Title of the article: Analysis of Lung Functions in flour mills and rice mills workers.

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ABSTRACT

Aims:
To find out the abnormalities in lung function tests, in relation to smoking and non-smoking workers exposed to flour and rice dust.

Study Setting : 207 asymptomatic healthy male.
Study Design: Cross – sectional study

Material and Methods:
The subject is instructed to take maximal inspiration (to TLC) and he was connected to medspiror through the mouthpiece, after that nose clip is applied and the subject was asked to exhale forcefully into the medspiror as fast as possible.

Statistical analysis:
Technique used like Student’s ‘t’ test for two groups and ANOVA for multiple group comparisons..

Results:
Majority of lung function test parameters showed reduced levels in flour mill workers when compared to rice mill workers. However the difference was not statistically significant.

Conclusion:
It is concluded that flour dust and rice husk dust causes deterioration of pulmonary functions in subjects working at mills (flour and rice).

Key-words: Lung function, smoker, non-smoker, flour and rice mill worker

Introduction:
Each day, our lungs are directly exposed to more than 7000 liters of air, which contain varying amount of inorganic & organic particles, as well as potentially lethal bacteria & viruses. In general, lot of uncertainty exists about the role of environmental pollutants in production & progression of airway abnormalities. Airway pathology changes have been recorded with industrial & fumes. Dust, the tiny particles dispersed in air due to mechanical disintegration of rocks, minerals, & other materials by impulsive forces such as drilling, blasting, crushing, grinding, milling, sawing and polishing or to the agitation or breaking down of organic materials such as cotton fibers, pollens & fungal pores. Fumes consists of metal oxides formed by heating metals to their melting point.1,2 With the formidable upsurge in pulmonary physiologic research over the past four decades, has seen a marked increase in our understanding of the functional disturbances & pathophysiology of lung diseases.3 Since the middle of 20th century medical departments of a large number of factories became concerned, as number of pulmonary impairment cases with workplace-relationship had developed. Significance of pulmonary functions in assessing respiratory responses to various air borne pollutants has been known and large number of studies have been undertaken to see the effect of dust in various occupations.4,5,6 Spirometric measurements FVC & FEV1 are considered as an integral part of epidemiological respiratory health studies.2,7,8 Effects of dust are well documented in coal mine, cotton, talc, asbestosis, wooden dust, iron foundry & jute mill.9,10,11 Reduction in ventilatory function were observed in cotton workers, coal miners, asbestosis, wooddust & in grain elevators.12,13,14,15,16 Effect of rice and flour dust on pulmonary function parameters are not reported in literature and only few studies have been conducted in all over India. Only some cases of asthma &
rhinitis were noticed in flourmill workers. Few have mentioned the decrease in FEV1 value, grain weevil protein was found to be the reason of allergic asthma in these subjects & rice husk also decreases the pulmonary functions. It is also observed that diffusion & FEV1 % were decreased in bakers who were having allergy to flour but they were not able to find any immunoglobulin in unconcentrated serum in these subjects. Davis et al.1976 found out that grain might be an important cause of asthma after exposure to grain dust. They observed that there was involvement of small & large airways rather than lung parenchyma. However, the results of previous studies are inconsistent particularly in relation to lung function impairment in flour mill & rice mill workers. This study was undertaken to evaluate the pulmonary functions of workers exposed to dust in flour mills, rice mills.

**Subjects and Methods:**

207 asymptomatic healthy male subjects employed in flour mills and rice mills in and around Davangere between age group 20 to 50 years.

After recording all data, subject was asked to sit on the stool comfortably. The subject is instructed to take maximal inspiration (to TLC) and he was connected to medspiror through the mouthpiece, after that nose clip is applied and the subject was asked to exhale forcefully into the medspiror as fast as possible. Each test was repeated three times and with interval of 5 minutes between each test and the best of three readings was taken.

**Results:**

FVC-Forced vital capacity
FEV1-forced expiratory volume in 1 sec
PEFR-Peak expiratory flow ration
FEF25-75-Mean forced expiratory flow during the middle hald of the FVC
FEF200-1200-mean forced expiratory flow ratio between 0.2 to 1.2 liters of volume change.
FEF25%-forced expiratory flow after 25% of the FVC has been expired
FEF50%-forced expiratory flow after 50% of the FVC has been expired
FEF75%-forced expiratory flow after 75% of the FVC has been expired
FEV1/FVC-capacity ratio expressed as percentage.

