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Physiology

EXERCISE LABILITY INDEX – A RELIABLE INDICATOR OF RESPIRATORY STATUS IN ASYMPTOMATIC INDIVIDUALS

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ABSTRACT Quality air is a basic need for our healthy well being. But with modernization, the environmental pollutants are increasing to an alarming level day by day. Bronchial lability is an inherited characteristic of the airways which demonstrates in response to various factors, such as allergy, exercise, drugs etc. The response of the airways to exercise is biphasic: initial bronchodilation then bronchoconstriction.

The objective of the study was to find the Exercise Lability Index (ELI) in healthy individuals.

A cross sectional study was done among 210 healthy adults (aged 18-35yrs).

The Harvard Step test was conducted to induce exercise. Lung function test was performed with computerized spirometer (Medspiror). ELI was calculated using formula –

ELI (PEFR) = Highest PEFR - Lowest PEFR X 100
Initial PEFR value

ELI > 22 is being considered abnormal.

Out of total 210 subjects, 32 subjects (15.24 %) had high ELI-PEFR values.

The study depicted that high ELI was prevalent in the study population, though there was no history of any symptoms, which indicates some degree of pulmonary ventilatory impairment.

KEYWORDS : Bronchial lability, Exercise Lability Index, Peak Expiratory Flow Rate

INTRODUCTION:

Quality air is a basic need for our healthy well being. Rapid urbanization has parallelly affected the health status of human being to various extent. With changing lifestyle and modernization, the environmental pollutants and allergens have also increased tremendously. Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Both outdoor and indoor air pollution causes respiratory and other diseases, which can be fatal.[1] A variety of lung diseases such as – Asthma, COPD, Rhinitis, etc. are prevalant worldwide as a result of pollution. According to 2012 data, about 4.3 million people per year die prematurely from illness attributable to the household air pollution and 3.7 million premature deaths are caused by outdoor air pollution mainly due to particulate matters.[2] According to WHO, 4-8% deaths yearly occur due to air pollution. European Community Respiratory Health Survey(ECRHS) and International Study of Asthma and Allergies in childhood (ISAAC) have assessed that asthma has about 300 million prevalance worldwide accounting for 2,50,000 deaths yearly. In India, it is about 57,000 deaths yearly (WHO, 2004). Rhinitis (allergic or non-allergic) is often associated with about 70% asthmatics. It has been estimated that by the year 2025, 100 million more asthmatics will be added to the present burden of asthma, which is presently at 22nd rank worldwide according to DALYs (Disability Adjusted Life Years). . COPD, ranked 10th in DALYs, has a prevalance of about 210 million globally and 12 million in India of which 6–7 % are non- smokers.[3]

MATERIALS AND METHODS:

This cross sectional study was carried out in a duration of 1 year in 210 healthy individuals aged 18 – 35 years in Assam Medical College campus.

EXCLUSION CRITERIAS:

- Subjects having respiratory illness or allergy such as- bronchial asthma, bronchitis, tuberculosis etc.
- Pregnant women.
- Subjects having drugs for any systemic illness.
- Subjects having any neuromuscular disease or joint problem.
- Smokers
- Tobacco chewers.
- Subjects who have undergone any major surgery.
- Subjects with history of syncope associated with forced exhalation.
- Alcoholics.
- Diabetics.

PARAMETERS RECORDED DURING THE STUDY WERE:

1. Age (years).
2. Sex.
3. Weight (Kilograms).
4. Height (Centimetres).
5. Respiratory parameters (by medspiror)-

i) Forced vital capacity (FVC).
ii) Forced expiratory volume at 1st second (FEV1).
iii) FEV1 / FVC ratio.
iv) FEV 25-75%.
v) Peak expiratory flow rate (PEFR).

EXERCISE LABILITY INDEX:

Exercise lability index can be calculated as – the difference between highest value during exercise and lowest value after exercise of lung parameter (PEFR) as a per cent of the initial value before test exercise.[4,5,6,7]

ELI (PEFR) = Highest PEF during exercise - Lowest PEF after exercise X100
Initial PEF value

HARVARD STEP TEST:

The Harvard Step test is a test of aerobic fitness and the features of this test is that it is simple to conduct and requires minimal equipment. A wooden step of 20 inches / 50.8 cm height and a stopwatch was used.[8]

A written and informed consent was taken from all the subjects after proper explaination of the entire procedure of performing the test. A detailed clinical examination of the respiratory, cardiovascular, gastrointestinal and central nervous system was done. The test was performed between 9:00 am to 12:00 am to avoid any diurnal variation in the lung functions. Each subject was given a proper demonstration of both the spirometric and step test manoeuvre to be performed. The manoeuvre of spirometric recording was done in sitting position with head slightly elevated. The procedure was repeated for 3 readings each time and the best of the 3 readings was taken for analysis. For step test,

subjects were asked to step-up and step-down of the wooden step continuously at the rate of 30 steps/min for a total duration of 5 mins. Spirometric recordings were taken before, during (at 3rd min) and after exercise (at 0^{th}, 5^{th}, 10^{th}, & 15^{th} min).

Statistical Analysis:
Data was organised in Microsoft Excel 2007 and analysed by applying proper statistical tests in Statistical Package of Social Sciences (SPSS package version-16) and Graph pad prism 5 software .

