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High blood pressure in children attending pediatric clinic at King Abdulaziz University Hospital, Jeddah, Saudi Arabia

Ranya A. Ghamri[1], Amal A. Hegazy[2,3], Anan Z. Azizkhan[4], Sultanah F. Alsalmi[4], Noha A. Alharbi[4], Rawan A. Hemedy[4], Amani A. Alharbi[4]

Abstract:

BACKGROUND: High blood pressure (BP) is an important health issue on a global level. It is one of the major factors for mortality in Saudi Arabia. Furthermore, high BP is considered a significant risk for heart disease responsible for 30% of all deaths all over the world. The aim of this research was to determine the prevalence of hypertension in children attending the pediatric clinics and determine the common risk factors associated with high BP.

MATERIALS AND METHODS: It was a cross-sectional study conducted among 6-15 year aged children attending the pediatric clinic at King Abdulaziz University Hospital in Jeddah; children were selected using sytematic random sampling technique. Data was collected by interviewing the parents using a structured questionnaire. SPSS was used for data entry and analysis. Computed frequency and percentages for categorical variables, and mean and standard deviations for continuous variables. Chi-square test and correlation used to determine associations, and logistic regression performed to determine factors associated with blood pressure >= 95th percentile.

RESULTS: The prevalence of hypertension and prehypertension was 14.4% and 6.5%, respectively, in males, whereas, in females, it was 16.3% and 5.2%, respectively. A high prevalence observed for the 6–10 years age group as compared with the 11–15 year age group, and the difference was statistically significant (P = 0.001). A high prevalence of hypertension and prehypertension in overweight and obese group was noticed. A significant positive correlation between systolic BP and weight, height, and BMI was demonstrated. The common risk factors for hypertension in this study were the age range of 6–10 years, (odds ratio OR = 2.44), overweight and obese children (OR = 2.44), children with family history of hypertension (OR = 1.39), and children with low birth weight (OR = 1.05).

CONCLUSION: These factors are considered risk factors for such a chronic disease as cardiovascular disease. Consequently, continuous BP monitoring and early identification of high BP in children are some of the greatest strategies for the prevention of chronic diseases in adulthood.

Keywords:

Children, high blood pressure, hypertension, prehypertension

[1]Departments of Family Medicine and [2]Community Medicine, Faculty of Medicine, King Abdulaziz University, [4]Medical Intern, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia, [3]Department of Community and Occupational Medicine, Faculty of Medicine (for Girls), AlAzhar University, Cairo, Egypt

Address for correspondence:
Prof. Amal A. Hegazy, Department of Community Medicine, Faculty of Medicine, King Abdulaziz University, P. O. Box 80205, Jeddah 21589, Saudi Arabia.
E-mail: renalahmed@gmail.com

Introduction

High blood pressure (BP) in early age is an increasing health problem. The frequency of prehypertension and hypertension are 3.4% and 3.6%, respectively, in childhood between the ages of 3 and 18 years.[1] The presence of hypertension in children usually leads to hypertension in maturity,[2] and high BP in adulthood is considered the foremost reason of early death all over the world.[3]

High body weight is considered a common risk factor of primary hypertension in childhood;[4-6] other risk factors are family history of high BP, or cardiovascular disease, gender, and a mother who smoked

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throughout pregnancy. However, breastfed children have a lower risk of high BP.[4,7-9] Additional risk factors such as race and ethnicity have not been linked to high BP in kids.[6,10]

Normal BP reading in kids differ by age, gender, and height. Consequently, a better understanding of how to detect and treat high BP in childhood is necessary to reduce the prevalence.[11] Identification of hypertension in children depends on the percentile chart, and it is defined as a mean systolic or diastolic BP (SBP or DBP) level of at least three separate readings that is in the 95th percentile or greater. After identification, it can be classified into two stages: Stage I or II to help in estimation and evaluation.[12]

High BP in children is recognized as a predictive factor of adult hypertension, and it is underestimated in developing countries. The number of healthy children and adults diagnosed with high BP is rising.[13]

Primary hypertension is discovered more in children with high body weight. In addition to such other risk factors as sedentary life, high consumption of diet high in calories, sodium, potassium, smoking, consumption of alcohol, stress, and low-quality sleep are related to high prevalence of hypertension in children.[14]

Evidence suggests a strong relationship between high body weight, elevated level of uric acid, diet high in sodium, infection, increased blood sugar, inheritance, maternal smoking during pregnancy, and low birth weight, with the development of high BP in children.[15] Many studies from developed countries show a current rise in the frequency of high BP (4.5%) in kids and young adults.[6] Our aim in these studies was to determine the prevalence of hypertension in children attending the pediatric clinic at King Abdulaziz University Hospital (KAUH) and discover the common risk factors associated with hypertension in the study group.

