# Which major atherosclerosis risk factors represents the extent of coronary artery disease?

**Masoumeh Sadeghi[(1)], Kamran Pourmand[(2)], Hamid Sanei[(3)], Ramin Heidari[(2)], Mohammad Talaei[(4)]**

## Abstract

**BACKGROUND:** Coronary artery diseases are the most prevalent cause of death in Iran. Despite the vast information regarding the risk factors for the incidence and development of such diseases, major risk factors for the extent and severity of atherosclerosis in the patients have not yet been clearly identified. This study aimed to investigate the determinants of severity and extent of coronary artery disease in patients who underwent clinically indicated coronary angiography.

**METHODS:** In this cross-sectional study, coronary angiograms of 325 men and 235 women (aged 4-60 years) were analyzed quantitatively. Systolic and diastolic blood pressures, body weight, height, fasting blood sugar, serum lipids, and smoking habits of patients were then collected in a questionnaire. The relationships between angiographic scores and potential risk factors of coronary artery disease such as hypertension, obesity, hyperlipidemia, diabetes, and smoking were evaluated using logistic and multiple linear regression analyses.

**RESULTS:** We found significant differences between age and fasting blood glucose in patients with positive and negative coronary angiograms ($P < 0.05$). Diabetic patients had higher scores compared to non-diabetics in both genders. The same differences were found in obese men. According to regression coefficients, fasting blood sugar in both genders (males = 0.017 and females = 0.016), diastolic blood pressure in males (0.044) and body mass index (BMI) (0.005) and high density lipoprotein cholesterol (-0.081) in females were significant predictive factors for severity and extent of coronary artery involvements.

**CONCLUSION:** Our findings showed that in patients with positive coronary angiogram, fasting blood sugar in both genders, high diastolic blood pressure in males, and high density lipoprotein cholesterol and BMI in females might be stronger predictors of the extent of coronary artery involvements. Prevention of these risk factors may be effective in controlling the progress of coronary artery diseases.

**Keywords:** Coronary Artery Disease, Extent, Risk Factors, Angiography.

***ARYA Atherosclerosis Journal 2012, 7(Suppl): S63-S69***

***Date of submission:*** 25 Dec 2011, ***Date of acceptance:*** 1 Feb 2012

## Introduction

Coronary artery disease is one of the major causes of mortality among women and men. This disease is the cause of about one-fifth of the deaths. Factors such as age, family history, abnormal blood lipid profile, hypertension, diabetes mellitus and smoking have been shown to be effective on coronary artery disease incidence.[1] Although such factors are also thought to determine the severity and extent of coronary atherosclerosis, the associations are not yet clear.[2] Previous studies have suggested diabetes mellitus to play a role not only in the development of coronary disease, but also in its outcomes and manifestations. In fact, the involvement of three vessels can be seen in most diabetic patients. The involvements in these patients are broader than non-diabetic patients.[3] The metabolism of blood lipids in diabetics results in increased triglyceride, elevated low-density lipoprotein cholesterol (LDL-C) and decreased high-density lipoprotein cholesterol (HDL-C) which are other risk factors for coronary artery disease. However, these factors have not yet been proven to be indicative of the extent of involvement.[4,5] Another risk factor is increased blood pressure whose role in exacerbating coronary artery disease has been noted in many

1- Associate Professor, Cardiac Rehabilitation Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.
2- Cardiologist, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
3- Associate Professor, Isfahan Cardiovascular Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.
4- MPH, Isfahan Cardiovascular Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.
Correspondence To: Hamid Sanei, Email: h_sanei@med.mui.ac.ir



www.mui.ac.ir

studies while some others ruled it out.[6,7] Although all mentioned factors can result in the development of coronary artery disease under natural conditions, it the most effective factors in the development of atherosclerosis in patients with coronary artery disease manifestations have not yet been exactly determined.[3-9] In the present study, we investigated the relationship between these risk factors and the severity of coronary artery disease in the coronary angiography of patients with stable angina. The study was conducted in order to specify main risk factors indicating more severe involvements of the coronary arteries in males and females.

