EVALUATE THE EFFECT OF CIGARETTE SMOKING IN LIPID PROFILE, BODY MASS INDEX (BMI), BLOOD PRESSURE (BP), RESTING HEART RATE AND RR INTERVAL IN HEALTHY SMOKERS AND COMPARE IT WITH NON-SMOKERS

Chandmal Agarwal1, Rishabh Gupta2, Puneet Rijhwani3, Shekhar Kapoor4, Silky Singla5

1Associate Professor, Department of General Medicine, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan.
2Junior Resident, Department of General Medicine, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan.
3Professor and HOD, Department of General Medicine, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan.
4Assistant Professor, Department of General Medicine, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan.
5Junior Resident, Department of Dermatology, Venereology and Leprosy, Guru Nanak Dev Medical College and Hospital, Amritsar.

ABSTRACT

BACKGROUND
Cigarette smoking is an important and independent risk factor for atherosclerosis, coronary artery disease, peripheral vascular disorders, cerebrovascular diseases, cancer and for chronic obstructive airway disease (COAD). Several studies worldwide give the evidence that tobacco either chewed or inhaled alters the lipid profile in normal individuals.1 A recent prediction by World Health Organisation suggests that deaths in India may exceed 1.5 million annually by 2020 by tobacco consumption.3

The purpose of this study is to evaluate the effect of cigarette smoking in Lipid Profile, Body Mass Index (BMI), Blood Pressure (BP), Resting Heart Rate and RR interval in healthy smokers and compare it with non-smokers.

MATERIALS AND METHODS
50 healthy male subjects of age 20 - 45 years and 50 age matched male smokers attending Mahatma Gandhi Medical College and Hospital who had the history of smoking one or more cigarettes per day regularly for at least past one year. After taking an informed consent from the patient, a complete General and Systemic examination will be done following which Body Mass Index (BMI), ECG and blood test for serum lipids will be done. Total cholesterol, LDL (low density lipoproteins), VLDL (very low-density lipoprotein), TG (triglycerides), HDL (high density lipoprotein), ECG (RR interval), HR (heart rate) and BP (blood pressure) were recorded.

RESULTS
Mean age in cases and controls is 34.42 ± 6.68. Statistically, this difference was insignificant (p > 0.05). In our study, the mean value of total cholesterol level in smokers ranges between 136 - 201 (mean 170.38 ± 15.17) and in non-smokers range between 140 - 182 (161.69 ± 11.18). Statistically, this difference is significant (p value .001). In our study, the mean value of LDL cholesterol level in smokers ranges between 76 - 188 (mean 118.44 ± 35.770) and in non-smokers range between 72 - 110 (85.18 ± 8.048). Statistically, this difference is highly significant (p value < .001). In our study, the mean value of VLDL cholesterol level in smokers ranges between 21 - 33 (mean 24 ± 2.35) and in non-smokers range between 14 - 19 (17.5.888 ± 1.03). Statistically, this difference is highly significant (p value < .001). In our study, the mean value of TG in smokers ranges between 120 - 226 (mean 149.58 ± 46.141) and in non-smokers range between 110 - 136 (125.30 ± 5.737). Statistically, this difference is highly significant (p value < .001). In our study, mean value of HDL in smokers ranges between 27 - 47 (mean 39.96 ± 4.673) and in non-smokers range between 31 - 52 (42.74 ± 4.526). Statistically, this difference is significant (p value < .05). In our study, mean value of HDL in smokers ranges between 27 - 47 (mean 39.96 ± 4.673) and in non-smokers range between 31 - 52 (42.47 ± 4.526). Statistically, this difference is significant (p value < .05). In our study, mean value of SBP in smokers ranges between 120 - 146 (mean 131.83 ± 7.16) and in non-smokers range between 119 - 144 (129.80 ± 5.409). Statistically, this difference is non-significant (p value > .05). In our study, mean value of DBP in smokers ranges between 70 - 86 (mean 77.58 ± 4.669) and in non-smokers range between 68 - 90 (77.96 ± 5.92). Statistically, this difference is non-significant (p value > .05). In our study, mean value of HR in smokers ranges between 70 - 93 (mean 83.76 ± 5.766) and in non-smokers range between 63 - 80 (74.14 ± 4.194). Statistically, this difference is highly significant (p value < .001). In our study, mean value of RR interval in smokers ranges between 64 - 86 (mean 7322 ± 0.5304) and in non-smokers range between 74 - 93 (.8180 ± 0.4267). Statistically, this difference is highly significant (p value < .001). In our study, mean value of BMI in smokers ranges between 18.20 - 25.18 (mean 21.42 ± 1.36) and in non-smokers range between 21.10 - 28.50 (23.86 ± 1.64). Statistically, this difference is highly significant (p value < .001).

