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Physiology

"COMPARATIVE ANALYSIS OF PULMONARY FUNCTION TESTS OF MID TRIMESTER PRIMIGRAVIDAE INDUSTRIAL AND NON –INDUSTRIAL AREA OF DURGAPUR, WB"

Dr Abha Gupta	Associate Professor, Department of Physiology, I Q City Medical College, Durgapur.
Dr Pratibha Gupta	Associate Professor, Department of Anatomy, I Q City Medical College, Durgapur.
Dr Sudhanshu Gupta	Senior Resident, Department of Anaesthesia, Sanaka Hospital, Durgapur.

ABSTRACT **Objective:** To compare lung function of mid trimester primigravidae women living in industrial area and non-industrial area of Durgapur. **Material and methods**: 60 mid trimester primigravidae visiting at the hospital fulfilling inclusion criteria were randomly selected for the study and divided in two groups. Group I group included subjects living in non-industrial belt and group II were industrial area subjects. Each subject underwent into pulmonary function test and results obtained were recorded. **Results:** In the present study, it was observed that mid trimester primigravidae pregnant ladies under study who were living in industrial areas had statistically significant in terms of FVC, FEV1, FEF25-75. However FEV1/FVC, PEFR were statistically non –significant.

KEYWORDS : Mid –Trimester, Air pollution, Primigravidae, Pulmonary function test.

OBJECTIVES

This industrial set based non randomized, case control, analytical study shall be carried out to compare the Pulmonary Function test (PFT) parameters like FEV1, FEV, FEF 25-75% and PEFR of mid - trimester pregnant women living in industrial and non- industrial area of Durgapur and to find out extent of any correlation exists between living in industrial area on pulmonary function tests.

INTRODUCTION

Durgapur is one of most industrialised city in the entire eastern India. Durgapur is known worldwide for the wide range of industries that it houses making it one the biggest industrial hub in eastern India. Durgapur has a whole array of manufacturing industries. Among them, Durgapur Steel Plant (DSP) (SAIL) and Alloy Steel Plant (ASP) (SAIL) are the two major ones around which the city and the other industries came up. There are a number of power plants, chemical, sponge iron and engineering industries and many small scale factories. Among them Durgapur Projects Limited (DPL), DTPS, DVC are well known. Durgapur is located on NH 2 hence pollution by heavy vehicle further aggravate the situation. The location as well as excellent communication facilities of Durgapur has attracted investors to bet for their money. Presence of a large number of industries in Durgapur is the single biggest reason for the high level of pollution in this industrial town. Industrial pollution is the pollution which is directly linked with industry, in contrast to other pollution sources. Rapid industrial growth in a city creates several health problems to workers and their dependents. Pollution produced by the factories in form of water, air, chemical and noise are hazardous and contributing to significant co morbidities. Areas in vicinity to industries possess very high concentrations of suspended particulate matter (571 microg/m3), SOx (132 microg/m3) and NOx (97 microg/m3)1. The density of particulate matter and oxides of nitrogen in the ambient air is becoming so high that it will lead to a greater probability of various kinds of respiratory diseases in the inhabitants of the Durgapur industrial area. The threat of cancer also persists because of the presence of various carcinogens like benzene in the air being inhaled.

Pregnancy is associated with significant dynamic physiological and anatomical changes in respiratory system. Pregnancy is associated with physiological changes in the control of breathing, in lung volumes, in the mechanics of respiration and in acid base balance. Due to the increase in oestrogen concentrations in pregnancy; the respiratory system undergoes anatomic changes leading to increased vascularity and oedema of the upper respiratory mucosa. Tongue and epiglottis also increase enlarged. There is capillary engorgement throughout respiratory tract which may be responsible for vocal cord oedema or swelling. The diaphragm is pushed 4–5 cm upward due to the increased intra-abdominal pressure from the enlarging uterus and fluid third spacing. This leads to bibasilar alveolar collapse, basilar atelectasis, and decreased in both functional residual capacity and total lung capacity decrease by 10–20%. In contrast to this, thoracic cage Antero- posterior and transverse diameters increase by 2-3 cm. Due to lower ribs flare out and increase in sub costal angle (from 68 to 103 degrees) Circumference increase by 5-7cm. These changes are due to relaxin which is secreted by corpus luteum. It relaxes ligament attached to the ribs. Large airways are dilated leading to decreased airway resistance by 35%. Changes to lung volume are significant occurs from the 20th week.ERV and RV gradually decrease that are 20% less at term (than non-pregnancy level). Causes of ERV and RV change include Elevation of the diaphragm and Increase in pulmonary blood volume. FRC decreases by 20% at term. In supine, FRC is about 70% of that in erect position. Tidal volume begins to increase in the first trimester which is 40% above non-pregnant level at term. Changes in lung Capacities at term includes

- Inspiratory capacity (IRV) increases 10%
- Expiratory capacity (ERV) decreases 20%
- Total lung capacity decrease by 5%
- Vital capacity unchanged.
- Tidal volume increases by 30-50%.

