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Anthropometric and metabolic profile of adolescents born prematurely in a municipality in the West of Paraná

Perfil antropométrico e metabólico de adolescentes nascidos prematuros em município do Oeste do Paraná

Perfil antropométrico y metabólico de adolescentes prematuros en un municipio del oeste de Paraná

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ABSTRACT

Objective: To relate to the degree of prematurity and weight adequacy at birth with a lipid, glycemic, pressure, and anthropometric profile of adolescents born prematurely. **Methods:** A cross-sectional study. Sample of 50 premature adolescents – gestational age less than 37 weeks – classified as follows regarding gestational age and birth weight: Adequate for Gestational Age (AGA), Small for Gestational Age (SGA), and Large for Gestational Age (LGA). Anthropometric measurements were evaluated: Blood Pressure (BP), glucose, Total Cholesterol (TC), Triglycerides (TG), collected by digital puncture. Analysis by descriptive statistics, Fisher's exact association test, and analysis of variance (ANOVA) considering a 5% significance level. **Results:** 8% presented Metabolic Syndrome (MS), 70% were classified as AGA, 30% were overweight, 6% were born extremely preterm, and 14% very preterm. It showed a significant association between BP and the degree of prematurity (p=0.027) and a tendency for associating prematurity and TG (p=0.05). **Conclusion and implications for practice:** Pressure levels were influenced by the degree of prematurity; a tendency to increased TG was evidenced. Premature babies are more vulnerable to developing MS, pressure changes in adolescence, and possible changes in glycemic homeostasis due to TG alteration, indicating the need for follow-up in childhood and adolescence considering their higher risk for cardiovascular disease.

Keywords: Premature Birth; Adolescent Health; Cardiovascular Diseases.

RESUMO

Objetivo: Relacionar o grau de prematuridade e adequação de peso ao nascer ao perfil lipídico, glicêmico, pressórico e antropométrico de adolescentes nascidos prematuros. **Métodos:** Estudo transversal. Amostra com 50 adolescentes nascidos prematuros – idade gestacional menor que 37 semanas – classificados com base na idade gestacional e peso ao nascer: Adequado para Idade Gestacional (AIG), Pequeno para Idade Gestacional (PIG) e Grande para Idade Gestacional (GIG). Avaliaram-se medidas antropométricas; Pressão Arterial (PA); glicose, Colesterol Total (CT), Triglicerídeos (TG), coletados por punção digital. Análise por estatística descritiva, teste de associação exato de Fisher e análise de variância (ANOVA), considerando 5% de significância. **Resultados:** 8% apresentaram Síndrome Metabólica (SM). 70% foram classificados como AIG, 30% apresentaram excesso de peso. 6% nasceu prematuro extremo e muito prematuro (14%). O grau de prematuridade associou-se significativamente a PA (p=0,027) e mostrou tendência à associação com o TG (p=0,05). **Conclusão e implicações para a prática:** Os níveis pressóricos são influenciados pelo grau de prematuridade; foi evidenciado tendência a TG aumentados. Prematuros têm maior vulnerabilidade para desenvolver SM, alterações pressóricas e possíveis alterações na homeostase glicêmica devido à alteração de TG, indicando a necessidade de seguimento na infância e adolescência atentando ao seu maior risco para doenças cardiovasculares.

Palavras-chave: Nascimento prematuro; Saúde do adolescente; Doenças cardiovasculares.

RESUMEN

Objetivo: Relacionar el grado de prematuridad y la adecuación del peso al nacer con los lípidos, la glucemia, la Presión Arterial (PA) y el perfil antropométrico de adolescentes nacidos prematuros. **Métodos:** Estudio transversal. Muestra con 50 adolescentes prematuros - edad gestacional menor de 37 semanas - clasificados según la edad gestacional y peso al nacer. Se evaluaron medidas antropométricas; PA; glucosa, Colesterol Total (CT), Triglicéridos (TG), recolectados por punción digital. Análisis estadístico descriptivo, prueba de asociación exacta de Fisher y análisis de varianza (ANOVA), considerando 5% de significancia. **Resultados:** El 8% tenía Síndrome Metabólico (SM), el 70% fue clasificado como adecuado a la edad gestacional, el 30% tenía sobrepeso. Hubo asociación significativa entre la PA y el grado de prematuridad (p = 0.027); y tendencia a asociación entre grado de prematuridad y TG (p = 0.05). **Conclusión y implicaciones para la práctica:** los niveles de PA están influenciados por el grado de prematuridad; se evidenció tendencia al aumento de TG. Los prematuros presentan mayor vulnerabilidad para el desarrollo de SM, cambios en la PA y posibles cambios en la homeostasis glucémica debido a alteración de TG, indicando necesidad de seguimiento en la infancia y adolescencia, considerando su mayor riesgo de enfermedad cardiovascular.

Palabras clave: Nacimiento prematuro; Salud del adolescente; Enfermedades cardiovasculares.

