

A Study of Impairment of Lung Functions in Adult Sweepers

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Abstract:

Street sweepers play an important role in maintaining the health and hygiene in the cities. Sweepers are exposed to dust while cleaning the streets and roads. The dust raised by street sweeping consists of a complex mixture of soil, sand particles, dust, motor vehicle tear and wear particles, bioaerosols, plant particles etc. Exposure to these dusts irritate the respiratory tract leading to varying degrees of respiratory symptoms and airway obstruction.

50 female sweepers by profession and age matched 50 healthy females were selected for the study. A brief history was taken and clinical examination of the respiratory system and other systems were done to exclude medical problems and to prevent confounding of results.

There was statistically significant decrease in the level of FVC, FEV₁ & PEFR in sweepers compared to control group. It was also observed that the level of FVC, FEV₁ & PEFR decreased with increase in duration of sweeping. There was statistical significant decrease in the level of all values within first five years of sweeping.

The reduction in FEV₁ & 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.

Key words: Sweepers, Lung Functions

INTRODUCTION

Street sweepers play an important role in maintaining the health and hygiene in the cities. This job exposes street sweepers to a variety of risk factors such as dust, bioaerosols, volatile organic matter and mechanical stress, which make them susceptible to certain occupational diseases.(1-3) The important morbid conditions detected in these workers include the diseases of the respiratory system and eye, accidents, injuries, cuts and wounds, skin infections, animal bites, etc.(4-7) At present, the standards and norms for the management of municipal solid wastes in industrialized countries have substantially reduced the occupational health impacts. However, in developing countries, the health related underpinnings of solid waste management still need to be addressed. Workers manually collect the wastes. There is little, if any, protection to workers from direct contact and injury and virtually no dust control at the workplaces. Solid waste collectors are exposed to large amount of dusts, microorganisms, toxins and diesel exhaust pollution than the recommended norms⁸. Sweepers are exposed to dust while cleaning the streets and roads. The dust raised by street sweeping consists of a complex mixture of soil, sand particles, dust, motor vehicle tear and wear particles, bioaerosols, plant particles etc¹. Exposure to these dusts irritate the respiratory tract leading to varying degrees of respiratory symptoms and airway obstruction.⁹ Tiny particulates that migrate far into the respiratory system are generally beyond the body's natural cleaning mechanisms such as mucociliary clearance and are likely to be retained.¹⁰

OBJECTIVES

1. To study the lung functions of sweepers in terms of Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV₁), Ratio of FEV₁/FVC, Forced Expiratory Flow in the middle half of FVC (FEF₂₅₋₇₅) and Peak Expiratory Flow Rate (PEFR).
2. To study the similar lung function parameters of appropriately matched controls .
3. To compare the results of the above two groups and hence study the effect of smoking on lung functions in early adults.

MATERIAL AND METHODS.

The present study was conducted in the Department of Physiology, J.J.M. Medical College, Davangere.

The study was undertaken to observe the effects of dust particles on the lung functions of sweepers of age group 20-40 years. This is done by comparing the lung functions of sweepers with the lung functions of healthy adult female subjects. The duration of sweeping in years is also considered to see the dose response relationship.

50 female sweepers by profession and age matched 50 healthy females were selected for the study. A brief history was taken and clinical examination of the respiratory system and other systems were done to exclude medical problems and to prevent confounding of results

All the subjects gave an informed consent after detailed procedure of the non-invasive technique was explained to them. A brief personal history, smoking history and a clinical examination of all the systems were done to

exclude medical problems and to prevent confounding of result.

The lung functions of all the subject were done in the morning session (Between 11 am to 1 pm) of the college hours. The physical characters such as height in centimeters and weight in kilograms of all the subjects were recorded.

All these personal information like Age, Sex and a brief history were entered in the patient information chart giving a separate ID for each subject.

We used an RMS MEDSPIROR for measuring the lung functions. This Spiro -meter has a mouth piece attached to a transducer assembly which is connected to an adaptor box and this is connected to the computer by a serial cable. A software from Recorders and Medicare system is loaded onto the computer. This software allows the calculation of the predicted values for age, sex, weight and height and it also gives the recorded values of all the parameters.

Subjects were motivated prior to the start of maneuver. The subjects were made to sit on a stool, we would attach a nose clip and ask the subject to take a maximum inspiration and then place the mouth piece firmly in mouth and ask him to execute a maximum forced expiration with full efforts, and this is followed by a maximum forced inspiration.

