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Review Of Research

PULMONARY (LUNG) FUNCTIONING TEST OF EMPLOYEES IN EDUCATIONAL INSTITUTE OF JALGAON CITY, MAHARASHTRA

Kiran Pawar
Department of Environmental Sciences, Moolji Jaitha Collegt, Jalgaon, Maharashtra.

Sarika Karda
Department of Environmental Sciences,Moolji Jaitha Collegt, Jalgaon, Maharashtra.

Abstract:-

The air we breathe has not only life supporting properties but also potential life damaging properties. Vehicular pollution is most important and one of the major source for the ambient air pollution in urban areas. The present investigation is based on measurement of Lung functioning of some employees of an educational institute who are exposed to heavy traffic areas. The selection of employees was done according to age group, vehicles they use and the heavy traffic signal points they are passing. The software based spirometer shows remarkable variations in Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1) and Peak was used for pulmonaryfunctioning test (PFT) of selected employee'sExpiratory Flow Rate (PEFR). The ambient air quality was also assess and monitored during the period of Oct –Dec 2013 at main gate of educational institute and near areas for finding the air pollutants concentrations in such areas. From this it was observed that the concentration of suspended particulate matter (SPM) and respirable suspended particulate matter (RSPM) was exceeding the permissible limits given by CPCB. While the concentration of NOx and SOx found within limits given by CPCB. To develop exact relationship between these air pollutants and PFT test further study will be required which will be going on.

Harshika Kaul
Department of Environmental Sciences, Moolji Jaitha Collegt, Jalgaon, Maharashtra.

Gauri Rane
Department of Botany, Moolji Jaitha College, Jalgaon, Maharashtra.

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Air, vehicular, Lung functioning, Spirometer, air pollutants.

INTRODUCTION

Normal air contains about 78% nitrogen, 21% oxygen, 0.93%, argon 0.038% carbon dioxide, and several other trace gases. Changes in the gaseous composition of earth's atmosphere have become a prime concern for today's world due to human activities.

Although a number of physical activities (volcanoes, fire, etc.) may release different pollutants in the environment, anthropogenic activities are the major cause of environmental air pollution. Hazardous chemicals can escape to the environment by accident, but a number of air pollutants are released from industrial facilities and other activities and may cause adverse effects on human health and the environment. Increased urbanization and industrialization in recent years in many developing countries have led to corresponding increases in atmospheric concentrations of primary and secondary pollutants (WHO/UNEP, 1992; Slanina et al., 1995; Mage et al., 1996). India and other developing countries have experienced a progressive degradation in air quality due to industrialization, urbanization, lack of awareness, number of motor vehicles, use of fuels with poor environmental performance, badly maintained poor roads and ineffective environmental regulation (Joshi and Chauhan, 2008).

Timely monitoring of ambient air is taken up by WHO under the GEMS since decades. Of the many sources of air pollution in Indian cities, transport sector has been identified as the major contributor (Sharma and Chowdhury, 1996) Vehicular air pollution in India is due to a combination of poor vehicular maintenance, bad vehicle technology, poor fuel quality and non-existent traffic planning. The major pollutants emitted by vehicles include CO, HC, SO_2, NO_x and SPM. Vehicular emissions being released at the ground level are not easily diluted unlike industrial emissions. In addition, high rise buildings close to the roads in metropolitan cities hinder the dispersion of pollutants naturally.

REVIEW OF LITERATURE

Sengupta et al. (1974) has reported the age-induced asthma in the Indian population. Jain & Saxena (2002) conclude that the paved portion of roads having bad patches and slowing down of vehicles due to heavy traffic contributes to emission of higher air pollutants in urban centers. The prevalence of obstructive, restrictive and mixed type of functional impairment of the lung was found to have direct relationship with the dust concentration and duration of exposure (Chattrjee 1989).

Ambient air pollution in several large cities of India is amongst the highest in the world. Apart from local effects, air pollutants can travel long distances and cause impacts far from its source (Agrawal, 2005). Indian cities are facing serious problem of airborne particulate matter (Agarwal et al., 1999). In both children and adults, upper respiratory illness is mainly caused by viral agents especially the rhinoviruses, coronaviruses, influenza and parainfluenza virus, adenovirus and respiratory syncytial virus. Viral infection often leads to bacterial infection such as pneumonia in the developing countries (Graham, 1990).

