

# A cross sectional study of pulmonary functional tests in street cleaners of city in North Karnataka

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## Abstract

**Background:** Street sweepers play important roles in environmental health by maintaining the cleanliness of the streets; however, these individuals are exposed to many risks. Occupational lung diseases are one of the major causes of respiratory morbidity and mortality especially workers working without proper protection. In present study pulmonary functional tests in street cleaners of city in north Karnataka were conducted and compared with normal subjects. **Material and Methods:** This cross-sectional study was conducted in individuals aged 21-60 years, working as street cleaners 6 days a week, without using respiratory protective equipment (cases) and compared with individuals working in medical college as a clerical staff, with no occupational exposure to respiratory pollutants (controls). **Results:** In present study, 90 street cleaners randomly selected were studied and compared with controls. Majority of cases were of 31-40 years age (35.56 %), male (65.56 %), school education  $\leq$  4th standard (56.67%), working for <8 hours/day (68.89 %), working since 10-20 years (36.67%). Smoking habit was seen in 35.56% cases, all were male. 12.22 % has history of smoking since less than 10 years, while 23.33 % had smoking history for more than 10 years. Alcoholic consumption was noted in 41.11% cases. We noted a significant difference for forced expiratory volume in one second (FEV1), forced vital capacity (FVC), peak expiratory flow rate (PEFR) and forced expiratory flow rate (FEF 25%-75%) between smoker street cleaners and smoker control subjects as well as nonsmoker cases and controls. Changes were unfavourable in street cleaners, also FEV1/ FVC was less than 80 % in street cleaner group. **Conclusion:** We noted pulmonary function test results suggestive of obstructive type of impaired pulmonary function in street cleaner group.

**Keywords:** pulmonary function test, impaired pulmonary function, street cleaner, smoking.

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## INTRODUCTION

Street sweepers play important roles in environmental health by maintaining the cleanliness of the streets; however, these individuals are exposed to many risks while

working. During street sweeping, dust moves upward through the sweeper's movements, movements of vehicles, and human traffic, so the street sweepers are constantly exposed to dust. The presence of various particles and gases from vehicular emission like carbon dioxide, carbon monoxide, sulphur, benzene, lead, nitrogen dioxide, nitric oxide and black smoke etc. play a role in the pathogenesis of respiratory diseases. Acute effects include irritation of the eyes and nose, lung function changes, headache, fatigue and nausea. Chronic exposure is associated with cough, sputum production and reduction in lung function.<sup>1,2</sup> Occupational lung diseases are one of the major causes of respiratory morbidity and mortality especially in developing countries where the majority of workers work without proper protection. Although chronic irritation of the airways from cigarette smoke is the most

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important single causal factor for developing COPD, a recent statement from the American Thoracic Society (ATS) concluded that there was sufficient epidemiologic evidence to infer a causal relationship between occupational respirable exposures and development of COPD.<sup>4</sup> It has been estimated that approximately 15–20% of the population burden of COPD is attributable to occupational exposures.<sup>5</sup> In present study pulmonary functional tests in street cleaners of city in north Karnataka were conducted and compared with normal subjects.

## MATERIAL AND METHODS

This cross-sectional study was conducted in the Department of ENT, Belagavi Institute of Medical Sciences, Belagavi, India. Study duration was of 1 years (July 2018 to June 2019). Study was started after obtaining the ethical clearance from the institutional ethics committee.

**Inclusion criteria:** Cases - individuals aged 21-60 years, working as street cleaners 6 days a week, without using respiratory protective equipment. Controls – Individuals working in medical college as a clerical staff, with no occupational exposure to respiratory pollutants.

**Exclusion criteria (cases and controls):** Individuals with histories of asthma, COPD, tuberculosis, acute and chronic respiratory infections, Individuals with abdominal or thoracic surgeries, cardiovascular diseases, diabetes and hypertension, renal diseases, Individuals with histories of working in other occupations.

The enrolled Individuals were explained the purpose of the study and the briefed about the involved non-invasive technique in the study. The workers who gave informed consent were included in the study as cases. Participants underwent detailed direct interview, providing information of socio-demographic profile, signs and symptoms, such as coughing, phlegm, wheezing and dyspnoea, work experience, personal history, smoking history, chronic respiratory symptoms, exercise history. occupational exposure, usage of personal protective measures was administered to participants, which was filled after interview, followed by routine clinical examination of the participants and medical histories. The data obtained from this questionnaire was used to determine the prevalence of

respiratory symptoms between the two groups. Spirometric test was done in between 10 to 11 am in Clinical Physiology laboratory in accordance with the guidelines of pulmonary function measurements.<sup>6,7</sup> Subjects performed tests on the electric auto spirometer in the sitting position with nose clip. 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). The parameters recorded were 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%). Smoking is a major confounding factor, for pulmonary functional tests as it can impact findings significantly. Thus we compared results of non-smoker street cleaners with non-smoker control subjects while report of smoker street cleaners were compared with smoker control subjects Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

