Effect of cigarette smoking on coronary arteries and pattern and severity of coronary artery disease: a review

Nahid Salehi¹, Parisa Janjani¹, Hooman Tadbiri², Mohammad Rozbahani¹ and Milad Jalilian¹

Abstract
Objective: Smoking is a risk factor for coronary artery disease (CAD) and a known factor influencing the severity and pattern of CAD. We summarized evidence regarding the effect of smoking on the number of occluded coronary arteries and the severity and pattern of CAD.

Methods: We extracted data from observational studies reporting the pattern and severity of CAD in smokers. The quality of studies was assessed using the Strengthening the Reporting of Observational Studies in Epidemiology checklist, and results are reported in the Garrard table. The review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.

Results: We screened 11 studies including 6037 samples. Six studies reported no relationship between smoking and the number of damaged arteries. One study reported that smoking was related to occlusion in the left anterior descending artery, but there was no relationship between smoking and the location of occlusion in the arteries. Smoking was related to CAD severity in five studies.

Conclusions: Smoking was found to be related to CAD severity and location of the damaged artery in the heart. However, there was no significant association of smoking with the number of damaged arteries and location of arterial occlusion.

¹Cardiovascular Research Center, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran
²Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Corresponding author:
Milad Jalilian, Cardiovascular Research Center, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran.
Email: miladj1994@gmail.com

Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (https://creativecommons.org/licenses/by-nc/4.0/) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (https://us.sagepub.com/en-us/nam/open-access-at-sage).
Introduction

Owing to the increasing number of deaths from non-communicable diseases, especially in developing countries, the World Health Organization has declared non-communicable diseases among the health priorities for the next two decades. Among these, cardiovascular disease is now recognized as the most important and leading cause of death in many countries, seen in 48% of the population in the United States (US). The total annual cost of cardiovascular disease in the US is estimated at USD 180 billion, of which USD 170 billion is for direct costs and USD 10 billion is for indirect costs owing to the loss of production and labor capacity. The overall percentage of deaths from cardiovascular disease during the 20th century rose from 10% to 30%. The main cause of cardiovascular disease is reported to be coronary artery disease (CAD), with 2 out of 10 deaths being associated with CAD, and CAD-related deaths are expected to rise from 17.3 million in 2012 to 23.6 million in 2030. The prevalence of cardiovascular disease is rapidly increasing in developing countries. The coronary arteries, which originate in the aorta and immediately above the aortic valve, are responsible for supplying blood to the heart muscle. Several tests are used to diagnose cardiovascular disease. One of these is angiography, which is the gold standard method for diagnosing CAD. CAD is mostly caused by smoking and physical inactivity, but high blood pressure, dyslipidemia, and some factors related to ethnicity also lead to CAD. Numerous studies have been performed on the prevalence of cardiovascular risk factors in different populations, but inconsistent results have been reported because CAD is a multifactorial disease with risk factors that include age, sex, family history, genetic factors, hypertension, diabetes mellitus, smoking, and high blood cholesterol. As a primary risk factor, smoking plays a major role in premature coronary atherosclerosis and in accelerating atherosclerosis by increasing the oxidation of low-density lipoprotein (LDL) and damaging coronary endothelial vasodilation. In addition to causing CAD, premature and accelerated coronary atherosclerosis are determinants of the severity and extent of vascular occlusion. Understanding the patient’s pattern and severity of vascular occlusion is important because these factors determine the choice of appropriate treatment and the success of treatment. Various studies have examined the effect of multiple risk factors, such as diabetes, hypertension, hyperlipidemia, sex, and smoking, on the pattern and severity of CAD. Of these risk factors, smoking is one of the most important, but related studies have yielded conflicting results.

Given the rapid increase in CAD and the widespread use of tobacco products, including cigarettes, understanding the importance of smoking and its effects on the pattern and severity of CAD is critical. Therefore, in this study, we aimed to aggregate the findings on this topic. Because no studies have reviewed the pattern of
coronary artery occlusion and severity among cigarette smokers, understanding these factors will help physicians in choosing the appropriate treatment for their patients.

