Blood Pressure Screening in School-aged Children in Tehran

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Introduction. Hypertension is one of the most common diseases in the world and a major risk factor for cardiovascular, renal, and neurologic diseases. It seems that hypertension and overweight in children are a growing epidemic. The aim of this study was to investigate the prevalence of hypertension in school-aged children in Tehran.

Materials and Methods. In a cross-sectional study, blood pressure and anthropometric measurements were performed on school-aged children in Tehran from 2008 to 2009. Children aged 7 to 11 years from 5 public schools in Tehran were included. Blood pressure, weight, and height measurement were performed at the school. At each screening, 3 seated blood pressure, weight, and height measurements were made and at least after 3 minutes of rest and choosing proper cuff, blood pressure was measured by a pediatric nephrologist and a pediatric assistant.

Results. A total of 425 school-aged children were included. Twenty-four percent of the primary school children had hypertension and 12% were shown to be overweight. Hypertension was more common in students of the north of Tehran in comparison to other geographic parts of Tehran. There was a significant difference in the prevalence of hypertension between girl students of north of Tehran and girls of the other parts of Tehran.

Conclusions. We concluded that hypertension is a common problem in school-aged children. Our study re-emphasized the need for prevention and control of high blood pressure in children to manage the global diseases burden due to hypertension.

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INTRODUCTION

Hypertension is one of the most common diseases in the world and an important risk factor for nephrologic, cardiovascular, and neurological diseases. Compared to decades ago, childhood hypertension and overweight are more common in United States nowadays.[1,2] Based on recent studies, the prevalence of childhood hypertension ranges from 5.4% to 22.9%,[3-10] and the prevalence of obesity is 18% to 25%.[4] Nowadays, hypertension and prehypertension are significant health problems in the young due to the marked increase in the prevalence of overweight.[5] It seems that a higher body mass index (BMI) is associated with elevated systolic and diastolic blood pressure levels.[6] Since hypertension is a significant risk factor for different disorders, prevention and control of elevated blood pressure in children might be an important strategy for limiting global diseases. With assessment of blood pressure levels in childhood we can predict hypertension in adult. This fact would provide the opportunity to intervene before hypertension is established.[8] The Aim of this study was to investigate the prevalence of hypertension in school-aged children and to determine what percent of these hypertensive children were previously undiagnosed.

MATERIAL AND METHODS

Sampling Strategy

In this cross-sectional descriptive study, blood pressure and anthropometrics evaluations were performed on school-aged children from 2008 to 2009 in Tehran. After approval from the ethics committee of the Pediatric Infectious Research Center, 5 primary intermediate schools, each located in one of the 5 geographic districts of Tehran, were selected at random for data collection. The 3 schools from the north, east, and west parts of the city were girls' schools and those from the center and east were boys' schools. The purposes of the study were explained to the parents by trained members of the study team and inform consents were obtained before starting the study. After random selection, school goers whose parents gave permission for screening were enrolled and relevant data were documented on predesigned forms.

Studied Population

The study groups were children aged 7 to 11 years from convenience samples of 5 randomly selected public schools in Tehran.

Demographic Data

In this study, blood pressure, body weight, and height measurements were performed at the school. Weight and height were measured for each student by an Omron scale (Omron, Kyoto, Japan) and a Seca device (Bradford, Massachusetts, USA), and BMI was calculated as weight in kilograms divided by squared height in meters. The most current pediatric anthropometric reference data, specific for gender and age, were used to establish height, weight, and BMI percentile for each student.[11] At each school screening, 3 seated blood pressure, weight, and height measurements were made, and at least after 3 minutes of rest and choosing a proper cuff, blood pressure was measured by a pediatric nephrologist and a pediatric assistant (Welch Allyn, Jungingen, Germany) and by auscultatory mercury method. None of the examiners wore a white coat during examinations. When the examiners detected prehypertension or hypertension in the study group, they measured blood pressure twice more after 15 and 30 minutes. If the second and third measurements showed hypertension, the investigators identified it as prehypertension or hypertension.

Definitions

Normal systolic blood pressure and diastolic blood pressure were defined as less than the 90th percentiles for gender, age, and height. Prehypertension was defined as an average systolic or diastolic blood pressure between the 90th and 95th percentiles for gender, age, and height. Hypertension defined as an average systolic and/or diastolic blood pressure higher than the 95th percentiles for gender, age, and height.[8]

Overweight was defined as a BMI of the 95th percentile or a BMI of 25 kg/m^2 to 29.9 kg/m^2. Obesity was defined as a BMI of 30 kg/m^2 to 34.9 kg/m^2. *Z* scores of BMI were generated from equations provided by the Centers for Disease Control and Prevention, and exact BMI percentiles were calculated for each participant. Body mass index percentile categories of the 5th, 10th, 25th, 50th, 75th, 90th, and 95th were generated by rounding the exact BMI percentile to the nearest categorical threshold.[11,12]

Laboratory Assessments

In order to rule out major nephrologic problems in the study group, urinalysis, urine culture, urine protein, and kidney ultrasonography were done. All the laboratory examinations and kidney ultrasonographies were done in one center by the same staff, and urine protein was evaluated by the dipstick method.