INTRODUCTION

Prematurity is the main cause of infant morbidity and mortality, being considered a worldwide public health problem,[1] with technological advances and specialization of human resources in neonatology, there is an increase in the survival of children with lower gestational age (GA) and lower birth weight. Consequently, several repercussions are observed after the neonatal period, throughout the life of this individual, highlighting a higher incidence of Cardiovascular Diseases (CVDs), Diabetes Mellitus type 2 (DM2) and obesity.[2,3]

Thus, prematurity, as well as, low birth weight, have been identified as markers for metabolic programming,[4] a phenomenon that associates metabolic conditions at birth with the development of diseases in adulthood, such as, Metabolic Syndrome (MS).[3,5] This is defined as the presence of three or more metabolic changes, among which hypertriglyceridemia, low high density lipoprotein *(*HDL), insulin resistance, hyperglycaemia, arterial hypertension, and visceral obesity stand out.[6]

Children born Prematurely (PT) or underweight often have a phase of acceleration and recovery of growth (catch-up) that can also be associated with MS and obesity in adulthood. In this sense, reinforcing the risk of CVD, it is ratified that insulin sensitivity is reduced in children who had catch-up in their growth.[7]

In this way, the prematurity associated with critical development windows[8] – pregnancy, lactation, early childhood and adolescence, increases the vulnerability of these individuals to develop chronic diseases throughout their lives, in particular CVDs and DM2. However, adolescence is still one of the critical windows that have not been much studied, as the PT newborn is often not followed-up until this period of life.

The relation between prematurity and low birth weight with the highest risk for atherosclerosis, obesity, hypertension, and coronary heart disease. In addition to a tendency towards sedentary lifestyle in adulthood, is already well defined in the literature, mainly in the international literature.[3,9] However, among those born PT in Brazil, there is still the need for more evidence of this relation, especially during adolescence. The present study aimed to relate the degree of prematurity and birth weight adequacy to the lipid, glycemic, blood pressure, and anthropometric profile of adolescents born prematurely.

METHODS

It is a study with a quantitative approach and cross-sectional design, carried out in a medium-sized municipality in the western region of Paraná. The sample was of convenience type, contemplating PT born in the period from 1998 to 2006, since, during the collection period, the participants would be between 10 and 19 years old. Based on the prematurity index of the municipality under study, which was 9.4%[10] in 2015, it is estimated that there are more than 4,000 adolescents born PT in the municipality, out of a total of 40,707 young people in this age group – according to the last census of 2010.[11]

As the system of live births, in the municipality is not in the public domain and the data prior to 2005 were not fully recorded, it was not possible to access the records of premature births online. Thus, we opted for a manual search in health records in a Basic Health Unit in the city, enabling the identification and active search of adolescents who were born during the period under analysis and who were PT. According to the 2015 territorialisation, the basic health unit has an estimated population of 9,000 users, with approximately 1,260 adolescents aged 10 to 19 years old, of whom approximately 120 were born PT. The study population, therefore, consisted of 120 adolescents; of this total, we identified 91 medical records with a birth weight record below 2,500g, since there is no record of Gestational Age (GA) in the charts. Considering that many PT births weigh less than 2,500g,[12] this was the cut-off point for the inclusion of participants in the sample. After analyzing these medical records, 10 adolescents were excluded from the sample because they were not PT; four refused to participate; one was hospitalized, and with 43 it was not possible to contact them by phone to schedule an appointment at the unit after three attempts on alternate days and times.

Other sources for identification consisted of a direct approach to the adolescents who sought the basic health unit, indication of family members and contact with a local school. Then, another 32 adolescents born during the study period were obtained; of these, four were not PT; three refused to participate; two currently reside in another city and it was not possible to contact six of them. Therefore, all premature adolescents identified in the different search modalities were included in the study; the ones who were born in the period from 1998 to 2006; who resided in the territory of the local basic health unit where the participants were contacted; and who attended the scheduled appointment at the health unit with a responsible person. Thus, the final sample consisted of 50 adolescents born PT in the analyzed time frame.

With their acceptance to participate, consultations at the UBS were scheduled according to the availability of the adolescent and of a responsible person. They were informed about the ethical aspects for signing the assent terms by the adolescent, and the consent by the guardian. Research approved by the Certificate of Presentation for Ethical Appreciation (CAAE) 16348813.7.1001.0107, and opinion number 1,134,712, on June 28th, 2015. The interview was conducted by the nurse researcher, from March to June 2017, using a form based on the system proposed by Goldenring and Cohen,[13] with investigation of personal and family history. Birth data were obtained from the immunization records: GA (weeks), weight (kilograms), height (centimeters). To assess birth weight, adequacy by gender and GA was performed in Adequate for Gestational Age (AGA), Small for Gestational Age (SGA) and Large for Gestational Age (LGA).[12] The classification regarding the degree of prematurity followed the guidelines of the World Health Organization (WHO):[1] 'extreme PT' less than 28 weeks; 'very PT' between 28 and 31 weeks and 6 days; 'Moderate to late PT' between 32 weeks and 36 weeks and 6 days. Since the lipid profile can be altered by the type of food consumed and by sedentary lifestyle, although these variables were collected

following the guidelines of the Food and Nutritional Surveillance System of the Ministry of Health and the World Health Organization to assess the frequency and time of physical activity, these were not part of the scope of this manuscript, in view of the number of associations made here to evidence the relation between prematurity and pressure, lipid, glycemic, and anthropometric profile in the sample.

