Gender differences in cardiovascular risk factors among adolescents in Aseer Region, southwestern Saudi Arabia

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Objective: The objective of this study was to explore gender differences in the prevalence of silent and clinical apparent cardiovascular risk factors among adolescents in Aseer Region, southwestern Saudi Arabia.

Materials and methods: A cross-sectional study on a stratified sample of 1869 adolescents was carried out. They were interviewed and examined for weight and height, systolic and diastolic blood pressure using standardized techniques.

Results: The study revealed high prevalence of some potential behavioral and biological cardiovascular diseases (CVD) risk factors among adolescent males and females in the study area. Behavioral risk factors included inadequate low consumption of fruits and vegetables, physical inactivity, and smoking. Physical inactivity was significantly more prevalent among females than males (42.9% and 25.7%, respectively). Smoking was significantly more among females than males (11.8% and 1.3%, respectively). Biological risk factors found were family history of CVD, obesity and high blood pressure. Obesity was significantly prevalent among females (29.4%) compared to males (20.6%). Males had significantly more high blood pressure than females. In logistic regression analysis, being male (aOR = 2.992, 95% CI = 1.933–4.742) and obesity (aOR = 2.995, 95% CI = 2.342–3.991) were found to be significant risk factors in developing high blood pressure among adolescents in the region.

Conclusions: Presence of cardiovascular risk factors among adolescents is a public health problem in the region. There is a need for a national program in the country to prevent and control cardiovascular risk factors among adolescents.

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The odds of developing cardiovascular disease are enhanced if risk factors in childhood and adolescent age, including obesity and hypertension, are present, and the risk of adult cardio-

vascular disease may begin in childhood. In different studies, adult atherosclerosis [1,2], adult hypertension [3], adult metabolic syndrome [4], and high body mass index (BMI) [5] have been

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correlated with cardiovascular risk factors in childhood or adolescent age of the same individuals. Moreover, a recent study from the US [6], suggested that cardiovascular risk factors may be correlated between children and their parents.

Cardiovascular risk factors have a tendency to cluster together in either sex [7]. Males were 10% more likely than females to develop high systolic blood pressure (SBP) as adults. High SBP has been reported to be more prevalent among males than females in several cross-sectional studies [8,9].

The Aseer Region (population of 12,00,000) is located in the southwest of Saudi Arabia covering an area of more than 80,000 km². The region extends from the high mountains of Sarawat (with an altitude of 3200 m above the sea level) to the Red Sea, and lies few kilometers from the northern border of neighboring Yemen.

The objective of the present work is to explore gender differences in the prevalence of silent and clinical apparent cardiovascular risk factors among adolescents in Aseer Region, southwestern Saudi Arabia.

Materials and methods

The calculated minimal sample size for the present study was 1291 students (based on an anticipated population proportion of 16% [10], and with an absolute precision of 2% at 95% confidence interval) [11]. It was planned to include a total of 1500 students. Two districts were randomly selected from Aseer Region (Abha and Ahad Rufeida). A sample of 12 schools for males and females was randomly selected using stratified sampling technique with proportional allocation to location (urban or rural), gender, type of school (government or private) and educational level (intermediate or secondary). Two classes from each educational level (1st, 2nd and 3rd year) were randomly chosen from the selected schools.

Ethical considerations and approval for the conduct of the field survey was obtained from the Ministry of Education and School Health Unit in Aseer Region. These letters of approval were given to each school principal to ensure full cooperation prior to the study. Confidential letters were sent to parents of the study sample from researchers and school health units explaining in detail the purpose of the study and asking for their consent. The letters included questionnaires inquiring about socio-demographic conditions of the family. All students in the selected class present during the study period were considered.

Data were collected by fourth-year medical students (a group 32 males and 2 females) trained in interviewing skills, and directly supervised by the Family and Community Medicine staff. The structured questionnaire used in the study was the validated Arabic version of CDC Adolescent Health Survey adopted in the Jeddah Study [12]. The structured questionnaire included information on socio-demographic conditions, family history of cardiovascular diseases, smoking habits, behaviors related to physical activities, food choices, as well as direct measurements of weight, height, systolic and diastolic blood pressure. Anthropological measures of weight and height were taken during the interview. Each subject was examined barefoot, wearing only light clothes. Weight was measured using standardized calibrated scales to the nearest 0.1 kg and height was measured to the nearest 0.1 cm using the standardized wall mounted height boards with a sliding head piece according to the following protocol: no shoes, heels together, child's heels, buttocks, shoulders, and head touching the vertical wall surface with line of sight aligned horizontally. The measured body mass indexes were computed and classified into four categories according to age: normal weight (15th–<85th percentile), overweight (85th–<95th percentile), obese (>95th percentile). An underweight group (<15th percentile) was not found in the study cohort. This classification is in accordance with the recommendation of the Expert Committee on Clinical Guidelines for Overweight in Adolescence and the World Health Organization (WHO) Expert Committee in Overweight [13]. Overweight and obese categories were combined in the analysis.

