

# A Study On The Association Of Coronary Artery Disease And Smoking By A Questionnaire Method

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## ABSTRACT

**Background:** Coronary artery disease is an important cause of morbidity and mortality in developed and developing countries. Cigarette smoking is thought to be major risk factor.

**Aim:** To study coronary artery disease among smokers by the Rose questionnaire method.

**Methods:** A cross-sectional study was done from March 2005 to March 2006. The presence of coronary artery disease was detected by the Rose Angina Questionnaire. The questionnaire method which was adopted was noninvasive and inexpensive.

**Results:** This study showed that the occurrence of coronary artery disease was higher in the smokers (61%), with a relative risk of 1.71(95% confidence interval 1.4, 2.0) as compared to the nonsmokers (36%), which was significant. Increased levels of nicotine may be a contributory factor to atherosclerosis which is observed in smokers.

**Conclusion:** Cigarette smoking not only accelerates the early onset of coronary artery disease but also increases the risk of the development of coronary artery disease by more than 80%.

**Key Words :** Coronary artery disease, Cigarette smoking, Rose angina questionnaire, and Rose smoking questionnaire

## INTRODUCTION

Coronary artery disease (CAD) [1] is the end result of the accumulation of atheromatous plaques within the walls of the coronary arteries. Atherosclerosis is a disease in which fatty substances such as cholesterol, cellular waste, calcium and other substances are deposited along the lining of the artery walls. These sticky, yellowish deposits, known as plaques, may progress to the narrowing of the arteries and is the most common cause of chronic arterial occlusive disease[1]. Epicardial coronary arteries are the major sites of atherosclerotic disease. A spectrum of symptoms result, the severity of which depends on the extent of the involvement and the available collateral circulation. Thus, the symptoms may range from pain at rest to exertion. The pain is due to insufficient blood flow in the myocardium, which is caused by blocked arteries[1]. The major risk factors for atherosclerosis are gender, age, heredity, cigarette smoking, diabetes, high blood pressure, high triglyceride levels, low density lipoprotein levels, chronic kidney disease, abdominal aortic aneurysm, alcohol abuse, overweight, not getting enough exercise, excessive amounts of stress and excess C-reactive protein and homocysteine, etc.[1]. Cigarette smoking constitutes the single most important, independent and effective risk factor of atherosclerosis as per many previous studies[1]. It is well known that the risk of smokers developing coronary heart disease is at least 2–4 times of that seen in nonsmokers. Although all types of tobacco smoking are known to increase the risk of developing CAD, smoking cigarettes particularly increases this risk more than pipe smoking or cigar smoking. Environmental tobacco smoke which is also called passive smoke is known to cause chronic respiratory conditions, cancer, and heart disease. Active and passive tobacco smoke is associated with the dysfunction of the endothelial physiology and vascular impairment.

The American Heart Association estimates that nearly 40000

people die yearly from heart and blood vessel disease which is caused by passive smoking. Further, yearly, more than 400,000 people die from smoking related illnesses in the United States alone. Cigarette smoking is said to be responsible for between 17% and 30% of all deaths from cardiovascular illness. The effects of cigarette smoking are dose-related and life style modification measures involving quitting smoking are probably the single most important steps to decrease the chance of coronary artery disease and a heart attack[1].

A preliminary Google search showed scanty results regarding the questionnaire based studies which were done with respect to the male smokers in south Karnataka, with respect to the Coronary artery afflictions in 2005, when we embarked on this questionnaire based study. A similar search using the key words 'smokers', 'coronary artery disease', 'south Karnataka at Health University' and 'Medline data bases' also returned few results. Hence, we decided to go ahead with this inexpensive exploratory study to estimate the incidence of coronary artery disease among the smokers in south Karnataka.

