Pediatric hypertension in the Eastern Province of Saudi Arabia

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ABSTRACT

الأهداف: وصف مستوى ضغط الدم لدى البنين والبنات في المنطقة الشرقية بالمقارنة مع القيم المرجعية للأطفال السعوديين، كما هدفت الدراسة إلى مقارنة قيم ضغط الدم بين أفراد العينة الحالية بناء على العمر والجنس.

الطريقة: أُجريت هذه الدراسة المقطعية في القطيف والأحساء، المنطقة الشرقية، المملكة العربية السعودية وذلك خلال الفترة من أبريل إلى مايو 2014م. وشملت عينة الدراسة على 146 طالب وطالبة من طلاب المرحلة المتوسطة والثانوية. ولقد قام أفراد فريق الحملة الصحية بقياس الوزن ومستوى الجلوكوز العشوائي في الدم وضغط الدم وذلك في الصباح الباكر أثناء اليوم الدراسي.

النتائج: أوضحت نتائج الدراسة بأن ضغط الدم الانقباضي لدى 30% من عينة الدراسة قد كان أكثر من أو يعادل 140 مم زئبقي، فيما كان ضغط الدم الانبساطي لدى 22% أكثر من أو يعادل 90 مم زئبقي. وبلغ ضغط الدم الانقباضي لدى فتيات العينة الحالية بين عمر 16–13 أكثر من 95% من القيم المرجعية للأطفال السعوديين. وعند تقسيم أفراد العينة تبعا للجنس والمرحلة الدراسية (متوسط وثانوي)، أوضح تحليل التباين الأحادي وجود فروق ذات دلالة إحصائية في معدل الضغط الدم الانقباضي بين البنين في المرحلة المتوسطة(127±2.5) مم زئبقي وأولئك في المرحلة الثانوية (136±2.1) مم زئبقي (p<0.05)، وكذلك بين البنين والبنات في المرحلة المتوسطة (138±1.6) مم زئبقي (p<0.01).

الخاتمة: توصي الدراسة الحالية إلى أهمية إجراء مزيد من القياسات والدراسات في بعض المناطق في المملكة والتي قد تختلف قيمها عن قيم ضغط الدم المرجعية للأطفال السعوديين. كما ونوصي بتنفيذ برامج لتصحيح أسلوب الحياة في مدارس البنات.

Objectives: To compare the levels of blood pressure (BP) between male and female adolescents in the Eastern Province of Saudi Arabia and reference percentiles for Saudi adolescents. A secondary aim was to explore the distribution of BP among the participants based on age and gender.

Methods: This cross-sectional study was conducted among 146 boys and girls attending intermediate and secondary schools in 2 regions (Al-Mallaha and Al-Mubarraz) in the Eastern Province of Saudi Arabia. Weight, random blood glucose, and BP were collected by a team of health educators in the morning of the school day between April and May 2014.

Results: Of the current sample of adolescents originally from the Eastern Province, 30% had systolic blood pressure (SBP) of ≥140 mm Hg and 22% had diastolic blood pressure of ≥90 mm Hg. For girls between 13 and 16 years old, the SBP was greater than the 95th percentile of Saudi national norms. Participants were classified by gender and school stage, and one-way analysis of variance showed significant differences in the means of SBP between intermediate boys (127±2.5 mm Hg) and secondary boys (136±2.1 mm Hg) ($p<0.05$), and between intermediate boys and intermediate girls (138±1.6 mm Hg) ($p<0.01$).

Conclusion: The increased level of BP among adolescents originally from the Eastern Province raises the need to update the current BP nomograms, considering possible differences for specific geographic areas across the country. Implementing therapeutic life style management in girls' schools is recommended.

