

ACUTE EFFECTS OF NONPHARMACOLOGICAL & PHARMACOLOGICAL SMOKING  
TOBACCO - A CASE STUDY (COMPARATIVE) UNDER VARIOUS AGE GROUPS

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ABSTRACT

On studying the acute effects of tobacco smoking on 145 individuals under various age groups, it was observed that nausea or vomiting or both occurred in 73.79 percent of the cases. In the novice with a maximum of 84.62 percent in the age group of 6 to 10 years, and minimum of 37.50 percent in the age group of 51 to 55 years. Athletic performance was found to be affected in 26.90 percent (maximum in the age group 11 to 15 years). This was observed due to increased airway resistance.

The maximum rise in B.P. in the range of 16 to 20 mm of Hg systolic and 11 to 15 mm of Hg diastolic was found to be in the age group of 16 to 20 years, while the minimum occurred in the age group of 41 to 45 years (0 to 5 mm of Hg systolic and 0 to 5 mm of Hg diastolic). The increase in GIT movements was recorded in only 20.69 percent (maximum in age group 16 to 20 years), a decrease found in 20.69 percent (maximum in age group of 16 to 20 years), while there was no change in the rest.

INTRODUCTION

Tobacco smoke is a ubiquitous personal and environmental pollutant. Human inhalation of cigarette smoke is a twentieth century phenomenon with major medical and economic consequences. In industrialized nations, the principal cause of preventable disease and premature death is cigarette smoking.

The custom of smoking tobacco is thought to have originated with the Indians of the western hemisphere, possibly as early as 100 A.D., with the first use of tobacco almost certainly being in religious rituals. By the end of the century, smoking had become a common practice throughout the world.

Despite the increasingly heavy use of tobacco, since then, the many health effects of smoking were not recognized until fairly recently. Unfortunately, the evaluation of scientifically valid data relating to the harmful effects of smoking on health has often been complicated by emotional and aesthetic considerations.

We had confined our attention to cigarette smoking because neither pipe nor cigar smoking appear to have such a profound effect on lung function, i.e. on human health, and also because there is remarkably little information relating to acute effects of pipe and cigar smoking on human health.

## 2. OBJECTIVE OF RESEARCH

Non-pharmacological (psychosocial, sensorimotor) and pharmacological (indulgent, sedative, stimulative, addictive) types of smoking have shown acute effects in the form of increased airway resistance, depressed-ciliary activity, sympathetic stimulation of the CVS (cardio vascular system), variable effects on alertness, on GIT (gastro-intestinal tract) and appetite.

The study has been taken into consideration to know the acute effects of cigarette smoking on human health, for which we have taken the following criteria:

- (a) nausea or vomiting, or both nausea and vomiting
- (b) acute effects upon systolic and diastolic B.P.
- (c) acute effects on GIT motility
- (d) acute effect on athletic performance

## 3. EXPERIMENTS AND EXPERIMENTAL PROCEDURES

Individuals from various age groups were chosen including both sexes. A total of 145 individuals were taken. Only the individuals who have never smoked in the past were taken into consideration. Each individual was asked to smoke one cigarette completely and then acute effects of it were found separately. Experimental procedures were followed separately with all the 145 individuals.

### 3.1 Nausea or Vomiting or Both

Nausea is a personal feeling which was felt by the individual after smoking a cigarette. Some individuals had nausea only, while others had only vomiting, and in some individuals nausea was followed by vomiting.

### 3.2 Effects on Blood Pressure

To know the effects on blood pressure, B.P. recordings were done by the electronic sphygmomanometer in order to decrease the error in recording blood pressure. Initially the cuff was put on and both systolic and diastolic B.P. were recorded. After taking the initial B.P., the individual was asked to smoke a cigarette; after the last puff, a recording of both systolic and diastolic B.P. was taken to find the difference from the initial value in the form of increase or decrease or no change. The cuff was not removed during the initial and affected readings, only the air pressure was released.

### 3.3 Effects on GIT Motility

GIT motility was recorded by stethoscope, putting it at the abdomen at the anatomical position of the ileocaecal junction, and the number of sounds per minute were recorded. The recordings were made

before and after the cigarette smoking. Thus, an increase or decrease or no change in GIT motility was found in every individual.

