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Prevalence and Risk Factors of Abnormal Coronary Angiography Findings

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Abstract

Background: Coronary artery occlusion is the primary reason for cardiovascular disease-related death worldwide. Hence, it is essential to identify the associated primary determinants for the proper prevention of coronary artery disease (CAD) and its related mortality and morbidity.
Objectives: We investigated the association between cardiovascular risk factors and occlusion of coronary arteries.
Patients and Methods: Using a cross-sectional study design, the medical records of 2046 consecutive patients suspected with cardiovascular disorders and referred to the angiography center at Imam Hossein hospital in Ilam province, Iran, between January 2010 and January 2012, were reviewed by census. Based on the angiography findings, the patients were classified as normal or included into coronary artery groups. The risk factors for cardiovascular disorders were also recorded. Binary and multivariable logistic regression models were used to determine the adjusted odds ratio (OR) for each risk factor.
Results: The final multivariable regression modeling showed that gender (OR = 3.44, 95% CI: 1.02 - 5.58), age (OR = 1.10, 95% CI: 1.05 - 1.15), family history of CAD (OR = 1.12, 95% CI: 1.30 - 1.94), current smoking (OR = 1.50, 95% CI: 1.02 - 1.98), systolic blood pressure (OR = 1.16, 95% CI: 1.05 - 1.28), diastolic blood pressure (OR = 1.04, 95% CI: 1.00 - 1.09), and high density lipoprotein (HDL)-cholesterol level (OR = 1.04, 95% CI: 1.00 - 1.08) significantly increased the risk for coronary artery occlusion.
Conclusions: Among the various non-modifiable variables, gender, age, and family history of CAD and among the modifiable variables, smoking, hypertension, and reduced HDL-cholesterol level increased the risk for coronary artery involvement. Further cohort studies and meta-analyses are required to delineate the causative association between these risk factors and coronary artery occlusion.

Keywords: Abnormal Coronary Angiography, Prevalence, Coronary Artery

1. Background

Cardiovascular disorders are one of the primary causes of mortality in most countries of the world (1), accounting for more than one-third of deaths in western countries (2). In Iran, more than 50% of mortalities are caused by cardiovascular disorders that have been identified as the major reason for death in different age subgroups (3). Various underlying factors such as hypertension, dyslipidemia, cigarette smoking, and family history of coronary artery disease (CAD) have been identified as major triggering factors for coronary artery involvement (4). It has been suggested that these factors may not only trigger CAD but also be responsible for the progression of CAD, a fact that has not yet been completely approved by all researchers (5). Several hypotheses have been proposed with regard to the potential effects of high consumption of saturated fats and cholesterol, which leads to the formation of atheroma plaques and arterial stenosis (6, 7). Kasaoka et al. (8) showed that increased levels of blood pressure and serum cholestrol in Japanese diabetic individuals were not associated with the distribution of coronary lesions; however, the severity of coronary lesions was significantly higher in patients with high serum cholesterol concentration. This relationship with respect to the increased level of cholesterol was confirmed in several studies; however, conflicting results were obtained regarding elevated blood pressure and smoking (9, 10).

Various diagnostic approaches are available for the assessment of patients suspected with CAD, among which coronary angiography is most commonly used for the diagnosis of CAD. At present, more than one million people annually in the united states of America undergo cardiac catheterization for diagnosis and treatment (11). Several researchers have considered this method can be used for

assessing symptomatic as well as asymptomatic subjects who just have the risk factors for cardiovascular disorders (12).

2. Objectives

In this study, we aimed to determine the association between risk factors for CAD and the odds ratio for coronary artery involvement in patients undergoing coronary angiography.