## Materials and Methods

The present cross-sectional study was conducted on patients with stable angina who were candidates for coronary angiography. It was performed during six months in the educational-therapeutic Chamran Hospital (Isfahan, Iran). Considering $\alpha = 0.05$, $\beta = 0.1$, the distribution of coronary artery disease severity as 3.5, and an index score of 1, the total required sample size was calculated as 514. Convenient sampling method was used to select subjects. For each patient, a questionnaire including demographic information such as age, gender, place of residence, and education level was completed. History of previous diseases such as diabetes, hypertension, high blood lipids, and positive family history of coronary artery disease were also recorded. Patients were then examined by a physician. Moreover, height, weight, waist circumference, and blood pressure of the subjects were measured and recorded. Right arm blood pressure was measured twice for each patient in sitting position, in the standard mode with an appropriate cuff and after 15 minutes of rest. Mean of the two measurements was included in the study. Standard scales and meter tapes were used to measure weight and height while patients were wearing light clothing. After 10 to 12 hours of fasting, a 10-ml blood sample was taken from each patient to evaluate fasting blood sugar (FBS). Blood glucose was measured after separating the serum. The same blood samples were also used to spectrophotometrically measure total cholesterol and triglyceride levels with an autoanalyzer. HDL-C levels were determined after heparin manganese precipitation. Patients with FBS > 126 mg/dL or those consuming glucose-lowering drugs were considered as diabetic.[9] Hyperlipidemia was defined as having total cholesterol, triglyceride, and LDL-C levels higher than 200, 150, and 100 mg/dL, respectively and HDL-C levels below 50 mg dL in women and less than 40 mg/dL in men.[10] In addition, subjects were identified as hypertensive if their mean blood pressure was higher than 140/90 mm Hg or they were using medications to treat high blood pressure.[11] Patients who smoked cigarettes daily were considered as smokers.[12] Overweight and obesity were described as having body mass index (BMI) over 25 kg/m$^2$ and 30 kg/m$^2$, respectively.[13] A history of heart disease in the first degree relatives among men younger than 55 years old and in women younger than 65 years of age was considered as a positive family history.[14]

Chest pain or equivalent symptoms (shortness of breath, fatigue, and syncope) with the specified amount of activity usually between 2 and 10 minutes which improved with resting and trinitroglycerin (TNG) consumption was defined as stable angina.[14]

In the next phase, all patients underwent standard angiography using Seldinger's method in Chamran Hospital. Angiographic video films were investigated by three cardiologists. The extent of atherosclerosis involvement was scored between zero and 21. In order to calculate the score for each patient, first, the number of major atherosclerotic coronary arteries was scored as 0-3. Then, for each atherosclerotic artery, proximal, medial, and distal segments with stenosis were scored between 0-3 resulting in a total range of 0-9. Finally, the extent of atherosclerotic stenosis was categorized as less than 50%, 50-75%, and more than 75% and scored between 0-3 for each coronary artery (total score: 0-9). By adding the three scores, an overall score of 0-21 was recorded for each patient.

Data was entered into data entry forms using EPI software. To perform bivariate analyses, t-test and chi-square test were used to compare quantitative and qualitative variables, respectively. In order to conduct multivariate analyses and adjust the risk factors associated with angiographic results based on age and gender, the overall angiographic response (positive/negative) was entered in the model as a dependent variable. Other variables such as cigarette smoking (yes/no), systolic and diastolic blood pressures (mm Hg), total cholesterol (mg/dL), HDL-C (mg/dL), triglyceride (mg/dL), LDL-C (mg/dL), BMI (kg/m$^2$), waist circumference (cm), age (years) and gender were also included. These variables were investigated by logistic regression analysis. In order to investigate the main purpose of the study, involvement scores in patients with positive angiographic results in quantitative scale were entered into in the generalized linear model (GLM) as dependent variables, while gender and smoking status were considered as fixed factors and other variables with quantitative scale as covariates. Based on the obtained results, multiple



www.mui.ac.ir

linear regression analysis was performed. The study data was analyzed by using $SPSS_{13}$ (SPSS Inc., Chicago, IL) at a significance level of $P < 0.05$.