### 3.4 Effect on Athletic Performance

Increased airway resistance takes place due to the nonspecific effects of submicronic particles, e.g. carbon particles less than 1 micron across. This effect is due to the reflex mechanism. Even inert particles of this size cause bronchial narrowing sufficient to double airway resistance. This is insufficient to cause dyspnoea, though it might affect athletic performance, which varies from individual to individual. A four to five fold increase in resistance is necessary to cause noticeable dyspnoea and a ten to twenty fold increase to cause severe dyspnoea such as can occur in bronchial asthma.

Various methods for measuring the airway resistance are:

- (a) Body plethysmography (DuBois Botelho & Comroe in 1956).
- (b) Oesophageal balloon technique (Mead & Whittenberger 1953).
- (c) Forced oscillations technique (DuBois, Brody, Lewis & Burgess 1956).

The airway resistance was measured by the body plethysmographic method before and after the cigarette smoking. The increase in airway resistance is an indicator of affected athletic performance.

## 4. TYPES OF SMOKING

### 4.1 Non-pharmacological

Type of smoking in which the plasma concentration of nicotine is not adjusted automatically by changes in puffing rate and inhalation. It is of two types:

- (a) Psychosocial - Type of smoking in which an individual uses the symbolic value of the act to increase social confidence status and self esteem.
- (b) Sensorimotor - Type of smoking in which oral, sensory and manipulatory satisfaction is obtained.

### 4.2 Pharmacological

Type of smoking in which the plasma concentration of nicotine is adjusted automatically by changes in puffing rate and inhalation. It is of four types:

- (a) Indulgent - It is the most common type of smoking, which is done to obtain pleasure or to enhance an already pleasurable situation. In it, frequency varies greatly.
- (b) Sedative - Type of smoking which is taken into account to ease an unpleasant situation.
- (c) Stimulation - To get a "lift", to aid thinking or concentration, help with stressful situations, or help performance of monotonous tasks.

- (d) Addictive - To avoid withdrawal feelings that occur as the plasma nicotine concentration falls below a minimum, usually about 30 minutes after the end of the last smoke. A variant is automatic smoking when the smoker may light up automatically, often being unaware of the act of smoking becoming aware only if a cigarette is not at hand.

## 5. SMOKE

### 5.1 Smoke of Cigars & Pipes

Smoke of cigars and pipes is alkaline (pH 8.5) and the nicotine is relatively unionized and lipid soluble so that it is readily absorbed in the mouth. Cigar and pipe smokers thus obtain nicotine without inhaling the smoke.

### 5.2 Smoke of Cigarette

The smoke of cigarettes is acidic (pH 5.3) and the nicotine is relatively ionized and insoluble in lipids. Desired amounts of nicotine are only absorbed if it is taken into the lungs where the enormous surface area for absorption compensates for the relative lipid insolubility. The amount of nicotine absorbed from tobacco smoke varies from 90 percent in those who inhale to 10 percent in those who do not.

Cigarette smoke is a heterogeneous aerosol which is produced by incomplete combustion of the tobacco leaf. It is composed of gases and vapours in which droplets are dispersed. Emergence of mainstream smoke is from the mouthpiece during puffing while sidestream smoke is emitted between puffs at the burning cone and from the mouthpiece.

The composition of the smoke is influenced by several factors including the type of tobacco, temperature of combustion, length of the cigarette, porosity of the paper, additives and filters. The major constituents of tobacco are carbohydrates, nonfatty organic acids, nitrogen containing compounds and resins. The selected cigarette smoke constituents and their effects are listed on the following page. Cigarette temperatures vary greatly from 30 °C at the mouthpiece to 900 °C at the burning cone. In the presence of intense heat some tobacco constituents undergo pyrolysis (thermic decomposition). Volatile substances are distilled directly into the smoke. Unstable molecules recombine to generate new compounds (pyrosynthesis). As the smoke is filtered by unburnt tobacco and is redistilled by the burning cone, a concentration of smoking constituents occurs. Some substances found in tobacco pass unchanged into cigarette smoke.