3. Patients and Methods

Study population: This cross-sectional study reviewed the medical records of all consecutive patients suspected with cardiovascular disorders and referred to the angiography center at Imam Hossein hospital in Ilam province, Iran, between January 2010 and January 2012, by census sampling. In total, 3265 recorded files were assessed, among which 2046 files were complete and finally reviewed. Baseline characteristics and clinical data of the patients, including demographics, traditional risk factors for CAD, laboratory analyses results, and angiography findings, were extracted from the files by trained experts deployed in the angiography ward and collected using the study questionnaire (Figure 1).

Study parameters: In this study, the use of at least 10 cigarettes/day was considered as the criterion for cigarette smoking. Family history of CAD was defined as the presence of disease among first-degree relatives (sister, brother, father, and mother) of the patients, which developed before the age of 55 years old in men and before the age of 65 years old in women. Hypercholesterolemia was defined as total cholesterol $\geq$ 5.0 mmol/L, high density lipoprotein (HDL)-cholesterol $\geq$ 1.0 mmol/L in men or $\geq$ 1.1 mmol/L in women, and triglycerides $\geq$ 2.0 mmol/L; hypertension was defined as systolic blood pressure $\geq$ 140 mmHg and/or diastolic $\geq$ 90 mmHg and/or on antihypertensive treatment (13); and diabetes mellitus was defined as the presence of symptoms of diabetes plus at least one of the following: plasma glucose concentration $\geq$ 11.1 mmol/L, fasting plasma glucose $\geq$ 7.0 mmol/L, and 2-h pp $\geq$ 11.1 mmol/L. Each case had a standard CD of angiography, which was performed using the Seldinger method and interpreted by a single cardiologist in terms of CAD. For preventing between-observer variations, only a single cardiologist was employed to assess CD angiography.

3.1. Statistical Analysis

The results are expressed as mean $\pm$ standard deviation (SD) for quantitative variables and percentages for categorical variables. The groups were compared using the student's t-test for continuous variables and chi-square test (or Fisher's exact test, if required) for categorical variables. Predictors exhibiting a statistically significant relationship with CAD were taken for binary multivariate logistic regression analysis to investigate their independence as predictors adjusted for age and other independent parameters. Odds ratio (OR) and 95% confidence intervals (CI) were calculated. $P \leq 0.05$ was considered statistically significant. All the statistical analyses were performed using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA) and SAS version 9.1 for Windows (SAS Institute Inc., Cary, NC, USA).

4. Results

Of the 2046 studied subjects, 937 (45.78%) were males and 1109 (54.22%) were females. In total, 791 cases (38.66%) had normal coronary angiography and others had abnormal angiographic findings. In both genders, patients with abnormal angiography features were older with higher systolic and diastolic blood pressures than those with normal angiography (Table 1). However, the two groups were similar in terms of lipid profile status. Fasting blood glucose was higher in female CAD group than in non-CAD group; however, this discrepancy was not observed among men with and without CAD. Residency status (rural or urban areas) did not affect CAD appearance in both men and women. In both genders, a family history of CAD was more prevalent in CAD than in non-CAD group; however, current smoking was more prevalent in male CAD patients but not in female patients compared with non-CAD group (Table 2).

Binary univariate analysis showed that among all baseline variables, male gender (OR = 2.15, 95% CI: 1.78 - 2.58), age (OR = 1.07, 95% CI: 1.06 - 1.08), smoking (OR = 2.00, 95% CI: 1.52 - 2.43), family history of CAD (OR = 1.47, 95% CI: 1.11 - 1.94), systolic blood pressure (OR = 1.02, 95% CI: 1.00 - 1.06), diastolic blood pressure (OR = 2.98, 95% CI: 2.97 - 2.99), low HDL-cholesterol (OR = 1.01, 95% CI: 1.00 - 1.02), and high total cholesterol level (OR = 1.100, 95% CI: 1.09 - 2.08) were the determinants of abnormal angiography features, while LDL-cholesterol and high fasting blood glucose could not predict this abnormal coronary features. In this context, the multivariable regression model (Table 3) showed that gender (OR = 3.44, 95% CI: 1.02 - 5.58), age (OR = 1.10, 95 % CI: 1.05 - 1.15), family history of CAD (OR = 1.12, 95% CI: 1.30 - 1.94), current smoking (OR = 1.50, 95% CI: 1.02 - 1.98), systolic blood pressure (OR = 1.16, 95% CI: 1.05 - 1.28), diastolic blood pressure (OR = 1.04, 95% CI: 1.00 - 1.09), and low HDL-cholesterol level (OR = 1.04, 95% CI: 1.00 - 1.08) significantly increased the risk for coronary artery occlusion.

