PREVALENCE OF RESTRICTIVE LUNG DISORDERS IN AUTO RICKSHAW DRIVERS.

Type: Original Article
Title: Prevalence of restrictive lung disorders in auto rickshaw drivers.

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Abstract:
Long term exposure to the traffic air pollution is associated with decrease in lung function and increase in respiratory disorders. Traffic air pollution includes a list of pollutants but the major being particulate matter, sulfur dioxide, oxides of nitrogen, ozone, lead and carbon monoxide. Professional vehicular drivers who spend 8-10 hours daily in traffic pollution are at higher risk of restrictive lung disorders. Long term exposure to ozone produces mainly pulmonary fibrosis which could be associated with decrease in FVC, FEV1. Carbon monoxide (CO) is one of the major pollutants and has been associated with restrictive type of lung diseases. Present study was conducted to assess the prevalence of restrictive lung diseases amongst the open cabin auto rickshaw drivers. Forced vital capacity (FVC), forced expiratory volume (FEV1), FEV1/FVC %, and peak expiratory flow rate (PEFR) of 100 auto rickshaw drivers were recorded as per all the standard norms. These readings were compared with 100 healthy, non drivers, working in offices.

Results: The auto rickshaw drivers showed significant reduction in FVC (P<0.01), FEV1 (P<0.05) and PEFR (P<0.05) where FEV1/FVC% did not show any significant change (P>0.05). Conclusion: The above findings are suggestive of restrictive lung disorders.
The World Health Organization (WHO) states that 2.4 million people die each year from causes directly attributable to air pollution (1). Number of deaths and cases of respiratory diseases due to air pollution are increasing worldwide and is a major concern of the developed world and the developing nations (2,3).

Worldwide more deaths per year are linked to air pollution than to automobile accidents. Direct causes of air pollution related deaths include aggravated asthma, bronchitis, emphysema, lung and heart diseases and respiratory allergies.

Air pollution is a chemical, particulate matter, or biological agent that modifies the natural characteristics of the atmosphere. The complex, dynamic, natural gaseous system of the atmosphere is essential to support life on Earth (4).

Pune is one of the most rapidly growing metropolitan cities of the country. The growth is associated with about 300 new motor vehicles being added per day in Pune district and also the increased industrial growth in and around the city (5). An increase in the migrant population that uses fossil fuel for the domestic use also adds to already rising pollution in the city.

The contribution of motorized traffic to air pollution is widely recognized. There is a list of pollutants known to us but the major Pollutants include particulate matter < 10 μm in size, sulfur dioxide, oxides of nitrogen, ozone, lead and carbon monoxide(3). The ambient air quality monitored in the vicinity of traffic junctures in Pune city by “Maharashtra Pollution Control Board” (6) showed intermittent increase in respirable Suspended Particulate Matter (RSPM) and oxides of nitrogen (NOx). While the ambient level of sulfur dioxide (SO2) was well below average. The maximum level of RSPM at residential area reached to 190μg/m³ as compared to the normal being 100 μg/m³ and the maximum level approached by NOx was 336μg/m³ as compared to normal value of 80μg/m³. These values are 100% to 400% higher as compared to maximal permissible levels.

Drivers of non air conditioned vehicles are affected more than air conditioned vehicle drivers (7). Several studies have shown a deterioration of ventilatory lung function in people who are constantly exposed to air pollution (8,9). Professional drivers e.g. auto rickshaw drivers, taxi drivers etc, who spend a lot of time in the traffic are at higher risk to respiratory diseases. In the recent past the problem of air pollution has occupied a prime position because many studies have shown that the air pollution is directly responsible for the increase in hospital admissions for respiratory disorders (10). So it is not surprising that lot of studies have
been carried out to assess the effect of air pollution on pulmonary function tests. Auto rickshaws are open cabin type of vehicles and their drivers who spend minimum 8 hours daily in traffic pollution are likely to be more affected than general population. This study has been designed to evaluate ventilatory lung functions in a selected group of auto rickshaw drivers of Pune city.

MATERIALS AND METHODS

The study was carried out in the Department of Physiology, of Bharati Vidyapeeth Medical College in Pune. The subjects selected were 100 auto rickshaw drivers (Group I) who had been driving auto rickshaws of open cabin type for more than 5 years and for more than 8 hours daily in Pune city. A group of another 100 individuals (Group II) who were normal citizens, not auto rickshaw drivers, working in offices for 8 hours or more and minimally exposed to traffic pollution was also selected as a control group. The height, weight and age of the study group were well matched with the control group. Both the study group and control group were non smokers, not suffering from any cardio respiratory ailments and between the age group of 25-45 years.