CONCLUSION
The data suggests that serum total cholesterol, LDL cholesterol, VLDL cholesterol, TG and HR were significantly higher in smokers as compared to non-smokers; serum HDL levels and BMI was significantly lower in smokers as compared to non-smokers, but there was no significant difference between SBP and DBP of smokers and non-smokers.

KEYWORDS
High-Density Lipoprotein Cholesterol; Low-Density Lipoprotein Cholesterol; Lipoproteins; Risk Factors; Smoking; Triglycerides; Body Mass Index; Blood Pressure.

**Effects of Cigarette Smoking**

Smoking leads to increase in carbon monoxide\(^4\) that causes damage to the endothelium leading to atherosclerosis. Smoking causes anoxaemia in the tissue and myocardium due to formation of carboxyhaemoglobin and also increases the platelet aggregation.\(^5\) Nicotine increases adrenaline from the adrenal cortex that causes increase in free fatty acids (FFA) and hepatic synthesis and secretion of cholesterol and very low density lipoprotein (VLDL) and TGL.\(^6\) Smoking leads to decrease in oestrogen levels, which decreases HDL cholesterol concentration.\(^7\) Smoking leads to hyperinsulinaemia, which decreases the activity of lipoprotein lipase\(^8\) leading to increased concentration of LDL, VLDL and TGL in the serum.

**Chart 1. Chart showing a possible Mechanism by which Nicotine Absorbed from Cigarette Smoke may Elevate Plasma Lipids and Lipoproteins**

<table>
<thead>
<tr>
<th>Cigarette Smoking</th>
<th>Absorption of nicotine into the body</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Secretion of catecholamines, cortisol and growth hormones</td>
</tr>
<tr>
<td></td>
<td>Activation of adenyl cyclase in adipose tissue</td>
</tr>
<tr>
<td></td>
<td>Lipolysis of stored TG and release of FFA into plasma</td>
</tr>
<tr>
<td></td>
<td>Release of FFA from adipose tissue TG into plasma bound to albumin</td>
</tr>
<tr>
<td></td>
<td>Increased Hepatic synthesis of TG, VLDL-C</td>
</tr>
<tr>
<td></td>
<td>Increased Plasma TG, VLDL-C</td>
</tr>
<tr>
<td></td>
<td>Decrease HDL-Cholesterol</td>
</tr>
</tbody>
</table>

**Materials and Methods**

**Design and Sampling/Design**

Descriptive comparative study.

**Sample Size**

50 male non-smokers in Group 1 and 50 male smokers in Group 2 were taken individually in each group.

**Sampling**

The study enrolled 50 male non-smokers in Group 1 and 50 male smokers in Group 2 are taken individually in each group with age group between age 20 - 45 years, attending the outpatient Department of Medicine at Mahatma Gandhi Medical College and Hospital, Jaipur.

**Sampling Procedure**

Patients were divided into two Groups as Group 1 and Group 2.

**Group 1**

In this group, 50 healthy male non-smokers (controls) in age group of 20 - 45 years were taken, attending Medicine Department at Mahatma Gandhi Medical College and Hospital, Jaipur.

**Group 2**

In this group 50 male smokers (cases) in age group of 20 - 45 years were taken, attending Medicine Department at Mahatma Gandhi Medical College and Hospital, Jaipur.

**Inclusion Criteria**

50 healthy male subjects of age 20 - 45 years and 50 age matched male smokers attending Mahatma Gandhi Medical College and Hospital, who had the history of smoking one or more cigarette per day regularly for at least past one year. The sample size estimation was also done at conveniences.

**Exclusion Criteria**

Subjects with diabetes mellitus, ischaemic heart disease or peripheral vascular disease, chronic renal disease, any infectious or debilitating illness, taking antibiotics, steroids, thiazide diuretics, aspirin, non-steroidal anti-inflammatory drugs, immunomodulatory drugs and drugs that influence lipidd level will be excluded from the study.

The subjects who are passive smokers, ex-smokers and those who underwent recent hospitalisation, surgery and radiotherapy will also be excluded.

Since smoking is extremely rare among women in this area due to cultural reasons, women were not included. Study by convenient sampling technique since the duration of the study was short duration. The sample size was selected by convenience sampling technique.

**Ethical Issues**

Ethical Clearance was Sought from Hospital Ethics Committee. Besides this-

1. Written consent was taken from patients participating in the study.
2. Confidentiality was maintained.

**Statistical Analysis**

100 patients participated in descriptive comparative study, which was conducted in Department of Medicine at Mahatma Gandhi Medical College and Hospital, Jaipur. Patients were divided into two groups as Group 1 (non-smokers) and Group 2 (smokers). All the included patients completed the study and were statistically analysed. The observations were tabulated in the form of mean ± standard deviation (SD) and analysed using ‘t’ test for intergroup comparison. Difference in categorical data was assessed by chi-square test (χ\(^2\)).
Comparison and level of significance was determined as its ‘p’ value with:
- \( p > 0.05 \) - Insignificant.
- \( p < 0.05 \) - Significant.
- \( p < 0.001 \) - Highly Significant.

