Spirometry pattern and respiratory symptoms in sweepers

Hadi Eshaghi Sani [1]   Mona Najaf Najafi [2]   Hamid Sharifi [3]

[1] Department of Occupational Medicine, Faculty of Medicine, Hormozgan University of Medical Sciences, Bandar Abbas, Iran.
[2] Department of Community of Medicine, Clinical Research Unit, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.
[3] Rezident, Department of Occupational Medicine, Faculty of Medicine, Hormozgan University of Medical Sciences, Bandar Abbas, Iran.

Original Article

Abstract

Correspondence:
Hamid Sharifi, MD.
Department of Occupational Medicine, Hormozgan University of Medical Sciences.
Bandar Abbas, Iran
Tel:+98 9151583114
Email:
Sharifih3@mums.ac.ir

Introduction: Multiple and sometimes contradictory evidence exists on the relationship between dust exposure and respiratory symptoms with pulmonary disorders. The study was conducted to examine the effects of chronic exposure to street dust on the pulmonary parameters and respiratory complaints in sweepers.

Methods: This cross-sectional study was conducted on 100 sweepers working in district 3 Bandar Abbas municipality in 2014. The control group was selected from the staff of the same municipality with an office/administrative position who lacked occupational respiratory exposures. In order to investigate pulmonary parameters, spirometry with Spirolab MIR3 were performed and FVC, FEV1, FEV1/FVC, PEF and FEF25-75 parameters were measured. Data were analyzed using STATA 12 software. Two Way ANOVA was used to compare respiratory parameters between two groups.

Results: Prevalence of respiratory symptoms including cough, sputum, shortness of breath and wheezing had no significant differences in two groups. Values of FEV1, FEF25-75 and PEF showed significant decrease when adjusted for the effect of smoking on sweeper compared with administrative personnel ($P < 0.05$). There were no statistically significant differences between two groups and other variables of FVC and FEV1/FVC.

Conclusion: It seems that sweepers cleaning street, who are constantly exposed to dust, are at risk of developing respiratory symptoms and decline in spirometric indices. It is useful to apply protective measures to prevent exposure to dust and to perform annual spirometry for early detection of respiratory disorders in sweepers.

Key words: Spirometry, Dust, Respiratory Symptoms

Introduction:

Sweepers are exposed to numerous risks during the work, such as dust, bioaerosols, volatile organic materials and mechanical stresses, making them sensitive to occupational diseases. Most important diseases in this group of workers include problems in respiratory system, eyes, accidents, injuries, cuts, skin infections, animal bites, etc. (1,2). 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 (3). This dust contains a mixture of soil, sand, vegetable particles etc (4). Exposure to

dust irritates the respiratory system leading to varying degrees of respiratory symptoms and airflow obstruction (3). These small particles are usually passed through natural cleaner mechanisms, such as mucociliary clearance numerous and replace in the lungs (5). Replacement of these particles in the lung causes the release of various cytokines resulting in inflammatory reactions and tissue damage. This reaction may cause irritation of the airways and exacerbate asthma and fibrosis (6).

Occupations related to the increased prevalence of respiratory diseases include construction, leather, rubber workers, food products, textile, spray painters and welders (7,8). Substances that have been associated exclusively with the increased prevalence of lung diseases include quartz, asbestos, solvents, wood dust and welding fumes (9,10). Increased resistance and airway changes are usually reversible, so if disorders are diagnosed early and further exposure to risk materials is avoided, the onset of irreversible disease can be prevented (11). Since there is no automated system to collect garbage in Bandar Abbas and street sweepers of the municipality do not use the proper protective equipment, the present study was conducted to determine the effects of exposure to dust on the respiratory status of Bandar Abbas sweepers and compare the results with a group of people who do not have occupational exposure to dust particles.

Methods:

In this cross-sectional study, which was conducted in 2014, 100 sweepers working in district 3 Bandar-Abbas municipality entered the study for the examination of spirometric lung pattern with respiratory symptoms. Moreover, 100 people were included as the control group from the administrative staff of the same district. In the present study, participants were selected by convenience sampling method and participants in the study were selected according to the criteria of three years of work experience. The participants agreed with their full satisfaction with examining their demographic and clinical data.