## Results

Out of 560 patients who underwent coronary angiography, 352 cases (58%) were male. Angiographic results were positive in 80.6% of men and 68.9% of women (P = 0.002). Table 1 presents the levels of total cholesterol, HDL-C, triglyceride, FBS, systolic and diastolic blood pressure, age, BMI, and waist circumference in individuals with or without coronary artery disease (with positive and negative angioplasty, respectively) stratified based on gender. In both genders, there were significant differences regarding age and FBS levels between patients with positive and negative angiography results. A significant difference in systolic blood pressure between the two groups was observed only in men. On the other hand, women of the two groups were significantly different in terms of triglyceride and HDL-C levels.

Table 2 shows the frequency of disorders like high cholesterol, low HDL-C, high serum triglyceride levels, diabetes and hypertension in the two groups of patients with positive and negative results of coronary angiography. While men only significantly differed in diabetes, women were different in terms of

**Table 1.** Comparison the mean values of risk factors stratified based on gender in patients with positive and negative angiography results

| Angiography result | Male | | | Female | | | Total |
|---|---|---|---|---|---|---|---|
| | n = 352 | | | n = 235 | | | n = 587 |
| | Positive | Negative | | Positive | Negative | | |
| | n = 262 | n = 63 | P | n = 162 | n = 73 | P | |
| | Mean ± SD | Mean ± SD | | Mean ± SD | Mean ± SD | | Mean ± SD |
| Total-C | 196.47 ± 40.14 | 196.43 ± 34.32 | 0.994 | 217.79 ± 3.67 | 206.6 ± 38.39 | 0.057 | 203.84 ± 41.34 |
| HDL-C | 38.29 ± 9.16 | 38.94 ± 9.05 | 0.613 | 42.33 ± 9.65 | 47.05 9.62 | 0.001 | 40.67 ± 9.80 |
| TG | 166.27 ± 85.46 | 172.52 ± 85.59 | 0.606 | 189.39 ± 98.44 | 160.01 ± 80.83 | 0.018 | 172.87 ± 89.32 |
| FBS | 124.48 ± 52.69 | 108.95 ± 31.37 | 0.003 | 136.28 ± 60.23 | 118.68 ± 41.61 | 0.011 | 125.41 ± 52.40 |
| SBP | 124.69 ± 16.47 | 119.56 ± 18.29 | 0.031 | 126.92 ± 19.37 | 121.82 ± 20.63 | 0.068 | 133.18 ± 27.55 |
| DBP | 70.39 ± 12.04 | 68.17 ± 12.38 | 0.105 | 69.92 ± 14.77 | 70.13 ± 11.95 | 0.916 | 69.57 21.82 |
| Age | 58.99 ± 9.61 | 54.95 ± 9.69 | 0.003 | 60.38 ± 8.14 | 55.36 ± 8.28 | 0.000 | 58.47 ± 9.32 |
| WC | 94.71 ± 12.08 | 92.87 ± 13.02 | 0.288 | 97.40 ± 11.37 | 96.71 ± 12.47 | 0.681 | 95.55 ± 12.10 |
| BMI | 25.67 ± 3.83 | 26.34 ± 4.03 | 0.219 | 28.43 ± 4.29 | 28.04 ± 5.06 | 0.538 | 26.86 ± 4.34 |

CAD: Coronary artery disease; Total-C: Total cholesterol; HDL-C: High density lipoprotein cholesterol; TG: Triglyceride; FBS: Fasting blood sugar; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; WC: Waist circumference; BMI: Body mass index

**Table 2.** Comparing the prevalence of risk factors between patients with positive and negative angiography results stratified based on gender

| Angiography result | Male | | | Female | | | Total |
|---|---|---|---|---|---|---|---|
| | Positive | Negative | P | Positive | Negative | P | |
| Hypercholesterolemia | 43.5 | 46.0 | 0.778 | 65.4 | 55.6 | 0.187 | 51.6 |
| Low HDL-C | 64.5 | 61.9 | 0.770 | 77.8 | 64.4 | 0.038 | 68.0 |
| Hypertriglyceridemia | 48.2 | 56.5 | 0.260 | 58.1 | 39.7 | 0.011 | 50.9 |
| Diabetes | 33.7 | 9.5 | 0.000 | 42.2 | 31.5 | 0.119 | 33.2 |
| Hypertension | 60.7 | 47.4 | 0.067 | 78.3 | 64.3 | 0.026 | 65.0 |
| High WC | 56.0 | 45.2 | 0.156 | 95.0 | 97.5 | 0.371 | 70.7 |
| High BMI | 12.7 | 20.6 | 0.111 | 29.9 | 27.8 | 0.877 | 20.6 |

HDL-C: High density lipoprotein cholesterol; WC: Waist circumference; BMI: Body mass index
Values are expressed as percentages.



www.mui.ac.ir

hypertriglyceridemia, hypertension, and low HDL-C.

