Trends of alterations in pulmonary function and symptoms in garment workers of Garden-Reach-Metiabruz area of Kolkata

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ABSTRACT

Introduction and Aim: In spite of being the 2nd highest contributor in foreign exchange earning of the country, the work environment of most of the units of textile industry including readymade garment manufacturing is unsafe and unhealthy for the workers resulting in several health problems. Information, though available for other parts of our country regarding impacts on respiratory health and pulmonary functional status, are completely inadequate for the workers of Garden Reach-Metiabruze area of Kolkata. The present study was undertaken to investigate the physical characteristics, pulmonary functional status and to identify the presence of any respiratory symptoms among the workers of the said area.

Materials and Methods: A total of 80 male workers were selected as experimental subjects and divided into two age groups, namely, 18-35 years and 36-49 years and an age-matched control subjects were selected (n= 50) from the same area with no exposure of the work environment. The physical characteristics i.e., height, weight, body surface area (BSA) and body mass index (BMI) were evaluated for all the subjects. Pulmonary function test (PFT) was performed through spirometry for Forced Vital Capacity (FVC), Forced Expiratory Volume 1 % (FEV1%), Slow Vital Capacity, Maximum Voluntary Ventilation and Peak Expiratory Flow Rate. A questionnaire was used to evaluate the respiratory symptoms.

Results: All the PFT parameters were significantly decreased in the workers compared to control though there was no difference in physical characteristics in the subjects of both the age groups. Respiratory symptoms were also prevalent among the workers and even temporary work cessation led to improvement of the symptoms in most of the subjects.

Conclusion: Together these results indicate that these workers are also having poor, altered and deranged pulmonary functional status having obstructive and mixed (obstructive plus restrictive) type that may develop several pathologic conditions, breathing difficulties and respiratory symptoms. Shifting of duties or decreased time of exposure to the work environment, use of personal protective equipment etc. might have some beneficial effects on the symptoms. Further studies and interventions are needed to combat the severe health consequences and improve workers' health with maintenance of optimal productivity.

Keywords: Garment manufacturing industry; pulmonary functional status; respiratory symptoms; cotton dust.

INTRODUCTION

Workers of industry, agriculture, mining and other working environments often encounter occupational health hazards. If the work stresses reach beyond the level of human tolerance, it may lead to ill-health. Occupational diseases and injuries may result from specific exposures at work. Additionally, work exposures may aggravate certain illnesses or be a factor in causing diseases of multiple etiologies (1). In India, textile industry including readymade garment manufacturing is the 2nd highest contributor of export (2). About 3million workers are employed in more than 70,000 garment manufacturing units in the country (3).

In most of the unorganized garment manufacturing units, the work environment is unhealthy and unsafe for the workers resulting in several health problems, among which respiratory health is maximally compromised (4). The development of the industry in our country occurred at several zones centering the cities like Lucknow, Pune, Delhi, Ahmedabad, Varanasi, Mumbai, Kolkata etc., In Kolkata, large-scale manufacturing of garments has flourished in the region of South-Western suburb of the city, namely Garden-Reach-Metiabruz. Several studies have been performed to assess the respiratory health and other health hazards of the workers in the cities mentioned above (5-9), but no study have been found to be conducted in the fore-mentioned region of Kolkata, excepting a single recent sociological study on these workers reported about their poorer conditions and worse status with increased tie of local market with global market (10).

Therefore, the purpose of our present investigation is to evaluate the physical characteristics, pulmonary functional status including Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), FEV1/FVC ratio, Peak Expiratory Flow Rate (PEFR), Slow Vital Capacity (SVC) and

Maximum Voluntary Ventilation (MVV) to have an idea of obstructive and/or restrictive type of respiratory distress in these workers along with identification of respiratory symptoms, if any prevailing among them.

MATERIALS AND METHODS

Selection of Subject

The study population of this work was male. The workers from readymade garment manufacturing units of Gardenreach-Metiabruze region were selected for the study and the total number of the experimental group subjects were 80 and they were divided into two age groups 18-35 years, (n=50) & 36-49 years (n=30). Years of exposure in this job, smoking habits, frequency of smoking, family history of respiratory or other malnutrition related diseases were recorded by questionnaire.

