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EFFECT OF TOBACCO CONSUMPTION ON BLOOD PRESSURE, SERUM LIPIDS AND ANTHROPOMETRIC INDICES AMONG SAURASHTRA POPULATION OF GUJARAT

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ABSTRACT

Aim: To study the effect of tobacco consumption on blood pressure, serum lipids, body mass index and waist-hip-ratio according to age and gender. **Methods and Material**: The study population consisted of 400 normal healthy individuals as controls and 746 first time detected and untreated hypertensive subjects in the age group of 30-80 years of age. The control and hypertensive subjects were further divided into two subgroups i.e. tobacco consumption and tobacco non-consumption within two age-groups: 30-50years and 51-80 years. Blood samples were drawn from all the subjects following an overnight fast and total cholesterol was measured by CHOD-PAP method, serum triglyceride by GPO-PAP method and HDL-C by HDL-C plus method using "Accucare" kits. Serum LDL-cholesterol (LDL-C) was calculated by Fredrickson-Friedwald formula. Blood pressure (BP) and anthropometric measurements were measured by a standardized protocol. **Results**: Highly significant increases in TC, TG, LDL-C, BMI and atherogenic indices and a decrease in HDL-C were observed in tobacco consuming hypertensive

groups as compared to tobacco non-consuming controls. In women, a significant increase was seen with tobacco consumption in both controls and hypertensive cases when compared to their non-consuming counterparts. In relation to gender, men had increased values compared to women except in HDL-C and BMI wherein vice versa was found. Also with increase in age each of the parameters increased in both, the controls as well as the hypertensive subjects except the atherogenic and anthropometric indices. **Conclusions:** Tobacco consumption shows an increase in the level of blood pressure, serum lipids and BMI which may be the major contributor to increased risk of cardiovascular morbidity and mortality and in precipitation of HT.

Keywords: Tobacco, Blood Pressure, Serum Lipids, BMI, WHR

INTRODUCTION

The causal associations between cigarette smoking and human diseases are irrefutable. Scientific evidence has linked tobacco use with the development of more than 25 diseases like CAD, stroke, aortic aneurysm and peripheral artery disease **[1, 2]**. Tobacco habits play an important role in precipitation of hypertension and also have an established influence on cardiovascular mortality and morbidity **[3, 4, 5]**. Also a recent study described an association between obesity and prevalence of chronic conditions including hypertension and high blood cholesterol levels **[6]**. With this background, the present study was conducted to study the relationship of tobacco consumption with blood pressure, serum lipids and anthropometric indices according to age and gender.

SUBJECTS AND METHODS

Study Population

The study population included subjects from Jamnagar with varied lifestyle based on their occupation. A total of 1146 subjects (593 women and 553 men) participated in the study. Individuals' $\geq$ 30 years of age were included in the study. Random subjects free of not only hypertension (HT) but any disease and also who were not on any particular medication were included in the study as controls. The control group consisted of 400 healthy people (217 women and 183 men) in the age group of 30 to 80 years. In the patient group, first time detected untreated hypertensive subjects of 30-80 years of age and a total of 746 (376 women and 370 men) individuals were enrolled. HT was considered to be present if the SBP $\geq$ 140 mm Hg or the DBP $\geq$ 90 mm Hg, recent JNC VII **[7]**

classification were used for classifying HT. Control and patient volunteers were further divided into two subgroups i.e. tobacco consumption and tobacco non-consumption, wherein, tobacco in all its forms were considered to be tobacco consumption.

Anthropometric Measurements

A weighing (bathroom) scale and stadiometer were used to measure the weight (nearest 0.5 kg) and height (nearest 0.1 cm) of each subject using standard procedure. Body Mass Index (BMI) [weight in kg/ height in m^2] was calculated. The waist circumference and the hip were measured using a non-stretchable measuring tape. Waist-hip-ratio (WHR) was calculated from the data.

Collection of Samples

Venous blood withdrawn after an overnight fast of 12 hrs was used to estimate the parameters.

Biochemical Markers

Total cholesterol was measured by CHOD-PAP method, serum triglyceride by GPO-PAP method and HDL-C by HDL-C plus method using "Accucare" kits. The test was carried out according to the manufacturers' instructions. Measurements of serum cholesterol, triglycerides and HDL-C, were done on the ERBA semi-auto analyzer.

(Germany). LDL-Cholesterol (LDL-C) concentration was calculated using Fredrickson-Friedwald formula. The cut-off values for abnormal lipid levels were considered according to the National cholesterol education programme (NCEP) guidelines Adult treatment panel III (ATP III) **[8]**. Atherogenic ratios [TC/ HDL] >5 and [LDL-C/HDL-C] >3.5 was taken as elevated.

