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Reduced Pulmonary Functions in Wool Industry Workers of Amritsar District of Punjab with Over 10 Years of Exposure- A Case Control Study

Amar Jyoti[1], Savita Dogra[2], Swaran J.[3], N. S Neki[4], Tushar Bhagat[5]

[1,2,3]Assistant Prof. Physiology Deptt, Govt. Medical College, Amritsar.

[4]Professor, Medicine Deptt, Govt. Medical College, Amritsar.

[5]Mbbs Student, Govt. Medical College, Amritsar.

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ABSTRACT

Background: Occupational lung disease is the biggest disability in this era of pollution and occupational hazards. In the present world the incidence of respiratory illnesses has increased in the last 4-5 decades leading to environmental and industrial pollutants. **Methods:** In this study one hundred of age between 20-60 years wool industry workers with 10 and more than 10 years of exposure. Same number age, height and weight matched normal control were also taken. All were nonsmoker, previously not suffering from any chronic lung disease and their Pulmonary Function tests, in terms of F.V.C., FEV in 0.5, 1st & 3rd second ($FEV_{0.5}$, FEV_1, FEV_3, $FEF_{25-75\%}$, P.E.F. R., M.V.V. F.E.V. $FEF_{0.5}$ / F.V.C.%, F.E.V. 1/ F.V.C.%, F.E.V. 3/ F.V.C.% were done, analysed and compared. **Results:** highly significant in FVC, FVC0.5, FEV1, FEV3 and MVV, significant in $FEF_{25-75\%}$, $FEF_{25\%}$, FEF $FEF_{50\%}$, FEF $FEF_{75\%}$, and non-significant in FEV0.5/FVC %FEV_1/FVC%, FEV_3/FVC% ratio. Table III concluded that results were highly significant in FVC, $FVC_{0.5}$, FEV_1, FEV_3, $FEF_{25-75\%}$, $FEF_{25\%}$, $FEF/FEF_{50\%}$, $FEF/FEF_{75\%}$ and MVV, significant in PEFR and F.E.V_1./F.V.C.%, non-significant in F.E.V_3./F.V.C.%, ratio. **Conclusion:** Pulmonary functions drastically decreased in wool industry units as compared to Control subjects.

Keywords: Wool dust, occupational lung disease, Forced Vital capacity, lung functions.

INTRODUCTION

Occupational lung diseases are the biggest disability in this era of pollution and occupational hazards. The first recorded mention of breathlessness among handlers of food grain was by Ramazzini (1713) and since then he is considered as father of occupational medicine.[1] Harmful effects of mining also dates back to pre-history when man first started to dig underground for flints to make arrowheads and axes.

In the present world the incidence of respiratory illnesses has increased in the last 4-5 decades leading to derangement of lung functions. The pulmonary fibrosis may result from asbestos and quarts exposure; pulmonary oedema and bronchiolitis from toxic gas inhalation and allergic responses from organic dust exposure like cotton, hemp, jute and grain dust.[2] In the past 40 years lung functions tests have been increasingly used for diagnosis, assessment and clinical management of breathlessness, epidemiological and research tools and in industrial preventive medicine. Spirometery is a simple non-invasive method of accessing lung functions. It is an invaluable screening test to identify patients with obvious and underlying lung disease.

In cotton and wool industry pollution is mainly due to wool and cotton dust. Wool dust consists of wool fibres, silica, organic particles from sheep skin, dung etc. Wool has been reported as physiologically inactive material producing very little allergic and chemical reactions in lungs.[3] However a higher incidence of chronic non-specific broncho-pulmonary disease is reported among industrial workers with the reduction in ventilator capacity suggesting that these workers may develop acute and chronic respiratory symptoms.[4]

This has been found that pulmonary function tests in terms of Vital capacity, FEV1 and FEV25-75% in slate pencil industry, wool carpet industry and diamond cutting and polishing industry workers are significantly lower than in normal subjects.[5]

Present study has been done on computerized spirometer by going in the working place of wool textile industry of Amritsar district and then comparing the results with equal number of healthy controls. Purpose of this study was to find out the changes in the ventilatory functions following exposure to the wool dust and to assess the damage to the pulmonary tissue due to industrial pollution and to ensure health and safety of workers by

Name & Address of Corresponding Author
Dr. Savita Dogra,
Assistant Professor
Department of Physiology
Govt. Medical College, Amritsar.

apprising the employers and at the same time increasing the productivity.

MATERIALS AND METHODS

Present study has been conducted in the department of Physiology, Government Medical College, Amritsar, Punjab. In this study one hundred non-smoker, previously not suffering from any chronic lung disease, of age between 20-60 years and measuring their Pulmonary Function tests, called here in Experimental Group (E). In addition same one hundred non-smoker, non-exposed subjects in the same age group from residents of Amritsar district had also been taken which served as Control Group (C)

In all subjects a detailed personal and family history was taken including any history of smoking or exposure to household fumes and such subjects were excluded from study. General physical examination was done. Other exclusion criteria was no history of any cardio-pulmonary disorder, exertional dyspnoea, obesity, smoking and any chest deformity.

