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CARDIOVASCULAR RISK FACTORS AND ANTHROPOMETRIC MEASURES IN CHILDREN AND ADOLESCENTS

Jayne Ramos Araújo Moura*
Eugênio Barbosa de Melo Júnior**
Mayara Vidal Torres Pimenta***
Cyléa Abdalla de Miranda Silva****
Ana Míria de Oliveira Batista*****
Ana Roberta Vilarouca da Silva******

ABSTRACT

The aim of this study was to analyze the association between changes in anthropometric measures and the frequency of cardiovascular risk factors in children and adolescents. Cross-sectional study with a sample of 421 children and adolescents. Data collection occurred from August to November 2014, through the completion of the form with information regarding identification, socioeconomic aspects, anthropometric measurements, blood pressure measurement and physical activity practice, as well as biochemical examinations. The main results were: 59.6% were female, with a mean age of 11.4 years. Those who had higher body mass indexes and/or altered waist circumference were more likely to have elevated systolic blood pressure, high triglyceride and high-density lipoprotein cholesterol. Those who were overweight and/or with excess central adiposity presented significant frequencies of risk factors, such as arterial hypertension and disorders in the lipid profile, for the development of cardiovascular diseases.

Keywords: Risk factors. Cardiovascular diseases. Obesity. Child. Teenager.

INTRODUCTION

The various changes in the standard of living of the modern population, including children and adolescents, directly influenced by technological advances in recent years, have contributed to the increased physical inactivity and body weight and, consequently, to the appearance of NoncommunicableChronic Diseases (NCCD)[1-2].

Overweight and obesity have been identified as important elements in the genesis of these diseases, in the short or long term, since the accumulation of body fat does not present in isolation, but as a predisposing factor for the appearance of other morbidities, such as Systemic Arterial Hypertension (SAH) and dyslipidemias[3]. Moreover, the prevalence of overweight and obesity has been surpassing malnutrition and low weight in all age groups, social and demographic strata. By 2020, about 9% (60 million) of children worldwide will be obese[4-5].

Linked to these factors, the low Physical Activity Level (PAL), represented by sedentary behaviors (related to abusive use of television, video game and computer) contributes to increase body weight, and this can contribute substantially to the emergence of SAH[6].

In addition, a chronic illness in childhood or adolescence is generally a risk condition for the appearance of several other associated problems, especially of a psychological nature, due to the peculiar vulnerabilities of this phase[7].

In this context, the Health in School Program (PSE – Programa Saúde na Escola in Portuguese) was implemented in order to promote the prevention and control of nutritional diseases, aimed at promoting the health of children and adolescents, resulting from a partnership between the Ministries of Health and Education. The PSE actions aim to contribute to the integral formation of the students, by expanding actions of promotion, prevention and attention to the health of the students of the public school system[1].

*Nurse. Master student in science and health at the Universidade Federal do Piauí (UFPI). Picos, PI, Brazil. E-mail: jayneramoura@gmail.com.
**Nurse. Master student in science and health at the UFPI. Picos, PI, Brazil. E-mail: eugeniobmj@gmail.com.
***Nurse. Picos, PI, Brazil. E-mail: m.pimenta_91@hotmail.com.
****Nurse. Picos, PI, Brazil. E-mail: cyleabdalla@hotmail.com.
*****Nursing student at the UFPI. Picos, PI, Brazil. E-mail: anamiriaenf@outlook.com.
******Nurse. Doctor in nursing, Professor of the Nursing Department at the UFPI. Picos, PI, Brazil. E-mail: robertavilarouca@yahoo.com.br.

Thus, the school environment emerges as a suitable place to obtain information that may represent the local reality, since it concentrates a significant portion of the younger population, since, generally, due to their own characteristics of adolescence, they are not very frequent at health services.

Therefore, the study proposes to verify the existence of an association between changes in anthropometric measures and the frequency of Cardiovascular Risk Factors (CVRF) in schoolchildren and adolescents.