These people were referred to the clinic of occupational medicine Clinic, Hormozgan University of Medical Sciences, to complete occupational health records. Since the examination was compulsory, all sweepers and administrative staff were sent for examination. Participants in the study were referred to occupational medicine clinic for occupational health examinations. Standard form for occupational health examinations was used to collect personal information (approved by the office of environmental health and ministry of health). Spirometry was performed with Spirolab MIR3. Firstly, height and weight were measured using a digital stadiometer scale by the residents of occupational medicine center. Height, weight, sex and date of birth were recorded and standard values were determined for each individual according to the machine standards for caucasians. Spirometer was calibrated on a daily basis and in accordance with the recommendations of the American Thoracic Society (15).

According to the Association of Thoracic America, subjects were informed not to eat heavy meal 3 hours prior to admission as well as not to use tobacco about an hour ago and be sure to wear loose and comfortable clothing. After providing an adequate description of how to perform the test and checking its contraindications, testing was performed in sitting position. According to the information received, spirometry specified the expected values for spirometry parameters for each individual. By means of spirometry, the measured values for each individual were divided into these values and percentage of respiratory parameters per person was calculated. Breathing pattern was recorded in the device data and charts. After obtaining at least three acceptable tests (in accordance with the Thoracic Society of America), the best test was selected. By these tests - FVC, FEV1, FEV1/FVC, PEF and FEF25-75 - the parameters were measured and information and diagrams were interpreted in accordance with the Thoracic Society of America and spirometry patterns (obstructive, restrictive, and mixed) were obtained for the two groups. The analyzed data was collected using STATA 12 software. To compare quantitative variables of height and weight, independent T-test was used along Mann-Whitney test for age and experience. Fisher's exact test was also used to compare the qualitative variables between two groups. Moreover, Two Way ANOVA test was used to compare respiratory

parameters between two groups. Since age, height and weight were considered in the calculation of measured spirometry parameters in percentage by machine, the above variables did not need adjustment and smoking was just adjusted in the model. In all tests, p-value less than 0.05 was considered statistically significant.

Results:

The study was conducted on 100 sweepers and 100 administrative personnel. The average age of sweepers was 31. 89±7.31 with the control group having an average age of 38.07±7.64. Demographic information of sweepers and control groups are shown in Table 1.

Table 1. Demographic data of sweeper and control group

Variable	Sweepers	Control group	p-value
Age	31.89 ± 7.31	38.07± 7.64	<0.001*
Height	171.55 ± 7.29	172.57± 6.78	0.31&
Weight	62.27 ±10.08	75.36± 12.82	<0.001&
Work experience	5.69 ± 2.95	7.3± 6.15	0.54*

*Mann-Whitney test, &independent t-test

During examination of sweepers and control group regarding the respiratory symptoms, no statistically significant differences were found between two groups (P=0.75). Concerning the pulmonary signs during examination, there were no significant differences.

Table 2 shows the prevalence of respiratory data in both groups.

Table 2. Clinical data of sweepers and control group

Symptom	Control group	Sweepers	P-value
Hoarseness	0	3 (3%)	0.123
Wheezing	1 (1%)	2 (2%)	0.751
Crackle 1	1 (1%)	1 (1%)	0.751

Three sweepers (3%) and 12 subjects (12%) of the control group were smoking, showing statistically significant difference in this regard with higher percentage of subject smoking in the control group (P=0.015). Average values of measured percent for spirometry parameters are listed in Table 3.

Table 3. Average values for measured percentage for spirometric parameters

Parameter (percent)	Sweeper	Control group	P-value
FVC*	10.76±91.86	14.3±94.20	0.23
FEV1**	11.96±87.82	13.14±92.76	0.006
FEV1/FVC	6.63±80.24	5.70±81.75	0.063
FEF$_{25-75}$&	21.37±75.11	23.09±82	0.019
PEFᵒ	15.74±83.69	14.92±89.13	0.013

* Forced Vital capacity; ** Forced Expiratory Volume in one second; & Forced Expiratory flow rate; ᵒ Peak Expiratory Flow. All the above parameters were calculated and compared after adjusting two groups based on the variable for smoking.

As is seen, the values of the measured percent for FEV1, FVC, FEV1/FVC, FEF25-75 and PEF parameters in the sweepers are lower than that of the control group. The loss for FEF25-75, PEF FEV1 parameters is significant according to statistical tests.

