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## RESEARCH ARTICLE

## ESTIMATION OF PEFR IN SUGARCANE MILL WORKERS IN MADURAI CITY

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**Abstract**

Environmental pollution plays a major role in Health hazards of the Respiratory system of individuals working in any mills, factories or industries.

In order to ensure their safety and welfare and to avoid occupational hazards, to keep them hale and healthy, this study was undertaken in a small group of sugarcane mill workers in National sugar factory, Alanganallur in Madurai city with the help of Portable Wright's Peak Flow Meter.

Health education was given to lead a better life wearing protective gadgets, taking healthy food, doing regular physical activities and avoid consumption of alcohol and smoking and to keep their life fit and to stay healthy.

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**INTRODUCTION**

Sugar industry is the second largest agrobased industries in India. In Tamilnadu, Sugar cultivation is done in 2.4 lakhs hectares of land and there are 16 cooperative and 3 state owned sugarcane mills in and around Tamilnadu. Human health has long been known to depend on an interplay between heredity and the environment. This can be exemplified by the fact that respiratory function can be influenced significantly by environmental factors like exposure to chemicals including smoke inhalation. Air borne pollution possess potential hazards to human health. The goal of environmental medicine is to identify the causes of diseases and reduce them by providing adequate safety measures.

Sugarcane factory workers are exposed to dust allergens from the lifting of cane from agriculturists, crushing of cane using crushers, boiling, panning and then finally processing sugar. During the course of sugar making, they are exposed to a variety of irritants and allergenic substances which can affect their respiratory functions.

The respiratory functions in the individual can be assessed by the various methods such as chest measurements, estimation of various lung volumes and capacities using spirometer, study of concentration of respiratory gases, hydrogen ion concentration in the blood and radiological examinations like x-ray chest.

The overall ventilatory lung function can be assessed in field situations by determination of peak expiratory flowmeter which can be measured with the help of **Wright's peak flow meter**.

**AIM AND OBJECTIVES:**

1. Estimation of PEFR in sugarcane mill workers in Madurai city and in the population living near the sugarcane mill factory and in people living in far off village to serve as control.
2. Measurement of expansibility of the chest wall during respiration in the above personnel.
3. Finding total leucocyte count in the above individuals.
4. Association of body mass index and pulmonary function in the study and control groups.
5. Correlation of total leucocyte count and PEFR in individuals with smoking habit as elicited through proforma.

## REVIEW OF LITERATURE

### PULMONARY FUNCTION:

The most important function of the lung is to maintain partial pressure of oxygen and carbondioxide of the arterial blood within the normal limits. This is achieved by uptake of oxygen from the inspired air and giving up of carbondioxide into the expired air. Thus the tissue oxygenation is adequately maintained and accumulation of carbondioxide in excess in the tissue is prevented by the lungs.

#### A) HISTORICAL ASPECTS

**Leonardo da vinci** (1452- 1519) had considered the intercostal muscles to cause expansion of lungs. **Giovanni Alfonso Borrelli** (1680) had described about the mechanics of respiration. He was the first person to measure inspiratory lung volume. **Leewenhock** in 17<sup>th</sup> century first described in detail the lining epithelium of respiratory tract. The frequency of ciliary movement has been recorded to be about 15 times /second.

**John Hutchinson** in 1846 measured the subdivisions of lung volumes with the help of spirometer in over 2000 persons and thereby laid the foundation for the modern test of ventilatory function.

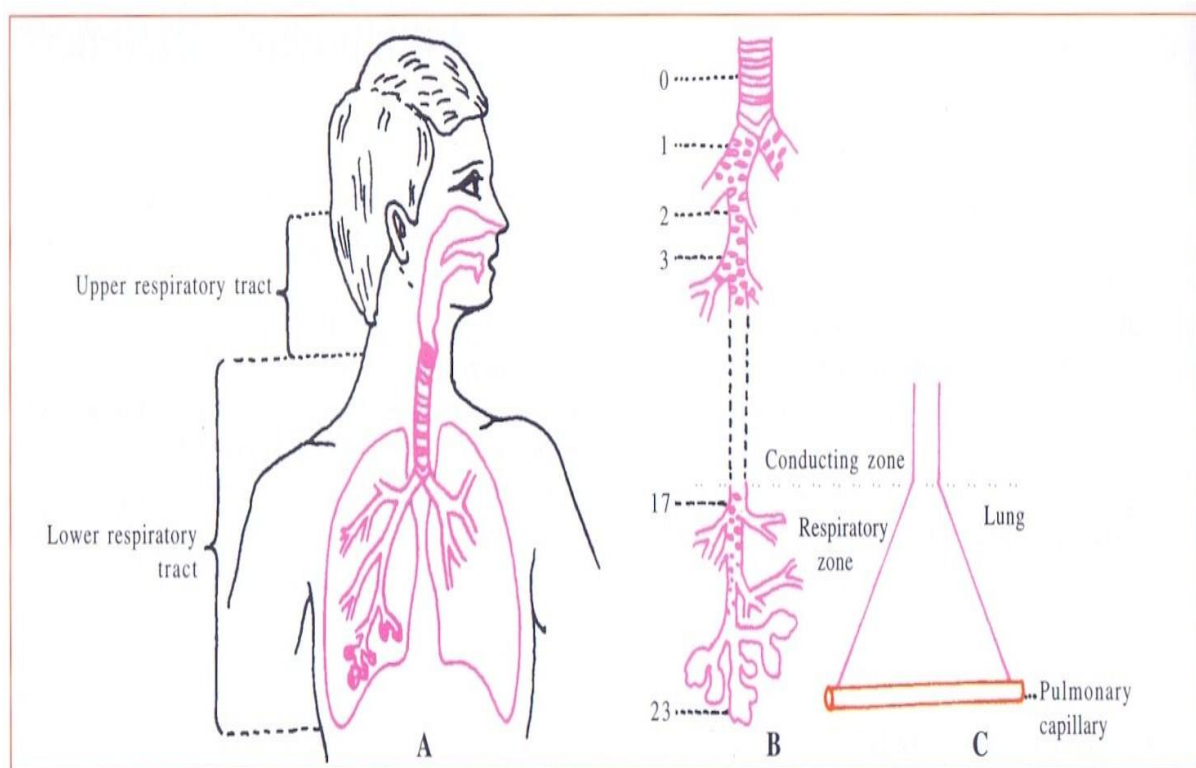
**Cripps et al** in 1923 found that the vital capacity is increased with weight upto 155 pounds and fell slightly with weight above 200 pounds.

**Aslett et al** in 1939 described the correlation of vital capacity with the height of the individual.

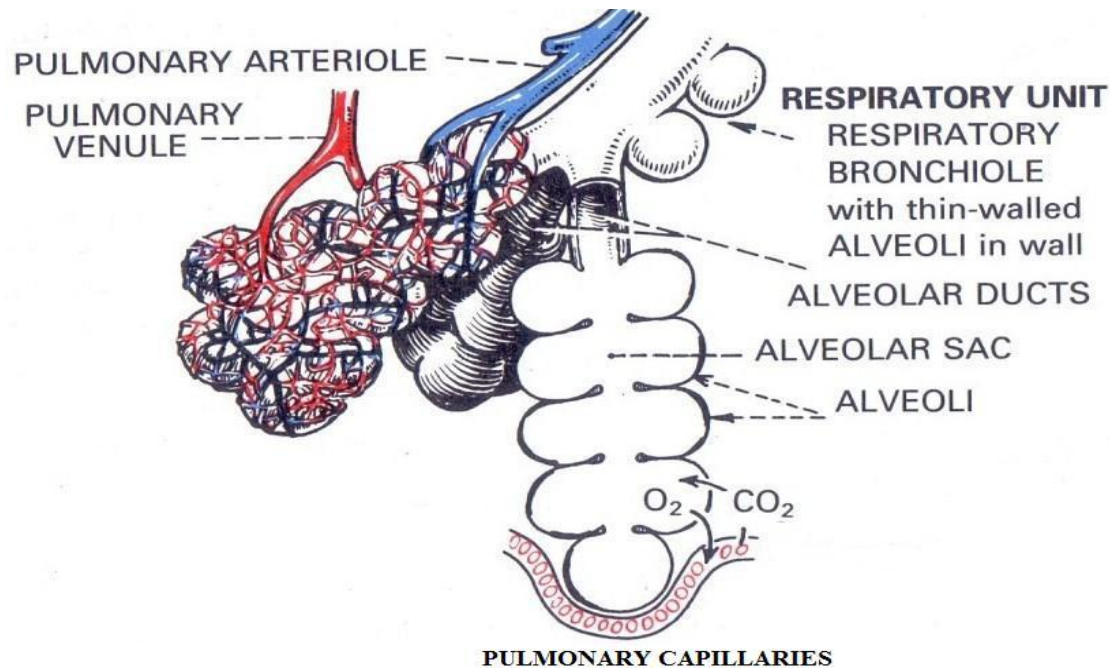
**Whitfield et al** in 1950 correlated the vital capacity with chest expansion and this was used for a long time as a measurement of physical fitness.