Table 3 compares angiographic scores of patients with positive angiographic results between genders, and patients with or without any of the risk factors (rows of the table). In addition, the angiographic scores in each group of men and women were compared between subjects with and without risk factors (columns of the table). Except for smoking, in which men and women were not significantly different due to the very low number of female smokers, significant differences were observed between women and men in terms of angiographic scores, i.e. men scored much higher. Angiographic scores were also significantly different between obese and non-obese men as well as diabetic and non-diabetic men. The only detected difference among women was higher angiographic scores of diabetics compared to non-diabetics.

Age (odds ratio (OR): 1.067; 1.038-1.096), smoking (OR: 4.152; 2.179-7.909), systolic blood pressure (OR: 1.009; 1-1.018), HDL-C levels (OR: 0.97; 0.948-0.993), and FBS level (OR: 1.007; 1.002-1.012) were significantly entered into the logistic regression analysis model.

The obtained model from GLM analysis by considering involvement scores of patients with positive angiography as the quantitative dependent variable, gender and smoking as fixed factors and other variables with quantitative scale as covariates was reported as significant ($P < 0.001$; $df = 12$; $f = 6.71$). The model's r-squared and adjusted r-squared were equal to 0.188 and 0.160, respectively. Diastolic blood pressure ($P = 0.002$; $df = 1$; $f = 9.71$), FBS level ($P < 0.001$; $df = 1$; $f = 18.34$), BMI ($P = 0.004$; $df = 1$; $f = 8.55$), HDL-C level ($P = 0.005$; $df = 1$; $f = 7.91$), and gender ($P = 0.016$; $df = 1$; $f = 5.87$) were significantly entered into the model. However, systolic blood pressure ($P = 0.711$; $df = 1$; $f = 0.138$), age ($P = 0.152$; $df = 1$; $f = 2.07$), waist circumference ($P = 0.518$; $df = 1$; $f = 0.418$), blood triglyceride levels ($P = 0.721$; $df = 1$; $f = 0.128$), LDL-C level ($P = 0.138$; $df = 1$; $f = 2.21$), and smoking status ($P = 0.092$; $df = 1$; $f = 2.855$) were not included. Accordingly, samples of patients with positive angiography results were divided into two gender-based groups. For each gender, the factors that were significantly entered into the GLM model were separately examined in the multifactorial linear regression model (Table 4).

**Table 3.** Comparison of mean angiographic scores in patients with positive angiography between the two genders

| | **Female** | | | **Male** | | | | | **Total** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **± SD** | **N.** | **Mean** | **± SD** | **N.** | ***P-value** | **t** | **Mean** | **± SD** | **N.** |
| Total | 10.90 | 4.92 | 266 | 8.78 | 4.63 | 170 | < 0.001 | 4.48 | 10.08 | 4.91 | 436 |
| Obese people | 13.21 | 4.02 | 33 | 9.78 | 4.64 | 51 | 0.001 | 3.58 | 11.13 | 4.69 | 84 |
| Non-obese people | 10.59 | 4.96 | 230 | 8.36 | 4.59 | 119 | < 0.001 | 4.07 | 9.83 | 4.95 | 349 |
| P (t)** | 0.001 (- 3.39) | | | 0.067 (- 1.84) | | | | | 0.030 ( - 2.1) | | |
| People with high blood pressure | 10.93 | 4.74 | 149 | 9.12 | 4.72 | 132 | 0.002 | 3.19 | 10.08 | 4.81 | 281 |
| People without high blood pressure | 11.10 | 5.15 | 97 | 7.71 | 4.26 | 35 | < 0.001 | 4.65 | 10.20 | 5.14 | 132 |
| P (t)** | 0.799 (0.25) | | | 0.110 (- 1.60) | | | | | 0.824 (0.22) | | |
| Hypercholesterolemia | 11.50 | 4.78 | 115 | 9.07 | 4.89 | 109 | < 0.001 | 3.76 | 10.32 | 4.97 | 224 |
| Lack of hypercholesterolemia | 10.40 | 4.96 | 150 | 8.08 | 4.09 | 56 | 0.002 | 3.10 | 9.77 | 4.84 | 206 |
| P (t)** | 0.070 (- 1.82) | | | 0.199 (- 1.29) | | | | | 0.247 (- 1.15) | | |
| Diabetes | 12.13 | 4.97 | 88 | 9.69 | 4.74 | 71 | 0.002 | 3.14 | 11.04 | 5.00 | 159 |
| Absence of diabetes | 10.31 | 4.79 | 176 | 8.18 | 4.52 | 96 | < 0.001 | 3.51 | 9.56 | 4.80 | 272 |
| P (t)** | 0.004 (- 2.87) | | | 0.039 (- 2.08) | | | | | 0.002 (- 3.04) | | |
| Smokers | 11.43 | 4.45 | 118 | 9.71 | 6.21 | 7 | 0.969 | 0.33 | 11.33 | 4.55 | 125 |
| Non-smokers | 10.42 | 5.31 | 135 | 8.63 | 4.64 | 150 | 0.003 | 3.03 | 9.84 | 5.04 | 285 |
| P (t)** | 0.106 (- 1.64) | | | 0.557 (- 0.59) | | | | | < 0.001 (- 3.52) | | |

