A CROSS SECTIONAL COMPARATIVE STUDY OF SPIROMETRIC PARAMETERS IN AUTO RICKSHAW DRIVERS OF RURAL AND URBAN AREA AND ITS COMPARISON WITH THE UNEXPOSED POPULATION OF RESPECTIVE AREAS.

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Abstracts: **Background & Objectives:** Air pollution due to road traffic, urbanization and industrialization is a serious health hazard and thus the auto rickshaw drivers who are continuously exposed are at increased risk as compared to unexposed control group .So we conducted this study to evaluate spirometric parameters in auto rickshaw drivers with respect to age and sex matched unexposed control group. **Methods:** The study was conducted in 200 subjects – 50 auto rickshaw drivers from rural and urban area each and 50 controls from rural and urban area each. Subjects were asked to perform Spirometry test and dynamic parameters were recorded i.e FVC, FEV_1, FEV_1/ FVC ratio, PEFR, FEF_{25-75}%. **Result: S**ignificant reduction in all spirometric parameters except FEV_1/FVC in rural auto rickshaw drivers and FEV_1/FVC and PEFR in urban auto rickshaw was found as compared to their controls. **Interpretation & Conclusion:** Mixed type of lung impairment is seen with severity being more in rickshaw drivers as compared to their controls

Keywords- auto rickshaw drivers, obstructive, restrictive, rural, Spirometry, urban

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Introduction: The World Health Organization (WHO) states that 2.4 million people die each year from causes directly attributable to air pollution [1,2]. Environmentalist claims that living in an Indian metropolitan city is like smoking 10 – 20 cigarettes every day. More than 40,000 people die prematurely every year because of air pollution, says a world bank report of which Delhi share is the highest [3,4]. The human lungs inhale on an average 7 liters of air per minute. Thus, it is evident that lungs are the target organs for adverse effects of noxious gases due to air pollution [5].

Auto rickshaws are one of the chief modes of transport in many Asian countries. Auto rickshaw drivers are constantly exposed to emission of his own and other vehicles making them susceptible to adverse effects of air pollution than the general population [6]. The study was aimed to find out whether there is any significant difference in spirometric parameters of auto rickshaw drivers and non exposed group and to compare the values between rural population with the urban population and to know that residence in rural area has any beneficial effect on lung health or not. In view of the inherent reserve capacity of the respiratory system, the symptoms pertaining to involvement of respiratory system appear only after considerable pathology. There is need to study the lung function of auto rickshaw drivers to detect occupation related subclinical involvement of their lungs , so that necessary intervention can be undertaken before irreversible damage occurs [7,8.]

So we have undertaken this study to compare dynamic spirometric parameters i.e FVC, FEV_1, FEV_1/FVC, FEF_{25-75}% and PEFR in non smoker rural auto rickshaw drivers with their non exposed controls . Also we will compare spirometric parameters in non smoker urban auto rickshaw drivers with their controls and find out percentage decrease in these parameters between rural and urban auto rickshaw drivers.

Material & Methods:

This study is a comparative study. A synopsis of the study protocol was submitted to the Institutional Ethics Committee and approval was obtained. The study was conducted in 200 subjects – 100 were auto rickshaw drivers and 100 were

age and sex matched controls who were not exposed to air pollution. Further out of 100 auto rickshaw drivers, 50 were from rural area and 50 were from urban area. Similarly out of 100 controls, 50 were from rural area and 50 were from urban area.

The study was conducted on the field for the collection of data of rural auto rickshaw drivers and their control and the collection of data of urban auto rickshaw drivers and their control was done in the Department of Physiology.