#### B) FUNCTIONAL ANATOMY OF RESPIRATORY TRACT

The respiratory tract has been described in detail by the swiss anatomist **E.R. Weibel** in 1963. The respiratory tract is divided into upper and lower parts.



Upper respiratory tract starts from the nostril upto the vocal folds. The part of respiratory passages below the vocal folds is called lower respiratory tract. There are 23 generations of the tracheobronchial tree. The initial 16 divisions form the conducting zone since this part conducts air and its wall is too thick for gaseous exchange that is trachea, two main bronchi, 10 generations of bronchi and 4 generations of terminal bronchioles followed by 3 generations of respiratory bronchioles i.e. transition zone (17<sup>th</sup> -19<sup>th</sup>) which have some areas suitable for gaseous exchange. The last part 20<sup>th</sup> to 23<sup>rd</sup> generation is suitable for gaseous exchange and forms the exchange zone.



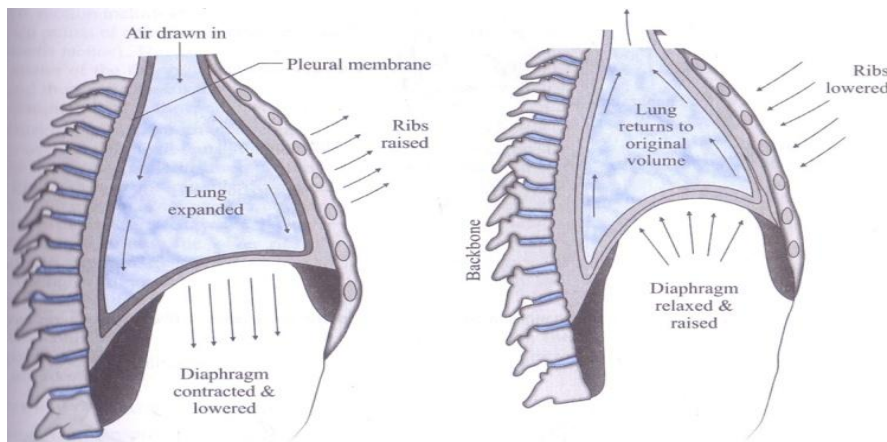
A respiratory bronchiole with all its branches is called primary lobule or acinus which is the physiologic unit of the lung. The 2 lungs contain approximately 700 million alveoli occupying a surface area of more than 70 square metres. There is cartilage in the wall of terminal bronchioles and the lining is ciliated epithelium. There is no cartilage in the wall of the respiratory bronchiole and the lining changes from ciliated epithelium to simple squamous epithelium.

The movement of the lungs are best considered in relation to the change in position of the chest wall and diaphragm.

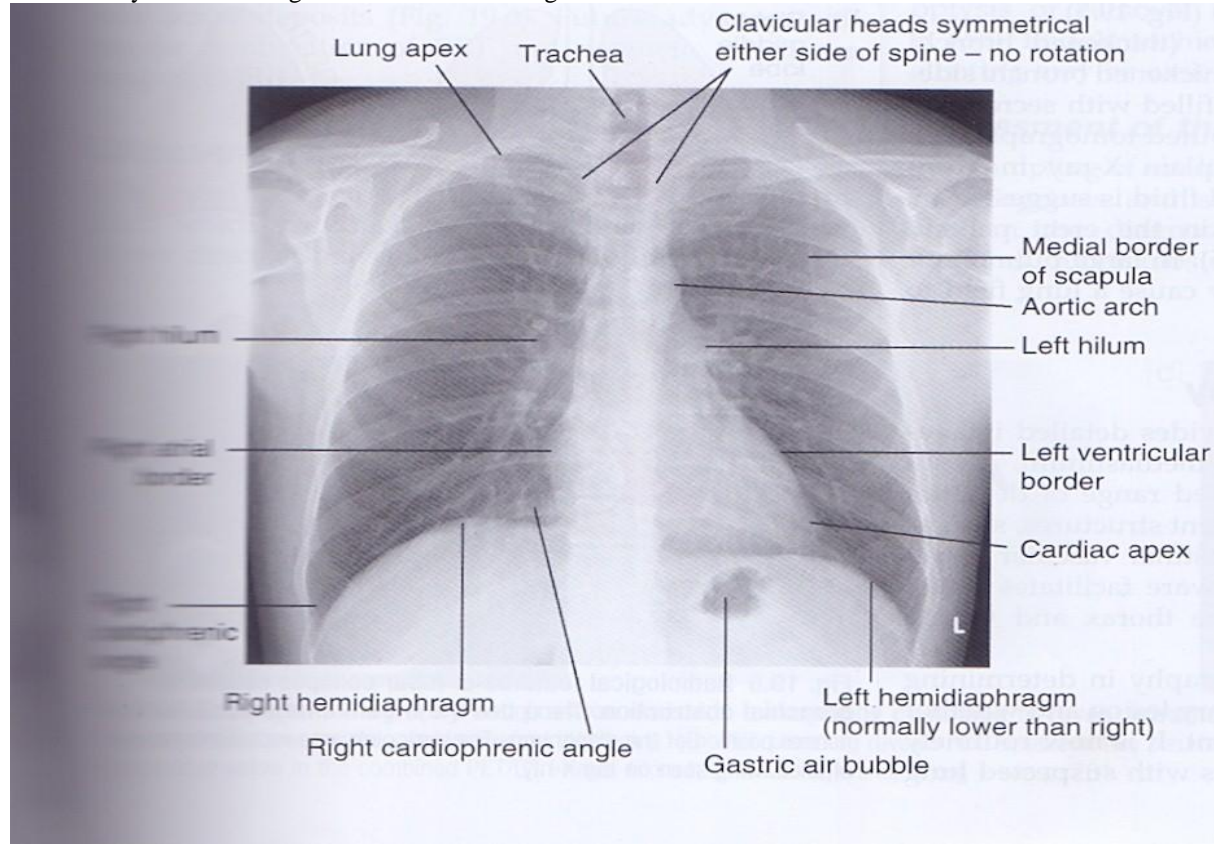
1. **The apex;** The thoracic inlet formed by the first 2 ribs, the vertebral column and the manubrium sterni moves upwards and forwards on inspiration to increase the anteroposterior diameter of the chest wall. In this manner the anterior part of the apex of the upper lobe is expanded directly.

2. **The thoracic cage;** This is best divided into 2 parts, the upper stretching from the second to the sixth ribs and the lower from the seventh to the tenth. The ribs move outwards and upwards on inspiration. In the upper portion, it is the anteroposterior diameter of the thoracic cage that is chiefly increased, whereas in the lower portion the main enlargement lies in the transverse diameter.

3. **The diaphragm;** The diaphragm is the principal muscle of respiration. In quiet breathing it can account for the whole of the inspired air, whilst in a maximal inspiratory effort it can still claim over 60%. It is hardly surprising, therefore, that the bases of the lungs are the parts which undergo the greatest movement.



