# **Original Research Article**

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# Assessment and association of various factors affecting pulmonary function of workers of a factory

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#### **ABSTRACT**

**Background:** Occupational health diseases are becoming vividly active in the present scenario of the generation. Because of the active industrialization of the world, in the last century various industries are growing each and every day in various fields in multiple countries. Textile industries alone are one of the most common industry and a source of occupation for more than 20 million workers in India itself. Therefore, it is very important to ensure proper preventive and medical strategies for the industrial workers.

**Methods:** A cross sectional study of 240 workers in a textile industry, was performed. For the study, a well structural questionnaire and peak expiratory flow rate (PEFR) examination was used. Several factors were considered for the abnormality of the PEFR and considerable associations were questioned. The statistical analysis is made by chi-square test and p values.

**Results:** There are positive association found with abnormal PEFR found and multiple factors including age of the workers, duration of exposure and type of exposure.

**Conclusions:** The industrial workers are very prone to develop pulmonary occupational diseases; therefore, it is very important to make preventive measures for its associative factors causing it.

Keywords: Function, Pulmonary, Textile, Workers

## **INTRODUCTION**

Occupational health diseases are becoming vividly active in the present scenario of the generation. Because of the active industrialization of the world, in the last century various industries are growing each and every day in various fields in multiple countries. Textile industries alone are one of the most common industry and a source of occupation for more than 20 million workers in India itself. Since the workers in the textile Industries have a continuous exposure for years, it can severely affect the health of the workers. There can be several factors affecting the pulmonary function of the workers in the textile industries. As, it is commonly seen in various industries in India, most of the workers do not use any

intervention in the course of their work and are therefore more prone to develop long term sequelae due to the same.

In this study we used-peak expiratory flow rate (PEFR) to suspect pulmonary function abnormality, PEFR is an effort dependent test, reflects the status of large airways.<sup>3</sup> PEFR is considered as one of the best measurements of fast exhalation of an individual and commonly used for testing breath shortness, cough, and wheezing.<sup>4</sup> Measurement of PEFR in our study along with association of various factors with abnormal PEFR may provide the better understanding of respiratory functioning and abnormality and its relation to various factors in textile workers. Therefore, the objective of the

study is assessment of sociodemographic profile, pulmonary function and its association with various chosen factors to the exposed and non-exposed workers of the textile factory.

#### **METHODS**

A cross-sectional study of 240 industrial workers working in a cotton textile industry, Mahalaxmi Mills, Narol, Ahmedabad, was undertaken from April 2019 to September 2019. Selection of subjects for the sample included the workers working in Mahalaxmi enterprises, a cotton textile industry in Ahmedabad. It comprised of 240 workers who were directly and indirectly exposed and were having similar age group and socio-economic status.

#### Inclusion criteria

Workers working in the day shift of the factory, workers with minimum one year of exposure, workers in the age group of 18-50 years, workers who gave well informed verbal consent to participate in the study.

# Exclusion criteria

Workers who were absent during the study, workers suffering from another respiratory disorder, workers with a history of respiratory medicine, workers with history of tobacco, smoking or alcoholism and workers who did not give the consent to the study.

A structural self-constructed questionnaire was used in the study. A well-informed verbal consent was taken by the participants of the study. It had open and closed ended questions. The questionnaire included Socio-demographic information in the form of age, sex, educational status and economic status of the workers. Occupational history was also included in the questionnaire including department of work, work experience and socio-economic status. Peak expiratory flow rate (PEFR) examination was performed to the participants of the study.

# The following steps were adopted to measure PEFR

- The marker was moved to the bottom of scale.
- The subject was asked to stand up straight.
- The subject was asked to take a deep breath.
- The subject was asked to hold his/her breath while the mouth piece was placed inside, between the teeth and they were asked to close their lips and to not put their tongue against or inside the hole.
- The subject was asked to blow out as hard and fast as possible.
- The number shown on the scale was recorded.
- The marker was moved back to the bottom and the above steps were repeated two more times.

The highest of the 3 recordings was taken as the PEFR.

The sampling technique used was purposive. The data was compiled and analyzed using google spreadsheets. To find the association between different factors- the statistical method of Chi-square test and p value was taken. A null hypothesis was formed with no association taken into consideration and Chi-square values and p value was calculated to find the possible association between the decided factors. The confidence interval taken for p value is 95% with 0.05 level of significance. Values corresponding <0.05 are found significant, the null hypothesis stands void and the factors are found to be associated for 95% confidence level.

#### **RESULTS**

Initially, the demographic profile of the workers was studied. In the study of 240 workers, 216 (90%) were males and 24 (10%) were females. Further, the age groups of the workers were studied - maximum number of workers were found in the age group of 30-34 and the minimum number of workers were found in the age group of 18-22 (Table 1).

