Original Article

Association Between the Risk Factors for Cardiovascular Disorders and Coronary Artery Occlusion on Angiography

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ABSTRACT

Background: coronary artery occlusion is the main reason for cardiovascular disease-related deaths the world over. Hence, identifying its main determinants is essential for the proper prevention of coronary artery disease and its-related mortality and morbidity. The present study investigated the association between cardiovascular risk factors and the occlusion of coronary arteries in patients.

Methods: In this cross-sectional study, the medical records of 2046 consecutive patients with suspected cardiovascular disorders who were referred to the Angiography Center at Imam Hossein Hospital in the Iranian province of Ilam between January 2010 and January 2012 were reviewed via census sampling. Based on the angiography findings, the patients were classified as normal or involved 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: In the final multivariable regression modeling, the variables of gender (OR=3.44 and 95% CI: 1.02 to 5.58), age (OR=1.10 and 95% CI: 1.05 to 1.15), a family history of coronary disease (OR=1.12 and 95% CI: 1.30 to 1.94), current smoking (OR=1.50 and 95% CI: 1.02 to 1.98), systolic blood pressure (OR=1.16 and 95% CI: 1.05 to 1.28), diastolic blood pressure (OR=1.04 and 95% CI: 1.00 to 1.09), and high-density lipoprotein cholesterol (HDL-C) (OR=1.04 and 95% CI: 1.00 to 1.08) significantly increased the risk for coronary artery occlusion.

Conclusions: Among the different non-modifiable variables, gender, age, and a family history of CAD and among the modifiable variables, smoking, hypertension, and a reduced HDL-C level increased the risk for coronary involvement. Further cohort studies and meta-analyses are required to clarify the causative association between these risk factors and coronary occlusion.
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KEYWORDS: Cardiovascular disease, Risk factor, Angiography

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Cardiovascular disorders are one of the main causes of mortality in most countries in the entire world, [1] and they account for more than one-third of deaths in Western countries. [2] In Iran, more than 50% of all mortalities are caused by cardiovascular disorders, which have been identified as the major reason for deaths in different age subgroups. [3] Various underlying factors such as hypertension, dyslipidemia, cigarette smoking, and a family history of coronary artery disease (CAD) have been identified as the 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 consensus over this issue, however, has yet to emerge in the medical community. [5] Several hypotheses have been proposed with regard to the potential effects of the high consumption of saturated fats and cholesterol on the formation of atheroma plaques and arterial stenosis. [6, 7] In a study by Kasaoka and colleagues [8] among Japanese diabetics, increased levels of blood pressure and serum cholesterol were not associated with the distribution of coronary lesions, but the severity of coronary lesions was significantly higher in the patients with high serum cholesterol concentrations. This relationship with respect to the increased level of cholesterol has been confirmed in most studies; nevertheless, the results obtained regarding elevated blood pressure levels and smoking are conflicting. [9, 10]

Various diagnostic approaches are available for the assessment of patients with suspected CAD. Coronary angiography is the most common method for the diagnosis of CAD. Today, more than one million individuals annually in the United States of America are undergoing cardiac catheterization for diagnosis and treatment. [11] Substantial evidence shows that this method can be drawn upon to assess not only symptomatic patients but also asymptomatic subjects with only the risk factors for cardiovascular disorders. [12] Our study aimed to determine the association between the risk factors for CAD and the odds ratio (OR) for coronary artery involvement in patients undergoing coronary angiography.

METHODS

Study Population

In the current cross-sectional study, the medical records of all consecutive patients with suspected cardiovascular disorders who were referred to the Angiography Center at Imam Hossein Hospital in the Iranian province of Ilam between January 2010 and January 2012 were reviewed through census sampling. Out of a total of 3265 recorded files, 2046 files were complete and eligible for the final review. The baseline characteristics and clinical data of the patients—including demographics, traditional risk factors for CAD, laboratory analysis results, and angiography findings—were extracted from the files by trained experts deployed on the angiography ward and recorded.

Study Parameters

In this study, the consumption of at least 10 cigarettes per day was considered a criterion for cigarette smoking. A family history of CAD was also defined as the presence of the disease in the first-degree family members (ie, sisters, brothers, father, and mother) of the patients before age 55 in men and before age 65 in women. Hypercholesterolemia was defined as a minimum total cholesterol level of 5.0 mmol/l, a minimum high-density lipoprotein cholesterol (HDL-C) level of 1.0 mmol/l in men or a minimum HDL-C level of 1.1 mmol/l in women, and minimum triglyceride levels of 2.0 mmol/l. Hypertension was defined as a minimum systolic blood pressure of 140 mm Hg and/or a minimum diastolic pressure of 90 mm Hg and/or being on antihypertensive treatment. Diabetes mellitus was defined as the presence of the symptoms of diabetes plus at least one of the following: a minimum plasma

glucose concentration of 11.1 mmol/l, a minimum fasting plasma glucose level of 7.0 mmol/l, and a minimum 2-hour post-prandial level of 11.1 mmol/l. Each patient had a standard CD of angiography, which was performed using the Seldinger method and subsequently interpreted by a single cardiologist with respect to CAD. Between-observer variations were avoided by the employment of only a single cardiologist to assess the angiography CDs.