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Hypertension is the first risk factor for cardiovascular disease, and causes renal and central nervous system morbidity and mortality. The increased prevalence of pediatric hypertension is associated with increased cardiovascular risk factors among adolescents and adults.[1] Pediatric hypertension can cause progressive tissue damage including heart, kidney, brain, and eye. This can lead to severe complications, including heart failure, pulmonary edema, stroke, and renal failure.[2] Pediatric hypertension is considered an increasing problem in Saudi Arabia. A large national study[3] that selected 16,226 children and adolescents in the 13 regions of Saudi Arabia showed that blood pressure (BP) rose steadily with age in both boys and girls. The average annual increase in systolic blood pressure (SBP) was 1.66 mm Hg for boys and 1.44 mm Hg for girls while the average annual increase in diastolic blood pressure (DBP) was 0.83 mm Hg for boys and 0.77 mm Hg for girls.[3] Understanding regional pediatric hypertension can help to explore causational factors of increasing pediatric hypertension in Saudi Arabia. For example, the south western region of Saudi Arabia is a high-altitude region that may contribute to childhood overweight and obesity.[4] Data from this province confirmed a high level of BP among 1,869 adolescents.[5] Furthermore, this study attributed the increase in hypertension to regional factors as well as familial and behavioral factors. The Eastern Province of Saudi Arabia is a coastal region, and approximately 2-27% of the original population in this region, mainly in Al-Qatif and Al-Hasa, may carry the gene of sickle cell disease (SCD). Of these, up to 1.4% were diagnosed with this disease.[6] Sickle cell disease has no direct effect on systemic hypertension although DBP for subjects with SCD was significantly higher compared with healthy subjects.[7] Additionally, a large study observing 195,874 adults found that the prevalence of obesity in the Eastern Province is very high, which meaningfully explained increased hypertension.[8] Several studies also found a high obesity rate among children, adolescents, and young female adults in the Eastern Province of Saudi Arabia,[9,10] which could increase the predisposition for hypertensive conditions among young people. Regional factors may explain the diversity of levels of BP among Saudi children and adolescents. Thus, the aim of this study was to investigate the prevalence of hypertension among boys and girls who attended intermediate and secondary schools in 2 regions (Al-Qatif and Al-Hasa) in the Eastern Province of Saudi Arabia, in comparison with the Saudi reference norms of BP in children and adolescents.

Disclosure. The author has no conflict of interests, and the work was not supported or funded by any drug company.

Methods. The Health Screening Program was conducted by the Saudi Diabetes and Endocrine Association (SDEA) and included several campaigns targeting schools and industrial companies in the Eastern Province of Saudi Arabia. The campaign permission was arranged by the office of the General Secretary, and the study design and ethical approval were revised according to the principles of the Helsinki Declaration. This study was approved by the Scientific Committee of the SDEA, Al-Khobar, Saudi Arabia.

The school screening program is one of these campaigns, which commenced in Al-Qatif (the town of Al-Mallaha) in the Eastern Province of Saudi Arabia. The campaign began with a lecture conducted in the town's social centre on the 6th of April 2014. On April 8-10, the health educators' team of the SDEA conducted a cross-sectional diabetes screening campaign for students at a combined, intermediate and secondary, girls' school and a combined, intermediate and secondary, boys' school. The measurements included weight, BP, and blood glucose. The total boys and girls in these schools were 191 students. Another similar campaign commenced in the following month starting on the 5th of May at secondary boys' school in Al-Mubarraz in Al-Hasa. All students were invited, and consent forms were sent to their parents or guardians. A simple random sampling was carried out when students agreed to participate on the study measures.

Based on the criteria of the current study, the sample size was 146 students consisting of 72 boys and 74 girls, which was excerpted from the database of the School Screening Program (**Table 1**). Selection criteria were as follows: age 13-18 years old; not being diagnosed with any of 3 metabolic risks including triglycerides, BP, and fasting glucose identified according to the ATPIII panel identification,[11] or being under treatments for these metabolic risks; being a non-smoker; and not being diagnosed with kidney failure or heart diseases. All participants were seated in an air-conditioned hall and had 3-5 minutes of rest preceding the measurement. The BP was measured in a sitting position with the arm supported at heart level, using an electronic sphygmomanometer and an appropriately sized cuff. The cuff was wrapped around the arm smoothly allowing 2 fingers to be placed under the cuff comfortably. The SBP and DBP were recorded digitally, and values appeared on the screen. While old oscillometric devices overestimated BP,[12] some newer models produce values equivalent to mercury sphygmomanometry.[13] Electronic devices using oscillometric techniques (Omron M3W; HEM-7202-E, OMRON Healthcare Co., Ltd, Kyoto, Japan) were used in the study. This model is recommended to use at rest according to the European Society of Hypertension International Protocol revision 2010.[14] In addition, automated oscillometric devices were used in the latest national study of BP in Saudi Arabian children and adolescents.[3]

