



TO MEASURE PEAK EXPIRATORY FLOW RATE IN BUS DRIVERS AND CONDUCTORS AS AN INDEX OF RESPIRATORY FUNCTION INFLUENCED BY ROAD TRAFFIC EMISSIONS IN SOUTH INDIA: A CROSS SECTIONAL STUDY

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ABSTRACT

Introduction: Air pollution is a huge problem that has been slowly evolving throughout the world for last few decades. The density of vehicles around the central area of Chennai is comparatively more. People who are exposed to this polluted air might be prone to develop some higher degree of respiratory impairment and hence were chosen to be studied. Peak Expiratory Flow Rate (PEFR) is a simple, non invasive test for ventilatory efficiency which is used widely in clinical practice. **Aim & Objectives:** The aim of this study was to measure the lung function of bus drivers and conductors in terms of Peak Expiratory Flow Rate (PEFR) and to compare with indoor office workers and also to correlate with the duration of exposure. **Materials and Methods:** A cross sectional study was conducted among bus drivers and conductors. The sample size was 200. We recorded PEFR of 100 bus drivers and conductors and compared with the age matched 100 controls who were employed as indoor office workers. **Results:** PEFR was significantly reduced in the bus drivers and conductors as compared to control subjects. **Discussion:** The decrease in lung function is due to continuous occupational exposure to air pollutants which has an adverse effect on their respiratory functions. **Conclusion:** We conclude that the lung functions of bus conductors and drivers are compromised significantly. There are multiple ways to reduce and prevent the harmful effects of pollutant exposure in future by regular respiratory checkups, encouraging personal protective equipment and imparting health education to them.

KEYWORDS: Peak Expiratory Flow Rate, Bus Conductors, Bus Drivers, Vehicle Exhaust, Air pollution.

INTRODUCTION

Air pollution may be described as contamination of the atmosphere by gaseous, liquid, solid wastes or by products that can endanger human health and welfare of plants and animals. Air pollution is a huge problem that has been slowly evolving throughout the world for last few decades. In very recent times, pollution from motor vehicles has become the most controllable air quality concern. The monitoring of present pollution reveals that if we do not act cautiously, vehicle pollution could harm the environment in which we live and reduce the quality of life for our future generations. The natural air has been continuously polluted by increase in urbanisation and quick rise of number of automobile vehicles. The number of cars, in most countries around the world, is now steadily increasing, and a speed up in technological development is required to try and combat the pollution problem.

The major pollutants which contribute to outdoor air pollution are sulphur dioxide, carbon monoxide, nitrogen oxides, ozone, total suspended particulate matter, lead, carbon dioxide, and toxic pollutants. There are over four million cars on the road today in Chennai, in a ratio of one for every two people in developed countries. Virtually all of them are powered by gasoline and diesel engines that burn petroleum to release energy. Petroleum is made up of hydrocarbons (large molecules built from hydrogen and carbon) and burning them fully with enough oxygen should produce nothing worse than carbon dioxide and water. In practice, fuels are not pure hydrocarbons and engines do not burn them completely. As a result, exhausts from engines contain all kinds of pollution, notably particulates (soot of various sizes), carbon monoxide (CO, a poisonous gas), nitrogen oxides, volatile organic compounds (VOCs), and lead indirectly produce ozone. Vehicles release pollutants not

only from their tailpipes, also the brake, tyre wear and tear, the slow rubbing away of the road surface as tyres rumble over it, and stirring up of the dust and debris on top of it also release significant amounts of PM₁₀ and PM_{2.5} particulates into the air.

In the previous years, many studies have reported significant associations between industrial pollution and various markers for acute respiratory morbidity. Numerous epidemiological studies have documented decline in pulmonary function and various other health problems associated with long-term air pollution exposure.^[1] The rapid increase in use of motor vehicles over the decades which is in coherence with the rise in human population all over the world, which includes our country, has led to pollution of the environment in various ways and multiple modes as adulteration in vehicle fuel, threatening the equilibrium between all objects on the earth. Vehicle exhaust pollution has been an important factor causing the degradation of the environment around us, the air we breathe, and the soil on earth we live on. Long term exposure to the air pollutants leads to deleterious effects on the respiratory functions of drivers and conductors.^[2] Also, the failure to use personal protective equipment poses a greater risk for the drivers and equally for the conductors. Exposure to air pollutants is known to be harmful to health, in general, and to the lungs, in particular.