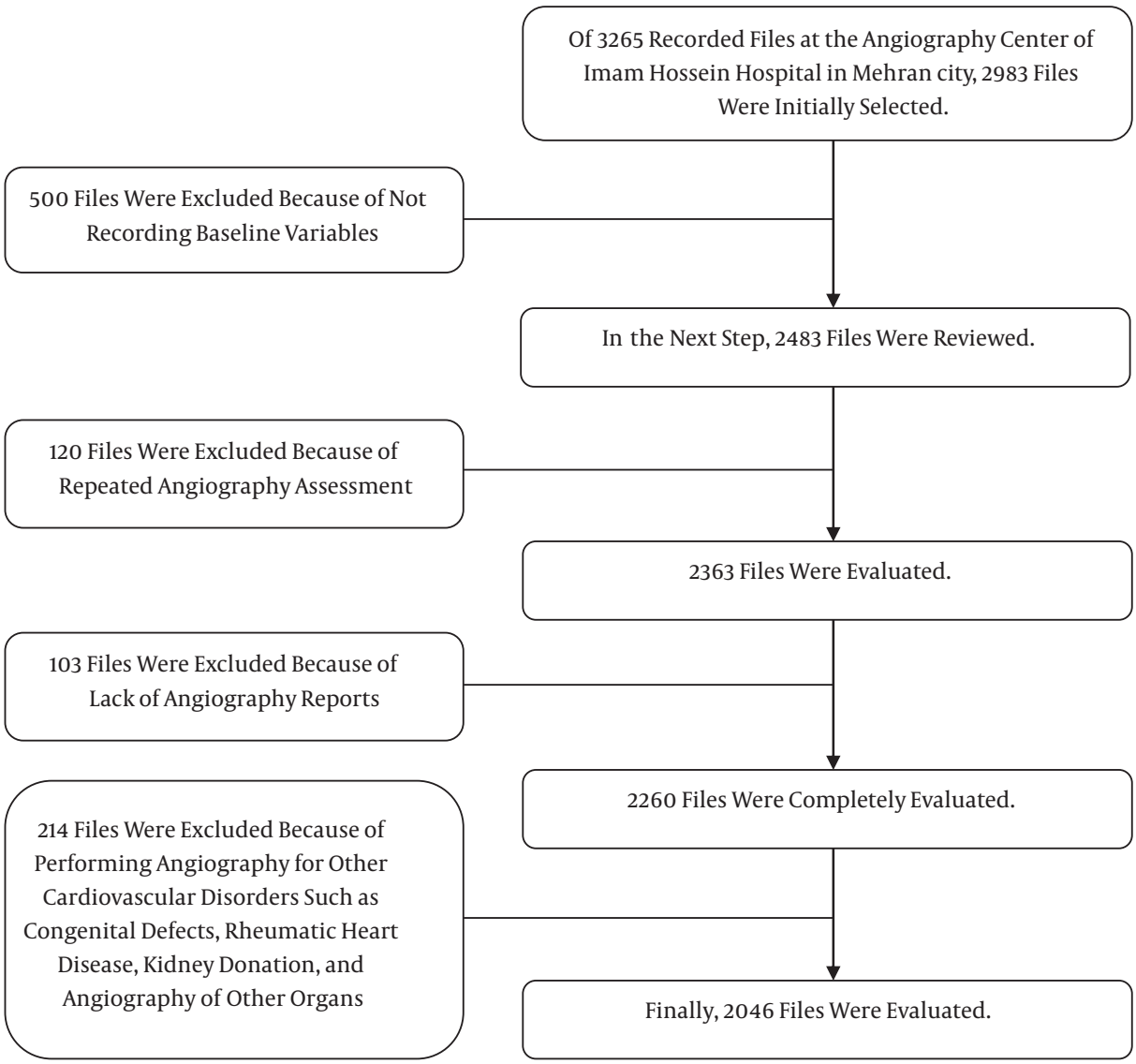

Figure 1. Flow Chart of Selection Procedure

5. Discussion

In the present study, we showed that among the modifiable variables, smoking, low HDL-cholesterol level, and systolic and diastolic blood pressures and among the non-modifiable indicators, male gender, advanced age, and family history of CAD could increase the risk for CAD in our study population. Moreover, univariate regression analysis revealed that increased level of total cholesterol was found to be associated with increased risk of CAD; however, the triggering effect of this variable was eliminated after adjusting for other variables as confounders in the multivariable regression modeling. These results are consistent with those reported by Hosseini et al. who showed that age, diabetes, and high blood pressure are the primary determinants of CAD (14). Therefore, the common triggering variables in our study and their observation were age and hypertension, but not increased level of blood glucose. Although a significant association was also observed in the study by Veeranna et al. (4), diabetes mellitus was not found to be the primary trigger for CAD in the study by Trianti et al. in a non-Iranian community (15). In the current study, after adjusting for gender, both systolic and diastolic blood pressures remained as CAD risk factors, simi-

Table 1. Continuous Coronary Disease Related Risk Factors in Patients With Normal and Abnormal Angiography Features[a]

Variables	Men			Women		
