

## Study Of Autonomic Functions In Male Current Tobacco Smokers And Non Smokers

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**Abstract:** Background: Smoking is the third top risk for health loss in India, leading to nearly one million deaths each year in the country. The study aims To investigate interrelationship of parameters of Autonomic Function between current smokers and non smokers. Material And Methods: The Study was conducted at Physiology Department , Medical college, Vadodara. All patients were enrolled applying inclusion and exclusion criteria. The study compared the autonomic function test data of two groups of subjects. Asymptomatic male aged 19 - 44 yrs in current tobacco smokers as cases and healthy non smokers as controls. History, Anthropometric measurements, clinical examination, Vital Parameters( like Heart rate, SBP and DBP ) and ECG recorded in lead 2 for R-R interval . Autonomic functions Tests like Expiration: inspiration ratio, Valsalva ratio, Change in DBP in sustained hand grip test Development of orthostatic hypotension on standing, Heart rate response to standing (30:15 ratio) were Recorded. Results: Maximum incidence was seen in >31 yrs of age(majority 31-40 age gp) The mean height in smokers was lower than in non smokers(161.98 ±13.011vs 170.7 ± 6.011) cms. The Weight of Cases and Controls were 70.21± 8.46 and 75.43±8.00 kg respectively. BMI of Cases and Controls were 27.45 ± 6.52 and 25.96 ± 3.20 respectively. Mean resting SBP is 132.23 ± 10.45 vs 121.33 ±7.46 mmHg ; Mean resting DBP is 81.26 ±4.87 vs 78.33 ± 8.1 mmHg and Mean basal HR is 84.36 ±7.83 vs 79.86 ± 9.43 per minute. The mean value of HR response to E: I ratio in cases and controls are 1.11 ± 0.15 and 1.55 ± 0.24 respectively. The mean values of valsalva ratio in cases and controls are 1.086 ± 0.085 and 1.713 ± 0.312 respectively(p<0.0001). The mean values of increase in DBP (mmHg) during sustained handgrip test in cases and controls are 10.8 ± 4.78 and 23.43 ± 6.06 mmHg respectively( p<0.0001). The mean values of decrease in SBP (mmHg)during postural change from lying to standing in cases and controls are 15.26 ± 5.27 and 4.3 ± 2.53 mmHg respectively with statistically highly significant difference(p<0.0001). Mean values of 30:15 ratio in cases and controls is 0.947 ± 0.165 and 1.045 ± 0.042 respectively. The mean difference in E: I ratio is statistically significant (p<0.0026).Conclusion: Smoking is so debilitating that immediate cessation of habit is always the first step of program to improve one's health. Clinical symptoms of autonomic failure may appear late in the course of disease. Early assessment of degree of autonomic dysfunction can prevent hazardous complications related to Smoking. [Vagadiya A Natl J Integr Res Med, 2020; 11(2):27-33]

**Key Words:** Autonomic Function Tests, , Current Smokers, Non Smokers

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**Introduction:** Smoking is one of the most common forms of recreational drug use. Cigarette smoking is today by far the most popular form of smoking and is practiced by over one billion people in majority of all human societies<sup>1</sup>. In India, smoking is a common habit that is prevalent in both urban and rural areas with about 17% smokers live in India<sup>2</sup>.

Cigarette smoking is a major risk factor for the development of chronic obstructive pulmonary disease, lung cancer, atherosclerosis, coronary heart disease, acute myocardial infarction, sudden cardiac death, Reynaud's disease and autonomic neuropathy.<sup>3</sup> A 2007 report states that, each year, about 4.9 million people worldwide die as a result of smoking<sup>4</sup>. Between 1980 and 2012, smoking prevalence among Indian men decreased from 33.8 percent to 23 percent. In 2012, female smoking prevalence was 3.2 percent, which is virtually unchanged since 1980<sup>5</sup>. A 2015 study found that about 17% of

mortality due to cigarette smoking in the United States is due to diseases other than those usually believed to be related<sup>6</sup>. When a cigarette is smoked, nicotine in smoke is deposited in type 1 and type 2 alveolar epithelial cells. From these cells nicotine passes in to pulmonary capillaries. Thus, nicotine-rich blood passes from the lungs to all the tissues and organs of the body, within a few seconds and immediately stimulates nicotinic acetylcholine receptors; this indirectly promotes the release of many chemical messengers such as acetylcholine, norepinephrine, epinephrine, arginine vasopressin, serotonin, dopamine, and betaendorphin<sup>7,8,9,10</sup>. Most cigarettes contain 1–3 milligrams of inhalable nicotine<sup>11,12</sup>.

