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COMPARISON OF PROBABLE RISK FACTORS AND LUNG FUNCTIONS AMONG UNDERGRADUATE MEDICAL STUDENTS IN NORTHERN MAHARASHTRA- A CROSS-SECTIONAL STUDY

Dr Alok Kumar Yadav[1*], Dr Shankar Yadav[2]

[1*]Associate Professor, Department of Physiology, Dr. Ulhas Patil Medical College and Hospital, Jalgaon, Maharashtra
[2]Assistant Professor, Department of Physiology, Bhagyoday Medical College, Kadi, Gujarat

***Corresponding Author:** Dr Alok Kumar Yadav
*E-mail: alokpgi@gmail.com

ABSTRACT:

Background: Lungs, by virtue of their direct contact with atmospheric air, are naturally the first to bear the onslaught of air contamination. Many risk factors are associated with pulmonary dysfunction. It is necessary to rule out such risk factors as allergy, smoking, childhood-onset respiratory infection, familial history of respiratory diseases, and childhood dyspnea. Although many studies were conducted in the past, most of the risk factors were not considered and compared with lung function among young adults.

Objective: To study and compare the lung function tests of young adult healthy college students with a history of exposure to risk factors and a control group.

Methodology: A Total sample of 330 subjects were recruited for the study, and the participants were explained in detail about the procedure, and written informed consent was obtained. Information about demographic data, socio-economic condition, lifestyle factors and probable risk factors for lung dysfunction was collected using a proforma. Using a computerised spirometer, various pulmonary function tests like Forced expiratory volume in one second (FEV_1), Forced vital capacity (FVC), FEV1/FVC in percentage, Peak expiratory flow rate (PEFR), Mean forced expiratory flow ($FEF_{25–75}$), and Tidal volume (TV) were measured. The lung functions of a control group and subjects with probable risk factors were compared and analysed by using appropriate statistical methods.

Results: Systolic blood pressure and heart rate values were higher among the smokers, which was statistically significant. Lung function tests (FEV1, FVC and PEFR) were significantly decreased (P value<0.05) in individuals with a history of childhood dyspnea as compared to controls. FEF_{25-75} was decreased significantly (P value<0.05) among smokers and individuals with a history of allergy. FEV1 and FVC were significantly reduced in the case of the underweight and overweight groups.

Conclusion: Smoking tends to increase blood pressure and heart rate along with a decrease in lung function, especially FEF_{25-75} parameter. Other common risk factors which are associated with reduced lung function are a history of childhood dyspnea and a history of allergy, mainly affecting FVC, FEV1, PEFR and $FEF_{25-75,}$ respectively. Lung functions are reduced in the underweight group.

Keywords: Lung function, PFT, Risk factors, BMI, Young adults.

INTRODUCTION

Lungs, by virtue of their direct contact with the atmospheric air, are naturally the first to bear the onslaught of air contamination.[1] Environmental, occupational and industrial hazards, which are some of the risk factors, generally affect the lung function. In the Indian scenario, occupationally related lung diseases are common due to deposition of dust, type of dust, period of exposure, concentration and size of the airborne particle in the breathing zone.[2] Other risk factors include smoking, low birth weight, childhood respiratory infection and history of allergy for pulmonary dysfunction.[3] According to the World Health Organisation, around 12% of the world's smokers are in India. Millions of people die every year from diseases secondary to smoking.[4] Hence, there is a need to assess lung function among the young adult population who are exposed to various risk factors.

Pulmonary function test is a generic term used to indicate a battery of studies or manoeuvres that are performed using standardised equipment. These tests evaluate one or more aspects of the respiratory system, like respiratory mechanics, lung parenchymal function/ gas exchange, cardiopulmonary interaction, etc. These tests are important for clinical, diagnostic & prognostic values as well as for research work purposes. Until today, plenty of work has been done to assess the pulmonary function in healthy as well as in diseased individuals, yet there remains scope to include many other risk factors.[5]

A spirometer is used in pre-recruitment to evaluate pulmonary fitness, which helps in distinguishing obstructive and restrictive lung diseases. It is also used to judge pulmonary efficiency in physical fitness testing. While recording pulmonary functions, the following factors, such as age, gender, ethnicity, body mass index, and body surface area, are taken into consideration.

