Blood Pressure in Children of Hypertensive and Normotensive Parents

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This study was conducted to compare the blood pressure (BP) of children (aged between 6 to 18 years) of hypertensive (n =746) and normotensive parents (n = 2238) in Iran. Blood pressure (BP), weight and height were measured. The mean systolic (SBP), diastolic (DBP) and mean arterial blood pressure (MABP) was significantly higher in children of hypertensive parents than controls in preadolescents (107.4 ± 1: 15.1, 68.7 ± 1:10.5, 81.1 ± 1:12.4 vs.100.2 ± 1:12.3, 61.1 ± 1:10.1, 74.4 ± 1:11.8 mmHg, respectively; p <0.05) and adolescents (111.7 ± 1:14.5,79.2 ± 1:11.3,90.7 ± 1:12.1 vs 109.4 ± 1:14.1,70.4 ± 1:11.1, 83.5 ± 1:12.2 mmHg respectively, p<0.05). The mean SBP and DBP in children of hypertensive mothers was significantly higher than controls (SBP: 108.8 ± 14.2 vs. 104.3 ± 15.2, 95% CI = 98.2-107.4, P<0.05 and DBP: 72.4 ± 11.4 vs. 67.6 ± 11.2, 95% CI = 64.2- 70.1 respectively, p<0.05). Regarding fathers, this difference was significant only for SBP (107.1 ± l5.4 vs. 104.4 ± l5.1, 95% CI=99.1-105.7,p<0.05). The mean SBP and DBP of children were higher when both parent being hypertensive than one of them (115.56 ± 1:15.45, 72.15 ± 1:11.27 vs 106.4 ± 1:15.31, 67.82 ± 1:12.47 mmHg respectively, p <0.05). Using logistic regression analysis, SBP and DBP more than 95th percentile in children were significantly associated with mean parental BMI (p <0.05).

Key words: *Hypertension, Parent, Prevention.*

Essential hypertension, a major risk factor for cardiovascular disease (CVD), is prevalent in the adult population(1-3). A prevalence of 18% has been reported from Iran(4). Blood pressure (BP) in children is a reliable predictor of adult blood pressure level(5,6). Therefore, it is important to identify children and adolescents who are at increased risk of developing essential hypertension as adults(7,8).

The present study was conducted to compare the mean BPs in children of hypertensive and normotensive parents.

Subjects & Methods

A sample size of 420 for cases was found to be adequate to achieve a confidence interval of 95% with 5% error on the basis of a pilot study on 300 children (75 cases and 225 controls) conducted by us. The figure inflated to 746 after allowing for the correction factor of 1.6% and for 10% loss of data.

The study was performed on 2984 children and adolescents aged between 6 to 18 years. 746 children of hypertensive parents were defined as cases and 2238 children of normotensive parents acted as controls. Subjects were selected by multi-stage random sampling from the schools of Isfahan city. BP measurements were done by a team of medical students of Isfahan University of Medical Sciences after a training program and evaluation of their interobserver and intraobserver variability. The parents of the study subjects were called to the school for

interview. Blood pressures were measured using mercury sphygmomanometers (Richter, Germany) in the sitting position. Appropriate size cuffs were used (cuff-width 40% of mid-arm circumference) with cuff bladders covering 80% to 100% of the arm circumference and approximately two thirds of the length of the upper arm without overlapping. Manometer readings at the first, fourth, and fifth Korotkoff phases were recorded.

The readings at the first and the onset of the fifth Korotkoff phase were taken as systolic and diastolic BP (SBP and DBP), respectively. All readings were taken in duplicate in the right arm and the average taken for final analysis.

Elevated BP was defined as the mean SBP or DBP above the 95th percentile for that age and gender after adjusting for weight and height(8). The mean arterial blood pressure (MABP) was calcuated as $\frac{2\,(DBP) + SBP}{3}$.

A parent with an average BP >140/90 mmHg or on antihypertensive drugs at the time of the study was classified as hypertensive.

Weight was measured to the nearest 0.5 kg (Seca Beam Balance), with the subject lightly dressed and barefoot. Standing height to the nearest 0.5 cm was also recorded and the body mass index (BMI) was calculated as Wt (kg)/ Ht^2(m).

Data were analyzed using the SPSS statistical package using the Student t test, linear and logistic regression analysis.

Results

Out of the 746 cases, 369 were preadolescents (6 years to less than 12 years) and 377 were adolescents (12 years to 18 years). In control group, 1113 were pre-adolescents and 1125 were adolescents. The mean SBP, DBP and MABP of children of hypertensive parents was significantly ($p < 0.05$) higher than controls, both in preadolescent and adolescent age groups (*Table I*).