The early detection of alterations may allow planning and developing preventive health actions, focusing on the adoption of a healthy lifestyle, focused on health promotion, aiming to prevent or delay the onset of NCCD. It also has a special impact in the nursing area, since these professionals act as articulators in programs of the Ministry of Health, such as the PSE, and knowing the reality may guide intervention actions and health education, specific to the public in question.

METHODOLOGY

This is a descriptive and cross-sectional study carried out at 12 municipal public schools in the urban area of the city of Picos-PI. The municipality has 73 public schools, being the municipal administration in charge of those that develop the education of the infantile and fundamental levels. The municipal public schools located in the urban perimeter were selected because they included both children as adolescents.

The population consisted of 1,452 schoolchildren of both genders, aged between 9 and 19 years old. The sample calculation, considering finite population, type I error of 5.0% for null hypothesis rejection, 95% confidence interval and 50.0% prevalence for cardiovascular risk factor frequency, resulted in a sample of 421 subjects, proportional to the number of students enrolled per school.

For the selection of the sample, the inclusion criteria were: age between 09 and 19 years old; being enrolled and regularly attending school; participate in all research stages, including the interview, anthropometric measurements, blood pressure measurement and biochemical measurements (triglycerides - TG, high-density lipoprotein cholesterol - HDL and glucose). The selection occurred by lot, and when the students refused to participate in the study, new raffles were made until reaching the sample quantity at each school.

Furthermore, those who were unable to obtain anthropometric measures (such as being pregnant or on a wheelchair), or being unable to perform the laboratory tests, such as failure to comply with the 12-hour fast or feeling sickbefore and/or during the bloodcollection could not participate in the study. However, during the sample selection, none of the participants was included in these criteria.

Data collection occurred from August to November 2014, by filling out a form containing socioeconomic information (age, self-reported color, employment status - in the case of adolescents, family income, economy class); anthropometric variables (weight, height, Body Mass Index - BMI and Waist Circumference - WC); and variables related to cardiovascular risk factors (BP, sedentary lifestyle, TG, HDL-cholesterol, fasting glycaemia).

Socioeconomic class was categorized based on household ownership and schooling, as recommended by the Brazilian Association of Research Companies[8].

Anthropometric data were collected as recommended by the World Health Organization[9]. Body weight was measured on an electronic scale (Techline®, Brazil) with a precision of 100g. The stature was measured using an anthropometric tape (Sanny®), with a scale between 1.0cm and 2.0m, fixed to a flat vertical surface withoutunevenness. The BMI was calculated and classified as: meagerness (meagernessor accentuated meagerness); eutrophy; overweight; obesity (obesity or severe obesity)[9]. WC was measured with an anthropometric tape (Sanny®) at the midpoint between the lower border of the last costal arch and the iliac crest, classified according to age, gender and race, being considered altered when it framed into the 90thpercentile or above[10].

Blood Pressure (BP) values based on the V Brazilian Guidelines for Hypertension, considering the 90th, 95thand 99thpercentiles of blood pressure for children and adolescents, according to the percentiles of height for both genders[11].

The TG analysis used the following cutoff points for categorization as altered: ≥75 mg/dl for children aged 0-9 years; and ≥90 mg/dl for the age group of 10 to 19 years[12]. The value of HDL-c was acceptable for children and adolescents when >45 mg/dl[12]. The fasting glycaemia was considered normal when the glycemic value found was <100 mg/dl[11].

In order to investigate the level of physical activity, all students answered, in the form of an interview, using the previous week as reference, the International Physical Activity Questionnaire (IPAQ - short version), with questions related to the intensity, frequency and duration of physical activity, classifying them as sedentary, insufficiently active, active and very active. This version of the IPAQ consists of eight open questions and its information allows estimating the time spent per week in different dimensions of activity and/or physical inactivity.

According to the IPAQ, those who declare that they do not practice at least 30 daily minutes, for at least five days a week, of mild or moderate activity are classified as sedentary; or 20 daily minutes of vigorous activity on three or more days of the week.