* compared between the two genders

** compared between the two groups of risk factors



www.mui.ac.ir

**Table 4.** Regression coefficients of effective factors involved in angiography score stratified based on gender

| | B | 95% CI for B | Standardized coefficients | t | P |
|---|---|---|---|---|---|
| **Male** | | | | | |
| FBS | 0.017 | 0.005, 0.28 | 0.181 | 2.905 | 0.004 |
| DBP | 0.044 | 0.15, 0.73 | 0.191 | 3.033 | 0.003 |
| HDL-C | -0.061 | -0.13, 0.007 | -0.114 | -1.764 | 0.079 |
| BMI | 0.146 | -0.15, 0.307 | 0.115 | 1.789 | 0.075 |
| Constant | 4.308 | -1.902, 10.519 | - | 1.367 | 0.173 |
| **Female** | | | | | |
| FBS | 0.016 | 0.005, 0.28 | 0.210 | 2.767 | 0.006 |
| DBP | 0.005 | -0.025, 0.035 | 0.024 | 0.307 | 0.759 |
| HDL-C | - 0.081 | -0.155, -0.008 | -0.167 | -2.185 | 0.030 |
| BMI | 0.223 | 0.055, 0.390 | 0.202 | 2.630 | 0.009 |
| Constant | 3.502 | -2.305, 9.308 | - | 1.191 | 0.235 |

FBS: Fasting blood sugar; DBP: Diastolic blood pressure; HDL-C: High density lipoprotein cholesterol; BMI: Body mass index

## Discussion

Based on the findings of this study, FBS levels were significantly different between patients with stable angina and atherosclerotic coronary arteries confirmed by coronary angiography and those with negative angiography results among both genders. This difference remained slight but significant even after eliminating diabetic women. On the other hand, the prevalence of diabetes only differed between the two groups of male patients. In addition, the significant age differences in both groups emphasized the importance of the results obtained from multivariate analyses after matching for age. However, the general significant differences in angiographic scores between men and women, makes the interpretation of gender-based differences between groups with and without risk factors difficult.

In this study, significant relationships were observed between angiographic scores of patients with positive angiographic results and risk factors such as gender, obesity, and diabetes. Moreover, the association between FBS and angiographic scores remained significant among both genders even after adjustments for age. In addition, relationships were detected between angiographic scores and BMI and blood HDH-C levels among women. On the other hand, FBS and diastolic blood pressure were significantly correlated with and angiographic scores among men.

This study could only reveal an association between diastolic blood pressure and increased angiographic scores in men. Although Chang et al. found a similar relationship between patients' blood pressure (measured by pulse pressure) and the severity of coronary artery disease, they could not establish such relation with diastolic blood pressure.[15] Jankowski et al. reported higher systolic blood pressure among patients with three atherosclerotic vessels involvement than those with one involved vessel. Nevertheless, this increase in blood pressure was not proved as an independent risk factor in the extent of coronary artery stenosis.[7] Another study in the same region confirmed the relationship between systolic blood pressure and the extent of coronary artery involvement.[16] Hence, the effect of diastolic blood pressure on the extent and severity of coronary artery involvement in men was a remarkable finding.