**Methods**

**Protocol and search strategy**

This study is registered in Kermanshah University of Medical Sciences. The aim of the study was to report the pattern and severity of CAD in patients who smoked cigarettes. We following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol in this study. This protocol is considered a valid method to comprehensively review past studies, following the conceptual and structural framework of review studies. We performed a comprehensive search using international databases up to 20 March 2021. The searched databases included Web of Sciences, PubMed, Scopus, Cochrane Library, Elsevier, and Google Scholar. The search strategy included MeSH terms and keywords mentioned in published articles, as follows: “cardiovascular,” “coronary artery,” “coronary vessels,” “cigarettes,” and “smoking.” The reference lists of eligible titles were also screened to identify additional articles.

**Inclusion criteria**

Included papers were observational studies, such as retrospective or prospective cohort studies and descriptive or analytical studies. We excluded review articles, letters to the editor, and similar articles. The included studies must have reported the number of occluded coronary arteries and the pattern and/or severity of CAD in patients who smoked cigarettes.

In this study, the pattern of CAD was considered to be the site of the occluded artery in the heart and the site of occlusion in the affected artery. Additionally, the type of occlusion was stenosis or plaque in the artery.

**Search validation and study selection**

All related articles found using our search terms, as well as those in the reference lists of eligible studies, were reviewed. First, all results were entered into Endnote software. The titles of studies were independently reviewed by three authors (MJ, NS, and PJ) to select potential studies for inclusion. The abstract and full text of the selected articles were then screened independently by these authors. Finally, articles that met the inclusion criteria were carefully screened and the data were extracted for the number of affected arteries and the pattern and severity of CAD. Any conflicts among the authors during screening were resolved through discussion. This process was guided by the PRISMA statement. Data were extracted using a standard form and the Garrard table.

**Quality assessment**

The quality of studies is one of the most important criteria for assessing the results of published reports. To assess study quality, we used the 22-item Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist. Each item is scored from 0 to 2, with minimum and maximum scores between 0 and 44. A score of 0 to 15.9 indicates poor quality, a score of 16 to 29.9 medium quality, and a score of 30 to 44 indicates high quality of the study.

**Data extraction and reporting**

Data from all eligible studies were screened and extracted by the research team. The data are reported in a Garrard table. The Garrard table was designed by Judith Garrard as a way to report the
Results

Selected studies
In the initial search, 139 studies were identified. After removing duplicate articles, 128 studies remained. In the evaluation of titles, 98 studies were considered for further screening; after reviewing the abstracts and full text of these articles, 38 studies were retained for data screening.

Finally, we included 11 studies with sufficient data on the number of arteries and pattern and severity of coronary artery occlusion among smokers (Figure 1).

Characteristics of studies
The 11 included studies were conducted between 2006 and 2018. All articles had a retrospective descriptive-analytical design. Seven studies were conducted in Iran and

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram of study selection.
WOS, Web of Science.
the rest were carried out in Italy, China, Japan, and the Netherlands. In all articles, 6037 samples were included, with a minimum and maximum of 80 autopsy samples and 2390 patients, respectively (Table 1).^{19,20,22,23,29–35}

In the 11 included articles, results were reported related to the number of arteries as well as the pattern and severity of CAD. The distribution of studies in terms of number of diseased coronary arteries, severity of coronary artery occlusion, or location of the occluded coronary artery in the heart or the location of occlusion in the coronary artery are as follows: eight results related to the number of coronary arteries, one result related to the location of the coronary artery in the heart, one result related to the location of occlusion in a coronary artery, and five results related to the severity of coronary artery occlusion (Table 1).

In the assessment of the study quality, five studies were high quality, four studies were medium quality, and two studies were poor quality (Table 1).

