CHAPTER VI

GENERAL DISCUSSION AND SUMMARY
Lung function tests are used to determine the effects of dust on the organism, to help to elucidate a number of important questions such as the study of pathogeny of pneumoconiosis, to carry out the preventive and curative treatment and for the solutions of problems connected with the assessment of working capacity. The utilisation of all facilities for detecting early forms and thereby preventing the development of pronounced forms of pneumoconiosis is an urgent problem. There is no doubt that respiratory tests in the detection of changes occurring in the course of different periods of exposure to dust contribute to the successful solution of the problem.

At present spirometry remains the most suitable screening tests for routine industrial applications. They are of value in determining the extent of disease, progression of disease, developing further understanding between functional, radiological and pathological changes and for legal and compensation purposes. It is now well accepted that ventilatory lung function tests measured with spirometer offers to differentiate restrictive syndrome and obstructive syndrome. The restrictive syndrome is present when the ventilatory capacity is reduced as a result of reduction in vital capacity. This condition is characterised by a normal or increased value for FEV\textsubscript{1.0s}. Obstructive syndrome is present when the ventilatory capacity is reduced as a result
of narrowing of airways, which is reflected by low FEV1.0.
Asbestosis, silicosis and other type of mineral dust diseases cause restrictive type of syndrome. Pneumoniosis causes obstructive type of lung syndrome and Farmer's lung cause restrictive and obstructive type of lung syndrome. Although in India, workers are exposed to different types of dusts in their different occupations, in literature there are limited data on pulmonary function tests in relation to those occupations. In the present cross sectional studies, the assessment of lung function tests had been undertaken in workers exposed to mineral dust i.e. asbestos and silica and vegetable dust i.e. tobacco and wool.

Studies in mineral dust exposed workers

It is observed in asbestos cement factory at Hyderabad, in the working environment, the maximum number of dust particles in Uppaf is 24 and the maximum respirable dust concentration is 0.72 mg/m$^3$ (Table - 2). In Ahmedabad asbestos cement factory the dust count is 55 Uppaf and respirable dust concentration is 6.35 mg/m$^3$ (Table - 2). In asbestos textile factory at Ahmedabad, the maximum dust count is 86 Uppaf and respirable dust concentration is 11.69 mg/m$^3$ (Table - 21). This indicates that contamination of working environment is more in textile factory followed by asbestos cement factory at Ahmedabad and Hyderabad. The percentage
difference of means of lung function tests in exposed workers compared to control workers in table - 76, reveals a high reduction of VC in all factory workers and percentage of reduction of VC is maximum in asbestos textile workers. In asbestos cement factory workers there is a high reduction of FEV\(_1.0\) than in textile workers. Other functional tests do not show much affection. These observations are depicted in Fig.1. This suggests that in workers exposed to asbestos dust, the loss of VC indicates restrictive type of lung pathology and this loss is proportional to the contamination of working environment. In workers exposed to asbestos dust, measurement of VC is not only useful as a guide for early detection of asbestosis, but also for the severity of exposure.

In silica dust exposed workers, it is observed(Table-37b) a linear significant decrement of VC with increasing 'X' ray category of pneumoconiosis. FEV\(_1.0\) is reduced highly significantly in category 1 and 2. There is significant reduction of FEV\(_1.0\) and FEV\(_25-75\) in category 1. Fig. 2 shows these observations. This suggests the predominance of restrictive type of lung disease in these workers. Measurement of VC in these workers is useful as a guide for early detection of silicosis.

Studies in vegetable dust exposed workers

In non virginia tobacco agricultural operations at Sanand, in the working environment, the maximum fungal spores
### Table 76

Mean Percentage Differences of Functional Tests in Asbestos Exposed Workers Compared to Control

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Asbestos cement factory workers at Hyderabad</th>
<th>Asbestos cement factory workers at Ahmedabad</th>
<th>Asbestos textile workers at Ahmedabad</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC(lit)</td>
<td>6.82**</td>
<td>8.39**</td>
<td>14.13**</td>
</tr>
<tr>
<td>FEV(1.0)</td>
<td>7.15**</td>
<td>12.26**</td>
<td>6.16</td>
</tr>
<tr>
<td>FEV1.0L</td>
<td>1.39</td>
<td>0.81</td>
<td>+1.52</td>
</tr>
<tr>
<td>FEF(lit/sec) 200-1200 ml</td>
<td>9.21 *</td>
<td>11.42</td>
<td>3.23</td>
</tr>
<tr>
<td>FEF(lit/sec) 25-75%</td>
<td>6.93</td>
<td>+0.96</td>
<td>3.00</td>
</tr>
<tr>
<td>FEF(lit/min)</td>
<td>3.50*</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

** = Significant at 1% level (P < 0.01)

* = Significant at 5% level (P < 0.05)