A control group of subjects (n= 50) were also selected from the residents of the same region but without having any exposure to this garment manufacturing jobs. They were office workers, school or college employees, businessmen etc. having no respiratory diseases. A letter of consent was taken from each participant declaring his voluntary willingness to act as a subject of the study and approval of the Institutional Human Ethical Committee (IHEC) was obtained at the outset of the experimentation.

Determination of physical characteristics

Body height and body weight of all the subjects were measured in bare foot on a standard scale. Body surface area (BSA) was calculated from the Du-Bois and Du-Bois formula (11) and Body mass index (BMI) was calculated from body height and body weight (12).

Determination of Pulmonary function status & Symptoms

The pulmonary function test (PFT) was carried out through spirometry. Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1%), FEV1/FVC ratio, Slow Vital Capacity (SVC), Maximum Voluntary Ventilation (MVV) and Peak Expiratory Flow Rate (PEFR) were measured by Spirometer (RMS-Helios 401, PC based model) (13). All these measurements were taken on the subject in standing upright position with nose clip attached. Three respiratory efforts were recorded and the best of the three performances was considered for calculation purposes. PFT results of the workers as well as control subjects were presented according to different age groups. Values were expressed in body temperature on atmospheric pressure of air saturated with water vapor (BTPS).

A modified questionnaire (14) was used for the respiratory symptoms. Emphasis was given on enquiry regarding occurrence of chest tightness, chest compression, wheezing, cough and phlegm appearance etc. Subjects with regular smoking habits and known respiratory illnesses were excluded from the study.

Statistical analysis

Standard statistical protocols were followed in the study. Student's Z-test of significance were performed. The level of significance for the difference between sample means was taken as*$p<0.05$ (15).

RESULTS

There was no significant difference in body weight, height, BSA and BMI between control and experimental group of subjects in both the age groups i.e., 18-35 years and 36-49 years (Table 1). Parameters of pulmonary function tests (PFT) such as FVC and FEV1% and FEV1/FVC ratio in both the age groups were significantly decreased in experimental group compared to control (Figs.1-6). Significant reduction in other PFT parameters including SVC, MVV were also found in experimental group in comparison to control for both the age groups i.e., 18-35 years and 36-49 years (Table 2).The PEFR showed no significant difference between control and experimental group for the lower age group i.e., 18-35 years and a significant decrease in experimental group in the 36-49 years age group (Fig. 7).

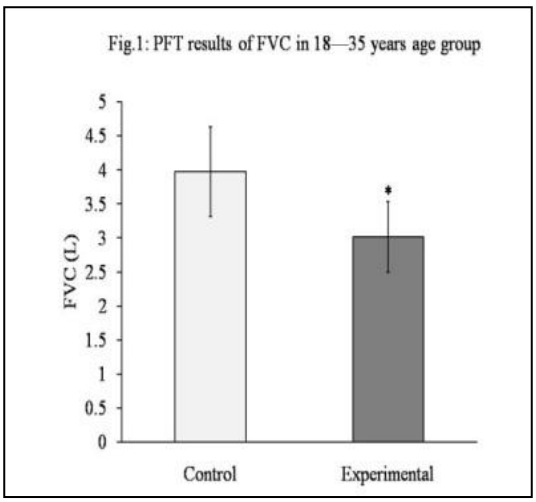
Table 1: Physical parameters (Body weight, height, BSA & BMI) results of 18-35 years & 36-49 years age group

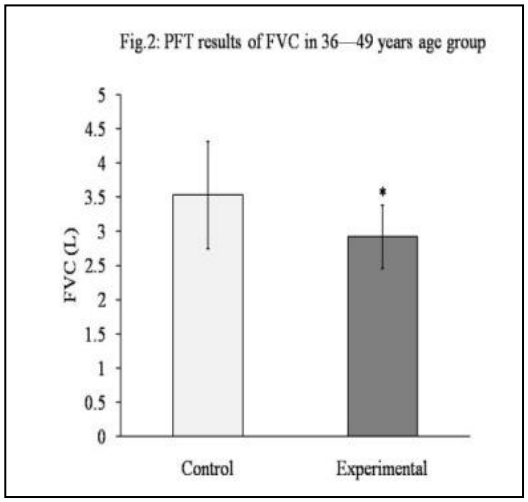
Physical Parameters	18-35 years age group		36-49 years age group	
	Control	Experimental	Control	Experimental
Body weight (kg)	64.18±7.78	56.85±9.70	66.90±13.52	58.28±12.47
Height (cm)	161±7.42	166.83±5.44	171.50±7.69	171.0±6.18
BSA (m^2)	1.66±0.10	1.62±0.05	1.58±0.19	1.49±0.09
BMI (kg/ m^2)	21.70±2.60	19.48±0.55	22.84±3.10	19.04±0.91

