ORIGINAL ARTICLE

A nationwide report on blood pressure of children and adolescents according to socioeconomic status: The CASPIAN-IV study

Zahra Fallah[1,2], Roya Kelishadi[1], Ramin Heshmat[3], Mohammad Esmaeil Motlagh[4], Gelayol Ardalan[5], Amir Kasaeian[6,7], Hamid Asayesh[8], Mostafa Qorbani[9,3]

[1]Department of Pediatrics, Child Growth and Development Research Center, Research Institute for Primordial Prevention of Non-Communicable Disease, Isfahan University of Medical Sciences, Isfahan, [2]Student Research Center, Isfahan University of Medical Sciences, Isfahan, [3]Chronic Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, [4]Department of Pediatrics, Ahvaz University of Medical Sciences, Ahvaz, [5]Department of School Health, Bureau of Population, Family and School Health, Ministry of Health and Medical Education, Tehran, [6]Department of Biostatistics and Epidemiology, School of Public Health, Tehran University of Medical Sciences, Tehran, [7]Noncommunicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, [8]Department of Medical Emergencies, Qom University of Medical Sciences, Qom, [9]Department of Community Medicine, School of Medicine, Alborz University of Medical Sciences, Karaj, Iran

Background: Hypertension is a major leading factor for global burden of diseases. Blood pressure (BP) tracks from childhood to adulthood. So, it is important to investigate its aff ecting factors. In this study we aimed to compare the BP status in the Iranian pediatric population according to the socioeconomic status (SES) of their living area. **Materials and Methods:** In this nationwide study, a representative sample of 14,880 students, aged 6-18 years was chosen by multistage random cluster sampling from 30 provinces in Iran. Anthropometric indices and BP were measured. A validated questionnaire, including the questions of the World Health Organization Global School-based Student Health Survey was completed. Findings were compared across the four regions of the country, categorized based on their elevating SES: Southeast, north-northeast, west, and central. **Results:** Participants consisted of 13,486 children and adolescents, that is, a participation rate of 90.6%, composed of 49.2% girls and 75.6% urban residents. The mean (standard deviation) age of participants was 12.47 (3.36) years. The region with highest SES (central) had the lowest rate of high BP (HBP), that is, 3.0% (95% of confidence interval [CI]: 2.4-3.9), and the region with lowest SES (southeast) had the highest rate, that is, 7.4% (4.4-12.2). The mean (95% CI) values of systolic BP for the four regions from lowest to highest SES were 100.5 (99.6-101.3), 100.9 (100.3-101.4), 101.7 (101.3-102), and 101.7 (101.2-102.1) mmHg. The corresponding mean Diastolic BP values were as follows: 65.4 (64.6-66.1), 63.4 (62.9-63.8), 65.6 (65.3-65.8), and 64.4 (64.0-64.7) mmHg. **Conclusion:** We found significant differences in mean BP and the frequency of HBP according to the SES of the living area. Further studies are necessary to find the underlying factors resulting in such differences.

Key words: Adolescent, blood pressure, child, high blood pressure, socioeconomic status

How to cite this article: Fallah Z, Kelishadi R, Heshmat R, Motlagh ME, Ardalan G, Kasaeian A, Asayesh H, Qorbani M. A nationwide report on blood pressure of children and adolescents according to socioeconomic status: The CASPIAN-IV study. J Res Med Sci 2015;20:646-55.

INTRODUCTION

High blood pressure (HBP) is the top global health burden risk factor.[1] BP tracks from childhood to adulthood. Childhood obesity epidemic and lifestyle changes have resulted in increasing prevalence of HBP in the pediatric population.[2,3] The strong relationship of even early stages of HBP with environmental factors as air pollution, noise pollution, and smoking, as well as with obesity suggest that its prevalence will have a persistent rise.[4]

Beside the effect of fetal programming process (Barker hypothesis)[5] and aforementioned factors, other factors, including being born small for gestational age or preterm, determine the BP value in childhood,[6]

Access this article online

Quick Response Code:

Website: www.jmsjournal.net

DOI: 10.4103/1735-1995.166210

Address for correspondence: Dr. Mostafa Qorbani, School of Medicine, Alborz University of Medical Sciences, Baghestan Boulevard, 31485/56, Karaj, Iran. E-mail: mqorbani1379@yahoo.com

Received: 08-01-2015; **Revised:** 27-04-2015; **Accepted:** 06-08-2015

which will define adult BP level through the "tracking" phenomenon.[7-10] Therefore, higher BP values in the pediatric age track into adulthood and would bring their long-term health consequences.

A number of studies worldwide have proposed the potential influence of living region on BP. For instance, the sixty percent higher prevalence of hypertension (HTN) in Europe compared with the United States and Canada,[11] high prevalence of HTN in regions like South Asia,[12] association of BP with different dietary habits in various regions with various sociodemographic circumstances,[13] and the concordance of low air quality of some regions with cardio-metabolic risk factors such as HTN[14] are some examples. Socioeconomic status (SES), especially education level has supposed to be affecting on cardiovascular health.[15] A meta-analysis provided evidence for the association between HTN and SES in rural populations of low- and middle-income countries according to the geographical region.[16] Another meta-analysis depicted such a relation at the global level.[17] However, in accordance with now-a-days globesity, youth from all circumstances are susceptible to metabolic risk.[18]

Iran is a large country of Middle East with diverse geographic, ethnic, economic and social specifications.[19]

Until date, not many studies have focused on evaluating noncommunicable diseases risk factors including BP in the pediatric population of Iran. There is scarce information at national level on BP of children and adolescents and no data exists on the comparison of their BP status across different provinces/regions of the country and its correlation to the social, economic, and ecological factors. In most available studies, those parameters are estimated at individual levels. Such information would help to discover the most vulnerable areas helping policy makers to make proper decisions. This study aims to compare the BP status in the Iranian pediatric population according to the SES of their living area.

MATERIALS AND METHODS

Study design, population, and sampling

The Childhood and Adolescence Surveillance and PreventIon of Adult Noncommunicable Disease (CASPIAN) study, is a national school based surveillance system inspired by World Health Organization (WHO) recommendations, which started on 2003 and has been conducted in four different surveys until 2012.[20] Detailed methods of the fourth survey are presented elsewhere.[21,22] In brief, CASPIAN-IV study was a national cross-sectional survey on 14,880 school students, aged 6-18 years. They were selected via multistage cluster random sampling from rural and urban areas of different cities in 30 provinces of the country. Stratification was performed based on living areas (urban/rural) and school grade (elementary/intermediate/high school). The sampling was proportional to size with equal sex ratio. The number of samples in rural/urban areas and in each school grade was allocated proportionally to the population of students in each grade. Cluster sampling with equal clusters was used in each province to scope the required sample size (48 clusters of 10 students in each province). The students from other nationalities residing in Iran (such as Afghans) or the students who themselves or their parents did not agree to enter the study were not included. Other students were included regardless of their health status due to the epidemiologic nature of the study.

Questionnaires

Questionnaires were compiled with some modifications on the WHO Global School-based Student Health Survey program.[20-23] The subjects filled out questionnaires in their schools under the supervision of trained staff and the presence of at least one parent.

Physical measurements

Anthropometric measures included height, weight and hip, waist and wrist circumferences. Then the body mass index (BMI), waist to hip and waist to height ratios were calculated.

Trained health professionals measured BP according to standard protocol[24] and by using calibrated instruments. After enough rest, BP readings were taken twice from each person with 5 min interval. The readings at the first Korotkoff sound were considered as the systolic BP (SBP) and at the fifth sound as diastolic BP (DBP). The average of two measurements was recorded.

According to the fourth report of the working group (formerly task force) on BP control in children, commissioned by the National Heart, Lung, and Blood Institute of the National Institutes of Health of America, BP levels equal or more than the 95th percentile value for the age, sex, and height it was considered as HBP.[24]

Quality control

In addition to training the data collection team, a detailed operation manual was developed and distributed to the team. A supervisor and a team of external evaluators monitored performance, and checked and calibrated equipment according to standardized protocols. The Context, Input, Process, and Product evaluation model was used to guide the evaluation of the project.[20]

Country regions

According to a previous national study, the country provinces are grouped into four different regions:

Southeast, north-northeast, west and central. The regions are defined based on a combination of geography and SES. SES was measured using an index constructed from variables from the 2006 country census, including years of schooling, employment rates, and family properties. These characteristics were combined using principal component analysis. The principal components in combination with geography were used to divide the country into four large regions. The southeast region had the lowest, the north-northeast region the second low, the west region the second high and the central region the highest SES [Figure 1].[19]

Ethical considerations

The study was approved by relevant regulatory organizations and institutional review boards. Written informed consent from parents and verbal assent from students were taken after the clear explanation. Data handled confidentially and de-identified. Each subject could withdraw his/her consent at any time.

