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Work Related Respiratory Symptoms and Pulmonary Function Tests Observed Among Construction and Sanitary Workers of Thoothukudi.

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Abstract: Respiratory disorders are among the most common occupational diseases. In order to assess the respiratory status of the Construction and Sanitary workers this study was conducted. The construction and sanitary workers are exposed to harmful dust particles as well as pathogens regularly which affect their respiratory system. A standardized questionnaire designed, covering all the required data was served to the workers and a total of 249 workers turned up. After considering the exclusion criteria, 101 construction workers and 56 sanitary workers in the study group were compared with 92 controls in terms of their respiratory status. Respiratory complaints were significantly higher in the study group compared to controls. Frequencies of abnormal spirometric findings were significantly higher in the study group. The study results demonstrated that occupational exposure to cement, road dust and unwanted wastes created severe harm to the workers respiratory system. Therefore, it is recommended to diminish workers' exposure to environmental dust by proper implementation of respiratory protection programs. Also, filling out the standard respiratory questionnaire and performing the pulmonary function tests are advised for workers in their periodic examination programs.
Key words: Respiratory complaints, Occupational exposure, Pulmonary function tests.

INTRODUCTION

Work-related disorders are the major cause for complaints and disability in worker populations. The main problem encountered in the environment is the respirable dust (<10 µm). When fine dust enters the respiratory system, the human body considers it to be foreign material which should be defended against. Exposure to ambient particulate air pollution is associated with increase in morbidity and mortality from respiratory and cardiovascular diseases.[1] Individuals working in dusty environment face the risk of inhaling particulate materials that may lead to adverse respiratory effects.[2] All construction sites generate high level of dust typically from concrete, silica, asbestos, cement, wood, stone, sand and the workers are exposed to this airborne dust.[3] Dust and cement particles which are inhaled are lodged in the lung and causes lung irritation, mucus hypersecretion initially, followed by lung function impairment, lung inflammation chronic obstructive lung disease, restrictive lung disease and pneumoconiosis and so on.[4-8]

Street sweeping is associated with exposure to dust, during sweeping the streets with brooms, and by vehicular movement as well as other human

activities raised several quantum of dust which are inhaled by the workers resulted in respiratory problems [9] and lung cancer as well as other types of cancer.[10] A high incidence of cough, chronic bronchitis, sneezing and eye irritation coupled with infection of the throat has also been reported.[11] The collection of household waste is a hard job, it also requires repeated heavy physical activity such as the manual lifting and handling of heavy bins[12,13] exposure is also associated with health effects such as respiratory symptoms, influenza-like symptoms and increased risk of chronic obstructive pulmonary disease.[6, 12-15]

Community based studies have demonstrated increased relative risks for respiratory symptoms consistent with chronic obstructive pulmonary disease (COPD) as well as for excess annual declines in Forced Expiratory Volume in one second (FEV_1) associated with occupational exposure to dust or gases. [16] In occupational respiratory diseases, Spirometry is one of the most important diagnostic tools which plays a significant role in the diagnosis and prognosis of these diseases and describes the effect of restriction or obstruction on the lung function. [17] It is also used for screening workers with exposures to agents associated with pulmonary diseases. Lung function is influenced by factors such as sex, age, height, weight, environment and ethnicity. [18] Lung function test provides a clearer understanding of pulmonary function in subjects of different races, age, sex, occupation and profession.

This study was undertaken to assess the effect of dust exposure on respiratory symptoms and lung function in the environment of Construction workers and Sanitary workers of Thoothukudi area. This study was designed in such a way to investigate the effect of duration of dust exposure and the lung function of the construction and sanitary workers.

MATERIALS AND METHODS

The construction workers and sanitary workers were interviewed using a standardized respiratory health questionnaire. A total of 157 workers responded and among them, 101 were construction workers and 56 were sanitary workers including both sexes. The age ranging from 20 to 60 years. The questions on personal and work characteristics including sex, age, height, weight, education level and employment history were collected. The various disorders observed and collected from the workers were confirmed with the help of a Pulmonologist. Based on the oral statement given by the workers the most affected construction workers (n = 20) and sanitary workers (n = 22) were identified and their lung function was assessed using the Spirometry. Control subjects were examined with same age group and experience separately with the Spirometry. The lung function statuses of the workers were compared with the control and the deviation in their status was assessed both numerically and statistically. The construction and sanitary workers worked for more than 8 hours a day and for six days a week, without using any self-protective measures.