The physical examination was performed in the presence of the responsible person, initiated by checking the Blood Pressure (BP) (millimeters of mercury – mmHg) with the adolescent seated, after 10 minutes at rest. Measurement in the right upper limb, supported at the height of the heart, with systolic BP (SBP) and diastolic BP (DBP) being measured twice, in an interval of five to 10 minutes. The Premium® brand aneroid sphygmomanometer was used, with an appropriate cuff for each individual. The means of the two measurements were classified by a percentile graph by age according to the 7th Brazilian Guideline on Hypertension.[14] For the classification of adolescents aged 18 and 19 years old, the parameters used were the same as those for adults.

The adolescent was weighed wearing light clothing on a portable digital platform scale, Líder® P200m. Height was verified with a Sanny® Standart wall stadiometer, scale in millimeters. The adolescent was barefoot, feet and heel together, buttocks and head against the wall, knees stretched, and gaze directed to the horizon. Weight (W) was recorded in kilograms and Height (H) in meters; to obtain the Body Mass Index (BMI), the formula $BMI=P/A^2$ (weight divided by height squared) was applied.[15] For the anthropometric assessment, the Z-score cut-off points recommended by the WHO and used in the Adolescent Health Handbook were used.[15]

The abdominal circumference (AC) was checked at the midpoint between the lower margin of the last rib and the upper border of the iliac crest with an inextensible measuring tape graduated in millimeters. The teenager was erect, with feet together and exposed abdomen. The data were evaluated according to the Guidelines of the Brazilian Diabetes Society,[6] which recommends the criteria of the International Diabetes Federation (IDF) for the diagnosis of MS in children and adolescents. In those over 16 years old, the parameters of adults were used.[7]

For collection of capillary blood, peripheral puncture was performed with automatic Premium® lancets on the pulp side of the third finger of the left hand. The glucose test was performed with an Accu-Chek® Active device, the result being compared to the reference values for plasma blood of the Brazilian Diabetes Society,[6] since, according to the manufacturer, the result obtained with the test strip corresponds to the concentration of glucose in the plasma.

For the Total Cholesterol (TC) and Triglyceride (TG) tests, the Accuntrend Plus® device was used with test strips for quantitative determination of TC and TG in fresh capillary blood. The result of the TC examination was presented in the measurement range of 150-300 mg/dL, with a variation coefficient of 0.8-3.7% as indicated in the manufacturer's manual. The TG was presented in the measurement range of 70-600 mg/dL, with a variation coefficient of 3.1-3.4%. The results were evaluated according to the Brazilian Consensus for the Standardization of the Laboratory Determination of the Lipid Profile,[16] which emphasizes that the determinations of the lipid profile can be considered without previous fasting.

Data analysis was performed using descriptive statistics and the analysis of the association between qualitative variables was performed using Fisher's exact association test and its hybrid version. The influence of qualitative variables on quantitative variables was performed by analysis of variance (ANOVA), considering 5% significance for the analyses. For the analysis of the proportion of adolescents in each group for the comparison of the categories, absolute frequency, sample proportion and Wilson's confidence interval valid for small samples were analyzed. All the statistical analyses were performed using the R software (R Development Core Team, Vienna, Austria).

RESULTS

Based on the presence of elevated AC, BP and TG, the prevalence of MS was identified in 8% of the PT studied. The mean GA of the sample was 33.18 weeks, with low variability in relation to the mean age (8.8%), characterizing them as moderate to late PT – 6% extreme PT, 14% very PT and 80% moderate to late PT. Regarding the birth weight adequacy for GA, 12% were born SGA, 18% LGA, and 70% AGA, with a mean birth weight of 2,046 g. Of the total sample, 26 (52%) PT were male, with a predominance of age between 10 and 14 years old (68%) and self-reported white-skinned (54%).

Table 1 shows the adolescents' characterization regarding the risk factors for MS. The mean of the AC was 72.2 cm and variability in relation to the mean of 18.85%; 10% had AC ≥ 90 percentile, featuring abdominal obesity. Regarding BP, 30% were classified as having high BP. Regarding the biochemical parameters evaluated, considering the time taken to perform the capillary puncture in relation to the last meal, only one adolescent presented altered blood glucose. However, it is noteworthy that 41% had high TG and 22% had high TC. In the physical examination, acanthosis nigricans was observed in three adolescents.

