RESEARCH PAPER | Medical Science | Volume : 5 | Issue : 12 | December 2015 | ISSN - 2249-555X

Prevalence of Airway Obstruction among Garment Workers Employed in Tirupur, India

KEYWORDS: Garment workers, Spirometry, COPD, GOLD, Bronchodilator inhalation

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ABSTRACT *Garment workers are continuously exposed to cotton dust which might decline in pulmonary functions and lead to occupational lung disorders. The selected 200 subjects working in garment industries were considered as experimental group while 50 subjects who were not workers in garment industries, as control group. Both experimental group and control group were interviewed by a pre-tested questionnaire and Spirometry was done before and after bronchodilator inhalation. For the assessment of COPD, Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines were used. The aim of the study were to assess the prevalence of airway obstruction among the workers based on post-bronchodilator spirometry, to examine the association between socio-economic variables, occupational history and clinical history with COPD and to find the effectiveness of bronchodilator inhalation. Statistical analysis used were Percentage, Average and Chi-square analyses and student 't' test. Out of 200 workers, 114 male and 86 female workers with a mean age 42.7 (±15.81) years and work experience 19.2 (±12.07) years employed in the garment industries were experimental group while 32 male and 18 female with a mean age 36.4 (±11.66) years and work experience 11.9 (±9.32) years were control group. The prevalence of COPD as per severity was Moderate (81.5%), Severe (17.5%) and Very Severe (1%) among experimental group while all control group had Mild COPD. When levels of COPD with its risk factors were associated, a significant difference at one per cent was found among experimental group for particulars namely shortness of breath and chest tightness and number of years of work experience whereas non-significant among control group. Also, a high significant difference at one per cent level was found between experimental group and control group indicating bronchodilator inhalation to be effective in the early diagnosis of COPD.*

Introduction:

The textile production industry is one of the oldest and most technologically complex of all industries. Garment industry is one of the most important strategic industries which constitute about 7% of total industrial production in the world and 8.3% of the total trade in industrial materials. Also, occupies more than 14% of the total labour force in the world. It employs about 40 million people in various countries of the world (Megeid et al., 2011). Many industrial processes produce airborne particles, and inhalation is the most common way of their absorption. As a result of development and growth of industry and the corresponding increase in production, the volume and variety of contaminants also increase (Entemadinejad et al., 2009). Textile workers can be exposed to dust (both natural and synthetic) generated from the textile products in various stages during the textile manufacturing process (Ghasemkhani et al., 2006). Occupation exposure to cotton dust may cause pulmonary function impairment. Cotton dust is defined as dust present in the air which may contain a mixture of contaminants such as ground-up plant matter, fibre, bacteria, fungi, soil, pesticides, and non cotton plant matter (Christiani et al., 1986).

Pulmonary function tests are performed to assess lung function, to determine the degree of damage to the lungs, diagnosis of certain types of lung disease and to analyze whether exposure to contaminants at work affects lung function. In occupational respiratory diseases, spirometry is one of the most important diagnostic tools, most widely used, most basic and effort dependent pulmonary function test. It plays a significant role in the diagnosis and prognosis of these diseases and describes the effect of restriction or obstruction on the lung function (Johncy et al., 2011). There is a sizable medical research literature regarding the occupational impact on the respiratory function of workers in various occupations like coal miners, cotton textile workers, welders, farm workers, chemical workers, cement workers, and others. Chronic obstructive pulmonary disease (COPD) is defined as a disease state characterised by progressive airflow limitation that is not fully reversible, and is associated with an abnormal inflammatory response of the lungs to noxious particles or gases, primarily cigarette smoke (Celli and MacNee, 2004). The spirometric

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testing should be determined for early detection of COPD. It is due to the fact that COPD is one of the leading cause of morbidity and mortality in industrialised countries worldwide, and is emerging as being increasingly important in developing countries (Calverley and Georgopoulous, 2006). Assuming that current trends in mortality continue, COPD will move from being the sixth leading cause of death worldwide in 1990 to the third in 2020 (Murray and Lopez, 1997). No earlier study among garment workers employed in Tirupur garment industries, India in terms of pulmonary function tests has been reported. Hence, the present study was undertaken with the following objectives:

- examine the association between socio-economic variables, occupational history and clinical history with levels of COPD in experimental and control groups
- assess the prevalence of airway obstruction among experimental and control groups
- find the effectiveness of bronchodilator inhalation between experimental group and control group

Materials and Methods:
Ethical approval was obtained from the Ethics Committees of the University to which the candidate belonged (Appendix 1). Written, informed consent was provided by all subjects.

