

## Risk factors of atherosclerosis in male smokers, passive smokers, and hypertensive nonsmokers in central Iran

**Rezvan Ansari<sup>(1)</sup>, Alireza Khosravi<sup>(2)</sup>, Ahmad Bahonar<sup>(3)</sup>, Shahin Shirani<sup>(4)</sup>,  
Roya Kelishadi<sup>(5)</sup>, Zahra Khosravi<sup>(6)</sup>**

### Abstract

**BACKGROUND:** Some studies showed that smoking follows an upward trend in Asian countries as compared with other countries. The purpose of this study was to examine the effect of cigarette smoking on cardiovascular diseases and risk factors of atherosclerosis in patients with hypertension.

**METHODS:** This study was conducted on 6123 men residing in central Iran (Isfahan and Markazi Provinces) that participated in Isfahan Healthy Heart Project (IHHP). Subjects were randomly selected using cluster sampling method. All the subjects were studied in terms of their history of cardiovascular disease, demographic characteristics, smoking, blood pressure, physical examination, pulse rate, respiratory rate, weight, height, waist circumference, and blood measurements including LDL-C, HDL-C, total cholesterol, triglyceride, fasting blood sugar and 2-hour post prandial test.

**RESULTS:** While 893 subjects suffered from hypertension, 5230 subjects were healthy. The hypertension prevalence was 2.5 times more in urban areas compared to rural areas that showed a significant difference as it increased to 3.5 times smoking factor was considered. The prevalence of risk factors of atherosclerosis and also cardiovascular complications in patients with hypertension were significantly higher than healthy people. Furthermore, they were higher in smokers with hypertension and those exposed to the cigarette smoke than nonsmokers.

**CONCLUSION:** Smoking and passive smoking had an increasing effect on the prevalence of risk factors of atherosclerosis and consequently the incidence of cardiovascular diseases in patients with hypertension.

**Keywords:** Hypertension, Cigarette Smoking, Cardiovascular Disease, Risk Factor.

**ARYA Atherosclerosis Journal 2012, 8(2): 90-95**

*Date of submission:* 28 Dec 2011, *Date of acceptance:* 29 Mar 2012

### Introduction

One of the major causes of reduction in death age due to the cardiovascular diseases is the increase in hypertension prevalence and its consequent atherosclerosis in Asian and West Asian developing countries as compared to Japan, Australia, and other developed countries.<sup>1</sup> The mortality rate of the people under 70 years due to the atherosclerosis in developing and developed countries is 26.5% and 46.7%, respectively.<sup>2</sup> According to the latest WHO definition, hypertension prevalence in Asian countries fluctuates between 5% and 35%.<sup>3</sup> Dyslipidemia, hypertension, and smoking are controllable risk factors of atherosclerosis that cause more than 80%

of the ischemic heart diseases.<sup>4</sup> Today, the studies show that smoking follows an upward trend in Asian countries as compared with other countries.<sup>5</sup>

Recent studies conducted in central Iran in 2002 showed that the prevalence of smoking and hypertension in people older than 19 years were 15% and 17.5%, respectively.<sup>6</sup> A meta-analysis study indicated that hypertension in almost all Asian countries had increased significantly from 1960 to 1990. The reason was later explained by a thorough study as increasing consumption of salt and fat, automated life, and especially increased prevalence of smoking. Dietary and lifestyle changes are certainly associated with the hypertension (blood

1- Researcher, Isfahan Cardiovascular Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.

2- Professor, Hypertension Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.

3- General Practitioner, Health Center of Isfahan Province, Isfahan, Iran.

4- Cardiologist, Isfahan Cardiovascular Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.

5- Professor, Isfahan Cardiovascular Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.

6- Researcher, Hypertension Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.