According to the spirometry results, in 5 sweepers (5%) and 2 subjects (2%) of the control group, a restrictive pattern was observed; in 9 sweepers (9%) and 6 subjects (6%) of the control group, obstructive pattern and mixed pattern in 2 sweepers were observed.

Conclusion:

According to the results of the study, there was no significant difference between the two groups in terms of pulmonary signs and symptoms. Regarding the expected mean percentages for spirometry parameters, the following percentages were measured for sweepers: FVC, FEV1, FEV1/FVC, FEF25-75 and PEF. All these percentages were lower than those obtained for the control group. This difference was statistically significant between these three parameters, i.e., FEV1 FEF25-75 and PEF. In studies that had examined the prevalence of respiratory symptoms in sweepers compared to control group, different results were obtained. In a study, rate of chronic bronchitis, asthma and bronchiectasis among the sweepers was obtained 8.1% and 2.1% in the control group, which showed a statistically significant difference between two groups (1). In addition, another study was carried out on sweepers with less than two years of work experience. The incidence of cough was (25.5%), sneezing (6%), chest pain (13%), which showed significant

differences in the prevalence of these symptoms compared with the control group (3). In another study, the prevalence of respiratory symptoms among sweepers was as follows: nasal irritation (50%), sneezing (64.6%), rhinitis (40%), cough (36.6%) and wheezing (23%). The difference in the prevalence of above symptoms between two groups was statistically significant, but the prevalence of other respiratory symptoms such as chest heaviness, chest pain and shortness of breath, lacked significant differences between two groups (16).

From our findings, it can be concluded that, although prolonged exposure to dust did not cause obvious symptoms of respiratory in sweepers, it resulted in a decline in spirometric parameters and lung volume that can be detected by spirometry during the periodical examinations. Regarding the prevalence of restrictive and obstructive patterns, no significant difference was observed between two sweeper and control groups. Due to the significant decline in FEF 25-75 and PDF spirometry parameters, it can be inferred that these exposures may cause obstructive changes in the small airways. In several studies conducted in various countries, especially the developing countries concerning the lung functions in exposure to dust, in most cases, chronic exposure to dust in sweepers and other occupations has led to a reduction in the spirometric pulmonary function parameters, although in a few of these studies, the reduction was not statistically significant compared to the control group. For example, a study was carried out in 2005 in Nigeria that investigated lung function in female street sweepers in Calabar and compared the results with a control group. Although the prevalence of some respiratory symptoms in sweepers was higher than the control group, the mean values of FVC, FEV1, FEV1/FVC and PEFR parameters with the control group showed no significant difference. Although there was no significant difference between the mean values of the parameters between two groups, the mean values were numerically lower than the control group in street sweepers, indicating that chronic exposure to this dust has caused a gradual impairment in lung function (3). Our results are somewhat similar to results of a study conducted in 2014 in India. In this study, spirometric parameters in 30 female sweepers were specified and the data obtained were compared with 30 healthy women.

Mean pulmonary parameters, including FEV1, FVC, PEFR, FEF25-75 and FEF200-1200, showed lower values in the sweepers than the control group and the difference was statistically significant. This reduction in the mean values of pulmonary parameters was high with increasing exposure to dust. Percent FEV1/FVC was slightly increased but no significant difference was observed between two groups in this parameter. The study showed that chronic exposure to dust in sweepers can cause reduction in pulmonary function parameters. Marked decrease in the value of FEF25-75 implies obstruction of the small airways (11). Another study was conducted on the sweepers and study groups were separated in terms of smoking and non-smoking. The mean percentage of expected values for pulmonary parameters of FVC, FEV1 and FEV1/FVC was measured and these values were compared with the control group. The mean percentage of expected values for pulmonary parameters in sweepers was lower than the control group and there was a statistically significant difference between two groups. Also with increasing duration of exposure to dust and work experience, lung function in sweepers was higher. The study showed that exposure to dust causes obstructive spirometric pattern in the sweepers (12).