Through the Z-score, 62% were classified as eutrophic, of which the majority are moderate to late PT and AGA. However, 30% of the sample was overweight – 22% overweight, 8% obesity. It was observed that of these overweight individuals, three (20%) were born SGA, three (20%) LGA, and nine (60%) AGA; while one (6.7%) was born with extreme PT, three (20%) very PT, and 11 (73.3%) were born with moderate to late PT. There was no statistical difference between the genders and age groups for the analyzed variables.

Family history showed a history of hypertension (84%), diabetes (68%), dyslipidemia (66%); in addition to obesity (64%) and heart disease (52%), factors related to the development of MS. Current hormonal changes in adolescents have also been reported, with an occurrence of 12%, including one case already diagnosed of insulin resistance and others with delayed or early puberty.

Table 1. Characterization of premature adolescents regarding risk factors for MS. Cascavel-PR, Brazil, 2018. (N 50).

Variable	N	%
Abdominal circumference		
10	19	38
25	5	10
50	9	18
75	11	22
90	5	10
Adequate*	1	2
Blood Pressure		
Adequate	35	70
High	15	30
Glycaemia		
Normal	49	98
Altered	1	2
Triglycerides**		
Desirable	29	59
High	20	41
Total Colesterol**		
Desirable	38	78
High	11	22
BMI		
Thinness	4	8
Eutrophic	31	62
Overweight	11	22
Obesity	4	8

Caption: BMI: Body Mass Index. * Refers to the AC classification of a 19-year-old adolescent, using adult guidelines. ** Sample of 49 adolescents.

Table 2 shows the distribution of the adolescents according to the degree of prematurity and their lipid, glycemic, blood pressure, and AC profile. In the intergroup analysis, there was a statistically significant difference in relation to the parameters elevated to the GA of BP, TC and TG.

Among the moderate and late PTs, there was a statistically significant difference among those with normal or altered values in the variables: glycaemia, AC, BP and TC, as well as in the very PT there was a difference between glycaemia and AC.

Although moderate to late PTs have a higher proportion of adolescents with high BP, TC, and TG in relation to the others with altered variables, it should be considered that 60% of those who were born with extreme or very PT presented high BP. Among moderate to late, this rate was 22.5%.

Table 3 shows the comparison of the lipid, glycemic, blood pressure, and AC profile of the adolescents studied, according to the birth weight classification. In the intragroup analysis of each variable, there is a statistically significant difference in the BP of the AGA and SGA groups, in relation to the TC this difference was observed in the AGA and for AC there was a statistically significant difference for the AGA and LGA. In the intergroup relation for the analysis of the altered variables, it was identified that there was a statistically significant difference for BP and TG.

Among LGA PTs, 44.4% had high BP, TG, and TC; whereas among AGA, 31.4% had high BP, 44.1% and 17.6%, respectively, with high TG and TC. SGAs did not present high BP, while 16.7% had high TG and TC.

Table 4 identifies the association among the degree of prematurity, adequacy of birth weight and the lipid, glycemic, blood pressure, BMI, and AC profile of the adolescents under study. A significant association is observed between the BP classification and the degree of prematurity (p-value=0.027).

Table 2 - Comparison among groups and within each group categorized according to the degree of prematurity with the following variables: pressure, glycemic, lipid profile, and abdominal circumference of adolescents born prematurely. Brazil, 2018 (N 50).

Degree of prematurity	Variables under study			
	Normal BP	**CI**	**High BP**	**CI**
< 28 wk.	2(0,04) aA	0,06 [0,02; 0,19]	1(0,02) aA	0,07 [0,01; 0,30]
28-31 wk.	2(0,04) aA	0,06 [0,02; 0,19]	5(0,10) abA	0,33 [0,15; 0,58]
32-36 wk.	31(0,62) bA	0,88 [0,74; 0,95]	9(0,18) bB	0,60 [0,36; 0,80]
Total	35(0,70)	1	15(0,30)	1
	Normal glycaemia	**CI**	**Altered glycaemia**	**CI**
< 28 wk.	3(0,06) aA	0,06 [0,02; 0,17]	0(0,00) aA	0,00 [0,00; 0,79]
28-31 wk.	7(0,14) aA	0,14 [0,07; 0,27]	0(0,00) aB	0,00 [0,00; 0,79]
32-36 wk.	39(0,78) bA	0,80 [0,66; 0,89]	1(0,02) aB	1,00 [0,21; 1,00]
Total	49(0,98)	1	1(0,02)	1

Caption: Wk.: weeks. BP: Blood Pressure; TC: Total Cholesterol; TG: Triglycerides; AC: Abdominal Circumference; CI: Confidence Interval. For each degree of prematurity (line), different capital letters represent significant differences in proportions among the levels of each variable; for each category of each variable (column), different lowercase letters represent significant differences in the proportions among the degrees of prematurity.

Table 2 - Continued...