Statistical Analysis

Mean, standard deviation and standard error were calculated. Student 't' test was applied using Minitab statistical software. '*P*' values were calculated to assess significance of the results.

RESULTS

The control and hypertensive subjects were divided into two subgroups i.e. tobacco consumption and tobacco non-consumption within two age-groups: 30-50 years and 51-80 years.

The tobacco consuming control group exhibited an increase in BP in both genders with regard to their age groups when compared to tobacco non-consuming control group **(Table 1)**, while in hypertensive subjects consuming tobacco, an increase like control group was observed in BP in both genders in 30-50 years age group while a

decrease was seen in 51-80 years age group in both genders **(Table 2)**. This rise and fall in BP values were highly significant ($P<0.001$) in hypertensive subjects **(Table 2.1)**, whereas healthy volunteers showed significance in only 30-50 years age group in both genders ($P<0.01$) **(Table 1.1)**. The dissimilarity of BP values in tobacco consuming hypertensives and tobacco non-consuming controls was vast **(Table 3)** and thus exceedingly significant (P<0.001) **(Table 3.1)** in both genders with respect to their age groups.

Serum lipid (TC, TG, and LDL-C) concentrations exhibited a similar trend like BP in relation to tobacco. Tobacco consuming controls and hypertensive subjects showed a highly significant increase ($P<0.01$) **(Table 1.1 & 2.1)** of all three serum lipid concentration in men and women of 30-50 years age group while an insignificant decrease was seen in case of 51-80 years age group in both men and women when compared to their individual non-consuming tobacco groups **(Table 1 & 2)**. The differences of serum lipid concentration in the two subgroups of tobacco: tobacco non-consuming controls and tobacco consuming hypertensives were found to be enormously significant ($P<0.001$) **(Table 3.1)** in both the genders and their age groups **(Table 3)**. The

atherogenic ratios (TC/HDL-C & LDL-C/HDL-C) showed a pattern, alike serum lipids and BP **(Table 1, 2 & 3)**.

HDL-C concentration on the other hand, illustrated an extremely significant ($P<0.001$) **(Table 2.1)** decrease in tobacco consuming hypertensives in male and female of both age groups **(Table 2)** while an insignificant increase in 30-50 years age group and a decrease in 51-80 years age group was observed in tobacco consuming controls **(Table 1 & 1.1)** when compared to their respective non consuming counterparts. The divergence of HDL-C concentration in the two tobacco subgroups were outstandingly significant ($P<0.001$) **(Table 3.1)** as the concentration of tobacco non-consuming controls were very high when compared to their tobacco consuming hypertensive counterparts **(Table 3)**.

In the anthropometric indices, BMI in both control and hypertensive tobacco consuming subjects showed an insignificant decrease **(Table 1.1 & 2.1)** in both genders and their age groups while WHR remained nearly alike in both tobacco consuming and non-consuming groups of control and hypertensive subjects **(Table 1 & 2)**. Both, BMI & WHR values of hypertensive patients consuming tobacco were much higher than those

observed in tobacco non-consuming controls (*P*<0.001) **(Table 3.1)**.