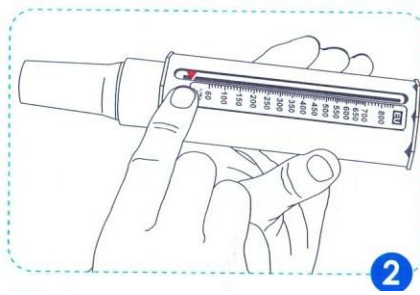
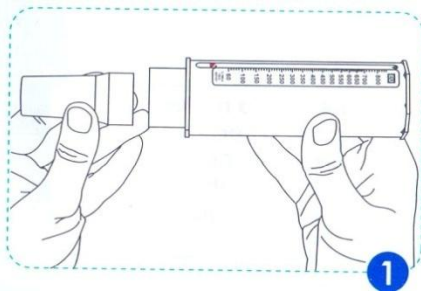
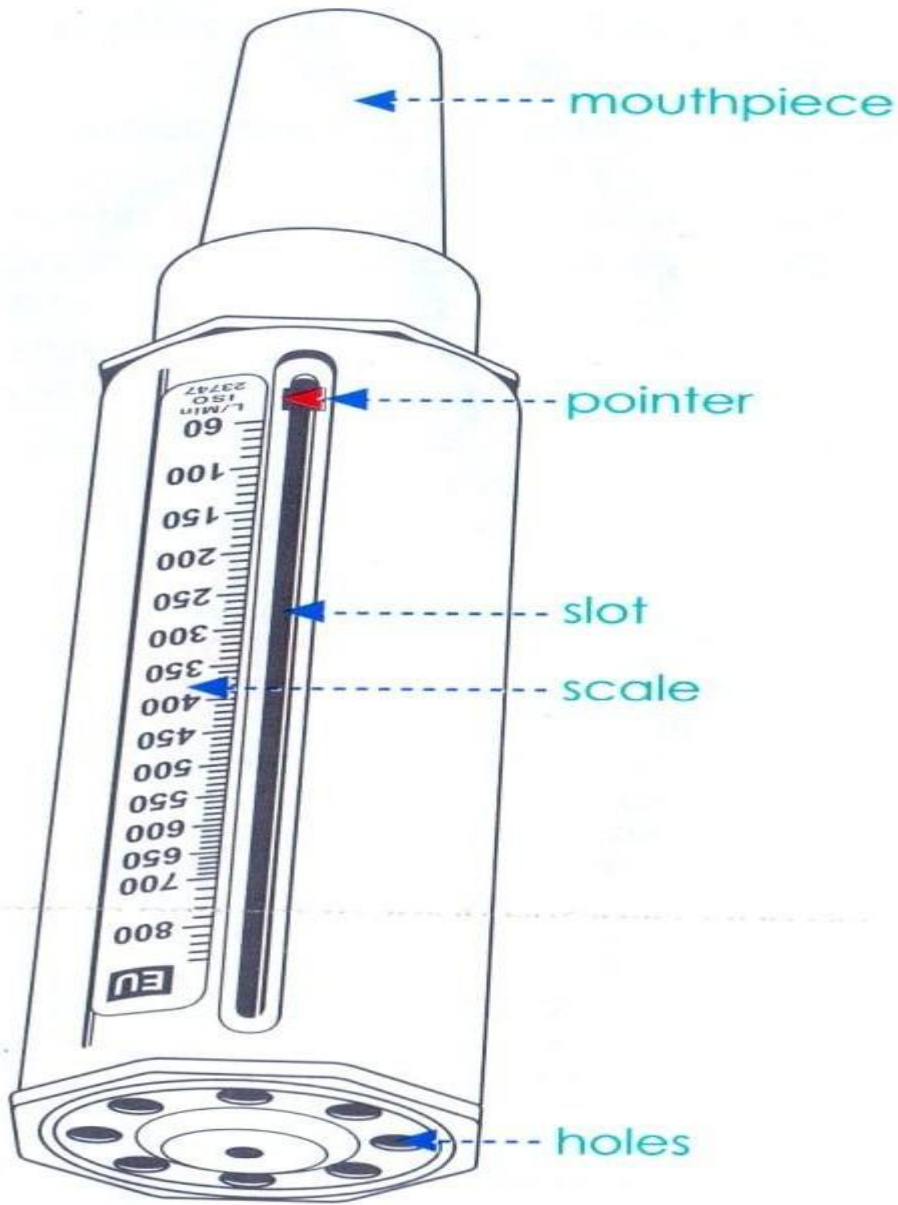
Radiographically the position of the diaphragm can be seen to vary markedly with changes in posture. In the supine position the abdominal muscles are relaxed and the intestines push the diaphragm up to its highest level. In this position, therefore, the diaphragm possesses its greatest potential powers of contraction. In the erect posture, on the other hand, the weight of the intestines falls away and the level of diaphragm descends. Frequently, however, the abdominal muscles are contracted, presumably in an attempt to maintain an even intraabdominal pressure. A similar set of circumstances prevails in the sitting position because the cupola lies at a lower level and the abdominal muscles may be contracting if the ventilation is large.

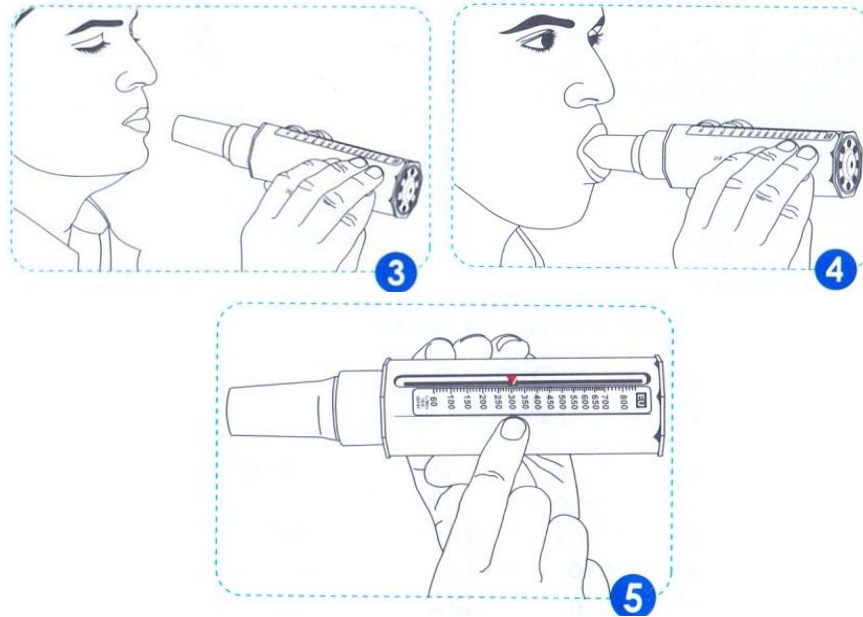


### C. EVOLUTION OF WRIGHT'S PEAK FLOW METER

Respiratory anemometers monitor airflow. In hot wire anemometers, the airflow cools the wire and this causes a change in electrical resistance. In the rotating vane anemometers developed by **Wright**, the vane is mounted in a tube and the air enters through oblique slots cut in its wall. The characteristics of the anemometer are determined by the shape and the size of the slots. These difficulties have now been overcome by programming a microprocessor to construct a calibration curve. The calibration signal can be a standard volume of gas delivered from a syringe with different amounts of force. ( **Morgan ventilo meter** ).

In constant pressure, variable orifice anemometers such as Wright's peak flow meter, a slot aperture in communication with a mouth piece is initially sealed off by a movable vane or piston restrained by a constant tension spring. Forcible exhalation into the instrument enlarges the aperture to the extent needed to maintain a constant pressure in the mouth piece. The maximal enlargement and the associated excursion of the vane reflect the peak expiratory flow. The initial calibration of the wright peak flow meter was also registered using pneumatachograph. Provided the resistance of the meter does not affect the peak flow, the calibration can also be performed with a computer- controlled pump. Using this approach **Miller and colleagues** in 1986 have observed certain deficiencies in some currently available peak flow meters including alinearity ( Eg. Mini wright peak flow meter ) and inappropriate damping.( eg Ferrasis meter ) **Singh H D** et al (1997 ) reported the comparison of peak flow rates obtained with Morgan spirochek and Minipeak flow meter and their correlation.





#### D. PEAK EXPIRATORY FLOW RATE

It is the maximum rate of airflow which is sustained for a period of 10 milliseconds during a forced expiration after a maximal inspiration. It is usually measured with Wright's peak flow meter which is small, portable handheld instrument. This does not require electric power and is suitable for population survey studies. PEFR has also been measured using Armstrong mini wright peak flow meter, vitalograph pulmonary monitor and pneumotachograph.

The **Armstrong** mini wright peak flow meter and **vitalograph** pulmonary monitor operate through air pressure directed against a diaphragm which displaces light weight piston. The health scan instrument is in effect a rotometer with airflow directed through a previously drilled orifice - the flow ranging from 90-700 lpm can be determined.

#### SIGNIFICANCE;

The normal values recorded in young man range from 400-600 litres per minute ( lpm ) while 300-400 lpm in young women. PEFR is found to be reduced in many lung disorders especially when there is obstruction in larger airways. PEFR is found to be significantly reduced in flour mill workers, cotton mill workers and hairdressers who are exposed to grain dust and fine fibres. The reduction in PEFR is marked in individuals who used to smoke in addition. PEFR reflects the calibre of bronchi and it is a function of the lung volume and it is dependent upon depth of preceding inspiration, the strength of muscles of expiration and the expiratory effort of the individual. Therefore PEFR estimation offers adequate information regarding the ventilatory efficiency. Peak flow meter makes the ventilatory efficiency criteria for accuracy and reproducibility and it is found to perform more uniformly.

#### Salient features of PEFR include

1. PEFR is the maximal flow rate during a single forced expiration.
2. PEFR is the single best test for measurement of ventilatory efficiency.
3. It is also dependent on the depth of the preceding inspiration, the strength of the muscles of expiration and the expiratory effort of the individual.
4. PEFR reflects the calibre of the bronchi. Used for assessing bronchodilation and circadian variation.
5. PEFR is a function of lung volume as well as the effort exerted.

#### e. CHEST EXPANSIBILITY

In normal subjects inspiration is effected by contraction of the external intercostals muscles and the diaphragm while expiration is a passive process which is dependent on elastic recoil of the lungs. Women make more use of the intercostals muscles than of diaphragm and their respiratory movements are predominantly thoracic. Men rely more on the diaphragm and their respiratory movements at rest are mainly abdominal.

#### CHEST WALL:

The chest wall comprises of the ribs, the intercostals muscles and fascia, blood vessels, nerves and lymphatics, the costal cartilages, the sternum and the vertebral column. Its function is to protect the thoracic viscera and to ventilate the lungs. The movement of the chest wall also plays a part in the filling of the heart. During forced

breathing the chest wall is moved by the active contraction of the accessory muscles of inspiration such as scalene, sternocleidomastoids and serratus anterior. At that time the size of the thoracic cavity increases and the pressure inside it decreases.

The muscles of anterior abdominal wall which are referred to as 'squeezers of the abdomen' (Wood Jones 1971) contract during forced expiration increasing the intra abdominal pressure pushing up the diaphragm helping in expiration.