Each cigarette generates approximately 500 mg mainstream smoke of which 92 percent is present in a gas phase and 8 percent is present in a particulate phase. Mainstream smoke contains 2 to 5 billion particles per millilitre, with the particle size ranging from 0.1 to 1.0 micrometre. Nitrogen, oxygen and carbon dioxide account for 85 percent of the smoke's weight. The remaining gases, vapours and particulate matter are the substances of medical importance. Some smoke constituents are absorbed directly through the mucosa of the mouth, nose, pharynx and upper respiratory airways, while others

## SELECTED CIGARETTE SMOKE CONSTITUENTS

Substance	Effect
<b>PARTICULATE PHASE</b>	
Tar*	Carcinogen
Polynuclear aromatic hydrocarbons	Carcinogen
Nicotine	Ganglionic stimulator and depressor
Phenol	Carcinogen and irritant
Cresol	Carcinogen and irritant
Beta-Naphthylamine	Carcinogen
N-Nitrosornicotine	Carcinogen
Benzo (a) pyrene	Carcinogen
Benz (alpha) anthracene	Carcinogen
Trace metals (e.g. nickel, polonium 210)	Carcinogen
Indole	Tumor accelerator
Carbarole	Tumor accelerator
<b>GAS PHASE</b>	
Carbon monoxide	Impairs oxygen transport and utilization
Hydrocyanic acid	Ciliotoxin and irritant
Acetaldehyde	Ciliotoxin and irritant
Acrolein	Ciliotoxin and irritant
Ammonia	Ciliotoxin and irritant
Formaldehyde	Ciliotoxin and irritant
Oxides of nitrogen	Ciliotoxin and irritant
Nitrosamines	Carcinogen
Hydrazine	Carcinogen

\* The aggregate of particulate matter in cigarette smoke after subtracting nicotine and moisture.

are inhaled into the lungs where they are absorbed and retained. Concentrations of toxic constituents in smoke often far exceed threshold limits of industrial toxins.

## 6. PHARMACOLOGY

Most studies in humans have dealt with exposure to whole smoke or selected constituents which are thought to pose the greatest risk to health, for example, nicotine and carbon monoxide.

### 6.1 Nicotine

Nicotine is the most characteristic component of tobacco. It is a highly toxic alkaloid. The average cigarette smoker who inhales absorbs about 2 mg nicotine per cigarette. The estimated acutely fatal dose for an adult is 1 mg/kg.

Pharmacokinetics - Nicotine is absorbed through mucous membranes in a highly pH dependent fashion. The plasma half-life of

nicotine is 30-80 minutes. It is largely metabolized to pharmacologically inert substances though some is excreted unchanged in the urine (pH dependent).

Pharmacodynamics - Nicotine can both stimulate and depress nervous tissue function, depending on the dose and the interval between doses, and the psychological state of the subject.

No definitive statement can be made relating the pharmacodynamics of nicotine to the pleasure experienced by the smoker. Smokers who become more alert tend to take a lower dose of nicotine than do smokers who become more tranquil. In doses used in smoking, nicotine causes release of catecholamines in the hypothalamus and anti-diuretic hormones from the posterior pituitary.

In large doses nicotine stimulates directly the ends of peripheral cholinergic nerves whose cell bodies lie in the central nervous system, i.e. it acts at autonomic ganglia and at the neuromuscular junction. This is what is meant by the term "nicotine like" or "nicotinic" effect. Higher doses paralyse at the same points. The central nervous system is stimulated, including the vomiting centre, both directly and via the carotid body; tremors and convulsions may occur. As with the peripheral actions, depression follows stimulation.

In low doses such as are taken in ordinary smoking, the effects of nicotine on viscera are probably largely reflex, from stimulation of sensory receptors (chemo-receptors) in the carotid and aortic bodies, pulmonary circulation and left ventricle. Some of the results are mutually antagonistic. The following account tells what generally happens after one cigarette, from which about 1 mg nicotine is absorbed, although much depends on the amount and depth of inhalation and on the duration of end-inspiratory breath holding.