According to the Saudi Hypertension Management Society (SHMS),[15] the BP of the participants was classified into 3 categories: normal (SBP <120 mm Hg and DBP <80 mm Hg), prehypertension (SBP 120-139 mm Hg and/or DBP 80-90 mm Hg), and hypertension (SBP ≥140 mm Hg and/or DBP ≥90 mm Hg). The BP of the participants, based on age between 13 and 18 years old and gender, was also compared with the Saudi Standard Reference Nomogram.[3]

Statistical analysis was performed by the IBM SPSS Statistics for Windows version 20.0 (IBMCorp, Armonk, NY, USA). Values were expressed as means ±SEM and/or as percentages. Means of BP across groups classified by gender and school age, and gender were compared by the Student's t-test. A mixed linear model Analysis of Variance was used to assess the interaction between age and gender. Metabolic variables (weight and blood glucose) were added as a fixed factor to the analysis. Post-hoc analyses were conducted on significant interactions using Tukey's range test. The limit of statistical significance was set at $p<0.05$.

Table 1 - The distribution of participants in the pediatric blood pressure study in the Eastern Province of Saudi Arabia, based on age and gender.

School level	Age (years)	Gender		Total
		Boys	Girls	
Intermediate school	13	8	17	25
	14	9	17	26
	15	19	15	34
Secondary school	16	13	4	17
	17	18	9	27
	18	5	12	17
Total		72	74	**146**

Results. **Table 2** shows the comparison of BP for the participants based on age and gender with percentiles of Saudi standard reference nomogram. It shows that values of SBP and DBP for all participants were approximately 90th percentile, and SBP for boys age 16 and 18 and girls ages 13-17 were equal to or greater than the 95th percentile.

Table 3 shows the classification of BP for participants based on an adult standard that classifies individuals as normal, prehypertension, and hypertension. It shows that SBP was at a pre-hypertensive level in 53% of participants, and at a hypertensive level in 29%. The DBP was at a level of prehypertension in 32% and

Table 2 - The rate of blood pressure for participants based on age and gender, compared with percentiles of Saudi standard reference normogram.[3]

Age (years)	Boys					Girls				
	Current	50th	75th	90th	95th	Current	50th	75th	90th	95th
SBP										
13	125	113	119	125	129	140	113	121	127	131
14	122	114	120	127	131	136	114	122	128	132
15	130	116	122	129	132	138	115	123	129	133
16	134	118	124	130	134	136	116	124	130	134
17	136	120	126	133	137	135	117	124	131	135
18	145	123	129	135	139	130	118	125	132	136
DBP										
13	78	68	74	80	83	80	69	75	80	83
14	77	69	75	80	84	78	69	75	80	84
15	81	70	76	81	84	88	69	75	81	84
16	77	70	76	82	85	84	70	76	81	85
17	80	71	77	82	86	83	70	76	82	85
18	72	72	78	83	89	82	71	77	83	86

BP - blood pressure, SBP - systolic blood pressure, DBP - diastolic blood pressure

Table 3 - Classification of blood pressure for boys and girls in intermediate and secondary schools in the Eastern Province of Saudi Arabia, based on absolute values (n=146).

Classification of BP (mm Hg)	Boys			Girls			General total
	Intermediate school	Secondary school	Total	Intermediate school	Secondary school	Total	
Systolic blood pressure							
<120	13 (36)	7 (19)	**20 (28)**	2 (4)	4 (16)	**6 (8)**	**26 (18)**
120-139	14 (39)	18 (50)	**32 (44)**	31 (63)	14 (56)	**45 (61)**	**77 (53)**
≥140	9 (25)	11 (31)	**20 (28)**	16 (33)	7 (28)	**23 (31)**	**43 (29)**
Diastolic blood pressure							
<80	18 (50)	16 (44)	**34 (47)**	26 (53)	7 (28)	**33 (45)**	**67 (46)**
80-89	9 (25)	14 (39)	**23 (32)**	12 (25)	12 (48)	**24 (32)**	**47 (32)**
≥90	9 (25)	6 (17)	**15 (21)**	11 (22)	6 (24)	**17 (23)**	**32 (22)**
Normal							
<120 and <80	11 (31)	3 (8)	**14 (19)**	2 (4)	3 (12)	**5 (7)**	**19 (13)**
Prehypertension							
120-139 and/or 80-89	11 (31)	14 (39)	**25 (35)**	24 (49)	11 (44)	**35 (47)**	**60 (41)**
Hypertension							
≥140 and/or ≥90	14 (39)	19 (53)	**33 (46)**	23 (47)	11 (44)	**34 (46)**	**67 (46)**

Data are expressed as number and percentage (%)

Table 4 - Metabolic characteristics of participants in the pediatric blood pressure study in the Eastern Province of Saudi Arabia (n=146).

