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Original Research Article

Pulmonary function of automobile repair workers in the informal sector of Raichur urban

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ABSTRACT

Background: Automobile repair workers of the informal sector are exposed to dusts, toxic fumes and aerosols. Long term occupational exposure may lead to pulmonary function impairment. Hence, the objectives were to study the occurrence of obstructive and restrictive pulmonary impairment among the automobile repair workers by using pulmonary function test and the factors associated with it.
Methods: A cross sectional study was carried out in automobile repair workers who work in informal sector in the urban area of Raichur in Karnataka. The pulmonary function tests viz. Forced Expiratory volume in one second, Forced vital capacity, Peak Expiratory Flow Rate per liter and FEV_1/FVC ratio in percentage were measured for each worker in sitting posture using a digital spirometer. Data collected were analyzed in SPSS 16.0 software. Chi-square test and t test was used.
Results: Out of the 97 automobile repair workers, 42 (43.3%) had normal pulmonary function. Among the abnormal PFT, 20 (20.6%) had obstructive lung function, 25 (25.8%) had restrictive lung function and 10 (10.3%) had mixed obstructive and restrictive lung function. The workers with abnormal PFT consisted of body repair workers (25.0%), mechanical workers (38.1%), spray painters (75.0%), battery repair workers (100.0%) and tyre retreading workers (88.9%).
Conclusions: In this study, 56.7% of workers had some form of pulmonary function impairment. Smoking, increase in duration of work hours and years of work showed significant pulmonary impairment. The study highlights the need for creating awareness and encouraging the use of protective gears such as masks, early screening, diagnosis and treatment of respiratory diseases among the garage workers.

Keywords: Automobile repair workers, Informal sector, Pulmonary function tests

INTRODUCTION

A broad spectrum of adverse health effects can be seen with various occupational settings. Those range from mild reversible conditions to progressive disorders. It can be linked with the rate and duration of exposures. Automobile repair industry is one such area where workers are exposed to particulate matter (soot), carbon monoxide, welding fumes, inorganic solvents, isocyanates in paints, heavy metal poisoning and accidental injuries.[1] The diseases from toxic exposures can take a long time to become apparent and are often not reported or diagnosed as being related to work.

A vast majority of automobile repair workers in our country are employed in the informal sector or unorganized sector. Despite the presence of the Unorganized Sectors' Social Security Act (2008), practically this sector gets no social security measures.[2] These workers are employed in makeshift wayside workshops and in small ill ventilated shacks. Most of

them do not have formal education, are not aware of occupational health hazards and work without any safety measures. They earn much less in spite of unregulated work hours when compared to workers in modern garages.

Automobile repair workers are engaged in a variety of activities including mechanical work, body repair, tyre retreading, spray painting and battery repair work. This routine exposes these individuals to various occupational health hazards.[3-7] Among the various vulnerabilities, respiratory morbidity suffered by this group is highly significant. Chronic exposure may lead to Occupational asthma or COPD.[8-10] The inhalation of respirable particles stimulates one or more chemically active species and cause inflammation which leads to small airway obstruction. Cigarette smoking has an interactive effect on occupational exposure to dusts and fumes.

Adequate data regarding occupational airway diseases is necessary to identify them and to implement safety measures to reduce the occupational risks. Additional challenges include the need to protect workers from potential occupational lung diseases. Despite possible adverse health effects there have been little epidemiologic investigations on the unorganized workers with occupational exposure in automobile repair industry in India. There are no published studies regarding the occupational exposure of automobile repair workers in this region.

METHODS

This cross sectional study was conducted in the town of Raichur; a tyre-II city in north Karnataka. It comes under the Hyderabad-Karnataka region and is categorized as one of the 'more backward' thaluka in the district according to Nanjudappa Commission. The climate is dry and atmosphere is dusty most of the year. According to 2011 censes, the total population of Raichur urban is 234,073. Out of which 117,657 are males and 116,416 are females.