Statistical analysis

STATA statistical software (Release 12. College Station, TX, USA: StataCorp LP) and survey data analysis methods were used for statistical analysis. Mean and 95% of confidence interval (CI) for quantitative measures and frequencies/prevalence rates with the same CIs were recorded for categorical variables. Analysis of variance and Chi-square tests were used for comparisons of BP across regions. $P < 0.05$ was considered as statistically significant. Plots of mean values of BP and prevalence rate of HBP distribution over the country were drawn using MapTools, SDMTools and Plotrix packages by R software (version 2.15.1).[25]

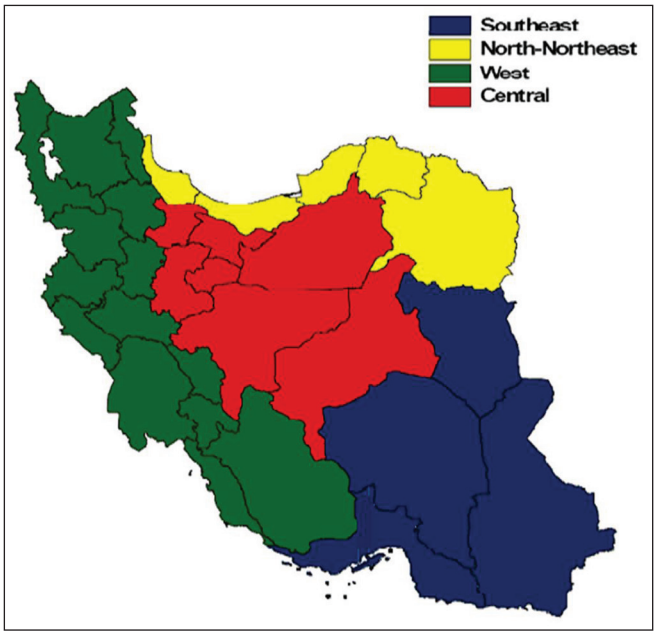

Figure 1: Country regions[19]

RESULTS

In this nationwide survey, 13,486 out of 14,880 selected students completed the study (response rate of 90.6%). They consisted of 6640 girls (49.2%) and 6846 boys (50.8%) with one of their parents, 75.6% from urban areas. For this part of study, the data of 13,367 students was complete, 1148 students from southeast (lowest SES), 2358 from north-northeast (second low SES), 6038 from west (second high SES), and 3823 from central (highest SES) regions [Table 1], the mean SBP (95% CI) of total population studied was 101.5 (101.2-101.7) mmHg and the mean DBP was 64.8 (64.6-64.9) mmHg. Prevalence rate (95% CI) of high SBP, high DBP, and high SBP, and/or DBP in the total population studied was 0.9 (0.7-1.1), 3.0 (2.5-3.6) and 3.7 (3.2-4.3) percent, respectively.

The data according to the four Iran regions are presented in Table 1. It shows a significant difference in the prevalence rate of high SBP and/or DBP between four regions: Southeast area, the lowest SES region, with a prevalence rate of 7.4% (4.4-12.2) has the highest rate ($P = 0.004$). The prevalence rate of high DBP across these regions shows similar pattern of difference ($P = 0.001$), but the corresponding figure was not different for high SBP rate among these four regions ($P = 0.228$).

The distribution of mean SBP and DBP values, as well as the prevalence rate of HBP across provinces, is depicted in Figures 2-4, respectively. They demonstrate that except some areas, higher values of mean BP and frequency of HBP are accumulated in high SES regions (central, west, and north regions).

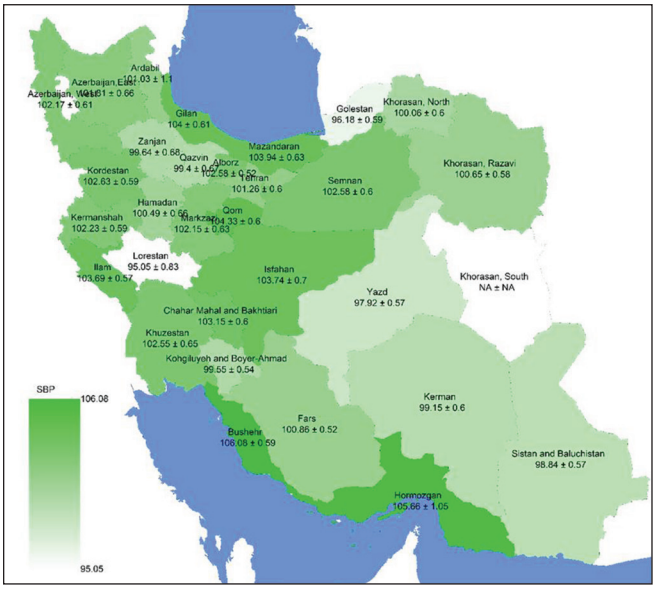

Figure 2: The mean of systolic blood pressure in Iranian children and adolescents at provincial level: The CASPIAN-IV study. Data are presented as mean ± standard error

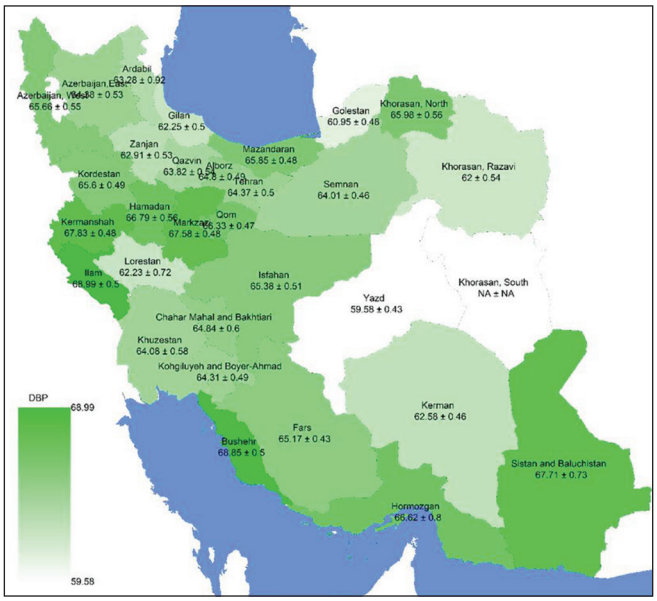

Figure 3: The mean of diastolic blood pressure in Iranian children and adolescents at provincial level: The CASPIAN-IV study. Data are presented as mean ± standard error

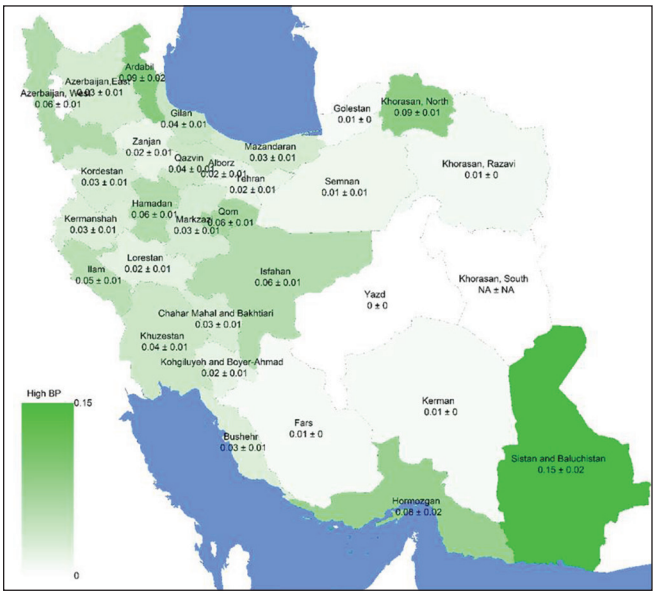

Figure 4: The prevalence of high systolic and/or diastolic blood pressure in Iranian children and adolescents at provincial level: The CASPIAN-IV study. Data are presented as prevalence ± standard error

Detailed information on mean BP and HBP prevalence rate of each province are presented in Appendix 1.