Study design and population:
The present study was conducted in Tirupur district which is situated in Western Tamil Nadu. Tirupur, also known as the "T-Shirt City", accounts for 80% of India's total production of knitwear for export. Out of 514 workers surveyed, 200 workers (nearly 40 per cent) who were willing to undergo spirometry test were selected. The selected 200 subjects working in garment industries were considered as experimental group while 50 subjects who were not workers in garment industries, as control group.

- Inclusion Criteria of the study were as follows:
- Working in garment industry for at least one year
- Subjects of both sexes who were willing to participate

Exclusion Criteria of the study were as follows:
- Subjects who were working in garment industry for a period of less than one year
- Subjects with respiratory disease like tuberculosis and pneumonia
- Subjects with cardiac and cardio vascular disease
- Less than 15 years of age

The workers' age, height and weight were recorded to use in the calculation of reference values. The details of demographic and respiratory symptoms of garment workers were collected using an interview schedule. With an interview technique as a tool for data collection, socio-demographic, occupational history and clinical history of both experimental group and control group were recorded on the predesigned proforma.

Pulmonary function test:
The spirometry test was carried out under the supervision of a leading Pulmonologist working in Tirupur Government Hospital. The pulmonary function tests was carried out using a computerized spirometer (Spirolab III Ver 2.8 SN 305001) using the standard laboratory methods. The spirometer was calibrated regularly and a brief physical and general examination was carried out and the anthropometric parameter (name, age, height, weight, occupation, smoker/non smoker, etc) was entered in the computer. All the pulmonary function tests were done on the subjects comfortably in a seated position. During the test, the subject was adequately encouraged to perform their optimum level and also a nose clip was applied during the entire maneuver. Tests were repeated three times and the best matching results were considered for analysis. The parameters measures by the apparatus were the Forced Vital Capacity (FVC), Forced Expiratory Volume in 1st second (FEV_1) and FEV_1/FVC. After initial spirometry, a bronchodilatory test was performed with inhalation of salbutamol 200 µg to all experimental subjects, administered via a metered - dose inhaler with a spacer. After an additional 15 minutes, postbronchodilator spirometry was performed (Fig.1).

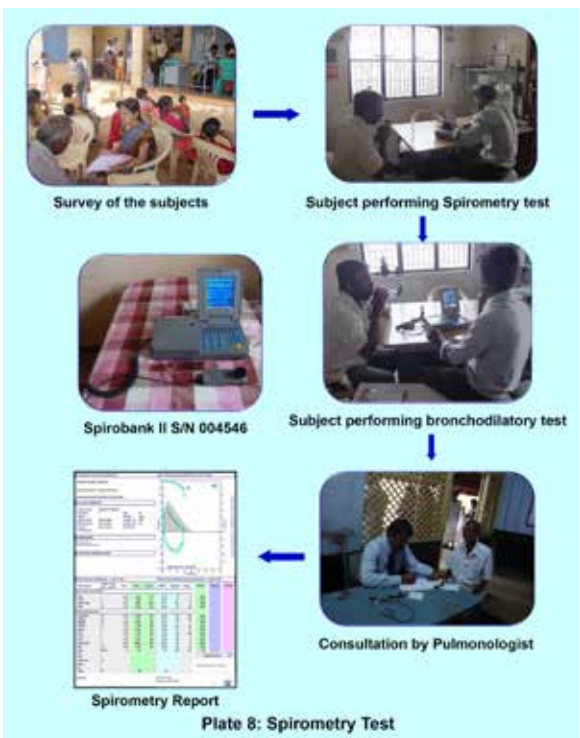

Plate 8: Spirometry Test

Definitions:
In accordance with the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines, irreversible airflow obstruction was defined as a postbronchodilator FEV_1/FVC ratio of < 0.70, which corresponds to GOLD Stage I (Fabbri and Hurd, 2003). Airflow obstruction was classified according to the GOLD criteria. Severity of COPD is distinguished in four stages:

Mild (GOLD Stage I): FEV_1/FVC ratio < 0.70 and FEV_1 > 80% predicted

Moderate (GOLD Stage II): FEV_1/FVC ratio < 0.70 and FEV_1 50% - 80% predicted

Severe (GOLD Stage III): FEV_1/FVC ratio < 0.70 and FEV_1 30% - 50% predicted

Very severe (GOLD Stage IV): FEV_1/FVC ratio < 0.70 and FEV_1 < 30% predicted or FEV_1 < 50% with signs of chronic respiratory failure

The values for FEV_1/FVC and FEV_1 were postbronchodilator, and were expressed as a percentage of predicted. The

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GOLD definition of reversibility was used, ie, FEV_1 increase of 200ml and 12% improvement above baseline FEV_1 following the administration of bronchodilator. The participants identified to have COPD were sent for further investigation and diagnosis at Tirupur District TB Centre, Government Hospital, Tirupur.

Statistical analysis:
Percentage analysis, average analysis, chi-square analysis and student t test were computed using SPSS software.

Results and Discussion:
The results of the demographic characteristics of experimental group and control group are given in Table 1 and Table 2 respectively.

Table 1. The demographic characteristics of experimental group

Particulars	Frequency (N=200)	Percentage
Sex		
Male	114	57.0
Female	86	43.0
Marital status		
Married	141	70.5
Unmarried	43	21.5
Widow	16	8.0
Sections		
Cutting	26	13.0
Stitching	76	38.0
Checking	41	20.5
Ironing	27	13.5
Packing	30	15.0
Worksite		
Dusty section	200	100.0
Overcrowding	102	51.0
Smoking history		
Passive smoker	51	25.5
Non smoker	77	38.5
Ex smoker	21	10.5
Current smoker	51	25.5
Drinking history		
Non drinker	122	61.0
Ex drinker	24	12.0
Current drinker	54	27.0
Drug addiction habit		
Non drug consumption	102	51.0
Ex drug consumption	6	3.0
Current drug consumption	92	46.0
Fuel used for cooking		
Kerosene	59	29.5
Wood and kerosene	78	39.0
Gas (LPG)	194	97.0

One hundred and fourteen male and 86 female garment workers totalling 200 workers with a mean age 42.7 (±15.81) years and work experience 19.2 (±12.07) years employed in the garment industries were enrolled in the study. Seventy per cent of workers were married. Nearly half of the workers (49%) were engaged in finishing section which was a combination of sections of checking, ironing and packing of garments. Thirty eight per cent of the workers were involved in stitching of garments while 13 per cent in cutting of fabrics. All the workers reported that the garment sections were dusty and half (51%) of them felt overcrowding. The latter was classified according to the number of persons per room. Some of the personal habits were developed by the workers probably due to job stress or due to the influence of their peer groups. The habits were such as smoking of cigarettes or bidis (25.5%), consuming alcohol (27%) and chewing tobacco (46%). Majority of workers used LPG gas (97%) as cooking fuel while nearly equal number of workers (29.5% and 39%) used wood and kerosene.

Table 2. The demographic characteristics of control group

Particulars	Frequency (N=50)	Percentage
Sex		
Male	32	64.0
Female	18	36.0
Marital status		
Married	35	70.0
Unmarried	15	30.0
Smoking history		
Passive smoker	5	10.0
Non smoker	40	80.0
Ex smoker	3	6.0
Current smoker	2	4.0
Drinking history		
Non drinker	47	94.0
Ex drinker	2	4.0
Current drinker	1	2.0
Drug addiction habit		
Non drug consumption	72.0	36
Current drug consumption	28.0	14
Fuel used for cooking		
Kerosene	17	34.0
Wood and kerosene	3	6.0
Gas (LPG)	50	100.0

Thirty two male and 18 female garment workers totalling 50 workers with a mean age 36.4 (±11.66) years and work experience 11.9 (±9.32) years were enrolled in the study. Seventy per cent of workers were married. Personal habits were also found among control group but in very less percentage. Fourteen per cent were tobacco chewers and only four per cent were smokers and two per cent were drinkers. All the subjects used LPG gas for cooking.

The height and weight of experimental and control groups were measured to obtain body mass index. Body mass index of experimental and control group is presented in Table 3.