Tabl-1: Physical characteristics of non-smokers and smokers of Mill workers

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Smokers (n=118)</th>
<th>Non-Smokers (n=89)</th>
<th>Total (n = 207)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>Range 21-50</td>
<td>Mean ± SD 35.5 ± 7.9</td>
<td>Range 20-50</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>150-188</td>
<td>166.7 ± 7.5</td>
<td>140-188</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>38-80</td>
<td>59.1 ± 10.0</td>
<td>38-90</td>
</tr>
</tbody>
</table>

Tabl-2 : Duration of exposure to dust and pulmonary functions in two groups

<table>
<thead>
<tr>
<th>Duration of exposure</th>
<th>Non Smokers (n=118)</th>
<th>Smokers (n=89)</th>
<th>F-value significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>2.73 ± 0.67</td>
<td>2.51 ± 0.66</td>
<td>2.23 ± 0.44</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td>2.21 ± 0.55</td>
<td>1.97 ± 0.53</td>
<td>1.90 ± 0.29</td>
</tr>
<tr>
<td>PFER (L/Sec)</td>
<td>7.48 ± 1.95</td>
<td>7.06 ± 1.77</td>
<td>6.38 ± 1.57</td>
</tr>
<tr>
<td>FEF25-75% (L/Sec)</td>
<td>4.17 ± 1.04</td>
<td>4.13 ± 1.22</td>
<td>3.83 ± 1.09</td>
</tr>
<tr>
<td>FEF200-1200% (L/Sec)</td>
<td>6.11 ± 1.86</td>
<td>5.76 ± 1.59</td>
<td>5.31 ± 1.86</td>
</tr>
</tbody>
</table>

P<0.05 NS
Table – 3 : Duration of Smoking on Pulmonary functions among flour and rice mill workers

<table>
<thead>
<tr>
<th>Smoking duration</th>
<th>≤5 yrs (n = 21)</th>
<th>&gt; 5 yrs (n = 68)</th>
<th>t-value significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>2.18 ± 0.61</td>
<td>1.97 ± 0.51</td>
<td>1.57 N.S.</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td>1.42 ± 0.40</td>
<td>1.39 ± 0.36</td>
<td>0.31 N.S.</td>
</tr>
<tr>
<td>PFER (L/Sec)</td>
<td>5.54 ± 1.79</td>
<td>5.67 ± 1.63</td>
<td>-0.33 N.S.</td>
</tr>
<tr>
<td>FEF 25-75% (L/Sec)</td>
<td>3.27 ± 1.51</td>
<td>3.50 ± 1.38</td>
<td>-0.68 N.S.</td>
</tr>
<tr>
<td>FEF 200-1200 (L/Sec)</td>
<td>4.29 ± 1.93</td>
<td>4.46 ± 1.49</td>
<td>-0.41 N.S.</td>
</tr>
<tr>
<td>FEF 25%</td>
<td>2.17 ± 1.04</td>
<td>2.43 ± 1.08</td>
<td>-0.99 N.S.</td>
</tr>
<tr>
<td>FEF 50%</td>
<td>3.60 ± 1.65</td>
<td>3.80 ± 1.45</td>
<td>-0.55 N.S.</td>
</tr>
<tr>
<td>FEF 75%</td>
<td>4.83 ± 1.72</td>
<td>5.19 ± 1.66</td>
<td>-0.89 N.S.</td>
</tr>
<tr>
<td>FEV1 / FVC (%)</td>
<td>69.7 ± 24.87</td>
<td>75.05 ± 23.95</td>
<td>-0.90 N.S.</td>
</tr>
</tbody>
</table>