(Table 3) and were extremely significant

Table 1: Effect of Tobacco on BP, Serum Lipids and WHR in Control Cases

Age Group	Tobacco	G	N	SBP mmHg	DBP mmHg	TC mg/dl	TG mg/dl	HDL-C mg/dl	LDL-C mg/dl	TC/ HDL-C	LDL-C/ HDL-C	BMI	WHR
30-50	Tobacco Non Consumption (A$_1$)	M	79	115.8 ± 0.89	74.7 ± 1.5	162.8 ± 3.8	98.4 ± 4.3	46.1 ± 1.5	97.0 ± 4.0	3.79 ± 0.14	2.34 ±0.14	24.44 ±0.48	0.93 ±0.009
		F	52	112.4 ± 0.65	72.4 ± 0.3	159.4 ± 2.5	93.6 ± 2.9	49.2 ± 0.97	91.5 ± 2.7	3.42 ± 0.08	2.01 ± 0.07	25.30 ±0.32	0.82 ±0.006
	Tobacco Consumption (A$_2$)	M	31	118.5 ± 1.3	77.5 ± 1.2	180.3 ± 4.3	118.1 ± 6.7	41.4 ± 1.8	115.2 ± 4.5	4.66 ± 0.29	3.04 ± 0.26	23.23 ±0.81	0.93 ± 0.01
		F	12	116.0 ± 1.4	75.5 ± 1.2	176.8 ± 6.2	101.3 ± 2.3	46.5 ± 2.4	110.0 ± 7.4	3.93 ± 0.29	2.49 ± 0.29	25.5 ± 1.4	0.81 ± 0.01
Above 50	Tobacco Non Consumption (B$_1$)	M	151	118.6 ± 0.53	78.0 ±0.32	182.3 ± 6.0	115.4 ± 6.9	41.0 ± 1.5	118.1 ± 5.8	4.85 ± 0.29	3.22 ± 0.25	24.17 ±0.78	0.82 ±0.006
		F	41	117.1 ± 0.75	75.6 ± 0.5	171.1 ± 4.5	95.1 ±10.0	48.3 ± 1.8	103.8 ± 5.0	3.73 ± 0.16	2.30 ± 0.15	24.61 ±0.46	0.83 ±0.008
	Tobacco Consumption (B$_2$)	M	21	121.7 ± 1.9	80.4 ± 1.5	175.4 ± 7.2	111.1 ± 6.3	44.2 ± 2.9	108.9 ± 6.5	4.18 ± 0.24	2.63 ± 0.22	21.14 ± 1.0	0.91 ± 0.01
		F	12	120.1 ± 1.3	79.1 ± 1.0	173.1 ± 6.6	96.8 ± 4.9	50.3 ± 1.8	103.4 ± 7.2	3.48 ± 0.19	2.10 ± 0.19	23.42 ± 1.2	0.83 ±0.01

Values are Mean ±Standard Error

Table 1.1: Statistical Analysis of Table 1

Comparison	SBP mm Hg	DBP mm Hg	TC mg/dl	TG mg/dl	HDL-C mg/dl	LDL-C mg/dl	TC/ HDL-C	LDLC/ HDL-C	BMI kg/m²	WHR
A_1M vs A_2M	P < 0.05	NS	P < 0.001	P < 0.01	P < 0.01	P < 0.001	P < 0.01	P < 0.01	NS	NS
A_1F vs A_2F	P < 0.01	P < 0.01	P < 0.01	P < 0.01	NS	P < 0.01	P < 0.05	P < 0.05	NS	NS
B_1M vs B_2M	NS	NS	NS	NS	NS	NS	NS	NS	P < 0.01	P < 0.001
B_1F vs B_2F	NS	P < 0.001	NS	NS	NS	NS	NS	NS	NS	NS
A_2M vs A_2F	NS	NS	NS	P < 0.01	P < 0.05	NS	P < 0.05	NS	NS	P < 0.001
B_2M vs B_2F	NS	NS	NS	P < 0.05	P < 0.05	NS	P < 0.01	P < 0.05	NS	P < 0.001
A_2M vs B_2M	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
A_2F vs B_2F	P < 0.01	P < 0.01	NS	NS	NS	NS	NS	NS	NS	NS

NS - Non Significant

Table 2: Effect of Tobacco on BP, Serum Lipids, BMI and WHR in Hypertensive cases

Age Group	Tobacco	G	N	SBP mmHg	DBP mmHg	TC mg/dl	TG mg/dl	HDL-C mg/dl	LDL-C mg/dl	TC/ HDL-C	LDL-C/ HDL-C	BMI	WHR
30-50	Tobacco Non Consumption (C_1)	M	78	136.5 ±2.5	87.3 ±1.4	234.3 ±5.5	185.3 ±8.9	38.7 ±1.3	128.2 ±5.6	6.40 ±0.25	4.35 ±0.22	29.05 ±0.72	1.00 ±0.01
		F	152	134.7 ±1.3	86.8 ±0.9	218.5 ±3.2	155.6 ±7.4	44.4 ±1.2	142.9 ±3.5	5.25 ±0.15	3.47 ±0.13	29.28 ±0.72	0.85 ±0.006
	Tobacco Consumption (C_2)	M	122	147.4 ±1.6	96.1 ±1.4	248.9 ±4.5	206.7 ±6.5	32.36 ±0.79	175.2 ±4.7	8.07 ±0.24	5.75 ±0.23	27.25 ±0.52	0.97 ±0.009
		F	48	143.8 ±1.9	95.1 ±1.6	238.3 ±5.3	186.2 ±7.0	36.11 ±1.9	164.9 ±5.2	6.87 ±0.34	4.79 ±0.30	28.11 ±1.1	0.86 ±0.01
Above 50	Tobacco Non Consumption	M	81	148.4 ±1.5	99.1 ±1.6	244.5 ±3.5	204.1 ±8.0	41.32 ±0.91	162.4 ±3.7	6.22 ±0.17	4.17 ±0.15	27.05 ±0.46	0.96 ±0.008
		F	120	146.0	95.1	239.3	179.2	45.7	157.8	5.53	3.70	28.54	0.87

