

## The Prevalence of Hypertension among 7-12 Year Old Schoolchildren in Kerman, Iran: a population-based study

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### Abstract

**Background:** The aim of this study was to find the prevalence of chronic hypertension and prehypertension conditions among children.

**Methods:** In this cross-sectional study, a total of 1017 students in Kerman schools were examined during a period from 2013 to 2014. The weight, height, body mass index (BMI), systolic and diastolic blood pressure and family history of high blood pressure were obtained. Pediatric Hypertension was defined as a mean systolic or diastolic reading (or both)  $\geq$  95th percentile and prehypertension was defined as the blood pressure reading between the 90th and 95th percentiles of the predicted values based on gender, age and height.

**Results:** According to the results, the prevalence of prehypertension and hypertension in schoolchildren was 1.9% and 3%, respectively. According to BMI, 13.7% of children were overweight and 14.3% were obese. There was a positive association between BMI and the development of hypertension.

**Conclusion:** Our findings demonstrated that approximately 3% of schoolchildren were afflicted with hypertension. Hypertension showed a positive association with overweight and obesity.

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### Introduction

Cardiovascular diseases are the leading causes of mortality worldwide, both in developed and developing countries(1), and hypertension is a significant risk factor for these disorders (2, 3). It has been shown that obesity, diabetes, and hypertension can increase the risk of developing cardiovascular diseases in childhood (3, 4). Pediatric hypertension could result in adult

hypertension, and it is also associated with left ventricular hypertrophy, increased carotid intima-media thickness, and impaired cognitive function (5).

The prevalence of hypertension has rapidly increased over the past decade among adolescents and children (6, 7). Obesity and genetic, environmental, and behavioral factors play an essential role in primary hypertension (8, 9). Epidemiological

studies have reported that 2 to 5 % of children are affected by hypertension; however, the definition of “high” blood pressure for children varies in different countries (10-12).

The diagnosis of pediatric hypertension is somewhat tricky since the normal values for pediatric blood pressure vary with age, sex, height, and regional guidelines (10). Several epidemiological and clinical studies have been performed on the prevalence of hypertension in adults; however, few studies have so far reported the incidence of hypertension in children (11-13). Fallah et al. reported that the prevalence of high diastolic blood pressure (DBP) and high systolic blood pressure (SBP) was 4.33% and 6.88% in Iranian children, respectively (14). In 2013, Basiratnia and colleagues reported that 11.8% of students with the age range of 11-17 years old were afflicted with hypertension (15).

Since there is no report on the prevalence of pediatric hypertension among students in the southeast part of Iran, we aimed to determine the prevalence of chronic hypertension among healthy schoolchildren in Kerman city, Iran. The results of this study may help the government to take appropriate actions with regard to attracting people’s attention to the risk factors associated with pediatric hypertension.

## Material and Methods

A total of 1017 students aged 7-12 years old from primary schools were recruited in Kerman City. In the first step, after obtaining consent from the school principal, informed consent was obtained from the parents of schoolchildren. The family history of hypertension was recorded in the informed consent forms. The demographic characteristics including age, sex, height, weight, body mass index (BMI) were registered from September 25<sup>th</sup>, 2014 to June 1<sup>st</sup>, 2015. The body mass index

(BMI) was calculated as the measured body weight in kilogram divided by the square of the measured height in meters. The BMI of children was calculated using the BMI percentiles for children with the age range of 5-17 years old (16).

BMI was classified as normal ( $BMI \leq 85^{\text{th}}$  percentile), overweight (BMI 85<sup>th</sup>–94<sup>th</sup> percentile), or obese ( $BMI \geq 95^{\text{th}}$  percentile). Pediatric hypertension was defined as systolic and/or diastolic blood pressure equal to or greater than the 95<sup>th</sup> blood pressure percentile for gender, age, and height, according to the cut-off values of the National High Blood Pressure Education Program Working Group (NHBPEP). Prehypertension was defined as the diastolic blood pressure or systolic blood pressure levels between 90<sup>th</sup> and 95<sup>th</sup> percentile for age, sex, and height (17, 18).

Before the measurement of the blood pressure, students were acclimatized to the visiting room for a minimum of 30 min and acquainted with the instrument and nature of the procedures. After 5 min of quiet sitting, the blood pressure was determined using a mercury sphygmomanometer and auscultation in the right arm (19). The weight, height, and blood pressure were measured by the same individual to minimize the variation of different measurements. Students showed systolic and/or diastolic blood pressure equal to or above the 95<sup>th</sup> blood pressure percentile for the predicted values, and the blood pressure was calculated twice at 3-minute intervals for two weeks (20). Students with proven hypertension were subjected to further clinical examinations and blood pressure measurements at a cardiology clinic.

## Statistical Analysis

Descriptive variables were analyzed using the Chi-square test, and continuous variables were assessed by the Student t-

test since the data were normally distributed. Categorical variables were presented as a percentage. The values are expressed as the mean and standard deviation (mean  $\pm$  SD). The SPSS software version 20 was employed for the analysis of data, and the  $P < 0.05$  was considered as statistically significant.

## Results

Out of 1017 students aged 7-12 years old, 519 ones (51%) were male. Our study showed that the total prevalence of hypertension was 3% (2.4% in stage 1 and 0.6% in stage 2).