Lung Compliance remains unchanged. Chest wall compliance decreases and Total lung compliance decreases by 20%. It is because of elevation of the diaphragm due to enlarging gravid uterus. Minute ventilation starts to increase in early weeks. Maximal hyperventilation occurs as early as week 8-10. Minute ventilation increases to 36% by 8th week and 50% above non-pregnant level at term. There is 40% increase in tidal volume and 10% increase in respiratory rate. It is because of stimulation of central chemo receptors of respiratory centre by progesterone.

Pulmonary function tests (PFTs) are useful for diagnosing the cause of unexplained respiratory symptoms and monitoring patients with known respiratory disease. Based upon previous knowledge of pulmonary changes in pregnancy, a study is planned to assess pulmonary function tests of pregnant women living in industrial area and non industrial area of Durgapur to assess the effect of air pollution on mid trimester uncomplicated prim gravid pregnant women.

MATERIAL & METHODS

A total of 60 primigravidae women in mid trimester were enrolled for the case control study between the periods of August 2016 – December 2016. Antenatal women of mid - trimester were studied by using a table of computer generated blocks of random numbers. Women fulfilling inclusion criteria, after proper informed consent being taken in the outdoor clinic was taken for pulmonary function testing at the department of pulmonary medicine at the hospital.

The study shall be conducted in accordance with the current relevant policies, requirements and regulations of Ethical Committee of I Q

City medical College & Narayana Multispecialty Hospital.

In the study, comparison of pulmonary function changes of antenatal women of mid trimester, middle socioeconomic status living in group I (Non -Industrial) & group II (Industrial) area was carried out. Group II comprised of 30 subjects each from industrial belt of Durgapur of radius of 10 kms, and subjects of group I were selected from a rural area - Village Mankar (Burdwan district), approximately 30 km away from group I being non-polluted from industrial pollution visiting to Narayana Multispecialty Hospital.

The study was carried out at department of pulmonary medicine in association with antenatal patients visiting in the antenatal clinic of department of obstetrics & gynaecology of Narayana Multispecialty Hospital, Durgapur. Age group of primi gravid, singleton pregnant ladies was between 20 to 35 years in both the groups. Exclusions of the study were – Multi- gravid , PIH, Ante partum haemorrhage , Anaemia (Hb < 9 gm. %), Polyhydramnios, Traumatic APH, Pregnancies complicated with medical illness – Cardiac disease, Hypertension, renal disease, Liver disease, Diabetes, Bronchial asthma, epilepsy, Tuberculosis, any ribcage deformity, Present or Past history of smoking or COPD and Patients on any drugs like bronchodilators –inhalers or systemic.

All pregnant ladies shall be confirmed of their pregnancy, place of residence and coexisting medical & surgical illness if any. Careful examination of the subject in relation to anthropometric measurements eg. Height (cm), weight (kg) and BMI was recorded. The basic parameters of Pulse, blood pressure, haemoglobin were recorded.

All the subjects were given instructions and demonstration with regard to performance of the pulmonary function test. The ladies would sit comfortably on a chair and shall be asked to breathe through mouthpiece of computerized spirometer instruments, with nose clip. All the procedures would be carried out in respiratory laboratory during morning hours between 8am to 12 noon in quite laboratory set up in order to alleviate the emotional and psychological stress. During the test subject would be adequately encouraged to perform at their optimum level. Test would be repeated at least three times and the best matching results were considered for analysis. All the recordings would be done at the BTPS.

Two curves were plotted, one was the flow volume curve in which the volume in litres was plotted on the X-axis and the flow of air in L/s was plotted on the Y-axis. The second curve was the time–volume curve in which the time in seconds was plotted on the X-axis and the volume in litres was plotted on the Y-axis. The following volumes, capacities, and flow rates were computed in the study and control groups:

1. Forced vital capacity (FVC): This is the volume of air that can be exhaled by a maximum forceful expiration after maximum inspiration. It is expressed in litres.

2. Forced expiratory volume 1 (FEV1): It is a fraction of FVC exhaled at the end of first second. It is expressed in litres.