Age (years)	Boys				Girls			
	SBP (mm Hg)	DBP (mm Hg)	Glucose (mg/dl)	Body mass (kg)	SBP (mm Hg)	DBP (mm Hg)	Glucose (mg/dl)	Body mass (kg)
13	125 ± 5	78 ± 5	118 ± 3	63.5 ± 4.3	140 ± 3	80 ± 2	95 ± 2	55.8 ± 4.0
14	122 ± 6	77 ± 4	115 ± 10	61.8 ± 4.5	136 ± 3	78 ± 2	93 ± 4	61.3 ± 4.7
15	130 ± 3	81 ± 2	117 ± 4	67.3 ± 2.5	138 ± 2	88 ± 4	88 ± 3	65.7 ± 3.2
16	134 ± 3	77 ± 3	103 ± 2	73.2 ± 2.9	136 ± 3	84 ± 3	93 ± 5	64.2 ± 10.3
17	136 ± 3	80 ± 2	97 ± 3	71.1 ± 4.4	135 ± 6	83 ± 5	105 ± 14	65.3 ± 6.7
18	145 ± 7	72 ± 12	96 ± 9	71.7 ± 13.3	130 ± 3	82 ± 3	85 ± 3	66.5 ± 4.5
Average	132 ± 2	79 ± 1	108 ± 2	68.5 ± 1.8	136 ± 1	82 ± 1	93 ± 2	62.4 ± 2.0

SBP - systolic blood pressure, DBP - diastolic blood pressure

at a level of hypertension in 22% of the participants. Accordingly, 46% of the participants were hypertensive.

Table 4 shows data of SBP, DBP, blood glucose, and body mass, and was classified by age and gender. The main effects of gender and age on SBP were not significant, but the interaction between age and gender was significant [F [5, 134] = 3.1, $p<0.05$, $\eta p^2 = 0.1$]. Post-hoc comparisons using Tukey's test showed that the difference between boys age 14 and girls age 13 tends to be significant ($p=0.056$). When using the Least Significant Difference (LSD) test, there were significant differences between boys age 13 and boys age 17 and 18, and girls age 13, 14, and 15 ($p<0.05$), and between boys age 14 and boys age 16, 17, and 18 ($p<0.01$), and girls age 13 ($p<0.001$), 14, 15, and 17 ($p<0.05$), and between boys age 15 and boys age 18, and girls age 13 ($p<0.05$), and lastly between boys age 18, and girls age 18 ($p<0.05$). The main effects of gender and age on DBP were not significant, and the interaction between age and gender was not significant. Including glucose and body mass in the model of SBP and DBP did not have any further effects. Bivariate correlation between these variables showed an expected strong correlation between SBP and DBP ($p<0.001$), and between body mass and age ($p<0.001$).

When SBP was classified by gender (boys and girls) and school stage (intermediate and secondary), one-way analysis of variance showed significant differences in the means between groups (F [3, 142] = 5.2, $p<0.01$). Post-hoc comparisons using Tukey's test

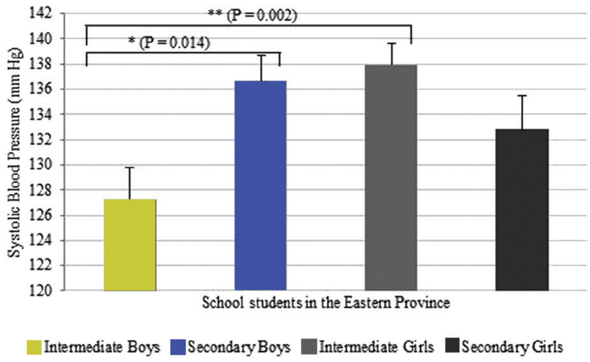

Figure 1 - Differences between adolescents in the Eastern Province of Saudi Arabia, based on gender (boys versus girls) and school stage (intermediate versus secondary) in systolic blood pressure. *Significant difference between intermediate boys and secondary boys, $p<0.05$. **Significant difference between intermediate boys and intermediate girls, $p<0.01$.