Although there are many studies conducted in the past considering the probable risk factors that affect the lung function, there appears scarcity of studies among the young adult population. Hence, the present study was undertaken to know the relationship between possible risk factors to which the individuals are exposed and their influence on the lung functions in their adolescent age. As the students studying in health science courses are the future doctors and health care providers of society, it is important to study the health status of these students, which in turn will improve the quality of life and also create awareness of the risk factors that affect lung function.

Materials and Methods

The present study was conducted in the Department of Physiology, Dr Ulhas Patil Medical College and Hospital, Jalgaon, Maharashtra

Source of data:

First-year health science students of Dr Ulhas Patil Medical College and Hospital, Jalgaon, Maharashtra

Method of collection of data:

- **Study design**: Cross-sectional study
- **Study period**: One year, January 2024 to December 2024
- **Sample size**:

The prevalence of impaired lung function among individuals with a history of associated risk factors in previous literature is 8.2%.

The sample size of 330 was calculated as -

$n=4pq/d^2$

p= prevalence of 8.2%

q=100-p

d=error (3% of p)

$n=4 X 8X 92/3^2$

n= 330

Inclusion criteria:
First-year Health Science students of the age group 18-25 years who are mentally and physically fit were recruited for the study.

Exclusion criteria:
Severe cardiovascular and pulmonary dysfunction.
History of previous surgery**.**
History of medication for chronic disease.
Neurological disorder.

Instruments for data collection:
- Computerised Spirolyzer. (RMS HELIOS 401 Chandigarh, ISO 9001:2000).
- Digital Blood Pressure monitor. (Omron digital BP monitor model 11 EM-403, Japan.).
- Weighing machine
- Height measuring stadiometer.

Method: -
The present study was initiated after obtaining ethical clearance from the institutional Human Ethics Committee. A total of 330 healthy young participants were randomly selected from first-year health science courses. The study population belonged to the age group of 18-25 years and with a similar socio-economic background. After obtaining the consent from participants, the study procedure was explained in detail. All the recruited subjects were given a proforma to complete, which consisted of age, personal data, demographic data, and health status. Students who had a history know pulmonary disease and were taking treatment for the same were excluded from the study.
Before recording of pulmonary function, the anthropometric data like height, weight, age and BMI were recorded. All vital parameters (Heart Rate, Systolic Blood Pressure and Diastolic Blood Pressure) were recorded. The pulmonary function tests were recorded using the computerised spirometer after demonstrating the procedure to the participants. The nose clip was applied at the nose, and the participants were asked to repeat the demonstrated procedure after applying the nose clip so that the participant inspires and expires through mouth mouthpiece of the transducer. The best of the three readings was considered for the study purposes. The recorded parameters were FEV_1, FVC, FEV1/FVC, FEF_{25-75}, PEFR, and TV.

Statistical Analysis:
The Welch test was used to compare groups with probable risk factors and lung function. Dunnett's test was used to compare lung function in different BMI groups. The data was analysed by using descriptive statistics. Statistical results were considered significant at $p<0.05$.

RESULTS
The present study was conducted to determine the relationship between various risk factors and lung functions among young adult college students of health science courses.

Table 1: Cardiovascular parameters in different groups

Groups	Total participants	Age (years)	SBP (mm Hg)	DBP (mm Hg)	HR (beats/min)
Control	93	19.65±1.30	110.24±15.18	73.69±10.59	77.19±7.48
Smoking	56	21.41±2.00	119.28±12.97	77.75±9.37	85.62±13.58
Allergy	54	20.66±2.29	111.63±19.60	76.75±7.5	83.15±9.37
Childhood Resp. Infection	81	20.66±2.10	112.03±17.53	76.38±8.63	82.66±10.21
Childhood dyspnea	10	19.90±1.83	114.40±15.66	76.4±12.54	83.20±10.04
Family history of Respiratory Infection	36	19.80±1.93	112.55±15.52	75.5±10.51	82.66±14.02
P value		<.001	0.041	0.172	<0.001