Standardized techniques for measuring blood pressure were used in the study [14]. Students should be seated quietly for at least 5 minutes in a chair with their backs supported and their arms bared and supported at heart level. Correct measurement of blood pressure requires the use of a cuff that is appropriate to the size of the upper right arm. The right arm is preferred for consistency and comparison with the standard tables. A technique to establish an appropriate cuff size is to choose a cuff having a bladder width that is approximately 40% of the arm circumference midway between the olecranon and the acromion. The bell of the stethoscope should be lightly placed over the brachial artery pulse, proximal and medial to the cubital fossa, and below the bottom edge of the cuff (about 2 cm above the cubital fossa). The cuff should be inflated to 30 mmHg above palpated SBP and deflated at a rate of 2–3 mmHg/s.

Both SBP and DBP should be recorded. The first appearance of sound (phase 1) is used to define SBP. The disappearance of sound (phase 5) is used to define DBP (Korotkoff sounds). Three or more readings separated by at least 5 min were averaged. Hypertension is defined as average SBP and/or diastolic BP (DBP) that is ≥ 95 th percentile for gender, age, and height on ≥ 3 occasions adjusted for Saudi adolescents [15]. For ethical considerations adolescents with high blood pressure were referred to school health facilities for further management.

Data were coded, validated and analyzed using SPSS PC + software package. Univariate analysis methods were used at 5% level of significance. Multivariate logistic regression analysis was used to identify potential risk factors of high blood pressure.

Table 1. Food choices (%) of adolescent males ($n = 1249$) and females ($n = 620$) in southwestern Saudi Arabia.

Food choices	Consumption in the previous week		
	Consumed	Never	P
<i>Fresh juices</i>			
Males	66.5	33.5	0.001*
Females	76.1	23.9	
<i>Fresh fruits</i>			
Males	72.9	27.1	0.088
Females	76.6	23.4	
<i>Fresh vegetables</i>			
Males	83.1	16.9	0.001*
Females	89.9	10.1	
<i>Soft drink cans</i>			
Males	85.1	14.9	0.001*
Females	72.7	27.3	
<i>Rice</i>			
Males	98.1	1.9	0.001*
Females	9.2	4.8	
<i>Bread</i>			
Males	98.3	1.7	0.386
Females	97.8	2.2	
<i>Meat</i>			
Males	94.0	6.0	0.001*
Females	81.1	18.9	
<i>Chicken</i>			
Males	94.2	5.8	0.321
Females	93.1	6.9	
<i>Fish</i>			
Males	47.0	53.0	0.003*
Females	54.2	45.8	
<i>Nuts</i>			
Males	58.9	41.1	0.721
Females	58.1	41.9	
<i>Fast food</i>			
Males	58.0	42.0	0.001*
Females	80.8	19.2	

* Significant ($P < 0.05$).

Results

The present study included 1869 adolescent school students; 1249 males and 620 females (with a response rate of 96.7% and 97.1%, respectively). Their ages ranged from 12 to 19 years. The mean age of boys (17.19 ± 1.15 years) was not significantly ($t = 0.355$, $P = 0.722$) from the mean age of females (17.17 ± 1.14 years).

Socio-demographic profile of the study sample

Results showed that the most frequent level of education among fathers of the adolescents was primary education (26.0%, and 26.1%, respectively). On the other hand, the most frequent mothers' education of boys and girls was illiterate (28.4% and 25%, respectively). The most frequent occupation of the studied sample's fathers was governmental employee (48.1% and 46.9%, respectively). Most mothers were homemakers, not employed outside of the home, (91.8% and 90.6%, respectively). A total of 325 males (26%) and 174 females (28%) had a house maid at home. The most frequent family sizes were 8 (15.8% among males and 16.7% among females). The mean family size was calculated to be 8.31 ± 1.5 among males and 8.25 ± 1.4 among females. Socio-demographic factors were not statistically different ($P > 0.05$) between males and females.