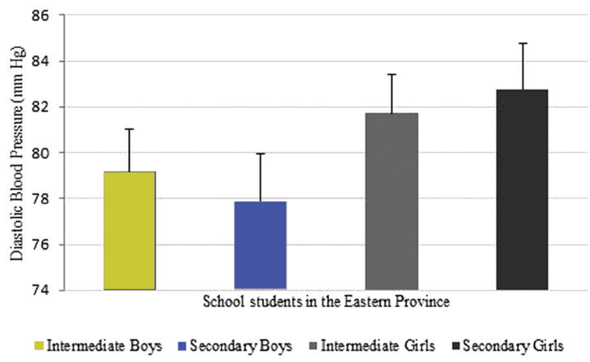

Figure 2 - Differences between adolescents in the Eastern Province of Saudi Arabia, based on gender (boys versus girls) and school stage (intermediate versus secondary) in diastolic blood pressure.

showed significant differences between intermediate boys and secondary boys ($p<0.05$), and between intermediate boys and intermediate girls ($p<0.01$), and there was no significant difference found for DBP (**Figures 1 & 2**). When SBP and DBP were classified by gender, an independent sample t-test showed that SBP and DBP for girls (136±1.7 mm Hg and 78 ±1.3 mm Hg) were higher than boys (132±1.7 mm Hg and 82±1.3 mm Hg), and the difference tended to be significant (p=0.058 and p=0.064).

Discussion. It was globally reported that the prevalence of pediatric hypertension was 1-5% with increasing prevalence up to 10% in some regions with BP >95th percentile, and the prevalence of prehypertension reaching as more as 30%.[1] It was reported that in American children age 3–18 years, the prevalence of prehypertension was 3.4% and the prevalence of hypertension was 3.6%.[16] In Saudi children, the prevalence of elevated SBP was 12.4%, and DBP was 7.9%.[17] The 2013 Saudi National Survey reported that 40.4% of males and 25.1% of females age 15–24 were pre-hypertensive, and only 4.2% of males and 2.3% of females were undiagnosed hypertensive.[18] The current prevalence of hypertension and prehypertension among adolescents originally from the Eastern Province of Saudi Arabia is substantially above these rates. Values of SBP and DBP for the current participants were ≥90th percentile in the Saudi National Standard Nomogram. A study from the southern western region of Saudi Arabia found that adolescents who had SBP and DBP ≥95th percentile constituted less than 10% of the participants,[5] which was lower than the current study.

Regional factors could explain part of the increase in pediatric hypertension in the current study. For this, the current participants were selected from originally Eastern populations. Children with diabetic or diagnosed with kidney failure or heart disease were excluded. Thus, this high level of BP could be attributed to essential hypertension rather than secondary hypertension. Further investigation of the correlation between systematic BP and some common diseases in the region such as SCD is required. The current findings support the assumption of regional diversity of pediatric hypertension in Saudi Arabia. It was reported that Italian pediatric BP tables are not representative for all geographic areas of Italy such as Sardinia Island.[19] Likewise, regional differences exist in the prevalence of some risk factors including BP in Sri Lanka.[20] There might be a need to update the current Saudi National Standard Nomogram, considering possible differences for some geographic areas of the country.

Female adolescents had a higher level of high BP than boys in the current study, but the difference was not significant. Other studies found that being male is a significant risk factor for developing high BP.[5] It is important to note that puberty affects BP,[21] and whether intermediate boys at 13 and 14 years old have reached their puberty was not examined. This could explain the lower levels of BP among intermediate boys. In addition, the distribution of SCD in females was greater than males in the Eastern Province.[22] The effect of gender differences on metabolic disorders needs further investigation, which may point to different patterns in different regions. For example, a study from the Western Province reported high levels of prehypertension at 37% and hypertension at 18% among female adults,[23] whereas a study conducted at the University of Dammam, Dammam, Saudi Arabia found that 13.5% of the 370 female students were pre-hypertensive.[24] The current female adolescent generation had higher BP levels compared with the previous generation from the same region. Appropriate non-pharmacological interventions for girls' schools in the Eastern Province especially Al-Qatif and Al-Hasa are suggested.

