Early atherogenic signs in a health area of Consolacion del Sur municipality

Adrian A. Naranjo Domínguez[a]✉, MD; Alexander A. Padrón González[a], MD; Gabino E. Arman Alessandini[b], MD; Ronald Aroche Aportela[c], MD; and Antonio Cabinda[d], MD, MSc

[a] Medical University. Pinar del Río, Cuba.
[b] Department of Reproductive Health and Family Planning. Provincial Health Sector. Pinar del Río, Cuba.
[c] Department of Interventional Cardiology. Center for Medical and Surgical Research (CIMEQ). Havana, Cuba.
[d] Abel Santamaría Cuadrado General Teaching Hospital. Pinar del Río, Cuba.

Este artículo también está disponible en español

✉ AA Naranjo Domínguez
*Calle 4ta Edif. 2 Apto. 23-C
Reparto 10 de octubre, Pinar del Río
Pinar del Río, Cuba.
E-mail address:*
adrian90@princesa.pri.sld.cu

ABSTRACT

Introduction: The World Health Organization has acknowledged that atherosclerosis is the most worrisome epidemic in the world due to its functional consequences.
Objective: To identify early atherogenic signs in children between 5 and 11 years of age who belong to an urban health area.
Method: An observational descriptive cross-sectional study was conducted. The universe consisted of 470 children, between 5 and 11 years of age, who receive primary health care in the Villa 1 People's Council of the 27 de Noviembre Polyclinic in Consolación del Sur, Pinar del Río, Cuba. The sample was selected using the simple random method, and consisted of 148 children whose parents gave informed consent for their participation in the study. Sociodemographic, anthropometric and other variables of interest were studied, including blood pressure, birth weight, and a family history of hypertension and diabetes mellitus.
Results: 58.1% of the schoolchildren in the study were male; 15 subjects (10.1%) had low birth weight and 22 (14.9%) were obese. A total of 15 schoolchildren (10.1%) were identified as hypertensives.
Conclusions: There was a predominance of males, where anthropometric values were slightly elevated compared to females. Overweight, obesity, a family history of disease and hypertension were identified as the most common atherosclerotic signs.
Key words: Atherosclerotic signs, Atherosclerosis, Schoolchildren

Señales aterogénicas tempranas en un área de salud del municipio Consolación del Sur

RESUMEN

Introducción: La Organización Mundial de la Salud ha reconocido que la aterosclerosis constituye la epidemia más preocupante en el mundo debido a sus consecuencias orgánicas.
Objetivo: Identificar las señales aterogénicas tempranas en niños entre 5 y 11 años de edad, pertenecientes a un área de salud urbana.

Método: Estudio observacional descriptivo con diseño transversal. El universo estuvo constituido por los 470 niños entre 5 y 11 años de edad que reciben atención primaria de salud en el Consejo Popular Villa 1 del Policlínico "27 de noviembre" de Consolación del Sur, en Pinar del Río, Cuba. La muestra, seleccionada por el método aleatorio simple, quedó constituida por 148 niños cuyos padres ofrecieron el consentimiento informado para participar en el estudio. Se estudiaron variables sociodemográficas, antropométricas y otras de interés: tensión arterial, peso al nacer, antecedentes patológicos familiares de hipertensión y diabetes mellitus.

Resultados: El 58,1 % de los escolares estudiados fueron del sexo masculino, 15 (10,1 %) presentaron bajo peso al nacer y 22 (14,9 %), eran obesos. Se detectaron 15 escolares (10,1 %) hipertensos.

Conclusiones: Predominó el sexo masculino, donde los valores antropométricos fueron ligeramente elevados con respecto al sexo femenino. Se identificaron al sobrepeso, la obesidad, los antecedentes patológicos familiares y a la hipertensión arterial como las señales ateroscleróticas más frecuentes.