Statistical Analyses

For statistical analysis, the chi-square test and analysis of variance were performed. Variables were presented as mean ± standard deviation and percentages. The association measures were reported as adjusted odds ratios (ORs). A *P* value less than .05 was considered significant, and 95% confidence intervals were calculated for adjusted ORs.

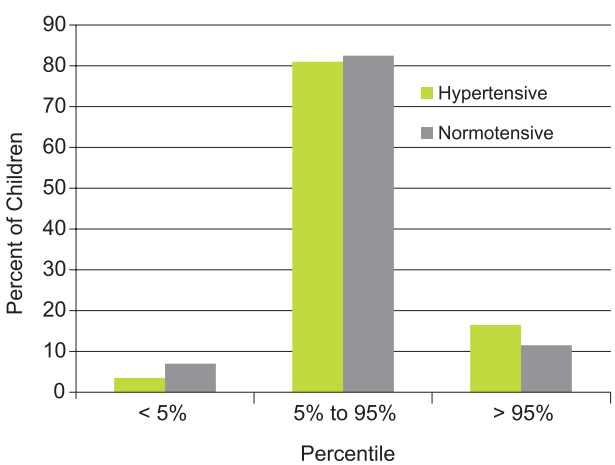
RESULTS

A total of 425 school-aged children were included, of whom 229 (53.9%) were girls. The mean age, weight, height, BMI, systolic and diastolic blood pressure in study group were 8.9 ± 1.34 years, 32.4 ± 10.0 kg, 133.8 ± 10.9 cm, 17.74 ± 3.25 kg/m^2, 102.0 ± 12.4 mm Hg, and 68.4 ± 9.8 mm Hg, respectively. In 313 children (73.6%) blood pressure was being evaluated for the first time and in 112

(26.4%) blood pressure had been evaluated before. Overall, 103 seemingly healthy students (24.2%) were shown to be hypertensive, and 53 (12.0%) were overweight. In the normotensive children, 15.5% were overweight and in the hypertensives, 11.5% were overweight ($P = .41$; Figure).

Hypertension was more common in students of schools located in the north of Tehran in comparison to other geographic parts of Tehran ($P < .001$). There was a significant difference in the prevalence of hypertension between girls of the north sample of Tehran and girls of the other parts of Tehran ($P < .001$). There was not any significant difference in the prevalence of hypertension between boy students of the center part and east part of Tehran. It was also revealed that overweight was more common in the students of the center part of Tehran. There was not any significant difference in overweight prevalence between girl students of the north of Tehran compared to girl students of the west and east parts of Tehran. Among the boy students, there was not any significant difference in the prevalence of overweight between geographic parts of Tehran.

Of the hypertensive children, 14 (13.6%) showed proteinuria (by dipstick method), but the prevalence of proteinuria in normotensive students was 4.7% ($P < .002$). Abnormality on kidney ultrasonography was documented in 30 (7.1%) of the study group. Hydronephrosis, urinary calculus, and urinary tract duplication were shown in 5%, 1% and 1%, respectively. There was no significant differences in kidney ultrasonography results between hypertensive and normotensive students ($P = .12$).



Body mass index distribution between students with and without hypertension.

DISSCUSSION

The results of this study showed hypertension in 24.2% of the children sampled from primary schools of Tehran. Overweight was determined in 12% of them. We also detected significant difference in the prevalence of hypertension and overweight between the school-aged children of different geographic parts of the city.