## MATERIALS AND METHODS

Our observational, exploratory, descriptive, cross-sectional, institutional study was aimed to assess the incidence of coronary artery disease among the smokers vis a vis the nonsmokers in suburban South Karnataka. This preliminary, one year study was conducted in the teaching referral hospital which was attached to the Sri Devraj Urs Medical College, Kolar, in South Karnataka, India, during March 2005 to March 2006. A total of 200 adult men above the age of 30 years, who visited the hospital with pain in the chest, were randomly selected and they constituted the materials for the present study. The subjects were categorized into smokers (the study group) and non-smokers (controls).

They were examined in detail after taking the individual, well informed consent after obtaining the mandatory clearance from the ethical committee of the institution. The exclusion criteria included tobacco chewers and tobacco use in any other form than smoking cigarettes and beedies. Also excluded were those subjects with a family history of diabetes mellitus, hypertension, coronary artery disease, chronic lung disease, and drug intake affecting the cardiovascular system. For each subject, personal history like drug history and the history of smoking were recorded in detail. Previous or current cigarette smoking was considered as a positive smoking history. The number of cigarettes and their frequency were also noted. All subjects were asked to answer the well explained standardized Rose questionnaire either orally or in writing. The Rose Questionnaire, also called as the London School of Hygiene Cardiovascular Questionnaire, has been frequently used in epidemiological research as a standard, unbiased and validated measure of the prevalence of angina in general populations since its introduction in 1962 [2]. The questionnaire method which was adopted, was noninvasive and inexpensive and can be easily carried out in the community. The diagnosis of the coronary artery disease was confirmed by other methods. The data were collected and analyzed statistically.

## RESULTS

200 male subjects were selected as per the criteria which were laid down in the methods and materials section for the present study. The Rose questionnaire was used as a tool to detect coronary artery disease. The data which was thus collected was statistically analyzed and discussed. The results were compared between the two groups viz the smokers and the non smokers. Of the 200 participants, 150(75%) were smokers, 50 (25%) were nonsmokers. The data which were obtained were arranged in a tabular form and was interpreted. The analysis was performed by using the SPSS 8.0 statistical package for Windows. The continuous variables were expressed as the mean + standard deviation and the qualitative data were expressed as percentages. The Chi-square test was carried out to evaluate the significance of coronary artery disease in the two groups. The mean difference was significant at a  $P < 0.05$  level. A conclusion was drawn, based on the outcome of this statistical treatment.

[Table/Fig-1] shows the distribution of the subjects according to their ages. The youngest subject in the study group was found to be aged 31 years and the oldest was aged 70 years. The youngest subject in the control group was aged 31 years and the oldest was aged 70 years. The mean age of the study group was 48.56 years and that of the control group was 48.96 years. Table 2 shows the mean values in each age group. The parameters like the age at which smoking was started, the number of cigarettes, the duration of smoking and the end inspiratory breath holding (EIBH) in seconds, were taken into consideration. [Table/Fig-3] shows that the incidence of coronary artery disease was maximum in the age group of 51-60 years and that it was least in the 31-40 years age group.

[Table/Fig-4] shows that the coronary artery disease in non smokers was more in the older age group i.e. the age group of 61-70 years (24%), it was 12% in the age group of 51-60 years, and that it was absent between the age group of 31-50 years. Coronary artery disease was not seen in age group of 31-50 years and the incidence seemed to increase as the age

	31-40 YRS	41-50 YRS	51-60 YRS	61-70 YRS
Serum Sodium (Mmol/L)	10	10	10	20
Serum Potassium (Mmol/L)	NIL	NIL	6	4
Cigarettes				
Filter	25	38	33	15
Non Filter	4	4	11	10
Pipe & Cigar	NIL	NIL	NIL	NIL
Mixed	NIL	NIL	NIL	NIL
Total	39	52	60	49

[Table/Fig-1]: Distribution Of Subjects By Smoking And Age

	31-40 yrs	41-50 yrs	51-60 yrs	61-70 yrs
Age Of Start Smoking ( Years)	22.6 ± 4.9	25.0 ± 3.6	26.2 ± 3.4	26.4 ± 4.5
No. Of Cigarettes	15.2 ± 4.2	16.4 ± 3.9	16.7 ± 2.1	15.2 ± 4.2
Duration Of Smoking ( Years)	16.2 ± 3.9	22.0 ± 3.8	26.2 ± 3.9	38.6 ± 6.7
End Inspiratory Breath Hold (Sec)	30	20	30	20

