ORIGINAL ARTICLE

Comparison of different screening methods for blood pressure disorders in children and adolescents ☆

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Abstract
Objective: To compare different methods of screening for blood pressure disorders in children and adolescents.
Method: A database with 17,083 medical records of patients from a pediatric cardiology clinic was used. After analyzing the inclusion and exclusion criteria, 5,650 were selected. These were divided into two age groups: between 5 and 13 years and between 13 and 18 years. The blood pressure measurement was classified as normal, pre-hypertensive, or hypertensive, consistent with recent guidelines and the selected screening methods. Sensitivity, specificity, and accuracy were then calculated according to gender and age range.
Results: The formulas proposed by Somu and Ardissino's table showed low sensitivity in identifying pre-hypertension in all age groups, whereas the table proposed by Kaelber showed the best results. The ratio between blood pressure and height showed low specificity in the younger age group, but showed good performance in adolescents.
Conclusion: Screening tools used for the assessment of blood pressure disorders in children and adolescents may be useful to decrease the current rate of underdiagnosis of this condition. The table proposed by Kaelber showed the best results; however, the ratio between BP and height demonstrated specific advantages, as it does not require tables.
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Comparação entre diferentes métodos de rastreamento para distúrbios da pressão arterial em crianças e adolescentes

Resumo
Objetivo: comparar diferentes métodos de rastreamento para distúrbios da pressão arterial em crianças e adolescentes.

Método: foi utilizado um banco de dados com 17083 prontuários de pacientes de uma clínica de cardiologia pediátrica. Após análise dos critérios de inclusão e exclusão, 5650 foram selecionados. Estes foram divididos em duas faixas etárias: entre cinco e 13 anos e entre 13 e 18 anos De acordo com a aferição da pressão arterial, a mesma era classificada como normal, pré-hipertensiva ou hipertensiva de acordo com guidelines recentes e dos métodos de rastreamento selecionados. Posteriormente, foram calculadas a sensibilidade, especificidade e acurácia de cada um de acordo com o gênero e faixa etária.

Resultados: as fórmulas de Somu e a tabela proposta por Ardissino apresentaram baixa sensibilidade na identificação de pré-hipertensão em todas as faixas etárias, enquanto a tabela proposta por Kaelber apresentou os melhores resultados. A razão entre pressão arterial e altura apresentou baixa especificidade na faixa etária menor, mas apresentou bom desempenho em adolescentes.

Conclusão: as ferramentas de rastreamento para distúrbios da pressão arterial em crianças e adolescentes podem ser úteis para diminuir o subdiagnóstico que ocorre atualmente nessa condição. A tabela proposta por Kaelber apresentou os melhores resultados, entretanto a razão entre PA e altura apresenta vantagens específicas, como a não necessidade de tabelas.

Introduction

Systemic arterial hypertension (SAH) is a major risk factor for cardiovascular morbid events,[1] which predominantly occurs in adults and the elderly. However, its prevalence is increasing in the pediatric age group,[2] mainly due to changes in lifestyle.

Despite the importance of this condition, SAH is rarely diagnosed in childhood.[3] Several factors contribute to this, but the diagnostic process is deemed as one of the main reasons.[4] It involves the analysis of several tables of percentiles, as the blood pressure (BP) in pediatric patients varies according to age, gender, and height.

Several methods have been described to simplify the diagnosis of hypertension in children and adolescents.[5] Some of them involve the use of mathematical formulas,[6] others use simplified tables,[7–9] and the latest uses cutoffs based on the ratio between BP and height.[4] The comparison of these methods can be useful in determining an adequate tool for the screening of BP disorders.

Therefore, this study aimed to compare different screening methods to identify high BP in children and adolescents. The methods used were Somu equations, the ratio between BP and height, and the tables proposed by Kaelber, Mitchell et al., and Ardissino.

Methods

This was a retrospective study based on medical record analysis in a pediatric cardiology clinic in Northeast Brazil. A total of 17,083 records were analyzed and those that did not have all of the following information were excluded: weight, height, systolic BP (SBP), diastolic BP (DBP), and gender. Also excluded were those aged less than 5 years and those 18 years of age or older. A total of 5,650 records were analyzed.

The outpatient clinic protocol established the measurement of BP with appropriate cuff size for age and arm circumference (Bic Medical Device Industry, SP, Brazil), after ten minutes of rest, on the right arm, and with the patient in the sitting position. Height was determined using a stadiometer, with the patient barefoot, whereas weight was measured using an electronic scale and with the patient wearing light clothing. Body mass index (BMI) was defined as weight divided by height squared. BP was measured by a pediatric cardiologist, while height and weight were measured by a trained professional. Only the first measurement of each variable was considered for each patient.

All data were tabulated in a spreadsheet. BP levels were classified as normal, pre-hypertensive, and hypertensive according to the recommendations of NHBPEP (National High Blood Pressure Education Program)[10] These guidelines use a combination of several tables of percentiles (SBP, DBP, age, and height for each gender) for the diagnosis of pre-hypertension and hypertension, and are considered the gold standard in this study. They were also divided into two age groups: between 5 and 13 years and between 13 and 18 years. In this study, children are defined as belonging to the first age group and adolescents to the second. It is worth mentioning that more than one BP measurement is needed to diagnose BP disorder. Therefore, in the present study, the terms pre-hypertensive and hypertensive refer, respectively, to patients with pre-hypertensive and hypertensive BP levels at the first measurement rather than at the final diagnosis.

Patients were classified as normal or high BP according to the simplified tables proposed by Kaelber,[8] Mitchell et al.,[7] and Ardissino,[9] by the equations proposed by Somu,[6] as well as by the ratio between BP and height proposed by Lu.[4] The latter uses cutoffs obtained from the ratio between SBP and height and between DBP and height. The cutoff points used in the study were those described by Guo et al.[11] for pre-hypertension and SAH. Table 1 depicts these methods. Obesity was defined as BMI greater than or equal to the 95th percentile.

Subsequently, sensitivity, specificity, accuracy, likelihood ratios, and predictive values for each test were calculated