Subjects selected were male, non smoker and non obese auto rickshaw drivers between 25 - 50 age group of rural and urban area who were driving for 8 – 10 hours per day since at least last 5 years. Subjects were recruited as per inclusion and exclusion criteria. Smokers Known case of (k/c/o) hypertension, ischemic heart disease, past h/o myocardial infarction, diabetes, alcoholic liver disease, portal hypertension, acute or chronic respiratory illness. History of recent trauma to chest, thoracic surgery in the past or congenital or acquired chest or spine deformity like kyphosis, scoliosis or kyphoscoliosis were excluded from the study.

	Control (Rural) n= 50	Rural auto rickshaw drivers n = 50	Control (Urban) n = 50	Urban auto rickshaw drivers n =50	p value
Age (years)	40.87 ±6.65	41.61 ±7.82	42.21 ±7.45	41.46 ±8.70	>0.05
Height (meters)	1.63 ± 0.05	1.62 ± 0.09	1.65 ± 0.12	1.64 ± 0.08	>0.05
Weight (kg)	63.18 ± 7.25	65.62 ± 8.33	65.84 ± 8.57	64.56 ±7.12	>0.05
BMI (kg/m^2)	23.77 ± 2.42	23.24 ± 3.24	24.12 ±3.12	23.75 ± 2.5	>0.05

The study protocol was explained in detail to the selected subjects. Written informed consent was taken. Questionnaire was designed to obtain basic information on demography including weight and height. Pulmonary function parameters were recorded in between 12 pm to 5 pm in afternoon using portable RMS Helios 702 Spirometer, RMS, Chandigarh. This spirometer is automated and has a flow sensor which converts the airflow signals to digital signals. Values obtained were in liters (L) and in percentiles of the existing database for the normal healthy Indian population depending on age, sex, height and weight. The Spirometry was carried out as per the guidelines laid down by the American Thoracic Society and European Respiratory Society (ATS/ERS) in seated position.[9,10]

The detailed data was entered into the Microsoft excel sheet and Values were reported as Mean ± S.D. Data was analyzed using students unpaired t test for inter group comparison. Statistically non significant at $p > 0.05$

Demographic and baseline characteristics were compared using ANOVA test. The level of significance was at $p<0.05$.

Results:

Table 1: Descriptive statistics for demographic and baseline characteristics

We conducted study on sample size of total 200 subjects. The difference in Mean ± SD of age, height , weight, and BMI in rural control and auto rickshaw drivers, urban control and auto rickshaw drivers and rural and urban auto rickshaw drivers was non significant ($p > 0.05$).Therefore all the groups are comparable.

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Table 2 shows Comparison of spirometric parameters in rural control and rural auto rickshaw drivers.

Parameter	Rural Control Mean ± SD	Rural Auto rickshaw drivers Mean ± SD	p value
FVC (L)	3.52 ± 0.45	3.15 ± 0.57	< 0.05*
FEV_1(L)	3.39 ± 0.23	2.95 ± 0.31	< 0.05*
FEV_1/FVC (%)	96.26 ± 6.23	93.37 ± 7.34	> 0.05
$FEF_{25-75\%}$(L/sec)	4.75 ± 0.72	4.35 ± 0.9	< 0.05*
PEFR (L/sec)	7.58 ± 1.86	6.83 ± 1.38	< 0.05*

p > 0.05 Statistically not significant (NS),Statistically Significant at p <0.05* (S)

Table 2 shows there is significant (p <0.05) reduction in all values except FEV_1/FVC. Decreased FVC suggests restrictive lung disease whereas decreased PEFR and $FEF_{25-75\%}$ suggest large and small airways obstruction respectively. Therefore we got mixed type of lung impairment i.e. obstructive plus restrictive type of lung disease.