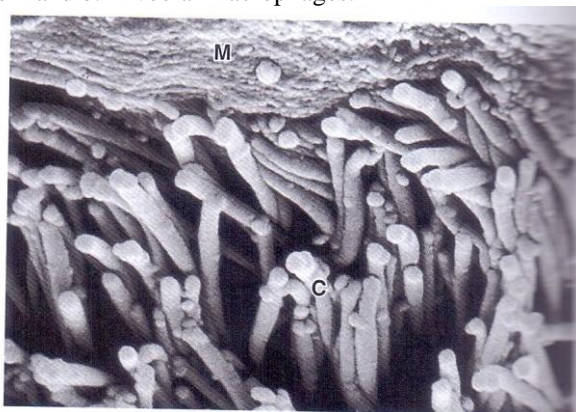
#### f. LUNG DEFENCE MECHANISM

The inspired air contains many foreign particles, most of which pass out of the lungs in the expired air in the next breath.

The other particles are deposited in the respiratory passages in the following ways;

- i. Large particles sized over 5 microns are impacted and trapped in the nose, pharynx and at the bifurcation of trachea and large bronchi. Sedimentation occurs because the increasing cross sectional area of the conducting airways leads to a decrease in the linear velocity so that gravitation forces may act on the particles (New House et al 1976).
- ii. Medium sized particles (1-5 microns) sediment in the bronchial tree especially in the small bronchioles and are deposited on the surface of the alveoli.
- iii. Very small particles diffuse into the alveoli and are deposited on their walls. These deposited particles are disposed off by two mechanisms.

- a. Mucociliary system and b. Alveolar macrophages.



Mucociliary system comprises the mucus covering which is about 5 microns thick and has an outer viscous gel layer which traps the particles and the inner thin serous fluid which lubricates the ciliary action. The cilia are about 6 microns long and its movement consists of a rapid forward stroke during which its tips contact with gel layer and a slow recoil when they are bent and move in the inner layer. The ciliary movement therefore causes mucus blanket to move like an escalator. The ciliary function and mucus movement can be impaired by tobacco smoke and noxious gases. The alveolar macrophages are found among the parenchymal pneumocytes. They secrete wide variety of important enzymes, cytokines and complements that are essential for the clearance of opsonised organisms and immune complexes. (Nathan C J et al 1987)

#### 2. ENVIRONMENT –IN AND AROUND SUGAR MILL

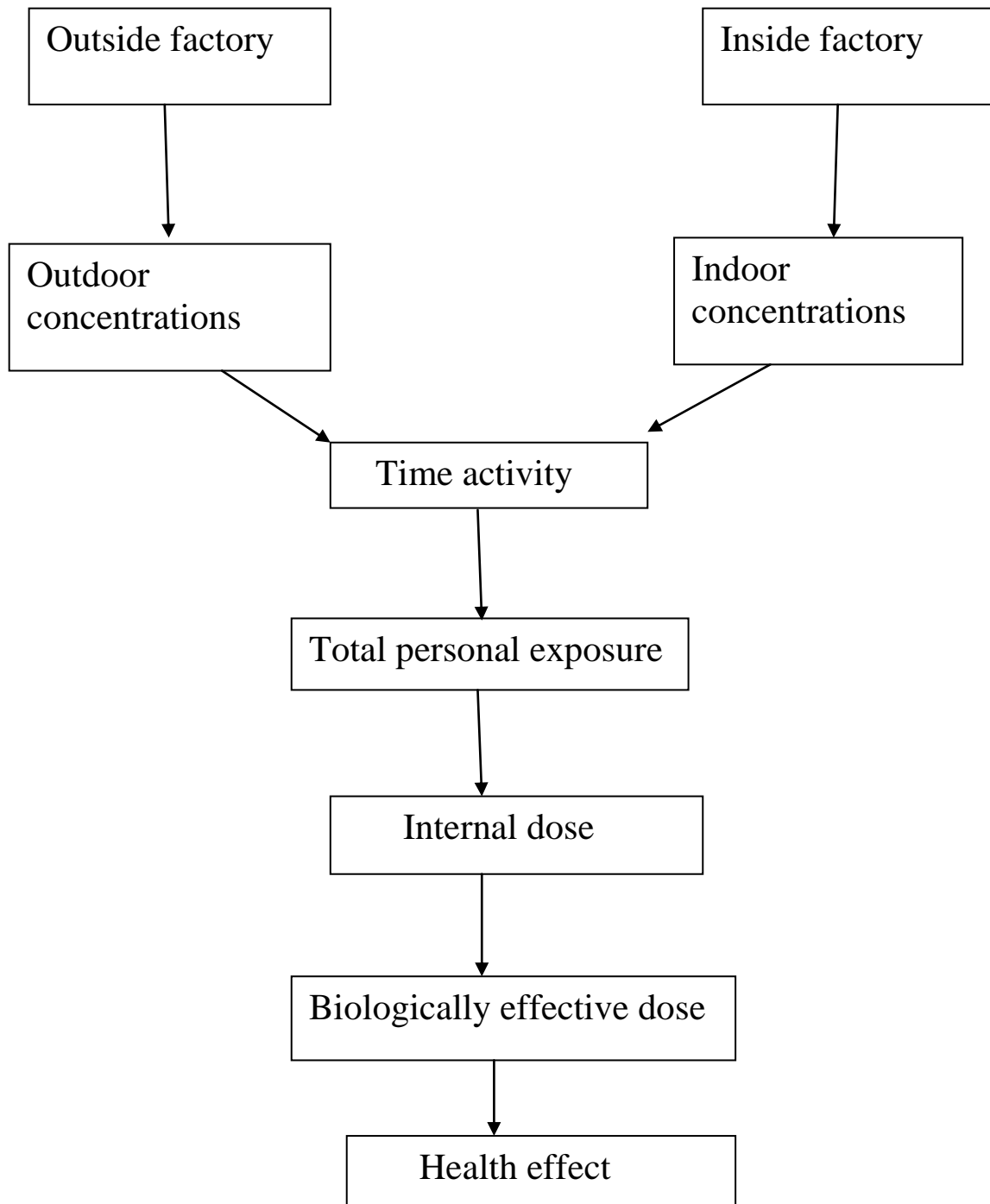
Sugar making process was known in India as early as 3000 BC. In Sanskrit, the word sugar is Sakkara. Gaura, another old Indian word for sugar was derived from the name of Gur for domestic non purified sugar.

Sugar industry is a raw material oriented industry- its raw material being sugarcane. The sugar mills are located within 100 kms radius of the cane fields. Being weight losing raw material, the sugarcane has to be crushed within a short time after it is cut to get good result. Crushing of sugarcane starts from November to May every year depending upon the availability of sugarcane. Sugarcanes are cut in size and pressed out by means of a set of 3 or more roller system. Heating at a certain degree of temperature purifies the juice. The juice that is obtained is heated to 70°C temperature and milk of lime and powdered sulphur are added. This causes a high rise in temperature of the mass which is then cooled by cooling system. This process is repeated. The mixture is then passed through a juice purifier machine, which separates the purified juice and the thick muddy juice. The purified part of the juice is then put on an evaporator fitted with filters. The juice after further heating in a vacuum boiling pan, turns into a crystalline substance. This is raw sugar. To make sugar white, the raw material is dissolved in