RESULTS AND OBSERVATION:

TABLE 1: Physical parameters of study population:

	AGE (years)	WEIGHT (kg)	HEIGHT (cm)
MEAN	26.65	60.59	163.02
SD	4.36	11.18	11.02

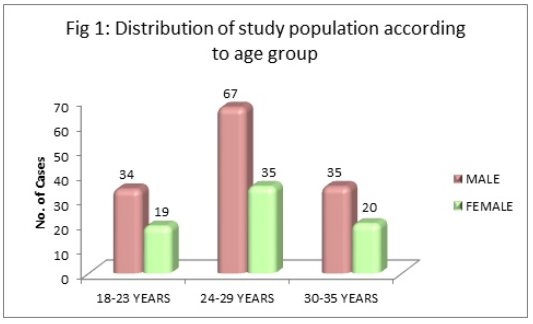

TABLE 2: Mean value of ELI-PEF with SD:

ELI-PEF	MEAN (%)	SD (±)
	13.02	8.39

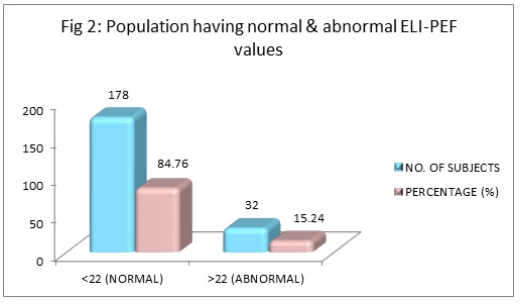

TABLE 3: Distribution of ELI-PEF values in the study population according to age group:

AGE GROUP	TOTAL	ELI < 22	ELI > 22			p-VALUE
		NO.	%	NO.	%	
18-23 YEARS	53	38	71.70	15	28.30	0.009
24-29 YEARS	102	91	89.22	11	10.78	
30-35 YEARS	55	49	89.09	6	10.91	
TOTAL	210	178	84.76	32	15.24	

DISCUSSION:

The present study was conducted to assess the respiratory status in the normal healthy individuals, who are daily exposed to some level of polluted air, by undergoing a short duration of exercise test.

Table 1 shows the mean (±SD) age of the study population was 26.65±4.36 years, weight was 60.59±11.18 kg and height was 163.02±11.02 cm.

Fig 1 shows the distribution of the study population according to different age groups. Maximum number of subjects were found to be in the age group 24-29 years (48.6%) followed by the age group 30-35 years (26.2%) and age group 18-23 years (25.2%).

In age group 18-23 years 34 were males and 19 were females. In age group 24-29 years 67 were males and 35 were females. In age group 30-35 years 35 were males and 20 were females.

Table 2 shows that the mean (±SD) ELI-PEF value was found to be 13.02±8.39.

Fig 2 shows the distribution of the study population according to the normal (ELI< 22) and abnormal (ELI > 22) values of ELI-PEF. It was found that 15.24 % (32) had abnormally high ELI-PEF values while the remaining 84.76 % (178) had normal ELI-PEF values.

Table 3 shows the distribution of ELI-PEF values in the entire study population according to different age groups. It was found that in age group 18-23 years, out of total 53 subjects, 71.70% (38) had ELI-PEF <22 and 28.30% (15) had ELI-PEF >22. In age group 24-29 years, out of 102 subjects, 89.22% (91) had ELI-PEF <22 and 10.78% (11) had ELI-PEF >22. And in age group 30-35 years, out of total 55 subjects, 89.09% (49) had ELI-PEF <22 and 10.91% (6) had ELI-PEF >22. The association between age groups and ELI-PEF values was found to be statistically significant (p=0.009).

Bronchial lability is the sum of airway constriction and dilation. Thus an increase in exercise induced bronchial lability can be produced by an increase in bronchodilation during exercise, increase in bronchoconstriction after exercise or a combination of both. The bronchodilation could be due to factors such as - decrease in vagal tone, increased beta-adrenergic stimulation occurring during exercise. Inhibitory mediators such as some prostaglandin (PGE2) may also play a role in causing the bronchodilation by inhibiting histamine-induced muscle contraction. The bronchoconstriction is caused by mediator release resulting from airway cooling or osmolality changes. The dry, cold air inspired during exercise stimulate thermally active receptors with resultant bronchoconst riction. It is also caused by mediators like prostaglandins (PGI2) and leukotrienes released from locally resident cells (such as mast cells) or cells brought to the airways by the circulation (such as basophils, eosinophils and neutrophils).

Similar study was conducted by Peter Konig and Simon Godfrey among the first degree relatives of asthmatic children and found that the exercise-induced bronchial lability was high in 32% of the apparently healthy relatives of the asthmatic children. From this study the authors interpreted as giving support to the hypothesis that bronchial lability is an inherited characteristic which must combine with a triggering mechanism to result in clinical asthma. Kalyani Premkumar and S.Walter conducted a comparative study between 29 males and 39 females where all subjects were nonsmokers, with no personal history of allergy. In their study they found that although the subjects were normal, ELI-PEFR was abnormal. Dr. Sheetal Diliprao Bhavsar et al also conducted a similar study in healthy 30 males and 30 females and found that ELI-PEF was abnormal in the subjects, 9.44±1.45 in males & 9.97±2.58 in females. Their study showed that the respiratory response patterns of men and women during exercise and after it were significantly different.

CONCLUSION:

The present study depicted that exercise-lability index, which is a measure of bronchial hyper-responsiveness of the airways to different stimuli in the environment including exercise, was prevalent in the study population even though there was no history of any symptoms related to it. There was biphasic response of the airways in response to exercise showing initial bronchodilation followed by bronchocon striction. Thus it was concluded from the present study that prevalence of high exercise-induced bronchial lability in the community indicates the presence of some degree of pulmonary ventilatory impairment

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