	Normal Angiography (n = 269)	Abnormal Angiography (n = 668)	P Value	Normal Angiography (n = 515)	Abnormal Angiography (n = 581)	P Value
Age, y	50.8 ± 12.5	60.1 ± 12.4	< 0.001	51.8 ± 11.2	61.9 ± 10.7	< 0.001
Systolic blood pressure, mmHg	126.1 ± 14.4	131.0 ± 20.1	< 0.001	129.4 ± 18.4	135.6 ± 20.9	< 0.001
Diastolic blood pressure, mmHg	77.7 ± 10.2	79.4 ± 10.9	0.05	77.0 ± 12.3	78.8 ± 13.8	0.04
LDL-cholesterol, mmHg	102.0 ± 30.0	102.5 ± 32.4	0.92	107.0 ± 34.7	109.5 ± 58.3	0.67
HDL-cholesterol, mmHg	55.0 ± 15.5	51.7 ± 12.9	0.13	58.4 ± 15.7	58.9 ± 15.6	0.74
Triglyceride, mmHg	136.9 ± 81.6	146.3 ± 112.8	0.39	161.8 ± 121.8	163.5 ± 112.4	0.45
Total cholesterol, mmHg	178.1 ± 45.5	174.7 ± 53.7	0.86	186.2 ± 44.8	183.0 ± 9.5	0.15
Fasting blood sugar, mmHg	115.8 ± 56.0	120.5 ± 60.6	0.80	111.5 ± 45.6	123.7 ± 57.3	0.02

[a]Values are expressed as mean ± SD.

Table 2. Prevalence of Cardiovascular Related Risk Factors Among Those With Normal and Abnormal Angiography According to Gender[a]

Variables	Male			Female		
	Normal Angiography	Abnormal Angiography	P Value	Normal Angiography	Abnormal Angiography	P Value
Residency			0.96			0.96
Urban area	234 (29.0)	574 (71.0)		456 (46.7)	520 (53.3)	
Rural area	37 (29.1)	90 (70.9)		61 (46.9)	69 (53.1)	
Current smoking			0.04			0.36
Yes	72 (24.3)	224 (75.7)		17 (39.5)	26 (60.5)	
No	94 (30.5)	214 (69.5)		317 (46.7)	362 (53.3)	
Family history			0.05			0.01
Yes	23 (17.8)	106 (82.2)		73 (38.8)	115 (61.2)	
No	88 (25.9)	252 (74.1)		211 (49.4)	216 (50.6)	

[a]Values are expressed as No. (%).

lar to another study by Fakhir Nafakhi et al. (16), but not to the study by Veeranna et al. (4).