DISCUSSION

This study, which to the best of our knowledge is the first study of its kind in the Middle East and North Africa region, revealed significant differences in mean BP and frequency of HBP of children and adolescents according to the SES of their living area.

In the current study, the region with highest SES (central) had the lowest rate of HBP, whereas the region with lowest SES (southeast) had the highest rate of HBP.

The documented differences may have different causes. Considering demographics, the mean age (P = 0.91) and sex frequency (P = 0.68) of participants did not differ in the four regions. However, the proportions of living area in terms of urban and rural residence were not exactly the same (P < 0.001). The southeast region has the highest proportion of rural participants. Other than that, this region is considerably far from the metropolitan part of the country,[26] therefore it can be expected to have the most common health problems. Our findings are in line with a study in Sweden that documented the effect of social inequity on BP.[27] In Nigeria, a higher rate of elevated DBP, has been recorded in nonurban inhabitants.[28] Our finding on very high frequency of elevated DBP in one province of that region is also consistent with a study in China, in which in a specific coastal region, unexpectedly high prevalence rate of HBP (26.22% for boys and 20.27% for girls) is reported.[29]

Ethnic issues may affect the situation, as well. That part of Iran has some ethnic similarities with south Asian countries as Pakistan, which have shown considerably high prevalence rates of HTN in some reports.[12,30,31] Other region-specific factors, as dietary habits,[32] may contribute to the situation, SES is another determining parameter. Some recent meta-analyses have studied the association of SES with HBP.[16,17] One of them concluded that in low- and middle-income rural parts of the world, income as a part of SES is a major factor positively associated with HTN, but the educational level association with HTN varies with geographical region.[16] Other meta-analysis which is not confined to lower income countries has depicted the inverse association of SES especially the level of education with BP.[17] Therefore socioeconomic parameters may affect health situation relative to the epidemiologic transition stage which the region lies in. It is important to search the issue considering the complex interaction of possible determinants.[33] Hence the underlying causes of large difference of the southeast region with other provinces of Iran should be determined in future studies, however, technical problems in measuring BP should be considered as well.

Among three other regions, the north-northeast area, the second low SES region, has the second high HBP rate. This region has the highest mean of BMI, which affects the BP situation. As explained earlier SES is contributing to results as well.

The second high SES (west) region results are almost similar to the second low SES (north-northeast) region. Both regions

Table 1: Some anthropometric and blood pressure indices in national and regional level by sex and living area: the CASPIAN-IV study

Region: Category	*n* (%)	Age (years)	SBP (mm Hg)[a]	DBP (mm Hg)[a]	High SBP (%)[b]	High DBP (%)[b]	High SBP and/or DBP (%)[b]
Southeast							
Boys	539 (47)	12.7 (11.9-13.6)	101.8 (100.5-103)	65.3 (64.2-66.3)	0.9 (0.3-2.4)	5.9 (2.7-12.2)	7.2 (3.7-13.6)
Girls	609 (53)	12.1 (11.4-12.9)	99.4 (98.3-100.4)	65.4 (64.3-66.4)	0.4 (0.1-1.4)	7.5 (3.5-15.5)	7.7 (3.6-15.6)
Urban	630 (54.9)	13.0 (12.2-13.8)	102.4 (101.2-103.5)	66.5 (65.4-67.5)	0.7 (0.3-1.8)	6.6 (3.2-13.2)	7.3 (3.6-14.0)
Rural	518 (45.1)	11.7 (10.8-12.5)	98.2 (97.0-99.3)	64.0 (62.9-65)	0.5 (0.1-2.3)	6.9 (2.8-15.9)	7.7 (3.4-16.5)
Total	1148 (100) (8.6% of study population)	12.4 (11.8-13.0)	100.5 (99.6-101.3)	65.4 (64.6-66.1)	0.6 (0.3-1.4)	6.8 (3.9-11.5)[‡]	7.4 (4.4-12.2)[†]
North-northeast							
Boys	1188 (50.3)	12.2 (11.7-12.7)	101.6 (100.8-102.3)	64.5 (63.8-65.1)	1.1 (0.5-2.2)	4.5 (2.7-7.3)	5.5 (3.5-8.5)
Girls	1170 (49.7)	12.7 (12.1-13.2)	100.3 (99.5-101.0)	62.2 (61.5-62.8)	0.4 (0.1-1.1)	1.1 (0.5-2.4)	1.6 (0.9-2.9)
Urban	1711 (72.5)	12.8 (12.4-13.3)	102.2 (101.5-102.8)	64.4 (63.8-64.9)	0.8 (0.4-1.6)	3.4 (2.1-5.4)	4.2 (2.8-6.3)
Rural	647 (27.4)	11.4 (10.7-12.0)	97.6 (96.6-98.5)	60.6 (59.7-61.4)	0.4 (0.1-1.9)	1.3 (0.4-3.9)	1.8 (0.7-4.3)
Total	2358 (100) (17.6% of study population)	12.4 (12.1-12.8)	100.9 (100.3-101.4)	63.4 (62.9-63.8)	0.7 (0.4-1.3)	2.8 (1.8-4.3)[‡]	3.6 (2.4-5.1)[†]
West							
Boys	3050 (50.5)	12.5 (12.2-12.8)	103.5 (103.0-103.9)	66.6 (66.1-67.0)	1.3 (0.9-1.9)	3.3 (2.4-4.5)	4.2 (3.2-5.5)
Girls	2988 (49.5)	12.4 (12.1-12.7)	99.9 (99.4-100.3)	64.5 (64.0-64.9)	0.2 (0.1-0.5)	2.4 (1.5-3.7)	2.7 (1.8-4.0)
Urban	4536 (75.1)	12.9 (12.6-13.1)	103.0 (102.6-103.3)	66.2 (65.8-66.5)	0.9 (0.6-1.3)	3.0 (2.2-3.9)	3.7 (2.9-4.7)
Rural	1502 (24.9)	11.2 (10.7-11.7)	97.9 (97.2-98.5)	63.5 (62.9-64.0)	0.3 (0.1-0.7)	2.5 (1.3-4.8)	2.7 (1.5-5.0)
Total	6038 (100) (45.2% of study population)	12.4 (12.1-12.7)	101.7 (101.3-102)	65.6 (65.3-65.8)	0.8 (0.5-1.1)	2.8 (2.2-3.7)[‡]	3.5 (2.8-4.3)[†]
Central							
Boys	2012 (52.7)	12.0 (11.6-12.4)	102.6 (101.9-103.2)	64.6 (64.1-65.0)	1.2 (0.8-2.0)	2.9 (2.1-4.1)	3.5 (2.6-4.8)
Girls	1811 (47.3)	12.8 (12.4-13.3)	100.7 (100.1-101.2)	64.3 (63.8-64.7)	1.2 (0.5-2.4)	1.7 (1.0-2.7)	2.5 (1.6-3.8)
Urban	3223 (84.4)	12.5 (12.2-12.9)	102.2 (101.7-102.6)	64.7 (64.3-65)	1.4 (0.9-2.2)	2.3 (1.7-3.2)	3.1 (2.4-4.1)
Rural	600 (15.6)	11.6 (10.8-12.4)	98.8 (97.7-99.8)	63.5 (62.5-64.4)	0.1 (0.0-1.1)	2.3 (1.0-4.9)	2.5 (1.1-5.1)
Total	3823 (100) (28.6% of study population)	12.4 (12.1-12.7)	101.7 (101.2-102.1)	64.4 (64.0-64.7)	1.2 (0.8-1.18)	2.3 (1.8-3.1)[‡]	3.0 (2.4-3.9)[†]
National							
Boys	6789 (50.7)	12.3 (12.1-12.5)	102.7 (102.3-103.0)	65.5 (65.2-65.7)	1.2 (0.9-1.6)	3.6 (2.9-4.4)	4.5 (3.7-5.4)
Girls	6578 (49.3)	12.5 (12.3-12.7)	100.2 (99.8-100.5)	64.1 (63.8-64.3)	0.5 (0.3-0.9)	2.4 (1.8-3.3)	2.9 (2.2-3.8)
Urban	10100 (75.5)	12.8 (12.6-12.9)	102.6 (102.3-102.8)	65.4 (65.1-65.6)	1.0 (0.8-1.4)	3.1 (2.5-3.7)	3.8 (3.2-4.5)
Rural	3267 (24.5)	11.4 (11.1-11.7)	98.1 (97.6-98.5)	63.2 (62.8-63.5)	0.3 (0.1-0.6)	2.9 (1.9-4.5)	3.3 (2.2-4.9)
Total	13367 (100) (100% of study population)	12.4 (12.3-12.5)	101.5 (101.2-101.7)	64.8 (64.6-64.9)	0.9 (0.7-1.1)	3.0 (2.5-3.6)	3.7 (3.2-4.3)