The difference seen between the two genders in terms of angiographic score was also reported by another study in which the extent of coronary artery involvements were higher among men.[7] Such a difference existed between all groups of patients having one risk factor with others.

Based on our results, diabetics and non-diabetics of both genders were also significantly different in terms of angiographic scores, i.e. having diabetes increased the severity and extent of atherosclerotic involvements even after adjustment for age in multivariate analysis. Another study also suggested the extent and severity of atherosclerotic involvements in diabetes type 1 patients to be significantly higher than the normal population.[17] Similarly, Fallow and Singh indicated the severity of coronary artery involvements to be more and the prognosis to be worse in diabetics compared to non-diabetics.[18] On the contrary, some other studies could not confirm a relationship between diabetes duration and severity and the extent of coronary atherosclerotic involvement.[19] In the present study, in addition to the relationship of increased FBS level with positive angiographic result, a relationship was also observed between FBS and increased severity of coronary artery involvement in both genders of patients with coronary stenosis (positive result of coronary angiography).



www.mui.ac.ir

Our results regarding the association between obesity and severity and extent of coronary artery involvements were consistent with the Framingham study in which obesity was introduced as an independent risk factor for the incidence of cardiovascular disease in both genders.[20] However, we only found the severity and extent of coronary artery involvements in obese men to be more than thin or normal-weight men. Multivariate analysis of risk factors with coronary artery stenosis score revealed increased BMI to be also associated with increased coronary artery involvement in women. In accordance with our findings, Al Suwaidi et al. emphasized obesity as an independent factor in coronary endothelial dysfunction in patients with coronary artery disease.[21]

Elevated triglyceride levels and reduced HDL-C levels have been reported in several studies to be associated with the intensity and extent of coronary artery involvements.[5,22,23] Based on our results, serum HDL-C level was linked with the intensity and extent of coronary artery involvement in women (i.e. low HDL-C levels were significantly associated with angiographic score in the females). In addition, a one-unit increase in HDL-C level caused a 3%-reduction in the risk of coronary artery disease.

Another important finding of this study was the effect of smoking on the incidence of coronary artery disease and the severity and extent of involvements. Smoking increased the coronary stenosis risk by 4-folds. Moreover, the severity scores of coronary artery involvements in smokers were significantly higher. However, this difference in the two genders was not significant.

The findings of this study showed diabetes, obesity, high diastolic blood pressure, and low serum HDL-C levels to have the most significant correlations with the extent of coronary artery stenosis. Therefore, preventing and controlling these risk factors through lifestyle modification and drug therapy, in necessary cases, are of high importance.

## Acknowledgments

The Persian version of this article has been previously published in Journal of Isfahan Medical School: 2007, No: 85; 61-71.

## Conflict of Interests

Authors have no conflict of interests.

