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Original research article

A STUDY ON SPIROMETRIC INDICES IN COTTON MATTRESS WORKERS

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Abstract

Background: Work in the textile sector has been recognized as an occupational danger for than 300 years.[1] Byssinosis is the most frequent and well-studied disease affecting cotton textile workers; nevertheless, additional symptom complexes such as mill fever, weaver's cough, and mattress-maker's cough also affect textile workers.[2]

Objectives

1. To Evaluate the Health Hazards of the cotton Mattress workers after prolonged expose to cotton dust.
2. To assess the spirometric Profile in these cotton mattress workers.
3. To examine the relationship of the degree of impairment of lung functions with duration of exposure.

Material & Methods

Study Design: Community based prospective cross-sectional study.

Study Area: Department of Physiology and Department of General Medicine, Siddhartha medical college, Vijayawada, Andhra Pradesh.

Study Period: 1 year.

Study Population: cotton mattress workers are enrolled in to the present study to evaluate, spirometric profile.

Sample Size: 30 males cotton mattress workers are enrolled in to the present study to evaluate, spirometric profile and 15 cases of control group were evaluated.

Sampling Technique: Simple Random technique.

Study Tools and Data Collection Procedure: 30 male cotton mattress workers, along with control group of 15 male cases were taken, belonging to different areas of Vijayawada city. A detailed History & Clinical examination was done, other co-existing lung diseases like DM/HTN and smokers were excluded, spirometric (Pulmonary Function Test) evaluation done with the aid of Medispiror, Spirometer.

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Results are analyzed.

Results: Analysis shows that there was a significant variation between cotton mattress workers and non-cotton mattress workers as far as FVC, FEV1 are concerned, in these two tests, t-test values are -3.71327, -3.4394 respectively, and the corresponding p-values were 0.000866234, 0.001787 respectively and factor FEF25-75 shows significant decrement in seen as t-est value is -1.60617 corresponding p-value are 0.119072 respectively However the factors FEV1% and PEF shows no significant decrement or Increase In cotton mattress workers and others (t-test values -3.37492, 0.045478).

Conclusion: All the subjects with more than 5 years exposure are symptomatic (cough-100%, chest tightness 21%, S.0.B 21%). Sneezing is the predominant upper Respiratory symptom (80%). The occupation of cotton mattress making has a statistically significant cause-effect relationship with regard to ventilatory defect. FEV1 and FVC showed negative correlation with duration of exposure and that with increased duration exposure FEV1 and FVC values are decreasing.

Keywords: Cotton dust, PFT, short term exposure, long term exposure

Introduction

Work in the textile sector has been recognized as an occupational danger for than 300 years [1]. Byssinosis is the most frequent and well-studied disease affecting cotton textile workers; nevertheless, additional symptom complexes such as mill fever, weaver's cough, and mattress-maker's cough also affect textile workers [2].

Cotton workers are vulnerable to occupational lung disease, such as byssinosis and chronic bronchitis. The first stage of byssinosis is marked by acute reversible symptoms such as wheezing, chest tightness, shortness of breath, or cough, and is usually noticeable on the first day back to work following a 48-hour leave ('Monday Dyspnea'). Early symptoms are often accompanied by reversible decreases in lung function (across-shift drops in FEV1). With sustained exposure, the condition may worsen to the point that symptoms are persistent throughout the work week, eventually leading to severe respiratory dysfunction [3, 4].

Spirometry is a critical diagnostic and predictive tool, especially for industrial respiratory disorders. It is a simple and low-cost approach for measuring respiratory tract diseases [5]. Changes in main pulmonary function indicators such as forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), FEV1/FVC%, and peak expiratory flow rate can be used to determine the kind and degree of respiratory disease [6, 7]. The percentage anticipated value of these measures, on the other hand, is thought to be a considerably stronger predictor of respiratory diseases [8, 9]. Furthermore, alterations in the smaller airways can be measured using metrics such as FEF25%-75%.

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Sampling Technique: Simple Random technique.

Inclusion Criteria

1. Cotton mattress workers.
2. Working for more than 5 years.

Exclusion Criteria

1. Any co existing lung disease.
2. DM/HTN.
3. Smoking.
4. Co-existing cardiovascular disease.

Ethical Consideration: Institutional Ethical committee permission wasa taken prior to the commencement of the study.