**RESULTS**

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (Years) Mean ± SD</th>
<th>Total Cholesterol Mean ± SD</th>
<th>LDL Mean ± SD</th>
<th>VLDL Mean ± SD</th>
<th>TG Mean ± SD</th>
<th>HDL Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>34.42 ± 6.68</td>
<td>161.64 ± 11.18</td>
<td>85.18 ± 8.048</td>
<td>17.58 ± 2.35</td>
<td>149.58 ± 46.141</td>
<td>39.96 ± 4.673</td>
</tr>
<tr>
<td>Group 2</td>
<td>34.42 ± 6.76</td>
<td>170.38 ± 15.17</td>
<td>118.44 ± 35.770</td>
<td>24.00 ± 2.35</td>
<td>125.30 ± 5.737</td>
<td>42.74 ± 4.526</td>
</tr>
</tbody>
</table>

\( P \) value
- 0.964; NS
- 0.001* S
- <0.001** HS
- <0.001** HS
- <0.001** HS
- 0.003* S

Table 2. Total LDL (Low Density Lipoproteins) in the Study Cases and Controls

- **p < 0.001; Highly significant.**

Table No. 2 depicts comparison of mean values of LDL in the study cases and controls. In our study, the mean value of LDL cholesterol level in smokers ranges between 76 - 188 (mean 118.44 ± 35.770) and in non-smokers range between 72 - 110 (85.18 ± 8.048). Statistically, this difference is highly significant (\( p \) value < .001). This result has been displayed in Graph No. 3.

**Table 1. Age Wise Distribution of the Study Cases and Controls**

<table>
<thead>
<tr>
<th>Group</th>
<th>No. Range</th>
<th>Age (Years) Mean ± SD</th>
<th>‘t’ value</th>
<th>( P ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>50 23-45</td>
<td>34.42 ± 6.68</td>
<td>0.045</td>
<td>0.964; NS</td>
</tr>
<tr>
<td>Group 2</td>
<td>50 23-45</td>
<td>34.42 ± 6.76</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS: \( p > 0.05 \); Not significant

Table No. 1 depicts age wise distribution of the cases and controls. In our study, 50 healthy male subjects and 50 age matched male smokers in range of 23 - 45 years are taken. Mean ± SD is 34.42 ± 6.68. Statistically, this difference was insignificant (\( p > 0.05 \)). This result has been displayed in Graph No. 1.

**Table 3. Total LDL (Low Density Lipoproteins) in the Study Cases and Controls**

P < 0.05; Significant

**p < 0.001; Highly significant.**

Table No. 3 depicts comparison of mean values of LDL in the study cases and controls. In our study, the mean value of LDL cholesterol level in smokers ranges between 76 - 188 (mean 118.44 ± 35.770) and in non-smokers range between 72 - 110 (85.18 ± 8.048). Statistically, this difference is highly significant (\( p \) value < .001). This result has been displayed in Graph No. 3.
**p < 0.001; Highly significant**

Table No. 4 depicts comparison of mean values of VLDL in the study cases and controls. In our study, the mean value of VLDL cholesterol level in smokers ranges between 21 - 33 (mean 24 ± 2.35) and in non-smokers range between 14 - 19 (17.588 ± 1.03). Statistically, this difference is highly significant (p value < .001). This result has been displayed in Graph No. 4.

**p < 0.001; Highly significant**

Table No. 5 depicts comparison of mean values of triglyceride in the study cases and controls. In our study, the mean value of TG in smokers ranges between 120 - 226 (mean 149.58 ± 46.141) and in non-smokers range between 110 - 136 (125.30 ± 5.737). Statistically, this difference is highly significant (p value < .001). This result has been displayed in Graph No. 5.
Table No. 7 depicts comparison of mean values of SBP in the study cases and controls. In our study, mean value of SBP in smokers ranges between 120 - 146 (mean 131.83 ± 7.16) and in non-smokers range between 119 - 144 (129.80 ± 5.40). Statistically, this difference is non-significant (p value < .05). This result has been displayed in Graph No. 7.