The mean SBP, DBP and MABP in children of hypertensive mothers were significantly higher than those with normotensive mothers. Regarding the children of hypertensive fathers, this difference was significant only for SBP (*Table II*). The mean SBP and DBP of children were significantly higher ($p = 0.000$ for SBP and $p = 0.001$ for DBP) when both parents were hypertensive ($n = 119$) as compared to only one parent being hypertensive ($n = 627$).

Using linear regression analysis with BP as the dependent variable, a significant correlation was found between SBP and DBP of children and mothers and SBP of children and fathers. The highest correlation was found between SBP of mothers and SBP of children in both sexes ($r = 0.233$ for boys and 0.065 for girls; $p < 0.001$).

Linear regression analysis of children's blood pressure and parents' BMI showed significant correlation between mother's BMI and children's SBP ($r = 0.151$; $p < 0.001$) and DBP ($r = 0.120$; $p < 0.001$) and also between father's BMI and children's SBP ($r = 0.146$; $p < 0.001$) and DBP ($r = 0.115$; $p < 0.001$).

Using logistic regression analysis, a significant association was found between child's blood pressure (SBP and DBP) more than the 95th percentile and the age of parents and the mean parental BMI

$$\left(\frac{\text{Mother's BMI} + \text{Father's BMI}}{2}\right).$$

Discussion

Pediatricians usually manage few children with hypertension secondary to renal, endocrine, cardiac disorders and drugs(9). In recent years, there is an increased interest to

identify children with high risk of essential hypertension in adulthood. Data regarding the childhood origin of essential hypertension is conflicting. A population study performed in Belgium about the familial aggregation of BP showed a significant correlation of both SBP and DBP in the first family relatives of children(10). Brandao, *et al.* showed this correlation only for SBP(11). In the study by Holland and Beresford, no significant association was found with respect to SBP(12).

In our study, the mean SBP, DBP and MABP of children of hypertensive parents was higher than controls and a significant association was found between SBP of fathers and children and also between SBP and DBP of mothers and children. Investigators from the Framingham Heart Study evaluated familial BP associations and showed that both paternal and maternal SBP and DBP correlated significantly with that of offspring even after adjustment for covariates known to influence BP(13). In the study of Clarcke, *et al*. on a sample of children from the Muscatine Study, both the SBP and DBP aggregated more strongly in the families of children with labile high blood pressure than in the families with low or middle blood pressure(14).

As yet, no convincing evidence for sex differences in the genetic regulation of blood pressure has been described, but certain studies have shown some differences between the BP of girls and boys in correlation with their parents' BP. In the study of Patterson et al. the fathers' BP correlated with children's BP in both sexes but for mothers, the correlation was weak(15). In our study the highest relation was found between the BP of mothers and children of both sexes.

In our study, SBP and DBP above 95th percentile of children had significant association with the age and BMI of both parents. Similar association of parental - BMI and children's BP has been reported earlier(7). These findings reemphasize the importance of overweight and obesity of parents in predicting high BP and other CVD risk factors in their offspring.

Strategies for prevention of essential hypertension should start in childhood. Our previous studies did not show any increasing trend of hypertension in children and adolescents of our community(16), but showed a higher prevalence of some factors associated with increased risk of atherosclerosis in children of parents with premature myocardial infarction(17,18). The findings of the present study suggest the need of monitoring the BP of children of hypertensive parents. Pediatricians therefore

TABLE I–*Comparison of Mean Blood Pressure of the Cases and Controls*

BP (Mean ± SD)	Preadolescents (6 to <12 years)		Adolescents (12-18 years)	
	Cases (n = 369)	Controls (n =1113)	Cases (n = 377)	Controls (n =1125)
SBP	107.4 ± 15.1	100.2 ± 12.3	111.7 ± 14.5	109.4 ± 14.1
DBP	68.7 ± 10.5	61.1 ± 10.1	79.2 ± 11.3	70.4 ± 11.1
MABP	81.1 ± 12.4	74.4 ± 11.8	90.7 ± 12.1	83.5 ± 12.2

$P < 0.05$

Key Messages

- Children of hypertensive parents have significantly higher blood pressures than children of normotensive parents.
- Blood Pressure of children should be recorded if there is a family history of hypertension.
- Strategies for prevention of hypertension should start in childhood.

TABLE II–*Comparison of Mean Blood Pressure of Children of Hypertensive Father/Mother*

BP (Mean ± SD)	Fathers		Mothers	
	Hypertensive (n = 419)	Normotensive (n = 2565)	Hpertensive (n = 327)	Normotensive (n = 2657)
SBP	107.1 ± 15.4	104.4 ± 15.1*	108.8 ± 14.2	104.3 ± 15.2*
DBP	68.7 ± 12.4	68.2 ± 12.1	72.4 ± 11.4	67.6 ± 11.2*
MABP	80.2 ± 11.7	79.1 ± 12.2	83.7 ± 10.8	79.2 ± 7.2*

*P <0.05

have an important role to play in educating families and children about approaches that are useful in preventing hypertension.

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