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Body mass index, blood pressure and electrocardiogram for screening in healthy children at Pilar City, Buenos Aires, Argentina, 2012

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ABSTRACT

Introduction: obesity is frequent in argentinian children and arterial hypertension affects 2.4% of scholars. **Objective**: the objectives of the present study are to evaluate the prevalence of obesity and hypertension and their association, and to analyze the ability of electrocardiograms to detect conditions in healthy children and adolescents who attended to request a medical certificate of fitness. **Methods:** 1030 children (47.9% females and 52.1% males) ranging from 1 to 18 years old who concurred for a check up between Janury and March 2012, were consecutively included. Their body mass index, blood pressure, weight, height, and electrocardiogram findings were calculated and evaluated by a pediatrician and a cardiologist. **Results:** obesity was detected in 12.1% of males and 9.9% of females, and malnutrition was found in 1.9% and 1.4, respectively. Overweight was more frequent in males, consistent across all age groups. Systolic hypertension (adjusted to the 95th height percentile) was observed in 8.8% males and 8.6% females, more prevalent in children ranging from 4 to 11 years old. A significant association between hypertension and high body mass index was observed. The ECG assessments resulted in six patients with pauses, one patient with asymptomatic Wenchebach AV block, three patients with asymptomatic sinus arrest, and one patient with ventricular bigeminy. Five cases of Wolf-Parkinson-White syndrome were diagnosed, and 2.7% children had long QTc segments. **Conclusions:** a high prevalence of hypertension was found, which was more frequent in obese children. The electrocardiogram analysis resulted in patients with potentially high risk conditions. **MÉD.UIS. 2016;29(3):49-53.**

Keywords: Risk. Cardiovascular System. Hypertension. Obesity. Body Mass Index. Electrocardiography.

Índice de masa corporal, presión arterial y electrocardiograma en el cribado de salud de niños sanos en La Ciudad del Pilar, Buenos Aires, Argentina, 2012

RESUMEN

Introducción: la obesidad es frecuente en niños argentinos y la hipertensión arterial afecta a 2,4% de los escolares. **Objetivo:** evaluar la prevalencia de obesidad e hipertensión y su asociación, y analizar la detección de anormalidades en el electrocardiograma en una población de niños sanos que concurrieron para certificado de estado físico. **Materiales y método**: se incluyeron 1030 niños (47,9% de sexo femenino y 52,1% masculinos), de 1 a 18 años, que concurrieron a control durante Enero y Marzo de 2012. Se les realizó un electrocardiograma y medición de presión arterial, peso y talla. **Resultados:** el 12,1% de los varones y 9,9% de las niñas tenían obesidad y el 1,9% y 1,4%, respectivamente, tenían desnutrición. Fue más frecuente el sobrepeso y la obesidad entre los varones que en las mujeres, con distribución homogénea entre las edades. El 8,8 % de los niños y el 8,6% de las niñas tuvieron valores de presión arterial sistólica por encima del percentil 95 según talla, especialmente entre los 4 y los 11 años, con una asociación estadísticamente significativa entre la hipertensión arterial y el índice de masa corporal elevado. En el electrocardiograma hubo seis pacientes con pausas, un bloqueo aurículo-ventricular tipo Wenchebach asintomático, tres pacientes con paro sinusal y un paciente con bigeminismo ventricular. Se diagnosticaron cinco Wolf Parkinson White y 2,7% de los niños presentaron QTc prolongado. **Conclusiones:** hubo alta prevalencia de hipertensión arterial, más frecuente en niños con obesidad. Se detectaron pacientes con trastornos potencialmente graves en el electrocardiograma. **MÉD.UIS. 2016;29(3):49-53.**

Palabras clave: Riesgo. Sistema Cardiovascular. Hipertensión. Obesidad. Índice de Masa Corporal. Electrocardiografía.

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Introduction

Noncommunicable diseases, especially cardiovascular ones, presently account for about 56% of all deaths in poorly or relatively developed countries. This trend has been increasing in time [1]. Bad lifestyle habits started in childhood have been proved to persist through adulthood, favoring the development of cardiovascular risk factors.

Cardiovascular educational programs and healthcare methods based on diet and physical activity are now the cornerstone of cardiovascular health programs[2,3]. Moreover, although the benefit of measuring Blood Pressure (BP) in children and adolescents to prevent cardiovascular events in adults is still subject of controversy[4], there is an increasing concern about the link between these measurements and the potential development of heart disease during adulthood. There is also a growing concern about the worldwide early obesity epidemics[5,6], as it can lead to serious diseases, including diabetes[7]. Based on World Health Organization (WHO) data, obesity affects 7.3% of the children population in Argentina[8]. One study performed in rural schools in Argentina observed a prevalence of pre-hypertension and hypertension of 1.8% and 2.4%, respectively in children[9].

Incipient conditions or potentially serious risk factors which might endanger vulnerable groups may be detected through periodical clinical evaluations[10]; however, which kind of studies should be carried on is debatable.

Therefore, this document attempts to investigate the prevalence of obesity and hypertension, and the relationship thereof in a population of healthy children who requested a medical certificate of fitness, and to evaluate the prevalence of conditions potentially related to heart disease in a routine Electrocardiogram (ECG) assessment.