Correspondence To: Rezvan Ansari, Email: r\_ansari@crc.mui.ac.ir

pressure > 160/95 mmHg) increase from 2-3% in 1960 to 15-20% in 1990 in Asian countries.<sup>7</sup>

Cigarette smoke increases the incidence of atherosclerosis and its resulting mortality due to the toxic effects of smoke on the mechanisms of atherosclerosis, thrombosis, vasomotor system and arrhythmia.<sup>8</sup> The smokers and those exposed to cigarette smoke (passive smokers) have a different lifestyle than nonsmokers,<sup>9</sup> as these people consume more calories, fat, and alcohol, and less fiber, fruit, vegetables, vitamin supplements and useful oilseeds,<sup>10</sup> which increase the incidence of atherosclerosis and coronary artery diseases in smokers.<sup>11</sup>

With regard to the importance of hypertension and cigarette smoke in incidence of atherosclerosis and their upward trend in Asian countries, the present study assessed the effect of cigarette smoke on other risk factors of atherosclerosis and cardiovascular morbidity in central Iran in addition to the prevalence of hypertension in smokers.

### Materials and Methods

This cross-sectional study was conducted on 6123 men with hypertension and healthy people residing in central Iran (Isfahan and Markazi Provinces). The subjects were randomly selected from the national study "Isfahan Healthy Heart Project (IHHP)" using cluster sampling method.<sup>12</sup>

Considering the objectives of the study, a questionnaire was designed to ask about the subjects' cardiovascular disease history and demographic information. Calibrated mercury barometer and Seca scale and a tape measure, already validated in terms of their validity and reliability, were used to determine the systolic and diastolic blood pressure, weight, height and waist circumference. The blood pressure of the subjects was measured twice within 10 minutes based on the WHO standards after 4-5 minutes of rest in a sitting position from the right hand. Data collection and physical examination were done by three educated experts. The criteria for diagnosing hypertension were a history of hypertension and taking at least one kind of antihypertensive pills or a recent diagnosis of hypertension at least for two times (with a week interval) of recording systolic blood pressure  $\geq 140$  mmHg or diastolic blood pressure  $\geq 90$  mmHg. The subjects were weighed without shoes and with light clothing.

Other data included fasting blood sugar (FBS), two-hour postprandial plasma glucose (2hpp), triglyceride (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and platelet. The subjects were

asked to fast 12 hours before blood sampling. All the tests and blood sampling were carried out in laboratory of Isfahan Cardiovascular Research Center and the blood samples were delivered to the laboratory at  $-20^{\circ}\text{C}$ . It is worth mentioning that the quality of this laboratory was evaluated every 6 months to conform to Tehran's reference laboratory and Rafael Laboratory (St-Rafael) in Belgium.<sup>13</sup>

The data were entered to a computer using EPI-info software and were analyzed with one-way analysis of variance (ANOVA) and chi-square tests by using SPSS for Windows (version 12; SPSS Inc., Chicago, IL., USA). The significance level was defined as P less than 0.05.

### Results

Among the 6123 studied men residing in central Iran (Isfahan and Markazi Provinces), 5230 men (85.4%) did not suffer from hypertension of whom 29.3%, 34.0%, and 36.6% were smokers, passive smokers, and nonsmokers, respectively. 893 men (14.6%) suffered from hypertension of whom 28.6%, 28.8%, and 42.5% were smokers, passive smokers, and nonsmokers, respectively. Mean age of the patients with hypertension and healthy subjects was  $42 \pm 16$  and  $36 \pm 13$  years, respectively. Smoking did not show a significant difference among age groups of the patients with hypertension ( $P < 0.05$ ). The highest prevalence of hypertension was observed in age group of 25-34 years, which was similar in all three groups with hypertension and healthy subjects too. There was a statistically significant difference among the age groups in terms of smoking. Generally, the hypertension prevalence was 2.5 times more in urban areas than in rural areas, which showed a statistically significant difference as it increased to 3.5 by considering the smoking factor (smoker or passive smokers).