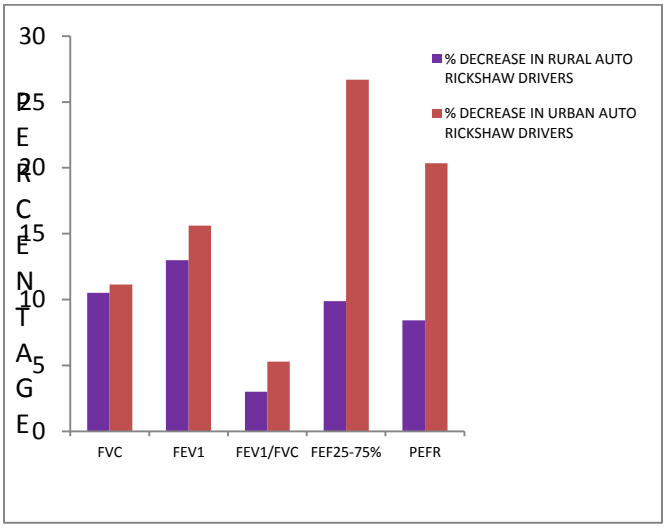
Table 3 : Comparison of spirometric parameters in urban control and urban auto rickshaw drivers.

Parameter	Urban Control Mean ± SD	Urban Auto rickshaw drivers	p value
FVC (L)	3.32 ± 0.18	2.95±0.36	<
FEV_1(L)	3.01 ± 0.11	2.54 ± 0.41	<0.001**
FEV_1/FVC(%)	90.87± 8.25	86.12±7.77	> 0.05*
$FEF_{25-75\%}$ (L/sec)	4.46 ± 0.23	3.27 ±0.69	<0.001**
PEFR (L/sec)	7.42 ± 1.53	5.91 ± 1.65	> 0.05

Statistically Non Significant (NS) at p >0.05, highly significant (HS) at p <0.001**

Table 3 shows comparison of various parameters in urban auto rickshaw drivers and urban control. There is highly significant (p<0.001) reduction in all parameters in urban auto rickshaw drivers as compared to control except FEV_1/FVC and PEFR. There is simultaneous decrease in FVC and FEV_1 so the overall percentage of FEV_1/FVC remains constant but there is reduced FEV_1 which means there is obstruction of airways as well.

Thus decreased FVC shows restrictive type of lung disease whereas decreased $FEF_{25-75\%}$ shows involvement of smaller airways with exclusion of larger airways ie PEFR. Therefore this is also mixed type of lung impairment i.e. restrictive plus obstructive lung disease.



Graph 1 shows percentage decrease in spirometric parameters in rural and urban auto rickshaw drivers. There was significant decrease in almost all parameters in urban auto rickshaw drivers as compared to rural but the maximum percentage decrease was found for $FEF_{25-75\%}$ which is 26.68% for urban auto rickshaw drivers as compared to 9.89% for rural and PEFR (20.35% for urban and 8.42 % for rural auto rickshaw driver) followed by FEV_1/FVC(5.28% for urban and 3.002 % for rural) and FEV_1(15.61 %for urban and 12.98% in rural) and lastly FVC (11.14 % for urban and 10.51 % for rural). Thus small and larger airways are much affected than lung parenchyma in urban auto rickshaw drivers as compared to rural ,therefore we get mixed pattern of lung disease in both urban and rural

autorickshaw drivers with severity more in urban auto rickshaw drivers.

DISCUSSION:

Automobile exhaust is a complex mixture of different gases like sulphur dioxide (SO_2), carbon dioxide (CO_2), carbon monoxide (CO), nitrogen dioxide (NO_2) and particulate matter. These pollutants causes bronchoconstriction, mucosal irritation and alveolar swelling leading to obstructive, restrictive or combined disorders of lungs[3].These air pollutants interact with epithelial cells and macrophages causing activation and release of mediators like interleukin1, TNF,fibronectin,lipid mediators, O2 derived free radicals, fibrogenic cytokines leading to collagen accumulation and fibrosis[4]. This pathogenesis is in the form of airway involvement and restrictive impairment. Our findings were in accordance with Binawara B K (2010)[5]. He conducted his study in taxi drivers in Bikaner city. They found when all the above mentioned five parameters were taken together, they all were reduced except FEV_1/FVC ratio indicating restrictive lung disease. But also the reduced values of PEFR indicate obstructive lung disease. While the values of FVC, FEV_1, $FEF_{25-75\%}$ were reduced significantly which indicates mixed restrictive and obstructive impairment.