Food choices of adolescents

Regarding food choices during the previous week, Table 1 shows that the least consumed food items were nuts, fish, fresh juices and fresh fruits. The study shows that 53.0% of boys and 45.8% of females had not consumed fish during the previous week. Similarly, 27.1% of males and 23.4% of females had not consumed any fresh fruits during the previous week. The most frequently consumed food items were rice and bread. More than half of the adolescent males (50.5%) and females (54.8%) are accustomed to eating rice at least once daily.

Physical activities of adolescents

As for physical activity and related behavior, more than one-third of the male students (38%) and more than half of the female students (52.7%) spent more than 3 hours daily watching television, 25.7% of males and 42.9% of females had not engaged in any physical exercise (for more than 30 minutes) at all during the previous week. As for the practice of physical exercise in schools, 31.1% of the boys and 100% of the females did not engage in the previous week. The schedule of the Ministry of Education is one

session per, week for males. Unfortunately the practice of physical education for females is not allowed in schools females for cultural reasons. The differences between males and females related to the practice of physical activity and related behavior were statistically significant ($P < 0.05$).

Parental consanguinity

The study showed that more than half of the parents (54.2%) were consanguineous. Almost one quarter (23.9%) were cousins.

Parental family history

Regarding parental history of hypertension, it ranged from 14.1% among mothers to 22.5 among fathers (Table 2). Similarly, fathers had a higher history of diabetes, angina or myocardial infarctions and high blood lipids (25.0%, 3.3% and 6.1%, respectively) compared to mothers (12.4%, 0.6% and 3.2%, respectively). No gender differences were found among the adolescents regarding parental consanguinity and family history.

Table 2. Cardiovascular risk factors among of adolescent males ($n = 1249$) and females ($n = 620$) in southwestern Saudi Arabia.

Risk Factor	Males		Females		Total		P
	No.	%	No.	%	No.	%	
<i>Parental history of hypertension</i>							
Among fathers	291	23.3	130	20.9	421	22.5	0.256
Among mothers	183	14.6	81	13.1	264	14.1	0.354
<i>Parental history of diabetes</i>							
Among fathers	325	26.02	143	23.1	468	25.0	0.165
Among mothers	167	13.37	64	10.3	231	12.4	0.059
<i>Parental history of angina or myocardial infarction</i>							
Among fathers	44	3.52	18	2.9	62	3.3	0.831
Among mothers	8	0.64	4	0.64	12	0.6	0.816
<i>Parental history of high blood lipids</i>							
Among fathers	77	6.16	38	6.1	115	6.1	0.503
Among mothers	42	3.36	17	2.7	59	3.2	0.806
Current smokers	147	11.8	8	1.3	155	8.3	0.001*
Over weight and obesity	257	20.6	182	29.4	439	23.5	0.001*
<i>Risk of high blood pressure</i>							
SBP (≥95th percentile)	85	6.0	22	3.6	107	5.7	0.025*
DBP (≥95th percentile)	162	11.3	37	6.0	199	10.6	0.001*

* Significant ($P < 0.05$).

Smoking habits

The prevalence of current smokers among the male adolescents (11.8%) was significantly ($P = 0.001$) higher compared to the prevalence among female adolescents (1.3%).

Obesity

The prevalence of obesity and overweight in the study amounted to 20.6% among males and 29.4% among females. The difference is statistically significant ($P = 0.001$).

Risk of high blood pressure

The study showed that 6.0% (85) of male adolescents had a high systolic blood pressure (≥ 95 th

Table 3. Multivariate analysis, adjusted Odds ratio (aOR) and antecedent 95% confidence intervals (CI) of potential risk factors determining high blood pressure among adolescent school males and females in southwestern Saudi Arabia.

