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Study of Pneumoconiosis in Thermal Power Station Workers

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Research Article

Abstract: **Aims and Objectives:** The study was carried out with the aim of finding respiratory parameters for detecting early impairment in thermal power station workers. The extent of damage caused by exposure to substances was also assessed. **Material and Methods:** The pulmonary function tests were carried out in 121 coal handling plant workers in Parli, Thermal power station. Biometric parameters were recorded along with family history, smoking history. The PFT was recorded by MEDSPIROR machine. **Results**: The PFT parameters were seen to be decreased in thermal power station workers. The study showed restrictive type of pulmonary impairment in the workers. The impairment was seen to be increasing with increase in the duration of exposure.

Key Words: Pneumoconiosis, Thermal Power Station Workers, PFT

Introduction: Occupational illnesses and associated hazards are direct fallout of industrial, agricultural and technological revolution. The industry and agriculture related respiratory disorders have been progressively increased with increase in technological advancements. (**1**)Exposure to toxic dust materials, textile dust/fibers, forage dusts and consequent air pollutants have led to an alarming increase in lung disease that reduces lung efficiency considerably.(**2**)Fibrosis of lung leading to Tuberculosis, lung cancer, farmer's lung, occupational asthma are some of common known industrial hazards. But, if noticed early, these disorders can be cured. The chances of improvement however diminish if occupational exposure continues. Timely detection, frequent checkups certainly could help in preventing the spread of such disorders.

Development of industrial techniques and processes now easily allows proliferations of altered formulations, changes in the structural features of new compounds the properties of the substances can thus be changed. Thus their dangerous potentials to cause impairment may surface only after a long period.

The present study attempts to point out reliable respiratory parameters to detect early impairments of respiratory system. Extent of damage caused by the exposure to hazardous substances was analyzed. It also had intention to help assess the response of the therapy and prognosis of disease and finally rehabilitation of the sufferers.

Material and Methods: The PFT was carried out in 121 coal handling plant workers in Parli thermal power station workers. Before any type of assessment of the patients, biometric parameters like race, age, sex, height, weight were noted. Detailed family history, smoking history were noted. Clinical examination was carried out to know any respiratory illness. Any obvious complaint like cough, chest pain was noted.

The PFT was carried out in seating position using MEDSPIROR; computerized lung function testing machine. The following parameters were recorded.

FVC $FEV_{0.5}$ FEV_1 FEV_3 PEFR $FEF_{25\%-75\%}$ $FEF_{2\%-12\%}$ $FEF_{25\%}$ $FEF_{50\%}$ $FEF_{75\%}$

The obtained data was analyzed by the mean and standard deviation of obtained percent predicted values. It was expressed in three age groups.

GROUP I: 20-30 years
GROUP II: 31-40 years
GROUP III: 41years onwards

Five exposure groups were formed

GROUP I: 1-5 years
GROUP II: 6-10 years
GROUP III: 11-15 years
GROUP IV: 16-20 years
GROUP V: 21 years onwards

The obtained data was also classified in various types of respiratory disorders such as restrictive, obstructive and mixed blockage types. The extent of severity of the pulmonary impairment has also been grouped.

Results: In 121 cases of coal handling plant workers; 71 cases (58.60%) were found suffering from

restrictive type of pulmonary impairment. 10 cases (8.20%) were found suffering from obstructive type of pulmonary disorder and 4 cases (3.30%) were found suffering from mixed blockage. The PFT parameters were found to be within normal limits of 36 cases.(29.90%). The overall pulmonary impairment was found to be 70.10% in these workers. The data is recorded in Table no. 1.

Table no. 2 gives the pulmonary impairment in relation to age. Group I showed only mild obstruction. No case of severe obstruction or restriction was observed. No case of mixed blockage was seen in this group.

The Table no. 3 relation of severity of respiratory disorders with reference to the duration of exposure. The severity of pulmonary impairment was seen to increase along with the duration of exposure. This was more evident in exposure Group III and Group V as compared to group I and Group II. Surprisingly, there was no case of severe restrictive, obstructive or mixed blockage in Group IV. As far as mild obstruction impairment is concerned; one case each from Group I, Group III and Group IV; two cases from Group V have been noted. In Group II, five cases suffering from mild obstruction were noted. Mixed blockage cases two each amongst 55 cases were seen.

Various respiratory parameters are listed in Table 4 and projected in the histograms. The respiratory parameters in age Group III were decreased drastically as compared to Group I and Group II. Mild decline in values of FVC, PEFR, FEF_{2-12}, $FEF_{50\%}$were noticed in age Group I and II. FEV_1 was seen normal except age Group III. The values of FEV_3, $FEF_{25-75\%,}$ $FEF_{25\%}$ also shows decrease in Group III. The FEV_3/FVC ratio has been noticed to remain constant in all groups.