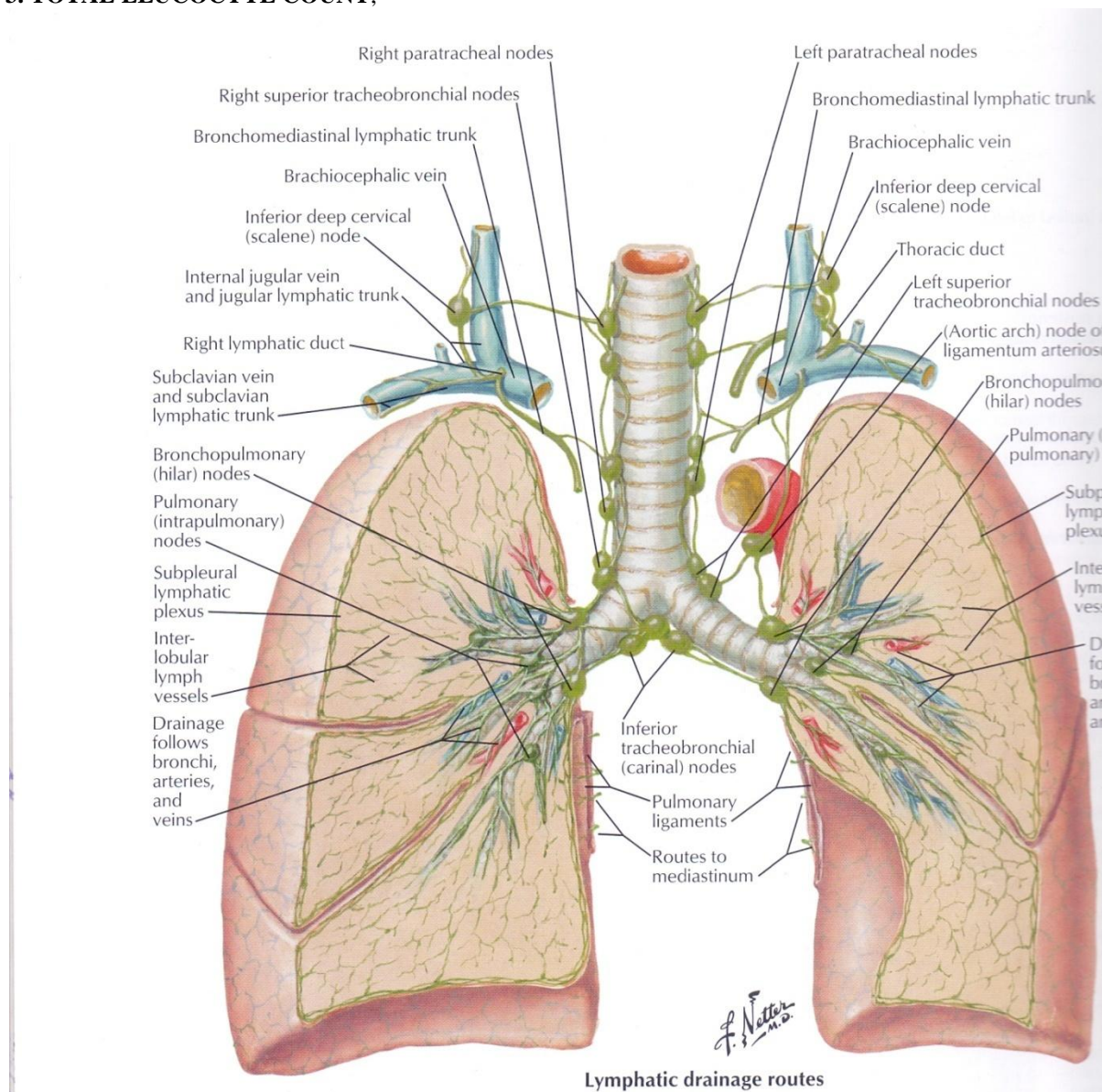
water and solution is filtered and heated again. Bagasse, the product obtained after crushing is used as a fuel for the industry.

Inside the factory when the people are working, they are exposed to the dust particles that arise during lifting the raw material during transport, crushing, purification and handling the finished product. Outside the factory, the workers and the people living near fields are exposed to the foliage of the sugar cane while cutting and transporting the material. The pollutants in the inhaled air include the fine particulate matter and chemicals that are used in the process of sugar making. Occurrence of *Aspergillus fumigatus* in sugarcane mills has been studied by **Sandhu R.S. et al** in 1976 and they have reported nearly 42.5% of the total aerial fungal colony being present in sugar mills whereas only 2% in University of Delhi campus.

Framework for considering exposure, dose and the development of environmental respiratory dust.



### 3. TOTAL LEUCOCYTE COUNT;



#### POSITION OF LYMPH NODES IN THE RESPIRATORY TRACT

The leucocytes are the nucleated cells in the blood concerned with the defence mechanism in the body. In the adults, the normal value is found to be varying from 4-11 thousands per cubic millimeter of the blood. The defence mechanism includes the phagocytosis and the production of immunoglobulins ( antibodies ) to combat either bacterial infection or prevention of foreign particulate matter from causing damage to the tissues of the body.

The leucocyte count is found to increase in conditions of increase in temperature and on exposure to dust in the inhaled air. **Schoen I** (1964 ) correlated cigarette smoking with blood eosinophilia. **Howell** (1966), **Corre et al** (1988) and **S.M.Lewis** and co found a significantly increased leucocyte count in heavy smokers for more than 20 years. **Roles H & Co** (1987 ) found a slight increase in the circulating neutrophils with PEFr alteration on exposure to airborne manganese dust.

#### 5. BODY MASS INDEX AND PULMONARY FUNCTION

**Quetelet's index** has been used for calculating in the present study, though there are several other indices available for calculating body mass index such as Ponderal index, Broca index, Lorentz's formula and Corpulence index. As early as 1913, the Society of Actuaries published that weight was an important predictor for the longevity of the individual. Build study (1979) has published tables of desirable weight for men and women of a

given height. The Belgian astronomer, **Quetelet** observed in 1869, that among adults of normal body build, weight was proportional to the square of height; in other words weight/height in squares was constant. This useful index is therefore called as Quetelet's index (Q I) but **Key and colleagues** in 1972 made a similar observation and named it Body Mass Index (BMI). The BMI normally ranges from 18.5-24.9 kilogram per square meter. **World Health Organisation** (1946) Report gives the much needed reference table for BMI. **Chattopadhyaya B.P. et al** (1994) studied 318 asymptomatic male jute mill workers of the Calcutta area and studied the relationship of PEFR with age, height, exposure to dust and smoking habit causing a low PEFR value when compared to 32 control population. **Cookson J.B. et al** in 1976 have estimated ventilator function in Rhodesian Africans and found higher PEFR values and similar reports have been obtained in Western subjects (**Flint and Kahn, 1962**). **Dr.H.D.Singh** has reported lower values of PEFR in South Indian adults which is similar to the data obtained by **Malik et al** in 1975. The difference between Indian and western population can be partly attributed to the physical build of the individual. The PEFR values in athletes, factory workers, police and army personal are found to be identical in the Indian and Western population. The vital capacity and the maximum breathing capacity has been found to be increased by 7% and 12% respectively in athletes compared to the non athletes and this is accounted for the presence of superior musculature in athletes. Obstructive sleep apnoea is believed to occur because of local fat accumulation in the trachea pharyngeal area and produce interrupted sleep associated with hypoxia and hypercapnoea.

### **6.EFFECT OF SMOKING ON PEFR AND TOTAL LEUCOCYTE COUNT**

Cigarette smoke is a heterogenous aerosol produced by incomplete combustion of tobacco leaf. **Mc Cusker**(1980) identified 4000 substances in cigarette smoke containing antigenic, cytotoxic, mutagenic and carcinogenic properties. The normal operation of the mucociliary system can be adversely affected by cigarette smoke which not only paralyses cilia and also changes the character of the mucus. It also inhibits the functions of alveolar macrophages and leads to hypertrophy and hyperplasia of mucus secreting glands. The inhaled cigarette smoke increases airway resistance due to vagally mediated smooth muscle constriction by way of stimulating submucosal irritant receptors. **Mathur M.L. & Co** (1996) assessed the anthropometric, radiological and smoking history related variables with PEFR in 286 sandstone quarry workers in desert and found significantly low PEFR values depending on exposure to dust, nature of job and number of beedies smoked compared to healthy adults from the study area. **Lee** (1997) found polymorphonuclear cells to release elastolytic enzymes which affects the alveolar structure. **Dosman** (1980) suggested that the polymorphonuclear cells are the most mobile that supply intense phagocytic and enzymatic firepower quickly to contain foreign substances in the host. **Friedman G.D. et al** (1973) demonstrated that mean white cell count and neutrophil counts are significantly higher in habitual smokers of cigarette. The elevation of white cell count is proportional to the number of cigarettes smoked daily, duration of smoking habit and the extent to which smoke is inhaled (**Parulekar V.G. et al** 1975). **Tashkin D.P. et al** (1984) suggested that once smoking has been stopped, the rate of fall of forced expiratory volume in first second with age reverted to the normal rate. Physical fitness and FEV1 declined by twice as much in smokers compared with non-smokers in the seven years of study (**Sand vik et al** in 1995).

### **MATERIALS AND METHODS**

A group of 100 sugar factory workers working at the National Sugar Factory, Alanganallur, Madurai district were selected as the study group.

Another group of 50 individuals from the neighbourhood of the factory living in the nearby village were selected for the study as they are also exposed to similar environmental pollution.

The third group of 50 persons living in a village 30 kilometers away from the sugar factory were selected for the study to serve as control.

The individuals selected for our study fall in the age group ranging from 30=60 years. After getting the Ethical committee's approval, informed consent from the individuals, the proforma containing the details regarding the duration of occupation, personal habits and the health status was filled up.

The following measurements and data were collected from the individuals of different groups- group I, group II and III from 10 a.m to 12 noon everyday during the study. 20 individuals were examined in a day.

I. The height and weight of the individuals was first recorded by using the standard inch tape and weighing machine.

II. The chest measurement was done with the help of the inch tape placed around the chest wall (at the level of the nipple in men and in women, the measurement was done just below the breasts) at rest and on deep inspiration. The difference was noted and that was taken as indicating the chest expansibility.

III. PEFR measurement was done using mini-Wright's peak flow meter after the demonstration for using the equipment correctly. Twenty individuals were examined daily for a period of 5 days.

The precautions undertaken while recording the PEFr include

- 1.The indicator in the flow meter was kept at the bottom of the scale.
- 2.The subject was asked to sit erect.
- 3.The mouth piece was cleaned with cotton dipped in antiseptic solution ( dilute solution of cetrimide ).
- 4.The subject was instructed to take a deep breath and blow into the peak flow meter as quickly and as forcibly as possible.
- 5.The PEFr recording was done 3 times and the average was taken for each individual.