## References

1. Truelsen T, Mahonen M, Tolonen H, Asplund K, Bonita R, Vanuzzo D. Trends in stroke and coronary heart disease in the WHO MONICA Project. Stroke 2003; 34(6): 1346-52.
2. Phillips GB, Pinkernell BH, Jing TY. Are major risk factors for myocardial infarction the major predictors of degree of coronary artery disease in men? Metabolism 2004; 53(3): 324-9.
3. Norhammar A, Malmberg K, Diderholm E, Lagerqvist B, Lindahl B, Ryden L et al. Diabetes mellitus: the major risk factor in unstable coronary artery disease even after consideration of the extent of coronary artery disease and benefits of revascularization. J Am Coll Cardiol 2004; 43(4): 585-91.
4. Kullo IJ, Bailey KR, McConnell JP, Peyser PA, Bielak LF, Kardia SL et al. Low-density lipoprotein particle size and coronary atherosclerosis in subjects belonging to hypertensive sibships. Am J Hypertens 2004; 17(9): 845-51.
5. Sposito AC, Mansur AP, Maranhao RC, Martinez TR, Aldrighi JM, Ramires JA. Triglyceride and lipoprotein (a) are markers of coronary artery disease severity among postmenopausal women. Maturitas 2001; 39(3): 203-8.
6. Jankowski P, Kawecka-Jaszcz K, Bryniarski L, Czarnecka D, Brzozowska-Kiszka M, Posnik-Urbanska A et al. Fractional diastolic and systolic pressure in the ascending aorta are related to the extent of coronary artery disease. Am J Hypertens 2004; 17(8): 641-6.
7. Jankowski P, Kawecka-Jaszcz K, Bilo G, Pajak A. Determinants of poor hypertension management in patients with ischemic heart disease. Blood Press 2005; 14(5): 284-92.
8. Syvanne M, Pajunen P, Kahri J, Lahdenpera S, Ehnholm C, Nieminen MS et al. Determinants of the severity and extent of coronary artery disease in patients with type-2 diabetes and in no diabetic subjects. Coron Artery Dis 2001; 12(2): 99-106.
9. American Diabetes Association: clinical practice recommendations 1995. Diabetes Care 1995; 18 (Suppl 1): 1-96.
10. Zipes DP, Libby P, Bonow R, Braunwald E. Factors for Atherosclerosis Disease. Heart Disease. Philadelphia: W.B. Saunders; 2005. p. 1013-56.
11. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL. et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension 2003; 42(6): 1206-52.
12. Abolfotouh MA, Abdel AM, Alakija W, Al Safy A, Khattab MS, Mirdad S et al. Smoking habits of King Saud University students in Abha, Saudi Arabia. Ann Saudi Med 1998; 18(3): 212-6.
13. National Institutes of Health NHLabi. Clinical guideline on the identification, evaluation and treatment of overweight and obesity in adults: the evidence report. National Institutes of health, National Heart, Lung and blood Institute 1998; 1-228.



www.mui.ac.ir

**14.** Braunwald E. The history Heart Disease. 7 ed. Philadelphia: W.B. Saunders; 2005. p. 63-76
**15.** Chung NA, Lydakis C, Belgore F, Li-Saw-Hee FL, Blann AD, Lip GY. Angiogenesis, thrombogenesis, endothelial dysfunction and angiographic severity of coronary artery disease. Heart 2003; 89(12): 1411-5.
**16.** Sadeghi M, Roohafza HR, Kelishadi R. High blood pressure and associated cardiovascular risk factors in Iran. Isfahan Healthy Heart Programme. Med J Malaysia 2004; 59(4): 460-7.
**17.** Pajunen P, Taskinen MR, Nieminen MS, Syvanne M. Angiographic severity and extent of coronary artery disease in patients with type 1 diabetes mellitus. Am J Cardiol 2000; 86(10): 1080-5.
**18.** Fallow GD, Singh J. The prevalence, type and severity of cardiovascular disease in diabetic and no diabetic patients: a matched-paired retrospective analysis using coronary angiography as the diagnostic tool. Mol Cell Biochem 2004; 261(1-2): 263-9.
**19.** Norhammar A, Malmberg K, Diderholm E, Lagerqvist B, Lindahl B, Ryden L et al. Diabetes mellitus: the major risk factor in unstable coronary artery disease even after consideration of the extent of coronary artery disease and benefits of Revascularization. J Am Coll Cardiol 2004; 43(4): 585-91.
**20.** Fleir JS. Obesity. In: Kasper Dl, Braunwald E, Fauci As, Hauser Sl, Longo Dl, Jameson JL, Editors. Harrison's principles of internal medicine. New York: McGraw Hill; 2001. p. 479-90.
**21.** Al Suwaidi J, Higano ST, Holmes DR, Lennon R, Lerman A. Obesity is independently associated with coronary endothelial dysfunction in patients with normal or mildly diseased coronary arteries. J Am Coll Cardiol 2001; 37(6): 1523-8.
**22.** Ducas J, Silversides C, Dembinski TC, Chan MC, Tate R, Dick A et al. Apolipoprotein (a) phenotypes predict the severity of coronary artery stenosis. Clin Invest Med 2002; 25(3): 74-82.
**23.** Nishtar S, Wierzbicki AS, Lumb PJ, Lambert-Hammill M, Turner CN, Crook MA et al. Waist-hip ratio and low HDL predict the risk of coronary artery disease in Pakistanis. Curr Med Res Opin 2004; 20(1): 55-62.



www.mui.ac.ir