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Investigating the Relationship Between Cigarettes and Hookah Smoking with Coronary Artery Disease

Ali Daryanavard [1], Mehran Ghasemzadeh [2], Soghra Fallahi [1], Shideh Rafati [2], Atefeh Ghareghani [3], Masoomeh Latifi [4], Fatemeh Khajavi Mayvan [5], Mohammad Hosein Sheybani Arani [5], Marzieh Nikparvar [3,*]

[1] Tobacco and Health Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran
[2] Student Research Committee, Hormozgan University of Medical Sciences, Bandar Abbas, Iran
[3] Cardiovascular Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran
[4] Department of Research and Technology, Hormozgan University of Medical Sciences, Bandar Abbas, Iran
[5] Student Research Committee, Faculty of Medicine, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

[*] ***Corresponding Author:*** Cardiovascular Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran. Email: nikparvarheart1@gmail.com

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Abstract

Background: Cardiovascular disease (CVD) is recognized as a leading global cause of mortality, with tobacco use being one of the established risk factors responsible for 29% of related deaths. Although tobacco smoking, particularly through hookah, is increasing globally, limited data are available to evaluate its impact on CVD. This study aimed to investigate the relationship between cigarette and hookah smoking and coronary artery disease (CAD).

Objectives: This study evaluated the relationship between cigarette and hookah smoking and coronary artery involvement based on coronary angiography findings.

Methods: In this hospital-based cross-sectional study, 256 patients were included, with 128 patients in the CAD group (showing at least 50% stenosis in the left main artery or over 70% stenosis in other coronary arteries) and 128 patients in the normal angiography group. We assessed their smoking status, categorizing participants as current smokers, ex-smokers, or never-smokers. To ensure the collection of accurate and reliable data, we conducted face-to-face interviews, observations, and administered a questionnaire and medical checklist.

Results: Based on multivariable logistic regression models, after adjusting for additional risk factors, individuals who smoked exhibited an approximately eight-fold higher likelihood of developing CAD compared to non-smokers. Additionally, hookah users showed a five-fold increase in CAD risk compared to non-hookah users (P = 0.001).

Conclusions: Cigarette and hookah smoking are significantly associated with CAD, with cigarette smoking showing a comparatively stronger association with CAD than hookah use when considering other risk factors.

Keywords: Cardiovascular Disease, Coronary Angiography, Smoking, Cigarettes, Hookah

1. Background

Cardiovascular disease (CVD), cancer, chronic obstructive pulmonary disease (COPD), and diabetes are recognized by the World Health Organization (WHO) as the four major non-communicable diseases (NCDs) worldwide (1). The prevalence of NCD-related deaths is alarming, with 15 million people aged 30 to 69 succumbing to these diseases annually. Over 80% of these premature deaths occur in low- and middle-income countries, underscoring a major public health challenge (2). Several modifiable behavioral risk factors, including tobacco use, unhealthy diet, physical inactivity, and harmful alcohol consumption, have been identified as key contributors to NCD development (1). Established risk factors for CVD include age, sex, smoking, obesity, dyslipidemia, physical inactivity, hypertension, and diabetes mellitus (1, 3). Of these, smoking is a leading modifiable risk factor, contributing significantly to global mortality. Smoking accounts for 5

million deaths annually, representing 12% of all global deaths (4), and is linked to 29% of coronary heart disease-related deaths (5). In high-income countries, a decline in coronary artery disease (CAD) has been attributed to a reduction in key risk factors, including smoking (5).

Despite this, the use of alternative forms of tobacco, such as water pipe or hookah smoking, is on the rise worldwide (6). The INTERHEART study, which spanned 52 countries, revealed that smoking—especially among men—is a major cause of acute myocardial infarction globally. Smokers face an elevated risk of non-fatal myocardial infarction compared to non-smokers (3-5, 7). Studies in Egypt have shown a stronger association between hookah smoking and severe CAD compared to cigarette smoking (8). While conventional risk factors, including male gender, smoking, hypertension, diabetes mellitus, hyperlipidemia (HLP), obesity, and family history of coronary heart disease, are widely recognized as contributing to atherosclerosis, limited data exist on the specific impact of different forms of tobacco use, such as hookah, on CAD.

