

The Prevalence of High Blood Pressure Among Children aged 11-18 Years in Birjand District, Eastern Iran in 2012: A Cross-Sectional Study

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Background: High blood pressure is a health problem in children. Adolescents with high blood pressure are more likely to become adults with hypertension.

Objectives: The present study was conducted to determine the prevalence of high blood pressure in high school children in Birjand, Iran in 2012.

Materials and Methods: The present study comprised 2450 students, 1338 girls and 1112 boys, aged from 11-18 years selected through stepwise randomized sampling from 28 secondary and high schools in Birjand, Eastern Iran. Blood pressure, weight, and height of the subjects were measured along with calculating the body mass index (BMI). Blood pressure measurements were categorized as normal, pre hypertension, or hypertension using the 2004 Fourth Report of blood pressure screening recommendations (10). The data obtained were analyzed using SPSS software (V: 15), T test, X², and ANOVA at the significant level $P < 0.05$.

Results: Overall prevalence of pre- hypertension and hypertension was 10.9% and 7.78%, respectively regarding systolic blood pressure, with respective values of 4.6%, and 0.9% for diastolic blood pressure, which was significantly higher in boys than girls. The prevalence rates of hypertension and pre hypertension increased with increasing (BMI).

Conclusions: The prevalence of high blood pressure in Birjand children is high. Routine monitoring of blood pressure and taking preventive measures to control obesity through lifestyle changes should be considered.

Keywords: Blood Pressure; Hypertension; Pre-Hypertension; Adolescent; Iran

1. Background

Cardiovascular diseases are a major cause of morbidity and premature mortality in most of the industrialized world and in many developing countries (1). Hypertension is already a highly prevalent risk factor for cardiovascular diseases. Hypertension plays a major etiologic role in the development of cerebrovascular diseases, ischemic heart disease, cardiac failure, and renal failure (2). It is known that children with hypertension are more likely to become hypertensive adults in future. Moreover, there is evidence that children with mildly elevated blood pressure (BP) are at increased risk for developing adult hypertension (3). Evidence of target organ damage, such as left ventricular hypertrophy (LVH) and pathological vascular changes have been found even in children with a recent diagnosis of high BP (4). Therefore, study on prevalence and early diagnosis of hypertension in childhood is an important strategy for promoting public health and prevention of cardiovascular diseases. In a developed country such as the US, more than 4 million children are estimated to have hypertension, a number

that has increased 5-fold over the last 30 years (5). In one study the prevalence of pre hypertension/hypertension among the US adolescents aged 12 to 19 years was 14% (6). A study carried out in 23 province of Iran on 21,111 children aged from 6 to 18 years showed an overall prevalence of systolic, diastolic as well as systolic or diastolic hypertension were 4.2, 5.4, and 7.7%, respectively (7). In 2008 in one study conducted in Rafsanjan, southeastern Iran, the prevalence of pre- hypertension and hypertension among adolescents aged 9 to 17 years was shown to be 15.2 and 11.2%, respectively (8). But in 1997 another study in Hamadan, Iran showed the prevalence of 1% for hypertension among school age children (9).

2. Objectives

The changes in lifestyle and dramatic rise in childhood obesity in developing countries is considered a major driving force behind the high prevalence of hypertension. Therefore the present study was conducted to determine BP in children aged from 11-18 years in Birjand

district, Iran.

3. Materials and Methods

The present cross-sectional study was carried out in 2012 on 2450 school children aged from 11 to 18 years including 1338 girls and 1112 boys in Birjand, Iran. The participants were selected through multistage random sampling. Considering the distribution of elementary schools in different districts of the city, initially 14 girls and 14 boys were chosen from the high schools. In relation to the population of each school and its proportion to the number of students in each class, some students were selected from each class based on random sampling. In this step 2750 students were selected and a questionnaire plus an informed consent form were sent to the students' parents. The parents were asked to fill out the questionnaire regarding demographic information and signed consent forms and return them to the school if agreed with their children's participation in the study provided that students did not have any chronic diseases or endocrine disorders such as diabetes and were not treated with corticosteroids. Finally, 2550 questionnaires were filled out and returned to school. In the next step, trained co-workers of the project, after getting permission from the education office and being ensured about its coordination, referred to schools and recorded the weight and height of the participants in a standard way and registered each in the respective form. At the end of the procedure, a few of the cases were excluded and the final population of the samples decreased to 2450 because of inaccurate information about age, history of drug consumption or chronic diseases. Anthropometric measurements were performed. In brief, height was measured to the nearest 0.5 cm to standardized guidelines and body weight to the nearest 0.1 kg using a calibrated electronic scale (SECA, Germany).