Variable	aOR	95% CI	
		Lower	Upper
Gender: Males vs. females	2.992*	1.933	4.742
Father education: Illiterate vs. educated.	0.673	0.313	1.118
Mother education: Illiterate vs. educated.	0.758	0.618	1.281
Mother occupation: Not working vs. working.	0.983	0.497	1.512
TV watching: 2+ h daily vs. <2 h daily	0.914	0.521	1.013
Physical exercise practice last week: Never vs. yes	0.911	0.348	1.568
Class physical exercise last week: Never vs. yes	1.213	0.666	1.542
Intake of fresh juices last week: Never vs. yes	1.113	0.645	1.533
Intake of fresh fruits last week: Never vs. yes	1.011	0.531	1.756
Intake of fresh vegetables last week: Never vs. yes	0.666	0.247	1.071
Intake of soft drinks cans last week: Yes vs. no	1.111	0.519	1.915
Intake of rice last week: Yes vs. never	1.618	0.988	2.177
Intake of bread last week: Yes vs. never	0.911	0.321	2.728
Intake of meat last week: Never vs. yes	0.841	0.321	1.159
Intake of chicken last week: Never vs. yes	1.122	0.549	2.011
Intake of fish last week: Never vs. yes	0.512	0.117	1.215
Intake of nuts last week: Never vs. yes	1.320	0.525	1.674
Intake of fast foods last week: Never vs. yes	1.011	0.835	2.114
Obesity: Obese vs. none obese	2.995*	2.342	3.991

* Significant ($P < 0.05$).

percentile) compared to 3.6% among adolescent females. Similarly, 11.3% of males had high DBP (≥ 95 th percentile) compared to 6.0% among adolescent females. The differences are statistically significant ($P = 0.025$ and 0.001 , respectively).

Using logistic regression analysis to identify risk factors associated with high blood pressure (Table 3) the following significant risk factors were identified; being a male (aOR = 2.992, 95% CI = 1.933–4.742) and obesity (aOR = 2.995, 95% CI = 2.342–3.991). On the other hand, socio-demographic variables (parental education and maternal occupation), other physical activities related behaviors and food choices were found to be of no significant value in developing high blood pressure among adolescents in the region.

Discussion

Adolescence is the transitional stage of development between childhood and full adulthood. Adolescence is a formative period during which many life patterns are learned and established or acquired. During adolescence many changes take place; biological, physiological, psychological, cognitive, sexual and emotional [1].

This study revealed high prevalence of some potential behavioral and biological cardiovascular disease (CVD) risk factors among adolescent males and females in the study area. Behavioral risk factors included inadequate consumption of fruits and vegetables, physical inactivity, and smoking. Biological risk factors found were family history of CVD, obesity and high blood pressure.

The association between the presence of risk factors from adolescence through middle age and the presence of coronary atherosclerotic plaques later in life has also been demonstrated. Likewise, the early control of risk factors also seems to positively affect further development of CVD. Therefore, diagnosing and combating these factors is of utmost importance from a public health standpoint, in order to tackle deaths from cardiovascular diseases. In relation to the world situation, two-thirds of CVD deaths are estimated to occur in developing countries, corresponding to double the amount found in developed countries [16].

The present study revealed high prevalence of physical inactivity and sedentary life styles among adolescents with significant excess among females compared to males in the region. It is suggested that the increased use of information and communication technology, particularly watching television, playing digital games and using computers

are critical sedentary factors. Physical inactivity in adolescence is related to body fat accumulation, which apparently can increase the probability of the onset and development of metabolic changes such as hypercholesterolemia, hypertriglyceridemia and hypertension, thus representing an important factor of public health concern [17]. Physical activity and diet have been shown to be the main factors in the prevention of cardiovascular illnesses and obesity. However, recently sedentary behavior has begun to be shown as having an important role in the development and prevention of these diseases, and indications have also been made that physical activity and sedentary behavior are not opposing sides of the problem. Recent studies attempted to evaluate how sedentary lifestyles are related with obesity and cardiovascular risk factors in children and adolescents [18]. Cultural factors limiting females' outdoor activities may explain the observed excess in sedentary life styles and physical inactivity in the region.

The present study found high consanguineous marriages among parents and high family history of CVD among adolescent males and females (without any gender differences) in the study area. Consanguineous marriages are common in many Arab countries. In Saudi Arabia a nationwide study showed a prevalence of 56% with first cousin marriage being the most frequent [19]. The heritability of cardiovascular risk factors is expected to differ between populations because of the different distribution of environmental risk factors, as well as the particular genetic make-up of different human populations. The epidemiologic evidence for the familial aggregation of CVD is also strong. Researchers from the Framingham Study, who used prospective data and consistently validated CVD events in parents, offspring, and siblings, reported that having CVD in at least one parent doubled the 8-year risk of CVD among men and increased the risk by 70%. The excess risk was independent of other risk factors such as age, ratio of total/HDL-cholesterol level, SBP, antihypertensive therapy, diabetes, BMI, and current smoking status [20].

