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Pulmonary function tests in nonsmoking auto rickshaw drivers

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Abstract: *Background:* Rapid urbanization, industrialization and increase in number of vehicles is aggravating environmental pollution. Continuous exposure to automobile exhaust has been shown to affect functioning of different systems of the body. *Methods:* The present study was taken up to assess the Pulmonary Function Tests (PFT) in auto rickshaw drivers. *Results:* There was a highly significant decrease in FEV_1, FVC and PEFR in the study group compared to control group ($p<0.05$). *Conclusion:* Mixed pattern (both restrictive and obstructive) lung impairment was found in auto rickshaw drivers. There was significant decrement of lung function in those working for more than 10 years.

Keywords: auto rickshaw drivers; non smokers; pulmonary function tests.

Introduction

Air pollution is increasing all over the world because of rapid urbanization, industrialization and increase in number of vehicles running on fossil fuels. The major modes of public transport in most cities are the buses and auto rickshaws which run on diesel. Complete combustion of diesel leads to production of carbon dioxide and water. But combustion of diesel in motor vehicles is incomplete causing formation of various gases, liquids and solid particles. Nitric oxide (NO_2), Carbon mono oxide (CO), Carbon dioxide (CO_2), Ozone (O_3) and Sulphur dioxide (SO_2) are the major gases produced. The solid particles are known as diesel exhaust particulate (DEP). Diesel exhaust particulate constitutes a large proportion of the particulate matter (PM) present in air. Compared to petrol engines, diesel engines produce less carbon monoxide, but give rise to a greater amount of nitrogen oxides, aldehydes and particulate matter [1-5].

Acute exposure to diesel exhausts lead to irritation of nose and eyes, headache, fatigue and nausea. Cough, sputum production and impairment of respiratory and cardiovascular systems are associated with chronic exposure. Auto rickshaw drivers are at increased risk because of increased exposure as they are working more than 8 hours per day. The aim of the present study was to compare the pulmonary functions in auto rickshaw drivers with healthy controls. The effect of the duration of exposure to the diesel fumes on pulmonary functions was also studied.

Material and Methods

The study comprised 60 healthy male nonsmoking auto rickshaw drivers, aged 25-50 years in and around Kozhikode city, Kerala. A group of 60 healthy males belonging to similar age group and socio economic status were taken as controls. Subjects having any respiratory symptoms or disease, bony deformity, allergic disease, cardiovascular disease, systemic disease were excluded from the study. There was no history of smoking, tobacco chewing and intake of alcohol in both groups. The auto rickshaw drivers included in the study were driving auto rickshaw for at least 5 years duration. Institutional ethical approval was taken before the start of the study.

Informed consent was taken from all subjects. Age, height, and weight were measured. All the pulmonary functions were recorded using computerized spirometer [Medspiror] during day time. Subjects were made familiar with the instrument. Regular sterilization of the mouthpieces was done before each use. All the readings were taken with subject sitting and wearing nose clips [6]. 3 readings were recorded and the best reading was considered.

Statistical analysis was done by Student's t-test using SPSS 17 software. $p<0.05$ was considered statistically significant.

Results

There was no significant difference between age, height and weight of the subjects and the controls (Table 1).

Table-1: Comparison of age, height and weight of the subjects and the controls

Parameter	Controls	Auto rickshaw drivers
Age (years)	35.6±6.90	36.5±4.10
Height (cm)	173.8±7.14	172.3±6.56
Weight (kg)	73.7±8.92	75.9±5.16

Compared to normal subjects, all the lung function parameters were reduced significantly in the auto rickshaw drivers (Table 2). FEV_1, FVC and their ratio were reduced significantly in auto rickshaw drivers. FEV_1/FVC % values were above normal values which indicate restrictive lung impairment. The reduced values of PEFR indicate obstructive lung impairment.