The respiratory parameters were found to decline with the increase in duration of exposure. The cases 1964 showed uniform decrease in Group I to Group V. The MVV in exposure Group I to Group IV was seen to be in normal limits but showed a decline in Group V. The FEV_1/FVC showed variations but FEV_3/FVC ratio was seen to be unchanged.

Discussion: The present study included that the restrictive type of pulmonary impairment is a major and commonest form of respiratory disorder. The prevalence of impairment in coal workers is 58.60%.The obstructive type was seen to be in 8.20% in coal workers. Spirometry parameter was seen to be in normal limits in 29.90% cases.

The coal handling workers get continuous exposure to weather that contains coal ash. Coal ash dust is rich in calcium, silicates, magnesium, aluminum, iron and also contains up to 10% of free silica. (3) The free silica content is most hazardous of all these substances.

A reduction in the respiratory parameters due to the change in the strength of the contractions of skeletal muscles with advancing age is a normal phenomenon. Between the age of 20-80 years, the strength of muscular contraction reduces gradually by 15%to 30 %.(**4**) In addition to this, stiffness of chest wall also increases with age. The resulting rigidity has been attributed to changes in the rib cage, particularly the calcification of the articulations which occur with age. (5)

There was general fall in the respiratory parameters. This fall was may be due to the decrease in the alveolar surface area and percentage of parenchymal air contained in alveoli with advancing age.(**6**) The elastic recoil is one of the prime determinant of maximal expiratory advancing age.(**7**)

The FEV_1/FVC ratio showed slight increase but the FEV_3/FVC ratio is constant in all the age groups. This is due to the low vital capacity and proportional decrease in FEV_1 and TLC. Such proportional decrease represents restrictive type of disorder.(**8**) In pneumoconiosis all respiratory parameters exhibit a moderate fall in exposure groups I to V.

The pulmonary manifestation in pneumoconiosis could be explained on the basis of pathological changes in the lung. The inhaled coal dust reaches to the bronchioles and arterioles that causes dilatation of both bronchioles and arterioles. (**9**)The aggravation produced by the dust in the vesicular tissue prevents expansion of the tissues. The longer exposure to coal dust results in massive pulmonary fibrosis.(**10**) With the onset of disability due to pulmonary fibrosis; abnormalities of pulmonary function become more evident. The affected pulmonary mechanics reduces pulmonary parameters.(**11**)

The present study has noted that pulmonary function deteriorates with age. According to (**12**) , the pulmonary performance decreases with increasing age even in the absence of impairment by respiratory disease or atmospheric pollution. The extent of impairment observed in our study is striking indicating an additive effect of coal dust inhalation to which workers from coal handling plants are exposed to. One has to also take into consideration the presence of free silica present in the coal dust. The higher values of PFT were obtained in younger age group than older age group(**13, 14, 15**) The loss of elastic recoil of lung and reduction of the strength of respiratory muscles might be jointly responsible for the impairment of dynamic lung function. $FEF_{25\%-75\%}$ was introduced by **(16)** as a sensitive parameter for the detection of air flow obstruction and $FEF_{2\%-12\%}$ detect minimal or slight impairment of ventilator function. Even in the present study, the values of $FEF_{2\%-12\%}$ decreases

from exposure Group I to Group V this may be the earliest sign of respiratory impairment. Absence of any sharp decrease in the values may be due to individual variation of PFT values and their susceptibility to work place hazards which causes impairment of pulmonary function. For these very reasons, sometimes little higher levels were observed in longer exposure groups than the shorter exposure groups.

The impairment found amongst the workers was of restrictive type 58.60%, obstructive type 8.20%, and mixed blockage type 3.30%. **Rajgopal and Doshi 19889 (17)** reported similar finding. Their studies have also revealed that maximum number of workers was affected by respiratory diseases when exposure was of longer duration. **Golli and his associates, 1969** (18) have also noted that the nature and frequency of the disease progresses with age. The findings in the present study that more number of moderate and severe type of pulmonary impairment fall in the category of higher age group and longer exposure confirms the earlier reports.

Table No.1: Prevalence of Pneumoconiosis

Type of Pulmonary Impairment	Total No Of Cases N= 121	Percentage (%)
RESTRICTIVE	71	58.60
OBSTRUCTIVE	10	08.20
MIXED BLOCKAGE	04	03.30
TOTAL	85	70.10
NORMAL	36	29.90

Table No.2: Severity of Pneumoconiosis in the Relation to the Age.