The test was performed over 3 maneuvers. The tests with the best maneuver was selected. The machine gives us the comparison of various parameters between 3 maneuvers and we accepted the best maneuver.

The parameters were Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV₁) & Peak Expiratory Flow Rate (PEFR) was considered

The results for each parameter were compared between the two groups and statistically analysed.

Statistical Analysis

Data was subjected for analysis using students unpaired 't'-test (two-tailed) for comparison between the groups. p value of 0.05 or less was taken as significant and one way ANOVA for multiple group comparison.

RESULTS:

FVC : The Actual Value of FVC (L) in normal healthy females was 3.17 ± 0.036 ($91.9 \pm 5.2\%$ of percentage predicted). The Actual Value of FVC (L) in sweepers was 2.51 ± 0.35 ($73.7 \pm 5.6\%$ of percentage predicted). There was statistically significant decrease in the level of FVC in sweepers compared to control group ($P < 0.001$) (Table 1).

FEV₁ : The Actual Value of FEV₁ (L) in healthy females was 2.89 ± 0.35 ($98.3 \pm 6.6\%$ of percentage predicted). The Actual Value of FEV₁ (L) in Sweepers was 1.99 ± 0.36 ($68.7 \pm 6.8\%$ of percentage predicted). There was statistically significant decrease in the level of FEV₁ in sweepers compared to control group ($P < 0.001$) (Table 2)

PEFR : The Actual Value of PEFR (L/Sec) in healthy non Sweepers was 8.23 ± 0.90 ($91.4 \pm 6.6\%$ of percentage predicted). The Actual Value of PEFR (L/Sec) in Sweepers was 5.83 ± 0.81 ($65.3 \pm 6.9\%$ of percentage predicted). There was statistically significant decrease in the level of PEFR in sweepers compared to control group. ($P < 0.001$) (Table 3).

TABLE 1: COMPARISON OF FVC BETWEEN NON SWEEPERS AND SWEEPERS

Groups	N	Actual value (L)		% Predicted	
		Range	Mean \pm SD	Range	Mean \pm SD
Non sweepers	50	2.18 – 4.10	3.17 ± 0.036	77.7 – 105.6	91.9 ± 5.2
Sweepers	50	1.56 – 3.24	2.51 ± 0.35	64.5 – 88.1	73.7 ± 5.6
Mean difference		0.66		18.2	
Significance	T	12.9		23.8	
	P	< 0.001 HS		< 0.001 HS	

TABLE 2 : COMPARISON OF FEV₁ BETWEEN NON SWEEPERS AND SWEEPERS

Groups	n	Actual value (L)		% Predicted	
		Range	Mean \pm SD	Range	Mean \pm SD
Non Sweepers	50	2.12 – 4.10	2.89 ± 0.35	82.7 – 111.0	98.3 ± 6.6
Sweepers	50	1.09 – 2.59	1.99 ± 0.36	55.3 – 81.7	68.7 ± 6.8
Mean difference		0.90		29.4	
Significance	t	18.0		31.0	
	p	< 0.001 HS		< 0.001 HS	

TABLE 3: COMPARISON OF PEFR BETWEEN NON SWEEPERS AND SWEEPERS

Groups	N	Actual value (L/sec)		% Predicted	
		Range	Mean \pm SD	Range	Mean \pm SD
Non Sweepers	50	5.40 – 10.6	8.23 ± 0.90	79.2 – 110.4	91.4 ± 6.6
Sweepers	50	4.17 – 7.68	5.83 ± 0.81	53.4 – 82.3	65.3 ± 6.9
Mean difference		2.40		26.1	
Significance	t	19.9		27.3	
	p	< 0.001 HS		< 0.001 HS	

It was also observed that the level of FVC, FEV₁ & PEFr decreased with increase in duration of sweeping. There was statistical significant decrease in the level of all values within first five years of sweeping (P < 0.001). (Table 4).