Smoking is a widespread habit among the general population in developing countries (17) and has been shown to be a major risk factor for CAD (18). In our study, the relationship between smoking and abnormal angiography pattern was revealed by both univariate and multivariate regression models; however, this association was more prominent in men, indicating the higher prevalence of smoking as a risk factor in men than in women referred for angiography assessment. This finding is similar to those reported by Darabian et al. in their study on Iranian patients (19) and by Habib et al. in their study on Arab patients (20). In contrast, the association between smoking and coronary artery occlusion was not achieved in other studies performed by Masoumi et al. (21) and Bigi et al. (22).

Lipoprotein changes, including increased level of total cholesterol, triglyceride, and LDL-cholesterol, as well as reduced level of HDL-cholesterol, are other factors that influence cardiovascular diseases. In this study, among the different lipid components, low HDL-cholesterol was the primary indicator of CAD, consistent with the study by Sadeghi et al. (23). In addition, Guo et al. (24) showed low HDL-cholesterol level is a strong risk factor predicting

Table 3. Odds Ratio for Risk Factors With Angiography Feature in Men and Women

Variable	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	P Value	OR (95% CI)	P Value
Gender, Male	2.15 (1.78 - 2.58)	< 0.001	3.44 (1.02 - 5.58)	0.04
Current smoking	2.00 (1.52 - 2.48)	< 0.001	1.50 (1.02 - 1.98)	< 0.001
Family history of CAD	1.47 (1.11 - 1.94)	0.007	1.12 (1.03 - 1.98)	0.009
Age	1.07 (1.06 - 1.08)	< 0.001	1.10 (1.05 - 1.15)	< 0.001
Systolic blood pressure	1.02 (1.00 - 1.06)	< 0.001	1.16 (1.05 - 1.28)	0.002
Diastolic blood pressure	2.98 (2.97 - 2.99)	0.004	1.04 (1.00 - 1.09)	0.05
LDL cholesterol	1.00 (0.99 - 1.00)	0.96	0.99 (0.96 - 1.01)	0.45
HDL cholesterol	1.01 (0.99 - 1.02)	0.05	1.04 (1.00 - 1.08)	0.03
Triglyceride	0.99 (0.99 - 1.00)	0.98	1.00 (0.99 - 1.00)	0.26
Total cholesterol	1.00 (1.09 - 2.08)	0.02	0.99 (0.98 - 1.02)	0.32
Fasting blood sugar	0.99 (0.99 - 1.00)	0.16	0.99 (0.98 - 1.00)	0.65

CAD and its severity. However, in our multivariate analysis, the triggering effect of increased total cholesterol on CAD was eliminated. Although Sukhija et al. reported a significant association between increased level of total cholesterol and CAD severity (25), similar to our observation, this association was not revealed in the study by Zand Parsa et al. (26).

Among the non-modifiable risk factors for CAD, the role of advanced age was obvious. Similar to our finding, Hosseini et al. showed higher prevalence of CAD and its severity in older than in younger patients (27). Humphries (28) also showed that average age was higher in those with abnormal angiography features. Moreover, Kreatsoulas et al. (29) showed that the prevalence of artery stenosis or occlusion was different in men and women, which is consistent with our results.

Our study had some potential limitations, including the cross-sectional pattern that leads to an impossibility of determining time priority between the independent and dependent variables. In addition, data extracted from the medical records in some files were unreadable and were inevitably excluded. Data of some confounding variables such as anthropometric indices were also not available in recorded files that were not considered for the analysis.