[a]Mean (95% CI); [b]Prevalence (95% CI); [†]Significant difference ($P = 0.0048$); [‡]Significant difference ($P = 0.0018$). The difference between mean age and sex frequency was not significant between four regions ($P = 0.91$ and 0.68 respectively); The difference between living area frequency was significant between four regions ($P < 0.001$). CI = Confidence interval; CASPIAN = Childhood and adolescence surveillance and preventIon of adult noncommunicable disease; SBP = Systolic blood pressure; DBP = Diastolic blood pressure

have intermediate SES and show intermediate prevalence rates of HBP between four regions.

In our study, the central part of the country, which has the highest SES and is the most industrialized and urbanized region, had the lowest rate of HBP. The overall higher level of SES may contribute to a better health status through better education, attitude and practice of residents, and better health facilities.[17,18] On the other hand, the higher SES, could result in higher levels of BP through unhealthier lifestyle and environmental exposures. In this region, the overall effect has been toward the better health outcome. These can be explained by the interaction of SES, ethnic issues, environmental circumstances, as well as dietary and physical activity habits.[34,35] They need to be investigated through following region-specific studies.

Study strengths and limitations

It is a large-scale epidemiologic study which covers different age groups, genders, SESs and ethnicities of Iranian pediatric population recruited through random cluster sampling. It provides sufficient information to delineate present situation. However, it is a cross-sectional survey and has its expected limitations such as being unable to reveal causality relationships.

CONCLUSION

The relatively high prevalence rate of HBP in the pediatric population of some areas of Iran deserves more attention. Due to the complex nature of contributing factors, it is necessary to design and conduct complementary research projects specific to every region.

Appendix 1: The mean (95% CI) and prevalence rate of HBP (95% CI) in provincial level by sex and living area: The CASPIAN-IV study

Province	SBP (mmHg)	DBP (mmHg)	High DBP (%)	High SBP (%)	High SBP and/or DBP (%)
Eastern Azerbaijan					
Boys (*n*=247)	101.5 (97.2, 105.9)	63.2 (59.8, 66.7)	3.4 (1, 11.3)	2.5 (0.9, 7.2)	4.7 (1.7, 12.1)
Girls (*n*=235)	102.1 (98.2, 106.0)	65.5 (62.6, 68.5)	0.9 (0, 3.4)	0.9 (0.22, 3.4)	1.7 (0.5, 5.5)
Urban (*n*=393)	102.2 (98.8, 105.6)	64.6 (62.1, 67.0)	2.3 (0.8, 7.2)	1.8 (0.7, 4.7)	3.4 (1.4, 7.9)
Rural (*n*=89)	99.8 (95.1, 104.4)	63.3 (57.0, 69.6)	1.3 (0.2, 7.7)	1.3 (0.2, 7.7)	2.5 (0.4, 14.8)
Total (*n*=482)	101.8 (98.8, 104.8)	64.4 (62.1, 66.6)	2.1 (0.8, 6)	1.7 (0.7, 4.1)	3.2 (1.4, 7.1)
Western Azerbaijan					
Boys (*n*=238)	105.9 (102.5, 109.3)	66.7 (63.2, 70.3)	4.6 (0.8, 6)	2.1 (0.8, 5.4)	6.2 (2.1, 17.3)
Girls (*n*=238)	98.4 (95.2, 101.5)	64.6 (61.5, 67.6)	5.4 (1.8, 15.6)	0	5.4 (1.8, 15.6)
Urban (*n*=317)	102.1 (98.8, 105.4)	65.4 (62.1, 68.7)	6 (2, 16.7)	1.3 (0.4, 4)	6.9 (2.6, 16.9)
Rural (*n*=159)	102.3 (97.6, 107)	66.2 (62.9, 69.5)	3.1 (1, 9)	0.6 (0.1, 4.2)	3.7 (1.2, 11.2)
Total (*n*=476)	102.2 (99.4, 104.9)	65.7 (63.2, 68.1)	5 (2, 11.9)	1 (0.4, 2.9)	5.9 (2.6, 12.5)
Ardabil					
Boys (*n*=80)	101.0 (90.9, 111.2)	65(58.8, 71.2)	8.8 (2.4, 27.3)	5 (1.8, 13.2)	10 (3.3, 26.7)
Girls (*n*=137)	101.0 (96.3, 105.8)	62.3 (57.1, 67.5)	7.9 (3.7, 16.1)	0.7 (0.1, 4.2)	8.6 (4.2, 17)
Urban (*n*=177)	102.7 (97.3, 108.1)	64.0 (59.4, 68.6)	10.1 (5.3, 18.4)	2.2 (0.7, 6.6)	10.6 (5.7, 18.9)
Rural (*n*=40)	93.5 (87.2, 99.8)	60 (53.7, 66.3)	0	2.5 (0.4, 13.3)	2.5 (0.4, 13.3)
Total (*n*=217)	101.0 (96.2, 105.8)	63.3 (59.3, 67.3)	8.2 (4.2, 15.6)	2.3 (0.9, 5.8)	9.1 (4.9, 16.3)
Gilan					
Boys (*n*=259)	104.9 (101.2, 108.6)	62.9 (59.6, 66.2)	3.1 (0.9, 10.4)	2.7 (1, 7.4)	5.8 (2.213, 14.2)
Girls (*n*=220)	102.9 (99.8, 106)	61.5 (58.8, 64.2)	1.8 (0.6, 5.6)	0.5 (0.1, 3.1)	2.3 (0.8631, 5.9)
Urban (*n*=369)	104.2 (101.4, 107.0)	62.4 (59.9, 64.9)	3.2 (1.3, 7.9)	1.6 (0.5, 4.8)	4.9 (2.2, 10.6)
Rural (*n*=110)	103.3 (98.1, 108.4)	61.7 (57.3, 66.1)	0	1.8 (0.3, 11.3)	1.8 (0.3, 11.3)
Total (*n*=479)	104.0 (101.5, 106.5)	62.2(60.0, 64.4)	2.5 (1, 6.2)	1.7 (0.6, 4.3)	4.2 (1.9, 8.7)
Mazandaran					
Boys (*n*=236)	105.0 (100.7, 109.3)	67.2 (64.7, 69.7)	2.9 (1.4, 6.2)	2.5 (1, 6.5)	5 (2.5, 10.1)
Girls (*n*=232)	102.8 (99.2, 106.5)	64.4 (61.7, 67.1)	1.3 (0.2, 8.8)	0	1.3 (0.2, 8.8)
Urban (*n*=369)	104.9 (101.8, 108)	66.1 (64.2, 68.0)	1.6 (0.7, 3.9)	1.6 (0.6, 4.3)	3 (1.3, 6.5)
Rural (*n*=99)	100.3(92.7, 107.9)	64.7 (59, 70.5)	4 (0.6, 22.8)	0	4 (0.6, 22.8)
Total (*n*=468)	103.9 (101, 106.9)	65.8 (63.9, 67.8)	2.1 (0.8, 5.3)	1.3	3.2 (1.5, 6.8)
Golestan					
Boys (*n*=269)	96.1 (92, 100.2)	62.0 (58.9, 65.2)	1.5 (0.5, 4.6)	0	1.5 (0.5, 4.6)
Girls (*n*=210)	96.3 (93, 99.6)	59.5 (56.6, 62.4)	0	0	0
Urban (*n*=270)	97.0 (93, 101.1)	62.1 (59.3, 64.9)	0.7 (0.2, 2.8)	0	0.7 (0.2, 2.8)
Rural (*n*=209)	95.1 (91.4, 98.7)	59.4 (55.8, 63.0)	1 (0.1, 6.4)	0	1 (0.1, 6.4)
Total (*n*=479)	96.2 (93.4, 99)	60.9 (58.7, 63.2)	0.8 (0.3, 2.7)	0	0.8 (0.3, 2.7)
Northern Khorasan					
Boys (*n*=270)	100.6 (97.7, 103.6)	68.0 (64.5, 71.6)	12.2 (6.1, 22.9)	0	12.2 (6.1, 22.9)
Girls (*n*=205)	99.3 (95.1, 103.5)	63.3 (59.9, 66.6)	2.4 (0.8, 7.1)	1.5 (0.4, 5.8)	3.9 (1.7, 8.5)
Urban (*n*=349)	102.2 (99.2, 105.2)	68.4 (65.6, 71.2)	10 (5.1, 18.7)	0.9 (0.2, 3.6)	10.8 (5.8, 19.3)
Rural (*n*=126)	94.2 (91.3, 97.0)	59.2 (54.7, 63.7)	2.4 (0.6, 8.9)	0	2.4 (0.6, 8.9)
Total (*n*=475)	100.1 (97.5, 102.6)	66 (63.3, 68.6)	8 (4.2, 14.6)	0.6 (0.1, 2.7)	8.6 (4.7, 15.1)
Khorasan Razavi					
Boys (*n*=150)	102 (97.6, 106.4)	61.1 (58.2, 64.2)	1.3 (0.9, 2)	0	1.3 (0.9, 2)
Girls (*n*=300)	100 (97.3, 102.6)	62.4 (59.2, 65.6)	0.7 (0.1, 4.6)	0.3 (0, 2.3)	1 (0.2, 4.2)
Urban (*n*=350)	101.2 (98.4, 104.0)	62.7(59.9, 65.6)	1.1 (0.4, 3)	0	1.1 (0.4, 3)
Rural (*n*=100)	98.6 (95.5, 101.6)	59.4 (56.1, 62.7)	0	1 (0.1, 6.5)	1 (0.1, 6.5)
Total (*n*=450)	100.6 (98.3, 103)	62 (59.7, 64.3)	0.9 (0.3, 2.4)	0.2 (0, 1.6)	1.1 (0.5, 2.7)
Sistanvabaluchestan					
Boys (*n*=192)	98.3 (94.5, 102.0)	65.3 (60.6, 70.0)	9.9 (4, 22.7)	0	9.9 (4, 22.7)
Girls (*n*=233)	99.3 (96.0, 102.6)	69.7 (64.0, 75.4)	18.5 (10.4, 30.9)	0	18.5 (10.4, 30.8)
Urban (*n*=219)	100 (95.9, 104.0)	69 (63.4, 74.5)	13.7 (6.2, 27.7)	0	13.7 (6.2, 27.7)