Table – 4 : Comparison of Lung Functions between Flour and Rice mill workers

<table>
<thead>
<tr>
<th>Groups</th>
<th>Flour Mill workers (n=112)</th>
<th>Rice Mill workers (n=95)</th>
<th>t-value significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>2.22 ± 0.86</td>
<td>2.35 ± 0.77</td>
<td>1.13 N.S.</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td>1.69 ± 0.56</td>
<td>1.85 ± 0.69</td>
<td>1.84 N.S.</td>
</tr>
<tr>
<td>PFER (L/Sec)</td>
<td>6.39 ± 1.86</td>
<td>6.51 ± 1.86</td>
<td>0.47 N.S.</td>
</tr>
<tr>
<td>FEF 25-75% (L/Sec)</td>
<td>3.82 ± 1.33</td>
<td>3.86 ± 1.18</td>
<td>0.25 N.S.</td>
</tr>
<tr>
<td>FEF 200-1200 (L/Sec)</td>
<td>5.19 ± 1.71</td>
<td>5.21 ± 1.78</td>
<td>0.07 N.S.</td>
</tr>
<tr>
<td>FEF 25%</td>
<td>5.88 ± 1.70</td>
<td>5.92 ± 1.73</td>
<td>0.16 N.S.</td>
</tr>
<tr>
<td>FEF 50%</td>
<td>4.19 ± 1.42</td>
<td>4.18 ± 1.27</td>
<td>0.01 N.S.</td>
</tr>
<tr>
<td>FEF 75%</td>
<td>2.52 ± 1.02</td>
<td>2.54 ± 0.86</td>
<td>0.06 N.S.</td>
</tr>
<tr>
<td>FEV1 / FVC (%)</td>
<td>76.13 ± 21.32</td>
<td>80.72 ± 32.35</td>
<td>1.22 N.S.</td>
</tr>
</tbody>
</table>

Height: mean height of subject in group I (smoker) 166.7 ±7.5 cms, and in group II (non-smokers) 166.5±9.5 cms.
Weight: subjects of group I (smokers) had the mean weight of 59.1±10 kgs, & in subjects group II (non-smokers) had the mean weight of 63.6±11.4kgs.
Table-2: shows that forced vital capacity(FVC) value of non-smokers exposed for less than 5 years shows the mean value of 2.73±0.67 & that exposed more than 5 years. But less than 10 years shows the mean value of 2.51±0.66 & those exposed more than 10 years shows the mean value of 2.23±0.44. Analysis showed that as duration of exposure increased FVC showed reduction of mean level (P<0.05). The FEV1 value of non smokers exposed for < 5 years shows the mean value of 2.21±0.55 & that expose >5 years & < 10 years shows mean value of 1.97 ±0.53 & those exposed more than 10 years gives mean value of 1.90±0.29. Analysis showed than as duration of exposure increased FEV1 is reduced significantly (P<0.05).
Even in smoker group also showed similar correlation between exposure and FEV1 valve level, as the exposure duration is increased there is a reduction in FEV1 level showing inverse relationship between variables. 

PEFR value of non-smokers exposed for < 5 years shows a mean value of 7.48 ±1.95 and that exposed >5 years & <10 years gives the mean value of 7.06±1.77 and those exposed >10 years shows the mean value of 6.38±1.57. 

Even in smoker groups also showed similar relation between exposure & PEFR values. It is observed that PEFR is seen to be reduced in both groups (smokers & non-smokers) with increased duration of exposure. But however it is not statistically significant. 

FEF25-75 value of non-smokers exposed for less than 5 years shows a mean value of 4.17 ±1.04 & that exposed more than 5 years and less than 10 years shows mean value of 4.13±1.22 and those exposed more than 10 years, mean value shows 3.38±1.03. 

The FEF200-1200 value of non smoker exposed for less than 5 years shows the mean value of 6.11±1.86 and that of exposed more than 5 years and less than 10 years shows the mean value 5.76±1.59, and those who exposed more than 10 years shows the mean value of 5.31±1.86. 

In the other group (smokers) exposed to dust for the same duration as above shows clear reduction in values as follows, 4.78±1.02; 4.58±1.40;4.47±1.47. we observed decreased values in smokers. 

FEF25% value of non-smoker exposed for less than 5 years, shows a mean value 2.60±0.73 & that exposed more than 5 years but less than 10 years shows the mean value of 1.63±0.88 & those who exposed more than 10 years shows the mean value 2.47±0.97.. 

In an least smoker exposed less than 5 years shows the mean value of 2.21±0.70 and that of more than 5 years and less than 10 years shows mean value of 2.64±0.84 and more than 10 years 2.30±1.21. 

There is clear reduction in smokers exposed, but not statistically significant 

FEF50 value of non-smoker exposed for less than 5 years showed the mean value of 4.59±1.16 & that of exposed more than 5 years and less than 10 years shows the mean value of 4.56±1.08. 

In case of smokers who exposed less than 5 years showed the mean value of 3.63±0.81 & that of who exposed more than 5 years and less than 10 years shows the mean value of 3.63±0.81 & those who exposed more than 10 years shows 3.46±1.60. 