The pulmonary function tests or pulmonary capacity of the subjects were determined by means of a portable Koko Legend Spirometer. Spirometry was performed on a computerized Koko Legend spirometer, nSpire health, Inc.USA (Model No.314000). 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 adjusted for Indian population. The test was conducted by a trained physician between 10-2 pm in a sitting position for all subjects. The test was performed and repeated three times after adequate rest and the results obtained were collected in the form of printout from the Spirometer. The parameters taken into account were Forced vital capacity (FVC), Forced expiratory volume in the first second (FEV_1), Forced expiratory ratio (FEV_1/FVC %), Peak expiratory flow rate (PEFR), and Forced expiratory flow (FEF_{25-75}%). The results are presented as mean ± SD and percentage difference. The data were statistically evaluated by calculating 'Z' using Microsoft excel equation version 6.1.

RESULTS AND DISCUSSION

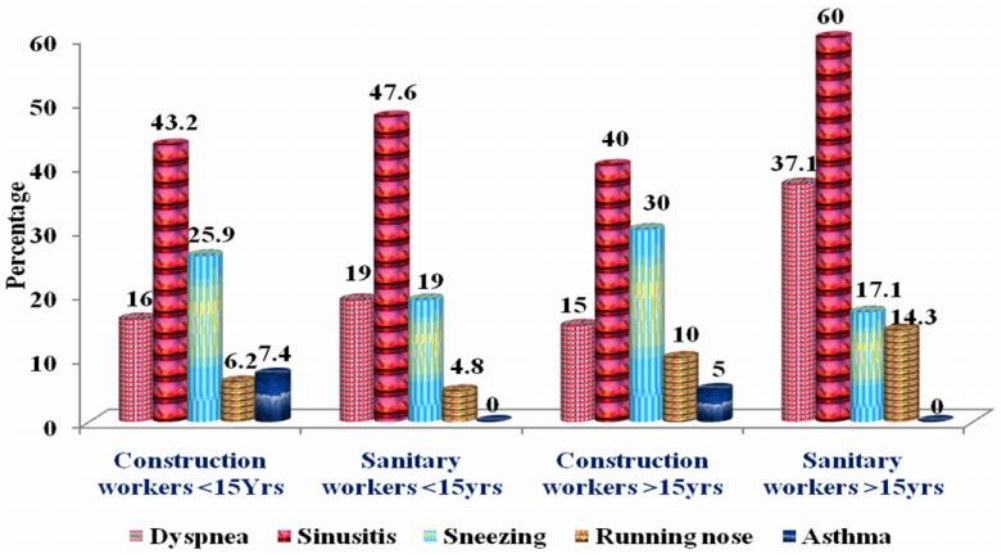
The anthropometric data for the studied workers, represented in Table 1. Construction workers, Sanitary workers and Controls were matched for age, height, weight and employment. The mean exposure duration less than 15 years was 12.5 ± 3.5 years for construction workers and 13.6 ± 2.3 for sanitary workers. The mean exposure duration more than 15 years was 22.5 ± 4.2 for construction workers and 28.2 ± 4.0 for sanitary workers. The mean age was 48.6 ± 10.5 years, the mean height was 157.3 ± 7.9 cm and the mean weight was 57.9 ± 13.5 kg. There were 64.3 % construction workers and 35.7 % sanitary workers. There was significant difference in the mean age, mean height and the mean weight between the two groups. There were no significant differences in the anthropometric parameters between the control and construction and sanitary workers with exposure duration of more than 15 years. The opposite trend was observed among the workers with exposure duration of less than 15 years.

Table 1. Anthropometric parameters of construction and sanitary workers with their matched controls. The values indicated are the mean ± SD.

