CORRELATION BETWEEN DURATION OF EXPOSURE TO COTTON DUST AND RESPIRATORY PARAMETERS IN POWERLOOM WORKERS

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Abstracts: **Background & Objectives**: Textile industry is one or the major industry in India and power looms stand as a backbone for the same. The people working in Power looms are continuously exposed to cotton dust which poses risk of respiratory disorders over the period of time. The present study was conducted with objectives of comparing the lung functions in subjects exposed to cotton dust with those unexposed and to find the correlation between duration of exposure to and respiratory parameters. **Methods**: This was an observational, cross sectional type of study conducted in the Department of Physiology at B.J.Medical College, Ahmedabad with the help of computerized spirometer RMS HELIOS-702. Total 100 subjects, 50 power loom workers and 50 controls were included in the study. After noting the anthropometric and general examination findings, respiratory parameters viz. Forced vital capacity (FVC), Forced expiratory Volume in 1 second (FEV1), FEV1/FVC ratio, Forced expiratory volume in 0.5 second (FEV 0.5), FEV 0.5/FVC, Forced expiratory volume 3 sec (FEV 3), FEV3/FVC, Peak expiratory flow rate (PEFR), Peak inspiratory flow rate (PIFR) and Maximum voluntary ventilation in minutes (MVV) were noted. Comparative analysis between both groups and correlation of the parameters with duration of exposure to cotton dust was done by student's unpaired t test and Pearson's correlation coefficient test respectively **Results**: All the respiratory parameters were reduced in power loom workers as compared with control subjects. There was statistically significant reduction in FVC, FEV1, FEV1/FVC, FEV 0.5, FEV 0.5/FVC, FEV 3, FEV3/FVC, PEFR and MVV in exposed groups. Strong negative correlation was observed between duration of exposure and FVC, FEV1, PEFR, FEV 3 & FEF 50. Moderate negative correlation was observed between duration of exposure and FEV1/FVC & FEV 0.5. **Interpretation and conclusion:** Cotton dust exposure makes huge impact on respiratory parameters of the power loom workers. This deterioration in respiratory health deteriorates with increasing duration of exposure. The health hazards caused by cotton dust should be controlled by creating awareness among the workers & employers.

Key Words: Powerloom workers, Cotton dust, Pulmonary function test, Spirometry

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Introduction:

The Indian Textile Industry counts among the leading textile industries in the world. Garment exports from India grew by 19% in the period July 2012–July 2013 to touch US$ 1.27 billion, on the back of increasing demand in developed economies such as the US, according to data released by the Apparel Export Promotion Council (AEPC).[1] Over the years, Gujarat has diversified its industrial base substantially. Today, almost all the districts of the state have witnessed industrial development in varying degree[2,3]. Power loom factories act as the back bone for this huge textile industry.

Other than the vast benefits of providing the whole country with the fabrics for fulfilment of various purposes and providing employment, this industry also exposes to various environmental & occupational hazards[4,5,6]. Byssinosis is one of the breathing disorders that occur in individuals with exposure to raw cotton dust which happens throughout the manufacturing process. It is clinically characterized by occasional (early stage) and then regular (late stage) chest tightness towards the end of the first day of the workweek (Monday–chest tightness). Incidence of byssinosis is reported to be 7 to 8% in three independent surveys carried out in Mumbai, Ahmedabad and Delhi[7]. The assessment of lung functions by spirometer and peak expiratory flow meter in textile mill and handloom workers has been studied extensively but there are few studies available for power loom workers. Moreover, the observations of various workers are conflicting about the effect of exposure on respiratory

functions. So to fulfil this lacuna, the present study was planned and conducted.

Objectives:

The present study was conducted with the following objectives:

- To compare the lung functions in subjects exposed to cotton dust with those unexposed.
- To find the correlation between duration of exposure to cotton dust and respiratory parameters.

Material and Methods:

STUDY DESIGN:

This was an observational, cross sectional type of study. It was conducted in the Department of Physiology at B.J.Medical College, Ahmedabad with the help of computerized spirometer RMS HELIOS-702 over a period of twelve months in various power loom workers of Ahmedabad city. Approval from institutional ethical committee was taken. Total 100 individuals, 50 power loom workers and 50 controls were included in the study.