**Confirmation test**

In 10 studies, patients underwent angiography; autopsy was used in only 1 study (Table 1). Therefore, angiography was the predominant method used to detect coronary artery occlusion. The study of CAD and its mortality dates back to the 18th century, but explanation of the pathogenic processes associated with CAD was published in the middle of the 19th century.^{36} Angiography is the gold standard method used to examine patients with CAD and its use is expanding with new technologies.\textsuperscript{37,38} Angiography was first invented in 1929 by Forssman and further developed in 1956 by Cournard and Richard as a diagnostic method. Sones first used selective coronary angiography in 1963. Coronary angiography refers to radiographic observation of the coronary arteries after contrast injection. In addition to coronary angiography, a complete invasive examination of the patient’s cardiovascular condition involves examination of the cardiac cavities and hemodynamic evaluation.\textsuperscript{39}

**Number of occluded coronary arteries**

In eight included studies, the relationship between smoking and the number of occluded coronary arteries in patients with CAD was investigated. The results in six studies showed no relationship between smoking and the number of damaged coronary arteries. Two studies reported a relationship between smoking and the number of damaged coronary arteries (Table 2); these studies showed that with increased number of cigarettes smoked, the number of occluded coronary arteries was increased.

**Location of occluded arteries in the heart**

Only one study reported a relationship between smoking and occlusion of the left anterior descending (LAD) artery among patients with CAD (Table 2).

**Location of arterial occlusion**

One study assessed the relationship between smoking and the location of occlusion in the coronary arteries. The study found no relationship between smoking and the location of occlusion in coronary arteries, but the number of smokers was higher among patients with non-proximal CAD (Table 2).

**Severity of coronary artery occlusion**

The relationship between smoking and the severity of CAD was investigated in five studies. The results of these studies showed a relationship between smoking and the severity of congestion. With increased number of cigarettes smoked, the severity of CAD was increased.
Table 1. Characteristics of 11 included studies.

| Studies               | Study aim                                                                 | Design | Test | Year - country | Patients/samples | Reported results | Quality - score |
|-----------------------|---------------------------------------------------------------------------|--------|------|----------------|------------------|------------------|-----------------|
| Hosseini et al. 22    | To determine factors related to number of occluded coronary arteries      | D/A    | AG   | 2013 - Iran    | 2390 with CAD    | N                | High - 36       |
| Jia et al. 23         | To determine relationship between the number of cigarettes smoked and the severity of coronary atherosclerosis | D/A    | AG   | 2009 - China   | 1096             | S                | High - 36       |
| Separham et al. 29    | To determine relationship between smoking and atherosclerosis location   | D/A    | AG   | 2007 - Iran    | 162              | LH               | Medium - 22     |
| Masoomi et al. 20     | To determine relationship between major coronary risk factors and number of diseased vessels in coronary angiography | D/A    | AG   | 2006 - Iran    | 196              | N                | Poor - 7        |
| Mousavinasab et al. 30| Determine risk factors for CVD in a population aged >35 years             | D/A    | AG   | 2017 - Iran    | 477              | S                | Medium - 20     |
| Leone et al. 19       | To determine relationship between coronary artery lesions and cigarette smoking in smokers | D/A    | Autopsy | 2014 - Italy | 80              | N                | Medium - 27     |
| Omrani-Nava et al. 31 | Distribution of atherosclerosis risk factors and relationship with number of damaged arteries | D/A    | AG   | 2018 - Iran    | 89              | N                | Poor - 11       |
| Golmohammadi et al. 32| To determine relationship between risk factors of coronary atherosclerosis and number of damaged coronary arteries | D/A    | AG   | 2016 - Iran    | 300             | N                | High - 32       |
| Buljubasic et al. 33  | To determine relationship between cigarette smoking and coronary atherosclerotic burden | D/A    | AG   | 2015 - the Netherlands | 581 | S | High - 34 |
| Parsa et al. 34       | To determine relationship between CAD risk factors and site of stenosis    | D/A    | AG   | 2010 - Iran    | 250             | N                | Medium - 25     |
| Yano et al. 35        | To determine relationship between smoking and severity of coronary stenosis | D/A    | AG   | 2016 - Japan   | 416             | S                | High - 36       |

D/A, Descriptive/analytic; Retro, retrospective; AG, angiography; CVD, cardiovascular disease; CAD, coronary artery disease; N, number of arteries; S, severity; LH, location in heart; LA, location in artery.
Importantly, this relationship was measured using different measurement criteria of severity. In two studies, the Gensini tool was used and narrowing of the arteries was considered in one study; in another study, plaque burden was measured (Table 2).