Studies from the Eastern Province of Saudi Arabia demonstrated that behavioral reasons can explain most of the increase in hypertension among adolescents and young adults in the region. These factors included physical inactivity,[24] obesity,[8,25,26] and eating habits, especially salt intake,[27] high fructose aerated beverages,[9,28] and energy drink consumption.[29] The random glucose level in the current study was normal, and glucose levels and body mass index were not correlated with the level of BP. Correlations between metabolic and biological factors and BP require adequate sample size, and several behavioral factors were not investigated in the current study. Further studies are required to adequately assess and interpret the correlation between these factors and BP.

One limitation of the current study was that the current measure was taken from a single reading in one visit. Multiple BP determination is more accurate than a single office reading, and the first reading is typically the highest. A minimum of 2 readings with at least one minute interval is suggested, and an additional one or 2 readings may be required if the difference between the first 2 readings is greater than 5 mm Hg.[30] It seems that a single visit is not recommended regardless of the number of measures, and a single visit can significantly overestimate the level of BP compared with the average of 3 visits.[1] The definition of pediatric hypertension has been strongly criticized because it is based on BP measurements at a single time point, and ambulatory measures for children are recommended.[31]

In conclusion, the main finding of this study is that adolescents originally from the Eastern Province had high levels of BP, compared with the Saudi standard reference. There might be a need to use specific regional population nomograms. This requires further multiple-occasional recording of BP routinely in the region. Future study framework should include associated factors such as genes, nutrition, culture, and social background. Moreover, the increased levels of BP among girls suggested implementing appropriate life style interventions to resolve this problem and help prevent adulthood hypertension.

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References

1. Bassareo PP, Mercuro G. Pediatric hypertension: An update on a burning problem. ***World J Cardiol*** 2014; 6: 253-259.
2. Thaker N. Hypertension in children. ***Apollo Medicine*** 2011; 8: 248-260.
3. Al Salloum AA, El Mouzan MI, Al Herbish AS, Al Omar AA, Qurashi MM. Blood pressure standards for Saudi children and adolescents. ***Ann Saudi Med*** 2009; 29: 173-178.
4. Khalid Mel H. Is high-altitude environment a risk factor for childhood overweight and obesity in Saudi Arabia? Wilderness & environmental medicine. ***Wilderness Environ Med*** 2008; 19: 157-163.
5. Mahfouz AA, Shatoor AS, Hassanein MA, Mohamed A, Farheen A. Gender differences in cardiovascular risk factors among adolescents in Aseer Region, southwestern Saudi Arabia. ***J Saudi Heart Assoc*** 2012; 24: 61-67.
6. Jastaniah W. Epidemiology of sickle cell disease in Saudi Arabia. ***Ann Saudi Med*** 2011; 31: 289-293.
7. Abdul-Mohsen MF. Echocardiographic evaluation of left ventricular diastolic and systolic function in Saudi patients with sickle cell disease. ***J Saudi Heart Assoc*** 2012; 24: 217-224.
8. Al-Baghli NA, Al-Ghamdi AJ, Al-Turki KA, El-Zubaier AG, Al-Ameer MM, Al-Baghli FA. Overweight and obesity in the eastern province of Saudi Arabia. ***Saudi Med J*** 2008; 29: 1319-1225.
9. Al Qauhiz NM. Obesity among Saudi Female University Students: Dietary Habits and Health Behaviors. ***J Egypt Public Health Assoc*** 2010; 85: 45-59.
10. Al-Saeed WY, Al-Dawood KM, Bukhari IA, Bahnassy A. Prevalence and socioeconomic risk factors of obesity among urban female students in Al-Khobar city, Eastern Saudi Arabia, 2003. ***Obes Rev*** 2007; 8: 93-99.
11. Kassi E, Pervanidou P, Kaltsas G, Chrousos G. Metabolic syndrome: definitions and controversies. ***BMC Med*** 2011; 9: 48.
12. Vidal E, Murer L, Matteucci MC. Blood pressure measurement in children: which method? Which is the gold standard. ***J Nephrol*** 2013; 26: 986-992.
13. Skirton H, Chamberlain W, Lawson C, Ryan H, Young E. A systematic review of variability and reliability of manual and automated blood pressure readings. ***J Clin Nurs*** 2011; 20: 602-614.