According to an estimate, dust pollutants comprise around 40% of total air pollution problem in India (Khan et al., 2005). Vehicular pollution contributes to 70% of total air pollution in Delhi, 52% in Mumbai and 30% in Calcutta (C.P.C.B., 2003; Ghokale and Patil, 2004).

OBJECTIVES OF THE STUDY

1.To determine the ambient air quality status at main entrance and nearby area of educational Institute of Jalgaon city.
2.Assessment of the respiratory health status of employees of educational Institute chronically exposed to ambient air pollution of Jalgaon city.

STUDY AREA

Jalgaon is one of the major city in Vehicular movement. As the Jalgaon is district place, Large MIDC area, reputed educational institutes, government offices, Agriculture/Grain/vegetable markets, big shopping complexes are situated in different parts of the city. As per provisional reports of Census India, population of Jalgaon city is 4, 60,468 in 2011 so use of different type's vehicles are more. Due to the good standard of living of the peoples, approximately each house of the city having one vehicle.

The present study was conducted in one of the reputed educational institute of Jalgaon city. The institute is situated middle part of the city near to National Highway No. 6. Two-three nationalize banks, hospitals, commercial shops; coaching classes and restaurants are situated near this study area. With this reasons the vehicular traffic is high at all times in this area including all types of vehicles. Approximately 3000 students are studied and near about 300 staff member are working in this institute. Among all of them 50% people came to institute by two-wheelers and four wheelers. As all the peoples living in different parts of the city, they cross minimum 2-3 heavy traffic signals points being directly exposed to ambient air pollution.

MATERIAL AND METHODS

The study was designed to assess the status of ambient air quality in and surrounding area of study area and examine pulmonary function test of employees who directly exposed to ambient air pollution.
The study was conducted in to two parts

I.Assessment and Monitoring of ambient air quality near study area
II.Pulmonary function test (PFT) procedure

I.Assessment and Monitoring of ambient air quality near study area

Assessment and monitoring of ambient air quality was carried out for the period of three months i.e. October-December 2013 to study the ambient air pollution status at vehicle parking area of institute with reference to different parameters such as SPM, RSPM, SO_2 and NO_2.

The status of air pollution was monitored by using High Volume Sampler (Envirotech APM 460 BL Respirable Dust Sampler-RDS). SPM and RSPM samples were collected with the help of high volume sampler on cup and glass fiber filter paper respectively for 24 hr. with air flow rate of 1- 1.5 m^3 min-1.

The difference in initial and final weights of the cup and filter paper will give the total quantity of SPM and RSPM collected over the 24 hr period.

Measurement of SO_2 (µg m^{-3}) in the ambient air was analyzed by the West- Gaeke method (1956) and NO_2 (µg m^{-3}) gas by the modified method of Jacob and Hochheisher (1958).