Thus when autonomic functions are compromised, it results into autonomic malfunction. Autonomic malfunctions are also known as "Dysautonomia", "Autonomic dysfunction", "Autonomic failure" and "Autonomic neuropathy. Autonomic failure is encoun-

tered in many clinical conditions as primary disorder or secondary disorder<sup>13</sup>. In these conditions clinical assessment may not be sufficient to assess the degree of autonomic failure. Clinical symptoms of autonomic failure may appear late in the course of disease. In these conditions assessment of degree of loss of autonomic function can be made by series of autonomic tests.

#### The Present Study Is Planned:

- 1) To find out the effect of tobacco smoking on autonomic functions.
- 2) To statistically compare the autonomic function tests data of male current tobacco smokers and non smokers.
- 3) To carry out the statistical analysis of the results and the collected data.
- 4) To create awareness among tobacco smokers about its adverse effects on health

**Material and Methods :** The present study was carried out at physiology department , Medical college, Vadodara during Jan 2015 to Feb 2016 . all patients were enrolled applying inclusion and exclusion criteria. all The study collected and compared the autonomic function test data of two groups of subjects. Asymptomatic male current tobacco smokers aged between 19 to 44 years from Baroda city were selected as cases and healthy non smoker males between 19 to 44 years of age were selected as controls. Exclusion criteria were applied to both the groups. Anthropometric measurements were taken and thorough clinical examination was done in following:

1. Class 3 and class 4 healthy employees of medical college and S.S.G hospital Baroda were selected as subjects.
2. Some voluntaries from Talavadi area of Ellorapark, Baroda were also selected as subjects.
3. Current smokers and non smokers were selected from same economic status, 30 cases and 30 controls.

**Inclusion Criteria:** 1.Asymptomatic male current tobacco smokers aged between 19 to 44 years from Baroda city.2.Adults, who have H/O smoking for at least last 10 years and currently smoke everyday or sometimes, are considered as current smokers,.3.Adults who have not smoked tobacco till date, in their entire life time, are considered as non smokers. (Centre for Disease

control,Atlanta U.S.A.)4.They were selected from Baroda city, on voluntary basis.

**Exclusion Criteria:** 1.Females.2.Current smokers and non-smokers who are simultaneously exposed to the occupations that include exposure to tobacco and nicotine such as “workers of tobacco processing plants”.3.Current smokers and non-smokers with H/O(i) Alcoholism(ii) Diabetes, Tuberculosis, Hypertension, HIV infection and Parkinson’s disease.(iii) Nerve trauma such as bruise, burns or cuts.(iv) Autoimmune disorders such as lupus erythematosus, degenerative disorders such as multiple systems atrophy.(v) Persons receiving active medications such as drugs for cancer,epilepsy, tuberculosis and hypertension.

The test subjects were called at research room at 9 am, in the Department of Physiology, Medical College Baroda. First a questionnaire form (below) was filled to assess the general health and activity level. Anthropometric measurements were taken and recorded followed by a thorough systemic examination. The subjects were explained the purpose and importance of the study. Only those, who consented and appeared to be motivated, were selected for the study. All the parameters were recorded throughout by the same instruments to avoid instrumental errors.

**Measurements:** A standard Anthropometric measurement such as weight in kilogram(Kg) in indoor clothing without shoes, standing height was measured in centimeters (cm) without shoes. BMI was obtained by following formula,  $BMI = \frac{wt}{ht^2}$  in kg/ht in m<sup>2</sup>. Subjects were made to rest for 10 minutes. Afterwards pulse rate and systolic and diastolic blood pressures were noted. The pulse rate was recorded by palpating the radial artery of the subject in sitting posture. The radial pulse was examined by palpating the radial artery against the head of the radius at the wrist for one minute.

Blood pressure was recorded over the right brachial artery at the level of cubital fossa with the subject in supine position and by using sphygmomanometer and stethoscope. The systolic and diastolic blood pressures in mmHg were recorded by both palpatory and auscultatory method. SCHILLER’S MULTIPARA MONITOR for measurement of Heart rate and ECG record in lead 2 for the measurement of R-R interval. DIGITAL BLOOD PRESSURE MONITOR

and HAND GRIP DYNAMOMETER used for BP and sustained hand grip test.

To investigate interrelationship of parameters between current smokers and non smokers, we have selected following tests for Autonomic functions taking into consideration the feasibility of conducting the same.

1. Expiration: inspiration (E: I) ratio.
2. Valsalva ratio.
3. Change in diastolic blood pressure in sustained hand grip test.
4. Development of orthostatic hypotension on standing.
5. Heart rate response to standing. (30:15 ratio).