Materials and Methods

This study was carried out on children in the age range of 6–15 years attending the pediatric clinic at KAUH in Jeddah. This hospital is a well-established hospital with a capacity of 650 beds offering a complete range of medical services. Like any university hospital in Saudi Arabia, it serves a large number of the population and receives patients from other hospitals. Ethical approval was obtained from the institutional review board/ethics committee, and informed written consent was taken from all participants in the study.

A cross-sectional study was conducted on a representative sample of children randomly selected through systematic random sampling from the pediatric clinic. We selected every fifth child because the average rate of patients attending the pediatric clinic was approximately 40 patients per day. Thus, about 5–6 patients per day were recruited to arrive at the required sample size of approximately 369 cases. The sample size was calculated using sample size formula,[16] to achieve this sample size at the 95% confidence level with an acceptable error of 5%. The minimal sample size needed for the research was estimated to be 369 children.

After a review of the literature related to hypertension in children, the researchers constructed a structured questionnaire. The data were collected by interviews with parents. The questionnaire elicited the following information: (a) Sociodemographic data and possible risk factors for hypertension such as age, gender, nationality, family history of essential hypertension, physical inactivity, high fat-diet intake, artificial feeding, low birth weight, obstructive sleep apnea (snoring during sleep), and maternal smoking. (b) Anthropometric measurements such as body weight, height, and body mass index (BMI). BMI percentile, which adjusts for age and sex in children, was used to quantify relative adiposity; in children, a BMI percentile from 85th to 95th defines overweight, and ≥95th BMI percentile defines obese.[17] (c) Hemodynamic data as SBP and DBP were measured, at least three separate readings, and we calculated the average of SBP and DBP. Diagnosis of BP depending on age, gender, and height. Normal BP (SBP and DBP) is defined as BP <90th percentile. BP in the 90th percentile and <95th percentile is considered prehypertension, while BP in the 95th percentile or greater is considered hypertension. It is further divided into stage I (more than the 95th percentile but <99th percentile) and stage II (more than 99th percentile).[18]

The data from the collected questionnaire were entered and analyzed using SPSS, version 16 software package (IBM, North Castle, NY, USA). Mean and standard deviation were given for normally distributed quantitative variables. Frequencies and percentages were given for qualitative variables. Chi-square test and correlation were used to detect the association, and multiple logistic regression analysis was used to assess the predictors of BP ≥95th percentile, adjusting for all potentially confounding variables simultaneously. The level of significance was set at $P < 0.05$.

Results

Participating children in this study numbered 369, with 216 (58.5%) males and 153 (41.5%) females. The prevalence of hypertension and prehypertension are demonstrated in Table 1; in the males, it was14.4% (7.9% stage I and 6.5% stage II), and 6.5%, respectively.

However, in females, it was 16.3% (7.8% stage I and 8.5% stage II) and 5.2% respectively.

Table 2 shows the association between BP classification (hypertension, prehypertension, and normal) and demographic variables in the study group. There was no statistically significant difference between BP classification and gender (P = 0.79). Based on age classification, we noticed a high prevalence of hypertension and prehypertension in the 6–10 years age group (19.9% and 8.7%, respectively) in comparison with the 11–15 age group (9.8% and 2.9%, respectively), and the difference was statistically significant (P = 0.001).

Regarding BMI, the table displays a high prevalence of hypertension and prehypertension in the overweight and obese groups (26.7% and 5.3%, respectively) in comparison with the group with normal body weight (12.2% and 6.1%, respectively), and the difference was statistically significant (P = 0.01). However, the association between BP classification and such other demographic variables as nationality, family history of hypertension, physical inactivity, high fat-diet intake, artificial feeding, low birth weight, and maternal smoking were not statistically significant as $P > 0.05$.