5.1. Conclusion

In conclusion, among the various non-modifiable variables, gender, age, and family history of CAD and among the modifiable variables, smoking, hypertension, and reduced HDL-cholesterol level increased the risk for coronary artery involvement and thus should be considered as powerful triggers for coronary lesions such as occlusion. Further cohort studies and meta-analyses are required to delineate the causative association between these risk factors and coronary artery occlusion.

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References

1. Khaki-Khatibi F, Yaghoubi AR, Rahbani NM. Study of antioxidant enzymes, lipid peroxidation, lipid profile and immunologic factor in coronary artery disease in East Azarbijan. *Int J Med Biomed Res.* 2013;**1**(2):147–52.
2. Thom T, Haase N, Rosamond W, Howard VJ, Rumsfeld J, Manolio T, et al. Heart disease and stroke statistics–2006 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation.* 2006;**113**(6):e85–151. doi: 10.1161/CIRCULATIONAHA.105.171600. [PubMed: 16407573].
3. Gaziano JM. In:. Zipes DP, Libby P, Bonow RO, Braunwald E, editors. Philadelphia: braunwald's heart disease; 2005. pp. 423–55.Global burden of cardiovascular disease.
4. Veeranna V, Pradhan J, Niraj A, Fakhry H, Afonso L. Traditional cardiovascular risk factors and severity of angiographic coronary artery disease in the elderly. *Prev Cardiol.* 2010;**13**(3):135–40. doi: 10.1111/j.1751-7141.2009.00062.x. [PubMed: 20626669].
5. 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. [PubMed: 15015144].