**Standing To Lying Ratio(S/L Ratio):** Longest R-R interval during last 5 beats before lying / Shortest R-R interval during first 10 beats after lying down

**Tachycardia Ratio:** Shortest R-R interval during valsalva efforts/ Longest R-R interval before the valsalva efforts

**QT-QS2 Ratio:** A high value of QT/QS2 ratio is indicative of greater sympathetic tone while lower values indicate a lower sympathetic ton

**Cold Pressor Test:** Usually a response of 15-20 mmHg increase in SBP and an increase of 10 mmHg in DBP are considered as normal response to cold pressor test.

All the autonomic function tests were conducted as per protocol of autonomic function lab, All India Institute of Medical Science (AIIMS), New Delhi.

## Results:

**Table 1. Age Distribution In Non Smokers**

Age Groups (In Years)	No. Of Patients	Percentage
25-30	11	36.66
31-40	15	50
41-50	04	13.33
Total	30	100

Table 1 shows that The majority of the patients were in age group 31-40(50%), next common being age group was 25-30(36.66%).

**Table 2. Age Distribution In Current Smokers**

Age Groups (In Years)	No. Of Patients	Percentage
25-30	03	10
31-40	21	70
41-50	06	20
Total	30	100

In current smoker group, the majority of patients were in age group 31-40(70%), next common being age group was 41-50(20%). Cumulatively Maximum incidence was seen in >31 years of ages. So from this data Age distribution of control and case group is quite similar.

**Table 3. Anthropometric Measurement In Non Smokers (N=30)**

Parameter	Mean	SD
Age(years)	33.73	5.45
Height(cms)	170.7	6.01
Weight( kg)	75.43	8.0
BMI (kg/m <sup>2</sup> )	25.96	3.2

The mean Age, Height, Weight and BMI in Non smokers were 33.73±5.45, 170.7±6.01, 75.43±8 and 25.96±3.2 respectively.

**Table 4. Anthropometric Measurement In Current Smokers**

Parameter	Mean	SD
Age(years)	37.1	4.38
Height(cms)	161.98	13.01
Weight( kg)	70.21	8.46
BMI (kg/m <sup>2</sup> )	27.45	6.52

The mean Age, Height, Weight and BMI in Current smokers were 37.1±4.38, 161.98±13.01, 70.21±8.46 and 27.45±6.52 respectively.

**Table 5. Distribution According To Vital Examination In Non Smokers**

Parameter	Mean	SD
Basal SBP	121.33	7.46
Basal DBP	78.33	8.1
Heart Rate	79.86	9.43

In present study, the mean Basal Systolic Pressure, Basal Diastolic Pressure and Heart rate in Non smokers were 121.33±7.46, 78.33±8.1 and 79.86±9.43 respectively.

**Table 6. Distribution According To Vital Examination In Current Smokers**

Parameter	Mean	SD
Basal SBP	132.23	10.45
Basal DBP	81.26	4.87
Heart Rate	84.36	7.83

In present study, the mean Basal Systolic Pressure, Basal Diastolic Pressure and Heart rate in Current smokers were  $132.23 \pm 10.45$ ,  $81.26 \pm 4.87$  and  $84.36 \pm 7.83$  respectively.

**Table 7. Distribution According To Autonomic Function Tests In Non Smokers**

Parameters	Mean	SD
E/I ratio	1.55	0.24
Valsalva Ratio	1.713	0.312
Sustained Handgrip Test DBP(mmHg)	23.43	6.06
Lying To Standing Test SBP(mm Hg)	4.3	2.53
30:15 Ratio	1.045	0.042

**Table.8 Distribution According To Autonomic Function Tests In Current Smokers**

Parameters	Mean	SD
E/I ratio	1.11	0.15
Valsalva Ratio	1.086	0.085
Sustained Handgrip Test DBP(mmHg)	10.8	4.78
Lying to Standing Test SBP(mm Hg)	15.26	5.27
30:15 Ratio	0.947	0.165

The mean value of heart rate response to E: I ratio in smokers and non smokers are  $(1.11 \pm 0.15)$  and  $(1.55 \pm 0.24)$  respectively. The mean values of valsalva ratio in smokers and non smokers group are  $(1.086 \pm 0.085)$  and  $(1.713 \pm 0.312)$  respectively. The mean values of increase in diastolic blood pressure (mmHg) during sustained handgrip test in smokers and non smokers are  $(10.8 \pm 4.78)$  mmHg and  $(23.43 \pm 6.06)$  mmHg respectively. The mean values of decrease in systolic blood pressure (mmHg) during postural change from lying to standing in smokers and non smokers group are  $(15.26 \pm 5.27)$  mmHg and  $(4.3 \pm 2.53)$  mmHg respectively. The mean difference in systolic blood pressure is statistically highly significant ( $p < 0.0001$ ). Lower S/L ratio is obtained in autonomic deficiency. Mean values of 30:15 ratio in current smokers and non smokers is  $(0.947 \pm 0.165)$  and  $(1.045 \pm 0.042)$  respectively.

