ORIGINAL ARTICLE

Blood Pressure Distribution in an Iranian Adolescent Population: "Tehran Lipid and Glucose Study"

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Summary

Significant hypertension in adolescence is defined according to Blood Pressure (BP) distribution among general population. The present study was conducted to determine the BP distribution in Iranian adolescents. In a population-based study held in Tehran, BP data for 2560 participants aged 10-17 years (1247 boys and 1313 girls) were collected. The 90th and 95th percentiles of systolic (SBP) and diastolic BP (DBP) were obtained for different age and height subgroups of boys and girls. While the 90th and 95th percentiles of SBP obtained in our study were generally lower than international guidelines, the corresponding percentiles of DBP were higher. Significant associations were found between BP and age, height, weight and BMI. According to our findings, it is necessary to prepare BP reference tables according to regional surveys.

Key Words: Adolescence, Blood pressure, Epidemiology, TLGS

Introduction

High blood pressure is one of the most important risk factors for cardiovascular diseases [1-4]. This modifiable risk factor is a common health problem in Iran[5]. Some scientists believe that the roots of essential hypertension in adults are already present in childhood and adolescence[6-9]. According to the National Institute of Health (NIH), blood pressure values in childhood can predict values of blood pressure 15 years later. Longitudinal observations have shown that blood pressure increases consistently from infancy to adolescence and then adulthood [10-11]. In addition to age, the other important determinant of blood pressure in childhood and adolescence is body size [12-13]. Therefore, the interpretation of blood pressure for individual adolescent requires some adjustment by age and body size.

The age- and height- based reference tables of blood pressure, developed by the Task Force on Blood Pressure Control in Children [14], are usually used by pediatricians. However, it has been shown that ethnic or genetic factors play a significant role in the blood pressure levels of a given population[15]. Since few studies have been conducted on the blood pressure of children and adolescents in Iran, the present study was designed to determine blood pressure distribution in a group of Iranian adolescents.

Materials and Methods

Study population:

Tehran Lipid and Glucose study (TLGS) is a longitudinal study in which the first phase is a cross-sectional population study or a baseline examination survey[5,16-17]. It has been designed to measure the prevalence of risk factors, including dyslipoprotenemia, hyperglycemia, obesity, smoking, and hypertension, for a representative sample of 15005 persons aged ≥3 years of an Iranian urban population from district No.13 of Tehran. Details for TLGS, its rationale and design have been published elsewhere [16]. In this article, we dealt with distribution of blood pressure in 2560 TLGS subjects between 10-17 years of age.

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Blood Pressure and Height Measurement:
Participants were initially been told to rest for 15 minutes. Then a trained and qualified physician measured blood pressure twice during physical examinations in a seated position after one initial measurement for determining peak inflation level using a standard mercury sphygmomanometer calibrated by the Iranian Institute of Standards and Industrial Researches. On the basis of the circumference of the participant's arm, an appropriate cuff (pediatric or regular) was chosen. The recordings were taken as recommended by the American Heart Association [18]. Height was measured in the upright position, without shoes, according to the standard protocol. All the procedures were performed at the research unit of the Tehran Lipid and Glucose (TLGS Unit) in the field center between 8 am and 2 pm.

Statistical Methods:
Subjects aged 10-17 years were initially selected and categorized into four age groups in each gender. The means, standard deviations, and percentiles of systolic and diastolic blood pressures by sex and age with respect to the height group were calculated by means of SPSS 9.05 statistical software package (SPSS Inc., Chicago, IL, US). Height was categorized into four groups: <25th, 25th-49th, 50th-74th, and ≥75th percentiles for each gender of different age strata. Measured heights were allocated accordingly. Pearson's and Spearman's correlation coefficients between SBP or DBP and the other variables were also calculated. This study was approved by appropriate Research Ethics Committee and informed consent was obtained from all participants or their parents.