3. FEV1 /FVC%: This is the ratio of the volume of air expired at the end of the first second of a maximum forceful expiration after maximum inspiration, to the total volume of air expired during the entire forceful expiration. FEV1 % = FEV1 /FVC × 100

4. Peak expiratory flow rate (PEFR): This is the maximum flow rate that can be sustained for a period of 10 ms by maximum forceful expiration following maximum inspiration. It is expressed in L/s.

5. Forced expiratory flow 25-75 (FEF 25-75): This is the mean rate of expiratory flow between 25% and 75% of expired FVC. It is expressed in L/s.

6. Forced expiratory flow 25 (FEF 25): This is the instantaneous flow rate at the point when 25% of FVC has been exhaled. It is expressed in L/s.

7. Forced expiratory flow 50 (FEF 50): This is the instantaneous flow rate at the point when 50% of FVC has been exhaled. It is expressed in L/s.

8. Forced expiratory flow 75 (FEF 75): This is the instantaneous flow rate at the point when 75% of FVC has been exhaled. It is expressed in L/s.

The actual values, predicted values, and the percentage of predicted values of each parameter were recorded. All PFT values have been expressed as percentage of predicted values. These have been compared between both the groups. Data were compiled in Excel spread sheet and the level of significance was tested by unpaired t-test. Categorical variables was expressed as Number of patients and percentage of patients and compared across the groups using Pearson's Chi Square test for Independence of Attributes. Continuous variables was expressed as Mean ± Standard Deviation and compared across groups using unpaired t test of the data follows normal distribution and Mann-Whitney U test if the data does not follow normal distribution. The statistical software SPSS version 20 was used for the analysis. An alpha level of 5% has been taken, i.e. if any p value is less than 0.05 it will be considered as significant.

OBSERVATIONS & RESULTS:

The comparative analysis of both group population and their pulmonary function test reports were summated in table below.

On careful comparison of both sub population, it was found that, there was no statistically significant difference in the demographics of two groups (Table 1, Figure 1). The observed FVC and % FVC was statistically significant in the two subset of population (Table 2, Figure 2). However, there was statistically significant finding was seen in observed FEV1, predicted FEV1 and percentage of predicted FEV1 (Table 3, Figure 3). However, the observed FEV1/FVC, predicted FEV1/FVC and percentage of FEV1/FVC values were not statistically significant (Table 4, Figure 4). The observed FEF25-75, predicted FEF25-75 and percentage of FEF25-75 were found statistically significant (Table 5, Figure 5). However, the observed PEFR predicted PEFR percentage of PEFR was found to be statistically not significant (Table 6 Figure 6).

Table 1: Demographics - Age, Height, weight, BMI

	GROUP			
	GROUP I	GROUP II		
	Mean ± Std. Deviation	Mean ± Std. Deviation	p Value	Significance
Age	22.7 ± 2.6	23.2 ± 2.88	0.475	Not Significant
Height	158.43 ± 5.73	155.83 ± 6.93	0.122	Not Significant
Weight	61.9 ± 5.54	62.3 ± 5.31	0.988	Not Significant
BMI	24.69 ± 2.34	25.76 ± 2.7	0.408	Not Significant

Figure -1: Demographics - Age, Height, weight, BMI

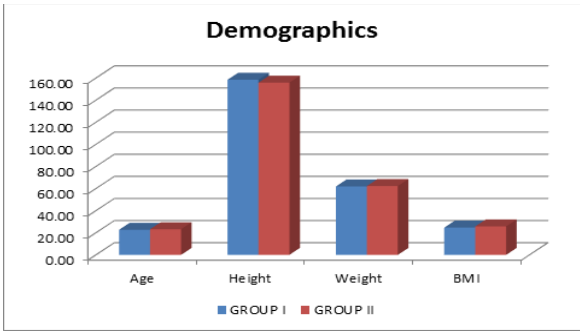


Table 2: FVC , Predicted FVC, % FVC

	GROUP			
	GROUP I	GROUP II		
	Mean ± Std. Deviation	Mean ± Std. Deviation	p Value	Significance
FVC	2.97 ± 0.26	2.64 ± 0.24	<0.001	Significant
P FVC	3.61 ± 0.28	3.48 ± 0.32	0.084	Not Significant
% Predicted FVC	82.32% ± 5.47%	75.95% ± 3.65%	<0.001	Significant

As depicted in table2, figure 2, the observed forced vital capacity and % predicted FVC of subjects under study showed statistically significant changes. Pregnant ladies living in industrialised belt showed 11.11% less FVC than non- industrialised areas. Similarly, group II pregnant ladies showed 7.73 less predicted FVC than other group.