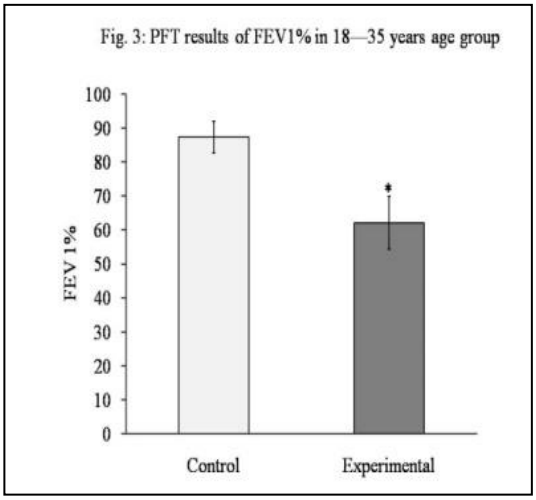
Table 2: Pulmonary function test results of SVC and MVV for 18-35 years and 36-49 years age group

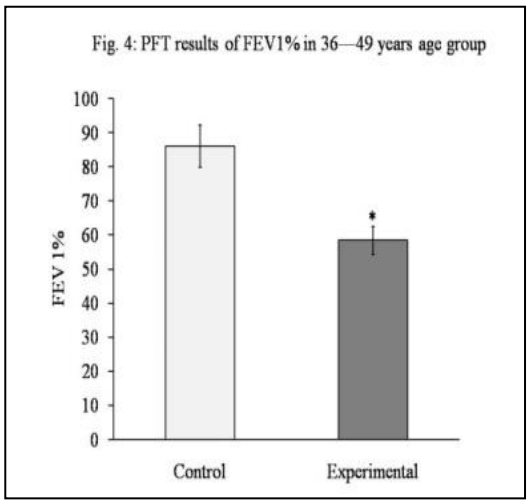
Parameter	18-35 years age group		36-49 years age group	
	Control	Experimental	Control	Experimental
SVC (L)	4.12±0.46	2.96±0.40*	3.54±0.48	2.73±0.36*
MVV (L/min)	120±14.2	96±8.6*	124±6.8	88±12.2*

Values marked with asterisks are significantly different from corresponding control values. Values are mean ± SEM. ANOVA followed by multiple comparison 'Z'-test where *p ≤ 0.05 was considered to be significant.









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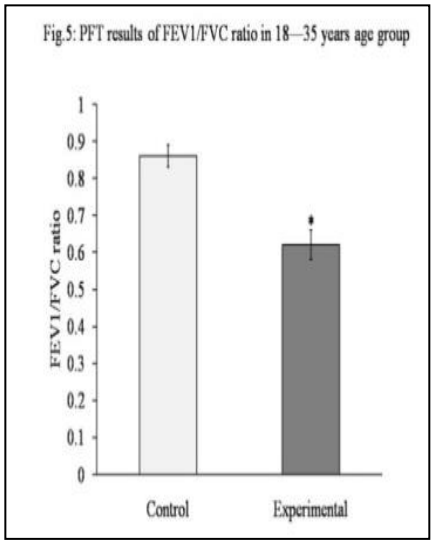