Similar study was done in urban auto rickshaw drivers and urban unexposed population by Jain A and his co workers (2012)[11], Afroz A (2013)[12], Pakkala A and his associates (2013)[7,8], Ingle S T et al (2005)[13]. They found significant decrease in FVC and FEV_1 in auto mobile drivers compared to their controls. There was non significant ($p > 0.05$) decrease in FEV_1/ FVC in auto rickshaw drivers of urban area than control of urban area. When all the three parameters considered together i.e FVC, FEV_1 and FEV_1/FVC highly significant decrease in FVC and FEV_1 and non significant decrease in FEV_1/FVC goes in the favor of restrictive lung disease. Similar finding was observed by Gavali S, (Brig.) Singh R, Kharche J S, Pranita A, (2012)[2]. They stated that this could be because the numerator FEV_1 may not be much reduced as compared to denominator FVC, so the ratio comes non significant. Contradictory results were found by Afroz A and his coworkers (2013)[12],Pakkala A and his co workers (2013)[7,8]. They found significant reduction in FEV_1/FVC ratio suggesting an obstructive pathology. There was highly significant ($p < 0.001$**) decrease in $FEF_{25-75\%}$ of urban auto rickshaw drivers as compared to urban control. Similar finding were obtained by Chattopadhyay B P et al(2003)[14], Afroz A (2013).[12] They also found significant reduction in $FEF_{25-75\ \%}$ .The mean of PEFR in urban control was 7.42 ± 1.53 and that of urban auto rickshaw driver was 5.91 ± 1.65.There was non significant ($p>0.05$) decrease in PEFR in auto rickshaw drivers of urban area than control of urban area. Similar finding was found by Afroz A and his colleagues (2013)[12], Kumar Bijendra et al (2010)[5], Sagar A (2007)[3.] They attributed this finding due to chronic exposure to air pollutants. They explained that person with less duration of exposure were found to have more compromised PEFR as compared to those with more exposure, since it was observed that as duration increases the acute symptoms subside[3.] However contradictory findings were obtained by Ingle S T (2005)[13], Pakkala A (2013)[7,8], Jain A and Singh M (2012)[15] They all found significant reduction PEFR indicating involvement of larger airways as well. Highly significant decrease in $FEF_{25-75\%}$ and non significant decrease in PEFR suggests that smaller airways are the target for exhausts of automobiles due to their ultrafine size.

From our study we conclude that exposure to exhaust pollutants is detrimental to lung function and this derangement in pulmonary function tests of auto rickshaw drivers can be reduced to lesser extent by undertaking early intervention to diagnose lung pathoglogy and its treatment.

CONCLUSION:

We concluded that, due to complex mixture of auto mobile exhaust few components of it affects

smaller and larger airways leading to obstructive lung diseases whereas particulate matters causing inflammatory reactions in lung parenchyma leads to restrictive lung disease. So we concluded that there is mixed type of lung impairment in rural as well as urban auto rickshaw drivers and its severity is more in case of urban controls and auto rickshaw drivers as compared to rural controls whereas rural auto rickshaw drivers bears the brunt of air pollution due to occupational exposure than the controls.

FUTURE ASPECTS OF THE STUDY

The study can be further expanded by measuring actual concentration of pollutants i.e. oxides of nitrogen and sulphur, particulate matter (PM) in atmosphere in different areas like rural / urban, less polluted / more polluted area and observing its effect on pulmonary function tests.

In highly polluted areas, effect of pollution on pulmonary function tests can also be studied in relation to duration of exposure.

Correlation of inflammatory markers of oxidative stress or exhaled amount of CO with lung damage can be extensively studied.

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