The prevalence of hypertension in smokers in Isfahan and Markazi Provinces was not significantly different. However, the prevalence of smoking in healthy subjects was significantly different as smokers and passive smokers in Isfahan province comprised 42.2% and 37.2%, respectively, and in Markazi province comprised 57.8% and 62.8%, respectively ( $P = 0.001$ ). The lowest prevalence of hypertensive and healthy subjects in three smoking groups belonged to people with high education and the highest prevalence belonged to men with high school diploma or less education. The difference between the healthy group and the subjects with hypertension was significant ( $P < 0.05$ ) (Table 1). The prevalence of risk factors of atherosclerosis in patients with hypertension was significantly higher than that of

healthy people and in smokers with hypertension and passive smokers was higher than in nonsmokers. The significant difference was found in HDL-C less than 35 mg/dl, high platelet, 2hbp, FBS and systolic and diastolic blood pressure among the three groups ( $P < 0.05$ ). The probability of increase in FBS in smokers with hypertension was 2.3 times more as that in nonsmokers and regarding dyslipidemia (high

LDL-C, low HDL-C, high total cholesterol and triglyceride) this ratio was 1.8 times. Pulse rate and respiratory rate of the patients with hypertension were significantly different in three groups as the cigarette smoke increased pulse rate and respiratory rate  $10 \pm 2$  and  $2 \pm 1$  times per minute, respectively, in smokers and passive smokers than nonsmokers ( $P < 0.05$ ) (Table 2).

**Table 1.** Demographic information of male smokers, passive smokers and nonsmokers in healthy subjects and those with hypertension

	Hypertension (n = 813)			Healthy (n = 5230)		
	Smoker	Passive smokers	Nonsmoker	Smoker	Passive smokers	Nonsmoker
Age (year)§	39.5 ± 15.8	37.5 ± 15.6	45.4 ± 18.2	39.0 ± 15.3	34.6 ± 12.9	37.7 ± 12.1
		P = 0.001*			P = 0.001*	
<b>Age groups (%)</b>						
19-24	14.2	24	16.7	12.7	24.3	19.2
25-34	30.6	30.5	20.1	32.4	24.6	28.4
35-44	26	17.6	13.8	31.1	21.3	19.3
45-54	12.2	11.2	13.8	14	10.7	14.1
55≤	16.9	16.7	35.7	9.8	9.1	18.6
		P = 0.001**			P = 0.001**	
<b>Frequency area (%)</b>						
Urban	70.7	78.9	72.6	68.7	78.2	68.4
Rural	29.3	21.1	27.4	31.3	21.6	31.6
		P = 0.001**			P = 0.001**	
<b>Frequency region (%)</b>						
Isfahan	57.3	55.3	58.9	42.2	37.2	49
Markazi	42.7	44.7	41.1	57.8	62.8	51
		P = 0.3**			P = 0.001**	
<b>Frequency education (%)</b>						
Uneducated	15.6	9.6	22.2	21.1	7.4	15.7
Primary level	34.6	24	30.2	43.5	22.8	27.3
Secondary level	40.7	48.4	44.9	44.5	50.1	40.8
University level	9.1	5.2	5.4	101 (9.8)	19.7	16.2
		P = 0.001**			P = 0.001**	

\* Significantly different using one-way ANOVA (tuky) test

\*\* Significantly different using chi-square test

§ Mean ± standard deviation

**Table 2.** The prevalence of risk factors of atherosclerosis in male smokers, passive smokers, and nonsmokers in healthy subjects and those with hypertension

	Hypertension				Healthy			
	Smoker (%)	Passive smoker (%)	Nonsmoker (%)	P	Smoker (%)	Passive smoker (%)	Nonsmoker (%)	P
TG > 200	33.1	29.3	28.1	0.2	28.4	27.8	28.7	0.5
LDL-C $\geq$ 160	14.8	13.9	12.6	0.2	13.9	10.1	13.1	0.05
HDL-C < 35	16.3	11.3	10	0.001	15.3	11.9	11.3	0.5
TC $\geq$ 200	45.3	42.7	43.2	0.3	44	40.7	37.2	0.05
Platelet > 450	11.7	9.6	8.2	0.5	9.5	10	8	0.02
2hbp $\geq$ 200	5.5	4.6	3	0.04	1.6	1.6	-	0.05
FBS $\geq$ 110	8.1	6.7	4.9	0.03	4.3	3.8	3.7	0.5