An automobile workshop to workshop survey was conducted to find out the number of automobile repair workers since there was no credible data about these workers. Most of the workshops were make shift structures made of tin sheet. The study period was one year. The total number of automobile repair workers in the informal sector was found to be 200. After applying inclusion and exclusion criteria 97 automobile repair workers were enrolled as total study population after taking written informed consent from them. No sampling method was used. They consisted of mechanical workers, body repair workers, spray painters, battery repair workers and upholstery workers.

Those automobile repair workers who were not willing to participate in the study, those with chronic lung disease including bronchial asthma, pulmonary tuberculosis and naso-bronchial allergy and those with bony deformities of thoracic cage like kyphosis and scoliosis were excluded from the study.

Using the interview technique, data was collected in the pre-designed, pre-tested pro-forma. They were interviewed with regard to demographic data, smoking habit and duration, duration of work, type of work and respiratory symptoms. They were also enquired about their awareness of health problems and usage of safety equipments at work place. After taking a case history, general examination was done after exposing the upper body systemic examination on cardiovascular and respiratory system was also done.

The pulmonary function test was carried out using Spirolab-III**,** a calibrated spirometer with built in computer program, using the standard laboratory methods. All the subjects were made familiar with the instrument and procedure for performing pulmonary function tests. The relevant pulmonary function tests were done on the subjects comfortably seated in an upright position with head positioned in Frankfurt plane. The subject was asked to hold the mouthpiece between lips and was asked to breathe in order to familiarize himself with the equipment. During the tests, the subject was adequately encouraged to perform at their optimum level and also a nose clip was applied during the entire maneuver.

To perform the FVC maneuver, the subjects were instructed first to breathe in deeply to their full extent. The transducer was placed in the mouth of the subject and asked to expel the air from their lungs as quickly as possible. Once all the air in the lungs has been expelled, the subject breathed in as quickly as possible, still with the transducer to the mouth, until the lungs were full. One single expiratory effort gave reading about many parameters. Out of those parameters, following were selected for study. Forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), peak expiratory flow rate (PEFR) per litre and (FEV_1/FVC ratio) ratio of forced expiratory volume in first one second to forced vital capacity, expressed in percentage was measured for each worker. Three readings were taken for each variable and the highest of the three recordings was recorded for each of the parameters**.** Patients were then classified into those with normal PFT, obstructive, restricted or mixed type based on the test results. This is depicted in Table number 1 and Figure 1. Disposable mouth pieces were used for each patient. A print out from the machine was taken which states the type of abnormal ventilatory function and observation recorded.

Data was analyzed using SPSS version 16. Chi square test and t test were used to find out the factors that were associated with abnormal pulmonary function. Binary logistic regression was used to find out the determinants of abnormal pulmonary function.

Table 1: General classification of ventilatory abnormalities according to spirometry.

Parameters	Obstructive	Restrictive	Mixed
FEV_1	Reduced	Reduced or normal	Reduced
FVC	Reduced or normal		Reduced
FEV_1/FVC	Reduced	Normal or increased	Reduced

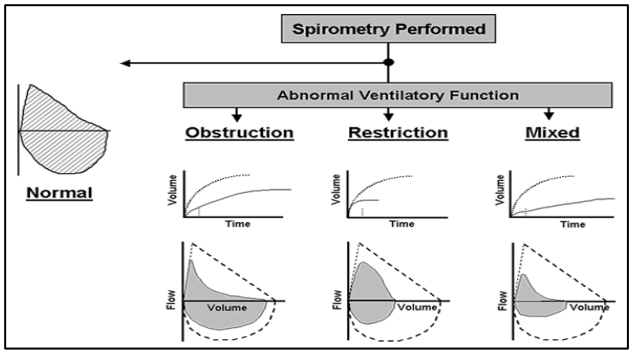

Figure 1: Schematic diagram illustrating idealised shapes of flow-volume curves and spirograms for obstructing, restrictive and mixed ventilatory defects.