Table 3 demonstrates the correlation between the average of SBP and DBP and the characters of study group. It displays a significant positive

Table 1: Prevalence of hypertension in study group

	BP			
	Hypertension		Prehypertension *N* (%)	Normal *N* (%)
	Stage I *N* (%)	Stage II *N* (%)		
Gender				
Male	17 (7.9)	14 (6.5)	14 (6.5)	171 (79.1)
Female	12 (7.8)	13 (8.5)	8 (5.3)	120 (78.4)
Age (years)				
6-10	19 (9.7)	20 (10.2)	17 (8.7)	140 (71.4)
11-15	10 (5.8)	7 (4.0)	5 (2.9)	151 (87.3)

BP=Blood pressure

Table 2: Relationship between blood pressure classification and characteristics of 6-15 year old children

	Blood pressure			*P*-Value
	Hypertension *N* (%)	Prehypertension *N* (%)	Normal *N* (%)	
Gender				
Male	31 (14.4)	14 (6.5)	171 (79.2)	0.796
Female	25 (16.3)	8 (5.2)	120 (78.4)	
Age (years)				
6-10	39 (19.9)	17 (8.7)	140 (71.4)	0.001*
11-15	17 (9.8)	5 (2.9)	151 (87.3)	
Nationality				
Saudi	16 (12.6)	10 (7.9)	101 (79.5)	0.364
Non-Saudi	40 (16.5)	12 (5.0)	190 (78.5)	
BMI				
Overweight/obese	20 (26.7)	4 (5.3)	51 (68.0)	0.009*
Healthy body weight	36 (12.2)	18 (6.1)	240 (81.6)	
Family history of hypertension				
Yes	38 (16.5)	13 (5.6)	180 (77.9)	0.651
No	18 (13)	9 (6.5)	111 (80.4)	
Limited physical activity				
Yes	11 (14.3)	4 (5.2)	62 (80.5)	0.914
No	45 (15.4)	18 (6.2)	229 (78.4)	
High fat-diet intake				
Yes	21 (13.4)	11 (7.0)	125 (79.6)	0.610
No	35 (16.5)	11 (5.2)	166 (78.3)	
Artificial feeding				
Yes	47 (15.3)	17 (5.5)	244 (79.2)	0.748
No	9 (14.8)	5 (8.2)	47 (77.0)	
Low birth weight				
Yes	11 (13.9)	5 (6.3)	63 (79.7)	0.971
No	45 (15.5)	17 (5.9)	228 (78.6)	
Maternal smoking				
Yes	2 (15.4)	0.0 (0.0)	11 (84.6)	0.707
No	54 (15.2)	22 (6.2)	280 (78.7)	

*Significant (P<0.05). BP=Blood pressure, BMI=Body mass index

correlation between SBP and weight ($r = 0.26$, $P = 0.00$), height ($r = 0.12$, $P = 0.01$), and BMI ($r = 0.10$, $P = 0.03$), but there was no correlation with age ($r = 0.08$, $P = 0.09$). However, as regards DBP, there was a significant positive correlation between DBP and age ($r = 0.10$, $P = 0.04$), weight ($r = 0.19$, $P = 0.00$), and BMI ($r = 0.18$, $P = 0.00$) while there was no significant correlation with height ($r = 0.09$, $P = 0.06$).

The most common predictors of hypertension as shown in Table 4 were the age range of 6–10 years; they were more likely to have hypertension (odds ratio [OR] =2.44) in comparison with the age group 11–15 years. Overweight and obese children were 2.44 times more likely to have hypertension than normal body weight children. Moreover, children with a family history of hypertension were likely to have hypertension than any other related groups, with an OR of 1.49.

Regarding the most common predictors of prehypertension, male gender and the group aged 6–10 years were more likely to have prehypertension than females and age group 11–15 years with an OR of 1.10, and 3.86, respectively. Besides, children with a family history of hypertension, those who have a high-fat diet intake, and those with a history of low birth weight were more likely to have prehypertension in comparison with any other related groups, with an OR of 1.02, 1.42, and 1.05, respectively.

Table 3: Correlation between average systolic and diastolic blood pressure and various characteristics of 6-15 year old children

	SBP		DBP	
	r	*P*-Value	*r*	*P*-Value
Age	0.088	0.09	0.106	0.04*
Weight	0.264	0.00*	0.194	0.00*
Height	0.123	0.01*	0.097	0.06
BMI	0.109	0.03*	0.188	0.00*

*Significant. BMI=Body mass index, BP=Blood pressure, *r*=Correlation, SBP=Systolic BP, DBP=Diastolic BP

Discussion

In 2010, it was estimated that high BP was responsible for about a quarter of all deaths from cardiovascular diseases and 1.9% of total deaths in KSA, according to the global burden of disease 2010.[19]