The BMI of each student was then measured. The percentages of Centers for Disease Control (CDC) were used in order to determine overweight and obesity. Thus, percentages 85-95 were taken as overweight with respect to age and sex (standard curve for female and male based aged of students); and those over 95 were defined as obese. Diastolic blood pressure was measured in the morning using a Japanese sphygmomanometer with an adult cuff. Blood pressure was measured on the right upper arm with the arm horizontal on a table, while the subject being in the seated position after resting for

about 5 minutes. Systolic blood pressure was measured as the first detectable sound (phase 1), and diastolic blood pressure was marked by fading Korotkoff sounds (phase 5). Two readings were recorded at an interval of 5 minutes, and the cuff was completely deflated between readings. The mean of two readings was calculated for analysis. Blood pressure measurements were categorized as normal, pre-hypertension, or hypertension using the 2004 Fourth Report of blood pressure screening recommendations (10). Normal blood pressure (NBP) was taken as systolic and diastolic values that was < 90th percentile for gender, age, and height. Pre-hypertension was taken as systolic and diastolic blood pressure \geq 90th percentile, but < 95th percentile for gender, age and height. Hypertension was indicated as systolic and diastolic blood pressure \geq 95th percentile for gender, age, and height (8). The data obtained were analyzed by means of SPSS software (V:15) using T test, χ^2 , and analysis of variance test at the significant level $P < 0.05$, with results expressed as mean \pm SD.

4. Results

The participants were 2450 students with mean age 14.46 ± 2.06 years, of whom 1338 (54.6%) were females and 1112 (45.4%) males. Their mean body weight was 49.92 ± 13.27 kg and their mean height was 156.21 ± 9.6 cm. Mean systolic and diastolic hypertension in the students were 106.14 ± 16.71 and 59.99 ± 11.12 respectively. Mean systolic and diastolic BP in the males was significantly higher ($P < 0.001$, Table 1). Besides, mean systolic BP in 12-18 year olds, and mean diastolic BP in 14/16-18 olds were significantly higher compared to other age groups (Table 1). Overall, 192 cases (7.78%) had either systolic or diastolic high blood pressure or both and were accounted as hypertensive. Of these, 170 Cases had only high systolic, 2 had only high diastolic and 20 subjects had both high systolic and diastolic blood pressure. The prevalence of high systolic and diastolic blood pressure was 8.5% and 6.5% with respective values of 3% males and 0.4% females ($P = 0.001$). Systolic blood pressure of 10.9% of the children was in the pre-hypertension range and 7.7% of the students were hypertensive. In regard to diastolic pressure, 4.6% of children were in pre-hypertension and 0.9% in hypertension states. The prevalence of hypertension in cases with > 95 percentile was significantly higher than those with normal BMI ($P = 0.001$, 28.9% vs. 7.7%, OR 6.3, Table 3).

Table 1. The Distribution Frequency of Children Regarding Systolic and Diastolic Blood Pressure ^{a,b}

Variables	Systolic HTN	Diastolic HTN	Systolic and diastolic HTN
Normal blood pressure	1992 (81.3)	2316 (94.5)	1946 (79.4)
Pre-hypertension	268 (10.9)	112 (4.6)	312 (12.73)
Hypertension	190 (7.7)	22 (0.9)	192 (7.87)
Total	2450 (100)	2450 (100)	2450 (100)

^a Abbreviation: HTN, hypertension

^b Data are presented as No. (%)

Table 2. The Age-Dependent Distribution of Systolic and Diastolic Blood Pressure ^{a,b}

Age, y	Systolic HTN			Diastolic HTN		
	Normal	Pre HTN	HTN	Normal	Pre HTN	HTN
11	216 (88.9)	19 (7.8)	8 (3.3)	228 (93.9)	15 (6.1)	0 (0)
12	366 (81.1)	58 (12.8)	27 (5.9)	410 (91.2)	35 (7.7)	5 (1.1)
13	337 (72.9)	71 (15.4)	54 (11.7)	397 (85.7)	62 (13.4)	4 (0.9)
14	317 (87.2)	25 (6.8)	22 (6)	360 (98.9)	0 (0)	4 (1.1)
15	254 (84.4)	26 (8.6)	21 (7)	298 (99.1)	0 (0)	3 (0.9)
16	226 (74.9)	43 (14.2)	33 (10.9)	301 (99.6)	0 (0)	1 (0.3)
17	195 (82.3)	24 (10.1)	18 (7.6)	234 (98.8)	0 (0)	3 (1.2)
18	81 (90)	2 (2.2)	7 (7.8)	88 (97.8)	0 (0)	2 (2.2)
Total	1993 (81.4)	268 (10.9)	190 (7.7)	2316 (94.5)	112 (4.6)	22 (0.9)
P Value	< 0.001			0.08		

^a Abbreviation: HTN, hypertension.

^b Data are resented as No. (%).

