

STUDY OF PULMONARY FUNCTION TEST IN FEMALES DURING THREE DIFFERENT TRIMESTER RESIDING IN POLLUTED AREAS OF BIKANER CITY IN RAJASTHAN, INDIA

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Abstract: Objective: To study the effects of pollution on pulmonary functions of pregnant women during three different trimesters residing in polluted areas of Bikaner city in Rajasthan, India and compare the parameters with pregnant women who live in less polluted areas of this city. **Material & Methods:** 100 normal pregnant women in the age group of 20-35 years irrespective of either primi or multigravida in first trimester of pregnancy. The subjects were divided in two groups of 50 each. 50 pregnant woman residing in polluted areas and 50 in less polluted areas. Pulmonary function test were conducted with the help of computerized spirometer (RMS-Helios 401 Transducer no 400-666) in sitting posture, during three different trimesters residing in polluted areas and less polluted areas. **Results:** On comparison of data using 't' and 'p' test reveals that the mean \pm SD values of FVC, FEV₁ and FEF_{25-75%} were statistically highly significant ($p \leq 0.0001$) in 2nd and 3rd trimester in less polluted area and were statistically non significant in 1st trimester in less polluted area as compared to polluted area. The mean \pm SD values of FEV₁/FVC, PEFR were statistically highly significant ($p \leq 0.0001$) in 1st, 2nd and 3rd trimester in less polluted area as compared to polluted area. **Conclusion:** There is statistically significant relationship between air pollution and poor lung function. Decline in the lung parameters FVC, FEV₁, FEV₁/FVC, FEF_{25-75%} and PEFR are observed in the population residing in these areas than the less exposed population.

Key words- Pollution, pregnant women, pulmonary functions

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Introduction-

In pregnancy profound alterations in the functioning of all the systems metabolic, digestive, renal, endocrine, behavioral and cardiopulmonary system of the mother occur to accommodate the needs of the developing fetus. ¹ Pregnancy is associated with significant changes in respiratory functions even in healthy women. ² Air pollution is one of the serious problems faced by the people in the developing countries like India. Generally in urban centers the residential areas are located along the roadside. The populations of such areas are continuously exposed to vehicular pollution. The major causes of increased emission of pollutants include the use of poor quality fuel,

traffic congestion and badly maintained motor vehicles. Pollutants can be in the form of solid particles, liquid droplets, or gases. Industries and vehicles are considered as major sources. The effect of air pollution includes breathing and respiratory problems, aggravations of existing respiratory and cardiovascular diseases, alterations in the body defense system against foreign materials and damage to lung tissue and carcinogenesis. ^{3,4} Prolonged exposure to dust can results in chronic bronchial problems. ⁵ Investigations of the respiratory health effects due to exposure to vehicular pollution exposures are necessary in order to predict the risk factors that may cause asthmatic response. ⁶ Road traffic is a major factor in ambient air

pollution in industrialized countries, contributing pollutants including fine particulate matter, carbon monoxide, Ozone, Sulfur dioxide, Hydrocarbons and oxides of nitrogen. The timing of exposure and the specific components of air pollution that possibly impact fetal development and birth outcome preterm birth and low birth weight mostly with high levels of carbon monoxide and particulate matter during the first trimester and the final months before birth.⁷ Pollution of atmosphere is greatly influences lung functions, so it may be important that how much extent pollution affects respiratory functions in pregnancy. Young children, pregnant women and elderly people often suffer more from the effects of air pollution. Although there are reports of changes in Pulmonary Function Tests during pregnancy and in pollution in the western population, but not much work has been documented on similar studies in Indian subjects, the literature which is a little less vocal on the subject for studies done on North Indian subjects. Hence because of different changes in respiration physiology throughout pregnancy and in pollution, it created an enthusiasm in our mind to take over this study.

Material & Methods-

This study was carried out in the department of physiology in close collaboration with department of obstetrics and Gynaecology of S. P. Medical College, Bikaner city of Rajasthan state in India. In the present study 100 normal pregnant women in the age group of 20-35 years irrespective of either primi or multigravida in first trimester of pregnancy, belonging to middle socio economic status and come for regular check up in hospital as outdoor basis were chosen. Out of 100 pregnant women fifty lived in high polluted areas were chosen as study group & fifty live in less polluted area chosen as control group.⁸ General physical examination of the subject including pulse rate, blood pressure, anthropometric measures age, height and