Groups	N	Age (yrs)	Height (cm)	Weight (kg)	Employment (yrs)
Control Subjects	11	30.5 ± 6.0	164.7 ± 9.1	64.7 ± 10.8	10.9 ± 3.0
Construction workers (<15 years)	10	38.9 ± 8.0	159 ± 9.2	61.7 ± 15.9	12.5 ± 3.5
Z value		3.31	1.97*	0.59*	1.43*
Sanitary workers (<15 years)	11	50 ± 7.1	155.7 ± 8.7	58.5 ± 15.4	13.6 ± 2.3
Z value		9.07	3.42	1.32*	3.89
Control Subjects	11	49.5 ± 8.9	162.2 ± 8.2	68.7 ± 7.3	24.1 ± 3.8
Construction workers (>15 years)	10	49.6 ± 12.8	157.2 ± 7.8	58.2 ± 13.3	22.5 ± 4.2
Z value		0.02*	2.02*	2.49*	1.19*
Sanitary workers (>15 years)	11	54.2 ± 7.8	157.3 ± 6.8	53.5 ± 9.2	28.2 ± 4.0
Z value		1.98*	2.41*	5.48	3.35
Total	42	48.6 ± 10.5	157.3 ± 7.9	57.9 ± 13.5	19.8 ± 7.7

* Non-significant at 0.05% level.

Figure 1. Work related physiological Complications observed among workers in relation to their year of experience.



The study result indicated that both categories of workers are affected by any one of the common respiratory disorders, which indicated the sign of malfunctioning of their respiratory system. Sanitary workers are affected to a greater extent than the construction workers. The workers having more than 15yrs of experience are more affected by various disorders. The various disorders observed among the Construction workers having more than 15yrs of experience are Dyspnea (15%), Sinusitis (40%), Sneezing (30%), Running nose (10%) and Asthma (5%) where as in case of the sanitary workers the percentage observed was 37.1, 60.0, 17.1, 14.3 percent respectively. The high incidence of Sinusitis, Sneezing and Dyspnea observed among the Sanitary workers and Construction workers are influenced by the dust flow that are prevailed in their working site.[6,11,13,15] Handling of household wastes and other infectious sanitary wastes by the sanitary workers further aggravate the respiratory disorders [12,13] among the Sanitary workers (Fig 1).

As far as the respiratory disorders and pulmonary function was concerned, there was no significant difference was detected among the workers in terms of duration of employment as well as in relation to the anthropometric parameters viz; age, sex, height and weight.[19-21] The prevalence of respiratory complaints like Dyspnea, Sinusitis, Sneezing, Running nose and Asthma among both the Construction and Sanitary workers were significantly higher when compared to control and it was influenced and aggravated by their occupational exposure, duration of exposure, nature and type of work and year of experience to their working environment and so on.[22-24] The dust that are floating in their vicinity due to various construction activity enter into their respiratory pathway through nose and mouth leading to chronic respiratory disease and the reduction of ventilator capacities. Several previous studies have shown increased respiratory symptoms among workers of different category supporting the results of the present study.[19,22,25-27]

High prevalence of respiratory disorders observed among the sanitary workers may be due to the road dust which is a complex mixture of soil dust, deposited motor vehicle exhaust particles, tyre dust, brake lining wear dust, plant fragments and other biological materials which are allergenic and may therefore irritate the respiratory tract leading to cough and other respiratory symptoms. The fact that the street sweepers rarely used any protective devices such as face masks and were exposed to a high dust level generated at the test sites may have contributed to increase in the prevalence of these symptoms.

Occupational respiratory diseases are usually caused by extended exposure to irritating or toxic substances that may cause acute or chronic respiratory ailments.[2,28] The incidence depends upon the chemical composition of dust, size of the particles, duration of exposure and individual susceptibility.[4] Dust originating from work operation like drilling, blasting and grinding becomes airborne and inhalation of particles may induce accelerated lung function decline.[29]

The comparison of lung function parameters of the construction and sanitary workers with experience less than 15 years and more than 15 years were matched with control are well illustrated in Table 2. All the studied Spirometric values observed were lower in the subjects than the control. There was a significant (0.05%) difference between the two groups in both mean values and the percent predicated values of lung function parameters.