Palabras clave: Señales ateroscleróticas, Aterosclerosis, Escolares

INTRODUCTION

Atherosclerosis is a disease of general metabolism that affects arteries, with severe impact on the organs irrigated by them, and is related, among other diseases, with ischemic heart disease and cerebrovascular disease, which are the major causes of morbidity and mortality in the world[1]. More than 7 million people die each year from cardiovascular disease and 1.3 million suffer non-fatal heart attacks. In the United States, it is estimated that each year 1.7 million patients are admitted with a diagnosis of acute coronary syndrome[2].

In Cuba, in 2011, heart diseases were the second leading cause of death with 22 178 deaths, with a rate of 197.5 per 100 000 inhabitants[3], showing a remarkable increase when compared with the year 2010, that recorded 16 435 deaths[4]; of these, ischemic heart disease was the most prevalent one.

The World Health Organization (WHO) has recognized that atherosclerosis is the most worrisome epidemic in the world, because its functional consequences (ischemic heart disease, cerebrovascular disease, peripheral arterial disease and chronic kidney disease) are the leading causes of morbidity, mortality, hospital admissions, and disability in the developed and developing nations, with high costs for the health systems, society, family and the individual who suffers from them[5].

There is now great concern about the consequences of atherosclerotic risk factors that are present from an early age. Studies in children and adolescents have noticed how these factors tend to persist over time to adulthood[6].

Atherosclerosis is not exclusive of humans. It begins with the origin of life itself, that is, from conception, and progresses from the first or second decade of life, until the appearance of clinical manifestations in later decades. Arrieta *et al.*[7] and Ferrer *et al.*[8], in pathomorphological and morphometric studies, with the use of the atherometric system, showed the veracity of this claim, and also demonstrated that the atherosclerotic lesion begins in the thoracic segment rather than the abdominal one, where it progresses more rapidly and with greater intensity[7,8].

The early atherosclerotic signs are those manifestations of atherosclerosis and known atherogenic risk factors that may be detected by health workers, even if their symptoms or signs are not apparent to the patient[9].

The prevention of adult diseases starting with child care is increasingly considered as a major topic in the broad field of Comprehensive General Medicine, although it is not yet a priority concern. The approach of the promotion of health in children for the prevention of chronic diseases in adults will reduce morbidity and mortality due to diseases linked to atherosclerosis[10,11].

The objective of this study was to identify the early atherogenic signs in children between 5 and 11 years of age who belong to an urban health area.

METHOD

An observational descriptive cross-sectional study was conducted in the population residing in Villa 1 People's Council, which belongs to the 27 de Noviembre Poly-

clinic in Consolación del Sur, Pinar del Río, Cuba, from January 1 and March 15, 2013.

Universe and sample

The study group consisted of 470 children between 5 and 11 years of age who receive primary health care in the above mentioned health area. The sample was selected using the simple random method and consisted of 148 children whose parents gave informed consent for their participation in the study.

Data collection

All children, during the medical interview, underwent anthropometric assessments. Units of measurement were used according to the international system of units. The data were recorded in a data collection form that was devised for this purpose, and included all study variables.

Measurement techniques

Body weight: A scale, in perfect working order, with the certificate of the National Bureau of Standards and Metrology, was used to measure body weight. The subject was placed standing in the center of the weighing platform, without being in contact with any surface around, so that the weight distribution was equal in both legs and his arms hang freely on both sides of the body.

Height: The measurement was performed with the subject wearing the indispensable clothes, without socks, shoes or personal clothing, and the entire unit was recorded to two decimal places. A stadiometer was used, whose central axis was perfectly vertical to the floor and its movable end, when raised, did not exceed a 90 ° angle with the vertical axis, graduated in centimeters and tenths of centimeters. The barefoot subjects were placed with their backs to the vertical axis, feet together, arms at their side, upright without separating the feet from the surface of the scale, and their heads in the Frankfort plane. Then, the movable rod was lowered, the horizontal line reached the vertex of the individual, and some pressure was applied to depress the hair.

Body mass index (BMI): It was calculated by dividing weight (in kilograms) by the square of height (in meters). Cuban BMI charts for children and adolescents 0-19 years were used as reference values[7-9].