			SBP	DBP	TC	TG	HDL-C	LDL-C	TC/HDL-C	LDL-C/HDL-C	BMI	WHR
(D₁)			±1.4	±1.2	±4.1	±6.9	±0.91	±4.5	±0.16	±0.15	±0.43	±0.006
Tobacco Consumption (D₂)	M	89	144.0 ±1.5	92.1 ±0.76	243.1 ±5.4	199.2 ±8.5	35.47 ±0.76	167.8 ±5.4	7.1 ±0.19	4.93 ±0.18	26.20 ±0.47	0.97 ±0.006
	F	56	142.7 ±1.9	91.3 ±1.2	236.3 ±7.5	156.2 ±7.9	39.9 ±1.7	165.1 ±8.1	6.43 ±0.35	4.60 ±0.33	27.24 ±0.71	0.86 ±0.01

Values are Mean ±Standard Error

Table 2.1: Statistical Analysis of Table 2

Comparison	SBP mm Hg	DBP mm Hg	TC mg/dl	TG mg/dl	HDL-C mg/dl	LDL-C mg/dl	TC/HDL-C	LDL-C/HDL-C	BMI kg/m²	WHR
C₁M vs C₂M	P < 0.001	P < 0.001	P < 0.01	P < 0.05	P < 0.001	P < 0.01	P < 0.001	P < 0.001	P < 0.01	NS
C₁F vs C₂F	P < 0.001	P < 0.001	P < 0.01	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	NS	NS
D₁M vs D₂M	P < 0.01	P < 0.001	NS	NS	P < 0.001	NS	P < 0.001	P < 0.001	NS	NS
D₁F vs D₂F	P < 0.05	P < 0.01	NS	P < 0.01	P < 0.001	NS	P < 0.01	P < 0.01	P < 0.05	NS
C₂M vs C₂F	P < 0.05	NS	P < 0.05	P < 0.01	P < 0.05	NS	P < 0.001	P < 0.01	NS	P < 0.001
D₂M vs D₂F	NS	NS	NS	P<0.001	P < 0.01	NS	P < 0.05	NS	NS	P < 0.001
C₂M vs D₂M	P < 0.05	P < 0.01	NS	NS	P < 0.001	NS	P < 0.001	P < 0.001	NS	NS
C₂F vs D₂F	NS	P < 0.05	NS	P < 0.001	P < 0.05	NS	NS	NS	NS	NS

NS - non significant

Table 3: Effect of Tobacco on BP, Serum Lipids, BMI and WHR in Control & Hypertensive Cases

Age Group	Tobacco	G	N	SBP mmHg	DBP mmHg	TC mg/dl	TG mg/dl	HDL-C mg/dl	LDL-C mg/dl	TC/ HDL-C	LDL-C/ HDL-C	BMI	WHR
30-50	Tobacco Non Consumption Control (A$_1$)	M	79	115.8 ±0.89	74.7 ±1.5	162.8 ±3.8	98.4 ±4.3	46.1 ±1.5	97.0 ±4.0	3.79 ±0.14	2.34 ±0.14	24.44 ±0.48	0.93 ±0.009
		F	52	112.4 ±0.65	72.4 ±0.3	159.4 ±2.5	93.6 ±2.9	49.2 ±0.97	91.5 ±2.7	3.42 ±0.08	2.01 ±0.07	25.30 ±0.32	0.82 ±0.006
	Tobacco Consumption HT (C$_2$)	M	122	147.4 ±1.6	96.1 ±1.4	248.9 ±4.5	206.7 ±6.5	32.36 ±0.79	175.2 ±4.7	8.07 ±0.24	5.75 ±0.23	27.25 ±0.52	0.97 ±0.009
		F	48	143.8 ±1.9	95.1 ±1.6	238.3 ±5.3	186.2 ±7.0	36.11 ±1.9	164.9 ±5.2	6.87 ±0.34	4.79 ±0.30	28.11 ±1.1	0.88 ±0.01
Above 50	Tobacco Non Consumption Control (B$_1$)	M	151	118.6 ±0.53	78.0 ±0.32	182.3 ±6.0	115.4 ±6.9	41.0 ±1.5	118.1 ±5.8	4.85 ±0.29	3.22 ±0.25	24.17 ±0.78	0.82 ±0.006
		F	41	117.1 ±0.75	75.6 ±0.5	171.1 ±4.5	95.1 ±10.0	48.3 ±1.8	103.8 ±5.0	3.73 ±0.16	2.30 ±0.15	24.61 ±0.46	0.83 ±0.008
	Tobacco Consumption HT (D$_2$)	M	89	144.0 ±1.5	92.1 ±0.76	243.1 ±5.4	199.2 ±8.5	35.47 ±0.76	167.8 ±5.4	7.1 ±0.19	4.93 ±0.18	26.20 ±0.47	0.97 ±0.006
		F	56	142.7 ±1.9	91.3 ±1.2	236.3 ±7.5	156.2 ±7.9	39.9 ±1.7	165.1 ±8.1	6.43 ±0.35	4.60 ±0.33	27.24 ±0.71	0.86 ±0.01