TABLE 4 : COMPARISON OF LUNG FUNCTION PARAMETERS WITH RELATION TO DURATION OF SWEEPING

Duration (yrs)	N	FVC (% Pred.)	FEV ₁ (% Pred.)	PEFR (% Pred.)
1-5	24	81.0 ± 5.7	77.4 ± 2.5	74 ± 4.2
6-10	29	73.6 ± 2.5	70.6 ± 4.4	64.6 ± 2.8
11-15	8	72.3 ± 1.3	68.3 ± 1.6	63.6 ± 3.8
16-20	24	70.7 ± 3.1	64.0 ± 3.0	60.5 ± 2.0
ANOVA	F	39.4	89.6	99.4
	P	< 0.001, HS	< 0.001, HS	< 0.001, HS

DISCUSSION:

In our environment, street sweeping with brooms without precautionary measures will affect the respiratory system. Inhalation of foreign materials can cause the lungs to react in wide variety of ways, irritating the airways, exacerbating the conditions such as asthma and setting up an inflammatory reaction and fibrosis.¹¹ Several studies have reported an increase in occupational lung diseases in women especially occupational asthma and airway diseases. This may due to increasing participation by women in occupations which were previously predominantly male. There is also evidence that airway deposition of aerosol in women's larger airways is more when compared to men and that women may be more susceptible to developing chronic bronchitis, though this potential to increased susceptibility has not been assessed in relation to work exposures.¹²

There is increase in occupational lung disease in women sweepers as participation of women as sweepers is more in India. The present work specifically focuses on how the occupational environment affects women's respiratory health. We have analyzed the relationship between the pulmonary function impairment and the duration of exposure to dust in female sweepers. The results of the present study showed a significant reduction in the mean values of FVC, FEV₁ & PEFr, in sweepers as compared with their matched controls, as well as directly proportional impairment of their lung function parameters to the duration of exposure.

FVC measures "Ventilable" lung volume; a decrease therefore reflects, (1)Restriction secondary to pulmonary or pleural fibrosis. & (2)Air trapping secondary to airway obstruction.¹³ The decreased FVC in my study might be due to second cause

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CONCLUSION:

The occupation related lung diseases in sweepers are most likely due to the deposition of harmful airborne dust particles that are inhaled during sweeping. If the abnormalities are detected early and if further exposure to dust is avoided irreversible diseases may be avoided. The following precautions are recommended to reduce the dust exposure during sweeping. Instead of using short handled brooms, work force may be advised to use long handled brooms which will reduce the amount and direct exposure to dust. The use of respiratory protection like face mask is the most widely used preventive measure which reduces airborne dust entry into lung during sweeping. Workers may be limited to three or four days of sweeping per week. Watering the street prior to sweeping will considerably reduce the dust.

REFERENCES:

- Krajewski JA, Tarkowski S, Cyprowski M, Szarapinska-Kwaszewska J, Dudkiewicz B. Occupational exposure to organic dust associated with municipal waste collection and management. *Int J Occup Med Environ Health* 2002;15:289-301.
- Dutkiewicz J. Bacteria and fungi in organic dust as potential health hazard. *Ann Agric Environ Med* 1997;4:11-6.
- Sigsgaard T, Hansen JC, Malmros P. Biomonitoring and work related symptoms among garbage handling workers. *Ann Agric Environ Med* 1997;4:107-12.
- Diggikar UA. Health status of street sweepers with reference to lung function tests [Dissertation]. Pune University; 2004.
- Nagaraj C, Shivram C, Jayanthkumar K, Murthy NN. A study of morbidity and mortality profile of sweepers working under Bangalore City Corporation. *Indian J Occup Environ Med* 2004;8:11-6.
- Gupta SC. A Socio-Medical survey of sweepers and their families in Lucknow Municipal Corporation [Dissertation]. Lucknow University; 1962.
- Study of health profile of street sweepers Pune Municipal Corporation. [Dissertation]. Pune University; 1986.
- Cointreau-Levine S. Occupational and environmental health issues of solid waste management 1995 Feb [cited on 2004 Jan 5]. <http://wgbis.ces.iisc.ernet.in/energy/paper/privatesector/collection.html>.
- Yogesh SD, Zodpey SP. Respiratory morbidity among street sweepers working at Hanumannagar Zone of Nagpur Municipal Corporation, Maharashtra. *Indian J Public Health*. 2008;52(3):147-49.
- Morgan WKC, Seaton A. Silicosis. In: Occupational lung diseases. 3rd ed. Philadelphia: WB Saunders Company, 1995: 222-37.
- Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL. Environmental lung diseases. In: Harrison's principles of Internal Medicine. Vol.2. 16th ed. New York: The McGraw Hill Companies, 2008: 1521-27.
- Wai Y, Tarlo SM. Occupational lung disease in women. In: European Respiratory Society Monograph. Vol. 25; 2003:131-141.
- Amato F, Querol X, Alastuey A, Pandolfi M, Moreno T, Gracia J, et al. Evaluating urban PM10 pollution benefit induced by street cleaning activities. *Atmospheric Environment*. 2009 ;43:4472-80.