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Original Research Article

A cross sectional study of pulmonary function tests in street cleaners of Udaipur region

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ABSTRACT

Objective: The objective of this study was to compare the respiratory symptoms and pulmonary functions of dust-exposed street sweepers with those of unexposed individuals.
Materials and Methods: This Cross Sectional Study was done in the Department of Physiology, RNT Medical College, Udaipur. 84 individuals were selected via simple random sampling. These sweepers worked 8 h each day, 6 days a week, without using respiratory protective equipment. In addition to the exposure group, 80 employees with no occupational exposure to respiratory pollutants were randomly chosen from the office workers in the municipality as the control group. Participants underwent detailed direct interview, providing information of chronic respiratory symptoms, cigarette smoking, exercise history & occupational exposure along with complete physical examination.
Results and Conclusion: 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(FEV1/ FVC ratio <80%) impairment of Lung functions. 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 (FEV1/ FVC ratio <80%) impairment of Lung functions.
In conclusion, it may be said that exposure to dust in sweepers has an immediate irritating effect on the respiratory tract, leading to some degree of lung function impairment.

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1. 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.

Street sweepers play important roles in environmental health by maintaining the cleanliness of the streets; however, these individuals are exposed to many risks. Unfortunately, the socioeconomic status and educational levels of street sweepers are low, and less attention is paid to their health.[1,2]

Air contamination alludes to the arrival of toxins into the air that is unfavourable to human well-being and the planet overall. It is comprised numerous sorts of contaminations incorporating materials in strong, fluid, and gas phases.[3] Recently, the main air pollutants are vehicle outflows, including carbon monoxide, carbon dioxide, unpredictable natural mixes or hydrocarbons, and nitrogen oxides.[4] The increasing severity and duration of traffic congestion have the potential to greatly increase pollutant emissions and to degrade air quality, particularly near large roadways. Long-term effects of air pollution can cause an onset of respiratory diseases.[5]

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2. Materials and Methods

This cross sectional study was done in the Department of Physiology, RNT Medical College, Udaipur. Written consent was taken from all the subjects.

Street sweepers with more than 5 years of work experience were included in this research. Individuals with histories of asthma, COPD, tuberculosis, acute and chronic respiratory infections, abdominal or thoracic surgeries, cardiovascular diseases, diabetes and hypertension, and those with histories of working in other occupations were excluded from the study.

84 individuals were selected via simple random sampling. These sweepers worked 8 h each day, 6 days a week, without using respiratory protective equipment. In addition to the exposure group, 80 employees with no occupational exposure to respiratory pollutants were randomly chosen from the office workers in the municipality as the control group.

Individuals with histories of asthma, COPD, tuberculosis, acute and chronic respiratory infections, abdominal or thoracic surgeries, cardiovascular diseases, diabetes and hypertension, and those with histories of working in other occupations were excluded from the study.

Participants underwent detailed direct interview, providing information of chronic respiratory symptoms, cigarette smoking, exercise history & occupational exposure along with complete physical examination.

All of the participants completed the American Thoracic Society respiratory questionnaire.[6] This scale assesses the respiratory state of individuals in terms of their signs and symptoms, such as coughing, phlegm, wheezing and dyspnoea, while taking into account their smoking, work experience and medical histories. The data obtained from this questionnaire was used to determine the prevalence of respiratory symptoms between the two groups.

Following parameters were studied:

2.1. Anthropometry

Age, Height, Weight.

2.2. Respiratory parameters

Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV1), FEV1/ FVC % ratio, Peak Expiratory Flow Rate (PEFR), Forced Expiratory Flow at 25%-75% of volume as percentage of Vital Capacity(FEF25%-75%).

Spirometric test was done in between 9 to 11am in Clinical Physiology laboratory in accordance with the guidelines of pulmonary function measurements by the American Thoracic Society.[7]

Subjects performed tests on the electric auto spirometer (Medspiror machine, RMS Chandigarh) in the sitting position with nose clip. After demonstrating the required manure in group, test results were noted after performing acceptable technique 3 times and the highest value was taken.

The following parameters were recorded: forced expiratory volume (FEV), forced expiratory volume in 1 second (FEV1) forced vital capacity (FVC), vital capacity (VC). The FEV1/FVC ratios were calculated as percentages. Means and standard deviations (s) were calculated.

2.3. Statistical analysis

Values were recorded as mean $\pm$ 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) Version 16.0 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.

Nonsmoker 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).

2.4. Pulmonary function test

Pulmonary function tests (PFTs) were performed in both groups based on the standard instructions (22) using a calibrated spirometer The actual parameters that were measured included the FVC, forced expiratory volume in the first second (FEV1), FEV1/FVC ratio, peak expiratory flow (PEF) and forced expiratory flow at 25%–75% of the pulmonary volume (FEF25%–75%). Each of the participants was advised to refrain from eating and smoking for 2 h before the test, avoid heavy exercise, and wear comfortable clothes (tight clothes restrict thoracic movement).

3. 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(FEV1/ 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(FEV1/ FVC ratio $<$80%) impairment of Lung functions.

Table 1: Comparison betweennon-smoker street cleaners with non-smoker control subjects

Parameters	Non Smoker Street Cleaners (n=80) ± SD	Non Smoker Control Subjects (n=30) ± 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
FEV1	63.82 ± 14.79	88.50 ± 8.80	<0.01*
FVC	85.87 ± 15.16	86.66 ± 12.92	NS
FEV1/ FVC	<80%	>80%	-
PEFR	65.65 ± 16.22	90.16 ± 14.30	<0.01*
FEF25% -75%	53.31 ± 20.20	84.00 ± 18.20	<0.01*

*means statistically significant (p value <0.05) change with CI(Confidence Interval) of 95%. NS means Non Significant change.

Table 2: Comparison betweensmoker street cleaners with smoker control subjects

Parameters	Smoker Street Cleaners (n=30) ± SD	Smoker Control Subjects (n=30) ± 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
FEV1/ FVC	<80%	>80%	-
PEFR	60.90 ± 16.91	60.62 ±18.22	<0.01*
FEF25% -75%	51.78 ± 19.31	72.30 ± 16.50	0.03*

*means statistically significant (p value <0.05) change with CI(Confidence Interval)of 95%.

4. Discussion

In our study we found a decrease in PEFR, decrease in FEV1 with normal FVC (FEV1/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 FEF25%-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. [8]

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. [9]

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. [10–12]

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 FEV1 along with normal FVC (FEV1/ 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.

5. Conclusion

In conclusion, it may be said that exposure to dust in sweepers has an immediate irritating effect on the respiratory tract, leading to some degree of lung function impairment. Protection of the workers with appropriate respiratory protective masks and educating them suitably are recommended. Effective dust-control measures such

as wetting the surface before sweeping, definitely reduce acute respiratory health hazards. Periodic assessment of pulmonary function by spirometry has to be done.

6. Source of Funding

None.

7. Conflict of Interest

None.

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