In the present survey, the prevalence of hypertension based on the mean of three successive days' measurements was 14.4% in males and 16.3% in females whereas that of prehypertension (90th percentile-<95th percentile) was 6.5% and 5.2% for males and females, respectively. In a study carried out in Brazil, in which BP was measured 3 times, 2 weeks apart for children aged between 7 and 10 years, the prevalence of hypertension was 8.1%, 3.2% and 2.1%, respectively.[20] In another Brazilian study, a relatively high prevalence of hypertension was reported (13.8%).[21] In a study carried out in the USA, the prevalence of hypertension in school-aged children was 19.4%.[6] In Costa Rica, the prevalence of hypertension was 2.7%, based on a protocol of 3 measurements, taking only the average of the last two.[22] In the Canadian study by, Eisenmann *et al*., a very high prevalence of hypertension (24.8%) was observed in children of 3–8 years.[23] In a recent systematic review and a meta-analysis studies of children and adolescents aged between 2 and 19 years, the prevalence of hypertension

Table 4: Multiple logistic regression showing risk factors for hypertension and prehypertension among 6-15 year old children

	Hypertension				Prehypertension			
	AOR	*P*-Value	95% CI		AOR	*P*-Value	95% CI	
			Lower	Upper			Lower	Upper
Gender								
Male	0.86	0.62	0.47	1.57	1.10	0.82	0.44	2.78
Age (years)								
6-10	2.44	0.00	1.29	4.58	3.86	0.01	1.36	5.34
BMI								
Overweight/obese	2.44	0.00	1.28	4.63	0.95	0.93	0.30	2.98
Family history of hypertension								
Yes	1.39	0.30	0.73	2.64	1.02	0.95	0.41	2.55
Limited physical activity								
Yes	0.91	0.80	0.43	1.91	0.92	0.89	0.29	2.89
High fat-diet intake								
Yes	0.77	0.40	0.41	1.42	1.42	0.43	0.58	3.45
Artificial feeding								
Yes	0.95	0.90	0.42	2.15	0.56	0.30	0.19	1.66
Low birth weight								
Yes	1.05	0.93	0.46	2.03	1.05	0.92	0.36	3.03

AOR=Adjusted odds ratio, CI=Confidence interval, BMI=Body mass index

ranged between 0.2% and 24.8%. The pooled prevalence was 5.5%.[24] The difference in the rate of hypertension and prehypertension observed between those studies should be borne in mind in the light of the difference in the ages of the children as well as the protocol used in diagnosis of hypertension.

In agreement with others,[23,24] no gender difference was detected in the prevalence of hypertension in children in the current survey. However, male children were more likely to have prehypertension.

The child's age was one of the two significant predictors of hypertension in the present study. The children aged 6–10 years were more likely to have hypertension in comparison with older children aged 11–15 years. Our findings disagree with two Brazilian studies which concluded that SBP rose concomitantly with advancing children's age.[23,25]

The results of our study revealed that the prevalence of hypertension and prehypertension were significantly higher in overweight and obese group of children in comparison with children of normal body weight. This finding agrees with several previously published studies carried out worldwide.[21,20,24,26] Moreover, Mavrakanas *et al*., 2009, observed that obese children had a 5–6-fold higher risk of hypertension than normal children.[27] Obese children might also become victims of bullying, which ultimately results in low self-esteem, anxiety, and shyness, and stress,[20] causing such chronic medical conditions as hypertension.[28]

Children with a family history of hypertension in this study were more prone to having hypertension, and this agrees with some literature.[18] The Bogalusa heart cohort study[29] concluded that low birth weight was significantly associated with the development of hypertension later in life. This is in accord with the finding in our study which revealed low birth weight as a significant predictor of prehypertension.

Conclusion and Recommendation

The prevalence of hypertension was higher in young children, the overweight, the obese, and children with a family history of hypertension. These factors are considered risk factors for chronic diseases such as cardiovascular diseases. Consequently, continuous BP monitoring, early diagnosis of hypertension in children, and a change in lifestyle are some of the greatest plans for the prevention of chronic diseases in adulthood. A larger more comprehensive study is recommended for children in different healthcare facilities in Jeddah.

Limitation

This study has some important limitations worth mentioning. First, it was carried out in only one health institution, which does affect generalizability of results for other institutions in Jeddah. Second, its cross-sectional nature did not allow the temporal association between hypertension and prehypertension on one hand and risk factors on the other.

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Conflicts of interest

There are no conflicts of interest.

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