Table 1: Age wise distribution of workers.

Age group (years)	Total number of workers	Male	Female
18-22	9	7	2
22-26	24	23	1
26-30	40	38	2
30-34	47	41	6
34-38	41	35	6
38-42	33	30	3
42-46	19	18	1
46-50	27	24	3
Total	240	216	24

The next demographic factor studied was educational status of the workers- Maximum number of workers were found to have had secondary education, while very few were just literates. 0.92% of males were just literate and 0% females were found just literate. 57.87% males and 66.66% females had secondary education. 18.51% males and 29.16% females had higher secondary education and 22.68% males and 1% females were graduates.

The next demographic factor studied was the economic status of the workers- maximum number of workers (62.5%) of workers had income in the range of Rs. 100001-20000. The mean income of the workers found was Rs. 16,700. 13.88% of males and 25% females had income Rs. ≤1000. 61.11% males and 75% females had income Rs. 10001-2000. 16.66% males and 36% females had income in the range of Rs. 20001-30000. 6.01% males and 0% females had income in the range of Rs. 30001-4000 and only 2.31% males and 0% females had income Rs. >4000.

The next factor studied was the type and section of exposure of the workers of the factory. Maximum number of workers had exposure with hazardous chemicals (59.58%) (Table 2). The next factor studied was the years of exposure of the workers of the factory, maximum number of workers had 1-5 years of exposure (Table 3).

Table 2: Section and type of exposure of the workers.

	Male	Female	Total		
Section of exposure	Number	Number	Number	Percentage	Type of exposure
Account	10	0	10	4.16	No exposure
Boiler	29	11	40	16.55	Excessive heat, lubricating oil, coal, grease
Checking**, helper work, stitching	31	13	44	18.83	Dust, cotton dust, fumes of flannel cotton fabrics
Engineer*, production unit, quality check (Q.C.), storing unit	143	0	143	59.58	Chemicals and fumes, iron, zinc, xylene, toluene, benzene, caustic soda, reactive colors
Effluent treatment plant	3	0	3	1.25	Sewage water and chemicals

<sup>\*\*</sup>Checking before dispatch of products, \*Engineering department for the maintenance of machinery.

Table 3: Years of exposure of workers.

Years of exposure	Male Number	Female Number	Total Number	Percentage
1-5	83	18	101	42.083
6-10	69	6	75	31.25
11-15	43	0	43	17.916
16-20	18	0	18	7.5
21-25	2	0	2	0.83
26-30	1	0	1	0.416
Total	216	24	240	100

Table 4: Association between age and peak expiratory flow rate.

A 30 (700 mg)	Normal PEFR (>350 ml/min)		Abnormal PEFR (≤350 ml/min)		Total
Age (years)	Number	%	Number	%	
18-20	4	6.153	5	2.857	9
20-24	12	18.46	12	6.8	24
25-29	15	23.07	25	14.28	40
30-34	13	20	34	19.4	47
35-39	9	13.8	32	18.2	41
40-44	6	9.23	27	15.4	33
45-49	2	3.07	17	9.7	19
50-60	4	6.15	23	13.14	27
Total	65		175		240

Table 5: Association between exposure of excessive heat, lubricating oil, coal, grease and abnormal PEFR.

Type of exposure	PEFR normal (>350 ml/min)	PEFR abnormal (≤350 ml/min)	Total
No exposure	4	6	10
Excessive heat, lubricating oil, coal, grease	10	30	40

Table 6: Association between dust, cotton dust, fumes of flannel cotton fabrics and abnormal PEFR.

Type of exposure	PEFR normal (>350 ml/min)	PEFR abnormal (≤350 ml/min)	Total
No exposure	4	6	10
Dust, cotton dust, fumes of flannel cotton fabrics	5	39	44

Table 7: Association between chemicals and fumes, iron, zinc, xylene, toluene, benzene, caustic soda, reactive colors and abnormal PEFR.

Type of exposure	PEFR normal (>350 ml/min)	PEFR abnormal (≤350 ml/min)	Total
No exposure	4	6	10
Chemicals and fumes, iron, zinc, xylene, toluene, benzene, caustic soda, reactive colors	16	127	143

Further, association of various factors affecting lung function was studied with the help of peak expiratory flow rate (PEFR). Values of PEFR ≤350 ml/min is considered abnormal (Table 4).

The first factor studied was the effect of age on PEFR. A null hypothesis was formed indicating no association between abnormal PEFR and age of the workers, Chisquare test found was 16.528 and p value found was 0.0207068. Thus, null hypothesis stands void and there is a positive association between age and abnormal PEFR found. The next factor studied was the effect of the type of exposure on PEFR. A null hypothesis was formed indicating no association between abnormal PEFR and exposure of excessive heat, lubricating oil, coal and grease, Chi-square test found was 0.892857 and p value found was 0.3447. Thus, null hypothesis stands and there is no association between the factors found (Table 5).

