and glycemia (p=0.027), indicating that adolescents with higher values of these markers present with MS. Regarding HDL-C, there was also significance, whose relationship was reversed, i.e., participants with MS had lower values of this marker.

Table 5. Relationship between nutritional status and MS in adolescents, Picos – PI, 2014.

Nutritional Status	MS		Statistics		
	Yes	No	p-value	OR†	CI‡ (95%)
Appropriate weight	1	169	0.004**	0.083	0.010 – 0.666
	0.6%	99.4%			
Overweight	8	111			
	6.7%	93.3%			
Total	9	280			
	3.1%	96.9%			

** Fisher's Exact Test; † Odds Ratio; ‡ Confidence Interval.

The track phenomenon, which explains the effect from long action sequences issued over the years, determines that the prevalence of these risks in adults probably began at childhood. This condition may

worsen if the adopted life habits are favorable to the development of cardiovascular disease. Lifestyle changes with increased food intake and decreased exercise explain this process[16-17].

Typically, children and adolescents are not targets of great concern when it comes to cardiovascular risk, but the calculations that relate cardiovascular risks have been crucial, especially when performing effective prevention measures[18]. Thus, the use of the Global Risk Score (Global RS) in 10 years, the most used when assessing individuals without high-risk conditions for cardiovascular disease and with a probability <5%, can transform individuals initially characterized by low risk in 10 years into individuals characterized by high risk over the lifetime[10].

The data presented in table 5 show that the MS associated with overweight (p=0.004), and overweight adolescents are 91% more likely to have MS (OR=0.083). Thus, 3.1% of the adolescents in this study presented with MS and 42.6% of them presented at least one risk factor. From the analyzed blood components, we can state that, of every 10 teenagers, seven have a chance to develop some of the risk factors.

Understanding these risks for the aging process are translated by the values observed in this study as a powerful tool able to design the future of the population regarding cardiovascular disease and MS. However, if applying care actions provided by a health care professional to assist the human being, such events will be minimized[10], mainly awakening the teenager for the need of self-care, since the concern about the adolescents' health is a concerned about the different ways to live this phase and, consequently, the future phases[19].

For the development of adolescent independence with regard to health and disease, encouraging his/her involvement is essential, as well as the involvement of the family and the population in general, along with public health and education professionals, and the decentralization of the biomedical model that still exists[20].

Nevertheless, the current daily life of youngsters have already contributed heavily to the MS installation in their organism. The absence of regular physical activity and excessive consumption of fatty foods are paths that lead to the development of the syndrome[18].

When these same teenagers have undergone a classification of MS, which considered the percentile of body mass index (BMI), this value rose to 31.3%[15]. Another study conducted in Mexico, using the diagnostic criteria of the International Diabetes Federation (IDF), with 466 teenagers aged from 11 to 13 years, showed prevalence of 20.0% for metabolic syndrome; 49.0% presented abdominal obesity; 69.0% presented low concentration of HDL-C; 29.0% presented high TG levels, and 8.0% and 13.0% of them presented systolic and diastolic pressures, respectively[18].

The data from this study have ratified that teenagers with MS had the highest values of WC (p=0.001), TG (p=0.000) and glucose (p=0.027), as well as the lowest HDL-C values (p=0.000), when compared with adolescents without the MS. It strengthens directly the link between cardiac risk factors for the emergence of the MS, with the prevalence of low HDL-C and central obesity among the components. HDL has a cardioprotective role already well established. Its anti-atherosclerotic property takes place by its ability to promote the output of cholesterol in cells, minimizing the accumulation of foamy cells in the artery wall. Kinetic studies with subjects with MS have shown that the low concentration of HDL cholesterol results from an elevation in its catabolism[15].

This analysis shows that the adolescent with excess body weight, regardless of gender or age, has a probability of around 91% (OR=0.083) to develop MS, currently representing a 1/10 risk for the population.