Acute cardiovascular responses to nicotine observed in normal smokers include increases in systolic and diastolic blood pressure, heart rate, force of myocardial contraction, myocardial oxygen consumption, coronary artery flow, myocardial irritability and peripheral vasoconstriction. Nicotine has also been shown to increase platelet aggregation and serum concentrations of free fatty acids and ADH. Nicotine plays an important but not exclusive role in maintaining the smoking habit. Increase in free fatty acid concentration in the blood, and also platelet stickiness may be a factor in atheroma and thrombosis.

On GIT, Nausea and vomiting occur in the novice, probably due to stimulation of the vomiting centre. The effects on the mobility of the GIT are variable. In some cases motility is increased, in some cases it is decreased, while in some cases there is no change.

It is well known that tolerance develops to nicotine and that a first experience commonly causes nausea and vomiting which quickly ceases with repetition of smoking.

## 6.2 Carbon Monoxide

It is a toxic gas which interferes with oxygen transport and utilization. Because cigarette smoke contains 2 to 6 percent carbon

monoxide, smokers inhale concentrations as high as 400 parts per million (ppm) and develop elevated carboxy-haemoglobin (COHB) levels. While the range of COHB for smokers is 2 to 15 percent, levels for non-smokers are near 1 percent. The average COHB level for moderate cigarette smokers is 5 percent. Carbon monoxide produces its adverse effects by reducing the amount of available oxyhaemoglobin and myoglobin and displacing the oxygen haemoglobin dissociation curve to the left. Chronic, mild elevations of COHB due to smoking are a common cause of polycythemia and may produce subtle impairment of the CNS function.

## 7. RESULTS AND DISCUSSION

### 7.1 Nausea or Vomiting or both Nausea and Vomiting

On studying the acute effects of tobacco smoking on 145 individuals, it was observed that nausea or vomiting or both nausea and vomiting occurred in 73.79 percent of the cases. In the novice with a maximum of 84.62 percent in the age group of 6 to 10 years, and a minimum of 37.50 percent in the age group of 51 to 55 years (Table 1, Fig. 1).

### 7.2 Effect of Blood Pressure

On studying the acute effects of tobacco smoking in 145 individuals, it was observed that the maximum rise in systolic B.P. occurs in the age group of 16 to 20 years, in the range of 16 to 20 mm of Hg; while the maximum rise in diastolic B.P. in the range of 11 to 15 mm of Hg was found in the age group of 16 to 20 years. The minimum rise in both systolic and diastolic B.P., in the range of 0 to 5 mm of Hg, was found in the age group of 41 to 45 years (Table 2).

In percent, the maximum rise in systolic and diastolic B.P. was found as follows (Table 3). In the range of 0 to 5 mm of Hg, the maximum rise in both systolic and diastolic B.P. was found in 50 percent of the cases in the age group of 41 to 45 years. In the range of 6 to 10 mm of Hg, the maximum rise in the systolic B.P. was found in 69.23 percent of the cases in the age group of 6 to 10 years; while the maximum rise in diastolic B.P. was found in 61.54 percent of the cases in the same age group. In the range of 11 to 15 mm of Hg, the maximum rise in systolic B.P. was found in 53.46 percent of the cases in the age group of 31 to 35 years; while the maximum rise in diastolic B.P. was found in 56.25 percent of the cases in the age group of 16 to 20 years.

In the range of 16 to 20 mm of Hg, the maximum rise in the systolic B.P. was found in 68.75 percent of the cases (Fig. 2).

### 7.3 Effect on GIT Motility

On studying the acute effects of tobacco smoking on 145 individuals, it was found that GIT movements increased in 20.69 percent of the cases, decreased in 20.69 percent of the cases; while there was no change in the rest. The increase in GIT motility varied from 6.25 percent in the age group of 51 to 55 years to 43.75 percent in the age group of 16 to 20 years, while an decrease in GIT motility varied from 6.25 percent in the age group of 51 to 55 years to

Table 1. Showing the Number of Cases Having Nausea and Vomiting and their percentage

Age Group (in years)	No. of Cases	Nausea or Vomiting or Both	Percentage
Below 5	-	-	-
6 to 10	13	11	84.62
11 to 15	11	9	81.82
16 to 20	16	13	81.25
21 to 25	12	10	83.33
26 to 30	15	12	80.00
31 to 35	13	10	76.92
36 to 40	14	11	78.57
41 to 45	8	6	75.00
46 to 50	7	4	57.14
51 to 55	16	6	37.50
56 to 60	8	5	62.50
Above 60	12	10	83.33
<b>TOTAL</b>	<b>145</b>	<b>107</b>	<b>73.79</b>