SUBJECTS SELECTION CRITERIA:

Subjects from Ahmedabad city working in Powerloom for more than 3 years were selected for the test group and controls were taken from the general population of Ahmedabad.

EXCLUSION CRITERIA:

The exclusion criteria for the study were the factors or diseases, which affect the Spirometric variables. The exclusion criteria for our study were
1) Subjects not giving consent for study.
2) Subjects giving history of allergy.
3) Subjects with respiratory disease as documented by history and physical examination.
4) Subjects with congestive cardiac failure or volume overload
5) Subjects who could not perform Spirometry as for example in stroke, or those not conforming to the adequacy parameters in sequential attempts.
6) Those individuals who have diabetes mellitus, hypertension and chest deformity.
7) Subjects with history of smoking.

After taking informed consent, detailed history was taken from the subjects to collect information regarding their name, age, economic back ground, and work experience in present & previous occupation. History including relevant history was taken especially regarding duration of works, duration of smoking and any known respiratory pathology. This was followed by anthropometric measurements recording age (yrs), height (cm), weight (kg) and BMI (kg/m^2) and all subjects selected for study underwent thorough clinical examination (general and systemic).

Pulmonary function tests were performed with the help of computerized spirometer RMS HELIOS-702 with subject in sitting posture wearing a nose clip and breathing through mouth piece (Recommendations of American Thoracic Society were followed while performing Spirometry)[8]

The following parameters were assessed – Forced vital capacity (FVC), Forced expiratory Volume in 1 second (FEV1), FEV1/FVC ratio, Forced expiratory volume in 0.5 second (FEV 0.5), FEV 0.5/FVC, Forced expiratory volume 3 sec (FEV 3), FEV3/FVC, Peak expiratory flow rate (PEFR), Peak inspiratory flow rate (PIFR) and Maximum voluntary ventilation in minutes (MVV).

Statistical analysis:

The analysis for comparing the values of power loom worker's group and control group was done by student's unpaired't' test. P value less than 0.05 was considered as significant.

Correlation between duration of exposure and various respiratory parameters was done by Pearson's correlation coefficient test.

Result:

There were 100 subjects in all, out of which 50 were power loom workers while 50 controls were from normal population. There was no statistically significant difference in age, height, weight, BMI, heart rate, respiratory rate, blood pressure and random blood sugar between the two groups (Table 1).

Table 1: Anthropometry and general examination findings

Parameter	Control group (n=50)	Power loom workers (n=50)	P value
Age (yrs)	37.32 ± 8.87	35.56 ± 9.00	0.33
Height (meters)	1.63. ± 0.05	1.64 ± 0.04	0.27
Weight (Kg)	67.64 ± 8.53	65.96 ± 8.01	0.31
BMI (Kg/m^2)	25.41 ± 2.9	24.52 ± 2.39	0.10
Respiratory rate (per minute)	14.8±1.24	14.38 ± 1.01	0.19
Mean Blood pressure (mmHg)	96.19 3.07	97.23 ± 3.91	0.14
Random blood sugar (mg/dl)	102.82±4.89	101.60 ± 9.51	0.42

Out of 50 power loom workers, 10 subjects had cotton dust exposure for ≤ 5yrs, 35 subjects for 6 to 15yrs and rest of the 5 subjects had the exposure for >15yrs.

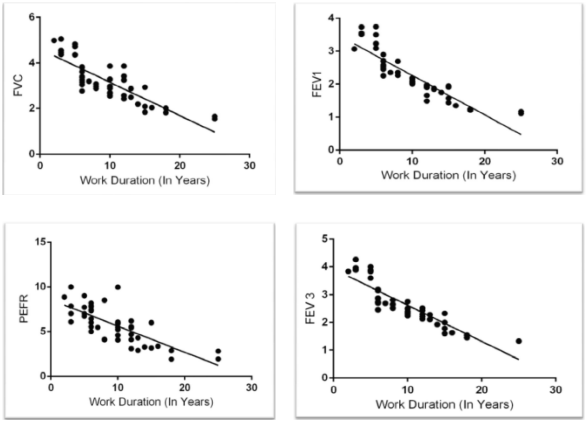
When respiratory parameters of both the groups were compared, most of the respiratory parameters in power loom workers were comparatively lower than control subjects. A significant reduction was observed in FVC, FEV1, FEV1/FVC ratio, PEFR, FEV3, FEF50, FEV3/FVC and MVV (Table 2). No significant difference was observed in PIFR and FEV0.5/FVC ratio in the two groups.