All the subjects were explained the experimental protocol before the start of study. The data including a detailed history, standing height of each individual was measured and expressed in centimeters to the nearest 1 centimeter, weight in kilograms was recorded. Although the procedure of spirometry does not involve any invasive procedure nor any life threatening risk, written consent was however taken before the procedure and it was a fully voluntary study.

Ventilatory lung functions were recorded on a Computerized portable “Schiller SP-1” lung function unit, the automated flow Spirometer with a sensor, converts the air flow into digital signals and gives direct readings of all parameters recorded. Test readings were recorded at noon time(11), as expiratory flow rate is highest at noon. All the readings were taken in standing position. Subjects were properly instructed regarding the test prior to the actual performance. Properly fitting disposable mouthpieces and nose-clips were provided. Three readings were taken and best of three readings was selected.

The parameters selected on Spirometer for the study were ,Forced vital capacity ( FVC) (in Liters). Forced expiratory volume in one second (FEV1) (in Liters). The percentage of forced expiratory volume in one second to forced vital capacity (FEV1/FVC%).
The readings were automatically compared by the inbuilt predicted pulmonary function norms in the spirometer for the Indian population depending upon the age, sex, height and weight. Peak Expiratory Flow Rate (PEFR) was recorded by using “Vitalograph” peak flow meter made in Ennis Ireland. The volunteer was asked to inspire maximally and then expire as fast and as forcefully as possible into the flow meter. Highest of three such expiratory flow efforts was recorded and expressed in L/minute and compared with predicted norms for Indian population (12). The standard Algorithm and Miller’s Diagnostic Quadrant was used for categorizing spirometric results (13). Statistical analysis was done by using SPSS software for statistical analysis. The significance was calculated by ‘Z’ test where the ‘Z’ value more than 1.96 was considered to be significant. The ‘p’ value <0.01 was considered to be highly significant and <0.05 was considered to be just significant. The ‘p’ value >0.05 was considered to be not significant.

RESULTS

The age in years, weight in kilograms and height in centimeters in mean ± SD of groups were: Group I (auto rickshaw drivers) age 35.93 ± 5.83, height 166.51 ± 5.41 and weight70.21 ± 10.69 where in Group II (non auto rickshaw drivers) age 33.8 ± 6.15, height 163.25 ± 9.34 and weight 67.4 ± 9.12. Table I shows the mean FVC of the group I (2.94 ± 0.58 L) when compared with the mean FVC of the group II (3.27 ± 0.33 L) showed highly significant reduction (p < 0.01). The mean FEV₁ recorded in group I was 2.67 ± 0.51 L which showed statistically significant reduction but for p value at < 0.05 as compared to control group whose mean FEV₁ was 2.91 ± 0.34 L however the FEV₁/FVC % did not show statistically significant change. Table II shows statistically significant reduction of PEFR, 480.8 ± 22.14 in Group I but for p value at <0.05 as compared to the PEFR, 491.7 ± 17.41 in Group II (control group).

Table – 1: Comparison of pulmonary functions between Study group I and Control group II.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group II (Control)</th>
<th>Group I (Study Group)</th>
<th>P Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD (n=100)</td>
<td>Mean ± SD (n=100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FVC (L)</td>
<td>3.27 ± 0.33</td>
<td>2.94 ± 0.58</td>
<td>&lt; 0.01</td>
<td>HS</td>
</tr>
<tr>
<td>FEV₁ (L)</td>
<td>2.91 ± 0.34</td>
<td>2.67 ± 0.51</td>
<td>&lt; 0.05</td>
<td>S</td>
</tr>
</tbody>
</table>
Table – 2: Comparison of PEFR between Study group I and Control group II.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group II (Control)</th>
<th>Group I (Study Group)</th>
<th>P Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEFR (L/min)</td>
<td>Mean ± SD (n=100)</td>
<td>Mean ± SD (n=100)</td>
<td>&lt; 0.05</td>
<td>S</td>
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<td></td>
<td>491.7 ± 17.41</td>
<td>480.8 ± 22.14</td>
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S : Significant