Results

Altogether, 2560 individuals (1247 boys and 1313 girls) participated in the survey. Table I summarizes the characteristics of the studied population. The relationships between SBP or DBP and age, height, weight or body mass index (BMI) were assessed in boys and girls, separately. Pearson's and Spearman's correlation coefficients between SBP or DBP and the other variables are shown in Table II. Significant associations were found between blood pressure and all other variables. SBP had a stronger association with each variable than DBP. The strongest relationships were found between blood pressures and weight. The associations between SBP and age, height, weight and BMI were more prominent in boys than in girls, while DBP showed stronger associations in girls than boys. Percentiles of height in different sex and age groups are shown in Table III. Clear differences were observed between results from this study and that conducted in the USA. Boys and especially girls in the current study were shorter than their USA counterparts and these differences were more prominent in late adolescence. Tables IV and V present 90th and 95th percentiles of SBP and DBP in different age and height groups in boys and girls, respectively. In comparison with the 90th and 95th percentiles of SBP in similar age and height groups in the Task Force study, our boys and girls generally showed lower SBP percentiles, especially in late adolescence. In contrast, the DBP percentiles of our boys and girls were prominently higher than their counterparts in the Task Force study, especially in early adolescence.

Table I: Characteristics of the studied adolescent population, Tehran Lipid and Glucose Study

Characteristic	Boys (n=1247)	Girls (n=1313)	t	P-value
Age (years)	13.61± 2.23	13.64± 2.23	-0.313	0.755
Height (cm)	156.61±14.78	153.37± 9.73	4.725	<0.001
Weight (kg)	49.16±16.68	47.33±12.87	-1.171	0.002
BMI (kg/m2)	19.54± 4.32	19.85± 4.11	6.542	0.057
SBP (mmHg)	105.71±12.00	103.54±11.28	3.101	<0.001
DBP (mmHg)	70.48± 9.19	70.91± 9.39	-1.902	0.242

Table II: Correlation between SBP or DBP and age, height, weight or BMI in adolescents, Tehran Lipid and Glucose Study

		Boys (n=1247)				Girls (n=1313)			
		Age	Height	Weight	BMI	Age	Height	Weight	BMI
SBP	Pearson's	0.261	0.289	0.449	0.430	0.189	0.218	0.390	0.383
	Spearman's	0.255	0.291	0.405	0.378	0.191	0.224	0.376	0.369
DBP	Pearson's	0.101	0.130	0.221	0.218	0.166	0.177	0.301	0.293
	Spearman's	0.101	0.138	0.195	0.171	0.166	0.191	0.294	0.280

All correlations are significant at the 0.001 level (2-tailed)

Table III: Height distribution by age and sex, Tehran Lipid and Glucose Study

Sex	Age (years)	Number	Percentile of height (cm)				
			25	50	75	90	95
Boys	10	128	131	136	141	145	147
	11	150	137	141	145	151	154
	12	160	141	145	150	156	162
	13	155	148	153	160	165	168
	14	188	153	160	168	172	175
	15	165	160	167	172	176	179
	16	152	166	172	176	179	180
	17	165	169	173	178	181	184
Girls	10	133	133	138	143	147	151
	11	152	138	143	148	153	158
	12	174	146	150	155	158	160
	13	180	151	156	161	163	165
	14	151	154	157	161	165	167
	15	204	155	159	163	166	167
	16	151	157	160	164	168	169
	17	176	156	159	163	167	171

Table IV: The 90th and 95th percentiles of blood pressure for boys of different age groups by percentiles of height, Tehran Lipid and Glucose Study

Age groups	N		SBP Height groups				DBP Height groups			
			25th	50th	75th	90th	25th	50th	75th	90th
10-11	273	90th	114	116	122	116	81	81	83	83
		95th	121	119	125	121	85	89	85	89
12-13	311	90th	115	113	119	124	78	79	82	83
		95th	119	118	124	129	86	85	85	87
14-15	348	90th	119	121	120	122	82	80	80	82
		95th	125	128	126	124	86	83	83	85
16-17	315	90th	129	128	127	129	82	83	83	85
		95th	136	131	134	132	86	86	88	90