Percentage of Cases Having Nausea or Vomiting or Both According to Age Group in Years

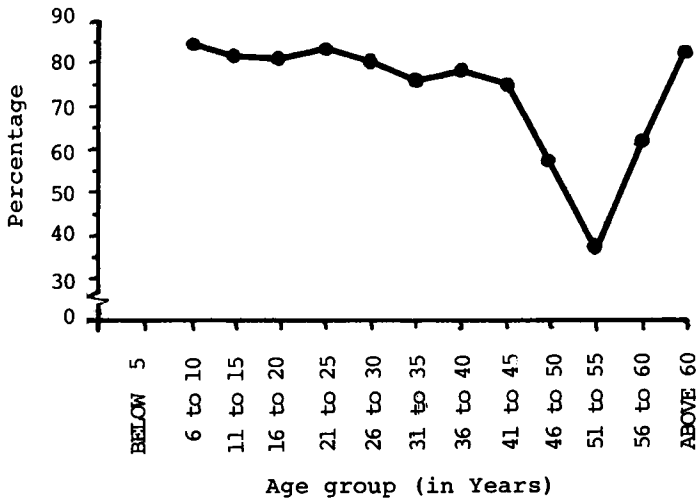


Fig. 1.

Table 2. Showing the Number of Cases Having Changes in Blood Pressure

Age Group (in years)	No. of cases	RISE IN B.P.								No Change	
		0 to 5 mm		6 to 10 mm		11 to 15 mm		16 to 20 mm			
		S	D	S	D	S	D	S	D	S	D
Below t	-	-	-	-	-	-	-	-	-	-	-
6 to 10	13	-	2	9	8	4	3	-	-	-	-
11 to 15	11	-	1	6	5	3	5	2	-	-	-
16 to 20	16	1	1	1	6	3	9	11	-	-	-
21 to 25	12	1	2	4	4	6	6	1	-	-	-
26 to 30	15	1	2	5	7	7	6	2	-	-	-
31 to 35	13	1	3	3	5	7	5	2	-	-	-
36 to 40	14	2	4	6	6	6	4	-	-	-	-
41 to 45	8	4	4	-	-	-	-	-	-	4	4
46 to 50	7	2	2	3	4	2	1	-	-	-	-
51 to 55	16	3	6	9	7	3	3	1	-	-	-
56 to 60	8	2	3	4	4	2	1	-	-	-	-
Above 60	12	3	4	5	5	4	3	-	-	-	-
<b>TOTAL</b>	<b>145</b>	<b>20</b>	<b>34</b>	<b>55</b>	<b>61</b>	<b>47</b>	<b>46</b>	<b>19</b>	<b>-</b>	<b>4</b>	<b>4</b>

S = Systolic, D = Dyastolic

Fig. 2. SHOWING THE LINE DIAGRAMS FOR VARIOUS RANGES OF RISE IN BLOOD PRESSURE ACCORDING TO THE AGE GROUP IN YEARS

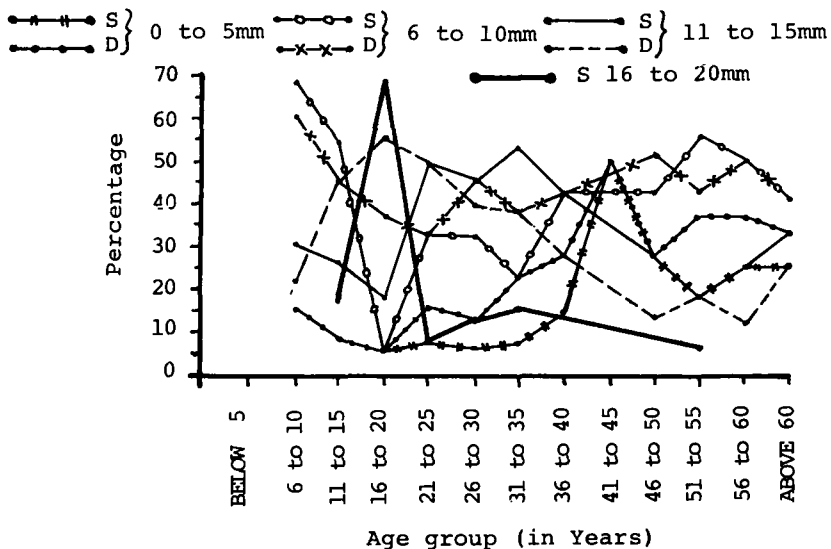


Table 3. Showing the Percentage of Gases Having Rise in Blood Pressure in Various Stages