(*continued*)

Appendix 1: (Continued)

Province	SBP (mmHg)	DBP (mmHg)	High DBP (%)	High SBP (%)	High SBP and/or DBP (%)
Rural (*n*=206)	97.7 (94.5, 100.9)	66.4 (60.9, 72)	15.4 (7.1, 30.1)	0	15.4 (7.1, 30.1)
Total (*n*=425)	98.8 (96.2, 101.4)	67.7 (63.8, 71.6)	14.6 (11.5, 18.3)	0	14.6 (11.5, 18.3)
Hormozgan					
Boys (*n*=142)	109.3 (101.6, 117)	70.1 (64.4, 75.7)	9.1 (3.6, 21.1)	2.8 (0.9, 8.1)	13.3 (6, 27)
Girls (*n*=126)	101.6 (96.1, 107.1)	62.7 (59.4, 66.1)	0.8 (0.1, 5.2)	0.8 (0.1, 5.2)	1.6 (0.4, 6)
Urban (*n*=129)	106.8 (98.3, 115.4)	68.3 (62.0, 74.6)	7.7 (2.2, 23.3)	1.5 (0.4, 5.3)	10 (3.136, 27.6)
Rural (*n*=139)	104.5 (98.3, 110.8)	65.1 (60.3, 69.8)	2.9 (1.2, 6.6)	2.1 (0.5, 8.3)	4.6 (0.9, 20.3)
Total (*n*=268)	105.7 (100.4, 110.9)	66.6 (62.7, 70.5)	5.2 (2.1, 12.3)	1.8 (0.7, 4.9)	7.8 (3.5, 16.5)
Bushehr					
Boys (*n*=249)	107.6 (104.2, 111)	71.1 (68, 74.3)	3.2 (0.9, 10.7)	0.8 (0.2, 2.9)	3.6 (1.2, 10.6)
Girls (*n*=216)	104.3 (101.4, 107.3)	66.2 (63.6, 68.9)	1.8 (0.6, 5.7)	0.5 (0.1, 3.1)	1.8 (0.6, 5.7)
Urban (*n*=427)	106.6 (104.1, 109.1)	68.7 (66.3, 71.1)	2.8 (1.1, 6.9)	0.7 (0.2, 2)	36 (1.3, 7)
Rural (*n*=38)	100.1 (91.2, 109.0)	70.4 (65, 75.8)	0	0	0
Total (*n*=465)	106.1 (103.6, 108.5)	68.8 (66.6, 71.1)	2.6 (1, 6.3)	0.6 (0.2, 1.9)	2.8 (1.2, 6.4)
Khoozestan					
Boys (*n*=222)	103.8 (99.7, 107.9)	62.6 (58.9, 66.2)	0.4 (0.1, 3.1)	1.8 (0.6, 5.6)	1.8 (0.6, 5.6)
Girls (*n*=198)	101.1 (97.2, 105)	65.8 (60.9, 70.7)	6.2 (1.2, 27)	0	6.2 (1.2, 27)
Urban (*n*=351)	103.1 (100.2, 106.1)	63.3 (59.9, 66.78)	0.9 (0.3, 2.4)	1.1 (0.4, 3.7)	1.7 (0.7, 4.1)
Rural (*n*=69)	100.1 (91.2, 109.0)	67.8 (57.1, 78.5)	14.5 (2, 58.8)	0	14.5 (2, 58.8)
Total (*n*=420)	102.5 (99.7, 105.3)	64.1 (60.6, 67.5)	3.1 (0.7, 13.5)	1 (0.3, 3.1)	3.9 (1.1, 13)
Ilam					
Boys (*n*=257)	105.6 (102.4, 108.7)	70.3 (67.5, 73.1)	3.5 (1.5, 7.6)	1.2 (2, 7.7)	4.6 (2.2, 9.6)
Girls (*n*=220)	101.4 (98.1, 104.8)	67.4 (63.9, 70.9)	5 (1.8, 12.9)	0.9 (0.1, 6.1)	5.9 (2.3, 14.1)
Urban (*n*=398)	104.0 (101.1, 107)	69.4 (66.6, 72.1)	4.5 (2.2, 8.9)	1.2 (0.3, 5)	5.8 (3.1, 10.6)
Rural (*n*=79)	101.8 (97.7, 106)	67 (63.1, 70.9)	2.5 (0.4, 14.7)	0	2.5 (0.4, 14.7)
Total (*n*=477)	103.7 (101.1, 106.2)	69 (66.6, 71.3)	4.2 (2.2, 7.9)	1 (0.3, 4.2)	5.2 (2.9, 9.3)
Kermanshah					
Boys (*n*=261)	103 (99.9, 106.0)	68.5 (66.1, 71)	2.7 (0.9, 7.3)	0.8 (0.2, 2.9)	3.8 (1.8, 7.9)
Girls (*n*=219)	101.3 (97.7, 105)	67 (64.6, 69.3)	0.9 (0.2, 3.4)	0.5 (0.1, 3.1)	1.4 (0.5, 3.9)
Urban (*n*=390)	103.3 (100.8, 105.9)	68.8 (66.9, 70.8)	2.1 (0.8, 5.2)	0.5 (0.1, 2)	2.8 (1.4, 5.7)
Rural (*n*=90)	97.4 (92.6, 102.1)	63.4 (60.9, 65.9)	1.1 (0.2, 6.9)	1.1 (0.2, 6.9)	2.2 (0.6, 7.4)
Total (*n*=480)	102.2 (99.9, 104.6)	67.8 (66.1, 69.6)	1.9 (0.7875, 4.398)	0.6 (0.2, 1.9)	2.7 (1.4, 5.1)
Kordestan					
Boys (*n*=262)	104.1 (100.6, 107.6)	66.7 (64.5, 68.9)	2.6 (0.934, 7.1)	2.5 (0.9, 5.8)	4.9 (2.3, 9.8)
Girls (*n*=209)	100.8 (98.4, 103.2)	64.29 (61.8, 66.6)	0.5 (0.1, 3.2)	0	0.5 (0.1, 3.2)
Urban (*n*=323)	105.2 (102.7, 107.8)	68.1 (66.4, 69.8)	2.1 (0.7, 5.9)	1.8 (0.7, 4.8)	3.9 (1.9, 8.2)
Rural (*n*=148)	96.9 (92.7, 101.2)	60.0 (57.0, 63.1)	0.7 (0.1, 4.4)	0	0.7 (0.1, 4.4)
Total (*n*=471)	102.6 (100.2, 105.1)	65.6 (63.7, 67.4)	1.7 (0.7, 4.3)	1.3 (0.5, 3.4)	2.9 (1.4, 5.9)
Hamedan					
Boys (*n*=239)	102.6 (98.9, 106.3)	67.4 (64.4, 70.5)	6.7 (3.3, 13.1)	1.7 (0.7, 4.1)	8 (4.4, 14.1)
Girls (*n*=230)	98.2 (95.1, 101.4)	66.1 (62.9, 69.3)	3.5 (1, 11.5)	0	3.5 (1, 11.5)
Urban (*n*=338)	103.9 (101.5, 106.4)	69.1 (66.9, 71.4)	5.3 (2.7, 10.1)	1.2 (0.5, 3)	6.2 (3.5, 11)
Rural (*n*=131)	91.5 (85.8, 97.2)	60.7 (55.5, 65.8)	4.5 (0.9, 20.3)	0	4.6 (0.9, 20.3)
Total (*n*=469)	100.5 (97.6, 103.4)	66.8 (64.3, 69.2)	5.1 (2.7, 9.5)	0.9 (0.3, 2.2)	5.8 (3.2, 10)
Zanjan					
Boys (*n*=192)	102.3 (97.3, 107.3)	64 (60.3, 67.7)	2.8 (1.1, 7)	0.5 (1, 3.6)	2.8 (1.1, 7)
Girls (*n*=251)	97.7 (95.1, 100.2)	62.1 (60.1, 64.2)	0.8 (0.2, 3)	0.4 (1, 2.7)	1.2 (0.4, 3.4)
Urban (*n*=279)	101.0 (97.4, 104.6)	62.5 (60.1, 64.8)	1.9 (0.7, 4.9)	0.7 (0.2, 2.8)	2.2 (1, 5.17)
Rural (*n*=164)	97.4 (92.5, 102.2)	63.6 (59.5, 67.7)	1.2 (0.3, 4.4)	0	1.2 (0.3, 4.4)
Total (*n*=443)	99.6 (96.7, 102.6)	62.9 (60.8, 65.1)	1.6 (0.7, 3.5)	0.5 (0.1, 1.8)	1.8 (0.9, 3.8)
Markazi					
Boys (*n*=277)	102.7 (98.5, 106.9)	68.6 (65.9, 71.3)	2.9 (1.3, 6.1)	1.8 (0.6, 5.4)	3.9 (2, 7.7)
Girls (*n*=199)	101.4 (97.9, 104.8)	66.1 (63.3, 68.9)	2 (0.6, 6)	0.5 (0.1, 3.4)	2 (0.7, 6)