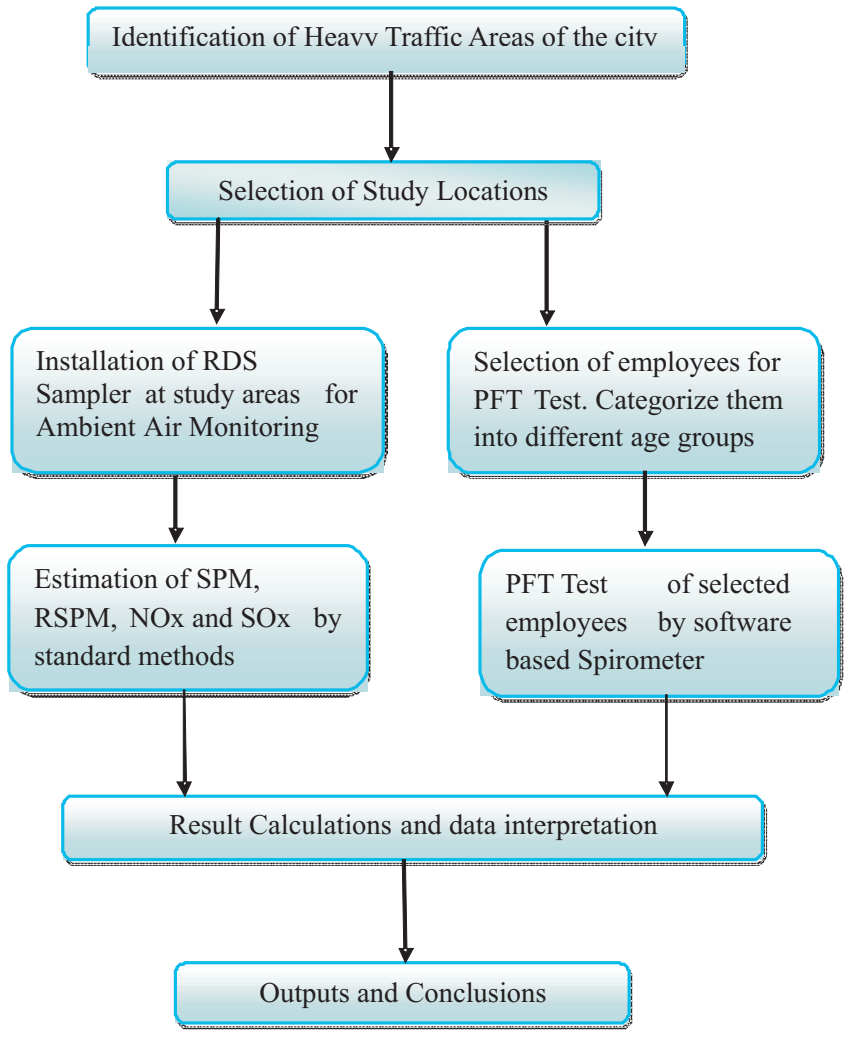

Fig 1 – Flow chart of methodology

II.PULMONARY FUNCTION TEST (PFT)

The present study was conducted on 100 employees. Out of them the observations of 84 employees were considered for the study. The detailed information of these 84 employees is given below in Table No.1. All these 84 employees (55 Males & 29 Females) were divided into four age group i.e. 21-30, 31-40, 41-50, 51-60 and having no smoking habits. All the subjects were choosed according to their mode of transportation and the signals (Chowk) which is they cross while coming to the institute. All pulmonary function tests were done on the subject comfortably seated in an upright position. During the test the subject should adequately encouraged to perform at their optimum level and also a nose clip applied during entire maneuver. The flow volume curve was recorded. Test was carried out three times and best matching result was considered for analysis.

Sr. No.	Age Group (Years)	Subjects		Total Nos.
		Male	Female	
1	21-30	17	4	21
2	31-40	9	12	21
3	41-50	11	10	21
4	51-60	18	3	21
			Total	**84**

Table 1:- Details of subjects involved in PFT Test

All the pulmonary functions (flow rate, lung volume and capacity) were measured by Spirotech portable Spirometer with in-built computer programme under standard condition. Before the test name, age, gender, height, weight and smoking habits of the subjects were entered in the soft ware of spirometer. According to this entered information spirometer gives two values one is predicted according to age, weight and height and other is result values. The Software using a set of predicted equations for the adults calculates the expected values. The detailed report was generated having all predicted and actual values, Flow Volume Graph & Volume-Time Graph which represents total 18 parameters out of which we consider 3 parameter for further reference.

RESULT AND DISCUSSION

1.Ambient Air Monitoring Data

The observed data of ambient air quality near main gate of the institute and at Mahabal area is tabulated in table no 2 and 3. The data of Mahabal area was taken in to account for the study because most of the employees came from this area. Also three signal points of heavy traffic are nearer to this area. The obtained data was compared with "residential zone standards" of CPCB.

Parameters	Months (Year-2013)			Limits (As per CPCB Standard) For 24 hrs.
	October	November	December	
SPM ($\mu g/m^3$)	910.25	887.10	1071.87	100
RSPM ($\mu g/m^3$)	334.56	302.16	291.20	100
NO_x ($\mu g/m^3$)	24.67	20.18	22.10	80
SO_x ($\mu g/m^3$)	21.77	19.38	20.35	80

Table 2:- Ambient air pollution status at main entrance of Educational institute.

Parameters	Months (Year-2013)			Limits (As per CPCB Standard) For 24 hrs.
	October	November	December	
SPM ($\mu g/m^3$)	187.78	195.00	201.88	100
RSPM ($\mu g/m^3$)	108.44	113.00	108.25	100
NO_x ($\mu g/m^3$)	33.56	43.00	37.25	80
SO_x ($\mu g/m^3$)	15.56	23.00	16.88	80

Table 3:- Ambient air pollution status at Mahabal Area near to educational Area (source: online monitoring data from MPCB, Jalgaon)

With above data it was observed that the oxides of nitrogen and sulfur were within limits in all months of study period at both locations.