Statistical Analysis

The results were reported as means ± standard deviations (SDs) for the quantitative variables and percentages for the categorical variables. The groups were compared using the Student *t*-test for the continuous variables and the χ^2 test (or the Fisher exact test, if required) for the categorical variables. The predictors exhibiting a statistically significant relationship with CAD were taken for a binary multivariate logistic regression analysis so as to investigate their independence as the predictors adjusted for age and the other independent parameters. ORs and 95% confidence intervals (CIs) were calculated. A *P* value of 0.05 or less was considered statistically significant. All the statistical analyses were performed using the SPSS software (SPSS Inc, Chicago, IL, USA), version 13.0, and the SAS software, version 9.1, for Windows (SAS Institute Inc, Cary, NC, USA).

RESULTS

Of the 2046 studied subjects, 937 (45.78%) were male and 1109 (54.22%) were female. In total, 791 (38.66%) patients had a normal coronary angiography and the others had abnormal angiographic findings. As is described in Table 1, in both genders, the patients with abnormal angiography features were older and had higher systolic and diastolic blood pressures than those with normal angiography findings. Nonetheless, the 2 groups were similar in terms of their lipid profile. Regarding the level of fasting blood sugar, this laboratory index was higher in the group of women with CAD than in the group of women with no CAD; however, this discrepancy was not observed in the men with and without CAD. The place of residence, defined as that in rural and urban areas, did not affect the incidence of CAD in both men and women. In both genders, a family history of CAD was more prevalent in the group with CAD than in the group with no CAD. In contrast, current smoking was more prevalent in the male patients with CAD but not in the female patients with CAD than in the patients with no CAD (Table 2). The binary univariate analysis showed that among all the baseline variables, the male gender (OR=2.15 and 95% CI: 1.78 to 2.58), age (OR=1.07 and 95% CI: 1.06 to 1.08), smoking (OR=2.00 and 95% CI: 1.52 to 2.43), a family history of CAD (OR=1.47 and 95% CI: 1.11 to 1.94), systolic blood pressure (OR=1.02 and 95% CI: 1.00 to 1.06), diastolic blood pressure (OR=2.98 and 95% CI: 2.97 to 2.99), low HDL-C (OR=1.01 and 95% CI: 1.00 to 1.02), and high total cholesterol (OR=1.100 and 95% CI: 1.09 to 2.08) were the determinants of abnormal angiography features, while LDL-C and high fasting blood sugar could not predict these abnormal coronary features. In this regard, the multivariable regression model (Table 3) revealed that the variables of gender (OR=3.44 and 95% CI: 1.02 to 5.58), age (OR=1.10 and 95% CI: 1.05 to 1.15), a family history of coronary disease (OR=1.12 and 95% CI: 1.30 to 1.94), current smoking (OR=1.50 and 95% CI: 1.02 to 1.98), systolic blood pressure (OR=1.16 and 95% CI: 1.05 to 1.28), diastolic blood pressure (OR=1.04 and 95% CI: 1.00 to 1.09), and low HDL-C (OR=1.04 and 95% CI: 1.00 to 1.08) significantly increased the risk for coronary artery occlusion.