Age Group (in years)	0 to 5		6 to 10		11 to 15		16 to 20	
	S	D	S	D	S	D	S	D
Below 5	-	-	-	-	-	-	-	-
6 to 10	-	15.39	69.23	61.54	30.77	23.08	-	-
11 to 15	-	9.09	54.55	45.45	27.27	45.45	18.18	-
16 to 20	6.25	6.25	6.25	37.50	18.75	56.25	68.75	-
21 to 25	8.33	16.67	33.33	33.33	50.00	50.00	8.33	-
26 to 30	6.67	13.33	33.33	46.67	46.67	40.00	13.33	-
31 to 35	7.69	23.08	23.08	38.46	53.46	38.46	15.39	-
36 to 40	14.29	28.57	42.86	42.86	42.86	28.57	-	-
41 to 45	50.00	50.00	-	-	-	-	-	-
46 to 50	28.57	28.57	42.86	57.14	28.57	14.29	-	-
51 to 55	18.75	37.50	56.25	43.75	18.75	18.75	6.25	-
56 to 60	25.00	37.50	50.00	50.00	25.00	12.50	-	-
Above 60	25.00	33.33	41.67	41.67	33.33	25.00	-	-

S = Systolic, D = Dyastolic

Table 4. Showing the Number of Cases Having Changes in GIT Motility and their Percentage

Age Group (in years)	No. of Cases	In- creased Motility	Per- cent- age	De- creased	Per- cent- age	No change	Per- cent- age
Below 5	-	-	-	-	-	-	-
6 to 10	13	5	38.46	2	15.38	6	46.15
11 to 15	11	4	36.36	4	36.36	3	27.27
16 to 20	16	7	43.75	6	37.50	3	18.75
21 to 25	12	3	25.00	4	33.33	5	41.67
26 to 30	15	3	20.00	4	26.67	8	53.33
31 to 35	13	2	15.38	3	23.08	8	61.54
36 to 40	14	2	14.29	2	14.29	10	71.43
41 to 45	8	1	12.50	1	12.50	6	75.00
46 to 50	7	1	14.29	-	-	6	85.71
51 to 55	16	1	6.25	1	6.25	14	87.50
56 to 60	8	-	-	1	12.50	7	87.50
Above 60	12	1	8.33	2	16.67	9	75.00
<b>TOTAL</b>	<b>145</b>	<b>30</b>	<b>20.69</b>	<b>30</b>	<b>20.69</b>	<b>85</b>	<b>58.62</b>

Multiple Bar Chart Showing the Percentage of Increased and Decreased Git Motility

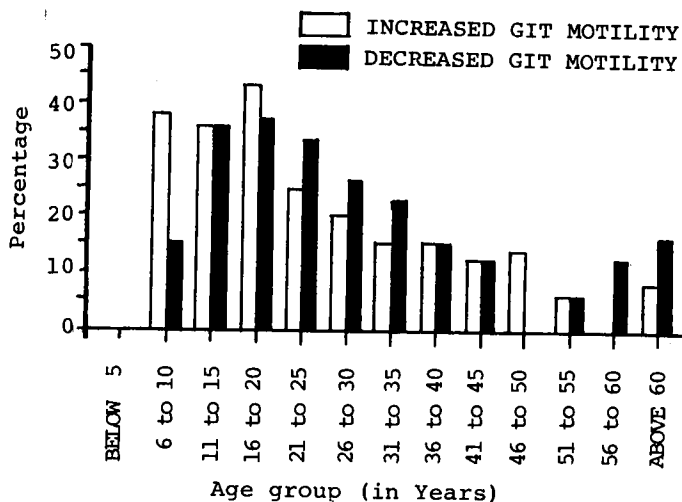


Fig. 3.