In addition, in the study where inclusion criteria for sweepers were considered experience work in more than three years, the study showed a significant decrease in the parameters of PEFR, FEV1 and FEF25-75 in the sweepers than the control group, but did not show a significant decrease in FVC. Meanwhile, the mean percent of FEV1 / FVC was less than 80%. All of the above can be indicative of the fact that sweepers with more than 5 years of work experience, had spirometric obstructive pattern (13). In a study, the acute effects of dust on pulmonary function of street sweepers on 25 female sweepers and 25 healthy women were studied. One spirometry was performed for sweepers and control groups before and after the sweeping. Mean values and percent expected for the parameters FVC, FEV1, PEFR, FEF25-75 and FEF200-1200, showed a significant decrease in the sweepers compared to the control group but the percentage of FEV1/FVC showed a significant increase in the sweepers than the control group. The average duration of exposure to dust in

the street sweepers was 7.5±4.1 years. For acute effects of dust on pulmonary function, spirometry was performed before and after the sweeping. There was a significant decrease in mean values and percent expected in the parameters FVC, FEV1, PEFR, FEF25-75 and FEF200-1200 after the sweeping and the percentage of FEV1/FVC was increased (14). Among the limitations of this study were that all sweepers working in Bandar-Abbas were not examined in this study and because physical health is important in recruitment, it is possible that some sweepers refrain from telling the truth regarding their respiratory symptoms history and smoking. The strength of the study was that the examination and spirometry were conducted by occupational medicine residents and referring all sweepers working in that area. In future studies for better evaluation, it is recommended that a study be carried out with a larger sample size among sweepers with more work experience in order to determine their spirometry patterns. If possible, supplementary tests such as Body Box should be used in future studies to determine the exact type of spirometry disorder. Engineering changes, such as using long-handled broom, damp when sweeping the streets and, if possible, the use of mechanized methods similar to developed countries can be considered. Management controls include restrictions on working hours and days as well as the use of more forces which reduce exposure to dust. Another important point is repeated examinations and periodic spirometry to diagnose pulmonary disorders at an early stage in order to prevent the occurrence of irreversible changes.

According to the findings, it appears that chronic exposure to dust in sweepers reduces lung function and according to the pattern of decline in FEF25-75 and PEF, we could say that this exposure is likely to cause obstruction in the small airways.

References:

1. Yogesh SD, Zodpey SP. Respiratory morbidity among street sweepers working at Hanuman nagar Zone of Nagpur Municipal Corporation, Maharashtra. Indian J Public Health. 2008;52(3):147-149.

2. Yogesh SD, Zodpey SP. A Study of morbidity pattern in street sweepers. A cross sectional Study. Indian Journal of Community Medicine. 2008;33(4):224-228.

3. NKU CO, Peters EJ, Eshiet AI, OKU O and Osim EE. Lung function, oxygen saturation and symptoms among street sweepers in Calabar-Nigeria. Nigerian Journal of Physiological Sciences. 2005;20(1):79-84.

4. Krajewski JA, Tarkowski S, Cyprowski M, Szarapinska-Kwaszewska J, Dudkiewicz B. Occupational exposure to organic dust associa ted with municipal waste collection and management. Int J Occup Med Environ Health. 2002;15(3):289-301.

5. Morgan WKC, Seaton A. Silicosis. In: Occupational lung diseases. 3rd ed. Philadelphia: WB Saunders Company, 1995: 222-237.

6. Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL. Environmental lung diseases. In: Harrison's principles of Internal Medicine. Vol.2. 19th ed. New York: The McGraw Hill Companies, 2008;1521-1527.

7. Hnizdo E, Sullivan PA, Bang KM, Wagner G. Association between chronic obstructive pulmonary disease and employment by industry and occupation in the US population: a study of data from the Third National Health and Nutrition Examination Survey. American Journal of Epidemiology. 2002;156(8):738-746.

8. Bakke PS, Baste V, Hanoa R, Gulsvik A. Prevalence of obstructive lung disease in a general population: relation to occupational title and exposure to some airborne agents. Thorax. 1991;46(12):863-870.

9. Lebowitz MD. Occupational exposures in relation to symptomatology and lung function in a community population. Environ Res. 1977;14(1):59-67.

10. Post WK, Heederik D, Kromhout H. Occupational exposures estimated by a population specific job exposure matrix and 25 year incidence rate of chronic non-disease (CNSLD): the Zutphen Study. Eur Respir J specific lung. 1994;7(6):1048-1055.

11. Johncy SS, hanyakumar G, Kanyakumari T. Chronic exposure to dust and lung function impairment: A study of female sweeper in India. National J of Physiology and Pharmacology. 2014;4(1):15-19.