6. Grundy SM, Bilheimer D, Blackburn H, Brown WV, Kwiterovich PJ, Mattson F, et al. Rationale of the diet-heart statement of the American Heart Association. Report of Nutrition Committee. *Circulation.* 1982;**65**(4):839a–54a. [PubMed: 7060268].
7. Kratz M. Dietary cholesterol, atherosclerosis and coronary heart disease. *Handb Exp Pharmacol.* 2005(170):195–213. [PubMed: 16596800].
8. Kasaoka S, Okuda F, Satoh A, Miura T, Kohno M, Fujii T, et al. Effect of coronary risk factors on coronary angiographic morphology in patients with ischemic heart disease. *Jpn Circ J.* 1997;**61**(5):390–5. [PubMed: 9192238].
9. Fallow GD, Singh J. The prevalence, type and severity of cardiovascular disease in diabetic and non-diabetic patients: a matched-paired retrospective analysis using coronary angiography as the diagnostic tool. *Mol Cell Biochem.* 2004;**261**(1-2):263–9. [PubMed: 15362512].
10. 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 nondiabetic subjects. *Coron Artery Dis.* 2001;**12**(2):99–106. [PubMed: 11281308].
11. Rosenstein G, Cafri C, Weinstein JM, Yeroslavtsev S, Abuful A, Ilia R, et al. Simple clinical risk stratification and the safety of ambulation two hours after 6 French diagnostic heart catheterization. *J Invasive Cardiol.* 2004;**16**(3):126–8. [PubMed: 15152161].
12. Gandelman G, Bodenheimer MM. Screening coronary arteriography in the primary prevention of coronary artery disease. *Heart Dis.* 2003;**5**(5):335–44. doi: 10.1097/01.hdx.0000080717.15994.64. [PubMed: 14503931].
13. The WHO STEPwise approach to Surveillance of noncommunicable diseases non-communicable Diseases and Mental Health . Geneva: World Health Organization; 2003. . Available from: http://www.who.int/ncd_surveillance.
14. Hosseini SA, Salehi A. The relationship between coronary risk factors and coronary artery involvement based on angiogrpahy findings. *Koomesh.* 2012;**14**(1):7–12.
15. Trianti M, Xanthos T, Iacovidou N, Dagres N, Lekakis JP, Kyriakou F, et al. Relationship between individual cardiovascular risk factors and localization of coronary atherosclerotic lesions. *Heart Lung.* 2011;**40**(3):201–7. doi: 10.1016/j.hrtlng.2010.06.007. [PubMed: 20739064].
16. Fakhir Nafakhi HA. Impact of hypertension on angiographic findings in patients with coronary artery disease. *Med Glas (Zenica).* 2013;**10**(1):136–9. [PubMed: 23348176].
17. Porsch-Oezcueruemez M, Bilgin Y, Wollny M, Gediz A, Arat A, Karatay E, et al. Prevalence of risk factors of coronary heart disease in Turks living in Germany: The Giessen Study. *Atherosclerosis.* 1999;**144**(1):185–98. [PubMed: 10381292].
18. Hamrah MS, Harun-Or-Rashid M, Hirosawa T, Sakamoto J, Hashemi H, Emamian MH, et al. Smoking and associated factors among the population aged 40-64 in Shahroud, Iran. *Asian Pac J Cancer Prev.* 2013;**14**(3):1919–23. [PubMed: 23679293].
19. Darabian S, Abbasi A. The correlation of ischemic risk factors with left main tract disease. *Feyz J Kashan Univ Med Sci.* 2007;**11**(3):31–5.
20. Habib SS, Abdel-Gader AM, Kurdi MI, Al-Aseri Z, Soliman MM. Lipoproteina(a) is a feature of the presence, diffuseness, and severity of coronary artery disease in Saudi population. *Saudi Med J.* 2009;**30**(3):346–52. [PubMed: 19271061].
21. Masoumi M, Nasri HR. Relationship between coronary risk factors and the number of involved vessels in coronary angiography. *Hormozgan Med J.* 2006;**10**(1):29–34.
22. Bigi R, Cortigiani L, Colombo P, Desideri A, Bax JJ, Parodi O. Prognostic and clinical correlates of angiographically diffuse non-obstructive coronary lesions. *Heart.* 2003;**89**(9):1009–13. [PubMed: 12923011].
23. Sadeghi M, Pourmand K, Sanei H, Heidari R, Talaei M. Which major atherosclerosis risk factors represents the extent of coronary artery disease?. *ARYA Atheroscler.* 2012;**7**:S63–9.
24. Guo YH, Zhang WJ, Zhou YJ, Zhao D, Zhou ZM, Zhang H. [Study of the relationship between cardiovascular risk factors and severity of coronary artery disease in patients underwent coronary angiography]. *Zhonghua Xin Xue Guan Bing Za Zhi.* 2005;**33**(5):415–8. [PubMed: 15932697].
25. Sukhija R, Aronow WS, Nayak D, Ahn C, Weiss MB. Increased fasting plasma insulin concentrations are associated with the severity of angiographic coronary artery disease. *Angiology.* 2005;**56**(3):249–51. [PubMed: 15889190].
26. Zand Parsa AF, Ziai H, Fallahi B. The relationship between cardiovascular risk factors and the site and extent of coronary artery stenosis according to angiographic findings. *Tehran Univ Med J.* 2010;**63**(8):182–7.
27. Hosseini SA, Abdollahi AA, Behnampour N, Salehi A. Relationship Between Number Of Involved Coronary Artery With Some Risk Factors By Angiography. *Payavard Salamat.* 2013;**6**(5):383–91.
28. Humphries KH, Pu A, Gao M, Carere RG, Pilote L. Angina with "normal" coronary arteries: sex differences in outcomes. *Am Heart J.* 2008;**155**(2):375–81. doi: 10.1016/j.ahj.2007.10.019. [PubMed: 18215611].
29. Kreatsoulas C, Natarajan MK, Khatun R, Velianou JL, Anand SS. Identifying women with severe angiographic coronary disease. *J Intern Med.* 2010;**268**(1):66–74. doi: 10.1111/j.1365-2796.2009.02210.x. [PubMed: 20210841].