Relationship between Arterial Blood Pressure and Body Mass Index of School Age Children of Southern Region of Iran

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Abstract- Despite an increasing prevalence of obesity and hypertension in young age, there is limited information on the contribution of body mass index (BMI) to blood pressure (BP) in these populations, especially in developing countries. This study examines the association between BMI and BP in four populations of school age children across southern region of Islamic republic of Iran.

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Introduction

Hypertension is a major problem, affecting every nations- both developed and developing - at the world and may lead to irreversible damages in vital organs, including central nervous system, cardiovascular system, and kidney. Besides being a major cause of morbidity and mortality, uncontrolled high blood pressure has a heavy impact on patients and families.

Despite evidence of an increasing prevalence of hypertension among children and adult, the consequences of hypertension through early years of life are poorly understood and often missed due to inaccuracy of instruments and lack of experienced staff. Silent nature of childhood hypertension results in damage on vital organs in late childhood and adulthood. Thus blood pressure measurement of children and timely management of childhood risk factors of hypertension (1) is an important step to prevention of mortality and morbidity of cardiovascular and renal disorders in older age. Further policies are needed to improve cardiovascular health of children and young adults, including lifestyles changes at home and in school, better methods of prophylaxis and diagnosis of high blood pressure, familiarity with local distribution pattern of hypertension, and improvement of blood pressure takings methods and accurate modification of hypertension complications. Hypertension in children is mostly secondary (mainly due to cardiovascular, renal, endocrine and medication) and only small percent is primary (2). Accurate blood pressure measurements should be a part of routine annual physical examinations for all children. NHBPEP (The National High Blood Pressure Education Program) recommend that all children ≥3 years old should have their blood pressure measured when seen at all medical visits (3). Although blood pressure in selected children <3 years old at risk for hypertension should be checked appropriately.

Blood pressure increases with age and varies with sex and ethnic origin. Many countries have established curves for different age–sex groups, based on Second Task Force recommendation cut-off points (4).The basic definitions for blood pressure are as following (5): normal blood pressure (BP) is systolic blood pressure (SBP) and diastolic blood pressure (DBP) that is less than the 90th percentile for sex, age, and height. Average SBP or DBP levels that are ≥90th percentile, but <95th percentile, had been "high normal" and were considered to be a risk for developing hypertension. This level is consistent to "prehypertension" in adults. It is now recommended that, as with adults, children and adolescents with BP levels at 120/80 mmHg or above, but less than the 95th percentile, should be considered prehypertensive, and thus need to lifestyle interventions.

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Hypertension is average SBP or DBP that is ≥95th percentile for age, sex, and height on at least three separate occasions.

To expand our available data on blood pressure distribution in the Yazd, Iran, we determined the blood pressure of school age children among two age groups - 7 and 17 years old - from both gender types.

Materials and Methods

This cross-sectional epidemiological study was conducted during the 21 September 2009 up to 21 March 2010 to investigate the prevalence of hypertension between two age groups of school students. The study cohort included students of 18 schools of all the Iranian Ministry of Education in Yazd city, located at southern Islamic Republic of Iran, over six months, using the two-stage cluster sampling method. The study group included 4800 students which divided equally between two sexes (2400 males and 2400 females) and two ages (2400 grade 1(7 year old) and 2400 grade 12 (17 year old) groups. Blood pressure, height, and weight of the participants were determined by the research group.

A standard protocol was established for the examination of the participants according to the second Task Force guidelines. The protocol was explained to the interviewers/examiners who were pediatricians. In respect to reach to similar results, all of the interviewers/examiners were trained by one of the investigators, who was a pediatrician. The aim of the study and the procedures were described to the students (participants). A digital sphygmomanometer (Omron, USA) was presented to all schools about two weeks before study, for familiarity of the procedure and for blood pressure measurement.