## RESULTS

In present study, 90 street cleaners randomly selected were studied and compared with controls. Majority of cases were of 31-40 years age (35.56 %), male (65.56 %), school education ≤ 4th standard (56.67%), working for <8 hours/day (68.89 %), working since 10-20 years (36.67%). Smoking habit was seen in 35.56% cases, all were male. 12.22 % has history of smoking since less than 10 years, while 23.33 % had smoking history for more than 10 years. Alcoholic consumption was noted in 41.11% cases. For comparison majority of characteristics were matched except educational status, working hours and duration of service, as they were beyond scope of study. Mainly controls were taken in preference to match cases with regard to smoking status.

**Table 1:** General characteristic

Characteristic	Cases (n=90) (%)	Percentage	Controls (n=90) (%)	Percentage
Age group (in years)				
21-30	29	32.22%	31	34.44%
31-40	32	35.56%	26	28.89%
41-50	19	21.11%	21	23.33%
51-60	10	11.11%	12	13.33%
Gender				
Male	59	65.56%	61	67.78%
Female	31	34.44%	29	32.22%

Educational status				
school education ≤ 4th standard	51	56.67%	7	7.78%
school education > 4th standard	29	32.22%	93	103.33%
Working hours				
≤8	62	68.89%		
>8	28	31.11%		
Duration of service				
≤10 years	34	37.78%		
10-20 years	33	36.67%		
>20 years	23	25.56%		
Other				
Smoking habit				
Less than 10 years	11	12.22%	11	12.22%
More than 10 years	21	23.33%	21	23.33%
Alcoholic consumption				
	37	41.11%	19	21.11%

On comparison between non-smoker street cleaners with non-smoker control subjects we noted a significant difference for forced expiratory volume in one second (FEV1), forced vital capacity (FVC), peak expiratory flow rate (PEFR) and forced expiratory flow rate (FEF 25%-75%), also FEV1/ FVC was less than 80 % in street cleaner group.

**Table 2:** Comparison between non-smoker street cleaners with non-smoker control subjects

Characteristic	Non Smoker Street Cleaners (n=60)	Non Smoker Control Subjects (n=60)	p Value
Age (years)	38.62 ± 9.29	39.01 ± 8.99	0.783
Forced Expiratory Volume in one second (FEV1)	66.22 ± 16.27	85.22 ± 11.23	< 0.001
Forced Vital capacity (FVC)	81.27 ± 12.65	88.39 ± 15.92	0.042
FEV1/ FVC	<80%	>80%	
Peak Expiratory Flow rate (PEFR)	63.88 ± 17.09	89.65 ± 16.24	<0.001
Forced Expiratory flow rate (FEF25%-75%)	61.44 ± 19.92	86.21 ± 16.41	<0.001

We noted a significant difference for forced expiratory volume in one second (FEV1), forced vital capacity (FVC), peak expiratory flow rate (PEFR) and forced expiratory flow rate (FEF 25%-75%) between smoker street cleaners and smoker control subjects. Changes were unfavourable in smoker street cleaners, also FEV1/ FVC was less than 80 % in smoker street cleaner group.

**Table 3:** Comparison between smoker street cleaners with smoker control subjects

Characteristic	Smoker Street Cleaners (n=30)	Smoker Control Subjects (n=30)	p Value
Age (years)	39.12 ± 10.37	38.89 ± 9.61	0.625
Forced Expiratory Volume in one second (FEV1)	59.96 ± 17.35	78.42 ± 16.80	<0.001
Forced Vital capacity (FVC)	69.34 ± 16.26	78.34 ± 15.31	0.002
FEV1/ FVC	<80%	>80%	-
Peak Expiratory Flow rate (PEFR)	56.29 ± 15.81	64.26 ± 13.56	0.008
Forced Expiratory flow rate (FEF25%-75%)	59.37 ± 18.14	69.91 ± 18.34	0.042

## DISCUSSION

Relatively high concentrations of exposure of traffic fumes affects urban workers such as traffic policemen, street sweepers, postal workers, and newspaper vendors, indicating health risks related to outdoor environment. Work-related asthma (WRA) and occupational chronic obstructive pulmonary disease (COPD) are serious and sometimes fatal diseases, which can lead to ill health, inability to work and lost productivity.<sup>8</sup> Pulmonary function test (PFT) play a crucial role in the diagnostic evaluation of patients with various lung diseases, such as obstructive airways diseases, restrictive lung diseases, neuromuscular disorders, vocal cord disorders, and upper airways obstructions.<sup>9</sup> Pushparani JP *et al.*,<sup>10</sup> studied 73

