

# Study of effect of smoking on blood pressure in normotensive men

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## ABSTRACT

### Study of effect of smoking on blood pressure in normotensive men.

**Introduction:** Though smoking has been conclusively found to cause significant cardiovascular morbidity, the literature on the topic of effect of smoking on blood pressure seem to show contradictory results. **Objective:** The aim of this study was to find out the effect of smoking on blood pressure. **Methodology:** A total of 2190 workers in a factory in south India were examined. A detailed history and examination was done on all the subjects. After six months, the same subjects were examined again. The statistical analysis applied in our study design was analysis of Co-variance [ANCOVA or ANOCOVA]. **Results:** In the age group of 20 to 40 years, the systolic and diastolic blood pressure was highest in the heavy smokers. In the 41 to 60 year group also the systolic blood pressure was highest in the heavy smokers, but the diastolic blood pressure was highest in the non-smokers. Blood pressure was found to be high in those who consumed alcohol and lower in those who engaged in sports. **Conclusions:** From this study we concluded that there was a rise in systolic blood pressure in smokers as compared to non-smokers. Blood pressure was also high in those who consumed alcohol and lower in those who engaged in sports.

**Keywords:** Blood Pressure, Smoking, cigarette, Male, Adult

## INTRODUCTION

Smoking, a uniquely human habit is indulged in, almost, all over the world, in different forms. Although the deleterious effects of cigarette smoking on the cardiovascular system have been clearly documented, the relationship between cigarette smoking and blood pressure and hypertension has not been fully characterized.<sup>1</sup> Though it is well established that cigarette smoking causes the blood pressure to rise acutely, there does not seem to be a consensus on the role of cigarette smoking as a cause for persistent high blood pressure or hypertension.<sup>2</sup> Some studies in fact have indicated that smokers tend to have lower blood pressure than non-smokers.<sup>3,4</sup> Other studies have

found higher blood pressure in smokers.<sup>5,6</sup> Some others have found that there are no consistent independent differences in blood pressure between smokers and non-smokers.<sup>7</sup> Since the results for the effect of smoking on blood pressure has shown varied results in various parts of the world the present study was planned to see if there was any relation between smoking and blood pressure in a south Indian population.

## METHODOLOGY

**STUDY DESIGN:** Cross-sectional study.

The study protocol was approved by the local ethics committee. Informed consent was obtained from all subjects prior to inclusion in the study.

**STUDY POPULATION:** The employees in the factory were examined at the site allocated in the factory. A total of

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2190 workers were eligible and examined initially. The same workers were examined again after an interval of six months.

### EXCLUSION CRITERIA:

1. Women
2. Subjects with hypertension and coronary artery disease (i.e. physician diagnosed cases and also people with history suggestive of angina).

### INTERVIEW DATA COLLECTED

**AGE:** All the subjects belonged to the age group of 20–60 years. They were further divided into those, less than 40 years and those above 40 years.

Occupational history and any significant past history or family history were also noted. Information about the number of cigarettes smoked per day, alcohol consumption, coffee intake and history of significant engagement in sports/exercise for at least thrice/week were also noted.

Each subject selected in the study was included in one of the following groups:

**NONSMOKERS:** People who have never smoked.

**LIGHT SMOKERS:** People who smoked less than 10 cigarettes per day.

**HEAVY SMOKERS:** People who smoked greater than 10 cigarettes per day.

**PHYSICAL EXAMINATION:** This was done between 2:00 PM to 4:00 PM in a quiet room allocated by the factory management for this purpose. The following precautions were taken before recording the blood pressure. The subjects were asked not to consume coffee in the preceding one hour. The subjects were asked not to smoke in the preceding ½ hour. The subjects should not have taken adrenergic stimulants like phenylephrine in nasal decongestants or eye drops for pupillary dilation. The subjects were asked to be seated and to avoid exertion in the preceding half an hour. The physical examination included height, weight, body mass index (BMI), pulse rate, and blood pressure measurement.

The blood pressure was determined with the subject in a sitting posture, using a standard sphygmomanometer with the cuff on the left arm. The average of the three readings was obtained during each visit. The systolic blood pressure corresponded to the first korotkoff sound and the fifth korotkoff sound taken as diastolic blood pressure.