Measurements were taken in a quiet and moderate temperature room (25-30°C) in each school. All interviewers/examiners wore regular clothing in order of avoiding white-coat hypertension. The participants should not any activity, including physical exercises, eating and drinking (except for tape water), at least for 15 minutes before examination. Body-weight with minimal clothing was recorded using a (Seca, Germany) scale sensitive to 0.1 kg. Height was measured without shoes sensitive to 0.5 cm using a non-stretch tape fixed to a vertical wall. Body mass index (BMI) was measured by body weight divided by square of height (kg/m2). The BMI values that were considered to be underweight, normal weight, at risk for overweight, and overweight, were defined as <5th, 5th–84th percentile, ≥85th and ≥95th percentile, respectively, of age- and sex-specific (6). After 2-3 minutes in sitting position, first measurements were done using digital sphygmomanometer for familiarity of students and finally a mercury sphygmomanometer (MDF800, Shanghai China) was used to measure blood pressure on the student's right arm whiles seated with forearm supinated and slightly flexed and supported at heart level. The cuff of sphygmomanometer was placed around upper arm with the lower edge about two cm above the antecubital fossa. Cuff bladder was arranged to cover about 75% of the upper arm .Then radial pulses was palpated and the cuff rapidly inflated to 30 mm Hg above where pulse no longer felt. The stethoscope was placed gently over artery, but not under the cuff, and then the cuff was deflated about 3 mm Hg per second while auscultating the arterial pulse. The systolic blood pressure was recorded when the first Korotkoff (K) sound was heard and K5 sounds was recorded as diastolic blood pressure. If the participants had a high blood pressure in first examination, then he/she was re-examined next day by the same examiner. Urinalysis was administered for those who had a high blood pressure above 95th percentile at two examinations. The whole data were evaluated using the SPSS software (version 10.0.5,SPSS Inc., Chicago, IL, USA)and *chi*-Square and Fisher Exact tests. Results were expressed as mean.

Results

Data of 4800 students were used; including 50% (n=2400, including 1200 grade 1 and 1200 grade 12) male, and 50% (n=2400, including 1200 grade 1 and 1200 grade 12) female. Table 1 shows the distribution of the Body Mass Index (BMI) by sex and age. In our study 6.25% and 9% of 7-years old and 17-years old boys were, respectively, at risk for overweight. Also 3.5% and 6.25% of 7-years old and 17-years old girls were at risk for overweight. Overweight students from sexes, respectively boy and girl, and both ages, respectively 7-years old and 17-years old, were 2.75%, 4%, 2.5% and 2.75%. The BMI values of 7 years old group were not significantly different , but the values of the 17 years old group were significantly (P=0.0001) different with respect to gender. Table 2 shows the percentage of at risk for overweight between two sexes. The BMI values of 7 years old group were not significantly different , but the values of the 17 years old group were significantly (P=0.0001) different with respect to gender.

Table 1. BMI distribution by sex and age (7 and 17 years old)

Sex→	Boy				Girl			
Age→	7y/o		17y/o		7y/o		17y/o	
BMI↓	No	%	No	%	No	%	No	%
<5th percentile	93	7.75	36	3	78	6.5	36	3
5th–84th percentile	999	83.25	1008	84	1050	87.5	1326	88
85th–94th percentile	75	6.25	108	9	42	3.5	75	6.25
≥95th percentile	33	2.75	48	4	30	2.5	33	2.75

Table 2. Comparison of at risk for overweight males and females

	7-year old	17-year old
Males	6.25% (n=75)	9% (n=108)
Females	3.5% (n=42)	6.25% (n=75)

Table 3 shows Systolic Blood Pressure(SBP) and Diastolic Blood Pressure(DBP) distribution by sex and age(7 and 17 years old).SBP more than 95th percentile, defined as hypertension was found in 2.0%, 1.5%, 2.5% and 2.0% of participants for 7-years old boys and girls and 17-years old boys and girls ,respectively. DBP more than 95th percentile, defined as hypertension was found in 1.5%, 1.0%, 2.0% and 1.75% of participants for 7-years old boys and girls and 17-years old boys and girls, respectively. Although both SBP and DBP were slightly higher between the male students and between 17 years age group, but there were not seen any significant difference among two sex and age groups. Between 7-years old students, there were 15 cases with isolated high SBP, 3 with isolated high DBP, and 27 cases with both high SBP and high DBP. Between 17-years old students, there were 12 cases with isolated high SBP and 3 with isolated high DBP and 42 cases with both high SBP and high DBP. There were 114 cases with high BP at the first examination, which reduced to 102 at the 2nd survey, all 12 excluded babies were 7-years old.27 participants from these 102 cases returned for urinalysis, from which only three 7-years old girls show hematuria.

Table 4 shows correlation among BMI and blood pressure (SBP & DBP) for both sexes at seven and 17 years old groups. All the SBP and DBP values of both ages and genders were significantly (P<0.0001) different with respect to BMI.