Understanding the significance of this relationship is crucial for resource allocation and the development of targeted policies to address this issue.

2. Objectives

This study, therefore, aims to assess the impact of cigarette and hookah smoking on coronary artery involvement as determined by coronary angiography.

3. Methods

3.1. Study Design and Population

In this hospital-based cross-sectional study, 256 patients who visited the angiographic center at Shahid-Mohammadi Hospital, Bandar-Abbas, Iran, from February 2019 to October 2020, were selected to investigate the relationship between cigarette and hookah smoking and CAD. The patients were divided into two groups on a 1:1 basis. One group included patients with at least 50% stenosis in the left main artery or more than 70% stenosis in other arteries, while the other group consisted of patients with normal coronary arteries based on coronary angiography.

Based on a previous study (1) and the following formula, the minimum sample size for each group was estimated to be 125 [$n = (Z_{\alpha/2}+Z_{\beta})^2 * (p_1(1 - p_1) + p_2(1 - p_2)) / (p1-p2)^2$, where $Z_{\alpha/2} = 2.57$, $Z_{\beta} = 2.33$, $p_1 = 0.39$, $p_2 = 0.13$]. An additional three participants were included in each group, resulting in 128 patients per group, totaling 256 participants. Convenience sampling was used to select individuals in each group based on the availability of information in their files archived in the angiography department.

Patients were excluded if they had stenosis of less than 50% on the angiography report, a history of malignancy, radiotherapy, chemotherapy, chronic inflammatory disease, chronic kidney disease, critical illness, heart failure, malignant cardiac arrhythmia, or if they were deceased. Additionally, patients who did not consent to participate in the study were excluded.

3.2. Smoking Status

We assessed smoking status as follows: Current smoker, defined as someone who currently smokes cigarettes or hookah or quit less than one month ago; ex-smoker, who had quit smoking for more than one month; and never-smoker, individuals who had never smoked. To collect accurate and reliable data from participants in both the CAD patient group and the group with normal coronary arteries, we employed a comprehensive approach, including face-to-face interviews, observations, and the use of a questionnaire and medical checklist. Before conducting the study, rigorous procedures were undertaken to validate and ensure the reliability of the questionnaire, thus confirming its effectiveness in capturing the necessary information accurately.

3.3. Data Analysis

The collected data were analyzed using SPSS version 23.0. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean values with standard deviations (SD). Bivariate analyses were conducted to examine differences in means using either the independent samples t-test or Wilcoxon tests as appropriate, while differences in proportions were assessed using the chi-square test. Univariable binary logistic regression was performed, followed by inclusion of independent variables with a P-value less than 0.25 in the multivariable logistic regression to estimate adjusted odds ratios (ORs). After adjusting for

Table 1. Demographic Data of Coronary Artery Disease Patients and Patients with Normal Coronary Arteries (No CAD) [a]

Characteristics	CAD	No CAD	OR (95% CI)	P-Value
Mean age (y), (SD)	58.73 (10.2)	53.6 (12.5)	1.04 (1.01 - 1.06)	0.001
Gender (male)	90 (70.3)	50 (39.1)	3.69 (2.19 - 6.21)	< 0.001
Marital status (married)	116 (90.6)	105 (82)	2.11 (1.01 - 4.46)	0.049
Employment status (employed)	64 (50)	45 (35.2)	1.84 (1.11 - 3.04)	0.020
Habitat (town)	58 (45.3)	64 (50)	1.16 (0.72 - 1.88)	0.530
Education				
Elementary school or lower education levels	91 (71.1)	82 (64.1)	1.48 (0.59 - 3.69)	0.400
Mid and high school	28 (21.9)	34 (26.6)	1.09(0.4 - 2.98)	0.540

Abbreviation: CAD, coronary artery disease.