The concentration of suspended particulate matter and respirable suspended particulate matter were high at both the locations. During the month of October (2013) the concentrations of SPM and RSPM near main gate of institute were 910.25 ($\mu g/m^3$) and 334.56 ($\mu g/m^3$) respectively. Also at Mahabal Area it exceeded the limits. The higher concentration of SPM and RSPM was observed in December (2013) near main gate of institute i.e. 1071.87 ($\mu g/m^3$) and 291.20 ($\mu g/m^3$) respectively.

2.Pulmonary function test (PFT) Data

Sr. No.	Parameter	Age Group							
		21-30 (A)		31-40 (B)		41-50 (C)		51-60 (D)	
		Expected	Observed	Expected	Observed	Expected	Observed	Expected	Observed
1	FVC	3.42±0.69	2.77±0.67	2.79±0.62	2.28±0.57	2.81±0.46	2.07±0.50	3.02±0.41	2.37±0.55
2	FEV1	2.89±0.62	2.45±0.57	2.28±0.56	2.11±0.55	2.23±0.40	1.87±0.47	2.35±0.33	2.16±0.45
3	PEFR	8.72±1.47	4.44±1.59	7.30±1.47	4.96±1.59	7.25±1.26	8.73±19.72	7.85±1.02	5.22±1.95

Table 4:- The age groups and observed values of PFT parameters in statistical manner.

The test was performed for comparison of expected and observed values against their individual pulmonary function test in different age groups.

Forced Vital Capacity is the maximal amount of air that can be exhaled following a maximal aspiratory effort. It was observed that FVC in age group (A) was (2.77 L) less than the expected (3.42 L) value. FVC in age group (B) was (2.28 L) less than the expected (2.79 L) value. FVC in age group (C) was (2.07 L) less than the expected (2.81 L) value. FVC in age group (D) was (2.37 L) less than the expected (3.02 L) value. Fig. 2 represents the bar graph of FVC test result.

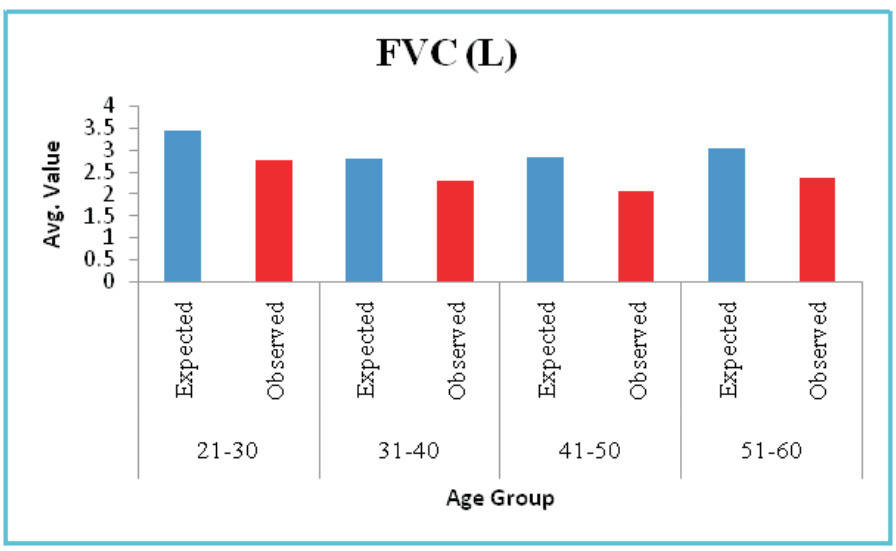

Fig. 2: Avg. Values of Forced Vital Capacity

FEV1 is the volume of air exhaled in a one second during a forced vital capacity effort. The observed FEV1 was very less in age group (C) i.e 1.87 L, while expected value is 2.23 L for the same. The observed FEV1 for remaining age group is also less than expected values. Fig. 3 shows the result of FEV1.