The next factor studied was the effect of exposure of dust, cotton dust, fumes of flannel cotton fabrics on PEFR. A null hypothesis was formed indicating no association

between abnormal PEFR and exposure of dust, cotton dust, Fumes of flannel cotton fabrics, Chi-square test found was 4.81091 and p value found was 0.02828. Thus, null hypothesis stands void and there is a positive association between the factors found (Table 6).

The next factor studied was the effect of exposure of chemicals and fumes, iron, zinc, xylene, toluene, benzene, caustic soda, reactive colors on PEFR. A null hypothesis was formed indicating no association between abnormal PEFR and exposure of chemicals and fumes, iron, zinc, xylene, toluene, benzene, caustic soda, reactive colors, Chi-square test found was 6.8276 and p value found was 0.008976. Thus, null hypothesis stands void and there is a positive association between the factors found (Table 7).

The next factor studied was the effect of exposure of sewage water and chemicals on PEFR. A null hypothesis was formed indicating no association between abnormal PEFR and exposure of Sewage water and chemicals, Chisquare test found was 1.7333 and p value found was 0.188816. Thus, null hypothesis stands and there is no association between the factors found (Table 8).

Table 8: Association between sewage water and chemicals and abnormal PEFR.

Type of exposure		PEFR abnormal (≤350 ml/min)	Total
No exposure	4	6	10
Sewage water and chemicals	0	3	3

Table 9: Association between years of exposure and abnormal PEFR.

Years of exposure	PEFR normal (>350 ml/min)	PEFR abnormal (≤350 ml/min)	Total
1-5	44	57	101
6-10	27	48	75
11-15	11	32	43
16-20	2	16	18
21-25	2	0	2
26-30	0	1	1

The next factor studied was the effect of years of exposure of on PEFR. A null hypothesis was formed indicating no association between abnormal PEFR and years of exposure, Chi-square test found was 16.528 and p value found was 0.0207068. Thus, null hypothesis stands void and there is a positive association between the factors found (Table 9).

## **DISCUSSION**

Occupational health diseases are proving to be a concerning factor in the medical sciences. There are various factors responsible for the enhancement of this health hazard. This study has shown a positive association between decreasing pulmonary function and years of exposure, type of exposure and the age of the workers.

(Table 10). This study is consistent with other studies which also pointed out the various environmental factors, working conditions, and occupational status from different sectors responsible for impact on a health of an individual.<sup>5</sup> There was another study which proved that long-term exposure to cotton dust was found to associated obstructive disease which increases with the duration of exposure and correlated with the pulmonary function.<sup>6</sup> Authors received similar results with our study. Although, there is a study which observed an inverse relationship

between chronic exposure to cotton dust and pulmonary functions after observing decreased level of PEFR in cotton mill workers.<sup>7</sup> While there are multiple studies which observed a decreased PEFR in the exposed group of individuals compared the non-exposed group of individuals.<sup>8</sup> In this study authors found a long-term effect exposure effect on the individuals, this is supported by another study which showed a significant reduction in respiratory functions due to continuous exposure to cotton dust.<sup>8</sup>

Table 10: Association of various factors with abnormal PEFR.

Variable	Normal PEFR	Abnormal PEFR	Chi-square value	P value	Association
Age (in years)					
18-22	4	5			
22-26	12	12			
26-30	15	25			
30-34	13	34	16.528	0.0207068	Yes
34-38	9	32			
38-42	6	27			
42-46	2	17			
46-50	4	23			
Years of exposure					
1-5	44	57		0.0189917	
6-10	27	48			
11-15	11	32	13.5164		Yes
16-20	2	16	15.5104		ies
21-25	2	0			
26-30	0	1			
Type of exposure					
Excessive heat, lubricating oil, coal, grease	10	30	0.892867	0.3447	No
Dust, cotton dust, fumes of flannel cotton fabrics	5	35	4.81091	0.02828	Yes
Chemicals and fumes, iron, zinc, xylene,					
toluene, benzene, caustic soda, reactive colors	16	127	6.8276	0.008976	Yes
Sewage water and chemicals	0	3	1.73333	0.18816	No

## **CONCLUSION**

This study has helped in acknowledging the health hazard faced by workers in the industrial field. They are frequently in close constant exposure to various chemicals which can lead to morbidity, financial crisis and even mortality. The study has acknowledged various factors affecting the pulmonary function of the workers and it impedes routine health care check-ups and a strict use of person protective equipment for the workers to prevent them leading to an occupational health disease.

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