Persons having history of Asthma, Chronic Infection of Lung, Tuberculosis, Bronchial allergy, were also excluded.

Following parameters were studied and recorded. Parameters and their respective abbreviations are as under

1. Body Surface Area (B.S.A.)
2. Forced Vital Capacity (F.V.C.)
3. Forced Expiratory Volume in 0.5, 1st & 3rd second ($FEV_{0.5}$, FEV_1, FEV_3)
4. Maximum Mid Expiratory Flow Rate (FEF25-75%)
5. Peak Expiratory Flow Rate (P.E.F.R.)
6. Maximum Voluntary Ventilation (M.V.V.)
7. Forced Expiratory Volume, Forced Vital Capacity Ratio expressed as percentage ($F.E.V._{0.5}$/ F.V.C.%, $F.E.V._1$/ F.V.C.%, $F.E.V._3$/ F.V.C.%)

Above tests were done on computerized spirometer (MEDSPIROR) under good daylight conditions in both experimental and Control groups and reading were recorded and data analysed and results were compared in both of groups and were compared with the previous studies done by other researchers.

RESULTS

The study concluded that as shown in Table I there was highly significant decline in FVC in wool industry workers. Other parameters like FEV_1, FEV_3 and M.V.V. were also highly significant lower than the control group. PFER, $FEF_{25-75\%}$, $FEF_{25\%}$, $FEF_{50\%}$ and $FEF_{75\%}$ were significantly lower. FEV_1/FVC% and FEV_3/FVC% ratio was also significantly lower. Results in $FVC_{0.5}$/FVC ratio were non-significant. As Table II shows results were highly significant in FVC, $FVC_{0.5}$, FEV_1, FEV_3 and MVV, significant in FEF_{25-75}, $FEF_{25\%}$, $FEF_{50\%}$ $FEF_{75\%}$ and non-significant in $FEV_{0.5}$/FVC %, FEV_1/FVC%, FEV_3/FVC% ratio. Table III concluded that results were highly significant in FVC, $FVC_{0.5}$, FEV_1, FEV_3, FEF_{25-75}, $FEF_{25\%}$, $FEF_{50\%}$ $FEF_{75\%}$ and MVV, significant in PEFR and FEV_1/FVC%, non-significant in FEV_1/FVC% ratio.

Table 1: Mean, Standard Deviation, t and p value and statistical significance of all 13 respiratory parameters between wool industry workers and control group

Parameter	Control Group (C)		Experimental Group (E)		t Value	p value	Significance
	Mean	S.D.	Mean	S.D.			
FVC	2.57	±0.62	1.86	±0.86	6.70	<0.001	HS
$FEV_{0.5}$	1.42	±0.69	0.88	±0.51	6.29	<0.001	HS
FEV_1	2,14	±0.64	1.38	±0.69	8.07	<0.001	HS
FEV_3	2.57	±0.62	1.84	±0.84	6.99	<0.001	HS
PEFR	3.30	±1.78	2.50	±1.23	3.69	<0.001	HS
FEF_{25-75}	2.42	±1.16	1.69	±0.96	4.84	<0.001	HS
$FEF_{25\%}$	3.08	±1.66	2.24	±1.09	4.22	<0.001	HS
$FEF_{50\%}$	2.77	±1.37	1.84	±1.00	5.48	<0.001	HS
$FEF_{75\%}$	2.12	±1.10	1.34	±0.74	5.88	<0.01	HS
$FEV_{0.5}$/FVC%	54.78	±20.90	50.18	±20.84	1.55	>0.05	NS
FEV_1/FVC%	82.80	±13.15	77.03	±21.37	2.30	<0.05	S
FEV_3/FVC %	100		98.78	±5.97	2.04	<0.05	S
M.V.V.	83.75	±26.10	55.45	±23.50	8.05	<0.001	HS

HS: Highly significant S: Significant NS: Non-significant

Table 2: Mean, Standard Deviation, t and p value and statistical significance of all 13 respiratory parameters between wool industry workers and control group with 6-10 years of exposure.

Parameter	Control Group (C)		Experimental Group (E) 6-10 yrs. N=21		t Value	p value	Significance
	Mean	S.D.	Mean	S.D.			
FVC	2.57	±0.62	2.00	±0.74	3.48	<0.01	HS
$FEV_{0.5}$	1.42	±0.69	0.91	±0.46	3.62	<0.01	HS
FEV_1	2,14	±0.64	1.52	±0.61	4.13	<0.001	HS
FEV_3	2.57	±0.62	1.94	±0.64	4.16	<0.001	HS
PEFR	3.30	±1.78	2.45	±1.16	2.35	<0.05	S
FEF_{25-75}	2.42	±1.16	1.81	±0.96	2.38	<0.05	S
$FEF_{25\%}$	3.08	±1.66	2.37	±1.18	2.05	<0.05	S
$FEF_{50\%}$	2.77	±1.37	1.96	±1.07	2.74	<0.01	S