Students were classified into different groups based on the history of exposure to various risk factors. Groups consisting of a negligible number of students exposed to some risk factors (preterm, low birth weight) were omitted. Table 1 shows the cardiovascular parameters in the six different groups, including their mean age, systolic blood pressure, diastolic blood pressure, and heart rate. The history of smoking was found to be higher in elder students, and all cardiovascular parameters were higher among the smokers, showing statistically significant differences with systolic blood pressure and heart rate.

Table 2 Pulmonary function tests in different groups.

GROUPS	FVC (L)	FEV1 (L)	FEV1/FVC (Percentage)	FEF_{25-75} (L/Sec)	PEFR (L/Sec)	TV (L)
Control	4.4±0.41	4±0.16	86.9±5.03	4.3±0.29	7.8±0.69	0.54±0.03
Smoking	3.5±0.57	3±0.46	86.1±4.73	3.9±0.56	7.1±0.85	0.52±0.02
Allergy	3.3±0.55	2.8±0.47	85.4±5.88	4±0.20	7±0.79	0.52±0.02
Childhood respiratory infection	3.4±0.57	2.9±0.48	86.5±5.10	4.1±0.68	6.8±0.94	0.52±0.03
Childhood dyspnea	2.7±0.67	2.3±0.54	86.8±3.74	4±0.13	6.7±0.65	0.52±0.02
Family history of respiratory infection	3.2±0.53	2.8±0.42	86.9±5.76	4.1±1.03	6.7±0.70	0.52±0.03
P value	<0.001*	<0.001*	0.538	0.003*	<0.001*	0.432

Table 2 shows the pulmonary function tests among the different risk factors. Subjects with a history of childhood dyspnea showed a statistically significant decrease in FEV_1 and FVC (P value 0.001). FEF_{25-75} was found to be significantly decreased among the smokers (p value=0.003) and the allergy group (P value =0.018) as compared with the normal individuals. PEFR was found to be significantly (p value<0.001) decreased in individuals with childhood dyspnea as compared to normal individuals. There was no difference in TV and FEV1/FVC ratio between the normal and individuals associated with risk factors.

Table 3: Effect of Body Mass Index on lung function.

BMI	n	FEV1 (L)	FVC (L)	FEV1/FVC (Percentage)	FEF_{25-75} (L/s)	PEFR (L/s)	TV (L)
NORMAL	272	2.93±0.39	3.34±0.45	86.2±5.07	4±0.53	6.8±0.72	0.54±0.04
UNDER WEIGHT	15	2.6±0.48	3.01±0.58	87.4±7.17	4.4±1.39	6.5±0.47	0.54±0.02
OVER WEGHT	43	2.7±0.62	3.11±0.45	87.4±5.04	3.9±0.52	6.4±1.26	0.53±0.05
P value		0.047*	0.028*	0.285	0.365	0.065	0.056

Table 3 shows the comparison of lung function tests in different BMI groups. FEV1 and FVC were reduced in overweight and underweight groups; however, this was statistically significant among the underweight groups.

DISCUSSION

The present study showed that cardiovascular parameters (blood pressure and heart rate) were high among smokers. Many studies have explained the immediate noxious effects of smoking, which causes overactivity of the sympathetic nervous system, increases myocardial oxygen consumption through a rise in blood pressure, along with heart rate and myocardial contractility due to stimulation of β_1 receptors. Nicotine present in cigarette smoke increases short-term blood pressure, heart rate by increasing cardiac output and peripheral vascular resistance immediately before any increase in circulating catecholamines, causing narrowing of arteries, stiffness of the arterial wall and making the blood clot. With each Cigarette smoking, blood pressure rises transiently with elevation of 20 mmHg, which further induces arterial stiffness, which persists even after cessation of smoking.[6-8]

In the present study, it was observed that there was a decrease in pulmonary functions among the individuals with a history of risk factors such as smoking, childhood dyspnea, and allergy, especially regarding FVC, FEV_1, FEF_{25-75} and PEFR.

