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A cross sectional study of Pulmonary Function Tests in street cleaners in Aligarh, India.

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Abstract

Street cleaners are exposed to different types of dusts, Bio-aerosols and fumes . These have deleterious effect on Lung functions . So we carried out this Study to see the effect of these in occupationally exposed persons that is Street cleaners (working for more than five years). In this Cross Sectional Study the study group comprised of 110 Street cleaners (working for more than five years) of which 80 were non-smokers and 30 were smokers and 60 Control subjects of which 30 were non-smokers and 30 were smokers . The Pulmonary Functions of these workers and Control Subjects were assessed using MIR (Medical International Lab) Spiro Lab II Spirometer in sitting position after taking valid written consent. There was-statistically significant decrease in Peak Expiratory Flow Rate (PEFR) ,Forced Expiratory Volume in first second(FEV1), FEV_1/FVC ratio <80% and Forced Expiratory Flow at 25%-75% of volume as percentage of Vital Capacity (FEF 25%-75%). So we found that the Occupational exposure of the workers to harmful dust, gases and Bio-aerosols leads to Obstructive type of impairment of Lung functions .

Keywords: Pulmonary Function Tests, FEV_1 ,PEFR , $FEF_{25\%-75\%}$, Street Cleaners, MIR Spiro Lab II Spirometer

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Introduction

During ventilation lungs establish a constant threat to entry of noxious media. The noxious media which is most common in the environment is dust. Dust consists of solid particles of minerals or organic materials dispersed in air.

The Street cleaners are exposed to dust particles , Bio-aerosols and various harmful gases .The dust particles and Bio-aerosols are either swallowed or coughed out to the exterior but the smaller particles between 1-5 micrometers settle down in the smaller bronchioles as a result of gravitational precipitation. Particles smaller than 1 micron in diameter diffuse in the wall of the alveoli and adhere to alveolar fluid which are then taken up by alveolar macrophages which later on leads to tissue destruction.

The study of respiratory mechanics is done by means of Pulmonary Function Tests(PFT) [1].Aim of the study was to measure PFT among Street cleaners which are exposed to dust, Bio-aerosols and various gases and it's comparison with normal subjects and to see the effect of dust ,Bio-aerosols and gases in causation of Asthma , COPD and other Obstructive changes in the lungs of Street Cleaners [2,3,4,5].

Material and Methods

This Cross Sectional Study was done in the Department of Physiology and Department of TB and Respiratory Diseases of J.N. Medical College, Aligarh. After approval of the study from the Ethical Committee of J.N. Medical College, valid written consent was taken from all the subjects .

110 Street cleaners who were doing cleaning work from last five years were taken for study group and they were matched with 60 Control Subjects of same Sex, Age (between 18 to 50 years),Height, Race, Socioeconomic strata and Smoking history.There were no drop outs in in the Study.
Subjects with History of any Upper Respiratory Tract Infection(URTI) within 2 weeks prior to testing or having chronic medical illnesses (Diabetes, Hypertension, Renal diseases, known chronic respiratory ailments etc.) were excluded from the study.

PFT was done with the help of computerized Spirometer MIR(Medical International Research) Spiro LabII with built in printer in sitting-posture, wearing a nose clip& breathing through mouth-piece. The main Spirometric parameters were measured and all the data with flow-volume and volume-time curves were printed out by the built in printer. Recommendations of American Thoracic society (ATS)/ERS task force series were followed while performing Spirometry [6].

Following parameters were studied:

1. Anthropometry: Age, Height ,Weight .
2. Respiratory parameters: Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV_1), $FEV_{1/}$ FVC % ratio, Peak Expiratory Flow Rate (PEFR),Forced Expiratory Flow at 25%-75% of volume as percentage of Vital Capacity($FEF_{25\%-75\%}$).

Statistical Analysis
Values were recorded as mean ± S.D.(Standard Deviation)for Statistical evaluation of the data generated.
Data was evaluated according to unpaired "t" test using SPSS (Statistical Package for Social Studies) Version16.0 software.
P value < 0.05 was taken to be statistically significant with CI(Confidence Interval)of 95%.

All the Street Cleaners and Control Subjects were divided into two groups that is Smoker and Nonsmoker. Non-smoker Street cleaners were compared with Nonsmoker Control Subjects for Lung Functions (Table 1) while Smoker Street cleaners were compared with Smoker Control Subjects for Lung Functions (Table 2).

Results

Table 1 shows that non-smoker Street cleaners and non-smoker Control subjects are similar in Anthropometric terms like Age, Height and Weight. While there is statistically significant decrease in PEFR, FEV1 and $FEF_{25\%-75\%}$ with FVC not decreased significantly among these groups .It means that non-smoker Street cleaners who were working for more than five years had developed Obstructive pattern(FEV_1/ FVC ratio <80%) impairment of Lung functions.

As shown in Table 2 smoker Street cleaners and smoker Control subjects are similar in term of Age , Height and Weight . There is significant decrease in FEV1 and $FEF_{25\%-75\%}$ while FVC is not changed significantly among these two groups. It means that smoker Street cleaners who were working for more than last five years had also developed Obstructive pattern(FEV_1/ FVC ratio <80%) impairment of Lung functions.