In both construction and sanitary workers the mean of the actual values of FVC, FEV_1, FEV_1/FVC%, PEFR and $FEF_{25-75\%}$ were significantly decreased to a greater extent when compared to control groups. In both the cases the mean predicted values of FVC, FEV_1, FEV_1/FVC%, PEFR and $FEF_{25-75\%}$ were also significantly decreased when compared to control groups except for FEV_1/FVC%. All the parameters further significantly decreased to a greater extent when the year of experience of the workers increased above 15 yrs.

The decrease in almost all spirometric values in both the studied workers, especially drop in FEV_1 may result in the risk of asthma.[7,30-32] Repeated and continuous of exposure of the workers to constant dust resulted in accumulation of huge amount of dust into the airway as well as lung resulted in the obstructive or restrictive type of impairment of the lung.[5]

Table 2. Experience-wise lung function data observed among construction and sanitary workers. The values indicated are the mean of observations and ± SD

Parameters	Actual value			Percent predicted			Percent difference (%)	
	Control Subjects (n = 11)	Construction Workers (n = 10)	Sanitary Workers (n = 11)	Control Subjects (n = 11)	Construction Workers (n = 10)	Sanitary Workers (n = 11)	Construction Workers	Sanitary Workers
Less than 15years								
FVC (L) **Z value**	3.29 ± 0.62	2.22 ± 0.91 3.76	1.71 ± 0.51 10.3	77.7 ± 8.7	54.5 ± 16.7 4.39	56.1 ± 16.7 4.29	23.2	21.6
FEV_1 (L) **Z value**	2.99 ± 0.53	1.96 ± 0.84 3.94	1.54 ± 0.47 10.4	84.7 ± 9.2	58.7 ± 19.2 4.78	64.1 ± 20.7 3.78	26.0	20.6
FEV_1/FVC% **Z value**	91.27 ± 5.42	87.6 ± 5.34 2.19*	89.8 ± 6.57 0.73*	109.6 ± 6.9	108 ± 6.9 0.73*	113.6 ± 9.4 1.43*	1.6	4
PEFR (L/s) **Z value**	7.5 ± 1.27	4.65 ± 2.07 4.36	3.46 ± 1.22 10.9	95.5 ± 22.8	56.1 ± 18.2 6.84	51.5 ± 16.8 8.71	39.4	44.0
FEF25-75% **Z value**	3.98 ± 0.84	2.44 ± 1.30 3.80	1.91 ± 0.71 9.83	106.5 ± 22.1	71.2 ± 34.2 3.26	73.8 ± 31.1 3.48	35.3	32.7
15 years or more								
FVC (L) **Z value**	2.70 ± 0.74	1.95 ± 1.24 1.92	1.59 ± 0.46 7.96	69.6 ± 15.2	50.4 ± 22.5 2.70	56.3 ± 16.4 2.69	19.2	13.3
FEV_1 (L) **Z value**	2.43 ± 0.70	1.59 ± 0.97 2.65*	1.55 ± 0.59 4.83	79 ± 16.3	52.2 ± 21.2 3.99	67.5 ± 21.4 1.77*	26.8	11.5
FEV_1/FVC% **Z value**	89.6 ± 4.65	82.7 ± 6.72 3.25	92.6 ± 10.0 1.01*	113.7 ± 6.53	105.2 ± 9.53 2.82	118.7 ± 13.2 1.26*	8.5	5
PEFR (L/s) **Z value**	5.76 ± 2.38	3.3 ± 1.51 5.25	3.73 ± 1.30 5.29	72.5 ± 22.4	44.1 ± 16.6 5.42	51.8 ± 16.6 4.13	28.4	20.7
FEF_{25-75}% **Z value**	3.29 ± 1.06	1.65 ± 0.95 5.50	2.15 ± 1.01 3.79	112.4 ± 28.1	58.2 ± 25.2 6.80	76.3 ± 36.4 3.29	54.2	36.1

* Non-significant at 0.05% level

Figure 2. Restrictive type of lung disorder observed among the workers in relation to the type of work