(*continued*)

Appendix 1: (Continued)

Province	SBP (mmHg)	DBP (mmHg)	High DBP (%)	High SBP (%)	High SBP and/or DBP (%)
Urban (*n*=367)	103.2 (99.9, 106.5)	68.7 (66.3, 71.0)	3 (1.5, 5.7)	1.6 (0.6, 4.3)	3.8 (2, 6.9)
Rural (*n*=109)	98.5 (92.3, 104.8)	63.9 (60.2,67.6)	0.9 (0.1,5.9)	0	0.9 (0.1, 5.9)
Total (*n*=476)	102.1 (99.2, 105.1)	67.6 (65.5, 69.6)	2.5 (1.3, 4.7)	1.3 (0.5, 3.4)	3.1 (1.7, 5.6)
Qazvin					
Boys (*n*=241)	101.7 (96.8, 106.6)	65.2 (61.6, 68.7)	3.8(1.9, 7.5)	1.7 (0, 1.5)	5 (2.7, 9.3)
Girls (*n*=238)	97.1 (93.9, 100.2)	62.4 (60.1, 64.7)	2.5(0.8, 8.1)	0	2.5 (0.8, 8.1)
Urban (*n*=359)	99.7 (95.9, 103.6)	63.2 (63.2, 65.9)	2.5 (1.2, 5.1)	1.1 (0.3, 3.5)	3.4 (1.7, 6.4)
Rural (*n*=120)	98.3 (95.6, 101.1)	65.6 (62.6, 68.7)	5 (1.3, 18.2)	0	5 (1.3, 18.2)
Total (*n*=479)	99.4 (96.4, 96.4)	63.8 (61.7, 66)	3.1 (1.6, 6.3)	0.8 (0.3, 2.7)	3.8 (2, 7)
Qom					
Boys (*n*=235)	109.0 (105.5, 112.5)	69.8 (67.3, 72.3)	10.5 (6.2, 17.1)	2.5 (1.1, 5.7)	11.3 (6.8, 18.1)
Girls (*n*=239)	99.6 (97.3, 102.0)	62.8 (60.4, 65.3)	0.4 (0.1, 2.9)	1.3 (0.4, 3.6)	1.7 (0.5, 5.2)
Urban (*n*=454)	104.4 (101.9, 106.9)	66.3 (64.3, 68.4)	5.5 (3.1, 9.5)	1.8 (0.8, 3.6)	6.3 (3.8, 10.4)
Rural (*n*=20)	101.7 (89.6, 113.9)	66.2 (59.0, 73.5)	5 (1.2, 18.7)	5 (1.2, 18.7)	10 (2.3, 34.5)
Total (*n*=474)	104.3 (101.9, 106.8)	66.3 (64.3, 68.3)	5.4 (3.1, 9.3)	1.9 (1, 3.7)	6.5 (4, 10.5)
Tehran					
Boys (*n*=238)	101.9 (98.3, 105.4)	62.7 (59.4, 66)	1.3 (0.3, 5.2)	0.8 (0.1, 5.6)	1.7 (0.4, 7.4)
Girls (*n*=229)	100.6 (97.2, 104)	66.1 (63.4, 68.8)	1.3 (0.5, 3.8)	0.9 (0.3, 3.3)	2.2 (1, 4.7)
Urban (*n*=447)	101.1 (98.5, 103.7)	64.3 (62, 66.7)	1.3 (0.5, 3.3)	0.9 (0.3, 2.9)	2 (0.9, 4.5)
Rural (*n*=20)	104.5 (96.9, 112.1)	65 (59.4, 70.5)	0	0	0
Total (*n*=467)	101.2 (98.7, 103.8)	64.4 (62.1, 66.6)	1.3 (0.5, 3.1)	0.9 (0.3, 2.8)	1.9 (0.9, 4.3)
Semnan					
Boys (*n*=236)	102.7 (98.5, 106.9)	62.7 (59.4, 66.1)	0.9 (0.1, 5.6)	1.3 (0.3, 5.1)	1.2 (0.3, 5.1)
Girls (*n*=239)	102.4 (98.8, 106.0)	65.3 (63, 67.6)	0.4 (0.1, 2.9)	1.3 (0.2, 8.3)	1.7 (0.4, 7.4)
Urban (*n*=406)	103.4 (100.4, 106.4)	64 (61.6, 66.3)	0.7 (0.2, 3.1)	1.5 (0.5, 4.8)	1.7 (0.6, 4.9)
Rural (*n*=69)	97.6 (91.1, 91.2)	64.2 (60.1, 68.3)	0	0	0
Total (*n*=475)	102.6 (99.8, 105.3)	64.0 (61.9, 66.1)	0.6 (0.2, 2.6)	1.3 (0.4, 4.1)	1.5 (0.5, 4.2)
Isfahan					
Boys (*n*=261)	103.4 (99.0, 107.8)	64.9 (62.4, 67.4)	3 (1.3, 7)	1.9 (0.6, 5.8)	3.8 (1.7, 8.3)
Girls (*n*=217)	104.1 (100.6, 107.6)	66 (63.4, 68.6)	5 (1.9, 13)	5.5 (1.8, 15.4)	7.8 (3.4, 17.1)
Urban (*n*=390)	104.0 (100.6,107.5)	65.5 (63.3, 67.6)	3.6 (1.5, 8.2)	4.3 (1.9, 9.8)	5.6 (2.8, 11.2)
Rural (*n*=88)	102.5 (99, 106)	64.9 (61.8, 67.9)	5.5 (2, 1.2)	0	5.5 (2, 1.2)
Total (*n*=478)	103.7 (100.9, 106.6)	65.4 (63.5, 67.2)	4 (2, 7.6)	3.5 (1.5, 8.1)	5.6 (3, 10.1)
Yazd					
Boys (*n*=277)	97.4 (93.5, 101.4)	59.1 (56.4, 61.8)	0.4 (0.1, 2.5)	0.4 (0, 2.5)	0.4 (1, 2.5)
Girls (*n*=199)	98.5 (95.4, 101.7)	60.2 (58.2, 62.3)	0	0	0
Urban (*n*=416)	99.2 (96.7, 101.8)	60.3 (58.6, 62)	0.2 (0, 1.7)	0.2 (0, 1.7)	0.2 (0, 1.7)
Rural (*n*=60)	88.8 (80.7, 97.0)	54.7 (47.9, 61.4)	0	0	0
Total (*n*=476)	97.9 (95.3, 100.6)	59.6 (57.8, 61.4)	0.2 (0, 1.5)	0.2 (0.0293, 1.5)	0.2 (0, 1.5)
Kerman					
Boys (*n*=199)	100.1 (96.2, 103.9)	62.0 (58.9, 65.2)	0	0.5 (0.1, 3.3)	0.5 (0.1, 3.3)
Girls (*n*=252)	98.4 (95.2, 101.6)	63 (60.8, 65.2)	1.2 (0.2806, 4.795)	0.8 (0.2, 3)	1.2 (0.3, 4.8)
Urban (*n*=285)	102.3 (99.5, 105.0)	64 (61.5, 66.5)	1 (0.3, 4.3)	1 (0.3, 3.1)	1.4 (0.4, 4.4)
Rural (*n*=166)	93.8 (90, 97.7)	60.2 (57.6, 62.7)	0	0	0
Total (*n*=451)	99.1 (96.6, 101.7)	62.6 (60.7, 64.5)	0.6 (0.2, 2.8)	0.7 (0.2, 2)	0.9 (0.3, 2.8)
Fars					
Boys (*n*=202)	100.8 (97.1, 104.6)	64.7 (61.5, 67.9)	1 (0.3, 3.6)	0.5 (1, 3.3)	1.5 (0.5, 4.1)
Girls (*n*=273)	100.7 (98.4, 103.3)	65.5 (63.5, 67.5)	0.4 (0.1, 2.5)	0	0.4 (0.1, 2.5)
Urban (*n*=347)	100.9 (98.1, 103.6)	64.9 (62.9, 66.8)	0.9 (0.3, 2.6	0.3 (0, 2)	1.1 (0.5, 2.9)
Rural (*n*=128)	100.8 (98, 103.6)	65.9 (61.9, 69.9)	0	0	0
Total (*n*=475)	100.8 (98.7, 103)	65.2 (63.4, 66.9)	0.6 (0.267, 1.9)	0.2 (0, 1.5)	0.9 (0.3, 2.1)
Kohgilouyeh					
Boys (*n*=201)	101.6 (97.7, 105.5)	66.5 (62.9, 70.1)	3 (1.3, 6.8)	0.5 (0.1, 3.4)	3 (1.3, 6.8)