$FEF_{75\%}$	2.12	±1.10	1.41	±0.73	3.17	<0.01	S
$FEV_{0.5}$/FVC%	54.78	±20.90	46.49	±19.17	1.72	>0.05	NS
FEV_1/FVC%	82.80	±13.15	78.32	±21.18	0.86	>0.05	NS
FEV_3/FVC %	100		98.29	±7.84	1.28	>0.05	NS
M.V.V.	83.75	±26.10	59.14	±20.39	4.37	<0.001	HS

HS: Highly significant S: Significant NS: Non-significant

Table 3: Mean, Standard Deviation, t and p value and statistical significance of all 13 respiratory parameters between wool industry workers and control group between 6-10 years of exposure and more than 10 years of exposure

Parameter	Control Group (C)		Experimental Group (E) More than 10 yrs. Exposure N=21		t Value	p value	Significance
	Mean	S.D.	Mean	S.D.			
FVC	2.57	±0.62	1.72	±0.93	6.48	<0.001	HS
$FEV_{0.5}$	1.42	±0.69	0.79	±0.53	6.17	<0.001	HS
FEV_1	2,14	±0.64	1.25	±0.74	7.75	<0.001	HS
FEV_3	2.57	±0.62	1.70	±0.93	6.63	<0.001	HS
PEFR	3.30	±1.78	2.45	±1.47	3.13	<0.01	S
FEF_{25-75}	2.42	±1.16	1.50	±1.15	5.01	<0.001	HS
$FEF_{25\%}$	3.08	±1.66	2.10	±1.21	4.06	<0.001	HS
$FEF_{50\%}$	2.77	±1.37	1.65	±1.11	5.41	<0.001	HS
$FEF_{75\%}$	2.12	±1.10	1.17	±0.81	5.92	<0.001	HS
$FEV_{0.5}$/FVC%	54.78	±20.90	46.49	±21.99	1.43	>0.05	NS
FEV_1/FVC%	82.80	±13.15	75.63	±23.80	2.24	<0.05	S
FEV_3/FVC %	100		98.94	±6.35	1.95	>0.05	NS
M.V.V.	83.75	±26.10	50.26	±23.53	8.12	<0.001	HS

HS: Highly significant S: Significant NS: Non-significant

DISCUSSION

Computerized spirometery has caused a great revolution in study of respiratory physiology and pulmonary functions. The lung tissue is constantly under threat from environmental and industrial pollutants. By determining the vital capacity (FVC), Timed Vital Capacity ($FEV_{0.5}$, FEV_1, FEV_3), Maximum Voluntary Ventilation (MVV) and Maximum Mid expiratory flow rate, it is usually possible to accurately detect and evaluate the underlying patho-physiology.

With same aim present study was undertaken. Other aim was to collect more data in industrial workers and to draw conclusive evidence as to how industrial work has on pulmonary functions in long term exposure (more than 10 years) on pulmonary functions.

Our data has shown that there is highly significantly decline in pulmonary functions in terms of FVC which has drastically decreased in wool industry units when compared to normal population of same area taken as control subjects. Rao N.M. et al in 1992,[6] observed the similar decrease in FVC in wool industry workers Same comparable results were seen in a study conducted in 1995 by Zuskin E. et al,[7] who observed significant fall in vital capacity in workers exposed to wool dust for more than 10 years. This may be due to wool fibres alone or in combination with other components of wool dust is causing chronic mechanical, allergic inflammation of bronchial mucosa & other parts of lung leading to thickening of bronchial mucosa and inflammatory response in alveoli and other parts of respiratory tract. These findings are concurrent with our findings. Our study showed that there is highly significant decrease in $FEV_{0.5}$ with more number of years of exposure to wool dust. These findings are concurrent with Kumar et al (1992),[8] Christiani et al (1994) and Fishwick et al (1996).[9,10]

The significant reduction in percentage predicted values of FEV_1 (82 vs 59), FVC (79 vs 63) and MVV (77 vs 64) were observed by Purohit R, Lata H, Walia L, Whig J. in 2014[11] in workers as compared to healthy controls indicates obstructive pattern of respiratory abnormality. In male workers, percentage predicted FEV1% was significantly lower. The values of all other parameters were lower in female workers. There was a significant decrease in FEV and FVC with increase in age in group I and this negative correlation was statistically significant.

CONCLUSION

There is highly significantly decline in pulmonary functions in terms of FVC, FEV0.5, FEV1, FEV3, FEF 25-75%, P.E.F.R which has drastically decreased in wool industry units when compared to normal population of same area taken as control subjects. And there is highly significant decrease in FEV 0.5 with more number of years of exposure to wool dust.

Abbreviations:

B.S.A.- Body Surface Area, F.V.C.- Forced Vital Capacity, FEV0.5, FEV1, FEV3 - Forced Expiratory Volume in 0.5, 1st & 3rd second, FEF25-75%- Maximum Mid Expiratory Flow Rate, P.E.F. R.- Peak Expiratory Flow Rate, M.V.V.)- Maximum Voluntary Ventilation, F.E.V.0.5, / F.V.C.%, F.E.V1./F.V.C.%, F.E.V3./F.V.C.% -

Forced Expiratory Volume, Forced Vital Capacity Ratio expressed as percentage

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