12. Anwar SK, Naeem M, Nasir N, Maryam K, Bilal K. Sweeper's lung disease: a cross-sectional study of an overlooked illness among sweepers of Pakistan. International J of COPD. 2013;8:193-197.

13. Shadab M, Agrawal DK, Ahmad Z, Aslam M. A cross sectional study of Pulmonary Function Tests in street cleaners in Aligarh, India. Biomedical Research. 2013;24(4):449-452.

14. Smilee Johncy S, Dhanyakumar G, Vivian Samuel T, Ajay KT, Suresh Y. Bondade. Acute Lung Function Response to Dust in Street Sweepers.Jo of Clinical and Diagnostic Research. 2013;7(10):2126-2129.

15. American Thoracic Society.ATS. Standardisation of spirometry. Available from http://www.thoracic.org/statements/resources/pfet/PFT2.pdf(Accessed 19/5/2014).

16. Smilee Johncy S, Dhanyakumar G, Vivian Samuel T, Ajay KT, Suresh Y. Bondade. Acute lung function response to dust in street sweepers. J Clin Diagn Res. 2013;7(10):2126-2129.

الگوی اسپیرومتری و علایم تنفسی در رفتگران

هادی اسحاقی ثانی ۱ **مونا نجف نجفی** ۲ **حمید شریفی** ۳

۱ گروه بیماریهای شغلی و طب کار، دانشکده پزشکی، دانشگاه علوم پزشکی هرمزگان، بندرعباس، ایران.

۲ گروه پزشکی اجتماعی، مرکز توسعه تحقیقات بالینی، دانشکده پزشکی، دانشگاه علوم پزشکی مشهد، مشهد، ایران.

۳ دستیار، گروه بیماریهای شغلی و طب کار، دانشکده پزشکی، دانشگاه علوم پزشکی هرمزگان، بندرعباس، ایران.

چکیده

مقدمه : شواهد متعدد و گاهاً متناقضی در زمینه ارتباط بین مواجهه با گرد و غبار و بروز علایم تنفسی و اختلالات ریوی وجود دارد. هدف از این مطالعه، بررسی تأثیرات مواجهه مزمن با گرد و غبار خیابان‌ها روی شاخص‌های ریوی و شکایات تنفسی رفتگران می‌باشد.

روش کار : این مطالعه مقطعی بر روی ۱۰۰ رفتگر شاغل در منطقه سه شهرداری شهرستان بندرعباس در سال ۱۳۹۳ انجام شد، گروه کنترل از کارکنان قسمت اداری همان منطقه شهرداری گرفته شد که پست اداری – دفتری داشته و فاقد مواجهات تنفسی شغلی بودند. جهت بررسی شاخص‌های ریوی، اسپیرومتری با دستگاه Spirolab MIR3 انجام شد و پارامترهای FVC FEV₁ FEV1/FVC PEF و FEF25-75 اندازه‌گیری شد. داده‌ها پس از جمع‌آوری با استفاده از نرم‌افزار STATA 12 مورد تجزیه و تحلیل قرار گرفت. برای مقایسه پارامترهای تنفسی بین دو گروه از آزمون Two Way ANOVA استفاده شد.

نتایج : شیوع علایم تنفسی شامل سرفه، خلط، تنگی نفس و خس خس سینه در دو گروه تفاوت معنی‌داری نداشت (P = ۰/۷۵) مقادیر FEV₁ FEF25-75 و PEF بعد از تطبیق اثر متغیر سیگار، در رفتگران به نسبت پرسنل اداری کاهش معنی‌داری را نشان می‌داد (P < ۰/۰۵)، سایر متغیرهای FVC و FEV1/FVC بین دو گروه تفاوت آماری معنی‌داری نداشت.

نتیجه‌گیری : به نظر می‌رسد رفتگرانی که نظافت معابر را انجام می‌دهند و به صورت مداوم در معرض گرد و غبار هستند، در خطر پیشرفت علایم ریوی و افت شاخص‌های اسپیرومتری قرار دارند. به کار بردن اقدامات حفاظتی جهت جلوگیری از مواجهه با گرد و غبار، انجام اسپیرومتری و معاینات منظم سالیانه برای تشخیص زودرس اختلالات تنفسی در رفتگران مفید است.

کلیدواژه‌ها : اسپیرومتری، گرد و غبار، علایم تنفسی