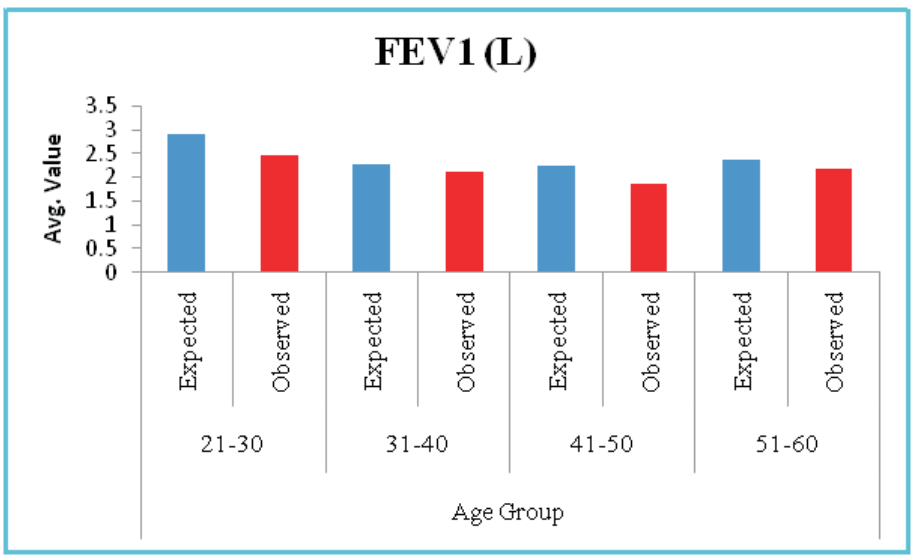

Fig. 3: Avg. Values of FEV1

Peak Expiratory Flow Rate (PEFR) is the best test of expiratory effort. The PEFR was worst affected in Age group (A). PEFR observed was 4.44 L/s, which is less than expected 8.72 L/s. In age group (C) it is observed that the observed value (8.73 L/s) is more than the expected value (7.25 L,s). The observed results for PEFR shown by Fig. 4.

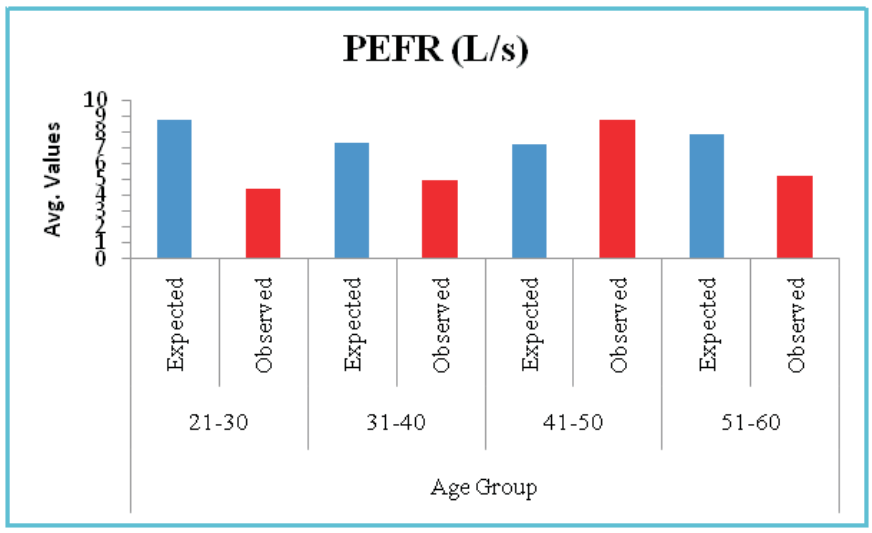

Fig. 4: Avg. Values Peak Expiratory Flow Rate

CONCLUSIONS

With the above results it was conclude that the ambient air quality near main gate of educational institute and Mahabal area was very poor. The level of NOx and SOx were within prescribed limits but the concentration of SPM and RSPM was very high cross the prescribed limits given by CPCB due to high vehicular movement in these areas.

By PFT test it was conclude that the observed values for Forced Vital Capacity (FVC) and FEV1 in all age grouped was lowered as compared to expected values. Peak Expiratory Flow Rate (PEFR) was lower in age group 21-30, 31-40 and 51-60; but in age group 41-50, PEFR was high as compared to expected values. To develop exact relationship between these air pollutants and PFT test further study will be required.

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AUTHORS CONTRIBUTIONS

KPP lead the study. KPP and SPK carried out air monitoring and PFT test. HAK and GMR contributed in selection of employees, PFT test and data interpretations. All the authors contributed equally for the final writing and compilation of the manuscript.

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