This study showed that obesity among adolescents in Aseer Region, southwestern Saudi Arabia is a public health problem. The problem is significantly more prevalent among females compared to males. Evidence from three major Saudi national cross-sectional studies showed that there were progressive increases in BMI of Saudi adolescents from 1988 to 1996 indicating that obesity among adolescents is a crisis in Saudi Arabia [21].

This study showed that almost one out of eight adolescent males in the region was currently smoking compared to 1% among females. A recent nationwide study in Saudi Arabia revealed an overall prevalence of smoking of 12.8%. Several studies have shown the risk of smoking in the development of CVD, moreover, the disease risks associated with cigarette smoking are proportional to the intensity and duration of smoking [22].

The study also showed a high prevalence of risk of high blood pressure among adolescent males and females in the region. In logistic regression analysis, gender (males) and obesity were found to be significant risk factors in developing high blood pressure among adolescents in the region. The evidence obtained from detailed investigations over past decades has shown that essential hypertension starts early in life and heart disease begins in childhood. Fatty streaks appear in the aorta in three-year olds. Childhood blood pressure is related to adult levels and, together with the changes in body mass index, is a significant predictor of adult blood pressure [23]. It is obvious that hypertension is a risk factor for cardiovascular diseases as ventricular failure, myocardial infarction, renal damage and stroke. The early detection and control of the disease would lead to significant reduction of complications and organ damage [23].

High blood pressure in adolescence has been reported to be more prevalent among males than females in different cross-sectional [9] and longitudinal [24] studies. This pattern may suggest that steroids may have an important impact on blood pressure level [25]. A recent study in Riyadh on patients undergoing isolated coronary artery bypass grafting (CABG) studied gender-based pre-operative risk factors. The average age of the study patients was around 60 years. Hypertension, diabetes, hyperlipidemia and obesity were more prevalent in females compared to males. Smoking was the only risk factor with higher prevalence in males compared to females [26].

A limitation of the present work is the lack of data concerning blood cholesterol and glucose due to lack of blood sampling for logistic reasons. Further studies including these factors in the region may identify the role of metabolic syndrome in adolescent cardiovascular diseases.

Recommendations should spotlight on more health education to deal with this high risk susceptible cluster to fill the gap in their behaviors. The blend of a reduced calorie diet and increased physical activity is recommended since it results in weight loss, decreases abdominal fat, and

increases cardio-respiratory fitness. There is a need for a national program in the country. Such a program should be part of a national plan to prevent diet-related chronic disease. The program should incorporate dietary management of obesity; promotion of physical activity; health education campaigns; training courses for health workers and consideration of the possibility of providing facilities for practicing physical activity and exercise in the community for adolescents.

Conflict of Interest

The authors have no conflicts of interest to declare.