**STATISTICS:** The analysis applied in our study design is the analysis of covariance (ANCOVA or ANOCOVA). Controlling the variability by applying analysis of covariance was done by grouping of the subjects into homogenous groups. The analysis of covariance was done mainly to adjust the source of bias and to remove the effect of disturbing variables.

### RESULTS

The results obtained from the observations are summarized in the Tables 1 to 4. In Table 1 which dealt with the population of young men the systolic blood pressure and the diastolic blood pressure was observed to be higher in the heavy smokers when compared to non smokers and light smokers. The heart rate was also found to be highest in the heavy smokers. The body mass index of light smokers was lower than that of non smokers and heavy smokers. The consumption of coffee was highest in the heavy smokers. In Table 2 which dealt with the population of men aged 41 to 60 years the systolic blood pressure was highest in the heavy smokers. However the diastolic blood pressure was higher in the non smokers when compared to smokers. The heart rate was highest in the heavy smokers. Here also coffee consumption was highest in the heavy smokers. In the Table 3 using covariance model it was found that the systolic blood pressure in subjects of the age group 20–40 years was significantly higher in those who consumed alcohol in the non-smoker's category. The diastolic blood pressure was significantly lower in the non

**Table 1: Characteristics of non-smokers, light and heavy smokers in the age group of 20 to 40 years**

Characteristics	Non-smokers n = 130	Smokers	
		Light n = 450	Heavy n = 500
Systolic BP	124.93 ± 6.28	126.1 ± 6.01	128.51 ± 6.41
Diastolic BP	78.09 ± 5.63	79.04 ± 5.61	80.16 ± 5.62
Heart rate	76.26 ± 5.61	76.82 ± 5.0	76.9 ± 7.26
BMI	23.48 ± 3.63	22.29 ± 3.0	23.62 ± 3.0
Alcohol (%)	20.2	16.1	20.4
Coffee (%)	64.6	65.3	68.3
Exercise (%)	17.1	20.4	18.2

**Table 2: Characteristics of non-smokers, light and heavy smokers in the age group of 41 to 60 years**

Characteristics	Non smokers n = 120	Smokers	
		Light n = 480	Heavy n = 510
Systolic BP	132.92 ± 4.6	134.23 ± 5.4	136.58 ± 4.0
Diastolic BP	87.31 ± 3.54	86.19 ± 2.86	86.47 ± 2.25
Heart rate	76.24 ± 5.02	76.82 ± 4.05	79.6 ± 5.38
BMI	24.03 ± 3.0	23.79 ± 3.47	24.43 ± 3.32
Alcohol (%)	29.3	26.2	27.3
Coffee (%)	58.1	58.6	61.2
Exercise (%)	17.5	18.3	16.6

**Table 3: Covariance model to show the effect of alcohol, coffee and sports on the systolic and diastolic blood pressure in age group of 20 to 40 years**

		Non Smokers	Smokers	
			Light	Heavy
Systolic BP	Alcohol	13.007 (0.033)	4.538 (0.265)	-7.362 (8.299)
	Coffee	-0.349 (0.865)	-0.784 (0.673)	-0.146 (0.953)
	Sports	-2.017 (0.495)	-3.776 (0.241)	-1.265 (0.769)
Diastolic BP	Alcohol	7.396 (0.186)	-2.118 (0.543)	-0.534 (0.931)
	Coffee	-3.867 (0.069)	-1.746 (0.276)	2.719 (0.214)
	Sports	-7.167 (0.012)	-2.866 (0.298)	2.783 (0.463)

() P value

smokers who engaged in sports. In Table 4 the systolic blood pressure was significantly lower in the age group of 41 to 60 years in those who engaged in sports in the non smokers group. The difference in diastolic blood pressure was not adequate to amount for statistical significance.

In all the tables though there was a downward trend in the blood pressure in those who consumed coffee, it was not statistically significant.