According to Kelishadi and colleagues' study from Isfahan, Iran, which was done in 2005, the overall prevalence of systolic, diastolic, and systolic or diastolic hypertension among Iranian children are 4.2%, 5.4%, and 7.7%, respectively.[3] Comparison of these figures with the prevalence of hypertension in our cohort shows that childhood hypertension is on the rise; our reported prevalence is similar to those recently reported in the other countries. Fuiano and colleagues from Italy reported the prevalence of elevated blood pressure at first screenings which was 35.1% in boys and 41% in girls, and the relative risk was significant for overweight patients. They concluded that these results showed an increasing epidemic of cardiovascular risk in children, as evidenced by an increase in the prevalence of overweight and hypertension.[12] Since late 1980s, the prevalence of childhood hypertension has increased in the United States as demonstrated by several large population-based surveys.[1,2,13,14] This was best illustrated in a report based upon the United States National Health Survey data that examined the mean BP for boys and girls between 8 and 17 years of age from various ethnic groups during 6 different periods from 1963 to 2002.[14] Another study using data on children aged between 8 and 17 years from the National Health and Nutrition Examination Survey reported similar findings of a temporal increase in both the mean systolic and diastolic BP (about 1.4 mm Hg and 3.3 mm Hg, respectively).[15] School-based screening studies have also demonstrated a rise in the prevalence of hypertension from 1.1% in 1989 to about 4.5% in 2000s.[2,13,16] Colin-Ramirez and coworkers from Mexico City reported that 3.6% of their pediatric study group had systolic hypertension, 14.2% had diastolic hypertension, and 22.8% had mixed hypertension; thus, they concluded that in a sample of Mexican children of low socioeconomic status, the prevalence of hypertension was high and waist circumference was the main factor in this regard.[17]

These data confirm this fact that the extent and severity of childhood hypertension and overweight are increasing.[9-12,17]

In the past decade, Ataei and colleagues evaluated BP distribution in 8848 Iranian school children aged 7 to 12 years in Tehran. They revealed a positive correlation between BP and height and weight in both sexes. In this study, the 50th and 95th percentiles of systolic and diastolic BP of Iranian children were different from those of the Second Task Force study.[18] They concluded that environmental and genetic factors are likely to be responsible for the differences.[7] These studies show some differences in the results during one decade in the same society, and as time goes by, remarkable changes happen in the risk factors and accompanying factors to hypertension in school-aged children in our population. Koulouridis and associates from Greece showed greater body weight in boys in comparison to girls and greater height and waist circumference and high-normal systolic and diastolic BP. They also reported a higher frequency of systolic and diastolic high BP in girls.[19] According to these data, there is a difference between the results of studies that were carried out in children to evaluate the correlations between weight, height, and hypertension. It seems that these differences might be related to ethnicity, diet, and environment. In Sanchez-Zamorano and colleagues' study from Morelos, the overall prevalence of elevated BP was 3.9%, which was not too high compared with previous studies. They concluded that a higher BMI is associated with elevated systolic and diastolic BP levels, indicating the importance of strategies for screening and for promoting educational programs for people lifestyles to prevent hypertension in adolescents.[6] In an Iraqi study which was done by Subhi, obesity was reported in 7.3% of children. The author showed that hypertension was 1.8 fold higher among obese than nonobese children.[20] Finally, King and coworkers from the United States reported a prevalence of 29.1% for overweight and 21.6% for elevated BP in school-aged students. They showed a direct relationship between elevated BMI and elevated BP for all groups, while African-Americans were more likely to have an elevated BP with a normal BMI. These findings demonstrated the important role of the school nurse in providing effective prevention strategies as screening programs.[21]

In contrast, Genovesi and colleagues demonstrated a low prevalence of 4.2% for high BP in their study group in Milan. In their query, different definitions were used for overweight and they report prevalence rates from 17.0% to 38.6% for overweight. The percentage of high BP was significantly higher in overweight than normal children.[5] Sorof and colleagues reported a prevalence of 20% for overweight among children in the United States.[2] They showed that the prevalence of elevated blood pressure after first, second, and third screenings was 19.4%, 9.5%, and 4.5%, respectively. In another report from the United States, Figueroa-Colon and colleagues reported a prevalence of 23% for obesity in black girls at the age of 5 years (10% in whites) and 47% at the age of 11 years (27% in whites).[22] They also reported that the prevalence of obesity in boys was 13% at the age of 5 years (6% in whites) and it was 29% at the age of 11 years (22% in whites). They showed that systolic and diastolic BP levels were significantly higher in obese than in nonobese children. Moreover, they reported a significant and growing prevalence of childhood obesity and hypertension in school-aged children.[22]

Recent studies have investigated fundamental differences in the prevalence of hypertension based on ethnicity and culture. These findings are noteworthy, because they show a major difference in prevalence of hypertension in different cultural groups. The results of these studies indicate that we need local studies in this regard to institute a general rule for detection of high BP and hypertension in each population. Except our study, these results further indicate that the primary contributing factor to hypertension was overweight.