There is a clear reduction in smokers exposed to dust it is statistically significant. 

FEV1/FVC ratio in non-smokers exposed to dust shows the mean value of 83.64±19.48 in workers exposed less than 5 years and in that those who exposed more than 5 years and less than 10 years shows the mean value of 81.57±20.75 and those who exposed more than 10 years it is 87.42±15.5. 

In relation to this smoker group shows the mean value of 72.9±22.3, 72.6±23.0, 78.8±25.8 exposed to dust to same duration as mentioned above there is clear reduction in smokers compared to non-smokers but not statistically significant. 

TABLE-3: in order to know the effect of smoking duration on lung function test of mill workers, smoking group was divided into two groups according to duration viz less than 5 years & more than 5 years of smoking. 

Out of total 89, with less than 5 years were (n) and more than 5 years were (n). Both FVC & FEV1 showed slightly reduced levels in higher smoking duration group(>5 years) when compared to less than 5 years group. However the difference was found to be statistically insignificant(P>0.05). Other parameters did not show any significant difference according to increasing duration of smoking. 

TABLE-4: the levels of lung function tests among the flourmill & rice mill workers were also assessed separately. In order to know the effect of exposure for flour & rice dust. Majority of lung function test parameters showed reduced levels in flour mill workers when compared to rice mill workers. However the difference was not statistically significant. 

Discussion: 
We observed a lower FVC, FEV1,PEFR, FEF25-75%, FEF200-1200, FEF50%, FEF75%, FEV/FVC were significantly reduced (P<0.001) in smokers. 

The acute exposure to cigarette smoke is associated in most studies with decreased mucociliary transport, which reduces or shows delay in alveolar clearance.
In relation to smoking it was observed that statistically significant difference exists between indices of ventilatory capacities of smoker & non-smoker. Amongst smokers of different grades, in non-smokers the difference was insignificant.

**Effect of flour dust and rice dust on pulmonary functions in mill workers**

It may be grain weevil protein or grain mite be responsible for asthma after exposure to grain dust causing small or large airways obstruction. Hendrick et al (1986) noted a decrease in diffusion and FEV1% in bakers again in a provocative test but did not find any immunoglobulin in their unconcentrated serum.

So, after assessing the effect of smoking we analysed the effect of flour dust and rice dust on pulmonary function test, and correlating the same regarding duration of exposure.

**Effect of duration of working at mills:**

Effect of duration of working at flour mill and rice mills is an important factor to determine the effect of flour and rice dust on pulmonary functions. It ranged from 1-18 years. When 30 mill workers with less than 5 years working duration shows the mean values FVC-2.73, FEV1-2.21, PEFR-7.48, FEF25-75%-4.12, FEF200-1200-6.14 and the workers exposed more than 10 years showed further reduction in pulmonary function test, FVC, FEV1 is significantly reduced and rest of the parameters are not statistically significant. This showed that their duration of working in flour mill & rice mill workers does effect the pulmonary function test, but the damage caused is not highly significant. The pulmonary functions of 25 mill workers with more than 10 years working duration showed significant reduction of FEV1, FVC (P<0.05).

It shows that increased duration of working at flour mill & rice mill increases the lung damage causing both airway obstruction and interstitial involvement. The lower values of lung function test among flour mill and rice mill workers exposed to grain dust for longer duration where in smokers in both groups suggest that dust exposure and smoking has effect on pulmonary function test.

Effect is very much dependent upon the extent of exposure, both in the form of duration of daily working hours and number of years they have worked in the mill.

A decrease in FVC, FEV1, PEFR, FEF25-75%, FEF200-1200, FEF25%, FEF50%, FEF75%, suggests that these parameters are very sensitive in detecting changes in pulmonary functions at an early stages.

Present study revealed that no significant change in pulmonary function test of mill workers, were obtained with increasing duration of smoking. This is probably due to the fact that smokers in one group have already shown in lower levels of pulmonary function test when compared to non-smokers. Therefore, pulmonary function is not dependent on smoking duration.

**Conclusion:** It is suggested that all the mill workers must be provided with better facilities and proper engineering measures (ventilation) so that employees are exposed to less dust. Further the workers should be encouraged to reduce or to stop smoking so as to prevent the development of harmful effects of smoking to themselves and to others.

**References:**

3. Reuben M, Cherniack: Disease a month; evaluation of Resp. junction in health and disease; Mosby Publication 1992 July No-V-XXVIII.