Type of Pulmonary Impairment	GROUP I 20-30 YRS N=14			GROUP II 31-40 YRS N= 70			GROUP III 41 YRS ONWARDS N = 37		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
RESTRICTIVE	06	01	---	26	12	01	13	09	03
OBSTRUCTIVE	03	---	---	04	---	---	02	---	01
MIXED BLOCKAGE	---	---	---	---	---	02	---	---	02

M1 = Mild M2 = Moderate M3 = Severe N = Number of Cases

Table No.3: Severity Of Pneumoconiosis in Relation To The Length Of Exposure

Type of Pulmonary Impairment	GROUP I 1-5 YRS n = 16			GROUP II 6-10 YRS n = 23			GROUP III 11-15 YRS n = 55			GROUP IV 16-20 YRS n = 12			GROUP V 21 YRS ON n = 15		
	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
RESTRICTIVE	08	01	---	06	01	---	24	11	02	07	02	---	02	05	02
OBSTRUCTIVE	01	---	---	05	---	---	01	---	---	01	---	---	02	---	---
MIXED BLOCKAGE	---	---	---	---	---	---	---	---	02	---	---	---	---	---	02

M1 = Mild M2 = Moderate M3 = Severe N = Number of Cases

Table No. 4: Prevalence of Respiratory Impairment in Pneumoconiosis in Relation to Age

RESPIRATORY PARAMETERS	GROUP I 20-30 Yrs n = 13	GROUP II 31-40 Yrs n = 72	GROUP III 41 YRS Onwards n = 36
FVC	78.53 (12.27)	77.93 (16.26)	69.41 (14.75)
FEV_1	87.76 (11.84)	88.97 (17.69)	77.25 (17.97)
FEV_3	78.23 (12.30)	78.52 (16.10)	69.27 (14.72)
PEFR	87.61 (17.20)	86.01 (23.91)	77.94 (21.78)
$FEF_{25\%-75\%}$	90.00 (26.41)	90.86 (27.48)	82.44 (30.36)
$FEF_{2\%-12\%}$	80.15 (20.23)	79.18 (27.45)	71.22 (28.16)
$FEF_{25\%}$	79.30 (19.06)	81.84 (25.13)	74.63 (22.26)
$FEF_{50\%}$	78.61 (25.16)	73.34 (23.43)	65.30 (21.74)
$FEF_{75\%}$	67.61 (20.77)	74.58 (28.55)	67.41 (33.56)
FEV_1/FVC	112.38 (05.09)	114.47 (07.49)	113.58 (13.34)
FEV_3/FVC	103.00 (00.00)	103.00 (00.00)	103.00 (00.00)
MVV	84.30 (19.59)	88.68 (16.69)	77.22 (18.28)

Mean values and standard deviation values in bracket.
n = number of cases.

Table No 5: Prevalence of Respiratory Impairment in Pneumoconiosis in Relation to the Length of Exposure

RESPIRATORY PARAMETERS	Group I 1-5YRS n = 16	GROUP II 6-10YRS n = 23	GROUP III 11-15YRS n= 55	GROUP IV 16-20YRS n= 12	GROUP V 21YRS Onwards n = 15
FVC	77.81 (13.54)	84.82 (18.83)	72.49 (15.15)	74.00 (13.70)	68.06 (16.80)
FEV_1	88.12 (14.65)	97.60 (14.12)	83.69 (18.15)	84.83 (15.08)	71.73 (16.62)
FEV_3	78.1 (13.64)	87.60 (12.85)	72.63 (15.34)	74.91 (13.53)	67.06 (16.64)
PEFR	83.56 (19.44)	86.82 (19.16)	84.60 (24.88)	86.91 (15.75)	73.86 (24.93)
$FEF_{25\%-75\%}$	94.06 (31.09)	86.43 (29.23)	89.69 (28.84)	79.08 (19.91)	75.26 (29.99)
$FEF_{2\%-12\%}$	84.62 (25.84)	81.91 (20.73)	78.08 (29.37)	76.58 (29.20)	58.20 (29.32)
$FEF_{25\%}$	86.62 (23.99)	78.60 (19.05)	80.96 (26.79)	81.08 (16.64)	60.06 (22.75)
$FEF_{50\%}$	79.50 (27.25)	72.26 (19.54)	73.05 (24.65)	63.58 (15.12)	58.93 (21.64)
$FEF_{75\%}$	73.62 (29.19)	73.17 (26.49)	76.47 (31.34)	57.75 (20.25)	60.66 (30.93)
FEV_1/FVC	113.37 (06.73)	111.34 (07.94)	116.54 (15.72)	114.25 (05.25)	109.53 (18.49)
FEV_3/FVC	103.00 (00.00)	103.00 (00.00)	103.00 (00.00)	103.00 (00.00)	103.00 (00.00)
MVV	84.50 (11.48)	92.47 (15.59)	85.70 (19.90)	81.33 (14.08)	72.40 (18.32)

Mean and standard deviation in bracket.
n = number of cases.

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