(*continued*)

Appendix 1: (Continued)

Province	SBP (mmHg)	DBP (mmHg)	High DBP (%)	High SBP (%)	High SBP and/or DBP (%)
Girls (*n*=247)	97.9 (95.5, 100.2)	62.5 (60.2, 64.9)	1.2 (0.3, 4.9)	0	1.2 (0.3, 4.9)
Urban (*n*=289)	100.2 (97.3, 103.2)	64.8 (62.0, 67.6)	2.7 (1.3, 6)	0.3 (0.1, 2.4)	2.8 (1.3, 6)
Rural (*n*=159)	98.3 (94.8, 101.8)	63.4 (60, 66.9)	0.6 (0.1, 4.2)	0	0.6 (1, 4.2)
Total (*n*=448)	99.5 (97.3, 101.8)	64.3 (62.1, 66.5)	2 (1, 4.2)	0.2 (.,1.6)	2 (1, 4.2)
Lorestan					
Boys (*n*=128)	95.8 (93.0, 98.7)	62.0 (58.5, 65.6)	1.6 (0.4, 5.6)	0.8 (0.1, 5.2)	2.3 (0.9, 6.3)
Girls (*n*=99)	94.0 (88.5, 99.5)	62.4 (56.3, 68.6)	2 (0.6, 6.4)	0	2 (0.6, 6.4)
Urban (*n*=168)	96.3 (92.9, 99.7)	63.1 (59.6, 66.6)	0.6 (0.1, 3.7)	0.6 (1, 4.1)	1.2 (0.3, 4.2)
Rural (*n*=59)	91.5 (86.4, 96.5)	59.7 (51.8, 67.5)	5 (1.9, 12.5)	0	5 (1.9, 12.5)
Total (*n*=227)	95.0 (92.0, 98.0)	62.2 (58.8, 65.6)	1.8 (0.6, 5)	0.4 (1, 3.1)	2.2 (0.9, 5.3)
Chaharmahal and Bakhtiari					
Boys (*n*=268)	106.7 (103.6, 109.8)	68.8 (65.2, 72.5)	4.4 (1.7, 11.4)	0.4 (0.1, 2.6)	4.4 (1.7, 11.4)
Girls (*n*=207)	98.6 (95.1, 102.1)	59.7 (56, 63.4)	,5 (0.1, 3.2)	0	1 (0.3, 3.5)
Urban (*n*=331)	105.6 (102.9, 108.3)	66.1 (62.5, 69.6)	2.1 (0.6, 7.1)	0	2.4 (0.8, 7.1)
Rural (*n*=144)	97.5 (92.4, 102.7)	62.1 (56.6, 67.5)	4.1 (1, 15.3)	0.7 (1, 4.5)	4.1 (1, 15.3)
Total (*n*=475	103.1 (100.5, 105.8)	64.8 (61.8, 67.8)	2.7 (1.1, 6.8)	0.2 (0, 1.5)	2.9 (1.2, 6.9)
Alborz					
Boys (*n*=231)	102.8 (100.0, 105.5)	64.2 (61.7, 66.6)	1.7 (0.7, 4.3)	0	1.7 (0.7, 4.3)
Girls (*n*=247)	102.4 (99.9, 104.9)	65.4 (63.4, 67.3)	2 (0.9, 4.4)	0.4 (1, 2.8)	2.4 (1.2, 4.8)
Urban (*n*=369)	102.9 (100.6, 105.2)	65.7 (63.9, 67.5)	2.1 (1.2, 4)	0.3 (0, 1.9)	2.4 (1.4, 4.3)
Rural (*n*=108)	101.4 (98.6, 104.3)	61.6 (58.9, 64.3)	0.9 (0.1, 5.8)	0	0.9 (0.1, 5.8)
Total (*n*=477)	102.6 (100.7, 104.4)	64.8 (63.2, 66.4)	1.9 (1, 3.4)	0.2 (0, 1.5)	2.1 (1.2, 3.6)

CI = Confidence interval; CASPIAN = Childhood and Adolescence Surveillance and Preventlon of Adult Noncommunicable Disease; SBP = Systolic blood pressure; DBP = Diastolic blood pressure; HBP = High blood pressure

Acknowledgments

The national surveillance protocol was approved by Isfahan University of Medical Sciences under the registration code 188092. This study was conducted as part of the National Surveillance Program funded by Ministry of Health and Medical Education of Iran. The authors would like to thank the large team working with the study in different cities and all participating students and their parents, their schools staff and all relevant administrators.

Financial support and sponsorship

The work has been done with the financial support of the ministry of Health of Iran.