Table 1. *Comparison between Non-smoker Street cleaners with Non-smoker Control subjects*

	Non- smoker street cleaners (n=80) Mean ± SD	**Non- smoker Control Subjects** (n=30) Mean ± SD	**P value**
Age (years)	36.06 ± 8.49	36.50 ± 8.96	NS
Height(meters)	1.70 ± 0.04	1.70 ± 0.05	NS
Weight(kilograms)	62.20 ± 9.20	61.50 ± 10.20	NS
FEV_1	63.82 ± 14.79	88.50 ± 8.80	<0.01*
FVC	85.87 ± 15.16	86.66 ± 12.92	NS
FEV_1/ FVC	<80%	>80%	$
PEFR	65.65 ± 16.22	90.16 ± 14.30	<0.01*
$FEF_{25\% -75\%}$	53.31 ± 20.20	84.00 ± 18.20	<0.01*

Values shown for FEV_1 ,FVC, PEFR, $FEF_{25\%-75\%,}$ are showing percentage predicted values for that Age, Height ,Weight, Sex, Race and Socioeconomic strata.
**means statistically significant (p value <0.05) change with CI(Confidence Interval)of 95% . NS means Non Significant change .*
$ FEV_1/ FVC % ratio indicates Obstructive pattern of impaired Lung Functions among Non-Smoker Street cleaners.

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Table 2. *Comparison between Smoker Street cleaners with Smoker Control subjects*

	Smoker Street cleaners (n=30) Mean±SD	**Smoker Control Subjects** (n=30) Mean±SD	**P value**
Age(years)	38.51 ± 11.78	37.12 ± 7.25	NS
Height(meters)	1.69 ± 0.07	1.71 ± 0.06	NS
Weight(kilograms)	61.20 ± 19.20	63.30 ± 20.30	NS
FEV1	59.96 ± 17.35	78.42 ± 16.80	<0.01*
FVC	85.00 ± 15.96	84.25 ± 11.20	NS
FEV_1/ FVC	<80%	>80%	$
PEFR	60.90 ± 16.91	60.62 ±18.22	NS
$FEF_{25\%-75\%}$	51.78 ± 19.31	72.30 ± 16.50	0.03*

- *Values shown for FEV_1 ,FVC , PEFR , $FEF_{25\%-75\%,}$ are showing percentage predicted values for that Age ,Height ,Weight ,Sex, Race and Socioeconomic strata.*
- **means statistically significant (p value <0.05) change with CI(Confidence Interval)of 95% .*
- *NS means Non Significant change .*
- *$ FEV_1/ FVC % ratio indicates Obstructive pattern of impaired Lung Functions among Smoker Sewage Workers.*

Discussion

In our study we found a decrease in PEFR, decrease in FEV_1 with normal FVC (FEV_1/FVC per cent ratio <80%) indicating an Obstructive pattern of impaired Lung Functions among these Street cleaners(Non-smokers) who were working for more than five years , further a decrease in $FEF_{25\%-75\%}$ showed that smaller airways were also getting obstructed. These findings are in accordance with the earlier work of Ramaswamy found significant decrease in pulmonary function parameters PEFR, FVC ,FEV1 in Sweepers as compared to control subjects. They also reported more decline in Pulmonary Function Test parameters with increasing duration of work [7].

Another study conducted in Delhi showed that impairment of Lung Functions in 62% of the Landfill workers employed in disposal of solid waste compared to 27% of the control subjects [8].

Various other authors have found similar decrease in Lung Functions in other Occupationally exposed workers who were exposed to dusts and Bio-aerosols etc.[5,9-14]. However a study in Calabar, Nigeria did not found a statistically significant decrease in FVC, FEV_1, and PEFR in Street cleaners as compared to Control subjects [15].

Furthermore in our study we found that the PFT parameters were also decreased in the Street cleaners who were chronic smokers and this is consistent with other studies that found that smoking aggravates the dust induced Bronchitis and airway obstruction [16-18].

The Street cleaners are exposed to dust particles , Bio-aerosols and various harmful gases.The dust and fumes to which a Street cleaner happens to be exposed usually accumulate in foci which lie in proximity to Respiratory Bronchioles and initially may not cause tissue destruction but as a Street cleaner remains persistently exposed to dust and fumes for years together it causes first the Obstructive pattern of Lung impairment then the Restrictive or mixed pattern. In our present study also we found an Obstructive pattern shown by Significant decrease in FEV_1 along with normal FVC (FEV_1/ FVC ratio <80%) .Also PEFR showed a significant decrease again showing obstruction of larger airways and the significant decrease in $FEF_{25\%-75\%}$ indicates about obstruction of smaller airways too.

Thus our study found that dust causes Obstructive pattern of Lung function impairment among Street cleaners (working for more than last five years) which is aggravated by smoking .So these Street cleaners should take proper preventive measures like use of facemask during cleaning work, use of modern equipment for cleaning work, sprinkling water on the street before doing cleaning work, stopping the smoking etc. And they should undergo regular health check-ups for early detection of Lung Function impairment for better health of this socially underprivileged group.

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