weight. Pulmonary function tests done using a computerized spirometer. PFT include FVC, FEV1, FEV1/FVC ratio, FEF25-75% PEFR. Then some women in II & III trimester were examined. The Pulmonary function test values were compared between first (up to 12 week), second (12 to 24 week) & third (25 to 40 week) trimester & between study and control group. During morning session, after taking written consent from subject pulmonary function test done. Pulmonary function test were conducted with the help of computerized spirometer (RMS-Helios 401 Transducer no 400-666) in sitting posture. The procedure was explained to subject. Subject were asked to take maximum deep inspiration then blow out with maximum effort in mouth piece of spirometer which already apposed between the lips firmly. Nose was closed by nose clips. As three reading of Pulmonary function tests were taken on instrument and the highest one selected for calculation. Instruction give to subject do not eat a heavy meal before the test. The instrument was fed with the ID, data, height in cm, age in years, weight in Kg, sex and room temperature prior to performance of test. The specifications of Instrument provides flow rate Liter/Sec versus volume (Liter) plot and volume verses time plot recordings on thermo sensitive paper. The actual values, predicted values for the specific patient, when compared to others of same age, height, sex and percentage predicted values, i.e. a ratio of actual value and predicted value expressed as percentage are displayed and if resources available printed records can be obtained. The blood pressure were recorded with a mercury column Sphygmomanometer, height by height measuring scale and weight by weighing machine in pregnant woman during three different trimester residing in polluted areas and less polluted areas. The subjects were divided in two groups of 50 each. 50 pregnant women residing in polluted areas and 50 in less polluted areas, all of them remained in same location during whole period of the study.

INCLUSION CRITERIA-

Selection of subjects: 1. Uncomplicated pregnant women. 2. Age group (20-35) years 3. Physically and mentally capable of adequate co-operation during the performance of the tests.

EXCLUSION CRITERIA-

Women suffering from high BP, asthma, tuberculosis, cardiovascular disease, eclampsia, smoking, sign of any bony deformity of the thoracic cage, or any drug history will be excluded from the study

Factors that contribute to variability between subjects:-

Many factors contribute to the between-individual variation in pulmonary function, including host factors such as age, height (or standing height, sitting height, arm span), gender, and race and ethnic differences. Factors such as exposure to environmental pollution, work place pollution, smoking and socioeconomic status, Nutrition, exercise, Level

of physical activity can improve health, enhance muscle strength, and increase lung volume and respiratory flow.

Sources of variability between subjects-gender-

30%, age- 8%, standing height- 20%, ethnic group-10%, body weight-2%, technical factors-3%, unexplained- about 30%

In our study of respiratory functions in three trimesters separately, we studied same subjects, so variability between subjects is reduced to minimum. Because variables like standing height, environmental factors, socioeconomic status, age, ethnic factors remain the same so the effect of pregnancy and

pollution on pulmonary function tests is better explained.

Value of various study parameters in respect of sample subjects were suitably recorded and classified to prepare master sheets for different categories of subjects as per objectives study. The data of Pulmonary function tests obtained by the Spirometer, age, height, weight, systolic and diastolic blood pressure, BMI were tabulated in master chart; from this sub tables on the plan were prepared. From the control data, same tables were formed as in study group. From all these data mean values were used with \pm standard error. Finally the results obtained were compared with the reference data. The data were expressed as mean \pm SD. statistical analysis was performed according to an intention to treat strategy. Quantitative Data gathered was analyzed using as mean \pm SD, 'p' test, 't' test. The Student's 't' test was used to compared the differences. Correlation coefficient was performed by Pearson correlation analysis (r). Values of $p < 0.05$, < 0.01 and > 0.05 were taken as statistically significant, highly significant and not significant respectively. Analysis was performed by using MSTAT software.

Observations:

Table 1 -FVC in liters during 1st, 2nd and 3rd Trimester in subjects living in polluted and less polluted areas

Trimester	Polluted area	Less polluted area	t	p
1st	2.26 \pm 0.102	2.310 \pm 0.17	1.710	0.090
2nd	2.107 \pm 0.05	2.240 \pm 0.16	5.22	0.0001
3rd	1.980 \pm 0.04	2.175 \pm 0.17	7.73	0.0001

polluted area

Table 2 -FEV1 in liters during 1st, 2nd and 3rd Trimester in subjects living in polluted and less polluted areas.

Trimester	Polluted area	Less polluted area	t	p
1 st	2.73±0.15	2.77±0.14	1.59	0.113
2 nd	2.46±0.11	2.58±0.11	5.20	0.0001
3 rd	2.18±0.06	2.32±0.10	8.32	0.0001

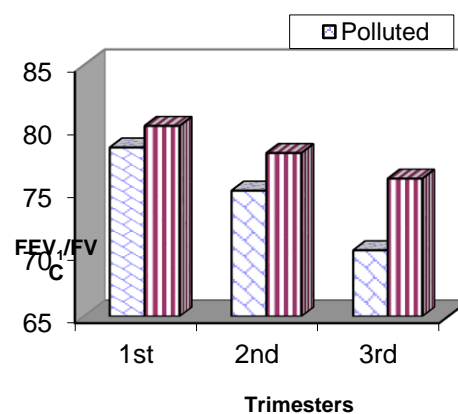
Table 3- FEF 25-75% in liters/sec during 1st, 2nd and 3rd Trimester in subjects living in polluted and less polluted areas

Trimester	Polluted area	Less polluted area	t	p
1st	1.774±0.09	1.851±0.13	3.29	0.0013
2nd	1.582±0.04	1.74±0.14	7.85	0.0001
3rd	1.39±0.037	1.65±0.13	12.8	0.0001

Table 4 – PEFR in liters/sec during 1st, 2nd and 3rd Trimester in subjects living in polluted and less polluted areas