Table-2: Comparison of spirometric parameters[#] among auto rickshaw drivers and control subjects

Parameters	Controls	Auto rickshaw drivers
FEV_1	91.85±1.77	68.55±5.29***
FVC	83.58±1.92	61.39±3.69**
FEV_1/ FVC %	90.63±10.81	86.55±11.84*
PEFR	87.83±2.60	68.69±3.87**

#-all values are percentage predicted
*-p<0.05, **-p<0.01, ***-p<0.001

Out of 60 auto rickshaw drivers, 52 were found to have impaired lung function tests. Most of them were found to have mixed pattern (obstructive and restrictive) lung impairments (Figure 1).

Fig-1: Auto rickshaw drivers having impaired lung function tests (52 out of 60)

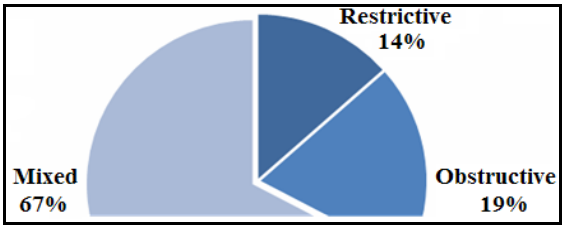

Table 3 shows the effect of duration on the lung function. FEV_1 and FVC values were significantly reduced in subjects driving auto rickshaw for more than 10 years as compared to those driving less than 10 years. PEFR was also reduced in drivers working for more than 10 years ($p<0.05$).

Table-3: Comparison of spirometric parameters between groups of auto rickshaw drivers

Parameters	Duration of Exposure	
	< 10 years(n=27)	> 10 years(n=33)
FEV_1	74.62±8.19	61.05±7.24***
FVC	67.55±6.74	58.92±4.26**
PEFR	71.07±5.64	66.13±7.52*

#-all values are percentage predicted
*-p<0.05, **-p<0.01, ***-p<0.001

Discussion

In the present study we recorded FVC, FEV_1, FEV_1/FVC %, and PEFR of 60 auto rickshaw drivers and compared with the 60 controls who were height, weight and age matched with the auto rickshaw drivers.

All the lung function parameters were reduced significantly in the auto rickshaw drivers as compared to control subjects in the same age group and socio economic status. Respiratory function tests of auto rickshaw drivers who had worked for more than 10 years were more affected than those who had worked for less than 10 years. Majority of the subjects were found to have mixed obstructive and restrictive lung impairment. The decrease in lung function in auto rickshaw drivers is due to continuous occupational exposure to pollutants having adverse effect on their respiratory functions.

Earlier studies in auto rickshaw drivers have shown similar results [7-8]. Decreased lung function has also been seen in taxi drivers [9], bus drivers [10-12], traffic police [13-14]. Gradual decrement has been found with increased duration of exposure [8].

Various mechanisms operate to prevent foreign matter from reaching the lung but particles < 2 μm in diameter ultimately reach

the alveoli [15]. 83% of particles with a diameter of 2.5 μm (PM<2.5) have been shown to be deposited in the lung [16]. 80% of diesel exhaust particles (DEP) have a size ≤0.1 μm.

The biological effect of DEP is initiated by oxidative stress [17–21]. In animal studies, these particles have been shown to produce reactive oxygen species in the lungs [22-23]. In humans, there is a strong relationship between particulate matter (PM) concentration of redox-active compounds and damage in macrophages and bronchial epithelial cells [24-26]. Moreover, in human airway epithelial cells, organic compounds adsorbed on particle surfaces does promote inflammation through CYP1A1-mediated reactive oxygen species (ROS) generation and release of cytokines after activation of transduction pathways involving MAPK and the transcription factor NF-kappaB [27]. This could finally culminate in pulmonary as well as systemic inflammation. Chronic inflammation of respiratory tract and lung parenchyma would contribute to the decrease in lung functions.

Conclusion

Respiratory functions of auto rickshaw drivers who are continuously exposed to diesel emissions (apart from other pollutants present in air) were significantly reduced as compared to control groups. Further, it was observed that respiratory function tests of auto rickshaw drivers who had worked for more than 10 years were more affected than those who had worked for less than 10 years. There are many ways to reduce and prevent the ill effects of pollutant. The auto rickshaw drivers should be imparted health education. They should use protective equipments like face masks. There should be regular periodic check up of auto rickshaw drivers.

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