Table V: The 90th and 95th percentiles of blood pressure for girls of different age groups by percentiles of height, Tehran Lipid and Glucose Study

Age groups	N		SBP Height groups				DBP Height groups			
			25th	50th	75th	90th	25th	50th	75th	90th
10-11	281	90th	113	118	120	116	83	84	81	81
		95th	120	120	124	122	87	85	88	85
12-13	353	90th	110	112	117	118	80	79	80	85
		95th	114	114	121	122	82	81	84	88
14-15	352	90th	119	119	119	124	82	82	84	84
		95th	127	122	123	126	88	87	86	88
16-17	327	90th	121	123	119	120	82	86	81	84
		95th	125	129	125	124	87	88	84	87

Discussion

The 90th and 95th percentiles of systolic and diastolic blood pressure were obtained for different sex, age and height subgroups of adolescents. Comparison of these percentiles with current guidelines indicates a prominent discrepancy. In spite of some controversies regarding the importance of high blood pressure levels in adolescence, most authorities agree that detection of adolescents with significant hypertension through annual examinations and their careful monitoring has some indisputable benefits [19-21]. The most widely used definition of adolescent hypertension is based on epidemiological studies. Normal blood pressure is defined as SBP and DBP less than the 90th percentile for age, sex and height. High normal blood pressure is defined as SBP or DBP between the 90th and 95th percentiles and significant hypertension SBP or DBP equal to or above the 95th percentile for age, sex and height.

Because of the lack of comprehensive and reliable data concerning blood pressure of adolescents outside North America, most countries use the reference tables developed by the Task Force study for everyday practice. Data in the Update on the Second Task Force report in 1996, 14 had been obtained from 10 different studies performed in the US and Canada between 1976 and 1991. These surveys involved more than 60,000 white, black and Mexican-American (56% white) children and adolescents between 1 and 18 years of age[14]. However, several epidemiological surveys have reported deviations from the Task Force guidelines regarding adolescent hypertension [22]. Our study also demonstrated prominent deviations from Task Force guidelines. These findings make it necessary to consider the ethnical and geographical variability of adolescent blood pressure in everyday practice and to prepare reference tables according to regional population-based surveys. Our study may serve to prepare such guidelines for the Eastern Mediterranean and South Asian regions.

The 90th and 95th percentiles of SBP in our study were generally lower than corresponding values seen in the Task Force study. This discrepancy is more prominent in late adolescence. This can be explained by the shorter height of our adolescents especially in late adolescence and the strong positive association between SBP and height. In addition, we used the mean of two blood pressure measurements in our study while in the Task Force study, only the first reading had been used, a factor that might also has contributed to the observed discrepancy. However, our 90th and 95th percentiles of DBP were greater than those of the Task Force study. This discrepancy is contradictory to the predicted discrepancy according to height. It may be regarded as the effect of diverse genetic and environmental factors. However, it should be remembered that a weaker association exists between DBP (rather than SBP) and height. This association, however, may explain the finding that this difference decreases with age, while the height differences become more significant.

The SBP of boys is significantly higher than girls. This is in agreement with present literature [14]. However, no significant difference was observed between boys and girls regarding DBP. Both DBP and SBP, the latter in particular, displayed strong correlations with age, height, weight and BMI. The stronger association between SBP (rather than DBP) and these variables have been reported earlier. The strongest relationship was found between SBP or DBP and weight rather than age, height or BMI. This is also in agreement with previous reports [22], indicating possibly that considering weight rather than height may be better if used for the assessment of blood pressure in adolescents.

Conclusion

In conclusion, considering the geographical variability of systolic and diastolic blood pressures observed, it is advisable for clinicians to be cautious in the application of existing guidelines being used to assess the blood pressure of adolescents and to emphasize the need to establish new guidelines on the basis of regional population-based surveys.

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