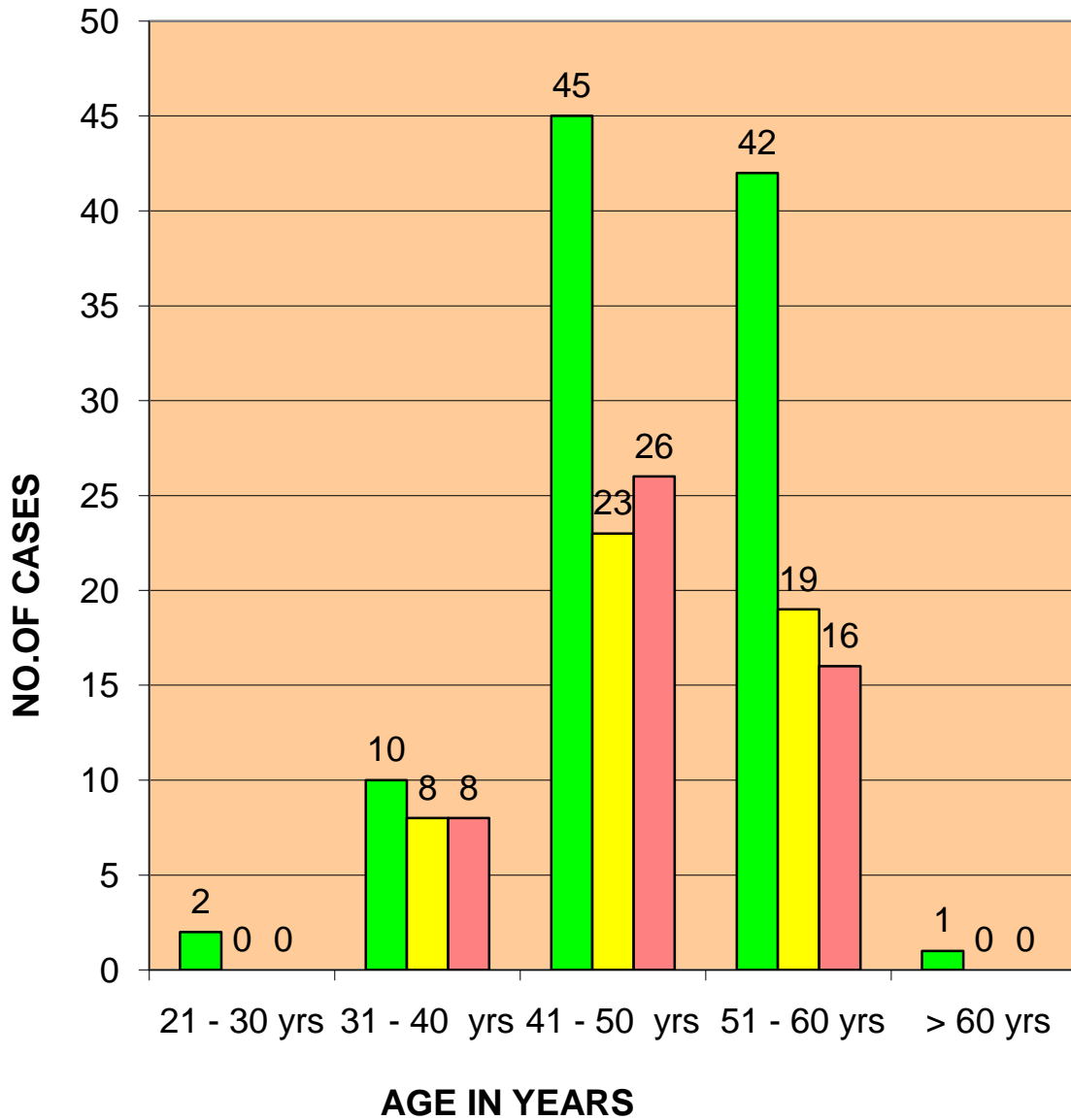
IV. With due precautions, the blood sample from the finger tip was collected for estimating total leucocyte count and was mixed with Turk's solution for dilution. The total leucocyte count was done in the Neubaur chamber in the routine method.

#### **OBSERVATION AND RESULTS**

**Diagram I** indicates the grouping and age of the individuals.

	21-30 years	2
Group I	31-40 years	10
	41-50 years	45
	51-60 years	42
Factory workers	> 60 years	1
Group II	31-40 years	8
Individuals in the neighbourhood Of the factory	41-50 years	23
	51-60 years	19
Group III	31- 40 years	8
Control	41-50 years	26
	51-60 years	16

DIAGRAM - 1 AGE DISTRIBUTION



■ Group I	Factory workers
■ Group II	Neighbourhood villagers
■ Group III	Control

DIAGRAM II

II. The average value of PEFR is found to be as follows;

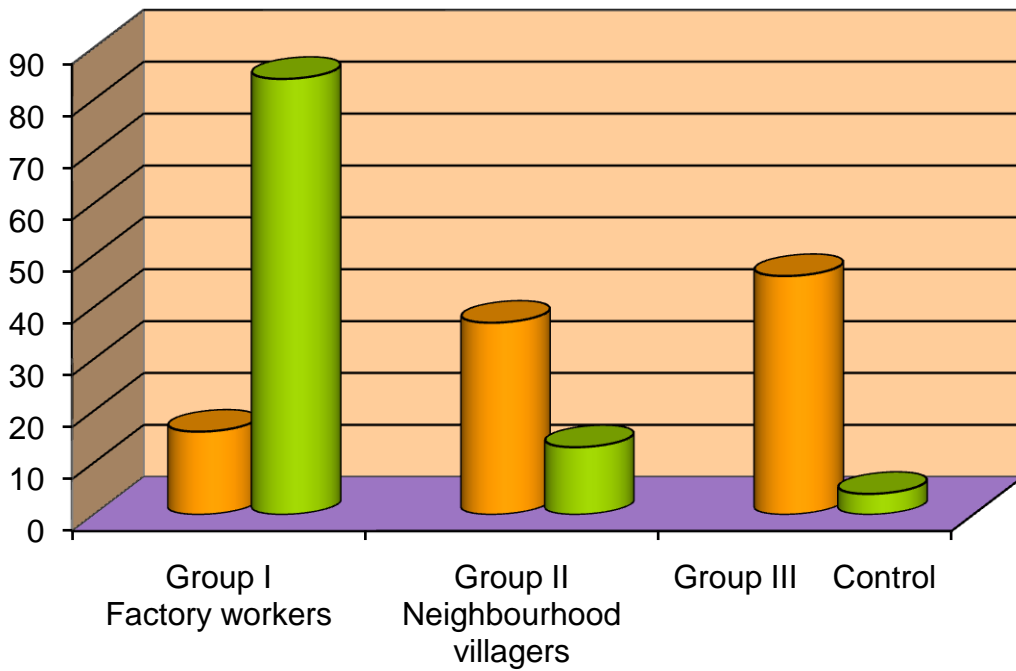
Group I- 306.73 + 19.38 Liters / minute.

Group II- 415.56 + 22.16 Liters / minute.

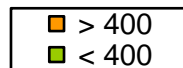
Group III- 469.66 + 13.52 Liters / minute.

Statistically the reduction in PEFR in Group I individuals is found to be highly significant (0.0003 ) as compared to Group II and III.

DIAGRAM - II



PEFR IN LITRES / MINUTE



**DIAGRAM III**

III. The chest expansibility ( difference between chest measurement at rest and on deep inspiration) on an average is found to be as follows in the different study group.

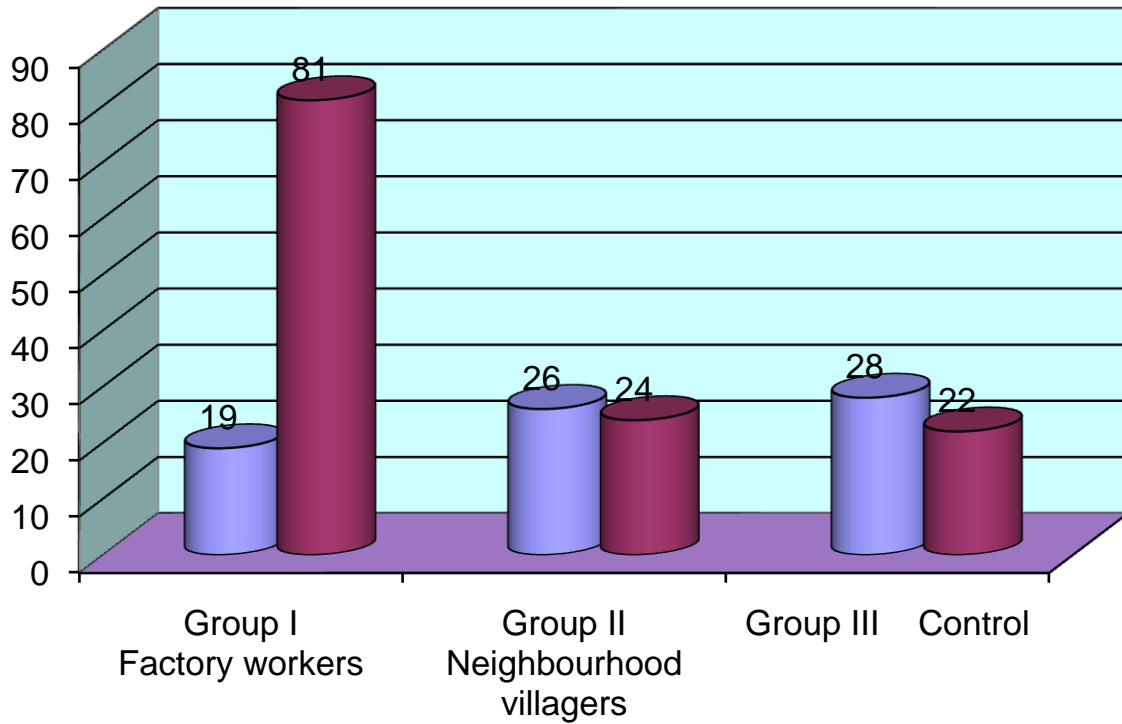
Group I 4.04 + (0.23 ) cms.