**Discussion**

In many countries, CAD is a main cause of disability, high health care costs, and death. Investigation of the causes and factors affecting the development of CAD dates back to 1948 in the US. In 1960, results of the Framingham Heart Study proved that smoking increases the risk of heart disease. Since then, smoking has been considered a major risk factor for CAD.

The effect of smoking on the incidence of coronary artery insufficiency has been studied by various researchers. The aim of the present study was to investigate this effect in terms of the number of occluded coronary arteries and the pattern and severity of coronary artery occlusion in patients with CAD. The results of such studies are often contradictory, perhaps owing to the multifactorial nature of CAD.

The findings of the present study showed that smoking was not significantly associated with the number of damaged coronary arteries in patients with CAD; however, this finding was reported in only two studies. Perhaps one reason for this is an insufficiently long study period. Smoking duration, smoking dose, and duration of illness can lead to an increase in the number of occluded coronary arteries.

The results of our review clarified the evidence that smoking is associated with the severity of CAD. Our study results also showed that smoking was associated with occlusion of the LAD artery and that

| Studies               | Influence of smoking                                                                 |
|-----------------------|--------------------------------------------------------------------------------------|
| Hosseini et al. 22    | No relationship between active smoking and number of occluded coronary arteries       |
| Jia et al. 23         | A relationship was found between the number of cigarettes smoked and severity score (Gensini) |
| Separham et al. 29    | A relationship was found between smoking and LAD stenosis                             |
| Masoomi et al. 20     | No relationship between smoking and number of occluded arteries                       |
| Mousavinasab et al. 30| A relationship was found between smoking and severity >50% (OR = 3.04)                 |
| Leone et al. 19       | A relationship was found between smoking with number of occluded arteries (one and three) |
| Omrani-Nava et al. 31 | A relationship was found between smoking and CAD severity (narrowing)                 |
| Golmohammadi et al. 32| No relationship between smoking with number of occluded arteries                      |
| Buljubasic et al. 33  | A relationship was found between smoking with severity (plaque burden)               |
| Parsa et al. 34       | No relationship found between smoking and location of arterial stenosis               |
| Yano et al. 35        | More smokers among patients with non-proximal stenosis (median/distal)                |

**Table 2.** Effect of smoking on number of disease arteries, pattern, and severity of CAD.

OR, odds ratio; LAD, left anterior descending artery; CAD, coronary artery disease; VD, vessel disease.
Smokers may be more likely to have non-proximal coronary artery occlusion. The reason for this association may be owing to the effect of cigarettes and nicotine on the vascular epithelium; under the influence of nicotine, the coronary vascular epithelium can become damaged. Smoking also increases sympathetic tone and causes vasoconstriction. Myocardial necrosis can be caused by the effects of nicotine. In general, two types of necrosis are caused by smoking and nicotine, ischemic necrosis and toxic necrosis, in which the myocardium is affected by the chemicals in cigarettes. Additionally, calcium deposition as atheroma is another known effect of nicotine. A further mechanism of smoking is its effect on increasing serum LDL and triglycerides in the blood as well as decreasing the amount of high-density lipoprotein. Smoking also causes vascular inflammation and the production of C-reactive protein. Jia et al. stated that smoking causes the onset and progression of atherosclerosis by inhibiting vasodilation and increasing vasoconstriction, stabilizing thrombosis, causing inflammation, and modifying lipid profiles.

Other evidence of the influence of smoking on CAD is the effect of smoking cessation on improving patients’ cardiovascular condition. One study found that smoking cessation in patients with CAD reduced the risk of myocardial infarction by up to 20% over the following year. Another study found that smoking cessation reduced the number and extent of changes in the coronary arteries. Smoking should be considered a risk factor associated with the severity of CAD. Additionally, smoking may be associated with the number of occluded coronary arteries and the location of CAD.