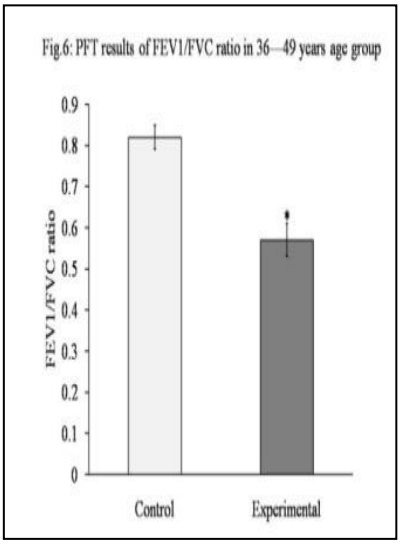

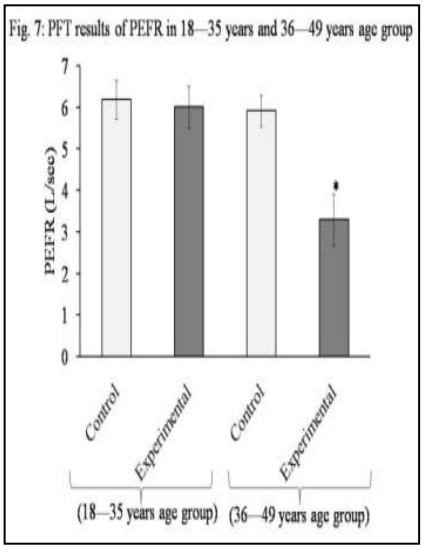

Values marked with asterisks are significantly different from corresponding control values. Values are mean ± SEM. ANOVA followed by multiple 'Z'-test where *p ≤ 0.05 was considered to be significant.

The respiratory questionnaire identifies difficulties in breathing process. Most of the symptoms of the questionnaire in control group were responded as positive in up to 16 % subjects for 18-35 years age-group and up to 23% for the 36-49 years age group, whereas in the experimental group the positive responses on the symptoms were between 45 to 61% for the 18-35 years age-group and 56 to 87% for the 36-49 years age group (Tables 3 & 4).

Table 3: Respiratory questionnaire: positive responses of 18-35 years age group

Sl. No.	Have you had, or do you have any of the following symptoms?	Control %	Experimental %
1.	Cough	09	45
2.	Phlegm	03	45
3.	Wheeziness	03	48
4.	Chest tightness	16	56
5.	Chest compression	11	61
6.	Breathlessness	11	58
7.	Watering eyes	02	48
8.	Running / Blocked nose	05	45
9.	Prolonged repetitive sneezing	08	46
10.	Do any of your symptoms get worse at night?	07	57
11.	Do any of your symptoms get better when you are away from work e.g., at weekend or holiday?	12	64
12.	Do you smoke?	00	00
13.	How many/much do you smoke per day?	00	00

Table 4: Respiratory questionnaire: positive responses of 36-49 years age group

Sl. No.	Have you had, or do you have any of the following symptoms?	Control %	Experimental %
1.	Cough	23	64
2.	Phlegm	08	56
3.	Wheeziness	09	62
4.	Chest tightness	15	83
5.	Chest compression	18	71
6.	Breathlessness	11	73
7.	Watering eyes	12	58
8.	Running / Blocked nose	13	57
9.	Prolonged repetitive sneezing	06	60
10.	Do any of your symptoms get worse at night?	21	81
11.	Do any of your symptoms get better when you are away from work e.g., at weekend or holiday?	20	87
12.	Do you smoke?	00	00
13.	How many/much do you smoke per day?	00	00

DISCUSSION

From the Table-1 of the results of the study it is found that body weight, height, BSA and BMI of experimental group of workers of both the age groups have no significant difference with control ($P>0.05$). Hence, experimental and control subjects for both the age groups match closely for these four parameters of physical characteristics.

The main purpose of our study is to investigate the differences in various pulmonary function tests like Vital Capacities(both FVC and SVC), FEV1%, FEV1/FVC ratio, MVV and PEFR in age-matched control and experimental group of workers with occupational exposure of textile industry, namely, readymade garment manufacturing of Garden Reach area of Kolkata. The results (Figs. 1-7 & Table-2) demonstrate that there is a significant reduction in lung volumes and capacities in almost all the parameters of the experimental group in comparison to control.

The size of the lungs greatly influences the ventilator capacity, which for many purposes is represented by FVC, SVC and MVV (16). Since, all of these are appreciably reduced in experimental group; the data indicate a restrictive type of pulmonary disease, as decreased FVC is an indicator of restrictive pattern of pulmonary disorders (17).