Degree of prematurity	Variables under study			
	Desirable TC	**CI**	**High TC**	**CI**
< 28 wk.	2(0,04) aA	0,05 [0,01; 0,17]	0(0,00) aA	0,00 [0,00; 0,26]
28-31 wk.	5(0,10) aA	0,13 [0,06; 0,27]	2(0,04) aA	0,18 [0,05; 0,48]
32-36 wk.	31(0,63) bA	0,82 [0,67; 0,91]	9(0,18) bB	0,82 [0,52; 0,95]
Total	38(0,78)	1	11(0,22)	1
	Desirable TG	**CI**	**Righ TG**	**CI**
< 28 wk.	1(0,02) aA	0,03 [0,01; 0,17]	1(0,02) aA	0,05 [0,01; 0,24]
28-31 wk.	6(0,12) aA	0,21 [0,01; 0,38]	1(0,02) aA	0,05 [0,01; 0,24]
32-36 wk.	22(0,45) aA	0,76 [0,01; 0,88]	18(0,37) bA	0,90 [0,70; 0,97]
Total	29(0,59)	1	20(0,41)	1
	AC <90	**CI**	**AC ≥90**	**CI**
< 28 wk.	2(0,04) aA	0,04 [0,01; 0,15]	1(0,02) aA	0,20 [0,04; 0,62]
28-31 wk.	7(0,14) aA	0,16 [0,08; 0,29]	0(0,00) aB	0,00 [0,00; 0,43]
32-36 wk.	36(0,72) bA	0,80 [0,66; 0,89]	4(0,08) aB	0,80 [0,38; 0,96]
Total	45(0,90)	1	5(0,10)	1

Caption: Wk.: weeks. BP: Blood Pressure; TC: Total Cholesterol; TG: Triglycerides; AC: Abdominal Circumference; CI: Confidence Interval. For each degree of prematurity (line), different capital letters represent significant differences in proportions among the levels of each variable; for each category of each variable (column), different lowercase letters represent significant differences in the proportions among the degrees of prematurity.

Table 3 - Comparison among groups and within each group categorized according to their birth weight adequacy with the following variables: pressure, glycemic, lipid profile, and abdominal circumference of premature adolescents. Cascavel, PR, Brazil, 2018 (N 50).

Fenton	Variables under study			
	Normal BP	**CI**	**High BP**	**CI**
AGA	24 (0,48) aA	0,69 [0,52; 0,81]	11 (0,22) aB	0,73 [0,48; 0,89]
SGA	6 (0,00) bA	0,17 [0,08; 0,33]	0 (0,12) bB	0,00 [0,00; 0,20]
LGA	5 (0,08) bA	0,14 [0,06; 0,29]	4 (0,10) abA	0,27 [0,11; 0,52]
Total	35(0,70)	1	15(0,30)	1
	Normal glycaemia	**CI**	**Altered glycaemia**	**CI**
AGA	34 (0,68) aA	0,69 [0,55; 0,80]	1 (0,02) aB	1,00 [0,20; 1,00]
SGA	6 (0,12) bA	0,12 [0,06; 0,24]	0 (0,00) aB	0,00 [0,00; 0,79]
LGA	9 (0,18) bA	0,18 [0,10; 0,31]	0 (0,00) aB	0,00 [0,00; 0,79]
Total	49(0,98)	1	1(0,02)	1
	Desirable TC	**CI**	**High TC**	**CI**
AGA	28 (0,57) aA	0,74 [0,60; 0,85]	6 (0,12) aB	0,55 [0,28; 0,79]
SGA	5 (0,10) bA	0,13 [0,06; 0,27]	1 (0,02) aA	0,09 [0,02; 0,38]
LGA	5 (0,10) bA	0,13 [0,06; 0,27]	4 (0,08) aA	0,36 [0,15; 0,65]
Total	38(0,78)	1	11(0,22)	1

Caption: AGA: Adequate for Gestational Age; SGA: Small for Gestational Age; LGA: Large for Gestational Age; BP: Blood Pressure; TC: Total Cholesterol; TG: Triglycerides; AC: Abdominal Circumference; CI: Confidence Interval. For each group (line), different capital letters represent significant differences in the proportions among the levels of each variable. For each category of variables (column), different lowercase letters represent significant differences in proportions among Fenton's classes

Table 3 - Continued...

Fenton	Variables under study			
	Desirable TG	**CI**	**Righ TG**	**CI**
AGA	19 (0,39) aA	0,66 [0,47; 0,80]	15 (0,31) aA	0,75 [0,53; 0,89]
SGA	5 (0,10) bA	0,17 [0,08; 0,35]	1 (0,02) bA	0,05 [0,01; 0,24]
LGA	5 (0,10) bA	0,17 [0,08; 0,35]	4 (0,08) bA	0,20 [0,08; 0,42]
Total	29(0,59)	1	20(0,41)	1
	AC <90	**CI**	**AC ≥90**	**CI**
AGA	32 (0,64) aA	0,71 [0,57; 0,82]	3 (0,06) aB	0,60 [0,23; 0,88]
SGA	5 (0,10) bA	0,11 [0,05; 0,23]	1 (0,02) aA	0,20 [0,04; 0,62]
LGA	8 (0,16) bA	0,18 [0,09; 0,31]	1 (0,02) aB	0,20 [0,04; 0,62]
Total	45(0,90)	1	5(0,10)	1