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

age, sex, marital status, occupation, education, residence, hypertension, diabetes, and HLP, the OR and 95% confidence interval (CI) were calculated to assess the relationship between hookah use, cigarette smoking, and CAD. Statistical significance was defined as two-tailed p-values of less than 0.05.

3.4. Ethical Considerations

The Ethical Review Board of the Hormozgan Health Research Council granted ethical approval for this study under the code IR.HUMS.REC.1398.026. Participants were informed of the study's purpose, and all participant information was handled with strict confidentiality.

4. Results

In this study, 256 patients were divided equally into two groups: Those with CAD and those with normal coronary arteries (no CAD). The demographic characteristics of the participants are presented in Table 1.

The findings from univariate logistic regression indicate that with each unit increase in age, the odds of CAD increased by 0.04 (OR = 1.04, 95% CI: 1.01 - 1.06, P = 0.001). The odds of CAD were 3.69 times higher for males than for females, and 2.11 times higher for married individuals compared to others. Additionally, employed individuals had 0.84 times higher odds of CAD than unemployed individuals (OR = 1.84, 95% CI: 1.11 - 3.04, P = 0.02) (Table 1).

In the CAD group, 32.8% of patients were current cigarette smokers, compared to only 7.8% in the group with normal coronary arteries, indicating a significant difference. However, no significant difference was observed between CAD patients and those with normal coronary arteries in terms of hookah use. Additionally, the proportion of patients who did not smoke cigarettes or hookah was significantly different between the CAD and non-CAD groups (P < 0.001) (Table 2).

Table 3 presents the frequency of cigarette smoking status across subgroups of individuals with diabetes, HLP, and hypertension, comparing CAD patients with those having normal coronary arteries.

Table 4 provides the frequency distribution of hookah smoking status within subgroups of individuals diagnosed with diabetes, HLP, and hypertension, comparing those with CAD to patients with normal coronary arteries.

After adjusting for confounding variables, individuals who smoke cigarettes demonstrated an approximately eight-fold increased risk of developing CAD compared to non-smokers (P < 0.001, 95% CI: 3.23 - 20.0, OR = 8.05). Similarly, the likelihood of developing CAD in hookah users was found to be five times higher than in non-hookah users (P = 0.001, 95% CI: 2.45 - 12.51, OR = 5.53) (Table 5).

5. Discussion

Although the significant impact of smoking on developing CAD is well-documented, water pipe use, particularly among younger populations, is spreading globally as it is often perceived as a safer alternative to cigarette smoking. Emerging research indicates that components in tobacco smoke can promote atherosclerosis and trigger symptoms associated with CAD in individuals who smoke, whether via cigarettes or hookah (2). In this study, the prevalence of cigarette,

Table 2. Baseline Characteristics of Two Type of Smoking (Cigarette and Hookah) Between Coronary Artery Disease Patients and Patients with Normal Coronary Arteries (No CAD) [a]

Characteristics	CAD	No CAD	P-Value
Cigarette smoking			< 0.001
Never	78 (60.9)	116 (90.6)	
Ex-smoker	8 (6.3)	2 (1.6)	
Current use	42 (32.8)	10 (8.8)	
Hookah			0.07
Never	89 (69.5)	103 (80.5)	
Ex-smoker	11 (8.6)	4 (3.1)	
Current use	28 (21.9)	21 (16.4)	
Never use of cigarette and hookah	48 (37.5)	92 (71.9)	< 0.001
Use of cigarette or hookah	71 (55.4)	35 (27.3)	< 0.001
Use of cigarette and hookah	9 (7.1)	1 (0.8)	0.06

Abbreviation: CAD, coronary artery disease.