Trimester	Polluted area	Less polluted area	t	p
1st	5.456±0.09	5.836±0.09	12.53	0.0001
2nd	5.104± 0.15	5.631±0.10	19.78	0.0001
3rd	4.85± 0.13	5.25±0.09	22.22	0.0001

Graph1-FEV1/FVC in % during 1st, 2nd and 3rd Trimester in subjects living in polluted and less



Result- On comparison of data using 't' and 'p' test reveals that the mean ±SD values of FVC, FEV1 and FEF25-75% were statistically highly significant in 2nd and 3rd trimester in less polluted area and were statistically non significant in 1st trimester in less polluted area as compared to polluted area. On comparison of data using 't' and 'p' test reveals that the mean ± SD values of FEV1/FVC, PEFR were statistically highly significant in 1st, 2nd and 3rd trimester in less polluted area as compared to polluted area.

No literature is yet available regarding effect of pollution on different trimester even in western countries. We may have been among first few workers on this ground. In the present study

the estimates were made on the lung function efficiency of the pregnant woman. The results of our study indicate reduction in the lung function efficiency among the pregnant woman exposed to higher traffic pollution.

Discussion-The results of our study indicate reduction in the lung function efficiency among the pregnant woman exposed to higher traffic pollution. During pregnancy, the ribcage undergoes structural changes in response to hormonal changes.⁹ Progressive relaxation of the ligamentous attachment of the ribs causes the sub-costal angle of the rib-cage to increase from 68 degrees to 103 degrees early in pregnancy before the uterus is substantially enlarged. This change persists for months after the end of pregnancy when the uterus returns to normal size. The increased elasticity of the rib-cage is probably the result of polypeptide hormone relaxin which is also responsible for the softening of the cervix and the relaxation of the pelvic ligaments^{10,11}. As the uterus enlarges during pregnancy causes the diaphragm to elevate about 4 cm and abdominal muscles have less tone and are less active during the pregnancy causing breathing becomes diaphragmatic. The rib cage is displaced upward and widens. The transverse diameter of the chest expands 2cm and the chest circumference of the lower rib-cage increases about 6 cm¹². The lower end-expiratory lung volume leads to an increased area of apposition of the diaphragm to the chest wall, which improves the coupling of the diaphragm and chest wall¹³. Thus, the increased TV in pregnancy is achieved without an increase in the respiratory excursion of the diaphragm. The enlarging uterus results in increasing abdominal pressure which decreases chest wall compliance, which falls about 35–40%¹⁴. The FEV1 / FVC ratio shows a definite decrease due to relative decrease in FEV1 as compared to FVC.¹⁵ Pollution is a significant cause of FEV1/FVC decrease which is almost proportionate to progression of pregnancy.¹⁶ The short term acute effects of air pollutants like sulfur dioxide include pulmonary function decrements, increased airway

responsiveness and airway inflammation and aggravation of pre existing respiratory diseases like asthma chronic exposure may lead to chronic obstructive pulmonary diseases and decreased lung functions including decreased PEF.¹⁷ Respiratory and cardiovascular adverse health effects seem more strongly associated with particles from traffic which are rich in elemental carbon and are the principle source of ultrafine particle exposure.¹⁸ Increased traffic exposure have been associated with reduced levels of lung function, a more objective measure of respiratory health.^{19,20} There is a strong association between the duration of exposure to air pollutants and lung function changes or air way obstruction.²¹

The lung compliance remains normal during pregnancy. Expiratory muscle strength is in the low-normal range²². Hormonal alternation in pregnancy causes a reduction in the trachea-bronchial smooth muscle tone and the increasing thoracic width may be compensating for the rise in the level of the diaphragm which occurs as a result of the enlarging gravid uterus.²³ The evidence that progesterone is a respiratory stimulant is strong²⁴ & due to sensitization of respiratory centre due to progesterone. All the readings of PFT were further decreased in subjects living in highly polluted area than in less polluted area indicating a causal role of pollution. Which needs further confirmation by carrying out large community based studies.

Pulmonary Function Tests, provide an accurate knowledge of the physiological changes in the pulmonary functions occurring during pregnancy, so proper evaluation of any respiratory ailment during pregnancy can be done. Moreover their precise knowledge allows the clinician to verify the extent of the adaptation in pregnant women and helps to avoid unnecessary treatment of physiological changes misinterpreted as pathological changes in reference to pre-pregnancy standards²⁵. The knowledge of the expected or desired changes in pulmonary parameters is fundamental to understanding of how the disease states affect

pregnancy and vice versa.²⁶ Assessment of pulmonary functions in normal women during pregnancy is also necessary for better antenatal care, in the assessment of fitness for anesthesia and to know the progress of pre-existing lung disease¹¹.

Conclusion- Our study indicates reduction in the lung function efficiency among the pregnant woman exposed to higher traffic pollution and all the changes were almost proportionate to progression of pregnancy. All the rates and ratios were decreased and more so as the pregnancy advanced showing incremental effect of pollution on pulmonary function tests in different trimesters showing the very need of protecting pregnant women from exposure to pollution during pregnancy.

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Disclosure: No conflicts of interest, financial, or otherwise are declared by authors