Study Tools and Data Collection Procedure

30 male cotton mattress workers, along with control group of 15 male cases were taken, belonging to different areas of Vijayawada city. A detailed History & Clinical examination was done, other co-existing lung diseases like DM/HTN, and smokers were excluded, spirometric (Pulmonary Function Test) evaluation done with the aid of Medispiror, Spirometer. Results are analyzed.

By using electronic spirometer, Medispiror, Spirometry has been done. It is designed to be used with electro mechanical pneumotach. The machine has the facilities of memory and taking out the prints. The Turbine: The machine is based on a turbine sensor working on the infrared interpretation principle. This principle guarantees assurance plus reproducibility, if the measurement in time and thus a reliability of measurement appropriate to such a professional use.

The main characteristics of this type of sensor are

a) Accuracy of measurement even at very low flows (end of the expiration).
b) Not affected by gas density on humidity.
c) Unbreakable and shock proof.
d) Simple to clean and sterilized.

Spirometry is done with a machine called 'spirometer'. A wide variety of such machines have been developed. These include the water seal, rolling seal, bellows volume and

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automated flow spirometers. The Volume spirometer holds at least. 8 liters volume of air and hence is bulky. In Automated Flow spirorneters, instead of holding volume, an airflow transducer is placed· next to mouthpiece which converts airflow into electrical signals. the electrical signals are integrated to give the volume and flow at a particular time. Automated spirometers are quite handy and the procedure of their disaffection is also quite simple. These spirometers are good but require frequent calibration.

Data is obtained from a forced expiratory maneuver and these are used to generate volume versus time curve in traditional spirometers. but, with the development of computers, now most of the electronic spirometers generate both volume-time and flow-volume types of curves. Though both types of curves give the same information, the flow-volume type of curves are helpful in detecting inadequate patient effort. Spirometeric indices help in diagnosis of both obstructive and restrictive type of ventilatory defects. A diurnal rhythm is now recognized. It produces the worst functions early in the morning. Therefore, the test should be repeated at the same time of the day.

Statistical Analysis

The study design is cross-sectional and prevalence study. Most of the variables used in our study are categorical. Hence frequency and prevalence were calculated. Pearson's chi-square test also known as the Chi-square test for independence and the Chi-square test of association was used to detect if there was any relationship between two categorical variables. ANOVA was used to compare the two means. A p-value of 0.05 is taken as significant.

Observations & Results

Table 1: Age distribution of study and control population

Age group	Study Group		Control Group	
	Number	%	Number	%
15-20	1	3.33	0	0
21-25	2	6.66	1	6.66
26-30	4	13.33	1	6.66
31-35	9	30.00	5	33.3
36-40	8	26.6	5	33.3
41-45	4	13.33	1	6.66
46-50	1	3.33	1	6.66
51-55	1	3.33	1	6.66
Total	30	100.00	15	100.00

30-40-year age group is predominant in study group.

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Table 2: Exposure wise distribution

Duration in year	Study Group	
	Number	%
5	2	6.66
6-10	19	63.33
11-15	7	23.30
16-20	0	0.00
21-25	2	6.66
Total	30	100.00

63.33% of the study group is exposed in the range of 5-10 years. 23.3% of the study population is exposed to 10-15 years.

Exposure Hours calculated by a formula.

Formula = No of working Hours/days x No. of working days/wk x 52x Total No. of years exposure.

53.29 of study population is in the range of 6000 to 20000 exposure hours.

Table 3: Symptomatology

100% of the study group are symptomatic

Symptom Wise	No. of Cases
Cough	30
Sneezing	24
Chest Tightness	21
S.O.B.	21
Wheeze	8

Cough and sneezing are the predominate symptoms. Chest tightness & shortness of breath come next.

Spirometric Profile

Spirometric Profile-Stastical Analysis

To test whether the severity of ventilatory defect is depending on exposure to cotton dust in cotton mattress workers or not.

Analysis shows that there was a significant variation between cotton mattress workers and non-cotton mattress workers as far as FVC, FEV1 are concerned, in these two tests, t-test values are -3.71327, -3.4394 respectively, and the corresponding p -values are 0.000866234, 0.001787 respectively and factor FEF25-75 shows significant decrement in seen as t-est value is -1.60617 corresponding p-value are 0.119072 respectively However the factors FEV1% and PEF shows no significant decrement or Increase In cotton mattress workers and others (t-test values -3.37492, 0.045478).