Abdominal circumference: a graduated tape measure was used, with an initial blank space for handling it. The subject was placed standing, with a relaxed abdomen, breathing out, the arms detached from the body, in front of the sitting examiner. The tape surrounded the subject, at the level of the umbilical region, midway between the anterior superior iliac crest and the lower border of the last rib, completely parallel to the ground.

Blood pressure (BP): The sphygmomanometer was properly calibrated and had the appropriate size for the age of the subjects under examination. Three BP measurements were performed, separated by a minimum of 5 minutes, and the average of the two final measurements was considered for registration. When high BP values were found, the measurement was repeated a week later. The subjects were sitting upright with their forearms resting on a table, at heart level. The cuff was placed without wrinkles approximately at heart level and leaving enough space for placing the stethoscope in the cubital fossa.

Variables

The variables that were analyzed included age (in years), sex (phenotype at birth), family history of diabetes mellitus and hypertension in first and second line relatives, or both; smoking, considering whether the subject was a passive smoker or not; and other variables described below.

Birth weight:
- Low weight: < 2500 grams
- Normal weight: 2500 - 4000 grams
- Fetal macrosomia: > 4000 grams

Nutritional assessment (classified according to BMI and age):
- Malnourished: < 3rd percentile
- Thin: 3-10 percentile
- Normal weight: 10-90 percentile
- Overweight: 90-97 percentile
- Obese: ≥ 97th percentile

Abdominal obesity (classified according to waist circumference):
- Normal: < 90 percentile
- Abdominal obesity: ≥ 90 percentile

Blood pressure (according to the IV Report on Hypertension in Children and Adolescents)[12,13]
- Normal: systolic and diastolic < 90 percentile

- Prehypertension or high normal BP: systolic and diastolic BP between 90-95 percentile
- Hypertension: systolic and diastolic BP > 95 percentile

Statistical Analysis

A database was created in Microsoft Office Access and was exported to SPSS for Windows version 11.5. Absolute and relative frequencies distribution was used in the description of the variables used.

Ethical issues

The ethical principles of human research were followed. The project was approved by the Medical Ethics Committee of the 27 de Noviembre Polyclinic. The identity of the subjects was respected; and informed consent was obtained from their parents.

RESULTS

There was a predominance of males in the group (58.1%) (**Table 1**) and the average age of the subjects was 7.96 ± 1.82 years. Mean age was higher in males than in females: 8.08 ± 1.82 and 7.79 ± 1.83, respectively. Also, 10.1% of children had a history of diabetes mellitus and 31.8% of them a history of hypertension, in second-line relatives.

The population mean for weight and height was 30.3 ± 10.2 and 1.31 ± 0.13, respectively. Most children (69.6%) had a normal weight (**Table 2**), and it is noteworthy that 14.9% of them were classified as obese. In addition, 28 children (18.9%) had an abdominal circumference ≥ 90th percentile, so they were classified as having abdominal obesity, although not all were actually obese, according to the nomograms of BMI for age.

During the conduction of the study, 15 subjects (10.1%) were identified as hypertensive and 7 (4.7%) classified as prehypertensive (**Table 3**).

DISCUSSION

Most strategies to reduce cardiovascular risk include changes in behavior and lifestyle when many habits are already established. However, due to how early lesions are present, as well as the fact that many of the habits are established in childhood and early life, actions to prevent the establishment of the risks in childhood and adolescence are critical in reducing these diseases[11,14].

Obesity has been called the epidemic of the 21st

Table 1. General characteristics of the sample. Villa 1 People's Council, 27 de Noviembre Teaching Polyclinic, Pinar del Río, Cuba.