The researcher and the trained staff applied the forms, with calibration of the equipment used for the anthropometric measurements and BP verification, aiming to establish uniform standards of internal and external consistency to the researchers. A laboratory hired for the examinations at the schools performed the blood collection, preferably the day after filling out the form, in a calm environment and under controlled temperature environmental conditions.

The data were analyzed and processed in the Statistical Package for the Social Sciences (SPSS), version 20.0. The normality of the data was evaluated using the Kolmogorov-Smirnov test. For the analytical inference, the Student's t-test for independent samples was used to compare the means of the CVRF in relation to the WC and BMI variables. After the classification of CVRF values for posterior analysis of association in relation to gender, WC and BMI, the Pearson chi-square test was used. Odds Ratio was also used in the analyses related to CVRF and WC and BMI. For all inferential statistical analyses, those with $p < 0.05$ were considered as statistically significant.

The Research Ethics Committee of the Federal University of Piauí approved this study (Opinion: 714.995, 2014). The participation of children and adolescents was voluntary, under signature of the informed consent form by adolescents and their respective parents or tutors.

RESULTS AND DISCUSSION

Among the 421 children and adolescents investigated, 59.6% were female. This percentage can be justified by the fact that, according to the last Demographic Census conducted in 2010 by the Brazilian Institute of Geography and Statistics (IBGE), the percentage of female residents in Picos corresponded to 52.2% of the total population[13].

The age ranged from 09 to 17 years, with an average of 11.4 ± 1.7 years, with the majority of the sample (85%) ranging from nine to 13 years. As for the color, 45.1% self-reportedpardos. Regarding economic class, no child or adolescent was in class A, while the predominant classes were C1 and C2, representing 70.3% of the sample.

Table 1 shows the distribution of CVRF in relation to gender. Among the participants in this study, 20.5% were overweight or obese. As for the WC marker, only 8.6% had excess central adiposity. In relation to PAL, 30.2% were classified as sedentary. Regarding BP levels, 7.8% and 9.0% of the sample presented high SBP and high DBP, respectively.

As for the lipid profile, 46% of the participants had HDL-c values below the ideal parameters, and 30.7% of the children and adolescents had increased triglyceride values. The component with the lowest rates of change was fasting glycaemia, since only 1.4% of the sample presented a decreased glucose tolerance.

In relation to gender, the only statistically significant variable was the level of physical activity. This may be justified by the fact that, despite the fact that the Brazilian sociocultural profile has undergone several modifications, children and adolescents of the female gender are still directed towards the care of the family and household chores, while the male genderis oriented to vigorous labor and intensity activities[14].

Table 1. Association of anthropometric variables and CVRF, among children and adolescents, according to gender. Picos, Piauí, 2015.

Variables	Total		Gender			p value*
			Female	Male		
	Nº	%	Nº	Nº	%	Nº
BMI			BMI			
Meagerness	56	13.3	31	56	13.3	31
Eutrophy	279	66.2	168	279	66.2	168
Overweight	47	11.2	34	47	11.2	34
Obesity	39	9.3	18	39	9.3	18
WC			WC			
Adequate	385	91.4	231	385	91.4	231
Inadequate	36	8.6	20	36	8.6	20
Physical Activity			Physical Activity			
Very active	116	27.5	49	116	27.5	49
Active	142	33.7	84	142	33.7	84
Irregularly active	36	8.6	24	36	8.6	24
Sedentary	127	30.2	94	127	30.2	94
MSBP			MSBP			
Normal	388	92.2	238	388	92.2	238
High	21	5.0	08	21	5.0	08
Arterial hypertension	12	2.8	05	12	2.8	05
MDBP			MDBP			
Normal	383	91.0	225	383	91.0	225
Limitrophe	20	4.9	14	20	4.9	14
Arterial hypertension	17	4.1	11	17	4.1	11
Glycaemia			Glycaemia			
Normal	415	98.6	246	415	98.6	246
DTG	06	1.4	05	06	1.4	05
High	-	-	-	-	-	-
HDL-c			HDL-c			
Desirable	227	54.0	136	227	54.0	136
Limitrophe	161	38.2	99	161	38.2	99
Low	33	7.8	16	33	7.8	16
Triglycerides			Triglycerides			
Desirable	292	69.3	163	292	69.3	163
Limitrophe	92	21.9	64	92	21.9	64
High	37	8.8	24	37	8.8	24