Table 3. SBP/DBP distribution by sex and age (7 & 17 years old)

Sex→	Boy				Girl			
Age→	7y/o		17y/o		7y/o		17y/o	
SBP ↓ / DBP ↓	NO	%	NO	%	NO	%	NO	%
<50 th percentile	465 / 528	38.75 / 44	429 / 351	35.75 / 29.25	465 / 504	38 / 42	498 / 480	41.5 / 40
50-75 th percentile	408 / 387	34 / 32.25	429 / 423	35.75 / 35.25	444 / 390	37 / 32.5	429 / 420	35.75 / 35
75-90 th percentile	210 / 201	17.5 / 16.75	219 / 294	18.25 / 24.5	201 / 213	16.75 / 17.75	168 / 192	14 / 16
90-95 th percentile	93 / 66	7.75 / 5.5	93 / 108	7.75 / 9	81 / 81	6.75 / 6.75	81 / 87	6.75 / 7.25
>95 th percentile	24 / 18	2 / 1.5	30 / 24	2.5 / 2	18 / 12	1.5 / 1	24 / 21	2 / 1.75

Table 4. Correlation between BMI and Blood Pressure (SBP & DBP)

BP Percentile→	<50th				50-75 th				75-90 th				90-95 th				>95 th			
	DBP		SBP		DBP		SBP		DBP		SBP		DBP		SBP		DBP		SBP	
BMI↓	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%
<5 th	240	5	237	4.9	3	0.06	6	0.13	0	0	0	0	0	0	0	0	0	0	0	0
5-10 th	306	6.4	309	6.4	63	1.3	60	1.25	0	0	0	0	0	0	0	0	0	0	0	0
10-25 th	732	15.25	639	13.3	225	4.7	282	5.9	0	0	36	0.75	0	0	0	0	0	0	0	0
25-50 th	432	9	483	10	648	13.5	630	13	159	3.3	126	2.6	0	0	0	0	0	0	0	0
50-75 th	135	2.8	153	3.2	462	9.6	483	10	225	4.7	186	3.9	0	0	0	0	0	0	0	0
75-85 th	18	0.4	27	0.6	216	4.5	240	5	384	8	339	7	108	2.25	120	2.5	0	0	0	0
85-95 th	0	0	0	0	3	0.06	9	0.20	117	2.43	108	2.25	171	3.6	168	3.5	9	0.2	15	0.3
>95 th	0	0	0	0	0	0	0	0	15	0.3	3	0.06	61	1.3	60	1.25	66	1.4	81	1.7

Discussion

High normal blood pressure- Prehypertension- is a risk factor for developing hypertension. Thus individuals with prehypertension need prophylactic measures and lifestyle modification. Available data on children and adolescent with prehypertension in Iran, especially in hot and dry climate such as Yazd city, is little. The prevalence of high normal SBP in this study was 7.25%. The 2% prevalence of hypertension in this study is similar to that of Shahr-e-Kord -1.8% in the age-group of 13-18 years -(7) with no significant difference among two age groups and both sexes .The prevalence of hypertension was 10.6% in male and 12.3% in female adolescents in Tehran (8), and 6.9% in age-group of 7-12 years in Qazvin (9). The prevalence of hypertension was 6.0% in the age-group of 14-19 years in the United States(10), 2.9% in the age-group of 4-18 years in Germany(11), 6.9% in the age-group of 6-18 years in Brazil (12), 3.4% in the age-group of 4-18 years in Argentina (13), and 4.4% in the age-group of 13-20 years in Turkey (14). There is positive correlation among BMI in both sexes and SBP and DBP (PV<0.0001). BMI of 3% (n=48) students was ≥95th percentile and of 6.2% (n=100) was 85^{th}–94^{th}, with no significant difference among two sexes. 38 students of this study had the hypertension at first examination that reduced to 34 after re-examination 24hr later by the same examiner. Of this group only 9 students returned for more survey, including urinanalysis. Only one 7 years old girl had microscopic hematuria. Regular measurement of blood pressure of overweight cases accompanied with lifestyle modification could be an effective preventive method for the early detection of hypertensive children and timely modification of its complications. In conclusion, at this study we measured blood pressure (SBP and DBP), height and weight of school children (males and females) aged seven and 17 years old in Yazd city in southern Iran and compared the results to that of others from Iran and the world. There was highly correlation among hypertension and BMI in both ages and sexes. This study can refines our data on blood pressure in children and adolescents inhabitant at warm climates, such as Yazd city, and help to establish normal blood pressure curves based on national data.

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