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

Table 3. Association Between Cigarette Smoking and Cardio-Metabolic Risk Factors [a]

Characteristics	CAD			No CAD			P-value
Cigarette smoking	**Never**	**Ex-smoker**	**Current use**	**Never**	**Ex-smoker**	**Current use**	
Diabetes mellitus							
No	58 (74.4)	8 (100)	36 (85.7)	102 (87.9)	0 (0)	10 (100)	< 0.001
Yes	20 (25.6)	0 (0)	6 (14.3)	14 (12.1)	2 (100)	0 (0)	0.029
Hypertension							
No	29 (37.2)	4 (50)	32 (76.2)	73 (62.9)	0 (0)	9 (90)	< 0.001
Yes	49 (62.8)	4 (50)	10 (23.8)	43 (37.1)	2 (100)	1 (10)	0.052
Dyslipidemia							
No	59 (75.6)	8 (100)	32 (76.2)	89 (76.7)	0 (0)	9 (90)	< 0.001
Yes	19 (24.4)	0 (0)	10 (23.8)	27 (23.3)	2 (100)	1 (10)	0.005

Abbreviation: CAD, coronary artery disease.

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

hookah, or dual use was substantially higher (62.5%) in the CAD group compared to patients with normal coronary arteries (28.1%), demonstrating a statistically significant difference (P-value < 0.001). Our findings also show a notably higher prevalence of CAD in those with a history of cigarette or hookah use than in those who never smoked. However, a lesser impact was observed among hookah users compared to cigarette smokers, possibly due to the smaller number of hookah users in this study.

A multivariate logistic regression analysis was conducted to control for confounding factors between the two groups. The results indicated that the likelihood of developing CAD in cigarette smokers and hookah users was 8 and 5.86 times higher, respectively, than in those who did not smoke cigarettes or hookah (P < 0.001; 95% CI: 3.23 - 20.0, OR = 8.05 and 95% CI: 2.38 - 14.43, OR = 5.86). Although the majority of studies support these findings (1, 3-6) (7-10), the results reported by Masoumi and Nasri, and Pourreza et al. differed (11, 12). This discrepancy may be attributed to variations in smoking patterns, such as the amount or duration of smoking, in these studies.

Given the absence of age and sex matching between the two groups, a subsequent univariate logistic regression analysis revealed a significant association. Specifically, each additional year of age was associated with a 0.04 increase in the likelihood of developing CAD. These findings align with previous research in the field (3, 4). This elevated risk with age can be attributed

Table 4. Association Between Hookah Smoking and Cardio-Metabolic Risk Factors [a]

Characteristics	CAD			No CAD			P-value
Hookah smoking	**Never**	**Ex-smoker**	**Current use**	**Never**	**Ex-smoker**	**Current use**	
Diabetes mellitus							
No	75 (84.3)	7 (63.6)	20 (71.4)	89 (86.4)	3 (75)	20 (95.2)	0.31
Yes	14 (15.7)	4 (36.4)	8 (28.6)	14 (13.6)	1 (25)	1 (4.8)	0.07
Hypertension							
No	44 (49.4)	5 (45.5)	16 (57.1)	66 (64.1)	2 (50)	14 (66.7)	0.14
Yes	45 (50.6)	6 (54.5)	12 (42.9)	37 (35.9)	2 (50)	7 (33.3)	0.47
Dyslipidemia							
No	68 (76.4)	9 (81.8)	22 (78.6)	77 (74.8)	3 (75)	18 (85.7)	0.14
Yes	21 (23.6)	2 (18.2)	6 (21.4)	26 (25.2)	1 (25)	3 (14.3)	0.39

Abbreviation: CAD, coronary artery disease.