The results of test of significance are of the comparison of actual mean values of control and exposed workers in the respective tables.
FIG. 1

PERCENTAGE DIFFERENCE OF MEAN VC, FEV₁₀ AND FEV₁₀% IN ASBESTOS WORKERS COMPARED TO CONTROL

ASBESTOS WORKERS AT HYDERABAD
ASBESTOS WORKERS AT AHMEDABAD
ASBESTOS WORKERS AT HYDERABAD

VC FEV₁₀ FEV₁₀%
concentration is 32 (mpcf x 10) and total dust concentration is 96 mpcf out of which 96.0 percent are in respirable range (Table - 39). The maximum concentration of fungal spores in Virginia tobacco operations at Rajeqanavary is 78 (mpcf x 10) and that total dust concentration is 14.15 mpcf out of which 92.62 percent is in respirable range (Table - 53, 54). In beedi processing workers, the dust concentration is 22.63 mpcf (Table - 63). The total dust concentration is maximum in non-Virginia agricultural operations.

The lung function tests in these workers (Table - 77) showed in male non-Virginia tobacco workers there is a significant reduction of VC and FEV\textsubscript{1.0} and a highly significant reduction in FEV\textsubscript{1.0}/FVC and FEV\textsubscript{25-75}. The percentage reduction of functional test is also maximum in these workers, compared to Virginia and beedi processing workers, may be because of high concentration of dust in the working environment. In Virginia tobacco workers, the functional tests showed a significant loss in FEV\textsubscript{1.0} and FEV\textsubscript{1.0}/FVC, whereas in beedi processing workers FEV\textsubscript{25-75} is showing a highly significant reduction. All these findings are depicted in Fig. 3. The significant reduction of FEV\textsubscript{1.0}, FEV\textsubscript{1.0}/FVC and FEV\textsubscript{25-75} indicates airway obstruction. This suggests that airway obstruction is a predominant effect in tobacco workers. Therefore, the measurement of FEV\textsubscript{1.0} and FEV\textsubscript{1.0}/FVC are useful as a guide for early detection of lung diseases in tobacco workers.
**Table 71**

**LEAD PERCENTAGE DIFFERENCE IN FUNCTIONAL TESTS IN TOBACCO CONSUMERS COMPARED TO CONTROL**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Non-Virginia Male</th>
<th>Non-Virginia Female</th>
<th>Virginia Male</th>
<th>Virginia Female</th>
<th>Beddi Processing Male</th>
<th>Beddi Processing Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC (lit)</td>
<td>7.27*</td>
<td>12.74</td>
<td>2.73</td>
<td>5.12</td>
<td>1.67</td>
<td>4.19</td>
</tr>
<tr>
<td>FEV (lit)</td>
<td>12.56*</td>
<td>22.16*</td>
<td>3.46*</td>
<td>5.09</td>
<td>5.30</td>
<td>2.63</td>
</tr>
<tr>
<td>FEV (l/sec)</td>
<td>1.43**</td>
<td>9.43*</td>
<td>4.32*</td>
<td>0.03</td>
<td>7.96</td>
<td>2.05</td>
</tr>
<tr>
<td>FFR (lit/sec)</td>
<td>13.18</td>
<td>21.40</td>
<td>1.98</td>
<td>7.13</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FFR (lit/sec)</td>
<td>16.63**</td>
<td>28.54**</td>
<td>3.94</td>
<td>3.54</td>
<td>15.30</td>
<td>21.53**</td>
</tr>
<tr>
<td>JFFR (lit/min)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.26</td>
<td>1.62</td>
</tr>
</tbody>
</table>

**= Significant at 1% level (P < 0.01)
* = Significant at 5% level (P < 0.05)

The results of the test of significance are of the comparison of actual mean values of control and exposed smokers in the respective tables.
In wool dust exposed workers all the ventilatory lung function tests are reduced significantly indicating both restrictive and obstructive type of lung disorders in these workers and this can be observed in Fig. 4. This loss in functional tests is as reported in Farmer’s lung. Measurement of VC and \( FEV_{1.0} \) is useful for early diagnosis of lung diseases in these workers.

In these cross sectional studies of workers exposed to mineral dusts i.e. asbestos and silica, measurements of VC is the best tool as a guide for early detection of pneumoconiosis. In vegetable dust exposed workers, measurement of \( FEV_{2.0} \) and \( FEV_{1.0} \) in tobacco workers and measurement of VC and \( FEV_{1.0} \) in wool workers are useful as a guide for early detection of pneumoconiosis.
TABLE 2

MEAS TO VC, FEV₁,0 AND FEV₁,0% IN MALE CONTROL AND EXPOSED SOL

WORCE AND FEMALE WOOL WORKERS

- MALE CONTROL
- MALE EXPOSED
- FEMALE EXPOSED

(1it)

VC
FEV₁,0
FEV₁,0%