When correlation was seen between duration of working in powerloom and various respiratory parameters, a strong negative correlation was seen with FVC (r = -0.830), FEV1 (r = -0.882), FEV3 (r = -0.887) PEFR (r = -0.753) and FEF 50 (r = -0.743) and moderate negative correlation was seen with FEV1/FVC, FEV 0.5, PIFR and MVV. The correlation of duration of exposure was very weak with FEV0.5/FVC and FEV3/FVC. (Table 2 and Graph-1)

Table 2: Pulmonary function test: Comparison and correlation.

Parameter	Control group (n=50)	Power loom workers (n=50)	P value	Correlation coefficient (r)
FVC (L)	3.70 ± 0.62	3.20 ± 0.91	0.0018	-0.830
FEV1 (L)	2.94±0.43	2.31±0.71	< 0.0001	-0.882
FEV1/FVC (%)	80.40±10.38	72.14±8.60	< 0.0001	-0.581
PEFR (L/sec)	6.66±1.33	5.71±2.03	0.0067	-0.753
FEV 0.5 (L)	2.02±0.47	1.58±0.79	0.0010	-0.699
FEV3 (L)	3.19±0.45	2.67±0.77	< 0.0001	-0.887
PIFR	3.23±1.30	2.82±1.31	0.1194	-0.442
FEF 50	4.92±0.93	4.13±1.21	0.0004	-0.743
FEV0.5/FVC	55.51±14.43	49.20±18.31	0.0585	-0.247
FEV3/FVC	86.94±6.92	83.28±5.16	0.0034	-0.218
MVV	159.75±28.02	116.25 ±36.45	< 0.0001	-0.446

Graph1: Correlation between working duration in powerloom and FVC, FEV1, PEFR or FEV3



Discussion:

In India, the textile industry contributes substantially to foreign exchange earned by the country. The textile industry is also providing employment to numerous people in the country. But, there is lack of awareness about the health

consciousness as on the part of both employer as well as employees. The main aim of this study was to provide an overview of the issue such as causes, consequences and health hazards arising due to cotton dust.

The mean FVC in power loom workers in our study was statistically lower than the control group (p=0.0018). The probable reason for the reduction of FVC might be exposure to endotoxin like release of histamine, 5HT and metabolites of arachidonic acid which act immediate mediator of bronco constrictions. We also observed a significant negative correlation with duration of exposure in the exposed groups, suggesting that exposure time is also related with reduction is ventilatory function. Almost all the workers of exposed groups did not exhibit any respiratory symptoms in our study. Therefore these asymptomatic individuals may develop respiratory symptoms later on, if exposure is continued.

The reduction of FEV1 in power loom workers was statistically significant (P<0.001) as compared to control, which match with above finding. The probable reason for the reduction of FEV1 (FEV1 represents airflow in both central and peripheral airways) might be release of endotoxin, which act as immediate mediator of bronchoconstriction construction.

We observed that the reduction in PEFR was significant (P<0.005) as compared to control groups. The probable reason for reduction in PEFR might be hypertrophy of mucosal cells, which may be due to irritation of mucosal cells by cotton dust resulting in the increased secretion of mucus and formation of mucosal plugs, which causes obstruction to exhaled air.

Conclusion:

Cotton dust exposure makes huge impact on respiratory parameters of the power loom workers. Most of the parameters were significantly low in the cotton dust exposed group as compared to the normal population. The condition even deteriorated when the duration of exposure to cotton dust increased.

As being the largest contribution to the national economical growth, we are giving utmost emphasis to the textile industry, especially in terms of developing high speed machineries, versatile machines and high quality products. At the same time we must also focus on health conditions of the humans involved in the manufacturing process where environmental conditions are not health friendly. Textile management and employer should follow the good working environments to control the cotton dust exposure to workers. The cotton dust which is creating health hazards to the lakhs of labourers involved in the textile manufacturing process should be controlled by creating awareness among the workers & employers.

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