Values are Mean ±Standard Error

Table 3.1: Statistical analysis of Table 3

Comparison	SBP mm Hg	DBP mm Hg	TC mg/dl	TG mg/dl	HDL-C mg/dl	LDL-C mg/dl	TC/HDL-C	LDL-C/HDL-C	BMI kg/m^2	WHR
A$_1$M vs C$_2$M	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001
A$_1$F vs C$_2$F	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.01	P < 0.01
B$_1$M vs D$_2$M	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.01	P < 0.001
B$_1$F vs D$_2$F	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.05

DISCUSSION

In the present study the effect of tobacco consumption on BP, serum lipids and anthropometric indices were studied on hypertensive subjects. The risk of smoking is dependent on the presence of HT and concomitant hyperlipidaemia. The multinational INTERHEART study have not only established smoking as cardiovascular risk factor, but also revealed a synergetic effect with the risk factors, such as HT, hypercholesterolemia, glucose intolerance and DM [9].

Hypertensive tobacco consumers in this study showed an age dependent variation in BP. A significant increase in BP in both genders in 30-50 years age group observed when compared to the non consuming counterpart but yet, both values in the two age groups were considerably higher to control cases. This finding was in agreement with recent reports suggesting that smoking [10, 11] may indeed be a harbinger for development of hypertension. Also it was in agreement with the epidemiological finding of Israel population [12] in which nonsmokers had lower BP.

Cigarette smoking is a major modifiable risk factor for CVD, including coronary artery disease (CAD), stroke, peripheral vascular disease, and congestive heart failure [4, 10]. Two recent studies showed that though different mode of addictions, smoking and tobacco chewing have an equal and comparable effects on lipid profile and therefore raising cardiovascular risk in same proportion[13, 14]. Cigarette smoking is

associated with high levels of TC, TG, LDL-C and low levels of HDL-C [15]. Also the Framingham Offspring Study showed that smoking was significantly associated with lower HDL-C levels of 4mg/dl in men and 6mg/dl in women [16]. All these evidences were in consistent with our study wherein TC and TG concentration of tobacco consumers in hypertensive volunteers showed a increase in 30-50 years age group while a decrease in 51-80 years age group when compared to hypertensive tobacco non-consuming counterparts. This study showed a consistent positive association between tobacco consumption and LDL-C values, while an inverse relation between tobacco consumption and HDL-C. The atherogenic ratios were also positively associated with tobacco consumption. Thus variations at hypertensive level of tobacco consumers might occur but when compared to their control counterparts a significantly positive correlation was exhibited between serum lipids, atherogenic ratios and tobacco consumption.

Among the anthropometric indices, BMI showed a decrease in hypertensive tobacco consumer while WHR did not vary much when compared to hypertensive tobacco non-consumers. But yet these indices were significantly higher compared to their control

counterparts. In agreement to this finding a study shows that the factor for pathogenesis of obesity is addiction to smoking among others [17]. Also an inverse relationship between cigarette smoking and weight is well documented [18] which again is in agreement to part of this study.

Thus in hypertensive tobacco consumers, HT itself being a risk factor for CHD, the possibility is enhanced by additive effect of hyperlipidaemia, smoking and obesity. These observations are confirmed from the multinational INTERHEART study [9].

CONCLUSION

This study showed a consistent positive association between tobacco consumption, BP, serum lipids and anthropometric indices, while an inverse relation was established between HDL-C and tobacco consumption among hypertensive individuals which may be the major contributor to increased risk of cardiovascular morbidity and mortality and in precipitation of HT. Therefore, tobacco consumption is the single most alterable risk factor contributing to premature morbidity and mortality that can be reversed by quitting consumption of tobacco.

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