Table 3. Body mass index of experimental and control group

Particulars	Frequency (N=200)	Percentage
BMI of workers		
Under weight	25	12.5
Normal	97	48.5
Over Weight	56	28.0
Obese	22	11.0
Particulars	**Frequency (N=50)**	**Percentage**
BMI of control group		
Under weight	4	8.0
Normal	27	54.0
Over Weight	15	30.0
Obese	4	8.0

The mean of Body Mass Index (BMI) of the workers' was found to be 23.6 (±4.66) while the mean of Body Mass Index (BMI) of the control was 23.9 (±4.32).

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Table 4 presents the details of occupational and clinical history of the experimental group.

Table 4. Details of occupational and clinical history of experimental group

Particulars	Frequency (N=200)	Percentage
Exposing/handling of toxic materials at worksite		
Cotton dust	198	99.0
Solvents	35	17.5
Wearing of protective device	41	20.5
Prevalence of respiratory symptoms		
Cold	35	17.5
Phlegm	120	60.0
Wheezing	33	16.5
Shortness of breath	115	57.5
Chest tightness	83	41.5
Past history of respiratory disease	75	37.5
History of atopy	75	37.5

Almost all the workers (99 %) were exposed to cotton dust and solvents (17.5%) during their working hours. Only 20.5 per cent of the workers wore protective devices during working hours. The prevalence of respiratory symptoms was 60 per cent of the total for phlegm, 57.5 per cent for shortness of breath, 41.5 per cent for chest tightness and more or less similar per cent for cold (17.5%) and wheezing (16.5%). History of respiratory disease and history of atopy were reported by equal number of workers (37.5%).

Table 5 presents the clinical history of control group

Table 5. Clinical history of control group

Particulars	Frequency (N=50)	Percentage
Prevalence of respiratory symptoms		
Cold	2	4.0
Phlegm	24	48.0
Wheezing	2	4.0
Shortness of breath	12	24.0
Chest tightness	8	16.0
Past history of respiratory disease	12	24.0
History of atopy	12	24.0

Subjects considered under control group had minimal prevalence of respiratory symptoms. Nearly half of the subjects (48%) reported to have phlegm followed by one fourth of them shortness of breath (24%) and four per cent for both cold and chest tightness. Nearly one fourth (24%) had past history of respiratory disease and history of atopy.

Table 6 depicts the categorization of severity of COPD as per GOLD guidelines among garment workers.

Table 6. Severity of COPD as per GOLD guidelines of experimental group

Particulars	Frequency (N=200)	Percentage
Mild	-	-
Moderate	163	81.5
Severe	35	17.5
Very severe	2	1.0

More than three fourth of the garment workers (81.5%) had moderate COPD followed by severe COPD (17.5%) and very severe COPD (1%). This implies that none of the subject under study was normal. Kamat et al. (1981) at Mumbai observed that prevalence of chronic bronchitis among cotton textile workers was 11-33 per cent. A study conducted at Tirupur by Jannet and Jeyanthi (2006) showed the same result that 23.07 per cent were chronic bronchitic symptomatics and 10.53 per cent were occupational asthmatic symptomatic.

Identifying occupational risk factors on the individual level is important for prevention of disease before it is advanced and for modifying disability risk once disease is established. The association between levels of COPD (FEV_1) with its risk factors of 200 garment workers is presented in Table 7.

Table 7. Association between levels of COPD with its risk factors of experimental group

Particulars	χ^2 values
Sex	5.18^{NS}
Age	9.36^{NS}
BMI of the subject	20.62^{**}
Marital status	2.67^{NS}
Smoking habit	9.45^{NS}
Drinking habit	4.92^{NS}
Drug addiction habit	3.00^{NS}
Kerosene as cooking fuel	2.81^{NS}
Wood and kerosene as cooking fuel	2.91^{NS}
Gas as cooking fuel	1.11^{NS}
Overcrowding in worksite	2.25^{NS}
Sections in which employed	8.22^{NS}
Duration of exposing/handling toxic materials	5.72^{NS}
Wearing of protective device	0.53^{NS}
Prevalence of respiratory symptom - Cold	2.87^{NS}
Prevalence of respiratory symptom - Phlegm	3.75^{NS}
Prevalence of respiratory symptom -Wheezing	2.10^{NS}
Prevalence of respiratory symptom - Shortness of breath	8.79^{**}
Prevalence of respiratory symptom - Chest tightness	8.79^{**}
Number of years of work experience	8.79^{**}
Past history of respiratory disease	0.31^{NS}
History of atopy	0.78^{NS}

*p<0.05, **p<0.01, NS: Non-Significant

Chi-square (χ^2) test was used to find the association between levels of COPD with its risk factors of experimental group. A significant association was found at one per cent level among garment workers who had respiratory symptoms namely shortness of breath and chest tightness and also number of years of work experience but all the other particulars were found to be non-significant.