Table 3. The Relationship Between Body Mass Index and Hypertension in the Students Under Study

Category	Hypertension, No.(%)	OR (95%CI)	P Value
BMI 85% Pcentile ^a		4.2 (3.1-5.7)	< 0.001
Normal	101 (5.1)		
Abnormal	91 (18.6)		
BMI 95% Pcentile		6.3 (4.1-8.7)	< 0.001
Normal	144 (6.3)		
Abnormal	48 (28.9)		

^a Abbreviation: BMI, Body Mass Index.

5. Discussion

The present study showed high prevalence of hypertension in adolescents in Birjand district. High blood pressure is a serious risk factor for cardiovascular diseases. This is important that 10.9% of the subjects had pre-hypertension. The fourth report on high blood pressure in children and adolescents by the National High Blood Pressure Education Program underlined the diagnosis of prehypertension in the assessment of cardiovascular risk in childhood. Children with BP values were consistently above the 90th percentile for age, gender, and height (10). It is predicted that, among adults with prehypertension, as many as 10% per year develop hypertension (11). Falkner et al. showed that 14% of boys and 12% of girls with prehypertension developed hypertension 2 years later (11). Thus individuals with prehypertension need prophylactic measures and lifestyle modification. Many studies on BP in pediatrics have been reported from various countries in the last decade (6, 12). The prevalence of prehypertension/hypertension among the US adolescents aged 12 to 19 years was 14% (6). In Mexican adolescents aged from 12 to 16 years the prevalence rates of hypertension and prehypertension were reported to be 10.6% and 10%, respec-

tively (12). One such comprehensive study was reported from Poland covering a total of 25,309 children in the age group of 7 to 19 years (13) where the prevalence rates of pre-hypertension and hypertension were 11.1 % and 4.9 % , respectively. A study carried out on 11-17 year olds in Houston, Texas showed the prevalence of pre-hypertension and hypertension in adolescents to be 15.7% and 3.2%, respectively (14). In another study in China in a sample of 78,114 children and adolescents it was found that the prevalence of high BP in pre-hypertension was 8.8 % in subjects with normal, and 27.69% in obese individuals (14). In India a survey of 24,842 school children in the age group 5 to 16 years where blood pressure data was available for 20,263 students. Hypertension by single measurement was diagnosed in 10.10 % of those with normal weight, 17.34 % in the overweight and 18.32 % in the obese (4). A study from Iran on 21,111 children in the age group of 6 to 18 years showed overall 7.7 % prevalence of systolic and diastolic hypertension (7). Another study in Iran (Tehran), showed hypertension in 12.7% of children and adolescents in both males and females (15). The prevalence of high blood pressure in our study population was slightly higher than most of the foregoing studies. The wide variation in prevalence is largely attributed to differences in population type, method of measuring blood pressure, numbers of BP measurements, geographic location, and age range. As in many epidemiologic studies, in our study BP was recorded as the mean of two measurements taken in one examination. The prevalence of systemic hypertension in the juvenile population has increased around the world, with the highest proportion in obese school children (16). In China the prevalence of high BP in children and adolescents aged from 7 to 17 years increased from 19.29% of boys and 14.69% of girls in 2000 to 26.16% of boys and 19.77% of girls in 2010 (17). Obesity represents a strong risk factor for the development of childhood hypertension. In the present study the prevalence of hypertension in obese children was higher than total population (28.9% v.s 7.7% OR = 6.3)

which is in agreement with other studies (15, 16). In the recent study mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) was significantly higher in boys than girls, especially in older ones. A similar finding is reported by other studies (18, 19). Although no significant difference in overweight was found between boys and girls, higher BP occurred in boys compared to girls. Several studies have reported sex differences as the risk for developing elevated BP in different populations (18-20). It is difficult to justify the differences in elevated BP among our sample. Several factors have been speculated upon to explain sex-related differences in elevated BP among children. The risk for elevated BP can be attributed to the impact of sex steroids on BP (19); a factor strongly suggested by experimental models (21). It may also be attributed to lifestyle or nutrition patterns, especially fast foods consumption by boys, a condition requiring further studies. Hypertension associated with obesity in childhood is largely addressed through prevention or correction of childhood obesity. Hence there are substantial needs for public health programs and policies that support and reinforce early intervention in childhood to prevent high blood pressure and associated co-morbidities.

5.1. Limitations

In this cross sectional study, the number of BP measurements is a crucial factor impacting the prevalence of hypertension which may be decreased upon repeated visits. A further limitation of this study may be due to error in recall of the lifestyle exposure and possibly BP outcome, because the study had no control over the exposure of interest such as diet or physical activity. In second stage of study, two visits for every person with high blood pressure are considered supplemented with laboratory tests and recording dietary habits and family history of BP. The results of the present study indicate that almost 20% of adolescents are already at risk for future cardiovascular diseases. Routine control of blood pressure and taking preventive measures should be considered to control obesity through lifestyle changes. Further studies are needed to identify other possible risk factors for high blood pressure.

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