MSBP: Mean Systolic Blood Pressure; MDBP: Mean Diastolic Blood Pressure; DTG: Decreased Tolerance to Glucose.*Pearson's Chi-square test ($\chi 2$).

Regarding BMI, overweight individuals had elevated SBP (OR: 3.65, 95% CI: 1.76-7.60), increased TG (OR: 2.65, 95% CI: 1.69-4.30), low HDL-c (OR: 3.07, 95% CI: 1.86-5.07). Similarly, those with increased WC exhibited elevated MSBP (OR: 5.01, 95% CI: 2.12-11.85), increased TG (OR: 3.16, 95% CI: 1.58-6.33) and low HDL-c (OR: 2.94, 95% CI: 1.39-6.07) (Tables 2 and 3).

Thus, both BMI-related and WC-related excess weight increases the likelihood of individuals exhibiting, at the same time, at least one CVRF, such as high BP and TG and low HDL-c levels.

The presence of high BMI in the sample (20.5%) had an intermediate frequency when confronted with the literature, in which the excess weight ranged from 13% to 27.6%[1,3,6]. This result is worrisome, since, according to the results of some studies, the weight gain in the early stages of life predisposes to its maintenance in the adult phase, as well as the progress of weight gain increases with the advancing age[3,4].

Regarding the sedentary lifestyle, in a isomorphic way, a randomized study that evaluated the effect of physical activity on the excess of corporal adiposity

in children observed that the levels of physical activity are higher for boys than for girls, as well as the time of sedentarism was higher for girls than for boys (mean of 418.2 vs 435.6 min/d)[15].

Table 2. Factors associated with the occurrence of high mean systolic and diastolic blood pressure and increased glycaemia, among children and adolescents, according to BMI and WC. Picos, Piauí, 2015.

Variables	High MSBP			High MDBP			Increased glycemia	
	OR*	CI95%	p**	OR*	CI95%	p**		OR*
BMI			BMI				BMI	
High	3.65	1.76-7.60	p<0.001	3.65	1.76-7.60	p<0.001	High	3.65
WC			WC				WC	
High	5.01	2.12-11.85	p<0.001	5.01	2.12-11.85	p<0.001	High	5.01

BMI: Body Mass Index; WC: Waist Circumference; MSBP: Mean Systolic Blood Pressure; MDBP: Mean Diastolic Blood Pressure.*OddsRatio; ** Pearson's chi-square (χ2).

In this context, the lifestyle adopted by children is the reflection of the one adopted by their parents, i.e. children naturally imitate their parents' eating habits and lifestyle. Thus, encouraging, in the same proportion, boys and girls to perform tasks and participate in activities/games that demand greater caloric expenditure is fundamental to reduce the levels of sedentarism found, more frequently, among the female gender.

Likewise, the school environment is an important space for health promotion practices and prevention of health problems for children and adolescents. Therefore, the sports and recreational practices developed in this scenario must be elaborated and offered equitably for both genders.

Table 3. Factors associated with mean systolic and diastolic blood pressure and increased glycaemia, among children and adolescents, according to BMI and WC. Picos, Piauí, 2015.

Variables	Increased TG			Low HDL-c		
	OR*	CI95%	p**	OR*	CI95%	p**
BMI						
High	2.65	1.62-4.31	<0.001	3.10	1.88-5.12	<0.001
WC						
High	3.16	1.58-6.33	0.001	2.90	1.39-6.07	0.003

BMI: Body Mass Index; WC: Waist Circumference; TG: Triglycerides; HDL-c: High Density Lipoprotein.*OddsRatio; ** Pearson's chi-square(χ2).