Caption: AGA: Adequate for Gestational Age; SGA: Small for Gestational Age; LGA: Large for Gestational Age; BP: Blood Pressure; TC: Total Cholesterol; TG: Triglycerides; AC: Abdominal Circumference; CI: Confidence Interval. For each group (line), different capital letters represent significant differences in the proportions among the levels of each variable. For each category of variables (column), different lowercase letters represent significant differences in proportions among Fenton's classes

Table 4 - Association among degree of prematurity, adequacy of birth weight with lipid, glycemic, blood pressure, and anthropometric profile of adolescents born prematurely. Brazil, 2018. (N 50).

Variable	Adequacy of birth weight	Degree of prematurity
Blood pressure classification(1)	0.168	0.027*
Glucose category(1)	0.999	0.999
Total cholesterol category(1)	0.493	0.122
Triglyceride category(1)	0.718	0.050;
Z-score BMI(1)	0.684	0.743
Percentile abdominal circumference(1)	0.890	0.363

Caption: (1) P-value referring to Fisher's exact hypothesis test; * represents significant results at 5% probability (p-value < 0.05); ** trend towards association (p-value = 0.05).

However, although there was no positive association, TG showed a tendency towards association in relation to the degree of prematurity (p-value=0.05). The other variables showed no significant association in relation to the adequacy of birth weight and the degree of prematurity.

DISCUSSION

Changes in the lipid, glycemic, and blood pressure profile of adolescents born PT are expected, since prematurity is an event that alters the critical period of development. This situation results in changes in metabolic, hormonal, and nutritional conditions at birth with implications for health status throughout life, for example, hypertension, MS, obesity, and DM2.[4,17] Lipid changes, especially increased levels of TC and TG, were the most frequent metabolic complications observed in the adolescents in our study. These data suggest that adolescence associated with premature birth may have a greater impact on lipid metabolism and consequently cardiovascular complications.

The American College of Endocrinology[18] considers the presence of elevated TG to be one of the frequent changes in individuals with insulin resistance, an event that is often associated with greater adiposity. In the present study, no significant changes in glucose were found; however, in 40% of adolescents born PT, excess body weight was recorded, in addition to changes in AC and TG. Therefore, assessing insulin resistance and glucose tolerance may be an important event for monitoring these individuals.

A research study[19] carried out with young adults born PT and control group, showed no difference in lipid and glycemic levels; however, among the PTs. hypertension was two to three times more frequent than those born at term, in addition to having higher blood pressure levels. The association with BP and the degree of prematurity could be observed in the sample of this study, given that the later PTs had more adequate pressure levels. A study[20] observed that although PTs had normal blood pressure values, PT adolescents had slightly higher values than those born at term, an event considered a predecessor of arterial

hypertension. The evidence indicates that prematurity seems to be related to changes in cardiovascular parameters, thus, the young adult born PT is at greater risk of developing CVDs due to higher values of SBP, higher mean heart rate and pulse pressure, as well as greater variation in BP.[3,17]

The Study of Cardiovascular Risks in Adolescents (*Estudo dos Riscos Cardiovasculares em Adolescentes*, ERICA),[21] carried out with adolescents aged 12 to 17 years old in the national territory, showed that 24.1% had pre-hypertension or hypertension, with the highest incidence (29.5%) of these alterations being observed among adolescents in the southern region. It is noteworthy that adolescents from the South region also had a higher prevalence of overweight (18.7%) and obesity (11.1%). This study evaluated metabolic parameters, with 20.1% presenting high TC, 24.2% borderline TC, 7.8% with hypertriglyceridemia and 12.0% with borderline TG.[22] The authors identified a prevalence of MS of 2.6%, according to the IDF criteria, altered glycaemia had a prevalence of 4.1% and AC ≥90 12.6%.[23] MS was present among adolescents; however, ERICA did not separate the adolescents by GA, not being possible to identify if there were PTs among them. Using high values of AC, BP, and TG as criteria in the analysis of the sample of our study, 8% of adolescents born PT with MS were identified.

Still, a number of studies[4,9] show that individuals born PT have higher levels of fasting glucose, low insulin sensitivity, and higher blood pressure levels when compared to those born at term. In this way, they indicate the importance of fetal growth for the development of MS and show an increase in prevalence as birth weight decreases. However, in this sample this association with glycaemia was not observed, since only one adolescent had altered glycaemia, although another had a diagnosis of insulin resistance and three had acanthosis nigricans.

Visceral obesity is an important marker of MS, which can be indirectly assessed by measuring AC, an expressive anthropometric index of intra-abdominal fat, which is simple and reproducible.[6,24] According to the IDF definition,[6] for adolescents to be diagnosed with MS, they must have AC with a percentile ≥90 according to age, gender, and ethnicity. In our sample, AC ≥90 was found in 10% of the adolescents; however, it stands out as a warning sign that 22% had a 75 percentile, adopted by some authors6 as a marker of abdominal obesity.

