International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 8; Issue 03 (E); March 2019; Page No.17858-17860
DOI: http://dx.doi.org/10.24327/ijcar.2019.17860.3402

Research Article

EVALUATION OF PULMONARY FUNCTION TESTS IN BUS DRIVERS AND CONDUCTORS IN COMPARISON TO INDOOR OFFICE WORKERS AROUND CHENNAI CENTRAL

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A R T I C L E I N F O

Article History:
Received 10th December, 2018
Received in revised form 2nd January, 2019
Accepted 26th February, 2019
Published online 28thMarch, 2019

Key words:
Pulmonary function tests, Bus drivers, Conductors, Indoor office workers Restrictive lung disease, Air pollution, Chennai Central

A B S T R A C T

Background: Air pollution is found to be on an increasing trend due to increase in number of vehicles on the road. Incomplete combustion of diesel in motor vehicles gives rise to various gases, liquids and solid particles. Bus drivers and conductors are exposed to it for more than 8 hours a day. The aim of this study is to compare the pulmonary functions in bus drivers and conductors with healthy indoor office workers, and also to determine the effect of duration of exposure to vehicle exhaust on pulmonary functions.
Materials and Methods: 200 male participants were selected from the community of which 100participants were bus drivers and conductors of 20 to 50 years age, and 100 participants were indoor office workers. Pulmonary function parameters, FVC, FEV1, FEV1/FVC ratio, and MVV were assessed by EASYONE™ DIAGNOSTIC SPIROMETER.
Results: The FVC and FEV1 were reduced to an extremely low level and was statistically significant in bus drivers and conductors when compared to indoor office workers. The FEV1/FVC ratio and MVV were also reduced but it was not statistically significant.
Conclusion: The respiratory functions of the bus drivers and conductors were significantly reduced when compared to the control groups.

INTRODUCTION

In urban India, air pollution is increasing due to rapid industrialisation and increase in number of vehicles on the road. Road transport is likely to remain a significant contributor to air pollution in the cities. Vehicles like cars, buses and auto rickshaws run mostly on diesel. Complete combustion of diesel gives rise to carbon dioxide and water. Incomplete combustion, as occurs in motor vehicles, gives rise to various gases, like nitric oxide, carbon monoxide, carbon dioxide, ground level ozone and sulphur dioxide, liquids and particulate matter. "Poorly maintained older vehicles, poor road conditions, and rapidly growing population and increasing number of vehicles make the problem of air pollution even worse." (Shakya *et al*, 2016)

Chattopadhyay *et al* (2003) states that " in garages, pollutants such as sulphur dioxide (SO_2), oxides of nitrogen (NO_X), carbon monoxide (CO), and volatile organic compounds (VOCS), are formed from the fuels, organic solvents used, and the diesel exhausts emitted by the vehicles. The drivers and conductors engaged in different bus routes were also exposed to VOCS. "The respiratory system is more susceptible to air pollution. Afroz, A *et al* (2012) state that "Occupational exposure to automobile exhaust and industrial smokes has been shown to affect the functioning of different systems of the body." Exposure to diesel exhausts may irritate the mucosa of the nose and eyes and the mucosal lining of the respiratory tract, causing cough with sputum production, and also impairment of cardiovascular system. Injury to the airways and lung parenchyma may also cause bronchoconstriction, increased mucus secretion and alveolar swelling. Bus drivers and conductors are at an increased risk as they are exposed for more than 8 hours per day.

The aim of the present study is to compare the pulmonary functions in bus drivers and conductorswith apparently healthy indoor office workers, and also to determine the effect of duration of exposure to motor vehicle exhaust on pulmonary functions.