As in the present study, another investigation reported that overweight adolescents expressed a higher prevalence of high BP in comparison to eutrophic individuals[16]. In the same perspective, a study that evaluated the prevalence and factors associated with high BP values in adolescents from Ponta Grossa-PA found that 12.4% of the sample had high BP, with a positive and significant correlation with excess weight (p<0.001)[17].

Regarding hyperglycemia, although 20.5% of the participants were considered overweight, and 8.6% with central adiposity, only 1.4% of the sample presented fasting glycaemia values classified as impaired glucose tolerance, without significant differences regardinggender. A study carried out with 237 Portuguese adolescents showed elevated fasting glycaemia in 1.3% of them[18].

Regarding the lipid profile of the sample, for HDL-c and TG, those who were overweight, both referred to the BMI marker and the WC marker, were at increased risk for the appearance of lipid changes with a tendency to low levels of HDL-c and increased levels of TG.

Similarly, an analysis performed with 75 Argentinian children and adolescents observed that HDL-c also became one of the most frequent CVRF among the analyzedparticipants[19]. In addition, the hypertriglyceridemic waistline in children and adolescents associates with an atherogenic lipid profile that gives approximately 2.5 times greater chances for the development of low HDL-c when compared to eutrophic individuals[20].

When analyzing the number of risk factors for each individual, only 28% of the sample, that is, 117 individuals, did not have any of the five analyzedfactors (SBP, elevated DBP, sedentary

lifestyle, hyperglycemia, hypertriglyceridemia, low HDL-c values). Among those who presented a risk factor for developing CVD, the means of BMI and WC were higher, with statistically significant differences in those who had three to four cardiovascular risk factors (Table 4).

Table 4. Association between the number of cardiovascular risk factors, among children and adolescents, with BMI and WC means.Picos, Piauí, 2015.

	1 - 2 factors		3 - 4 factors		
Variables	N	Mean	N	Mean	p value*
BMI	252	18.32	51	20.51	0.001
WC	252	67.16	51	73.08	0.001

BMI: Body Mass Index; WC: Waist Circumference. * Studentt test for independent samples.

Regarding the number of risk factors and their distribution in the sample, the youngsters presented a lifestyle that was prone to the development of cardiovascular diseases, especially those that had more than one associated risk factor.Obesity was specially analyzed as a predisposing factor for increased blood pressure, lipid profile disorders and insulin resistance[3,15].

Excess weight closely relates to the occurrence of prehypertension in children and adolescents, as well as to the increased risk for its development in adults, as well as to the development of hypercholesterolemia and hypertriglyceridemia and, therefore, CVD[14].

Obesity is known for its multi-causality, with interference of varying degrees: environmental, social and cultural. Most of the time, the factors related to weight accumulation are susceptible to change, as well as educationalinterventions, which should base on the construction of knowledge, since this phase of human development is favorable for the consolidation of habits, which are determinants for the establishment and maintenance of the later quality of life and health.

However, in order to reach this public, especially adolescents, there is a need to transcend health services and choose spaces that help in the process of health promotion, such as the school environment, living space and the usual social interaction of children and adolescents. Thus, information regarding the adoption of healthy living habits, such as the consumption of healthy foods and the adoption of regular physical activity can be accepted by school children.

FINAL CONSIDERATIONS

The participants in the study had high rates of excess body adiposity and expressive frequencies of risk factors for the development of CVD, especially low HDL-c, sedentary lifestyle and high triglycerides. Those who were overweight and/or with excess central adipositypresented an increased risk for the development of hypertension and disorders in the lipid profile.