Group II 5.08 + (0.33 ) cms.

Group III 5.58+ (0.19) cms.

Statistically the reduction in the expansibility of the chest in Group I is found to be highly significant with 'p' value 0.00003 when compared with other 2 groups.

DIAGRAM III



CHEST EXPANSIBILITY IN CMS



**DIAGRAM IV**

IV. The average body mass index as calculated by Quetelet’s index method is found to be

Group I 25.073 + ( 1.16 ) kg/m<sup>2</sup>.

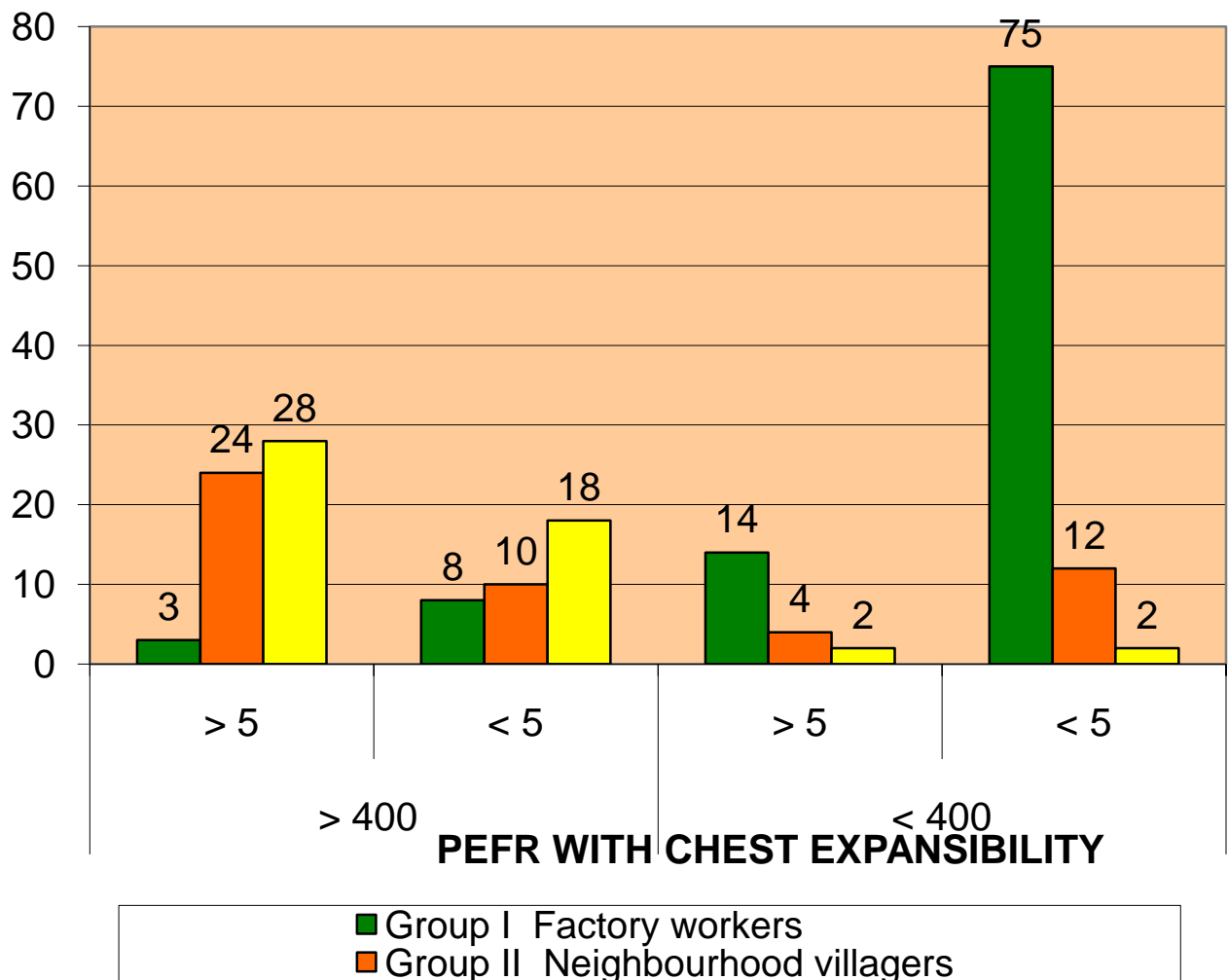
Group II 22. 316 + ( 0.65 ) kg/m<sup>2</sup>.

Group III 23.184 + ( 0.73 ) kg/m<sup>2</sup>.

Statistically, BMI is not significant as ‘p’ value is 0.0298.

V . **DIAGRAM IV** indicates the relation between PEFR and chest expansibility in different groups under study. It is found that 75 among 100 group I individuals have PEFR values less than 400 lpm and the chest expansibility less than 5 cms. Statistically it is significant since the ‘p’ value is less than 0.001.

**DIAGRAM - IV**



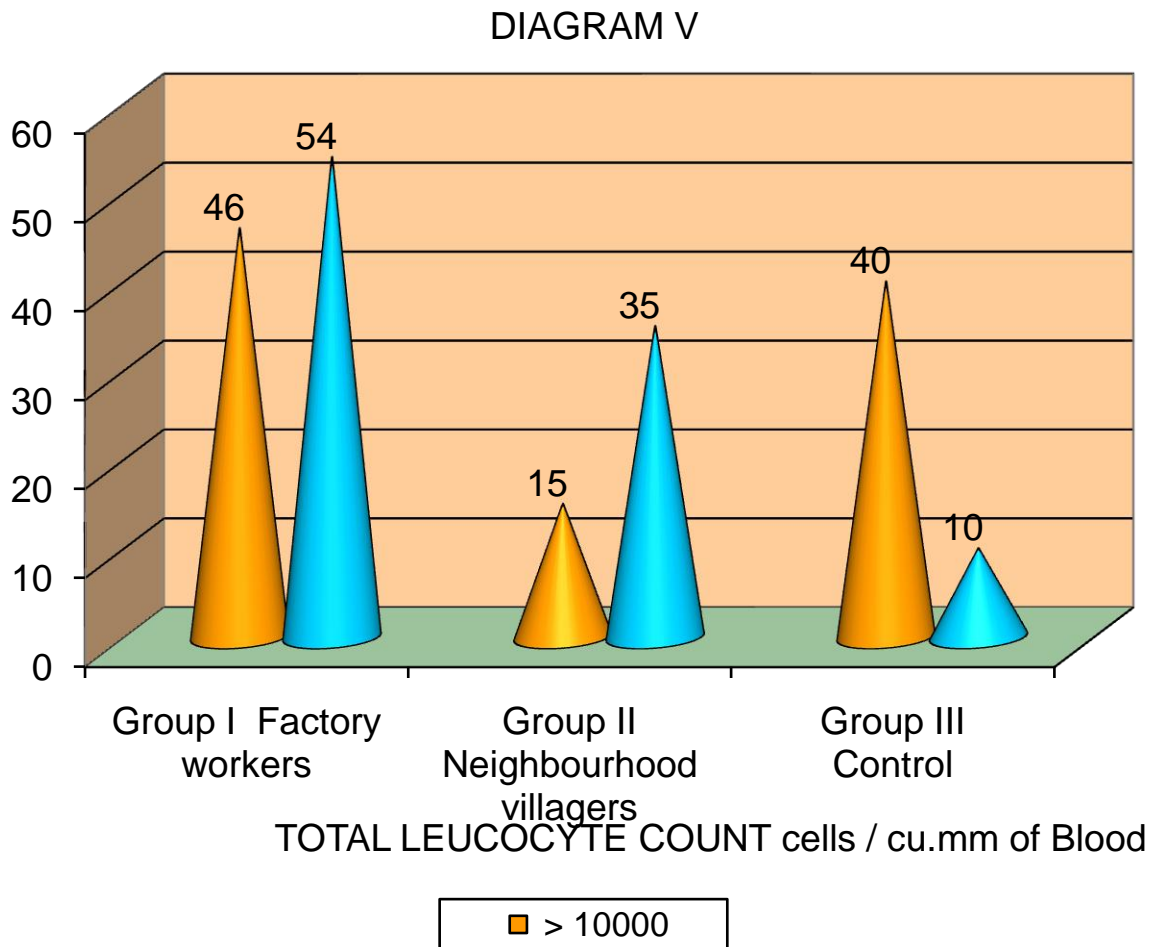
VI. **Diagram V** indicates the total leucocyte count in different study groups, the average being

Group I 9760.21+ (625.43 ) cells / cu mm.