RESULTS

In my study, the mean age of the study participants were 29.92 with a SD of 7.80. Out of the total 97 participants majority of them had education up to primary level as given in Table 2.

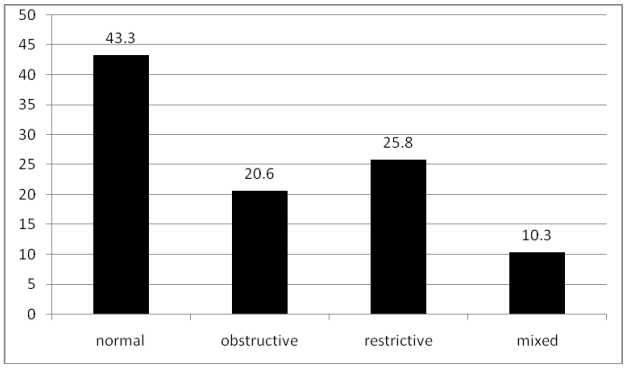

Figure 2: Distribution of study subjects based on their pulmonary function.

The mean values of FEV1, FVC, PEFR and FEV_1 / FVC ratio were less in smokers when compared to non-smokers. There is reduction in lung volumes of smokers when compared to non-smokers which is found to be statistically significant. This is shown in Table 6.

It was also observed that, as the number of working hours per day and duration of work in years increased, the percentage of workers with abnormal lung function also increased and this was found to be statistically significant as shown in Table 7 and 8.

Table 2: Distribution of study subjects based on their socio-demographic factors.

Socio-demographic factors	Frequency (n=97)	Percentage (%)
Age groups		
20-24	29	29.9
25-29	23	23.7
30-34	11	11.3
35-39	19	19.6
40-44	13	13.4
45-49	2	2.1
Education		
Illiterate	26	26.8
Primary	30	30.9
Secondary	21	21.6
Higher secondary	20	20.6
Smoking History		
Non smoker	24	24.7
Current smoker	70	72.2
Ex-smoker	3	3.1
Duration of working hours		
6-10	74	76.3
11-15	23	23.7
Years of Work		
Less than 5	33	34.0
6-10	22	22.7
11-15	14	14.4
16-20	16	16.5
More than 20	12	12.4

Table 3: Distribution of study subjects according to the respiratory morbidities.

Respiratory morbidities	Frequency (n=97)	Percentage (%)
Cough		
Present	35	36.1
Absent	62	63.9
Phlegm		
Present	9	9.3
Absent	88	90.7
Wheezing		
Present	6	6.2
Absent	91	93.8
Shortness of breath		
Present	15	15.5
Absent	82	84.5

It was observed in the study that, majority of them did not complain of any kind of respiratory symptoms such as cough (63.9%), phlegm (90.7%), wheeze (93.8%) or

shortness of breath (84.5%). This is described in Table 3 and the details of the pulmonary function test are provided in Table 4. However, the PFT revealed that 56.7% of them suffered from some form of pulmonary dysfunction such as obstructive (20.6%), restrictive (25.8%) and mixed (10.3%). This is depicted in Figure 2.

Factors such as an increase in mean age, low levels of education, habits such as smoking, occupation such as tyre treading with increasing years of work were found to be statistically associated with abnormal pulmonary function test as depicted in Table 5.

Table 4: Various parameters of the pulmonary function of the study participants.

Parameters	N	Minimum	Maximum	Mean	Std. Deviation
FEV1	97	11.50	149.10	76.7	26.18
FVC	97	28.50	150.70	88.2	25.83
PEFR	97	16.10	122.00	72.3	24.50
FEV1/FVC ratio	97	35.10	120.90	86.8	19.59

Table 5: Association of socio-demographic factors with pulmonary function test: bi-variate analysis.