  

	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD		Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	P
Systolic blood pressure	126.8 $\pm$ 22.5	120.8 $\pm$ 18.9	117.3 $\pm$ 18.4	0.001	114 $\pm$ 14.0	111.7 $\pm$ 12.9	109.1 $\pm$ 13.6	0.001
Diastolic blood pressure	85.9 $\pm$ 7.3	82.01 $\pm$ 6.1	70.3 $\pm$ 9.5	0.001	79.1 $\pm$ 8.3	77.7 $\pm$ 6.70	76.7 $\pm$ 6.7	0.001
Pulse rate	71.3 $\pm$ 4.5	68.31 $\pm$ 5	65.4 $\pm$ 4.2	0.01	63.1 $\pm$ 8.8	63.6 $\pm$ 7.10	62.8 $\pm$ 8.3	0.100
Respiratory rate	20.3 $\pm$ 6.1	19.8 $\pm$ 5	18.0 $\pm$ 3.1	0.01	17.32 $\pm$ 4.1	17.32 $\pm$ 4.59	17.1 $\pm$ 4.6	0.100

**Table 3.** The prevalence of cardiovascular diseases in male smokers, passive smokers, and nonsmokers in healthy subjects and those with hypertension

	Hypertension				Healthy			
	Smoker (%)	Passive smoker (%)	Nonsmoker (%)	P	Smoker (%)	Passive smoker (%)	Nonsmoker (%)	P
Diabetes	4.8	4.4	4	0.700	2.1	2.2	2.1	0.900
Angina pain	14.1	11.9	10.8	0.100	12.8	12.6	11.2	0.100
Heart disease	7.5	6.9	6.3	0.600	4.9	3.5	4.4	0.001
Myocardial infarction	1.5	0.9	0.7	0.010	0.5	0.4	0.4	0.030
Palpitation	25.1	24.3	19.5	0.006	22.4	18.8	18.1	0.100

The prevalence of obesity in smokers with hypertension was high. Considering body mass index (BMI), obesity in smokers with hypertension and healthy smokers was 3.7 and 4.5 times more than in nonsmokers ( $P < 0.05$ ). Waist circumference in patients with hypertension in three groups of smokers, passive smokers, and nonsmokers was 7.8%, 5.2%, and 5.1%, respectively ( $P = 0.1$ ). In healthy subjects, in three groups of smokers, passive smokers,

and nonsmokers it was 5.1%, 4.9% and 5.5%, respectively ( $P = 0.5$ ). The experience of angina pain, heart attack, palpitation, and heart disease in patients with hypertension especially smokers and passive smokers was more than that of healthy subjects (Table 3).

### Discussion

This study showed a high prevalence of hypertension in men of 25-34 years old, which was also higher in

smokers and passive smokers. The hypertension prevalence was 2.5 times in urban areas as that in rural areas that showed a significant difference as it increased to 3.5 by considering the smoking factor. The prevalence of risk factors of atherosclerosis in patients with hypertension was significantly higher than that in healthy people and it was higher in smokers with hypertension and passive smokers compared to nonsmokers. The high systolic and diastolic blood pressure, FBS, and low HDL-C showed a statistical significant difference. The prevalence of cardiovascular morbidity in men with hypertension who were smokers or exposed to cigarette smoke was higher than that in healthy subjects.

A study in India on 3148 rural people (1982 men and 1166 women) older than 20 years showed that 51% of the men and 5% of the women smoked. The smokers had low education and the prevalence of hypertension in smoking men and women was higher than in the healthy people and alcoholic smoking people were significantly more affected with hypertension, and most of them were men.<sup>12</sup>

A study conducted in 1997 on Isfahan's urban and rural population showed that the prevalence of hypertension in urban areas was more than 30%.<sup>14</sup> Another study by WHO showed a higher prevalence of hypertension in urban areas than in the rural areas.<sup>15</sup> An epidemiological study in 1997 in Isfahan estimated the prevalence of hypertension in urban areas as much as 30%.<sup>16</sup>