The results of our study corroborate with different studies already published in the literature: the highest incidence of overweight (76%) was found in adolescents who were born extreme PT and very PT.[7] According to Cook,[24] BMI is a less sensitive indicator of adiposity in children and adolescents, since it is unable to assess fat distribution. For this author, AC reflects not only the degree of obesity, but it also suggests the place of deposit, being important to predict cardiovascular risks. Obese adolescents, PT or not, are at high risk of becoming obese adults, with the perspective of developing clinical complications and putting their survival at risk.[25]

PTs are two and a half to four times more likely to have MS than those born at term.[19] Therefore, with this predisposition due to prematurity associated with obesity and overweight rates, PT adolescents form a vulnerable group to develop MS in adulthood, since obesity is considered a trigger for this syndrome.[19,24]

Still, family history is in line with the so-called vicious cycle, in which chronic non-communicable diseases increase the risk of prematurity which, in turn, increase CVD cases in all life cycles. When present in women born prematurely in fertile age, cases of prematurity will increase again.[1]

This study has the limitation of being cross-sectional and without a control group, as well as that there was no fractionation of the TC and the sample N was reduced. Still, data such as nutrition and physical activity are important to cross with the profile of these adolescents. These limitations prevent generalizations of the findings and indicate the need for further studies to strengthen this information and support the monitoring of PTs throughout their life cycle, suggesting studies with analysis of these variables.

CONCLUSION AND IMPLICATIONS FOR PRACTICE

A relation between prematurity and the occurrence of changes in the pressure, lipid, and anthropometric profile was evidenced in this sample of adolescents born prematurely, corroborating the literature in the area. Such finding indicates the need for measures that delay or prevent the onset of MS in individuals born prematurely. Since the picture of consequences of prematurity indicates the need to pay attention to the follow-up of the newborn PT to factors that expose them to a greater risk of late development of chronic health conditions. One of the strategies to prevent this problem after discharge from the neonatal intensive care units is the monitoring of these children throughout their childhood and adolescence. With the professional nurse being one of the members of the health team whose professional competence is the nursing consultation and the active search for monitoring the child and adolescents' health in situations of risk or vulnerability.