We evaluated the BP of our students just in one session. We think the negative correlation between hypertension and overweight might be because of this fact. Therefore, we highlight the importance of confirming elevated BP on multiple occasions, before labeling a child as hypertensive. Even among students with 2 sets of elevated BP screening, only 54% were persistently hypertensive at the third screening. Thus, in our point of view, our data is important and noteworthy in screening programs for detecting of hypertension in school-aged children; nevertheless, more general studies are needed to report the exact rate of hypertension in this age group.

CONCLUSIONS

We concluded that hypertension is a common problem in school-aged children, and this study confirms the presence of a growing epidemic of hypertension risks in this group. We recommend precise prevention strategies, which can be instituted at the local and national level, and modification in children life style. We also recommend monthly follow-up of children with high BP or overweight to decrease the rate of complications.

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CONFLICT OF INTEREST

None declared.

REFERENCES

1. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. JAMA. 2002;288:1728-32.
2. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ. Overweight, ethnicity, and the prevalence of hypertension in school-aged children. Pediatrics. 2004;113:475-82.
3. Kelishadi R, Ardalan G, Gheiratmand R, et al. Blood pressure and its influencing factors in a national representative sample of Iranian children and adolescents: the CASPIAN Study. Eur J Cardiovasc Prev Rehabil. 2006;13:956-63.
4. Chiolero A, Bovet P, Paradis G, Paccaud F. Has blood pressure increased in children in response to the obesity epidemic? Pediatrics. 2007;119:544-53.
5. Genovesi S, Giussani M, Pieruzzi F, et al. Results of blood pressure screening in a population of school-aged children in the province of Milan: role of overweight. J Hypertens. 2005;23:493-7.
6. Sanchez-Zamorano LM, Salazar-Martinez E, Anaya-Ocampo R, Lazcano-Ponce E. Body mass index associated with elevated blood pressure in Mexican school-aged adolescents. Prev Med. 2009;48:543-8.
7. Ataei N, Aghamohammadi A, Yousefi E, et al. Blood pressure nomograms for school children in Iran. Pediatr Nephrol. 2004;19:164-8.
8. Falkner B. The 4th Report on High Blood Pressure in Children and Adolescents. Pediatrics. 2004;114(Suppl 2):555-76.
9. Hansen ML, Gunn PW, Kaelber DC. Underdiagnosis of hypertension in children and adolescents. JAMA. 2007;298:874-9.
10. Ashrafi MR, Abdollahi M, Ahranjani BM, Shabanian R. Blood pressure distribution among healthy schoolchildren aged 6-13 years in Tehran. East Mediterr Health J. 2005;11:968-76.
11. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. Adv Data. 20001-27.
12. Fuiano N, Luciano A, Pilotto L, Pietrobelli A. Overweight and hypertension: longitudinal study in school-aged children. Minerva Pediatr. 2006;58:451-9.
13. Sinaiko AR, Gomez-Marin O, Prineas RJ. Prevalence of "significant" hypertension in junior high school-aged children: the Children and Adolescent Blood Pressure Program. J Pediatr. 1989;114:664-9.
14. Din-Dzietham R, Liu Y, Bielo MV, Shamsa F. High blood pressure trends in children and adolescents in national surveys, 1963 to 2002. Circulation. 2007;116:1488-96.
15. Muntner P, He J, Cutler JA, Wildman RP, Whelton PK. Trends in blood pressure among children and adolescents. JAMA. 2004;291:2107-13.
16. McNiece KL, Poffenbarger TS, Turner JL, Franco KD, Sorof JM, Portman RJ. Prevalence of hypertension and pre-hypertension among adolescents. J Pediatr. 2007;150:640-4, 4 e1.
17. Colin-Ramirez E, Castillo-Martinez L, Orea-Tejeda A, Villa Romero AR, Vergara Castaneda A, Asensio Lafuente E. Waist circumference and fat intake are associated with high blood pressure in Mexican children aged 8 to 10 years. J Am Diet Assoc. 2009;109:996-1003.
18. Task Force on Blood Pressure Control in Children. Report of the Second Task Force on blood pressure control in children. Pediatrics. 1987;79:1-25.
19. Koulouridis E, Georgalidis K, Kostimpa I, et al. Factors influencing blood pressure control in children and adolescents. Int Urol Nephrol. 2008;40:741-8.
20. Subhi MD. Blood pressure profiles and hypertension in Iraqi primary school children. Saudi Med J. 2006;27: 482-6.
21. King CA, Meadows BB, Engelke MK, Swanson M. Prevalence of elevated body mass index and blood pressure in a rural school-aged population: implications for school nurses. J Sch Health. 2006;76:145-9.
22. Figueroa-Colon R, Franklin FA, Lee JY, Aldridge R, Alexander L. Prevalence of obesity with increased blood pressure in elementary school-aged children. South Med J. 1997;90:806-13.

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