37.50 percent in the age group of 16 to 20 years. A minimum effect was found in the age group of 51 to 55 years and 56 to 60 years (Table 4, Fig. 3).

#### 7.4 Effect on Athletic Performance

On studying the 145 individuals, athletic performance was found to be affected in 26.90 percent. This was found due to increased airway resistance. The percentage of affected athletic performance varied from 12.50 percent in the age group of 41 to 45 years and 56 to 60 years to 45.45 percent in the age group of 11 to 15 years (Table 5, Fig. 4).

#### 8. CONCLUSION

On studying the acute effects of smoking tobacco on human health in various age groups, we have reached the following conclusions:

1. Nausea or vomiting or both nausea and vomiting occurred in 73.79 percent of the cases. The percentage being higher up to 45 years with the maximum of 84.62 percent between 6 and 10 years. It is having a sudden fall between 46 and 56 years with a minimum of 37.50 percent between 51 and 55 years. Above 60 years its percentage increases again (Fig. 1).
2. Systolic and diastolic blood pressure increase with a

Table 5. Showing the Number of Cases Having Affected Athletic Performance and their Percentage

Age Group (in years)	No. of Cases	Cases in which athletic performance was affected	Percentage
Below 5	-	-	-
6 to 10	13	5	38.46
11 to 15	11	5	45.45
16 to 20	16	6	37.50
21 to 25	12	4	33.33
26 to 30	15	5	33.33
31 to 35	13	3	23.08
36 to 40	14	3	21.43
41 to 45	8	1	12.50
46 to 50	7	1	14.29
51 to 55	16	3	18.75
56 to 60	8	1	12.50
Above 60	12	2	16.67
<b>TOTAL</b>	<b>145</b>	<b>39</b>	<b>26.90</b>

Percent of Cases Having Affected Athletic Performance According to Age Groups in Yrs.

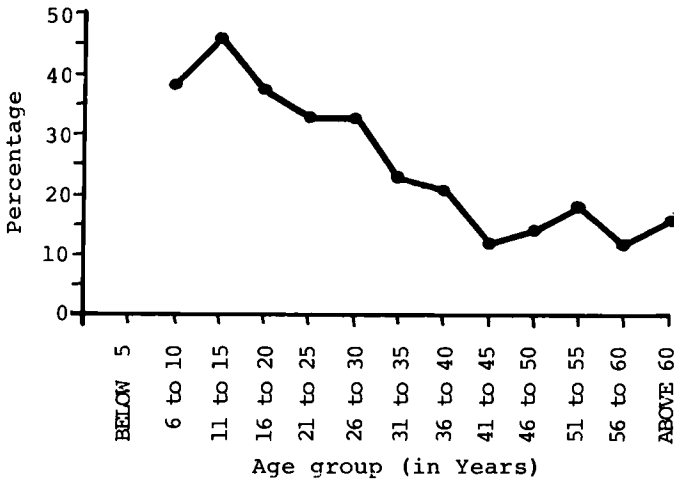


Fig. 4.

great variability in different age groups. The rise in systolic and diastolic blood pressures varied from 0 to 20 mm of Hg and 0 to 15 mm of Hg respectively. The maximum rise in both systolic and diastolic B.P. occurred in individuals between 16 and 20 years (Fig. 2).

3. GIT motility has shown both increase and decrease types of effects. It was found to be increased in 20.69 percent. Increase in GIT motility is higher at an early age and as the age advances, as an effect of tobacco smoking, the GIT motility decreases. GIT motility was found to be decreased in 20.69 percent, the percentage of decrease being less up to 10 years, becoming maximum between 16 and 20 years. The effect is that GIT motility decreases as the age advances. In 58.62 percent of the cases no changes in GIT motility were recorded. No change in GIT motility was found to be maximum (87.50%) between 51 and 60 years (Fig. 3).
4. The athletic performance was affected in 26.90 percent. It is more affected in the early ages, reaching a maximum between 11 and 15 years. The acute effect of smoking tobacco decreases as the age advances (Fig. 4).

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