The bus drivers and the accompanying conductors are always continuously and extensively exposed to the vehicle emissions. The exposed study groups are working in bus depots; some even stay longer, before and after their shift timings, stay close to their allotted bus in workshops and has to be with the bus because of their occupation. In capital city like Chennai they are in a condition to stay longer in running vehicles which are periodically struck in traffic jams and traffic signals too.

Peak Expiratory Flow Rate (PEFR) is a simple non invasive test of ventilator efficiency which is used widely in clinical practice and recorded with the help of Wright's peak flow meter. This is the expiratory flow rate during the peak of forced vital capacity. Peak Expiratory Flow Rate (PEFR) is a sensitive indicator for predicting the magnitude of airway obstruction.^[3]

The important sector that contributes to the air pollutants is related to the transport sector. The density of vehicles around the central area of Chennai is comparatively more and these bus drivers and conductors might be prone to develop some higher degree of respiratory impairment and hence were chosen to be studied.

AIMS AND OBJECTIVES

The aim of this study was to measure the lung function of bus drivers and conductors in terms of Peak Expiratory Flow Rate (PEFR). The objectives were to study the similar lung function parameter of appropriately matched indoor office workers and to

compare the results of the above two study groups and hence to study the effect of pollutants of automobiles on the respiratory system of drivers and conductors. Then also to correlate the lung parameter with the duration of exposure.

MATERIALS AND METHODS

A cross sectional study was conducted among bus drivers and conductors in the bus depot. The sample size was 200. The period of study was between November 2018 to January 2019. The Institutional Ethics Committee approval was obtained. The inclusion criteria were males, aged between 20 to 50 years who have been working for at least five years and more. They had been working eight hours each day. The exclusion criteria were history of any active lung disease or under steroid medications, known history of asthma, bronchitis, cardiovascular disease, chronic liver disease, kidney ailments, known diabetes and hypertension, bony deformities, chest injuries, allergic disease and any kind of acute illness. The history of smoking, alcohol intake and betel nut chewing was taken and excluded. The informed written consent was obtained before they entered the study. The procedure was well explained and demonstrated clearly to the study subjects. The lung functions of all the study subjects were done in the morning session (Between 11 am to 1 pm) in their bus depot.

The details were recorded in a structured proforma which included age, personal history and years of exposure, Height and weight were measured uniformly in a standardized height scale and weighing machine. PEFR were recorded using MINI-WRIGHT PEAK FLOW METER by Clement Clarke International Ltd, Edinburgh Way, Harlow, Essex CM 20 2TT in United Kingdom (UK) which is a portable device for measuring ventilator functions. It has a mouth piece, which is connected to a body piece that contains a calibrated scale with marker. The readings are in litres per minute. Subjects were motivated prior to the start of maneuver. The subjects were made to sit on a stool, attached with a nose clip and asked to take a maximum inspiration and then place the mouth piece firmly in mouth and blow out as fast as possible. The test was performed over 3 trials. The test with the best trial was selected. Regular sterilization was done before each recording. All the techniques of measurement, duration, instruments were maintained uniformly throughout the study.

RESULTS

All data were tabulated in Microsoft excel and statistical analysis was done by using SPSS software Version 14 by Student t test and Pearson Correlation Coefficient. The results obtained were expressed as Mean \pm SD. The socio demographic profile of the study population is tabulated in table 1. There is no statistical significance in the anthropometric measurements. The PEFR values compared between the bus drivers and conductors with the indoor office workers in table 2. It shows that PEFR

values of the bus conductors and driver were statistically, significantly lower than that control group. Then the duration of exposure to vehicle exhaust and PEFR values

of bus drivers and conductors correlated in table 3. Duration of exposure did not have a positive correlation with PEFR values.

Table 1. Sociodemographic profile of bus drivers and conductors with indoor office workers.

Variables	Bus Drives and Conductors n = 100 Mean ± S.D	Indoor Office Workers n = 100 Mean ± S.D	P Value
Age (Years)	42.97 ± 7.76	40.95 ± 8.05	0.072 ^{ns}
Height (Meters)	1.66 ± 0.56	1.69 ± 0.06	0.165 ^{ns}
Weight(Kg)	72.85 ± 12.09	70.05 ± 11.08	0.594 ^{ns}
BMI(Kg/m ²)	27.38 ± 5.13	25.98 ± 4.91	0.050 ^{ns}

ns – not statistically significant

Table 2. PEFR values between bus drivers and conductors with indoor office workers:

Study Parameter	Bus Drives and Conductors n = 100 Mean ± S.D	Indoor Office Workers n = 100 Mean ± S.D	P Value
PEFR(L/Min)	400.62 ± 108.42	452.12 ± 133.06	0.0030**

** Very Significant

Table 3. Correlation between PEFR values and duration of exposure in bus drivers and conductors.