## DISCUSSION

In the present study it was found that the systolic and diastolic blood pressure was higher in smokers when compared to the non-smokers in the younger age group. In the older age group only the systolic blood pressure

**Table 4: Covariance model to show the effect of alcohol, coffee and sports on the systolic and diastolic blood pressure in age group of 41 to 60 years**

		Non smokers	Smokers	
			Light	Heavy
Systolic BP	Alcohol	2.282 (0.0907)	-1.441 (0.542)	-1.21 (0.462)
	Coffee	-0.907 (0.890)	-0.128 (0.949)	0.08 (0.955)
	Sports	-26.79 (0.009)	-1.031 (0.685)	-1.26 (0.634)
Diastolic BP	Alcohol	0.092 (0.989)	0.621 (0.715)	-0.211 (0.905)
	Coffee	-1.58 (0.486)	-0.758 (0.665)	-0.376 (0.818)
	Sports	-0.942 (0.781)	-0.388 (0.863)	-3.375 (0.239)

() P value

was higher in the smokers. Primates P et al. in their study had also found significantly higher systolic blood pressure in heavy and moderate smokers than in non-smokers, whereas they did not find any such difference for diastolic blood pressure.<sup>8</sup> Mann SJ et al. in a study of 24 hour ambulatory blood pressure monitoring found that smokers maintained a higher mean daytime ambulatory systolic blood pressure than nonsmokers, even though office BP levels were similar.<sup>9</sup> However, Okubo Y et al. had found in Japanese subjects that the blood pressure of smokers was lower than that of non and ex-smokers.<sup>10</sup> Berglund G et al. had also found that blood pressure levels among cigarette smokers were lower than those of non-smokers.<sup>11</sup> There have been various hypothesis proposed to explain the relation between smoking and blood pressure. Rabinowitz BD et al. in their study had found that there was an acute rise in blood pressure in smokers which was mediated through elevation in circulating catecholamines.<sup>12</sup> Cohen SI et al. also showed that smoking nicotine free synthetic cigarettes had no effect on blood pressure or heart rate. Whereas, smoking tobacco cigarettes with high or low nicotine content increases heart rate and systolic and diastolic blood pressure.<sup>13</sup> The nicotine content of smoke is thought to be the cause of the catecholamine release that results in hemodynamic alterations.<sup>14</sup> Though the effects of smoking on blood pressure may be short lived, but repeated smoking during the day results in higher average pressures that may eventually promote sustained high blood pressure in smokers. Recently there have been many studies to see if there was any genetic link between smoking and high blood pressure.<sup>15</sup> Montasser ME et al. found cigarette smoking to be an important mediator of genetic effects on blood pressure and hypertension.<sup>16</sup> Another study by Yin RX et al. concluded that the differences in blood pressure levels between the nonsmokers and smokers might partly result from different interactions of several single nucleotide polymorphisms.<sup>17</sup> In our study the systolic and diastolic blood pressure was higher in those who consumed alcohol. Keil U et al. had also observed higher levels of systolic blood pressure with increasing alcohol intake at each level of smoking.<sup>18</sup> Chan et al. had shown that ethanol intake for four to twelve weeks was associated with rise in blood pressure in rat models due to increase in plasma norepinephrine.<sup>19</sup>

In our study the systolic and diastolic blood pressure was lower in those who engaged in sports and physical activity. Decrease in the body fat and also the sympathetic nervous system activity has been demonstrated in people who engaged in sports and physical activity. Regular exercise has been shown to reduce blood pressure in men

even with severe hypertension.<sup>20</sup> In our study it was found that both systolic and diastolic blood pressure was lower in those who consumed coffee; however the amount of decrease was not statistically significant. Due to the complex interactions between smoking, alcohol intake, genetic factors, body mass index, exercise and many other factors any independent chronic effect of smoking on blood pressure is difficult to study and this may explain the contradictory results in the various previous studies on this topic.

## CONCLUSION

Systolic blood pressure is higher in smokers compared to non-smokers.

The limitations of our study were:

Certain factors which might have an influence on blood pressure (e.g. diabetes) were not taken into consideration.

Only men were included in the study due to the inadequate number of women subjects.

Hypertensive subjects were excluded from the study as the knowledge of the diagnosis itself may produce a change in behavior with respect to smoking and other habits.

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