Figure 2: FVC, Predicted FVC

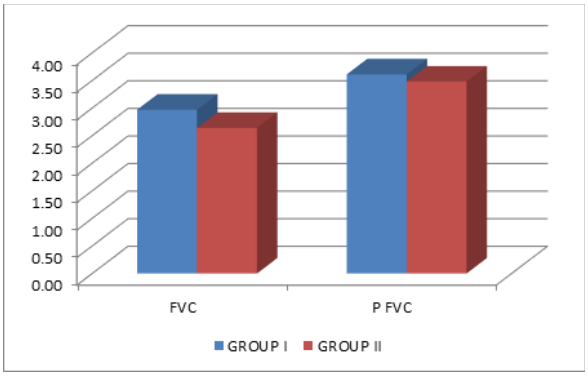
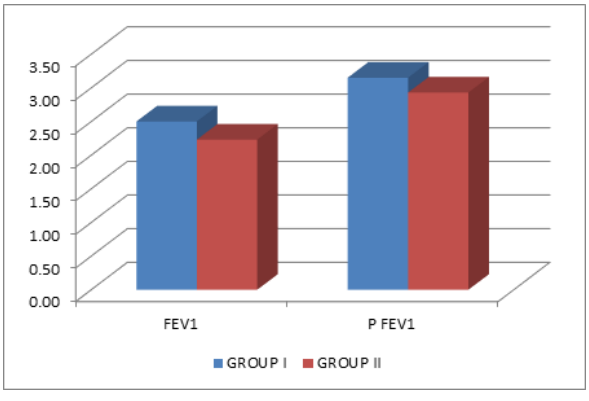


Table 3: FEV1, Predicted FEV1, % FEV1

	GROUP			
	GROUP I	GROUP II		
	Mean ± Std. Deviation	Mean ± Std. Deviation	p Value	Significance
FEV1	2.5 ± 0.27	2.23 ± 0.22	<0.001	Significant
P FEV1	3.15 ± 0.22	2.93 ± 0.6	0.040	Significant
% Predicted FEV1	79.57% ± 6.65%	73.3% ± 4.48%	<0.001	Significant

Figure 3: FEV1, Predicted FEV1,



As depicted in Table3, Figure3, the observed FEV1, predicted FEV1 and percentage of predicted FEV1 is found to be statistically significant in the subjects belonging to group II (Industrial areas). The subjects of group II has 7.87% less predicted FEV1 than of subjects belonging to group I (Non- industrial areas)

Table 4: FEV1/FVC, Predicted FEV1/FVC, %FEV1/FVC.

	GROUP			
	GROUP I	GROUP II		
	Mean ± Std. Deviation	Mean ± Std. Deviation	p Value	Significance
FEV1/FVC	84.14 ± 4.01	84.49 ± 2.41	0.684	Not Significant
P FEV1/FVC	86.03 ± 0.6	85.91 ± 0.63	0.453	Not Significant
% Predicted FEV1/FVC	97.82% ± 4.51%	98.4% ± 2.97%	0.574	Not Significant

However, as found in table4 and figure 4, FEV1/FVC ratio, predicted FEV1/FVC, percentage of predicted FEV1/FVC were not found statistically significant in present study among either group.

Figure 4: FEV1/FVC, Predicted FEV1/FVC, %FEV1/FVC.

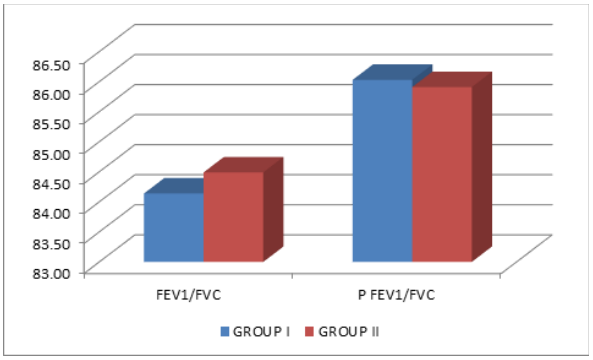


Table 5 : Observed FEF, Predicted FEF, % FEF.