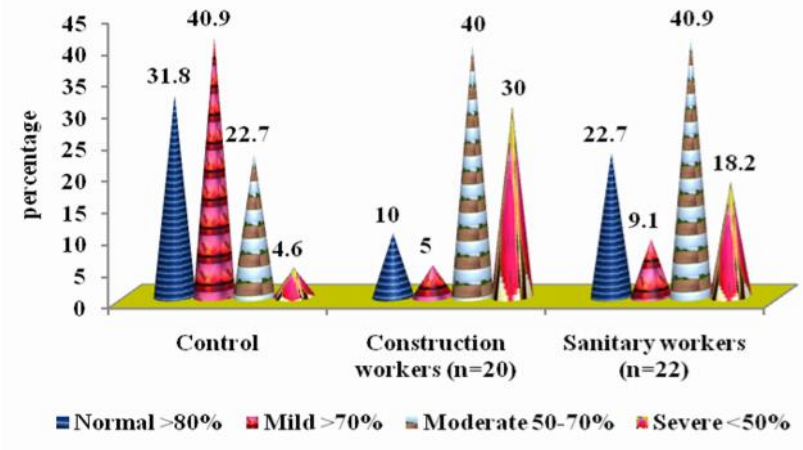
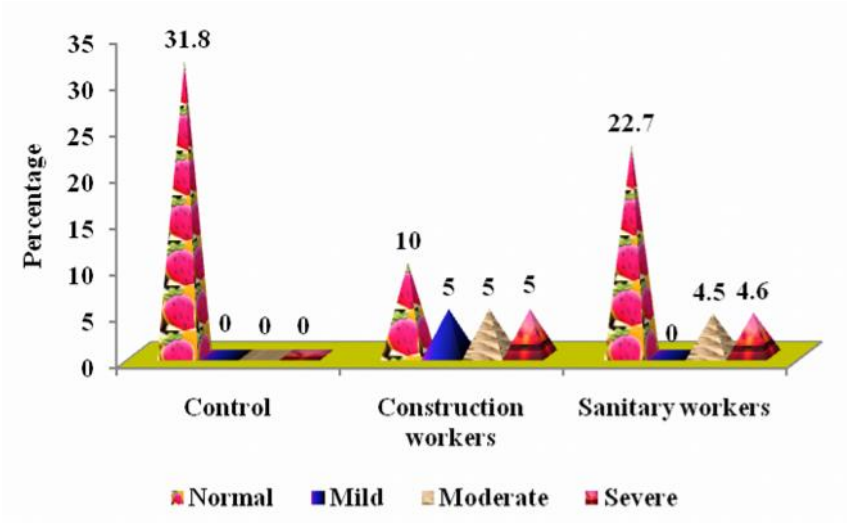


Figure 3. Obstructive type of lung disorder observed among the workers in relation to the type of work



In the present study it was clearly observed that about 75% of construction workers and 68.2% of sanitary workers had restrictive type of pulmonary disorder and about 15% of construction workers and 9.1% of sanitary workers had obstructive type of bronchial obstruction. The bronchial obstruction was significantly higher in the workers group than the control. As the year of experience increased the pulmonary dysfunction percentage was also significantly increased among the workers (fig 2 and 3).

Earlier studies evidenced that variations in spirometric measurements resulted into obstructive type of pulmonary dysfunction.[20,33-38] If the condition continued, the gradual deterioration of the lung function of the subjects lead to chronic disorders and other type of complications. The restrictive lung disease resulted in decrease in vital capacity and pulmonary parameters depending upon the duration of exposure to the dust.[39,40]

CONCLUSION

The present study concluded that the workers in the construction site and sweeping environment adversely affect their pulmonary function parameters like FVC, FEV_1, FEV_1/FVC%, PEFR and FEF_{25-75}% resulted in the obstructive pattern of lung function impairment which is associated with the years of exposure and airborne dust in the work site. In order to reduce the impact it is recommended that the workers should use protective face mask during work, use water through the drill stem, use saw that provides water to the blade, use wet sweeping instead of dry sweeping, wet down dusty areas and processes, watering of streets and provision of other protective devices in street sweeping to reduce the inhalation of dust by the sanitary workers.

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