[Table/Fig-2]: Mean Values In Each Age Groups

	SMOKERS TOTAL : 150			
	31-40YRS	41-50YRS	51-60YRS	61-70YRS
Cad Present Total :92	10(46.6%)	34(22.6%)	35(23.3%)	13(8.6%)
Cad Absent Total:58	19(12.6%)	8(5.33%)	15(10%)	16(10.6%)

[Table/Fig-3]: Occurrence Of Coronary Artery Disease (Cad) Among Smokers Group As Detected By Rose Questionnaire Method

	NON SMOKERS TOTAL : 50			
	31-40YRS	41-50YRS	51-60YRS	61-70YRS
CAD PRESENT TOTAL :18	NIL	NIL	6 (12%)	12 (24%)
CAD ABSENT TOTAL:32	10 (20%)	10(20%)	4(8%)	8(16%)

[Table/Fig-4]: Occurance Of Coronary Artery Disease (Cad) Among Non-Smokers As Detected By Rose Questionnaire Method

	CAD PRESENT	CAD ABSENT	TOTAL
SMOKERS	92	58	150
NONSMOKERS	18	32	50
TOTAL	110	90	200

[Table/Fig-5]: Framework Of A Case Control Study

advanced, as was seen in the age group of 61-70 years (20%), as a part of the normal senile thickening of the coronary vasculature. The comparison of [Table/Fig-3 and 4] show the occurrence of coronary artery disease among the smokers and the non smokers respectively. Among the nonsmokers, the aged people were at a higher risk of developing coronary artery disease. There was a high correlation between smoking and coronary artery disease (Pearson's correlation coefficient  $P < 0.01$ ).

[Table/Fig-5] shows that among the 200 subjects, 110 cases (55%) had chest pain on exertion and rest and that 90(45%) had no exertional chest pain. Among the 150 smokers, 92 (Incidence rate-61.3%) had a classic symptom of coronary artery disease which started in the third decade of life. Out of 50 non-smokers, only 18 (Incidence rate -36%) had coronary artery disease which started after the fifth decade of life. The exposure rate of the occurrence of coronary artery disease in the smokers was 83%. The exposure rate of the occurrence of coronary artery disease in the non smokers was just 64%. The statistical association between the exposure and the occurrence of CAD was calculated by p-values, which in this case was  $p < 0.001$ . The odds ratio was 2.81, which meant that the smokers showed a risk of having CAD 2.81 times more than non smokers. The relative risk (RR) among the smokers was 1.71(95% confidence interval 1.4, 2.0). We rejected the null hypothesis in our study, since the calculated Chi- square value (9.72) was greater than the table value of the chi square value (3.84) at a 5% level of significance. This means that the two attributes, coronary artery disease and smoking are not independent. Smoking increases the risk of development of CAD. The standard error of significance between CAD and smoking was 7.713, which was greater than 1.96 at a 5% level of significance. This means that there was statistical significance between CAD and smoking.

## DISCUSSION

Ischaemic heart disease (IHD) causes more deaths and disability and incurs greater economic costs than any other illness in the developed world. IHD is the most common, serious, chronic and life threatening illness in the United States, where >12 million persons have IHD, > 6 million people have angina pectoris, and > 7 million people have sustained myocardial infarction. Similar data has emerged from the burgeoning middle and upper classes in India. Large increases in IHD throughout the world are projected, and IHD is likely to become the most common cause of death worldwide by 2020[1]. This fact remains true, despite a 30% reduction in the mortality which was caused by CAD over the past 3 decades. Many factors have led to a decrease in the mortality and morbidity caused by CAD, including the introduction of coronary care units, bypass surgery (e.g., coronary artery bypass graft), thrombolytic therapy, angioplasty (e.g., percutaneous transluminal coronary angioplasty PTCA), and a tremendous emphasis on lifestyle modification. Over the decades, in India too, advanced coronary care set ups offering world class care have emerged in major cities and towns and health awareness regarding the disease is increasing in the communities [1].