Factors	Category	Normal pulmonary function	Abnormal pulmonary function	P-value
Mean age (SD)		26.40(6.93)	32.60(7.40)	0.001
Literacy	Illiterate	10(38.5%)	16(61.5%)	0.009
	Primary	7(23.3%)	23(76.7%)	
	Secondary	11(52.4%)	10(47.6%)	
	Higher secondary	14(70.0%)	6(30.0%)	
Smoking history	Current smoker	2(8.3)	22(91.7)	0.001
	Non smoker	39(55.7)	31(44.3)	
	Ex-smoker	1(33.3)	2(66.7)	

Table 6: Comparison of pulmonary function between smokers and non-smokers.

Pulmonary function	Smokers (n=24)	Non-Smokers (n=70)	t-value significance
FEV_1	62.14±6.27	81.1±82.73	3.72 p<0.0003
FVC	75.93±5.86	91.8±2.77	3.10 p<0.002
PFER	53.81±3.43	78.6±2.80	5.33 p<0.0001
FEV_1 / FVC	75.08±4.21	90.75±2.15	3.54 p<0.0006

Table 7: Distribution of study subjects with respect to duration of working hours per day and abnormal PFT findings.

Work hours	PFT result		Total
	Normal	Abnormal	
6 to 10	40 (54.1%)	34 (45.9%)	74 (100.0%)
11 to 15	2 (8.7%)	21 (91.3%)	23 (100.0%)
Total	42	55	97

χ^2 =12.914; d.f. =1 P= 0.0001.

Table 8: Distribution of study subjects with respect to years of work and abnormal PFT findings.

Years of work	PFT result		Total
	Normal	Abnormal	
< 5 years	27 (81.8%)	6 (18.2%)	33 (100.0%)
6 to 10	6 (27.3%)	16 (20.0%)	22 (100.0%)
11 to 15	6 (42.9%)	8 (57.1%)	14 (100.0%)
16 to 20	1 (6.3%)	15 (93.8%)	16 (100.0%)
> 20 years	2 (16.7%)	10 (83.3%)	12 (100.0%)
Total	42	20	97

χ^2 = 34.658; d.f. = 4 P=0.

DISCUSSION

The study found that 56.7% of the automobile garage workers had some form of pulmonary function impairment; obstructive and/or restrictive. Of the study subjects with abnormal lung function 20.6% had obstructive lung abnormality, 25.8% had restrictive abnormality and 10.3% had mixed lung function abnormality.

A study done in Kolkata by Chattopadhyay et al in similar setting revealed comparable results.[11] More than one third of the study participants were found to be suffering from abnormal lung functioning. Similar to the current study, the restrictive and obstructive types of the disease was exhibited by more than 20% of the automobile workers there. In the current study the restrictive type was slightly more prevalent than obstructive type of pulmonary malfunctioning. This pattern was observed in another study done among automobile garage workers, particularly among the spray painters.[12] This pattern of lung abnormality may be attributed to the particular chemical components they are exposed to. Studies done in developed nations among this group also exhibits lower lung functions. However, the percentage reduction of the various parameters of pulmonary function in the current study was much lower than those obtained from studies done in industrialized nations. The mean percent FEV1/FVC ratio in one such study was 96.6 as compared to 86.8 in the current study.[13] The reasons for such difference must be probed into by further studies.

Another study done in an urban area of south India reports the respiratory morbidity among automobile workers to be around 18%.[14] The assessment with spirometry further reduced this figure to 16%. Although the study settings are comparable the stark difference in the prevalence of respiratory morbidities is notable. Raichur being a dry place generates lot of dust in the atmosphere. This could also influence the lung function. Since all the workers live in the same geographical area, it was assumed that all the workers have equal exposure to atmospheric pollution. The study highlights the fact that the automobile garage workers are at a higher risk of altered pulmonary function. Hence, awareness and use of protective gears such as masks, early screening, diagnosis and treatment of respiratory diseases etc. should be encouraged among these workers.

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