Table 8. Diastolic Blood Pressure (DBP) Level in the Study Cases and Controls

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Range</th>
<th>DBP (mmHg)</th>
<th>Mean ± SD</th>
<th>'t' value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>50</td>
<td>68-90</td>
<td>77.96 ± 5.92</td>
<td>0.356</td>
<td>0.722; NS</td>
</tr>
<tr>
<td>Group 2</td>
<td>50</td>
<td>70-86</td>
<td>77.58 ± 4.669</td>
<td>0.732</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS: p > 0.05; not significant

Table No. 8 depicts comparison of mean values of DBP in the study cases and controls. In our study, mean value of DBP in smokers ranges between 70 - 86 (mean 77.58 ± 4.669) and in non-smokers range between 68 - 90 (77.96 ± 5.92). Statistically, this difference is not significant (p value > .05). This result has been displayed in Graph No. 8.

Table No. 9 depicts comparison of mean values of heart rate in the study cases and controls. In our study, mean value of HR in smokers ranges between 70 - 93 (mean 83.76 ± 5.766) and in non-smokers ranges between 63 - 80 (74.14 ± 4.194). Statistically, this difference is highly significant (p value < .001). This result has been displayed in Graph No. 9.

Table 9. Heart Rate in the Study Cases and Controls

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Range</th>
<th>HR (/minute)</th>
<th>Mean ± SD</th>
<th>'t' value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>50</td>
<td>63-80</td>
<td>74.14 ± 4.194</td>
<td>9.540</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Group 2</td>
<td>50</td>
<td>70-93</td>
<td>83.76 ± 5.766</td>
<td>8.099</td>
<td>&lt;0.001**</td>
</tr>
</tbody>
</table>

**p < 0.001; Highly significant

Table No. 10 depicts comparison of mean values of RR interval in the study cases and controls. In our study, mean value of RR interval in smokers ranges between 64 - .86 (mean .7322 ± 0.5304) and in non-smokers range between .74 - .93 (.8180 ± 0.0426). Statistically, this difference is highly significant (p value < .001). This result has been displayed in Graph No. 10.

Table 10. RR Interval in the Study Cases and Controls

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Range</th>
<th>RR (milliseconds)</th>
<th>Mean ± SD</th>
<th>'t' value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>50</td>
<td>64 - .86</td>
<td>.7322 ± 0.05304</td>
<td>8.913</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Group 2</td>
<td>50</td>
<td>64 - .86</td>
<td>.7180 ± 0.04267</td>
<td>9.099</td>
<td>&lt;0.001**</td>
</tr>
</tbody>
</table>

**p < 0.001; Highly significant

Table No. 11 depicts comparison of mean values of BMI in the study cases and controls. In our study, mean value of BMI in smokers ranges between 18.20 - 25.18 (mean 21.42 ± 1.36) and in non-smokers range between 21.10 - 28.50 (23.86 ± 1.64). Statistically, this difference is highly significant (p value < .001). This result has been displayed in Graph No. 11.

Table 11. Body Mass Index (BMI) in the Study Cases and Controls

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Range</th>
<th>BMI (kg/m²)</th>
<th>Mean ± SD</th>
<th>'t' value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>50</td>
<td>21.10-28.50</td>
<td>23.86 ± 1.64</td>
<td>8.099</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Group 2</td>
<td>50</td>
<td>18.20-25.18</td>
<td>21.42 ± 1.36</td>
<td>9.099</td>
<td>&lt;0.001**</td>
</tr>
</tbody>
</table>

**p < 0.001; Highly significant
In a similar study conducted by Singh D on Effect of Cigarette Smoking on Serum Lipid Profile, it was revealed that mean serum total cholesterol (268.88 ± 29.23 mg/dL) were significantly higher in chronic smokers as compared to non-smokers.9

In our study, mean LDL cholesterol in 50 smokers was 118.44 ± 35.770 mg/dL. Statistically, this difference is highly significant (p value < 0.001). In our study, mean value of HDL in smokers ranges between 27 - 47 (mean 39.96 ± 4.673). Statistically, this difference is significant (p value < 0.05). In a similar study conducted by Ramachandran Meenakashishundara, there was a rise in TC, TGL, LDL, Apo-B and fall in HDL and Apo-A; these changes were significant (p < 0.05).10

In our study, mean value of BMI in smokers range 21.10 - 25.18 (mean 21.42 ± 1.64). This difference is highly significant (p value < .001) (Table 11). In a similar study conducted by Pruphanswat and Rodu on the association of smoking and demographic characteristics on body mass index and obesity among adults in the US compared to never smokers, men and women current smokers had lower BMI and lower probability of obesity.11

We report that serum total cholesterol, LDL cholesterol, VLDL cholesterol, TG and HR were significantly higher in smokers as compared to non-smokers, serum HDL levels and BMI was significantly lower in smokers as compared to non-smokers, but there was no significant difference between SBP and DBP of smokers and non-smokers.

**Limitation of the Study**

Due to short duration of study, convenience sampling technique was followed. Thus, sampling size was also calculated by convenience. The results of the study cannot be generalised due to the potential bias resulting from the sampling technique and sample size estimation.

**REFERENCES**