According to Boschetto (2006), Cigarette smoking is the major risk factor for COPD. However, relevant information from the literature published within the last few years, either on general population samples or on workplaces, indicates that about 15 per cent of all cases of COPD is work-related.

The association between levels of COPD (FEV_1) with its risk factors of control workers is presented in Table 8.

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Table 8. Association between levels of COPD with its risk factors of control group

Particulars	χ^2values
Sex	1.17 NS
Age	3.78 NS
BMI of the subject	5.32 NS
Marital status	3.06 NS
Smoking habit	2.78 NS
Drinking habit	2.51 NS
Drug addiction habit	2.76 NS
Kerosene as cooking fuel	2.47 NS
Wood and kerosene as cooking fuel	0.19 NS
Prevalence of respiratory symptom - Cold	0.09 NS
Prevalence of respiratory symptom - Phlegm	1.11 NS
Prevalence of respiratory symptom -Wheezing	0.09 NS
Prevalence of respiratory symptom - Shortness of breath	3.46 NS
Prevalence of respiratory symptom - Chest tightness	1.46 NS
Number of years of work experience	49.85 NS
Past history of respiratory disease	33.37 NS
History of atopy	33.37 NS

*p<0.05, **p<0.01, NS: Non-Significant

When Chi-square (χ^2) test was used to find the association between levels of COPD with its risk factors of control group, all the particulars were found to be non significant.

Table 9 presents the effect of bronchodilator inhalation between experimental group and control group.

Table 9. Effect of bronchodilator inhalation between experimental group and control group

Group	Mean	Std. Deviation	t -value
Experimental	64.64	9.38	16.57**
Control	91.58	13.31	

*p<0.05, **p<0.01, NS: Non-Significant

't' test was used to find the effect of bronchodilator inhalation between experimental group and control group. FEV1 increased by 65 per cent in experimental group while 91 per cent in control group after bronchodilator test. A high significant difference at one per cent level was found between experimental group and control group when bronchodilator was administered to them.

Bronchodilators work through their direct relaxation effect on airway smooth muscle cells. Donohue (2004) and Calverley (2003) reported that 73 per cent of 813 patients with COPD increased their FEV1 by at least 12 per cent, or 200 ml, after long-term salmeterol treatment. However, 11 per cent of patients showed a similar increase in FEV1 after acute administration of ipratropium, 27 per cent after albuterol, and 35 per cent with both drugs combined.

A study conducted by Aliverti et al. (2005) showed that Salbutamol increased FEV1, forced vital capacity (FVC) and inspiratory capacity and reduced functional residual capacity (FRC) and residual volume significantly among in 18 patients with COPD. After the bronchodilator these patients tried to reduce the end expiratory lung volume when exercising, while those exercising longer continued to allow end expiratory abdominal wall volume to rise.

Recommendations:
Management of the industries should attempt to understand their worker's occupational exposures and whether he/she has been adequately trained in the dangers of these exposures. Administrative controls such as transfer to another job or change in work practices and benefits of personal protective equipment (eg. masks or respirators) should be strictly enforced.

Conclusion:
Garment industry is one of the major growth industries for export purpose and which require large number of workers. Respiratory problem is one of the major health threats to garment workers as they are exposed to textile dust for prolonged period. Therefore the workers engaged in the garment industry showed a significant higher prevalence of airway obstruction than among those who do not work in the garment industries.

A significant association was found at one per cent level among garment workers who had respiratory symptoms namely shortness of breath and chest tightness and also number of years of work experience. Spirometry is the most comprehensive screening method for chronic lung diseases, including those of occupational aetiology. Bronchodilator drugs such as salbutamol, a short acting β agonist, are widely prescribed for the symptomatic relief of breathlessness in COPD. In the present study, bronchodilator inhalation was found to be effective among workers in the early diagnosis of COPD.

Acknowledgement:
Authors acknowledge the cooperation of the garment workers in conducting spirometry test.

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