FINAL CONSIDERATIONS

The prevalence of excess body weight among teenagers in the study occurred regardless of gender, raising the odds for them to develop cardiovascular disease and MS with effective risk for future phases. Adolescents with overweight are 91% more likely to have MS.

Such finding draws attention from health professionals under a prospective perspective because the insistence of overweight adolescent's body and the relation of lipid and glucose values with the MS, demonstrating significant proportions, enhance the educational programs, appreciation of the primary assistance and care for with this population, guidance extended to the family and constant multidisciplinary interventions in an attempt to reduce adolescents' approach with any of the risk factors for the development of the MS.

RELAÇÃO ENTRE ESTADO NUTRICIONAL E SÍNDROME METABÓLICA EM ADOLESCENTES DO SEMIÁRIDO PIAUIENSE

RESUMO

Estudo descritivo realizado em nove escolas da rede privada do município de Picos-PI. O objetivo foi analisar a relação entre o estado nutricional e a síndrome metabólica em adolescentes do semiárido piauiense. A amostra foi composta por 289 adolescentes com idade entre 10 e 19 anos. Os dados foram coletados por meio de um formulário contendo dados socioeconômicos, antropométricos e medidas hemodinâmicas. Na definição de síndrome metabólica considerou-se a presença de três das quatro variáveis: obesidade central; dislipidemia; pressão arterial elevada; e glicemia de jejum alterada. Para a análise estatística foi utilizada a versão 20.0 para Windows® (Statistical Package for the Social Sciences). Foi encontrado excesso de peso corporal em ambos os sexos, com relação aos componentes da síndrome metabólica, os adolescentes apresentaram alteração nos TG (9,7%), Colesterol Total (20,7%), LDL-C (22,2%), tolerância à glicose diminuída (2,4%), HDL-C abaixo do desejável (34,6%), níveis pressóricos elevados (12,2%) e risco cardiovascular (28%). Adolescentes com excesso de peso apresentaram maior probabilidade (OR=0,083) de desenvolver a síndrome metabólica. Conclui-se que o excesso de peso esteve relacionado à presença da síndrome metabólica entre os adolescentes pesquisados.

Palavras-chave: Síndrome metabólica. Adolescente. Estado nutricional.

RELACIÓN ENTRE ESTADO NUTRICIONAL Y SÍNDROME METABÓLICO EN ADOLESCENTES DEL SEMIÁRIDO PIAUIENSE

RESUMEN

Estudio descriptivo realizado en nueve escuelas de la red privada del municipio de Picos-PI-Brasil. El objetivo fue analizar la relación entre el estado nutricional y el síndrome metabólico en adolescentes del semiárido piauiense. La muestra fue compuesta por 289 adolescentes con promedio de edad entre 10 y 19 años. Los datos fueron recolectados mediante un formulario conteniendo datos socioeconómicos, antropométricos y medidas hemodinámicas. En la definición del síndrome metabólico se consideró la presencia de tres de las cuatro variables: obesidad central; dislipidemia; presión arterial elevada; y glicemia de ayuno alterada. Para el análisis estadístico fue utilizada la versión 20.0 para Windows® (Statistical Package for the Social Sciences). Fue encontrado exceso de peso corporal en ambos los sexos, con relación a los componentes del síndrome metabólico, los adolescentes presentaron alteración en los TG (9,7%), Colesterol Total (20,7%), LDL-C (22,2%), tolerancia a la glucosa disminuida (2,4%), HDL-C por debajo de lo esperado (34,6%), niveles de la presión elevados (12,2%) y riesgo cardiovascular (28%). Adolescentes con exceso de peso presentaron mayor probabilidad (OR=0,083) de desarrollar el síndrome metabólico. Se concluye que el exceso de peso estuvo relacionado a la presencia del síndrome metabólico entre los adolescentes investigados.

Palabras clave: Síndrome metabólica. Adolescente. Estado nutricional.

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