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REFERENCES

1. Vogel JP, Chawanpaiboon S, Watananirun K, Lumbiganon P, Petzold M, Moller AB et al. Global, regional and national levels and trends of preterm birth rates for 1990 to 2014: protocol for development of World Health Organization estimates. Reprod Health. 2016;13(1):76. http://dx.doi.org/10.1186/s12978-016-0193-1. PMid:27317125.
2. Litvinchuk T, Singh R, Sehehan CT, Vasylyeva TL. Weight in infancy and obesity in children born preterm. Int J Integr Pediatr Environ Med. 2014;1:36-42. http://dx.doi.org/10.36013/ijipem.v1i0.13.
3. Sipola-Leppänen M, Vääräsmäki M, Tikanmäki EM, Hovi P, Miettola S, Ruokonen A et al. Cardiovascular risk factors in adolescents born preterm. Pediatrics. 2014;134(4):1072-81. http://dx.doi.org/10.1542/peds.2013-4186. PMid:25180275.
4. Barker DJP, Osmond C, Kajantie E, Eriksson JG. Growth and chronic disease: Findings in the Helsinki Birth Cohort. Ann Hum Biol. 2009;36(5):445-58. http://dx.doi.org/10.1080/03014460902980295. PMid:19562567.
5. Villalobos J, Velasquez ME, Farias A, Mejias A. Crecimiento, nutrición temprana y riesgo de diabetes y sindrome metabólico. Arch Venez Puer Ped. 2014;77(3):154-61.
6. Sociedade Brasileira de Diabetes. Diretrizes da Sociedade Brasileira de Diabetes (2015-2016). São Paulo: A.C. Farmacêutica; 2016. 337 p. [citado junho 20 2017]. Disponível em: www.diabetes.org.br/profissionais/images/docs/DIRETRIZES-SBD-2015-2016.pdf
7. Ribeiro AM, Lima MC, Lira PIC, Sil GAP. Baixo peso ao nascer e obesidade: associação causal ou casual? Rev Paul Pediatr. 2015;33(3):340-8. http://dx.doi.org/10.1016/j.rpped.2014.09.007. PMid:26122207.
8. Hemalatha R, Radhakrishna KV, Naveen Kumar B. Undernutrition in children & critical windows of opportunity in Indian context. Indian J Med Res. 2018;148(5):612-20. http://dx.doi.org/10.4103/ijmr.IJMR_1963_18. PMid:30666986.
9. de Jong M, Lafeber HN, Cranendonk A, van Weissenbruch MM. Components of the metabolic syndrome in early childhood in very-low-birth-weight infants. Horm Res Paediatr. 2014;81(1):43-9. http://dx.doi.org/10.1159/000355597. PMid:24281139.
10. Sistema de Informação Sobre Nascido Vivo. Dados nascidos vivos residentes em Cascavel. 2015. [citado 2 maio 2016]. Disponível em: http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sinasc/cnv/nvpr.def
11. Instituto Paranaense de Desenvolvimento Econômico e Social. Caderno Estatístico Município Cascavel. Maio, 2016. 44 p. [citado 26 May 2016]. Disponível em: http://www.ipardes.gov.br/cadernos/MontaCadPdf1.php?Municipio=85800
12. Fenton TR, Kim JH. A systematic review and meta-analysis to revise the Fenton growth chart for preterm infants. BMC Pediatr. 2013;59(13):59. http://dx.doi.org/10.1186/1471-2431-13-59. PMid:23601190.
13. Goldenring J, Cohen E. Getting into adolescent HEADSS. Contemp Pediatr. 1988;5(7):75-90.
14. Sociedade Brasileira de Cardiologia. 7ª Diretriz Brasileira de Hipertensão Arterial. Arquivos Brasileiros de Cardiologia. Arq Bras Cardiol [Internet]. 2016 [citado 19 jun 2017];107(3):83. Disponível em: publicacoes.cardiol.br/2014/diretrizes/2016/05_HIPERTENSAO_ARTERIAL.pdf.
15. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas e Estratégicas. Proteger e cuidar da saúde de adolescentes na atenção básica [Internet]. Brasília: Ministério da Saúde; 2017. [citado 16 jun 2018]. 234 p. Disponível em: <http://bvsms.saude.gov.br/bvs/publicacoes/proteger_cuidar_adolescentes_atencao_basica.pdf.
16. Sociedade Brasileira de Análises Clínicas. Consenso Brasileiro para a Normatização da Determinação Laboratorial do Perfil Lipídico [Internet]. São Paulo: A.C. Farmacêutica; 2016 [citado 16 junho 2017]. Disponível em: www.sbpc.org.br/upload/conteudo/consenso_jejum_dez2016_final.pdf
17. Sutherland MR, Bertagnolli M, Lukaszewski MA, Huyard F, Yzydorczyk C, Luu TM et al. Preterm birth and hypertension risk the oxidative stress paradigm. Hypertension. 2014;63(1):12-8. http://dx.doi.org/10.1161/HYPERTENSIONAHA.113.01276. PMid:24144644.
18. Einhorn D, Reaven GM, Cobin RH, Ford E, Ganda OP, Handelsman Y et al. American College of Endocrinology position statement on the insulin resistance syndrome. Endocr Pract. 2003;9(3):237-52. PMid:12924350.
19. Sipola-Leppänen M, Vääräsmäki M, Tikanmäki M, Matinolli HM, Miettola S, Hovi P et al. Cardiometabolic risk factors in young adults who were born preterm. Am J Epidemiol. 2015;181(11):861-73. http://dx.doi.org/10.1093/aje/kwu443. PMid:25947956.
20. González Stäger MA, Fernández AR, Valenzuelac CM, Sáezc AO, Navarretec ASM. Estado nutricional de adolescentes pertenecientes a una cohorte de niños nacidos prematuros. Rev Chil Pediatr. 2016;87(4):268-73. http://dx.doi.org/10.1016/j.rchipe.2015.11.004. PMid:26794475.
21. Bloch KV, Klein CH, Szklo M, Kuschnir MCC, Abreu GA, Barufaldi LA et al. ERICA: prevalências de hipertensão arterial e obesidade em adolescentes brasileiros. Rev Saude Publica. 2016;50(Supl 1):1s-9s. http://dx.doi.org/10.1590/s01518-8787.2016050006685. PMid:26910553.
22. Faria JR, Bento VFR, Baena CP, Olandoski M, Gonçalves LGO, Abreu GA et al. ERICA: prevalência de dislipidemia em adolescentes brasileiros. Rev Saude Publica. 2016;50(Supl 1):1s-10s. http://dx.doi.org/10.1590/S01518-8787.2016050006723.
23. Kuschnir MCC, Bloch KV, Szklo M, Klein CH, Barufaldi LA, Abreu GA. ERICA: prevalência de síndrome metabólica em adolescentes brasileiros. Rev Saude Publica. 2016;50(Supl 1):1s-11s. http://dx.doi.org/10.1590/s01518-8787.2016050006701. PMid:26910546.
24. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: Findings from the third National Health and Nutrition Examination Survey, 1988-1994. Arch Pediatr Adolesc Med. 2003;157(8):821-7. http://dx.doi.org/10.1001/archpedi.157.8.821. PMid:12912790.
25. Gungor NK. Overweight and obesity in children and adolescents. J Clin Res Pediatr Endocrinol. 2014;6(3):129-43. http://dx.doi.org/10.4274/jcrpe.1471. PMid:25241606.