Variables	Nº	%
Age		
< 6 years	17	11.5
6 - 9 years	94	63.5
> 9 years	37	25.0
Sex		
Female	62	41.9
Male	86	58.1
Family history of Diabetes Mellitus		
Yes, first line	1	0.7
Yes, second line	15	10.1
Yes, both lines	2	1.4
No	130	87.8
Family history of hypertension		
Yes, first line	12	8.1
Yes, second line	47	31.8
Yes, both lines	9	6.1
No	80	54.1
Smoking		
Passive smoker	44	29.7
Not a passive smoker	104	70.3
Birth weight		
Underweight	15	10.1
Normal weight	126	85.1
Fetal macrosomia	7	4.7

Table 2. Nutritional assessment and abdominal obesity.

Variables	Nº	%
Nutritional assessment		
Malnourished	5	3.4
Thin	6	4.1
Normal weight	103	69.6
Overweight	12	8.1
Obese	22	14.9
Abdominal obesity		
Normal	120	81.1
Abdominal obesity	28	18.9

century, considering the increase in its prevalence worldwide and in all age groups. According to the WHO, the number of overweight and obese persons may be increased to 1.5 billion in 2015, if this trend continues[5]. In Europe, its prevalence has increased 3 times in the last two decades with overweight figures close to 50% of adults and 20% in children, of which one third are obese[5,10]. In the United States the percentage of obese adults increased from 15.3% in 1995 to 23.9% in 2005[11].

Table 3. Behavior of BP values according to sex.

Clasification of BP	Female		Male		Total	
	Nº	%	Nº	%	Nº	%
High normal or prehypertension	2	1.4	5	3.4	7	4.7
Hypertension	10	6.8	5	3.4	15	10.1

In this study, 18.9% of the study population was classified as obese, similar figures have been reported in other studies. According to Ferrer *et al.*[8], in a study on overweight and obesity prevalence in primary school children conducted in 1994 in Havana, overweight was found in 14% of children and obesity in 9.3%. More recently, the Atherosclerosis Research and Reference Center of Havana participated in a multinational study[15] that found an overweight rate of 13.4% and an obesity rate of 6.9% in adolescents in this city.

Smoking and exposure to secondhand smoke, is one of the major preventable causes of morbidity and mortality[16,17]. In the United States there have been 14 million premature deaths from this cause since 1964 and each year 400 000 smokers die from diseases related to smoking[16].

Smoking accelerates the atherogenic process depending on both the duration and dose of the habit, and amplifies the effect of other cardiovascular risk factors. This situation accelerates atherosclerotic disease and has an impact in the occurrence of acute coronary syndromes. Specifically, thrombus formation, plaque instability and arrhythmias are influenced by smoking[18,19]. When studying the arteries of children and young people who died from accidental causes, a greater amount of fatty streaks and fibrous plaques was found in smokers than in nonsmokers, and the transformation of fatty streaks into fibrous plaques occurred earlier and with more intensity in smokers[15,20].

Regarding hypertension, it has been found that its incidence in childhood is between 2 and 5%[20]. It is known that the regional distribution of body fat (central obesity), assessed by the waist/hip ratio, should be considered in these children because it is a more reliable variable of cardiovascular risk than total body fat, calculated by BMI[21-23].

In this cohort, 10.1% of the children were diagnosed as hypertensive. Conçalves *et al.*[20], in a cohort of Brazilian children followed for 17 years until adulthood, showed that the maintenance of high blood pressure was associated with a more unfavorable profile of cardiovascular risk, represented by a higher prevalence of hypertension, overweight and obesity, lipid and glucidic disorders, and the presence of metabolic syndrome in adulthood; all of which confirms the need for preventive measures from the early stages of life.

Several factors are considered predictors of hypertension such as overweight[24], abdominal obesity[25,26], low birth weight, inadequate postnatal growth and inadequate dietary habits in the early years of life, including high salt intake, among others[27,28].

In 2004, a cross-sectional study was conducted in adolescents from Havana, with the aim of identifying early atherosclerotic signs, such as obesity, hypertension and smoking. It was found that 20.4% of adolescents were overweight, 9% had elevated BP values, 4.9% were active smokers and 8% had three of the studied signs[15].