street sweepers and sanitary workers, 67.1% were females, 2/3rd of them belonged to the age group of 30-40 years. Majority of them (82.2%) had reported to have musculoskeletal problems followed by respiratory problems (61.6%), ophthalmic problems (53.4%), skin problems (38.4%), mental health problems (39.7%). Most of the respondents had multiple problems. Musculoskeletal problems were more common among the female workers (p=0.002). Health problems like headache, fatigue, giddiness were more common among the workers who worked for >5 years (p=0.006). The utilization of health services was better among those workers who had formal school education (p=0.042). Nayera S. *et al.*,<sup>11</sup> studied 107 street sweepers and 104 office workers. The percentage of

participants with reduced FEV<sub>1</sub>, reduced FVC and reduced FEV<sub>1</sub>/FVC were significantly higher in the sweepers than in the control group (62.1% versus 34.6%, 58.3% versus 44.2%, and 32% versus 18.3% respectively). Chronic cough was also significantly higher in the sweepers than in the control group (17.5% versus 5.8%). Reduced FVC% was significantly associated to older age and longer duration of employment. Reduced FEV<sub>1</sub>/FVC was positively associated to smoking among sweepers. The results of the study by Priyanka VP<sup>12</sup> showed that, Peak Expiratory Flow Rate values were lower in exposed workers (sample population) as compared with control group. These workers were exposed to number of environmental and occupational hazards leading to musculoskeletal disorders (100%), respiratory problems (95%), dermatological problems (90%), headache (75%) and gastrointestinal problems (15%) during work. It was further observed that these workers were suffering from allergies (100%), cough and cold (75%), asthma and bronchitis lungs (65%), hearing disorder (50%), malaria and typhoid (25%), fever (15%) and vomiting (10%) after completion of work. In a similar study Sangolli B *et al.*,<sup>13</sup> noted that respiratory symptoms of cough (30%), chest pain (17.5%), sneezing (21.5%) were found to be in higher percentage among the municipal street sweepers than the controls. Only 20% of participants municipal street sweepers used personal protective measures, wearing protective masks, regularly in the past 1 year, during sweeping streets. It was found that FEV<sub>1</sub>, FEV<sub>1</sub>/FVC, PEFR and FEF 25%-75% were significantly lesser among non-smoker street sweepers, when compared with that of non-smoking controls. Similarly, these PFT values were significantly reduced among the smoker street sweepers and among the sweepers who didn't use protective masks while sweeping. Similar findings were noted in present study. Sharma M<sup>14</sup> found that non-smoker Street cleaners who were working for more than five years had developed Obstructive pattern (FEV<sub>1</sub>/ FVC ratio <80%) impairment of Lung functions. Smoker Street cleaners who were working for more than last five years had also developed Obstructive pattern (FEV<sub>1</sub>/ FVC ratio <80%) impairment of Lung functions. exposure to dust in sweepers has an immediate irritating effect on the respiratory tract, leading to some degree of lung function impairment. Ajay KT *et al.*,<sup>15</sup> noted a statistically significant decrease in the level of FVC, FEV<sub>1</sub> and PEFR in sweepers compared to control group. It was also observed that the level of FVC, FEV<sub>1</sub> and PEFR decreased with increase in duration of sweeping. There was statistically significant decrease in the level of all values within first five years of sweeping. The reduction in FEV<sub>1</sub> and PEFR is associated with chronic sweeping can be partially explained by loss of lung elastic recoil pressure which reduces the force required to drive air out

of the lung. This loss of elastic recoil pressure is attributed to microscopic enlargement of air spaces rather than to grossly visible emphysema Street cleaners are physically stressed and exposed to bioaerosols which can cause musculoskeletal and respiratory symptoms. When cleaning public facilities or emptying garbage cans, they may suffer from cut injuries, skin irritations and infections. Because they mostly work outdoors, they are exposed to cold, wind or heat. Environmental/traffic pollution (dust, particulate matter, ozone, carbon monoxide, nitrogen oxides) and natural UV exposure have to be taken into account as well.<sup>16</sup> Particulate matter of <1 µm size can reach the smaller bronchioles, diffuse in the alveolar fluids and eventually lead to tissue destruction, further resulting in various lung disorders.<sup>17</sup> The use of respiratory protection like face mask is an effective preventive measure to reduce airborne dust entry into lungs during sweeping.<sup>7,17</sup> At present, the standards and norms for the management of wastes in industrialized countries have substantially reduced the occupational health impacts. In developing countries, however, the health-related underpinnings of solid waste management still need to be addressed. For instance, workers manually collect wastes.<sup>18</sup>

## CONCLUSION

We noted that FEV<sub>1</sub>, PEFR and FEF 25%-75% values were significantly lesser among non-smoker street sweepers as well as smoker street sweepers when compared with control subjects. Also, FEV<sub>1</sub>/ FVC ratio <80% was noted among non-smoker street sweepers as well as smoker street sweepers suggestive of Obstructive type of impaired pulmonary function.

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