**Discussion:** Age: In non smoker group, the majority of subjects were in age group 31-40(50%), next common being age group was 25-30(11%). majority of the current smokers were in age group 31-40(70%), next common being age group was 41-50(20%). Cumulatively Maximum

incidence was seen in  $>31$  years of age. Due to criteria for subject's selection, mean value of Age in smokers  $(37.1 \pm 4.389)$  years was slightly greater than non smokers  $(33.73 \pm 5.452)$  years. Number of subjects in each group also was same.

Anthropometric Measurement: The mean height in smokers was lower than in non smokers  $(161.98 \pm 13.011)$  vs  $(170.7 \pm 6.011)$  cms. Similarly other anthropometric parameters like Weight and Body mass index(BMI) are also matched in two groups, The Weight of Current smokers and Non smokers were  $(70.21 \pm 8.46)$  kg and  $(75.43 \pm 8.00)$  kg respectively. BMI of Current smokers and non smokers were  $(27.45 \pm 6.52)$  and  $(25.96 \pm 3.20)$  respectively. BMI of more than 25 kg/sq.meter is considered as abnormally high and is a sign of obesity (Kelly 1997). However the difference between two was statistically not significant. Bahera and associates<sup>14</sup> (2010) found significant difference ( $p > 0.05$ ) in smokers and non smokers, Age  $(37.1 \pm 4.2)$  vs  $(37.2 \pm 4.4)$  years; Height  $(169.8 \pm 5.1)$  vs  $(168 \pm 7.7)$  cm; Weight  $(61.9 \pm 7.8)$  vs  $(62.6 \pm 7.6)$  kg; and BMI  $(21.5 \pm 3.1)$  vs  $(22.2 \pm 2.8)$  kg/m<sup>2</sup>. The study was carried out in 30 smokers and 30 non smokers.

Vital Parameters: Other parameters of our study in smokers and non smokers like Mean resting systolic blood pressure is  $(132.23 \pm 10.45)$  vs  $(121.33 \pm 7.46)$  mmHg; Mean resting diastolic blood pressure is  $(81.26 \pm 4.87)$  vs  $(78.33 \pm 8.1)$  mmHg and Mean basal heart rate is  $(84.36 \pm 7.83)$  vs  $(79.86 \pm 9.43)$  per minute. In our study we found significant difference in basal SBP ( $p < 0.0001$ ) and in basal HR ( $P < 0.0001$ ) and non significant in basal DBP ( $p < 0.095$ ).

#### Autonomic Function Tests:

Expiration: Inspiration Ratio the mean value of heart rate response to E: I ratio in smokers and non smokers are  $(1.11 \pm 0.15)$  and  $(1.55 \pm 0.24)$  respectively. The difference of mean values is statistically highly significant ( $p < 0.0001$ ). Bahera and associates<sup>14</sup> (2010) found statistically significant increase in heart rate and decrease in R-R interval among the smokers than non smokers ( $p < 0.001$ ), this study was carried out in 30 smokers and 30 non smokers group. Mohit Malge and K.Rajnith Babu<sup>15</sup> found mean values of E: I ratio in smokers  $(1.13 \pm 0.06)$  and non smokers  $(1.12 \pm 0.08)$  were statistically not significant ( $p < 0.5$ ). This study was carried out in 50 smokers and 50 non smoke.

The variation of HR with respiration is called Sinus Arrhythmia .Inspiration increases the HR (due to decreased cardiac vagal activity) whereas expiration decreases it (due to increased vagal activity). This phenomenon is primarily mediated by the vagal innervations of heart, thus indicated for testing the integrity of parasympathetic functions.