Methods

POPULATION

A cross-sectional cohort study was performed, using medical file data from outpatients ranging from 1 to 18 years old, who had attended a health examination visit at a site located in the city of Pilar (Buenos Aires, Argentina), between January and March 2012. The population included 1030 middle to high-class patients either on union-run or privately-run health insurance. Data were incorporated into an *ad-hoc* database attached to the patients' medical file.

DATA COLLECTION AND DEFINITION

Patients were assessed by a pediatrician, a cardiologist, a speech therapist, an ophthalmologist, and a dentist. Only the cardiologist and the pediatrician data were used in the study. Controls included an ECG assessment, independently evaluated by two cardiologists, as well as BP, weight, and height measurements.

Weight in kilograms was measured using SECA® mechanical scales, with the patient standing barefoot, in underwear. Height was measured in centimeters, with the patient's head on a Frankfort horizontal plane, using the scales built-in stadiometers, whereas Body Mass Index (BMI) was calculated using the Quetelet formula (weight/height^2).Overweight was defined as any weight above the 85th percentile, whereas obesity was defined as any weight above the 97th percentile, based on WHO tables[11].

Systolic and diastolic blood pressure were recorded using Korotkoff noises auscultation method, phases 1 and 5, respectively. Blood pressure measurements were taken after a five minute rest, with the patient sitting, using mercury sphygmomanometers with cuffs wrapped around the right arm circumference, and covering at least 80% of the shoulder-olecranon distance. Values are expressed as the mean of three measurements.

Blood pressure was considered normal if it was below the 90th percentile; it was considered normal/high if both systolic BP and diastolic BP were above the 90th percentile but below the 95th percentile, or if they were above 120/80 mmHg in all three measurements, even if they were below the 90th percentile. It was considered high if it was above the 95th percentile. Percentile values are modified according to the guidelines of the European Society of Hypertension

(ESH), the European Society of Cardiology (ESC), the American Academy of Pediatrics Working Group on High Blood Pressure in Children and Adolescents, and the RICARDIN II reference values[12].

Routine 12 lead ECG was performed as part of the assessment, even though it was not considered an essential study, because the evaluation was to be used as a medical certificate of fitness for sports. PR segment was considered short as follows: children under 3 (0.08 sec), 3 to 16 years old (0.10 sec), above 16 years old (0.12 sec). PR segment was considered long as follows: children 1 to 2 years old (0.15 sec), 3 to 7 years old (0.16 sec), 8 to 11 years old (0.17 sec), 12 to 15 years old (0.18 sec), above 15 years old (0.20 sec). QTc segment values were considered long if they were 0.44 seconds or longer[13,14].

STATISTICS

A minimum sample size of 870 patients was estimated for a 7% to 9% prevalence of obesity, with a 90% confidence and a 0.05 alpha error. Continuous variables are shown as mean ± Standard Deviation (SD) or median and interquartile range, depending on whether or not they are normally distributed. T-tests, Kruskal Wallis, and Wilcoxon rank-sum tests were used for comparisons, as suitable. Normality was visually assessed through the data histogram, by analyzing the mean–median relationship, the skewness and kurtosis values, or through Wilk–Shapiro test. Association between variables was analyzed by a logistic regression test. All analyzes were performed using STATA *9.0* (STATA Corporation, College Station, TX®).

Results

Analyses included data from 1030 patients [537 (52.1%) males], ranging from 1 to 18 years (mean 8.7 ± 3.6 years). In this population, BMI values above the 90th percentile were more frequent than values below the normal minimum (obese males and females, 12.1% and 9.9%, respectively; compared to malnourished male and females, 1.9% and 1.4%, respectively). Overweight and obesity were more frequent among males than females (17.3% and 12.1% compared to 15.4% and 9.9%, respectively). Overweight was homogenously distributed over all ages (See Table 1); however, obesity was lower in the higher age groups, where no malnutrition was observed in males or females.

Based on height, and more notably in the 4 to 11 years age group, 12.7% of males and 14% of females had Systolic Blood Pressure (SBP) values above the 90th percentile, whereas 8.8 and 9.9% were above the 95th percentile, respectively (See Table 2). A statistically significant association between hypertension and high BMI was observed where 24% of obese patients were hypertensive, 92.5% of non-obese children also failed to produce any high BP records (OR 3.9; 95% CI: 6,3–2.4; p=0.001).

ECG mean heart rate was normal across all age groups, with varying bradycardia prevalence, averaging 10.1% of the total population. Six patients were reported with pauses resulting in bradycardia (up to 20 bpm), including asymptomatic Wenckebach AV block, three patients were reported to have asymptomatic sinus arrest, and one patient was reported to have ventricular bigeminy. Short PR segment was reported in 6.2% of cases, including five patients diagnosed with Wolf-Parkinson-White (WPW) (three known, and two *de novo* reports). Long QTc segment was reported in 2.7% children, with incidence rates ranging between 0% and 10%, depending on age (See Table 3). Reports of short PR segment included five sibling pairs.