The study has some limitations, including the use of a cross-sectional design, which hampers verifying the reverse causality, mainly related to the behavioral variables, as well as the follow-up of the modifications of these factors. Furthermore, the analysis of WC in children and adolescents, for being used in the adult population, does not yet have a single internationally accepted framework. However, the findings are important to emphasize the need for early diagnosis of clinical and laboratory abnormalities and to verify possible associations.

The results are applicable to schoolchildren aged nine to 17 years from public schools in the city of Picos-PI. The studies with comparable methodologies and representative samples need to extend to other populations from different geographic regions in order to obtain information that supports the formulation and/or updating of public policies aimed at this age group in a collective environment. Longitudinal studies of an interventional character should also be carried out in order to offer knowledge and means for the adoption of healthy life habits and reduction of cardiovascular risk.

In addition, the integrationof the school environment into health servicesis possible and suggested, aiming at the promotion of prevention practices and strategies that are earlier and earlier, still in childhood, such as blood pressure measurement, waist measurement, and promotion of means for stimulating the adoption of healthy living practices and regular physical activities.

FATORES DE RISCO CARDIOVASCULAR E MEDIDAS ANTROPOMÉTRICAS EM CRIANÇAS E ADOLESCENTES

RESUMO

O objetivo do estudo foi analisar a associação entre alterações nas medidas antropométricas e a frequência de fatores de risco cardiovascular em crianças e adolescentes. Estudo transversal, com amostra de 421 crianças e adolescentes. A coleta de dados foi realizada no período de agosto a novembro de 2014, por meio do preenchimento do formulário com informações referentes a identificação, aos aspectos socioeconômicos, às medidas antropométricas, à aferição da pressão arterial e de prática de atividades físicas, além de exames bioquímicos.Os principais resultados encontrados foram: 59,6% eram do sexo feminino, com idade média de 11,4 anos. Aqueles que apresentaram maiores índices de massa corporal e/ou circunferência da cintura alterada tinham mais chances de apresentar pressão arterial sistólica elevada, triglicerídeo elevado e *high density lipoproteins* – colesterol baixo.Conclui-se que aqueles que estavam acima do peso e/ou com excesso de adiposidade central apresentaram expressivas frequências de fatores de risco, como hipertensão arterial e desordens no perfil lipídico, para o desenvolvimento de doenças cardiovasculares.

Palavras-chave: Fatores de Risco. Doenças Cardiovasculares. Obesidade. Criança. Adolescente.

FACTORES DE RIESGO CARDIOVASCULAR Y MEDIDAS ANTROPOMÉTRICAS EN NIÑOS Y ADOLESCENTES

RESUMEN

El objetivo del estudio fue analizar la asociación entre alteraciones en las medidas antropométricas y la frecuencia de factores de riesgo cardiovascular en niños y adolescentes. Estudio transversal, con muestra de 421 niños y adolescentes. La recolección de datos fue realizada en el período de agosto a noviembre de 2014, por medio del relleno de formulario con informaciones referentes a la identificación, los aspectos socioeconómicos, las medidas antropométricas, al control de la presión arterial y de la práctica de actividades físicas, además de exámenes bioquímicos. Los principales resultados encontrados fueron: 59,6% eran del sexo femenino, con promedio de edad de 11,4 años. Aquellos que presentaron mayores índices de masa corporal y/o circunferencia de la cintura alterada tenían más probabilidades de presentar presión arterial sistólica elevada, triglicérido elevado y high density lipoproteins–colesterol bajo. Se concluye que aquellos que tenían sobrepeso y/o estaban con exceso de adiposidad central presentaron expresivas frecuencias de factores de riesgo, como hipertensión arterial y desórdenes en el perfil lipídico, para el desarrollo de enfermedades cardiovasculares.

Palabras clave: Factores de Riesgo. Enfermedades Cardiovasculares. Obesidad. Niño. Adolescente.

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Corresponding author: Jayne Ramos Araújo Moura. Rua Hélio Leitão, 256; Bairro Junco. Picos/PI; 64607-635; e-mail: jayneramoura@gmail.com.

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