Comparison of FVC and FEV1 between study group and control group
DISCUSSION

In the present study we recorded FVC, FEV₁, FEV₁/FVC %, and PEFR of 100 auto rickshaw drivers and compared with the control of 100 individuals (non auto rickshaw drivers) from the general public who were height, weight and age matched with the auto rickshaw drivers. FVC reduction was highly significant in the study Group I where as FEV₁ showed slight statistically significant reduction, but FEV₁/FVC% did not show reduction. On the contrary, FEV₁/FVC% in study group depicted in Table I showed slight increase in Group I. This could be because the numerator FEV₁ was not significantly reduced as compared to denominator FVC which was significantly reduced. The PEFR values though slightly reduced in the group I were near lower limit of the normal predicted values.

The auto rickshaw drivers are exposed to motor vehicle exhaust both from diesel and petrol machines along with other pollutants already existing on roads. Long term exposure to pollutants have been associated with decrease in lung function and increase in respiratory symptoms (14).

Sources of air pollution especially in urban areas are industrial complexes, power plants and automobiles. The pollutants present in the ambient air which are harmful to human health have been identified by numerous studies. Particulate matter less than 10 µm in size (PM10), Particulate matter less than 2.5 µm in size (PM2.5), Oxides of sulfur (SOx), Oxides of nitrogen (NOx), Ozone (O₃), Lead (Pb), Carbon monoxide (CO) comprise bulk of the traffic pollution (1,3). Oxides of nitrogen present in the ambient air cause injury in the terminal bronchioles, decrease the pulmonary compliance and reduce the vital
capacity (15). The extremely high ambient concentration of coarse particulate matter less than 10µm in size (PM10) was strongly associated with significant reduction in pulmonary function (16). The study of effect of ozone on rat lungs, showed strong association between long term exposure to ozone and restrictive type of lung disease and appeared to have occurred due to stiffened lung without overt fibrosis (17). Tropospheric ozone is an oxidant air pollutant formed from oxides of nitrogen and volatile organic compounds in the presence of sunlight (18). Long term exposure to ozone produces mainly pulmonary fibrosis (19) which could be associated with decrease in FVC.

Carbon monoxide (CO) is one of the major pollutants and the toxic effects of CO (20) on respiratory muscles cause muscle weakness in both expiratory muscles and inspiratory muscles leading to restrictive as well as obstructive lung diseases.

Unleaded fuel has reduced the level of lead in the ambient air. Lead causes structural damage and impairs the functions of the lung (21). Many studies (22, 23) have reported that airborne iron was possibly associated with a decline in PEFR as iron in airborne particles was known to cause oxidative damage.

Ultra fine particles with diameters 0.005-1µm get deposited on alveolar walls and in the nuclei of the cells by diffusion and retained in lung parenchyma. These small sized particles are responsible for oxidative stress and mitochondrial damage probably because of their smaller size, larger surface to volume ratio and ability to penetrate into the cell interior and localize near mitochondria (24). The oxidative stress mediated by particles may arise from direct generation of Reactive Oxygen Species (ROS) from the surface of the particles or from soluble compounds carried by these particles such as polynuclear aromatic hydrocarbons. Oxidative stress might up regulate redox sensitive transcription factor via nuclear factor kappa B (NF-κB) in airway epithelial cells thus increasing the synthesis of pro inflammatory cytokines and resulting in cell and tissue injury (25).

In our study we dealt with the vehicular fuel exhaust pollution as a whole and no attempt was made to identify individual pollutants and feel that all the pollutants namely PM, SO₂, NOₓ, O₃ etc. act in tandem and cause structural damage to the lung there by causing reduced compliance and various other tissue changes leading to a restrictive pattern of pulmonary dysfunction.

In conclusion the findings of the study suggest that air pollution does adversely affect the ventilatory lung function on chronic long term exposure to traffic air pollution with prevalence of restrictive type of lung disorder. Although some of the parameters were significantly altered in some subjects, suggesting a restrictive type of disorder were apparently asymptomatic. The lungs have large functional reserve and the person will become symptomatic only when the lung functions are diminished markedly. A large sample and longitudinal study in this field will definitely be of a greater value in predicting the relationship between traffic pollution and ventilatory lung function.
REFERENCES

3. URL: http://en.wikipedia.org/wiki/Air_pollution
6. Ambient air quality monitored at Pune. URL: http://mpcb.mah.nic.in/envtdata/demoPage1.php