The risk for the incidence of hypertriglyceridemia, high LDL-C, and obesity with BMI  $\geq 25$  kg/m<sup>3</sup> was higher in smokers and patients with a history of hypertension.<sup>17</sup> A study by Tserat indicated that cigarette smoke was a known and controllable cause of mortality and coronary artery disease in the United States, as the smoking cessation reduced serum cholesterol from 240-299 to 200 mg/dl, controlled hypertension, and decreased weight to a normal limit. Further, life expectancy for the men who reduced their smoking up to 50% increased 1.2 years and for those who completely quit smoking increased 2.3 years and also cost-effectiveness of smoking cessation was estimated 7668-10993 USD per year.<sup>18</sup>

Several studies showed the risk factors of atherosclerosis like obesity, hypercholesterolemia, high triglyceride, diabetes, and especially smoking are largely higher in people with hypertension than those with normal blood pressure.<sup>12</sup> The study by Hyman et al. in Texas (Houston) showed that 65% smokers had quit smoking when they found they were affected with hypertension. The results of the above study revealed that giving information on cardiac risk factors and hypertension symptoms to people made

them quit smoking.<sup>19</sup> A study by Smith et al. found that men exposed to cigarette smoke had an increase in serum triglyceride by 15% and a decrease in HDL-C by 4.8%.<sup>20</sup> Moffatt et al. also showed the reduction of 14% in serum HDL of people exposed to cigarette smoke compared to those not exposed to cigarette smoke.<sup>21</sup> A study by Johansson et al. on lifestyle change and its effect on the health status and mortality of people showed smoking women who did not have physical activity and were obese (based on BMI) were 10 times more at risk of atherosclerosis risk factors including hypertension compared to nonsmoking women having physical activity and normal weight. In men, these risk factors were reported 5 times more than in women. On average, smoking, lack of physical activities, and hypertension were associated with mortality showing a hazard ratio of 1.6, 1.9 and 1.8, respectively.<sup>22</sup>

The study by Butowski and Winder on a history of heart disease in smokers with hypertension and passive smokers with hypertension showed heart diseases in smokers were much more than in nonsmokers.<sup>23</sup> A study by Kannel concluded that smoking correlated with risk factors of myocardial ischemia, obesity, angina, lifestyle, dyslipidemia, and high uric acid especially in people with hypertension and showed that the incidence of atrial fibrillation and tachycardia was higher in smokers.<sup>24</sup> Love et al. found that stroke rate in smoking youths was 1.6 times more than in nonsmokers and that smoking cessation could reduce the risk factors of stroke.<sup>25</sup>

Another study showed that atherosclerosis of coronary arteries increased by 25% in smokers with hypertension, which might be due to the inflammatory process in smokers according to the pathology results. The increase of serum cholesterol in smokers with hypertension was higher than that of nonsmokers of the same age group and the increase of atherosclerosis in abdominal artery might result in heart attack.<sup>9</sup> Smith et al. concluded in their study that cardiac ischemia in smoking people (smokers and passive smokers) was 1.3 times more than that in nonsmokers and the incidence of diabetes, hypertension, and thrombosis in smokers was higher than in nonsmokers.<sup>26</sup>

Accordingly, it can be concluded that smoking and hypertension increase the risk factors of atherosclerosis and cardiovascular morbidity, which gets worse when both causes are present. Therefore, smokers are recommended to quit smoking especially those with hypertension in order to control hypertension and decrease the intensity of cardiovascular and atherosclerosis risk factors.

### Acknowledgments

The Persian version of this article has been previously published in Iranian Journal of Medical Education: 2010 No: 5; 593-601.

### Conflict of Interests

Authors have no conflict of interests.

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**How to cite this article:** Ansari R, Khosravi A, Bahonar A, Shirani SH, Kelishadi R, Khosravi Z. **Risk factors of atherosclerosis in male smokers, passive smokers, and hypertensive nonsmokers in central Iran.** ARYA Atherosclerosis Journal 2012; 8(2): 90-95.