Discussion

Obesity and high blood pressure percentages were high in the children and adolescents of study population, and an association was found between both conditions. The importance of early weight control in children is supported by the findings of a study performed by the US Center for Disease Control and Prevention, where a follow-up group of children aged 5 to 14 years old who had been overweight in kindergarten were reported to have a higher prevalence of obesity[15]. Obese kindergarten children have about 50% probability of being obese after finishing primary school[16]. Previous studies demostrated that early detection facilitates the implementation of education strategies which will eventually result in lifelong good healthcare habits[17,18].

High blood pressure prevalence in children and adolescents was reported to be 1% to 5%, notably as secondary hypertension[19]. The risk factor most strongly associated with primary hypertension is increased BMI. A high association between these two variables was also observed in our records.

The American Academy of Pediatrics suggests that children aged three and above should have a BP measurement in each clinical visit[20]; the National Heart, Lung, and Blood Institute's Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents recommends one yearly BP monitoring in 3 to 17 years old children[21], and the American Heart Association[22] recommends one yearly routine assessment in children aged three or more, to be performed during health checks. Early detection can favor a timely treatment onset, including both lifestyle and diet changes, and family awareness.

Moreover, finding significant ECG abnormalities can help to identify a group of patients bearing a potential risk for arrhythmias, who could be treated with either specific procedures or drugs[23,24]. Long QTc segment detection is a crucial decision-making aid, since certain drugs may lead to potentially lethal arrhythmias due to this prolongation[25,26].

Sudden cardiac death in children and adolescents has a low incidence (0.8 to 6.2 per 100 000 people) and it is a socially and emotionally important health concern. Japan is the only country in the world to have a mass detection program for school children, which includes a specific medical file, physical examination, and ECG assessment. Potentially serious ECG abnormalities found in this study subjects may make them aware of the need for future consultations or more specific studies. Future longitudinal studies and a cost-effectiveness analysis seem justified[22].

BP levels were elevated in a high percentage of children, especially in children younger than eight. Since the obtained measurements arise from one single consultation, no definite hypertension diagnosis can be made; therefore, patients were encouraged to visit their pediatrician in order to rule out or confirm the diagnostic presumption. Pediatric sudden cardiac death may be caused by a variety of rare diseases, not all of which have an ECG correlate. Most commonly ECG detectable conditions include Hypertrophic Cardiomyopathy (HCM), long QT Syndrome (LQTS) and WPW. Their estimated prevalence rates are low among asymptomatic otherwise healthy children, and the use of ECG as a "highly discriminatory" test has not been established yet[23].

In a meta-analysis and review, using ECG, Rodday *et al.* found a LTQS phenotypic prevalence rate of 7 per 100 000 people (95% CI: 0–14). Most interestingly, the authors suggested that, for maximum precision, ECG should be performed on over 16000 subjects in order to find one single LQTS case, with only 14% of undetected LQTS cases (false negatives), and over 2000 false positives to one correctly detected LQTS patient[22]. However, in a study by Kobza *et al.*[27], including conscripts, i.e., older subjects, prevalence increased to 38 per 100 000 people (95% CI: 19–58).

In our study, the prevalence of children with long QT was 2.7%, with higher incidences in adolescents 17 to 18 years old; the prevalence of children with WPW was 5 per 1000 people, which turned out similar to the phenotypic prevalence rate reported in the meta-analysis (136 per 100 000 people, 95% CI: 55-218). ECG assessment may be useful in detecting hypertrophic cardiomyopathy, where a left side electrical axis, left-lead repolarization abnormalities, pathological Q waves, or left bundle branch block are found[28]. However, this was not assessed in our records.

The controversy over the usefulness of ECG for massive diagnosis focuses on the fact that rare diseases are prone to show a high number of false positives, because of their low phenotypic prevalence and the inherent inaccuracy of most medical tests[29]. This has a high cost, because it raises the need for additional diagnostic evaluations and potentially unnecessary treatments, which fundamentally would impair in both children and parents' quality of life.

Patients in the study population were all covered by privately-run health insurance and were recruited in one single site; therefore data may not be extrapolated to other populations. Patient number, as stratified by age groups, may be low. No ongoing BP measurement was performed; although other studies also detected hypertension based on single BP measurements.

Conclusion

The study records included a high prevalence of hypertension and obesity. Hypertension was more frequent in obese children. Early detection of high BP and obesity will help to introduce new lifestyle and diet measures to prevent adult heart disease. Some important abnormalities were detected in the routine ECG. ECG detection of potentially serious conditions is deemed to be cost-effective, and may warrant the use of higher complexity studies to further monitor the initial prognosis.

Ethical issues

The study was conducted according Good Clinical Practices and in compliance with the Argentine Data Protection Act. Considering that neither personal nor follow-up data were requested, and that the use of medical file retrospective data warranted the signature of any informed consent, subject information was used in compliance with the 25,326 Argentine Personal Data Protection Federal Act (*Habeas Data*) and Resolution 1480 exception.

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Conflict of Interest

The authors have no conflicts of interest and financial relationships relevants to this article to disclose.

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