Conflicts of interest

There are no conflicts of interest.

AUTHOR'S CONTRIBUTION

ZF: Contributions to concept/design, data interpretation, drafting of the manuscript, critical revision of the manuscript and approval of the article. RK: Contributions to concept/design, acquisition of data, data interpretation, drafting of the manuscript, critical revision of the manuscript and approval of the article. MEM, GA, RH: Contributions to concept/design, critical revision of the manuscript and approval of the article. AK, HA: Contributions to concept/design, data analysis/interpretation, critical revision of the manuscript and approval of the article. MQ: Contributions to concept/design, data analysis/interpretation, drafting of the manuscript, critical revision of the manuscript and approval of the article.

REFERENCES

1. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, *et al.* A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2224-60.
2. Falkner B. Hypertension in children and adolescents: Epidemiology and natural history. Pediatr Nephrol 2010;25:1219-24.
3. Kelishadi R. Childhood overweight, obesity, and the metabolic syndrome in developing countries. Epidemiol Rev 2007;29:62-76.
4. Kelishadi R, Poursafa P, Keramatian K. Overweight, air and noise pollution: Universal risk factors for pediatric pre-hypertension. J Res Med Sci 2011;16:1234-50.
5. Barker DJ, Winter PD, Osmond C, Margetts B, Simmonds SJ. Weight in infancy and death from ischaemic heart disease. Lancet 1989;2:577-80.
6. Bucher BS, Tschumi S, Simonetti GD. Childhood's determinants for high blood pressure in adulthood. Ther Umsch 2012;69:295-8.
7. Miersch A, Vogel M, Gausche R, Siekmeyer W, Pfäffle R, Dittrich K, *et al.* Blood pressure tracking in children and adolescents. Pediatr Nephrol 2013;28:2351-9.
8. Chen X, Wang Y. Tracking of blood pressure from childhood to adulthood: A systematic review and meta-regression analysis. Circulation 2008;117:3171-80.
9. Camhi SM, Katzmarzyk PT. Tracking of cardiometabolic risk

factor clustering from childhood to adulthood. Int J Pediatr Obes 2010;5:122-9.
10. Virdis A, Ghiadoni L, Masi S, Versari D, Daghini E, Giannarelli C, *et al.* Obesity in the childhood: A link to adult hypertension. Curr Pharm Des 2009;15:1063-71.
11. Wolf-Maier K, Cooper RS, Banegas JR, Giampaoli S, Hense HW, Joffres M, *et al.* Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. JAMA 2003;289:2363-9.
12. Neupane D, McLachlan CS, Sharma R, Gyawali B, Khanal V, Mishra SR, *et al.* Prevalence of hypertension in member countries of South Asian Association for Regional Cooperation (SAARC): Systematic review and meta-analysis. Medicine (Baltimore) 2014;93:e74.
13. Su Z, Cheng H, Zhao D, Duan J, Wang L, Hou D, *et al.* Dietary habits of school-age children and its associations with blood pressure level in Beijing, China. Zhonghua Yu Fang Yi Xue Za Zhi 2014;48:340-4.
14. Poursafa P, Mansourian M, Motlagh ME, Ardalan G, Kelishadi R. Is air quality index associated with cardiometabolic risk factors in adolescents? The CASPIAN-III study. Environ Res 2014;134:105-9.
15. Jankovic S, Stojisavljevic D, Jankovic J, Eric M, Marinkovic J. Association of socioeconomic status measured by education, and cardiovascular health: A population-based cross-sectional study. BMJ Open 2014;4:e005222.
16. Busingye D, Arabshahi S, Subasinghe AK, Evans RG, Riddell MA, Thrift AG. Do the socioeconomic and hypertension gradients in rural populations of low- and middle-income countries differ by geographical region? A systematic review and meta-analysis. Int J Epidemiol 2014;43:1563-77.
17. Leng B, Jin Y, Li G, Chen L, Jin N. Socioeconomic status and hypertension: A meta-analysis. J Hypertens 2015;33:221-9.
18. Voss LD, Hosking J, Metcalf BS, Jeffery AN, Frémeaux AE, Wilkin TJ. Metabolic risk in contemporary children is unrelated to socio-economic status: Longitudinal study of a UK urban population (Early Bird 42). Pediatr Diabetes 2014;15:244-51.
19. Farzadfar F, Danaei G, Namdaritabar H, Rajaratnam JK, Marcus JR, Khosravi A, *et al.* National and subnational mortality effects of metabolic risk factors and smoking in Iran: A comparative risk assessment. Popul Health Metr 2011;9:55.
20. Motlagh ME, Kelishadi R, Ardalan G, Gheiratmand R, Majdzadeh R, Heidarzadeh A, *et al*. Rationale, methods and first results of the Iranian national programme for prevention of chronic diseases from childhood: CASPIAN study. East Mediterr Health J 2009;15:302-14.
21. Kelishadi R, Ardalan G, Qorbani M, Ataie-Jafari A, Bahreynian M, Taslimi M, *et al*. Methodology and early findings of the fourth survey of Childhood and Adolescence Surveillance and PreventIon of Adult Non-communicable Disease in Iran: The CASPIAN-IV study. Int J Prev Med 2013;4:1451-60.
22. Fallah Z, Qorbani M, Motlagh ME, Heshmat R, Ardalan G, Kelishadi R. Prevalence of prehypertension and hypertension in a nationally representative sample of Iranian children and adolescents: The CASPIAN-IV study. Int J Prev Med 2014;5 Suppl 1:S57-64.
23. Kelishadi R, Majdzadeh R, Motlagh ME, Heshmat R, Aminaee T, Ardalan G, *et al.* Development and evaluation of a questionnaire for assessment of determinants of weight disorders among children and adolescents: The Caspian-IV study. Int J Prev Med 2012;3:699-705.
24. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics 2004;114 2(Suppl):555-76.
25. R Core Team. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. Vienna, Austria; 2013. Available from: http://www.R-project.org/ [Last accessed on 2015 Jul 01].
26. Hamano T, Kimura Y, Takeda M, Yamasaki M, Nabika T, Shiwaku K. Is location associated with high risk of hypertension? Shimane COHRE study. Am J Hypertens 2012;25:784-8.
27. Merlo J, Ostergren PO, Hagberg O, Lindström M, Lindgren A, Melander A, *et al.* Diastolic blood pressure and area of residence: Multilevel versus ecological analysis of social inequity. J Epidemiol Community Health 2001;55:791-8.
28. Ejike CE, Ugwu CE, Ezeanyika LU, Olayemi AT. Blood pressure patterns in relation to geographic area of residence: A cross-sectional study of adolescents in Kogi state, Nigeria. BMC Public Health 2008;8:411.
29. Ying-Xiu Z, Gui-Zhi S, Jin-Shan Z, Ming L, Zun-Hua C. Monitoring of blood pressure among children and adolescents in a coastal province in China: Results of a 2010 survey. Asia Pac J Public Health 2015;27:NP1529-36.
30. Yip W, Wong TY, Jonas JB, Zheng Y, Lamoureux EL, Nangia V, *et al.* Prevalence, awareness, and control of hypertension among Asian Indians living in urban Singapore and rural India. J Hypertens 2013;31:1539-46.
31. Yang S, Liu S, Wang Y, Wan H, Zhao D, Li Y, *et al.* High blood pressure in Chinese ethnic minorities: Report from rural Yunnan province. Am J Hypertens 2011;24:1209-14.
32. Hajjar I, Kotchen T. Regional variations of blood pressure in the United States are associated with regional variations in dietary intakes: The NHANES-III data. J Nutr 2003;133:211-4.
33. Kershaw KN, Diez Roux AV, Carnethon M, Darwin C, Goff DC Jr, Post W, *et al.* Geographic variation in hypertension prevalence among blacks and whites: The multi-ethnic study of atherosclerosis. Am J Hypertens 2010;23:46-53.
34. Messiah SE, Arheart KL, Lopez-Mitnik G, Lipshultz SE, Miller TL. Ethnic group differences in cardiometabolic disease risk factors independent of body mass index among American youth. Obesity (Silver Spring) 2013;21:424-8.
35. Stabouli S, Papakatsika S, Kotsis V. The role of obesity, salt and exercise on blood pressure in children and adolescents. Expert Rev Cardiovasc Ther 2011;9:753-61.