As displayed in Table 1, the rate of hypertension was not significantly ( $P=0.30$ ) different between male and female children. There was a significant and positive association between the incidence of hypertension and BMI. The results indicated that 61.3% of hypertensive students were either overweight (16.1%) or obese (45.2%).

As shown in Table 1, a total of 19 (1.9%) students were at the prehypertension stage, and the prevalence rate of prehypertension was significantly ( $P < 0.001$ ) higher in female children (2.6% in females vs. 1.2% in males).

**Table 1.** Blood pressure (mm Hg) of schoolchildren with respect to sex\*

Sex	Frequency	Normal B.P.	Pre-HTN	P value Pre -HTN	HTN	P-value HTN
Male	519 (51%)	497 (95.8%)	6 (1.2%)	0.001	16 (3%)	0.3
Female	498 (48%)	470 (94.4%)	13 (2.6%)		15 (3%)	
<b>Total</b>	1017	967 (95.1%)	19 (1.9%)		31 (3%)	

\*Values have been expressed as a No (%)

The BMI values demonstrated that 14.3% of students were obese, 13.7% were overweight, and 19.2% were underweight. The BMI showed no significant ( $P= 0.32$ ) difference when the gender was considered (Table 2).

Among students with hypertension, 4 (12.9%) children had a family history of hypertension (Table 3).

**Table 2.** The prevalence of obesity and overweight in studied students with respect to sex\*

Sex	Underweight	Normal	Overweight	Obese	P-value
Male	98 (18.9%)	282 (54.3%)	73 (14.1%)	66 (12.7%)	0.32
Female	97 (19.5%)	256 (51.3%)	28 (13.3%)	79 (15.9%)	
<b>Total</b>	195 (19.2%)	538 (52.8%)	101 (13.7%)	145 (14.3%)	

\*Values have been expressed as No (%).

**Table 3.** Correlation between the prevalence of hypertension and the parent's history of hypertension

Family history of HTN	Blood pressure N (%)			P-value
	Total	Normal	Hypertensive	
Yes	115 (14.4%)	111 (14.4%)	4 (12.9%)	0.82
No	688 (85.6%)	661 (85.6%)	27 (87.1%)	
<b>Total</b>	803 (100%)	772 (100%)	31 (100%)	

## Discussion

Our results showed that the prevalence rate of prehypertension and hypertension in schoolchildren (aged between 7 and 12 years old) was 1.9% and 3%, respectively. Hypertension is the strongest or one of the strongest risk factors for almost all different cardiovascular diseases acquired during life, cerebral stroke and renal failure (21).

Previous reports showed a wide variation in the prevalence of pediatric hypertension in different countries. A broad range of high blood pressure from 0.4% for high SBP to 24.1% for high DBP has been reported in Iranian pediatric population (22). In Fallah et al. (2014) study, 11.8% of Iranian students with the age range of 11-17 years old were hypertensive (14). Our results indicated that the prevalence rate of prehypertension in female children was significantly higher than that of males. The observed difference between male and female children may be due to higher physical activity in males compared with females, or it may stem from the increased sex hormones in the early pubescence at the age range of 10-11 years old in female children, which is not in agreement with the rate of prehypertension condition reported in children with the age range of 8-17 years old in the US (23). Genetic factors, geographic region, ethnicity, and nutritional state, may be influential in this discrepancy.

Din-Dzietham et al. (2007) reported the correlation between the ethnicity and prevalence of pediatric prehypertension/hypertension in non-Hispanic black and white, as well as in Mexican American children who had the age range between 8 and 17 years old. They showed a higher prevalence of HBP and pre-HBP in non-Hispanic black and Mexican American children than non-Hispanic white counterparts (23).

Dyson et al. (2013) reported that the prevalence of hypertension in schoolchildren was 5.2%, 10.1%, and 14.1% in China, India, and Mexico, respectively. Also, the prevalence of prehypertension in the three populations mentioned earlier was 13.4%, 9.4%, and 11.2%, respectively (11).

Previous reports showed a lower prevalence of pediatric hypertension in high-income countries, such as the USA and Switzerland with the percentage of 1–3% in Switzerland and 2.2% in the USA (24, 25).

In agreement with previous studies (11, 13, 15), our results revealed that about 28% of the study population was either overweight or obese, and the prevalence of prehypertension and hypertension in students with the age range of 7-12 years old showed significant correlation with obesity, overweight, BMI. Dyson et al. (2013) reported a 1.7-2.3-fold increase in the risk of developing overweight and a 3.5–5.5-fold increase in the risk of developing obesity in hypertensive children when compared

with children with normal weight (11). The association of hypertension with BMI in both normal and obese children was reported by HE and colleagues (26). There is a strong relationship between childhood obesity and problems such as hypertension, dyslipidemia, type 2 diabetes mellitus, nonalcoholic steatohepatitis, left ventricular hypertrophy, obstructive sleep apnea, orthopedic difficulties, and psychosocial problems during adulthood. Hence, childhood obesity should be regarded as a chronic medical condition that needs long-term management (27, 28).

Our study had some limitations, as all measurements were recorded by a single observer, which can be considered as a source of bias. Repeated measurements may have caused a decline in the blood pressure. We did not include other

confounding factors, such as physical activity, salt intake, and dietary habits in our study. Further studies with a larger population in the different age range are suggested to accurately estimate the prevalence of hypertension in children in various parts of Iran.

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### Conflict of Interest

The authors declare no conflict of interest.

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