Various diagnostic tests like Electrocardiogram (ECG), Exercise stress test Echocardiogram, Nuclear scan, Electron-beam computed tomography (EBCT), Computed Tomography angiography, Magnetic resonance angiography and Coronary angiography are available for the early diagnosis of CAD [1].

It is well appreciated that the symptoms of CAD can range widely,[1] from no symptoms at all, to mild intermittent chest pain, to pronounced and steady pain. A person who experiences angina may feel heaviness, tightness, pain, burning, pressure, or squeezing, usually behind the breastbone, but sometimes the pain also spreads to the left side of the neck, arms, jaws, and shoulders. Angina is often accompanied by lightheadedness, shortness of breath, nausea, sweating and fainting. These

symptoms are usually brought on by exertion and are relieved by rest. Nevertheless, some people (especially diabetics) have heart attacks without ever experiencing any of these symptoms [1].

Cigarette smoke contains chemicals like Nicotine, Carbon monoxide, Ammonia, formaldehyde, tars, etc. [2]. The chief pharmacological active ingredient in tobacco is nicotine (acute effects) and tars (chronic effects). The effects of nicotine on the cardiovascular system are known to be similar to sympathetic stimulation. It causes tachycardia, ventricular extra systoles, increase in plasma noradrenalin, blood pressure, and cardiac output and the oxygen consumption also increases. It increases atherosclerotic narrowing and platelet adhesiveness and it also lowers the high-density lipoprotein levels. Cholesterol-carrying lipoproteins also enter the walls of the arteries more easily, where they can develop into a hard plaque and atherosclerosis. This reduces the amount of oxygen that can be carried by the red blood cells into the bloodstream [3, 4].

We studied smokers and non smokers with coronary artery disease from the ages of 30 to 70 years. The peak incidence of coronary artery disease was in the age group of after 40 years. The average age of the start of smoking was nearly  $24.8 \pm 4.2$  in all the age groups. The number of cigarettes in each group on an average was  $15.8 \pm 3.8$  per day. The duration of smoking on an average was  $25.7 \pm 3.6$  years. The end inspiratory breath holding on an average was 25 seconds. The earlier the age of the start of smoking, the more was the number of cigarettes smoked, the longer was the duration of smoking and the longer was the end inspiratory breath holding and all these factors were found to increase the risk of development of coronary artery disease. The findings of the present study were in conformity with earlier studies which were done by many others, which are discussed below.

Winnifordetal[3] concluded that in patients with atherosclerotic coronary artery disease, cigarette smoking increases the myocardial oxygen demand but may cause an inappropriate decrease in the coronary blood flow and the myocardial oxygen supply. Their study explored the mechanism of smoking- induced coronary vasoconstriction and specifically researched on it to determine whether smoking causes an alpha-adrenergically mediated increase in the coronary artery tone[3]. Cigarette smoking and hypercholesterolaemia influence the renin-angiotensin system (RAS) functions, including increased RAS-mediated vasoconstriction, mitogenic signaling, and angiotensin II type 1 receptor (AT1R) expression as per the studies by Zak and Wita 4; who concluded that the 1166C allele increases the risk of CAD which was associated with the presence of cigarette smoking and hypercholesterolaemia[4].