Study Parameter	Duration of Exposure <10years n = 52 Mean ± S.D	Duration of Exposure >10years n = 48 Mean ± S.D	P Value
PEFR	412.29 ± 9748	385 ± 109.57	0.1927 ^{ns}

ns – not statistically significant.

DISCUSSION

In our respiratory function study, we recorded PEFR of 100 bus drivers and conductors and compared with the 100 controls who were employed as indoor office workers who were age matched. The respiratory function assessment parameter studied PEFR were reduced significantly in the bus drivers as compared to control subjects in the same age group. The decrease in lung function in bus drivers is due to continuous occupational exposure to pollutants having adverse effect on their respiratory functions. Previous studies in auto rickshaw drivers have shown similar results.^[4,5] Decreased lung function has also been seen in taxi drivers,^[6] traffic police.^[7,8]

The long term exposure to the air pollutants leads to deleterious effects on the respiratory functions of bus drivers along with the bus conductors too. Among the motor vehicle-generated air pollutants, diesel exhaust particles account for a significantly injurious percentage of the particles emitted in developed cities. Acute effects of diesel exhaust exposure include irritation of eyes and nose, lung function changes, headache, fatigue, and nausea. Chronic exposure is associated with cough, sputum production, and lung function decrements. Zuskin et al studied acute and chronic respiratory symptoms as well as ventilatory capacity in 116 bus drivers and 119 mechanics. Bus drivers and mechanics demonstrated a significantly higher prevalence of most chronic respiratory symptoms when compared to control workers.^[9] Inhaled particles cause inflammation and destruction of lung parenchyma. This may be due to inflammatory mediators and leucocytes, protease- anti

protease imbalance and oxidative stress which may contribute to this lung pathology.^[10]

Jones et al conducted a cross sectional study to evaluate the lung function and respiratory symptoms of Hong Kong bus and tram drivers exposed to air pollutants and observed that forced vital capacity, forced expiratory volume in one second and maximal voluntary ventilation were lower in the non air conditioned bus drivers compared with air conditioned bus drivers.^[11] Vehicle pollutants causes inflammation and narrowing of airways which results in increase in resistance to airflow and a decrease in elastic recoil pressure of the lungs.^[12]

The hydrocarbons and nitrogen oxides in petrol and diesel engine emissions, carbon monoxide, higher level of sulphur dioxide from their own driving vehicle and sulphate pollution causes chronic bronchitis with increased risk of bronchoconstriction. Those who are exposed to particulate matter than the unexposed indoor office workers have redox –active compounds leading to oxidative stress.^[13-15] This initiates inflammation, partial obstruction and alteration in respiratory function. The injury in terminal bronchioles produce CYP1A1 mediated ROS (reactive oxygen species), Cytokines, MAPK (Mitogen - activated Protein Kinase), NF (Nuclear factor) - Kappa B lead to chronic inflammation of respiratory tract and lung tissues. As per the results it is obvious that bus depot workers were having significantly low PEFR indicative of tracheobronchial inflammation and obstruction.^[16]

The PEFR is helpful in evaluating the extent and the rate of progression of the disease process (Shah and Mehta,

1961).^[17,18] Chronic exposure to air pollutants in SMOG causes lung irritation, repair and increases the risk of variety of cancer. Global statistics shows 15% of adenocarcinoma in men, up to 50% in women which are not attributed to smoking and one of the risk factors remain air pollution.^[19,20]

LIMITATIONS OF OUR STUDY

1. The sample size could still be larger.
2. The content of the particulate matter may throw more light in the pathophysiology of lung disease.

CONCLUSION

From the above study, we conclude that the lung functions of bus conductors and bus drivers are compromised significantly. There are multiple ways to reduce and prevent the harmful effects of pollutant exposure likely to occur at workplaces in future by regular respiratory checkups of bus drivers and conductors, encouraging personal protective equipment and imparting health education to them periodically. The regular practice of yoga with breathing exercises with lifestyle modifications are to be motivated and may be made compulsory in their routine work schedule. People need to be encouraged to use public transport or share cars whenever possible to minimize the pollution is created. There should be strict regulations implemented in using cleaner fuels. The preventive measures must be taken as a leap to reduce the diesel exhaust attributed respiratory morbidity. Early detection of respiratory impairment can be a great boon for preserving their respiratory health which is highly beneficial to the bus drivers and conductors and to the society.

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