MATERIALS AND METHODS

This study was started after obtaining Institutional Ethics Committee clearance and informed written consent from all the participants. This is a descriptive cross sectional study design, where a statistically adjusted sample size of 200 participants was selected from the community. 100 of the participants were either bus drivers or conductors. They were in the age group of 20 to 50 years. And another 100 participants were age, weight and height matched healthy individuals, whose occupation was noted to be indoor office work. All the subjects were males. Those participants who had any history of acute illness, fever, chronic bronchitis,

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tuberculosis, asthma, cardiovascular diseases, liver or kidney diseases, diabetes and hypertension were excluded from the study. All the subjects were asked to fill up a case proforma, containing questions about their socio demographic status and any history of medical illness. All the participants were subjected to a thorough clinical examination.

Clear instructions of the study procedure were given to all the participants. The procedure was conducted in sitting position and were instructed to wear nose clips. A disposable mouth piece was given to each participant to blow into the spirometer and it was cleaned with cotton and spirit in between each blow. Spirometry was performed using EASYONE^{TM} DIAGNOSTIC SPIROMETER, manufactured by ndd Medizintechnik AG, 8005 Zurich, Switzerland, and model: 2001, SN: 121487/2015. The participant was asked to take a deep and maximal inspiration and followed by a forceful and sustained expiration into the mouthpiece of the spirometer. This was repeated thrice for each participant with a gap of half an hour in between each blow. This was done to ensure reproducibility of values. The following parameters were noted after the recordings - Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV1), and FEV1/FVC ratio. The best of the three values were obtained. Maximum voluntary ventilation (MVV) was done by asking the participant to take a deep inspiration followed by hyperventilation for 15 seconds. This was also performed using the same instrument.

The data obtained were tabulated and results were analysed using SPSS software, version 21. There was not a notable difference observed in the values of height, weight and BMI between the bus drivers and conductors and indoor office workers (Table 1).

Table 1 Physical characteristics of study population

Parameters	Bus drivers and conductors (n=100)	Indoor office workers (n=100)	P value
Weight (Kg)	72.85 ± 12.09	70.55 ± 11.27	0.1656ns
Height (m)	1.66 ± 0.56	1.69 ± 0.06	0.5949ns
BMI (Kg/m2)	27.38 ± 5.13	25.98 ± 4.91	0.0501ns

ns - not significant

Compared to indoor office workers,the lung function parameters FVC and FEV1 were reduced extremely significantly in bus drivers and conductors (Table 2).

Table 2 Comparison of spirometric parametersamong the two study groups

Parameters	Bus drivers and conductors (n=100)	Indoor office workers (n=100)	P value
FVC (L)	2.67 ± 0.62	3.63 ± 0.06	0.0001****
FEV1 (L)	2.48 ± 0.53	3.44 ± 1.01	0.0001****
FEV1/FVC ratio	0.93 ±0.06	0.94 ± 0.06	0.2400ns
MVV (L/min)	88.11 ± 18.27	92.58 ± 25.57	0.1565ns

**** - Extremely significant
ns - not significant

FEV_1/FVC ratio values were not significantly reduced which indicate restrictive type of lung impairment.

The MVV values of bus driver and conductors were lower than those of indoor office workers but it was not significant.

The bus drivers and conductors were separated into two groups, those who were in this field for less than 10 years and those who were in this field for more that 10 years (Table 3).

Table 3 Comparison of spirometric parameters between two groups of bus drivers and conductors based on duration of exposure

Parameters	Duration of exposure <10years (n=48)	Duration of exposure >10years (n=52)	P value
FVC (L)	2.86 ± 0.64	2.49 ± 0.55	0.0025**
FEV1 (L)	2.64 ± 0,52	2.31 ± 0.49	0.0015**
FEV1/FVC ratio	0.92 ± 0.06	0.93 ± 0.07	0.4467ns
MVV (L/min)	88.72 ± 13.67	80.03 ± 22.77	0.0242*

** - Very significant,* - Significant, ns - not significant

The FVC and FEV1 values were reduced in those who were exposed for more than 10 years and the values were very significant.

The FEV1 / FVC ratio values were in fact more in those exposed for more than 10 years and the values were not significant.

The MVV values were also reduced in those exposed for more than 10 years and the values were statistically significant.