Implications and limitations
As mentioned, the results of this study can be used in identifying CAD and in choosing the appropriate treatment and care for patients with CAD. However, further studies are needed to confirm our results.

This study has some limitations. Although we conducted an extensive search of the published literature, a number of articles were excluded owing to a lack of sufficient data or inadequate study methods. Moreover, the quality of the included studies was not high in all cases.

Conclusion
In six of the studies included in this review, smoking was not related to the number of occluded coronary arteries; this relationship was observed in only two studies. A relationship between smoking and the severity of CAD was reported in five studies, as well as between smoking and occlusion of the LAD artery. However, no significant relationship was found between smoking and the location of occlusion in the coronary arteries. Smoking cessation can help to improve the health of patients with CAD.

Further high-quality studies are needed on the relationship of smoking with the number of occluded coronary arteries, the location of occluded coronary arteries in the heart, and the location of occlusion in coronary arteries among patients with CAD. Similar studies for other risk factors of CAD are warranted. Community-based programs to help prevent smoking are needed, to reduce the risk of CAD development in the population.

Acknowledgements
We thank Kermanshah University of Medical Sciences for their assistance in this study.

Author contributions
MJ and NS contributed to the concept of the study. MJ, NS, and PJ performed the comprehensive search and data extraction. The final report and manuscript was written, edited, and approved by all of the authors.
Declaration of conflicting interest
The authors declare that there is no conflict of interest.

Ethics approval and consent to participate
This study was approved by the ethics committee of Kermanshah University of Medical Sciences (registry number 300116). This study was conducted in compliance with the Declaration of Helsinki. This was a review study; therefore, there was no requirement for patient consent.

Funding
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ORCID iD
Milad Jalilian https://orcid.org/0000-0002-6462-1127

References
1. Haghdoost A and Mirzazadeh A. Familial aggregation of coronary heart disease risk factors in Kerman Province. Iranian Journal of Epidemiology 2006; 2: 59–64.
2. Benjamin EJ, Muntner P, Alonso A, et al. Heart disease and stroke statistics—2019 update: a report from the American Heart Association. Circulation 2019; 139: e56–e528.
3. Balady GJ, Williams MA, Ades PA, et al. Core components of cardiac rehabilitation/secondary prevention programs: 2007 update: A scientific statement from the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee, the Council on Clinical Cardiology; the Councils on Cardiovascular Nursing, Epidemiology and Prevention, and Nutrition, Physical Activity, and Metabolism; and the American Association of Cardiovascular and Pulmonary Rehabilitation. Circulation 2007; 115: 2675–2682.
4. Salehi E, Hagizadeh E and Alidooosti M. Evaluation Risk Factors of Coronary Artery Disease Through Competing Risk Tree. J Arak Uni Med Sci 2018; 21: 18–29.
5. Ebrahimi K, Khadem Vatan K, Salarilak S, et al. Epidemiological features of risk factors occurrence and outcomes of myocardial infarction in patients admitted to hospitals in West Azerbaijan Province during the years 2011 and 2012. Studies in Medical Sciences 2015; 26: 724–734.
6. Laslett LJ, Alagona P Jr, Clark BA 3rd, et al. The worldwide environment of cardiovascular disease: prevalence, diagnosis, therapy, and policy issues: a report from the American College of Cardiology. J Am Coll Cardiol 2012; 60: S1–S49.
7. Lydia K, Erastus M, Anne K, et al. Stroke distribution patterns and characteristics in Kenya’s leading public health tertiary institutions: Kenyatta National Hospital and Moi Teaching and Referral Hospital. Cardiovascular Journal of Africa 2018; 29: 68.
8. Dianati M, Mousavi M, Feshangchi S, et al. The study of coronary angiography results in patients referred to coronary angiography laboratory of Shahid Beheshti Hospital from November 2010 to April 2011. Cardiovasc Nurs J 2013; 2: 48–54.
9. Jamshidi N, Abbaszadeh A, Kalyani MN, et al. Effectiveness of video information on coronary angiography patients’ outcomes. Collegian 2013; 20: 153–159.
10. Abbasi SH, Sundin Ò, Jalali A, et al. Ethnic differences in the risk factors and severity of coronary artery disease: a patient-based study in Iran. J Racial Ethn Health Disparities 2018; 5:623–631.
11. Babapour SB and Kazemi KA. Prevalence of coronary artery disease among the candidate patients for cardiac valve’s surgery in Tehran-Imam Khomeini Hospital (1999–2003). 2007.
12. Soleymani A, Dastgiri S, Yaghoubi A, et al. Comparison of coronary artery disease risk factors between patients below and above 45 years old. Journal of School of Public Health & Institute of Public Health Research 2012; 9.
13. Hartman J and Frishman WH. Inflammation and atherosclerosis: a review of the role of interleukin-6 in the development of atherosclerosis and the potential for
targeted drug therapy. *Cardiol Rev* 2014; 22: 147–151.