Body composition is one of the main determinants of blood pressure in children. It is believed that overweight increases by more than 50% the risk of hypertension. Overweight children are more likely to remain overweight and adiposity is one of the most important risk factors for increased BP levels[27,28]. Studies confirm that there is a positive correlation between BMI and blood pressure, which is accompanied by structural and functional alterations of the heart, such as atrial and ventricular hypertrophy, with systolic and diastolic dysfunction, present in obese children and adolescents, with a tendency to persist and progress to

adulthood[12,20-27].

CONCLUSIONS

There was a predominance of males, where anthropometric values were slightly elevated compared to females. Overweight, obesity, a family history of disease and hypertension were identified as the most common atherosclerotic signs. There was no association between sex and the onset of hypertension.

REFERENCES

1. Sternby NH, Fernandez-Britto JE, Nordet P. Pathobiological determinants of atherosclerosis in youth (PBDAY Study), 1986-96. Bull World Health Organ. 1999;77(3):250-7.

2. Levi F, Chatenoud L, Bertuccio P, Lucchini F, Negri E, La Vecchia C. Mortality from cardiovascular and cerebrovascular diseases in Europe and other areas of the world: an update. Eur J Cardiovasc Prev Rehabil. 2009;16(3):333-50.

3. Ministerio de Salud Pública. Anuario Estadístico de Salud 2011. La Habana: Dirección Nacional de Registros Médicos y Estadísticas de Salud; 2012.

4. Ministerio de Salud Pública. Anuario Estadístico de Salud 2010. La Habana: Dirección Nacional de Registros Médicos y Estadísticas de Salud; 2011.

5. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization, 2011. [citado 16 May 2014]. Disponible en: http://whqlibdoc.who.int/publications/2011/9789240686458_eng.pdf?ua=1

6. Baltodano A, Esquivel ML, Mas C. Guías para la prevención primaria de la enfermedad cardiovascular aterosclerótica empezando desde la niñez. Rev Costarr Cardiol. 2004;6(2):63-72.

7. Arrieta M, Ávila M, González M, Trejo AG. Señales aterogénicas tempranas en adolescentes de secundaria básica de Arroyo Naranjo. Rev Cubana Med Gen Integr [Internet]. 2012 [citado 18 May 2014]; 28(3):270-81. Disponible en: http://scielo.sld.cu/pdf/mgi/v28n3/mgi06312.pdf

8. Ferrer M, Fernández-Britto JE, Piñeiro R, Carballo R, Sevilla D. Obesidad e hipertensión arterial: señales ateroscleróticas tempranas en los escolares. Rev Cubana Pediatr [Internet]. 2010 [citado 18 May 2014];82(4):20-30. Disponible en: http://scielo.sld.cu/pdf/ped/v82n4/ped03410.pdf

9. Fernández-Britto JE. La Señal Aterogénica Temprana (SAT): su importancia en el futuro de la vida. FUEDIN [Internet]. 2008 [citado 10 May 2014]: [aprox. 4 p.]. Disponible en: http://www.fuedin.org/actualizaciones/diabetes/act_08-03/aterogenica.html

10. Paterno CA. Factores de riesgo coronario en la adolescencia. Estudio FRICELA. Rev Esp Cardiol. 2003;56(5):452-8.

11. Mendis S, Nordet P, Fernandez-Britto JE, Sternby N. Atherosclerosis in children and young adults: An overview of the World Health Organization and International Society and Federation of Cardiology study on Pathobiological Determinants of Atherosclerosis in Youth study (1985-1995). Preven Control. 2005;1(1):3-15.

12. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. Pediatrics. 2004;114(2):555-76.

13. Ramírez Méndez M, Moreno-Martínez FL, Torres Ruiz D, Nieto Monteagudo CG, Osorio Gómez CM, Guevara González A, *et al*. Detección de hipertrofia ventricular izquierda en adolescentes con hipertensión arterial esencial. Hipertensión. 2006;23(9): 277-83.