DISCUSSION

In the present study, we recorded FVC, FEV_1, FEV_1/FVC ratioand MVV of 100 bus drivers and conductors and compared the values with the 100 indoor office workers who were age, height and weight matched. All the lung function parameters were reduced significantly in the bus drivers and conductors as compared to indoor office subjects, except FEV1/FVC ratio. Patients with chronic restrictive lung diseases have reduced FVC with proportionate reduction in FEV1, and hence (unlike the situation in obstructive lung diseases) the FEV1/FVC ratio is not reduced (Kumar *et al*, 2004). FVC, FEV1 and FEV1/FVC ratio are reliable indices of ventilatory capacity and help to distinguish between restrictive and obstructive ventilatory defects. In restrictive lung disorders, FVC is very much reduced, FEV1 is also much reduced, but FEV1/FVC ratio maybe normal or even supranormal.

Pulmonary function tests of drivers and conductors who had worked for more than 10 years were more affected than those who had worked for less than 10 years. The decrease in pulmonary function in bus drivers and conductors is most probably due to continuous occupational exposure to air pollutants which have an adverse effect on respiratory functions.Kumar *et al* (2004) states that the sequence of events in chronic restrictive lung diseases begins with some form of alveolar wall injury, which results in interstitial edema and accumulation of inflammatory cells (alveolitis). If the injury is mild and self limited, resolution with restoration of normal architecture follows. However, with persistence of the injurious agent, cellular interactions involving lymphocytes, macrophages, neutrophils, and alveolar epithelial cells lead to proliferation of fibroblasts and progressive interstitial fibrosis.

This current study provides valuable information for understanding of the adverse effectsof inhaled pollutants from environment on lung function. Bus drivers and conductors are a high risk group to the effects of automobile exhaust when compared to indoor office workers.

Similar results were obtained in an earlier study, (Mbelambela *et al*, 2017) comparing lung function of bus drivers, conductors and taxi motorcyclists (exposed group) with high school teachers (control group). The prevalence of respiratory symptoms was higher in the exposed group. Chattopadhyay *et al*, (2003) states that "The PFT values are found higher in low exposed group compared to the high exposed group. A gradual trend of reduction of lung volumes as well as flow rates were found as duration of exposure increased."

In another study, (Afroz, A *et al*, 2012) , a comparative study was done among three wheeler automobile drivers on pulmonary function tests in adult males of Gulbarga city. It showed that there was a high statistically significant decrease in FVC, and FEV1 in the study group (50 males in the age group of 20–50 year, who was driving auto rickshaw for 8 hours per day for more than 5 years in Gulbarga city) , when compared to the control group (50 males of the same age group from administrative post, who were not exposed to auto rickshaw driving.) There was a statistically significant decrease in FEV_1. In addition, there was a decrease in MVV but it was not statistically significant.

Another study by Rao *et al*, (1992) was done on shopkeepers to asses their pulmonary function status stationed near six different traffic junctions of Ahmedabad in relation to the environmental oxides of nitrogen (NO_X) levels measured near those junctions. For better appreciation of the results, these junctions were categorised as heavy, medium and low based on NO_X levels and accordingly pulmonary function status was assessed. The test revealed significant reduction in FEV1/FVC ratio in shopkeepers of heavy polluted areas. This study also shows that there is a linear increase in prevalence of lung impairment from low category to heavy category of NO_X and the impairment was more of restrictive type.

CONCLUSION

From the present study it was concluded that, respiratory functions of the bus drivers and conductors who are continuously exposed to emissions from vehicles, petrol and diesel exhaust and dust, were significantly reduced as compared to respiratory functions of age, weight and height matched control groups. To prevent the pulmonary dysfunction among these groups of people, medical observation and periodic checkups for lung function tests should be performed. Control strategies should be adopted to reduce the concentration of diesel emission particles and other pollutants in the air. This can be done by preventing the use of improperly tuned and old model vehicles. Personal protective equipment like face masks must also be worn by bus drivers and conductors. Imparting health education will also prevent respiratory morbidity. Further long term prospective studies will help in getting a comprehensive picture of long term effects of exposure to air pollution.

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