In another study on 808 persons [5] who were active smokers at the time of the incident infarction, 449 had quit smoking during hospitalization or after discharge. Among the quitters, the relative risk decreased as the duration of the cessation increased. In persons who quit smoking after infarction, the risk declined to equal that of the nonsmokers by 3 years after the cessation. [5]. After five years, the mortality was 22% among those who continued smoking and it was 15% among the quitters6 as per another study. The relative risk for mortality in smoking continuers vs. quitters was 1.55 (95% confidence interval, 1.29 to 1.85). This study supported the recommendation that patients with coronary artery disease should stop smoking.[6]

Herbert [7] reported that, when patients undergoing selective coronary arteriography were studied to determine whether the extent of their coronary artery disease (CAD) was related to cigarette consumption, those without demonstrable lesions averaged 29.0 pack years, while patients with a single vessel disease averaged 38.3 pack years, those with double vessel disease averaged 44.9 pack years and those with triple vessel disease averaged 67.5 pack years. Nonsmokers with significant CAD were ten years older than their smoking counterparts ( $p < 0.01$ ). This study demonstrated a correlation between the number of cigarettes consumed and the severity of CAD, as well as the accelerating effect of cigarette consumption on the development of CAD[7]. Further, endothelium dependent vasodilatation is mediated by the release of nitric oxide which is formed by constitutively expressed endothelial nitric oxide synthase (eNOS4a). This genotype was also associated with a history of myocardial infarction. This smoking dependent excess coronary risk in the eNOS4a homozygote is consistent with a predisposition to endothelial dysfunction[8].

In yet another study, the association between the extent and duration of the smoking habit and the severity of coronary atheroma was examined in 387 patients who underwent routine coronary arteriography before valve replacement surgery. The total number of cigarettes which were smoked in life correlated significantly with the severity of the coronary artery disease ( $p < 0.001$ ) and the number of coronary arteries correlated with stenoses of 50% or more ( $p < 0.001$ )[9].

Moniek et al[10] showed that inflammation and smoking were associated with a risk of cardiovascular disease, but that not much was known yet about their relationship. They studied the relationships with the inflammatory markers like C-reactive protein (CRP), interleukin-6 (IL-6), interleukin-1 $\beta$  (IL-1 $\beta$ ) and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ). IL-6 and TNF- $\alpha$  were significantly higher in patients than in controls. They concluded that inflammation is affected by both smoking and cardiovascular disease[10]. Another study [11] showed the effects of cigarette smoking and the cessation of smoking in a cohort of 1893 men and women from the Coronary Artery Surgery Study (CASS) registry, who were 55 years of age or older and had angiographically documented coronary artery disease. The six-year mortality rate was greater among the continuing smokers ( $n = 1086$ ) than among those who had quit smoking ( $n = 807$ ); the relative risk was 1.7 (95 percent confidence limits, 1.4, 2.0). Many other studies concluded that smoking cessation lessens the risk both in older as well as younger persons with coronary artery disease [12, 13, 14].

Rose GA, Blackburn H and Gillum RF used the WHO/Rose Questionnaire on ischaemic heart pain and intermittent claudication patients by doing epidemiological field surveys. They concluded that in this particular situation, the questionnaire diagnosis showed reasonable (about 83 %) sensitivity and high specificity as compared to the diagnosis which was made by the physicians. Rose et al noted that the interviews of the physicians took 15 minutes each, as compared to about 1 minute duration for the questionnaire [15].

S. Ugurlu, E. Seyahi and H. Yazici assessed the prevalence of angina, myocardial infarction and intermittent claudication by using the Rose questionnaire among patients with Behcet's syndrome. Male patients with vascular involvement had more

claudication (15/67) than those without vascular involvement (4/69) ( $P < 0.006$ )[16].

Many others studied the sensitivity, specificity, and the predictive value of noninvasive testing methods like the questionnaire method and compared them with traditional clinical evaluation methods and invasive techniques of vascular disease in a defined population. It has been felt that the former can be usefully incorporated in cardiovascular risk assessment and screening programs.[17, 18].

## CONCLUSION

Smoking increases the risk for the development of CAD by more than 80%. The coronary artery disease risk profile and the Rose questionnaire allows physicians to identify high-risk individuals during a routine office visit and these can also be used to educate patients about the modifiable risk factors, particularly smoking and blood pressure. Improved compliance with risk factor modification strategies may result in a beneficial impact on survival.

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