**Valsalva Ratio:** The mean values of valsalva ratio in smokers and non smokers group are  $(1.086 \pm 0.085)$  and  $(1.713 \pm 0.312)$  respectively. The difference of mean values is statistically significant ( $p < 0.0001$ ). Dr. Motilal .C.Tayade and Dr. Nandkumar B.Kulkarni 16 (2015) found mean values of valsalva ratio in smokers  $(2.87 \pm 1.09)$  and non smokers  $(4.89 \pm 1.24)$  respectively, were statistically significant ( $p < 0.01$ ). This study was carried out in 50 smokers and 50 non smokers 16. Other research workers G.A.Gould et al 17(1986), Mervi et al 18(1994) and Beatriz 19 et al (2011) etc. also found similar Results.

The Valsalva response assesses integrity of the afferent limb, central processing, and efferent limb of the baroreceptor reflex. There are four phases of BP and heart rate response to the Valsalva maneuver .Phases I and III are mechanical, related to changes in intrathoracic and intraabdominal pressure.

**Sustained Hand Grip Test:** The mean values of increase in diastolic blood pressure (mmHg) during sustained handgrip test in smokers and non smokers are  $(10.8 \pm 4.78)$  mmHg and  $(23.43 \pm 6.06)$  mmHg respectively .The mean difference in diastolic blood pressure is statistically significant  $p < 0.0001$ . Dr. Motilal .C.Tayade and Dr. Nandkumar B. Kulkarni 16 (2015) carried out sustained handgrip test .They found out that the rise in diastolic pressure was significantly less in smokers  $(6.12 \pm 2.8)$  mmHg as compared to nonsmokers  $(9.06 \pm 3.64)$  mmHg suggesting decrease in sympathetic Reactivity in smokers. Mervi et al 18(1994) also found rise in diastolic pressure was significantly less in smokers as compared to nonsmokers suggesting decrease in Sympathetic reactivity.

In the sustained hand-grip test ,there is a rise in heart rate and blood pressure .The cardiovascular response to isometric exercise are mediated partly by metabolic or mechanical changes or both, in response to contraction of the muscles that activate small fibres in the afferent limb of

the reflex arch. The normal response is rise in diastolic pressure of more than 15mmHg . The blood pressure rise is due to increased sympathetic activity.

**Lying To Standing Test:** The mean values of decrease in systolic blood pressure (mmHg) during postural change from lying to standing in smokers and non smokers group are  $(15.26 \pm 5.27)$  mmHg and  $(4.3 \pm 2.53)$  mmHg respectively. The mean difference in systolic blood pressure is statistically highly significant ( $p < 0.0001$ ). Lower S/L ratio is obtained in autonomic deficiency.

Mean values of 30:15 ratio in current smokers and non smokers is  $(0.947 \pm 0.165)$  and  $(1.045 \pm 0.042)$  respectively. The mean difference in E: I ratio is statistically significant ( $p < 0.0026$ ).

These figures indicate that in smokers, the heart rate does not return to basal levels even at the end of 30 seconds after standing unsupported. However in non smokers it returns to the basal level.

Baljoshi and associates 20 2013, found mean values of systolic fall in blood pressure in smokers  $(6.16 \pm 1.51)$  and non smokers  $(6.44 \pm 1.63)$  respectively, were statistically not significant ( $p > 0.05$ ). And mean values of 30:15 ratio in smokers  $(1.00 \pm 0.06)$  and nonsmokers  $(1.08 \pm 0.08)$  respectively, were statistically significant ( $p < 0.01$ ). This study was carried out in 25 smokers and 25 non smokers.

The blood pressure changes on standing are studied to assess the integrity of the sympathetic system. Immediately on standing, blood pressure falls but that activates the baroreceptor reflex and blood pressure returns to normal within 15 seconds. When systolic pressure fall by 20mmHg or more or diastolic pressure by 10 mmHg or more on standing, orthostatic hypotension is said to be present. On changing the posture from supine to standing the heart rate increases immediately, usually by 10-20 beats per minute. On standing the heart rate increases until it reaches a maximum at about the 15th beat, after which it slows down to a stable state at about 30th beat. The 30:15 ratio is a measure of parasympathetic function.

**Conclusion:** Smoking being the leading causes of Preventable Death globally, early cessation is only

way attributed to prevention of smoking-related diseases . All the nicotine action could be responsible for autonomic dysfunction in smokers. Non smokers maintained their autonomic functions and hence they are at an advantage of better autonomic reserve when they are affected by disease or other debilitating conditions. Cardiovascular autonomic function tests are reliable, noninvasive and easy to carry out. By using these simple tests, we can detect early Involvement of autonomic nervous system before Clinically related symptoms appear and thus are Useful in taking steps to prevent further progress of the disease.

#### Declarations:

Ethical Approval: The study was approved by the Institutional Ethics Committee for Human Research (IECHR) No: ECR/85/Inst/GJ/2013.

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