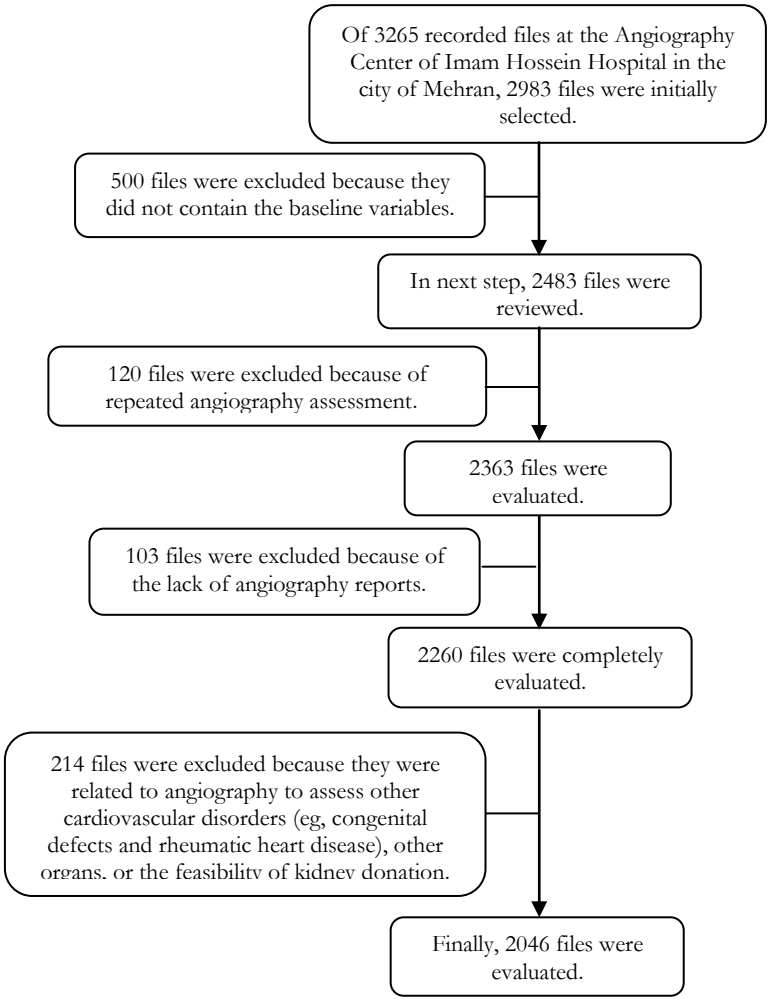

Figure 1. Description of sampling

Table 1. Coronary artery disease-related risk factors in the patients with normal and abnormal angiography features

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

LDL, Low-density lipoprotein; HDL, High-density lipoprotein

Table 2. Prevalence of coronary artery disease-related risk factors among those with normal and abnormal angiography findings according to gender

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

Table 3. Odds ratios for the risk factors with angiography features in the men and women

Variable	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Male gender	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
Triglycerides	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, Coronary artery disease; LDL, Low-density lipoprotein; HDL, High-density lipoprotein

DISCUSSION

According to the results of the present study, among the modifiable variables, smoking, low HLD-C, and systolic and diastolic blood pressures and among the non-modifiable indicators, the male gender, advanced age, and a family history of CAD increased the risk for CAD in our population. Additionally, in the univariate regression analysis, increased levels of total cholesterol were found to be associated with increased risks for CAD; however, we eliminated the triggering effect of this variable and adjusted it for the other variables as a confounder in the multivariable regression modeling. Our study results are consistent with those reported by Hosseini et al, [14] who found that age, diabetes, and a high blood pressure were the main determinants of CAD. Therefore, the common triggering variables in their study and ours were age and hypertension, but not increased levels of blood sugar. Whereas a significant association was also observed in a study by Veeranna et al, [4] diabetes mellitus was not demonstrated as the main trigger for CAD in an investigation by Trianti and colleagues [15] in a non-Iranian community. In the current study and after adjustment for gender, both systolic and diastolic blood pressures remained as CAD risk factors. This finding chimes in with the result of a study by Nafakhi et al [16] but is in contrast to the result reported by Veeranna et al. [4]

Smoking is a widespread habit in developing countries [17] and has been shown as a major risk for CAD. [18] In our study, we found a relationship between smoking and abnormal angiography patterns in both univariate and

multivariate regression models, with this association being more pronounced in the male patients—indicating a higher prevalence of smoking as a risk factor in the men than in the women referred for angiography. This finding is concordant with the results in a study by Darabian et al [19] among Iranians and also in a study by Habib et al [20] among Arab patients, whereas it runs contrary to the results obtained by Masoomi et al [21] and Bigi et al [22] among Iranian subjects.

Changes in the levels of lipoproteins—including increased levels of total cholesterol, triglycerides, and LDL-C, as well as reduced levels of HDL-C—are the other factors that affect cardiovascular diseases. In the current study, among the different lipid components, low HDL-C was the main indicator of CAD; this finding is consistent with the result reported by Sadeghi et al. [23] Likewise, Guo et al [24] showed that low HDL-C was a strong predicting factor of CAD and its severity. However, in our multivariate analysis, we eliminated the triggering effect of increased total cholesterol levels on CAD. In a study by Sukhija et al, [25] the association between increased levels of total cholesterol and CAD severity remained significant. Nonetheless, similar to our observation, this association was not revealed in an investigation by Zand Parsa et al. [26]

Of the non-modifiable risk factors for CAD, the role of advanced age is clear. In line with our findings, Hosseini et al [27] showed a higher prevalence rate of CAD and its severity in their older patients than in their younger counterparts. Similarly, in a study by Humphries and colleagues, [28] the average age was higher in those with abnormal angiography features. Kreatsoulas and colleagues [29] showed that the prevalence of artery stenosis or occlusion was different between their male and female study subjects, which is consistent with our results.

Our study had some potential limitations–including its cross-sectional design, which precluded a determination of time priority between the independent and dependent variables. Furthermore, the illegibility of some data extracted from the patients' medical files led to their exclusion from the analysis. In addition, the data on some confounding variables such as anthropometric indices were not available in the recorded files and were, thus, not considered for the analysis.

CONCLUSIONS

Among the different non-modifiable variables, gender, age, and a family history of CAD and among the modifiable variables, smoking, hypertension, and reduced HDL-C increased the risk for coronary involvement and should, thus, be regarded as the powerful triggers for coronary lesions such as occlusion. Further cohort studies and meta-analyses are required to clarify the causative association between these risk factors and coronary occlusion.

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