Group II 8468.2+ ( 573.82 ) cells / cu mm.

Group III 10716.68 + ( 278.30 ) cells/ cu mm.

Statistically there was reduction in total leucocyte count in Group I individuals with ‘p’ value 0.0007.



VII. Looking into the relation between Body Mass Index and PEFR in the studygroups

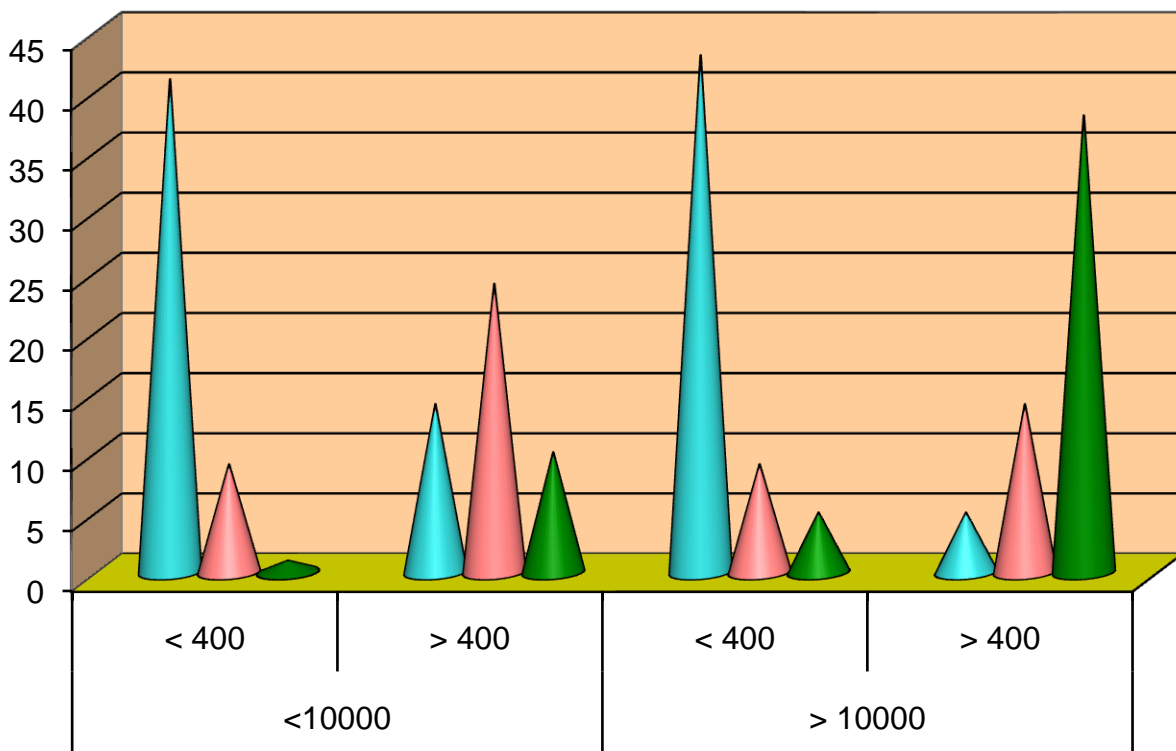
Group I 25.073 + ( 1.16 ) 306.73 + ( 19.38)

Group II 22. 316 + ( 0.65 ) 415.56 + (22.16 )

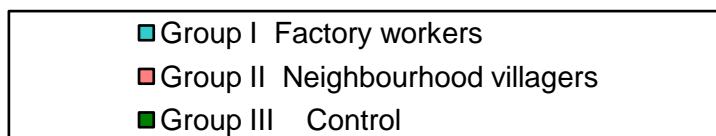
Group III 23. 184 + (0.73 ) 469.66.+ ( 13.52 )

Statistically it is found to be highly significant since tthe ‘p’ value is 0.000001.

DIAGRAM VI



Total leucocyte count with PEFR



IX. **Diagram VI** compares the total leucocyte count and PEFR values in the three groups of individuals studied. It is found that 43 out of 100 group I individuals show a reduction in the PEFR and increase in total leucocyte count. Statistically it is found to be significant as the 'p' value is less than 0.0001.

## DISCUSSION

In the recent times with enormous increase in changes in the environment due to industrialisation in the production of basic requirements of man, the occurrence of occupational hazards have become a great bother to the society. The present study indicates that the sugar factory workers exhibit a reduction in the pulmonary function. This is made out by a reduction in the PEFR which is an accepted indicator of lung function in field study. Hankinson J.L.(2000) measured serial PEFR measurements in persons exposed to workplace environment and documented changes in lung function.

The normal values of PEFR in men is found to be ranging from 400-600 lpm and in women from 300-400 lpm. The PEFR reflects mainly the calibre of the bronchi and the bronchioles and is dependent upon the depth of the preceding inspiration, the strength of the inspiratory as well as expiratory muscles and the expiratory effort. The reduction in the PEFR and the chest expansibility in the sugar factory workers and the villagers in the neighbourhood of the factory considered in our study can be explained as due to the exposure of the individuals to the dust of various kinds that include the particles of the dried sugarcane, chemicals that are added during the process of sugar making.

The normal lung defence mechanism comprising of the mucociliary system in the respiratory passages can be affected due to the irritants. This results in the narrowing of the respiratory passages and increased airway resistance. This in turn, causes the reduction in PEFR in the individuals. The finding in our study correlates with the earlier reports by Gupta P et al in 1999 in which study the reduction in PEFR is found in stone quarry workers of Rajasthan.

The normal value for chest expansibility is described to be varying from 5 to 8 cms. In the study group-74 out of 100 with reduction in PEFR, there's also reduction in chest expansibility. This can be attributed to relative lack of oxygen supply to the muscles because of reduction in pulmonary function.

Considering the body mass index in the 3 different groups of people, there is not much of significant variation on statistical analysis.

It is also found that the total leucocyte count when correlated with PEFR, there's a significant correlation between reduction in PEFR and an increase in the total leucocyte count in 50 out of 150 individuals in the Group I and II put together. There is a reduction in PEFR with the normal leucocyte count in 50 out of 150 of the Group I and II individuals.

The early reports of variation in total leucocyte count in different groups of workers is also found to be inconsistent. Migration of neutrophils from the lungs to the trachea- bronchial nodes were studied extensively by **Harmsen A et al** (1987).

It is interesting to note that the sugar factory workers who used to smoke for a duration of 5 to 20 years showed a reduction in PEFR and chest expansibility. This finding explains the definite pulmonary response to the polluted atmosphere conditions prevalent in and around the sugar factory worsened by smoking habit.

The body mass index appears to be normal inspite of the reduction in PEFR and the chest expansibility. This can be explained by the fact that the factory workers do not suffer from malnutrition because of relatively better economic status.

## CONCLUSION

From our study we find the environmental influence in the working place does play a significant role in sugar factory workers. There is distinct reduction in pulmonary function inspite of adequate nutrition that is shown by the body mass index value and the PEFR and chest expansibility. Care should be taken to reduce the environmental pollution by providing adequate ventilation in the working areas and also protective measures like usage of masks can be attempted to reduce the inhalation of dust particles. The personal hygiene can be improved by reducing the habit of smoking which otherwise will add fuel to the fire.

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## PROFORMA

Name of the employee; Age; Sex; M/F.  
 Address; Educational qualification;  
 Type of work; Income;  
 Medical history  
 Treatment History for Past treatment history  
 Diabetes Mellitus  
 Hypertension  
 Tuberculosis  
 Ischaemic Heart Disease  
 Bronchial Asthma  
 Acid Peptic Disorder  
 Epilepsy  
 Skin Disorder  
 Any other condition  
 Personal Habits  
 A. Smoking; Cigarette, Beedi  
  
 Duration; Number  
 B. Alcoholism; Daily / occasional.  
  
 Family History;  
 Married/ Unmarried/ Remarried/ Widower or Divorce  
 Type of Family; 1.Joint family Children;  
 2. Nuclear family Male/ Female.  
 General Examination  
 A. Anaemia F.Height in cms.  
 B. Cyanosis G. Weightin kgs.  
 C. Clubbing H. Pulse rate / mt  
 D.Lymphadenopathy I. Blood pressure mm.Hg.  
 E. Any chest deformity J. Respiratory rate / mt.  
 Cardio Vascular System  
 Respiratory System  
 Chest measurement in cms; Inspiration  
 Expiration  
 Investigations done;  
 Blood- Total Count--- cells / cu mm ofblood.  
 Differential Count  
 Hb in gms / dl  
 ESR mm at the end of one hour.  
 PEFR in litres / minute.