14. Laitinen TT, Pahkala K, Venn A, Woo JG, Oikonen M, Dwyer T, *et al*. Childhood lifestyle and clinical determinants of adult ideal cardiovascular health: the Cardiovascular Risk in Young Finns Study, the Childhood Determinants of Adult Health Study, the Princeton Follow-Up Study. Int J Cardiol. 2013; 169(2):126-32.

15. Fernández-Britto JE, Barriuso A, Chiang MT, Pereira A, Toros H, Castillo JA, *et al*. La señal aterogénica temprana: estudio multinacional de 4,934 niños y jóvenes y 1,278 autopsias. Rev Cub Invest Biomed [Internet]. 2005 [citado 10 May 2014];24(3):[aprox. 43 p.]. Disponible en: http://scielo.sld.cu/pdf/ibi/v24n3/ibi02305.pdf

16. Giovino GA. The tobacco epidemic in the United States. Am J Prev Med. 2007;33(Supl. 6):S318-26.

17. Sachais BS. Platelet-endothelial interactions in atherosclerosis. Cur Atheroscler Rep. 2001;3(5): 412-6.

18. Fernández-Britto JE, Wong R, Contreras D, Delgado J, Campos R, Norder P. Impacto del tabaquismo como factor de riesgo aterosclerótico en edades tempranas. Rev Cubana Invest Biomed [Internet].

1999 [citado 12 May 2014];18(3):176-88. Disponible en:
http://scielo.sld.cu/pdf/ibi/v18n3/ibi03399.pdf

19. Oquendo de la Cruz Y, Piñeiro Lamas R, Duarte MC, Guillen Dosal A. Síndrome metabólico en niños y adolescentes hipertensos obesos. Rev Cubana Pediatr. 2010;82(4):31-40.

20. Conçalves EM, Araujo A, Pozzan R, Fraça MF, Lopes F, Pizzi OL, *et al*. Presión arterial en jóvenes como marcador de riesgo cardiovascular en jóvenes estudio de Rio de Janeiro. Arq Bras Cardiol. 2009;93(6): 639-47.

21. Harmancey R, Wilson CR, Taegtmeyer H. Adaptation and maladaptation of the heart in obesity. Hypertension. 2008;52(2):181-7.

22. Genovesi S, Antolini L, Giussani M, Pieruzzi F, Galbiatis S, Valsecchi MG, *et al*. Usefulness of waist cincumference for the identification of childhood hypertension. J Hypertension. 2008;26(8):1563-70.

23. Moreno-Martínez FL. Obesidad y distribución regional de la grasa: viejos temas con nuevas reflexiones. CorSalud [Internet]. 2011 [citado 12 May 2014];3(1):1-3. Disponible en:
http://www.corsalud.sld.cu/sumario/2011/v3n1a11/distribucion.htm

24. Ferrer M, Rodríguez C, González MT, Díaz MB, Núñez M. Obesidad, hipertensión y tabaquismo: señales ateroscleróticas tempranas en adolescentes de la secundaria básica "Guido Fuentes". Rev Cubana Invest Bioméd [Internet]. 2009 [citado 13 May 2014];28(2):[aprox. 9 p]. Disponible en:
http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-03002009000200006&lng=es

25. Kovacs VA, Gabor A, Fajcsak Z, Martos E. Role of waist circumference in predicting the risk of high blood pressure in children. Int J Pediatr Obes. 2010;5(2):143-50.

26. Sung RY, Yu CC, Choi KC, McManus A, Li AM, Xu SL, *et al*. Waist circumference and body mass index in Chinese children: cutoff values for predicting cardiovascular risk factors. Int J Obes. 2007;31(3):550-8.

27. Facchini F, Fiori G, Bedogni G, Galletti L, Belcastro MG, Ismagulov O, *et al*. Prevalence of overweight and cardiovascular risk factors in rural and urban children from Central Asia: the Kazakhstan Health and Nutritional Examination Survey. Am J Hum Biol. 2007;19(6):809-20.

28. Li L, Law C, Power C. Body mass index throughout the life-course and blood pressure in mid-adult life: a birth cohort study. J Hypertens. 2007;25(6):1215-23.