14. Malakar AK, Choudhury D, Halder B, et al. A review on coronary artery disease, its risk factors, and therapeutics. *J Cell Physiol* 2019; 234: 16812–16823. DOI: 10.1002/jcp.28350.

15. Kantaria M, Buleishvili M, Kipiani NV, et al. Risk factors of coronary artery disease (Review). *Georgian Med News* 2020: 78–82.

16. McPherson R and Tybjaerg-Hansen A. Genetics of Coronary Artery Disease. *Circ Res* 2016; 118: 564–578. DOI: 10.1161/circresaha.115.306566.

17. Barua RS, Ambrose JA, Srivastava S, et al. Reactive oxygen species are involved in smoking-induced dysfunction of nitric oxide biosynthesis and upregulation of endothelial nitric oxide synthase: an in vitro demonstration in human coronary artery endothelial cells. *Circulation* 2003; 107: 2342–2347.

18. Sadeghi M, Pourmand K, Sanei H, et al. Which major atherosclerosis risk factors represents the extent of coronary artery disease? *ARYA Atherosclerosis* 2012; 7: 63–69.

19. Leone A. Relation between coronary lesions and cigarette smoking of subjects deceased from acute myocardial infarction. A histopathological study. *J Cardiobiol* 2014; 2: 5.

20. Masoomi M and Nasri H. Relationship between coronary risk factors and the number of involved vessels in coronary angiography. *Hormozgan Med J* 2006; 10: e89754.

21. Abdollahi AA, Hoseini SA, Salehi A, et al. Coronary artery lesions and some of its related factors in more than 5000 patients in Kosar Angiography Center (Golestan Province) from 2007 to 2009. *Scientific Journal of Kurdistan University of Medical Sciences* 2012; 17: 18–24.

22. Hosseini Seyed A, Abdollahi AA, Behnampour N, et al. Relationship Between Number Of Involved Coronary Artery With Some Risk Factors By Angiography. *Payavard Salamat* 2013; 6.

23. Jia EZ, Liang J, Yang ZJ, et al. Smoking and coronary atherosclerosis: follow-up study in China. *Clin Exp Pharmacol Physiol* 2009; 36: 690–695.

24. Moher D, Liberati A, Tetzlaff J, et al. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 2009; 6: e1000097. DOI: 10.1371/journal.pmed.1000097.

25. Von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Prev Med* 2007; 45: 247–251. DOI: 10.1016/j.ypmed.2007.08.012.

26. Sahebi A, Jahangiri K, Sohrabizadeh S, et al. Prevalence of Workplace Violence Types against Personnel of Emergency Medical Services in Iran: A Systematic Review and Meta-Analysis. *Iran J Psychiatry* 2019; 14: 325–334.

27. Vandenbroucke JP, Von Elm E, Altman DG, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. *Int J Surg* 2014; 12: 1500–1524. DOI: 10.1016/j.ijsu.2014.07.014.

28. Garrard J. *Health sciences literature review made easy*. Jones & Bartlett Learning, 2016.

29. Separham K and Shemirani H. Smoking or high blood pressure, which one is more important in premature coronary artery disease? *J Isfahan Med Sch Spring* 2007; 25: 1–9.