There was a significant decrease in FEF_{25-75} among the smokers. A vast data is supporting the possible reasons for reduction in FEF_{25-75} primary being bronchospasm, airway irritability or tightening of airways which makes the airways even smaller leading to difficulty in the breathing process.[9-11] Previous studies had linked smoking with airflow limitation which occurs due to release of inflammatory mediators causing bronchoconstriction either by increasing the smooth muscle tone or by causing fibrosis. All these changes promote the thickness of the wall, leading to narrowing of the airway and airflow limitation, destruction of the alveolar wall, which further contributes to narrowing of the airway lumen.[12]

In the present study, it was observed that there was a reduction in FVC, FEV_1, and PEFR in subjects with a history of childhood dyspnea. The previous study has also described that the decrease in lung functions among childhood dyspnea could be due to occlusion of the airway lumen by liquid, fibrin and mucus, leading to loss of communicating spaces. Fibrin acts as a potent inactivator of surfactant, which results in increased formation of liquid bridges across the airway lumen. A fall in FEV_1 is due to a fall in FVC and a secondary rise in FRC and RV, which leads to trapping of air. Airway hyper-responsiveness in childhood dyspnea reflects the closure of small airways rather than the narrowing of larger airways, which makes it difficult to open closed airways.[13]

The present study showed that FEF_{25-75} was reduced in the allergy group. The history of allergy includes indoor allergy, outdoor allergy, allergy to pollen grains, and allergy to weather changes. Studies in the past have shown health effects of air pollution where the ground level of ozone can irritate the respiratory system, aggravate and damage lung tissue and cause a reduction in lung function.[14] Air pollution may be due to agricultural, commercial, industrial, transportation and residential leading to penetration of particulate matter into the tracheo-bronchial tract deep into the

airways and inducing alveolar inflammation, sputum production and narrowing of the breathing passage.[15] Interaction with pollen grains also increases the release of allergens and causes an inflammatory reaction within the airways, where the pollen allergens penetrate the mucosa and interact with the immune system. Evidences prove that air pollution induces airway hyper-responsiveness to pollen allergens [16]

The present study showed a reduction in FEV_1 and FVC in underweight and overweight as compared to normal weight individuals. Reduced FEV_1 and FVC in underweight individuals may be attributed to diminished diaphragm contractility leading to shortening of the muscle mass which in turn lowers the dynamics of lung function[17]and the other possible reason could be related to low lung function at birth due to low birth weight and this decreased lung function may even continue in older life due to environmental or genetic factors. Reduced FEV_1 and FVC in overweight individuals is possibly due to mechanical limitations of expansion of the chest, as the accumulation of fat prevents movement of the chest wall and descent of the diaphragm, which may reflect intrinsic changes within the lungs, causing narrowing of the airways. The airway calibre in overweight is reduced because of structural and functional changes of airway wall, airway smooth muscle, lung parenchyma and upper airways by proinflammatory adipocytokines. Chronic reduction in end-expiratory lung volumes might cause micro-atelectasis, which further decreases lung function.[18]

CONCLUSION

According to the result and the discussion presented in this study, the following conclusion can be drawn-Smoking tends to increase blood pressure and heart rate along with a decrease in lung function, especially FEF_{25-75} parameter. Other common risk factors which are associated with reduced lung function are a history of childhood dyspnea and a history of allergy, mainly affecting FVC, FEV_1, PEFR and $FEF_{25-75,}$ respectively.

Lung functions get affected in different BMI groups. FVC and FEV_1 are particularly reduced in the underweight category. All the above-mentioned parameters are altered as compared to the control group, although the values remain within normal limits.

This knowledge of association between probable risk factors and altered lung functions will create awareness to take preventive measures in future life. This improves the life quality of young adults. A larger sample size with all probable risk factors could have been considered.

CONFLICT OF INTEREST

There are no conflicts of interest.

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