The difference between predicted and actual values show a significant difference between cotton mattress workers and control group in case of FVC and FEV 1 the difference is significantly more in cotton mattress workers than controls. [t-values are

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(FVC) 5.0493, p-value 0.000022 & (FEV1) t-value 4.707, p-value 0.000057]

Table 4: FVC

	Study		Control group		t-value	P-value
	Mean	S.D.	Mean	S.D.		
Actual (Measured Value)	2.5703	0.7517	3.3513	0.7980	-3.71327	0.000866234 (Significant)
Decrement (Deviation from Predictive)	1.0726	0.78	0.1466	0.534	5.0493	0.000022 (Significant)

FVC actual values and decrement when compared to predicted value in cotton mattress workers. There was a significant decrease in FVC values in cotton mattress workers when compared to their predicted value (P<0.00086).

Table 5: FEV1

	Study Group		Control group		t-value	P-value
	Mean	S.D	Mean	S.D		
Actual (Measured Value)	2.3153	0.6855	2.9373	0.6564	-3.4394	0.001787 (Significant)
Decrement (Deviation from Predictive)	0.7413	0.653	0.0526	4.707		0.000057 (Significant)

There was significant decrease in FEV1 values in cotton mattress workers when compared to with their predicted value, (P< 0.001787).

Table 6: FEV1%

	Study Group		Control Group		t-value	P-value
	Mean	S.D	Mean	S.D		
Actual (Measured Value)	89.1733	10.079	90.193	10.426	-3.37492	<0.710447 (Not Significant)
Decrement (Deviation from Predictive)	9.7933	10.164	7.24	10.750	-0.8868	0.382 (Not Significant)

FEV1% show there is no significant change in FEV1% in cotton mattress workers and others or in both (Maintaining equal ratio).

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Table 7: $FEF_{25-75\%}$

	Study Group		Control group		t-value	P-value
	Mean	S.D	Mean	S.D		
Actual (Measured Value)	3.069	1.3553	3.6706	1.3707	-1.60617	0.119072 (Not Significant)
Decrement (Deviation from Predictive)	1.207	1.258	0.7526	1.224	1.3037	0.2025 (Not Significant)

FEF_{25-75} shows significant decrement (P-value 0.119072).

Table 8: PEFR

	Study Group		Control group		t-value	P-value
	Mean	S.D	Mean	S.D		
Actual (Measured Value)	6.6953	2.23497	6.6693	2.2654	0.04547	0.964038 (Not Significant)
Decrement (Deviation from Predictive)	1.9626	2.1798	1.80	1.777	0.30996	0.758803 (Not Significant)

PEFR Shows minimal reduction (but not statically significant)

Table 9: Correlation with Hours

FVC shows negative correlation with increasing hours and exposure r=0.527 with P-value, 0.05 that indicates significant correlation.

FEV1 also shows negative correlation with increasing hours & exposure, r = 0.592 with P-value, 0.05 (Statistically significant).

FEF 25%-75% shows negative correlation r=0.399: P-value 0.11 Though the change in PEFR are not statistically significant r=0.342: P-value 0.096.

In FEV1% correlation and P-values are for hours r = 0.10 with P-value 0.7 respectively.

	FVC	FEV_1	FEV_1%	FEF_{25-75}	PEFR
Actual	-0.64	-0.68	-0.61	-0.47	-0.39
Decrease	-0.527	-0.592	-0.10	-0.399	-0.342

Correlation of ventilatory defect with increasing working hours and exposure to cotton dust.

Discussion

The Respiratory system of the human beings has a natural design to carry out several functions like gas exchange, defense mechanism, maintenance of pH and so on. Being in direct contact with atmosphere, it is also at a disadvantage of acquiring air borne infections and diseases caused by dust.

Several occupations are involved in the pathogenesis of occupational diseases. The offending agents, cotton fiber produce "Byssinosis" which can occur in acute and chronic forms. Several occupations were studied in the past by various researchers. Work related disorders like grain dust induced Industrial bronchitis, cotton seed crushing mills and herbal tea workers. Similar syndromes of humidifier fever have been

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described in cotton mills (Mill fever), Grain Silos (Grain fever), Piggeries (swine containment fever), and sewage worker (Sewage sludge fever).