	GROUP			
	GROUP I	GROUP II		
	Mean ± Std. Deviation	Mean ± Std. Deviation	p Value	Significance
FEF 25-75 (L/s)	2.72 ± 0.33	2.29 ± 0.17	<0.001	Significant
P FEF 25-75 (L/s)	3.71 ± 0.65	3.51 ± 0.18	0.048	Significant
% Predicted FEF	73.96% ± 8.63%	65.2% ± 5.5%	<0.001	Significant

It was observed (Table 5, Figure 5) in the present study that subjects belonging to group II has marked difference and statistically significant in FEF 25-75, predicted FEF 25-75 and percentage of predicted FEF 25-75. FEF 25-75 of group II (Industrial areas) were 15.8% less than subjects of group I (Non-industrial areas). Similarly, group II has 11.84% lower than group I in term of percentage of predicted FEF.

Figure 5: Observed FEF, Predicted FEF.

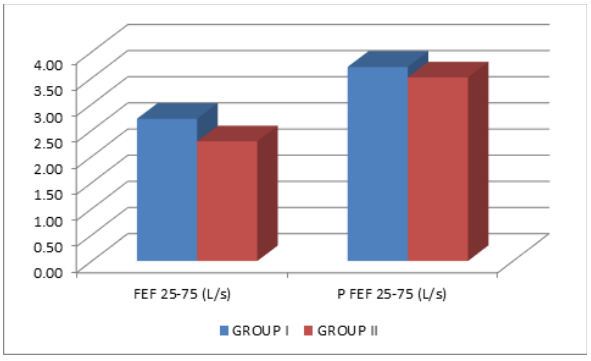


Table 6: PEFR, Predicted PEFR, % Predicted PEFR.

	GROUP			
	GROUP I	GROUP II		
	Mean ± Std. Deviation	Mean ± Std. Deviation	p Value	Significance
PEFR (L/s)	4.53 ± 0.73	4.61 ± 0.32	0.395	Not Significant
P PEFR (L/s)	6.55 ± 0.65	6.5 ± 0.39	0.206	Not Significant
% Predicted PEFR	69.02% ± 8.56%	70.85% ± 2.84%	0.525	Not Significant

As shown in Table 6, figure 6, PEFR, predicted PEFR and percentage of predicted PEFR of subjects belonging to both group had no statistically significant finding.

Figure 6: PEFR, Predicted PEFR

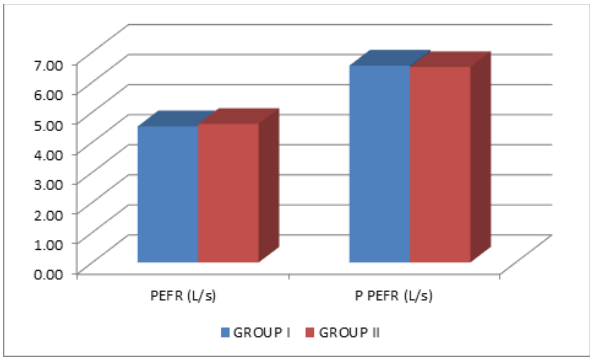
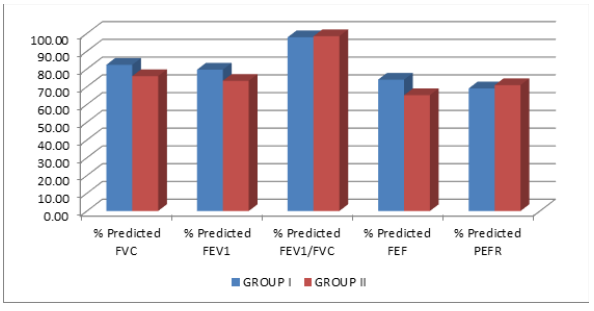


Figure 7: % FVC, FEV1, FEV1/FVC, FEF 25-75, PEFR



DISCUSSION:

In the present study, it was observed that mid trimester primigravidae pregnant ladies under study who were living in industrial areas had statistically significant in terms of FVC, FEV1, FEF25-75. However FEV1/FVC, PEFR were statistically non –significant. It is clearly observed from the study that there is marked reduction in lung function of pregnant ladies living in industrial areas.

CONCLUSIONS:

In recent times, PFT has been evolved as an important tool in assessing respiratory status. Rapid industrialisation has led to increased risk of health of human body in which pregnant status is not devoid of. In our study all the values were less in pregnant subjects of industrial area than non-industrial area suggesting a definite role of pollution in reduction of lung functions in pregnancy that need a strategy to save pregnant women living in industrial area.

LIMITATIONS:

Studies on larger population are required to be undertaken so as to set a standard reference range of the PFT values in the mid trimester of pregnancy. Such norms would aid in accurate evaluation of the changes in maternal respiratory function by treating physicians during management of pulmonary complications in pregnancy. This shall enable occupational health physician and regulatory bodies for limiting pollution in industrial area of Durgapur.

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