14. Takahashi H. Validation of the Omron i-Q142(HEM-1040-E), an upper arm blood pressure monitor, in oscillometry mode, for clinic use and self measurement in a general population, according to the European Society of Hypertension International Protocol revision 2010: dablEducational Trust; 2012 [Updated: 2014; Cited 2015 January 4]. Available from: http://www.dableducational.org/sphygmomanometers/devices_1_clinical.html
15. Saudi Hypertension Management Group. Saudi Hypertension Management Guidelines 2004. Riyadh (KSA): King Fahd National Library Cataloging-in-Publication Data; 2011.
16. Riley M, Bluhm B. High blood pressure in children and adolescents. ***Am Fam Physician*** 2012; 85: 693-700.
17. Al-Nozha MM, Ali MS, Osman AK. Arterial hypertension in Saudi Arabia. ***Ann Saudi Med*** 1997; 17: 170-174.
18. El Bcheraoui C, Memish ZA, Tuffaha M, Daoud F, Robinson M, Jaber S, et al. Hypertension and its associated risk factors in the Kingdom of Saudi Arabia, 2013: A National Survey. ***International Journal of Hypertension*** 2014; 2014: 8.
19. Bassareo PP, Marras AR, Mercuro G. About the need to use specific population references in estimating paediatric hypertension: Sardinian blood pressure standards (age 11-14 years). ***Ital J Pediatr*** 2012; 38: 1.
20. Wijewardene K, Mohideen M, Mendis S, Fernando D, Kulathilaka T, Weerasekara D, et al. Prevalence of hypertension, diabetes and obesity: baseline findings of a population based survey in four provinces in Sri Lanka. ***Ceylon Med J*** 2005; 50: 62-70.
21. Widén E, Silventoinen K, Sovio U, Ripatti S, Cousminer DL, Hartikainen AL, et al. Pubertal timing and growth influences cardiometabolic risk factors in adult males and females. ***Diabetes Care*** 2012; 35: 850-856.
22. Udezue E, Girshab AM. Differences between males and females in adult sickle cell pain crisis in eastern Saudi Arabia. ***Ann Saudi Med*** 2004; 24: 179-182.
23. Al-Zahrani MS. Prehypertension and undiagnosed hypertension in a sample of dental school female patients. ***Int J Dent Hyg*** 2011; 9: 74-78.
24. Koura MR, Al-Dabal BK, Rasheed P, Al-Sowielem LS, Makki SM. Prehypertension among young adult females in Dammam, Saudi Arabia. ***East Mediterr Health J*** 2012; 18: 728-734.
25. Al-Hariri MT, Alkahtani SA, Abdelgayed AM. Impact of Life Behaviour on Students Physical Fitness at University of Dammam in Saudi Arabia. ***Academic Research International*** 2014; 5: 87-93.
26. Al-Almaie SM. Prevalence of obesity and overweight among Saudi adolescents in Eastern Saudi Arabia. ***Saudi Med J*** 2005; 26: 607-611.
27. Alsuwaida A. Effect of salt intake on blood pressure in diabetic hypertensive patients in Saudi Arabia. ***Saudi Med J*** 2007; 28: 909-912.
28. Grasser EK, Dulloo A, Montani JP. Cardiovascular responses to the ingestion of sugary drinks using a randomised cross-over study design: Does glucose attenuate the blood pressure-elevating effect of fructose? ***Br J Nutr*** 2014; 112: 183-192.
29. Alsunni AA, Badar A. Energy drinks consumption pattern, perceived benefits and associated adverse effects amongst students of University of Dammam, Saudi Arabia. ***J Ayub Med Coll Abbottabad*** 2011; 23: 3-9.
30. Pickering TG, Miller NH, Ogedegbe G, Krakoff LR, Artinian NT, Goff D. Call to Action on Use and Reimbursement for Home Blood Pressure Monitoring A Joint Scientific Statement From the American Heart Association, American Society of Hypertension, and Preventive Cardiovascular Nurses Association. ***Hypertension*** 2008; 52: 1-9.
31. Batisky DL. Blood pressure variability, prehypertension, and hypertension in adolescents. ***Adolesc Health Med Ther*** 2012; 3: 43-50.