More amount of literature is available regarding Byssinosis but little literature is available as far as cotton mattress workers. Since cotton mattress work is a common profession everywhere and also in Andhra Pradesh, these professionals are at the risk of prolonged exposure to cotton fibers, This made research workers to look for clinicoradiological profile and lung function in those workers. Present study is designed to examine if there is really any bearing on the cotton mattress profession with reference to spirometric profile.

Both study and control population included in the study were above 15 years age group only for reason of better comprehension and understanding of the performance of spirometry and to get reliable results in a study.

The study and control population are age matched to a great extent (56.6%) 30-40 years age group is predominant in both groups. In the study group, 63.27% of their had exposure duration in the range of 5-10 years and 23.3% of the study group in the exposure range of 10-15 years. All put together 86,57% of the study population has the exposure duration of more than 5years (remaining exposure for exact 5 years) which is sufficient to exert pathological or pathophysiological effects in these profession. Since the working hours and days vary between worker to worker, a more concrete estimation of exposure is worked out in the form of exposure hours. 53.29% of the study population fall in the range of 6000-20,000 working hours.

All the subjects above 15years age are enrolled into the study and on inquiry 100% of them are symptomatic; cough and sneezing are the predominant symptoms. Cotton fibers are fine particles which cause mechanical irritation of nasal and bronchial Mucosa might cause these symptoms. Chest tightness and Shortness of breath were less common symptoms.

Statistically significant evidence was available to prove the point of the occupation of cotton mattress workers which has a definite bearing on the severity of restrictive ventilatory defect.

In case of FVC, the difference between predicted and actual values are noted between the study group and controls but the difference in the study, group (cotton mattress workers) is more and statistically significant. (t-value = 5.0493; $p<0.05$) and FEV1 described a statistically significant decrement change in the study group (t=4.707).

FEV1% value which is a ratio-percentage has not changed in the study as well as control groups, implying a restrictive defect in the study population and normal unchanged ratio in control population. PEFR and FEF25-75 values in the study group didn't change much when compared to predictlve value indicating that obstructive airway disease is less likely in the study population.

There is a negative correlation between exposure duration and the change in FVC, i.e., with increasing duration of exposure the FVC values fell down. The reason is self-explanatory. FEV1 also shows negative correlation but with statistical significance. One subject (3.33%) had a mild obstructive defect, reversibility if; noted. One subject with (3.33%) both mild obstructive and mild restrictive defect (mixed defect) was noted. Even if the obstructive ventilatory defect and mixed ventilatory defect of the two subjects are taken into account, there is no statistically significant difference.

Though symptoms are present in all the subjects of study group with varying periods of

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exposure to cotton dust, the ventilatory defect is mostly seen in the study group with a minimum duration of 6-10 years of exposure. In the present study, in terms of exposure hours, the restrictive defect is mostly seen with 10,000 hours to 35,000 hours, where in the maximum No. of workmen (13 subjects) fell in this category.

The results of the present study are compared with various other studies. All the studies were conducted on cotton workers working in mills and textile Industries. Hence exact comparison could not be made because the present study is on cotton mattress workers, working in one or two employed working establishment. The nature of the work is dissimilar though the substance is the same. Only one study is available in India by C. Bhandari *et al*., who studied on cotton mattress workers and observed statistically significant values of FVC, FEV1, PEF, FEF25-75 They also observed symptoms of breathlessness, chest tightness and cough. Among this 40% had normal, 32%) have restrictive, 20% had obstructive and 8% had mixed pattern of ventilatory defect. In the present study all the subjects are symptomatic with 26.66% being spirometrically normal, 66.66% showed restrictive defect. Out of which, moderate restriction is 36.66%, obstructive and mixed type of ventilatory defects were noted in 3.33% each. Still larger study populations may throw light on the exact picture of ventilatory abnormality. Further studies, measuring the concentrations of cotton dust at the work place and transfer factor (DLCO) of the lung are needed. At the moment the present study enjoys only the status of spirometric profile presentation in cotton mattress workers.

Conclusion

All the subjects with more than 5 years exposure are symptomatic (cough-100%, chest tightness 21%, S.0.B 21%). Sneezing is the predominant upper Respiratory symptom (80%). The occupation of cotton mattress making has a statistically significant cause-effect relationship with regard to ventilatory defect. FEV1 and FVC showed negative correlation with duration of exposure and that with increased duration exposure FEV1 and FVC values are decreasing.

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