References

- [1] Li S, Chen W, Srinivasan SR, Bond MG, Tang R, Urbina EM, et al. Childhood cardiovascular risk factors and carotid vascular changes in adulthood: the Bogalusa Heart Study. *JAMA* 2003;290:2271–6.
- [2] Raitakari OT, Juonala M, Kähönen M, Taittonen L, Laitinen T, Mäki-Torkko N, et al. Cardiovascular risk factors in childhood and carotid artery intima-media thickness in adulthood: the cardiovascular risk in young Finns study. *JAMA* 2003;290:2277–83.
- [3] Lauer RM, Clarke WR. Childhood risk factors for high adult blood pressure: the Muscatini Study. *Pediatrics* 1989;84:633–41.
- [4] Morrison JA, Friedman LA, Gray-McGuire C. Metabolic syndrome in childhood predicts adult cardiovascular disease 25 years later: the Princeton Lipid Research Clinics follow-up study. *Pediatrics* 2007;120:340–5.
- [5] Baker JL, Olsen LW, Sørensen TIA. Childhood body-mass index and the risk of coronary heart disease in adulthood. *N Engl J Med* 2007;357:2329–37.
- [6] Reis EC, Kip KE, Marroquin OC, Kiesau M, Hipps Jr L, Peters RE, et al. Screening children to identify families at increased risk for cardiovascular disease. *Pediatrics* 2006;118:1789–97.
- [7] Aizawa Y, Kamimura N, Watanabe H, et al. Cardiovascular risk factors are really linked in the metabolic syndrome: this phenomenon suggests clustering rather than coincidence. *Int J Cardiol* 2006;109:213–8.
- [8] Soro J, Lai D, Turner J, Poffenbarger T, Portman R. Overweight, ethnicity, and the prevalence of hypertension in school-aged children. *Pediatrics* 2004;113:475–82.
- [9] Davis CL, Flickinger B, Moore D, Bassali R, Domel BS, Yin Z. Prevalence of cardiovascular risk factors in schoolchildren in a rural Georgia community. *Am J Med Sci* 2005;330:53–9.
- [10] Mahfouz AA, Abdelmoneim I, Khan MY, Daffalla AA, Diab MM, Al-Gelban KS, et al. Obesity and related behaviors among adolescent school boys in Abha City, Southwestern Saudi Arabia. *J Trop Pediatr* 2008;54(2): 120–4.
- [11] Lwanga SK, Lemeshow S. Sample size determination in health studies. Geneva: World Health Organization; 1990.
- [12] Abalkhail B. Overweight and obesity among Saudi Arabian children and adolescents between 1994 and 2000. *East Mediterr Health J* 2002;8:212–5.
- [13] WHO. Nutrition in adolescence: issues and challenges for the health sector. Geneva: World Health Organization; 2005.
- [14] Khatib OM, El-Guindy MS, editors. Clinical guidelines for the management of hypertension. EMRO technical series 29. World Health Organization, Regional Office for the Eastern Mediterranean; 2005.

- [15] 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(3): 173–8.
- [16] McGill Jr HC, McMahan CA, Gidding SS. Preventing heart disease in the 21st century: implications of the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) study. *Circulation* 2008;117:1216–27.
- [17] Vasconcelos IQ, Stabelini Neto A, Mascarenhas LP, Bozza R, Ulbrich AZ, Campos W, et al. Cardiovascular risk factors in adolescents with different levels of energy expenditure. *Arq Bras Cardiol* 2008;91(4):207–12.
- [18] Martínez-Gómez D, Eisenmann JC, Gómez-Martínez S, Veses A, Marcos A, Veiga OL. Sedentary behavior, adiposity and cardiovascular risk factors in adolescents. The AFINOS study. *Rev Esp Cardiol* 2010;63(3):277–85.
- [19] El Mouzan MI, Al Salloum AA, Al Herbish AS, Qurachi MM, Al Omar AA. Consanguinity and major genetic disorders in Saudi children: a community-based cross-sectional study. *Ann Saudi Med* 2008;28(3):169–73.
- [20] Valdez R, Greenlund KJ, Khoury MJ, Yoon PW. Is family history a useful tool for detecting children at risk for diabetes and cardiovascular diseases? A public health perspective. *Pediatrics* 2007;120(Suppl 2):S78–86. Sep.
- [21] El Mouzan MI, Foster PJ, Al Herbish AS, Al Salloum AA, Al Omer AA, Qurachi MM, Kecojevic T. Prevalence of overweight and obesity in Saudi children and adolescents. *Ann Saudi Med* 2010;30(3):203–8.
- [22] Al-Nozha M, Al-Mazrou Y, Arafah M, Al-Maatouq M, Khalil M, Khan N, et al. Smoking in Saudi Arabia and its relation to coronary artery disease. *J Saudi Heart Assoc* 2009;21:169–76.
- [23] Klumbiene J, Sileikiene L, Milasauskien Z, Zaborskis A, Shatchkute A. The relationship of childhood to adulthood pressure: longitudinal study of juvenile hypertension in Lithuania. *J Hypertens* 2000;18:531–8.
- [24] Dasgupta K, O'Loughlin J, Chen S, Karp I, Paradis G, Tremblay J, et al. Emergence of sex differences in prevalence of high systolic blood pressure: analysis of a longitudinal adolescent cohort. *Circulation* 2006;114(24): 2663–70.
- [25] Ellis J, Infantino T, Harrap S. Sex-dependent association of blood pressure with oestrogen receptor genes ERalpha and ERbeta. *J Hypertens* 2004;22:1127–31.
- [26] Ahmad M, Arifi A, van Onslen R, Alkodami A, Zaibag M, Khaldi A, et al. Gender differences in surgical management and early clinical outcome of coronary artery diseases: single centre experience. *J Saudi Heart Assoc* 2010;22(2):47.