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

Table 5. Multivariable Analysis for the Association Between Smoking Behavior and Coronary Artery Disease

Variables	OR Crude (95% CI)	P-Value	OR Adjusted (95% CI) [a]	P-Value
Cigarette smoking				
Smokers (ref: Non-smokers)	6.19 (3.10,12.38)	< 0.001	8.05 (3.23,20.0)	< 0.001
Hookah smoking				
Smokers (ref: Non-smokers)	1.80 (1.01,3.21)	0.04	5.53 (2.45,12.51)	< 0.001

[a] By adjusting the effect of variables of age, sex, marital status, occupation, education, residence, hypertension, diabetes, and HLP, the OR and confidence interval (CI) were calculated to find the relationship between hookah use and cigarette smoking with CAD. Current smokers and ex-smokers were selected as smoking group and compared with non-smokers.

to age-related degradation of various organs and an increased prevalence of cardiovascular risk factors, which collectively lead to greater vascular damage when these factors coexist.

The univariate logistic regression analysis further indicated that men had a 3.69 times higher likelihood of developing CAD compared to women. This result is consistent with findings from other studies (3, 5, 6). The observed gender difference may be attributed to physiological differences as well as the higher prevalence of smoking among men compared to women.

In contrast to most studies, among social factors, the likelihood of CAD in married individuals was 2.11 times higher than in non-married individuals, as also noted in Mirkhani et al.'s study (7). The higher age, employment status, and multiple concerns associated with married life in developing countries may account for this difference from other studies. In this study, employed individuals had a 0.84 times higher chance of CAD compared to those who were not employed. This finding aligns with the study conducted by Pourreza et al. (12), which examined the impact of occupation on CAD. Mirkhani et al.'s research (7) also suggests that occupational stress and environmental factors may contribute to CAD.

Our study's comparative analysis of cardiometabolic risk factors and their prevalence between hookah and cigarette smokers, as well as those who had quit smoking or never smoked, found no association between CAD and diabetes, HLP, or hypertension in hookah users. Conversely, cigarette smoking was significantly associated with CAD in individuals with these underlying conditions. Based on our results, both cigarette and hookah smoking have a significant impact on the risk of CAD, with cigarette smoking showing a stronger association with CAD than hookah use. Furthermore, there was a notable association between cigarette smoking and CAD in individuals with underlying conditions such as diabetes, HLP, and hypertension, suggesting a possible synergistic effect of these conditions on CAD. This relationship was not

observed for hookah users with these underlying conditions, potentially due to the smaller number of hookah users in this group.

Consistent with previous studies, our research confirms the increasing annual risk of CAD with age and male gender. Additionally, marital status and employment may contribute to a higher risk of CAD. As this has not been extensively explored in other studies, further investigation is warranted.

5.1. Conclusions

Our results indicate a significant association between smoking cigarettes or hookah and the risk of CAD, with cigarette smoking showing a comparatively stronger link to CAD than hookah use. Additionally, a significant relationship was observed between cigarette smoking and CAD in individuals with underlying conditions such as diabetes, dyslipidemia, and hypertension, suggesting a possible synergistic effect of these conditions on CAD risk. This relationship was not found among hookah users with underlying conditions, which could be attributed to the smaller number of hookah users in this group. Consistent with previous studies, our research confirmed that the risk of CAD increases annually with age and is higher in males. Furthermore, being married and employed may also elevate the risk of CAD. Further investigations are recommended to explore these associations in more detail.

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Footnotes

Authors' Contribution: Conceptualization: A. D., A. G., and M. N.; methodology: S. F., S. R., M. G., and F. K. M.; investigation: M. L., M. S. A., A. D., and A. G.; writing-original draft preparation: F. K. M., M. S. A., M. G., and S. R.; writing-review and editing: F. K. M., M. S. A., S. R., and M. N.

Conflict of Interests Statement: The authors declare no conflict of interest.

Data Availability: The data sets used during the current study are available from the corresponding author upon reasonable request.

Ethical Approval: Hormozgan University of Medical Sciences Ethical Committee approved the study under the ethical code IR.HUMS.REC.1398.026 .

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