FVC is used to standardize the forced expiratory volume for lung size. For this purpose, FEV1 is reported as percentage of FVC and is used as a guide to airway caliber, independent of body size and stature (18). Moreover, FEV1/FVC ratio measures the amount of air a person can forcefully exhale in one second relative to the total amount of air he/she can exhale. This ratio is decreased in obstructive lung disorders and remain normal in restrictive lung disorders (19). Both of these parameters (FEV1% and FEV1/FVC ratio) show reduction in values which are found in obstructive group of lung diseases when airway resistance is high (18). Here, figs. 3-6 show much decrease in these parameters of experimental subjects for both the age groups compared to control indicating a pattern of obstructive lung disease.

Fig. 7 reveals that PEFR is decreased a little (statistically insignificant) in the experimental subjects compared to control of 18-35 years age

group, but significant decrease is found in experimental subjects of 36-49 years age group. The peak flow mainly reflects the caliber of the bronchi and larger bronchioles, which are subject to reflex broncho-constriction due to airway obstruction. Thus, resistance to airflow is increased leading to decreased PEFR (20). Though, decreased PEFR is a hallmark of obstructive pulmonary disease (18), probably exposure in working environment for a smaller number of years and younger physical profile of the experimental subjects of 18-35 years age group contributed in non-significant change of PEFR value compared to control.

Clinically, FVC should be normal or decreased in obstructive disease and much decreased in restrictive type. Conversely, the FEV1% and FEV1/FVC ratio should always be reduced in obstructive disease while these should be unaltered in restrictive disease (18, 19). Our results of experimental workers of both the age groups thus suggest an obstructive type of disease pattern with a predisposition of being mixed type (obstructive + restrictive) pulmonary disorders (18).

Therefore, our findings confirm and expand the previous reports of pulmonary function abnormality in cotton workers (here garment manufacturing workers) of different parts of our country (5-9) and indicate an obstructive as well as mixed (obstructive + restrictive) pattern of pulmonary function (21). Acute decrements in lung function have been observed in cotton textile workers and in previously unexposed individuals after exposure to cotton dust (22). This response has been related to concentrations of total and respirable dust, and to grade, microbial and endotoxin content of cotton (23). Thus there may be a positive relationship between exposure to cotton dust and symptoms of cough and phlegm and the noxious effects of this dust inhalation on respiratory tract as etiology of cough, phlegm, wheeziness etc. is evident among them (Tables-3, 4).Probably exposure to cotton dust is leading to the symptoms reflected in our present results (21, 24). Though, concentration of cotton dust could not be measured in the present study, micro-dust concentrations ($PM_{2.5}$ and PM_{10}) in the ambient air of the workers show a much higher levels than the permissible limits (24, unpublished work). Therefore, altered and deranged pulmonary function of the garment-manufacturing workers of the present study may be attributable to the occupational exposure of the cotton dust. It is possible that they will develop pathologic changes that cause airway obstruction such as chronic bronchitis, asthma, bronchiectasis, bronchiolitis etc. and even some restrictive disorders including pneumonia, pneumoconioses, sarcoidosis etc., (19, 21).

The results of other respiratory symptoms like chest tightness, breathlessness, compression etc., (Tables-3, 4) also reveal prevalence of a high percentage in the workers compared to control. The positive response for the question no. 11 is maximum in the workers of both of the age groups (64% and 87%) which signifies that cessation of work, even if temporary, leads to improvement of the symptoms and betterment of respiratory health. Thus, our results confirm and strengthen the previous report of beneficial effect of work cessation on respiratory health of textile workers (25).

CONCLUSION

Thus, it can be concluded that, the readymade garment manufacturing workers of Garden Reach Metiabruze region are also having poor, altered and deranged pulmonary functional status having obstructive and mixed (obstructive plus restrictive) type that may develop pathologic conditions along with breathing difficulties similar to the textile workers of other parts of our country. Respiratory symptoms are also prevalent in them that improve in work cessation. These workers are exposed to a highly dust contaminated ambient air that might have immunologic and inflammatory consequences requiring further investigations and intervention. Shifting of duties with decreased time of exposure to the work environment, use of personal protective equipment like masks etc. might have some beneficial effects on the symptoms. Further studies and due consideration are warranted to maintain the workers' health and optimal productivity of this garment manufacturing industry of Kolkata.

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CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the whole work with any other person(s) or institution(s).

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