30. Mousavinasab N, Yazdani Cherat J, Bagheri B, et al. Identifying the risk factors for cardiovascular disease in individuals aged above 35 years using logistic regression model. *Journal of Mazandaran University of Medical Sciences* 2017; 26: 50–56.

31. Omrani-Nava V, Hedayatizadeh-Omran A, Alizadeh-Navaei R, et al. Gender Distribution of Atherosclerosis Risk Factors and Its Relation with the Number of Involved Vessels. *Journal of Mazandaran University of Medical Sciences* 2018; 28: 83–90.

32. Golmohammadi A, Sadeghi MT, Bakhshayeshi M, et al. Relation of atherosclerosis risk factors with the number of involved coronary arteries in angiography. *Medical Science and Discovery* 2016; 3: 65–70.
33. Buljubasic N, Akkerhuis KM, De Boer SP, et al. Smoking in relation to coronary atherosclerotic plaque burden, volume and composition on intravascular ultrasound. *PLoS One* 2015; 10: e0141093.

34. Parsa AFZ, Ziai H and Fallahi B. The relationship between cardiovascular risk factors and the site and extent of coronary artery stenosis during angiography. *Tehran University Medical Journal* 2010; 68.

35. Yano M, Miura SI, Shiga Y, et al. Association between smoking habits and severity of coronary stenosis as assessed by coronary computed tomography angiography. *Heart Vessels* 2016; 31: 1061–1068.

36. Nabel EG and Braunwald E. A tale of coronary artery disease and myocardial infarction. *N Engl J Med* 2012; 366: 54–63. DOI: 10.1056/NEJMra1112570.

37. Thadani U. Cardiovascular Therapeutics: A Companion to Braunwald’s Heart Disease. *Am Heart Assoc* 2002.

38. Gandelman G and Bodenheimer MM. Screening coronary arteriography in the primary prevention of coronary artery disease. *Heart Dis* 2003; 5: 335–344.

39. Sedghi M, Hashemi SM, Khosravi A, et al. Evaluation of the Coronary Angiography Results in Patients Referred to Cardiac Centers in Isfahan City, Iran. 2017; 2017: 6. Coronary artery; Angiography; Risk factors 2017-04-05.

40. Kannell WB, Dawber TR, Kagan A, et al. Factors of risk in the development of coronary heart disease—six-year follow-up experience: the Framingham Study. *Ann Intern Med* 1961; 55: 33–50.

41. Kannell WB, Dawber TR, Friedman GD, et al. Risk factors in coronary heart disease: the Framingham Study. *Ann Intern Med* 1964; 61: 888–899.

42. Benowitz NL, Jacob P 3rd, Jones RT, et al. Interindividual variability in the metabolism and cardiovascular effects of nicotine in man. *J Pharmacol Exp Ther* 1982; 221: 368–372.

43. Ambrose JA and Barua RS. The pathophysiology of cigarette smoking and cardiovascular disease: an update. *J Am Coll Cardiol* 2004; 43: 1731–1737.

44. Desideri G and Ferri C. Endothelial activation. Sliding door to atherosclerosis. *Curr Pharm Des* 2005; 11: 2163–2175.

45. Leone A, Bertanelli F, Mori L, et al. Features of ischaemic cardiac pathology resulting from cigarette smoking. *Journal of Smoking-Related Disorders* 1994; 5: 109–114.

46. Leone A, Landini L Jr, Biadi O, et al. Smoking and cardiovascular system: cellular features of the damage. *Curr Pharm Des* 2008; 14: 1771–1777.

47. Yusuf S, Hawken S, Öunpuu S, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* 2004; 364: 937–952.

48. Twardella D, Kùpper-Nybelen J, Rothenbacher D, et al. Short-term benefit of smoking cessation in patients with coronary heart disease: estimates based on self-reported smoking data and serum cotinine measurements. *Eur Heart J* 2004; 25: 2101–2108.

49. Frid D, Ockene IS, Ockene JK, et al. Severity of angiographically proven coronary artery disease predicts smoking cessation. *Am J Prev Med* 1991; 7: 131–135.