Ventilatory function and personal breathing zone dust concentrations in Lancashire textile weavers

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Abstract

Background—To report findings on ventilatory function and estimations of concentrations of personal breathing zone dust in Lancashire textile weavers. Weaving room dust is considered to be less harmful than that encountered in the cardroom or spinning room and weavers are generally thought to have less respiratory disability than carders or spinners. However, this occupational group has not been extensively studied.

Methods—Each person was given a respiratory symptom questionnaire (modified Medical Research Council, UK, questionnaire on respiratory diseases). Ventilatory function tests, forced expiratory volume in 1 second (FEV₁) and forced vital capacity (FVC) were performed on each person. A representative sample of workers from each occupational group underwent dust sampling in their personal breathing zone. Dust concentrations and ventilatory tests were analysed statistically with the Student’s t test, Pearson’s correlation coefficient, and forward step regression for relations with symptoms and environmental factors. Significance was p ≤ 0.05.

Results—The FEV₁ and FVC were reduced in workers with respiratory symptoms (non-specific chest tightness, shortness of breath, persistent cough, and wheezing) as well as in preparation room workers, current and former smokers, Asians, those working with predominantly cotton fibre (>50% cotton) and starch size. Mean total dust concentration (pd₁) in the personal breathing zone was 1.98 mg/m³. The corresponding value for total dust with large fibres lifted off the filter paper (pd₂) was 1.55 mg/m³. There was a strong correlation (r=0.94, p<0.0001) between pd₁ and pd₂. Non-specific chest tightness was predicted by low dust concentrations and persistent cough by high dust concentrations. On regression analysis, impairment of ventilatory function (FEV₁, FVC) was predicted by smoking, male sex, age, not working in the weaving shed, not being white, and personal dust concentrations.

Conclusions—The FEV₁ and FVC were impaired in smokers and those exposed to high dust concentrations in the personal breathing zone. Symptoms were inconsistently related to dust concentrations in the personal breathing zone.

Keywords: weavers; dust concentrations; personal sampling; spirometry; textiles

It has been recognised for a long time that dust in the textile environment is related to respiratory illness.1–3 Investigators at the turn of the century4 and in the 1930s documented the high prevalence of disease and disability among cotton operatives. Since then, important advances have been made in the epidemiology of disease associated with work in the cotton mills. Several investigators have shown respiratory disability in cotton workers, based on clinical and ventilatory function evaluation.4–9

There is some debate regarding the optimum ventilatory test for assessment of respiratory disability in textile workers.10 11 22 23 Cinkotai et al12–15 used both workzone and personal breathing zone dust sampling. They found that personal breathing zone dust sampling correlated better with byssinotic symptoms. Recent work has also shown that in operatives exposed to cotton, up to 10-fold variation in exposure to dust can occur when comparing these two methods.24 However, most of the work already referred to has been carried out on cotton spinners, and not on weavers. It has been suggested that dust in the weaving shed is different, as a large part of it consists of “size” (a coating of starch, or other material, applied to yarn before it is submitted for weaving), which is liberated during the weaving process. Application of a coating of size may also prevent cotton dust from being liberated during the weaving process. The thought that weaving room dust is less injurious for health is reflected in the dust standards recommended by Corn, for the United States5—that is, a level of 0.75 mg/m³ for weaving and sizing and 0.20 mg/m³ for yarn manufacture and cotton washing. The generally held view is that byssinosis and other symptoms are not major problems for textile weaving. However, a few investigators have reported high prevalence of byssinosis and respiratory disability in cotton weavers.26–29

We used a respiratory symptom questionnaire, spirometry, and measurement of total inhalable dust in the personal breathing zone to study textile weavers around Manchester. Respiratory symptoms and factors associated with them are the subject of a separate paper. Ventilatory function and dust concentrations in the
personal breathing zone and their relation to symptoms are presented in this paper.

Methods
The study was cross sectional in design and conducted in the Lancashire area. Sixteen mills were surveyed. We did not have previous knowledge of working conditions in these mills. Every worker participating in the study was given a modified Medical Research Council (MRC), UK, respiratory symptom questionnaire with additional questions to identify byssinosis and other work related respiratory symptoms, and was validated for the study. If a symptom improved when away from work, it was said to be work related. Personal factors recorded were age, height, sex, and ethnic origin. Smoking data included type and extent of exposure in each mill.

LUNG FUNCTION TESTS
Measurement of timed vital capacity has been extensively used in the assessment of textile workers. The FEV1, has good reproducibility,31 and is easily applied in a field setting. Changes in the maximal midexpiratory flow have been shown in cotton operatives by many workers.32 It has been suggested that indices based on the maximum expiratory flow volume curve are better than FEV1, when studying ventilatory function of cotton workers, as the cotton dust reaction starts in peripheral airways. The reproducibility of forced expiratory flows, however, is only moderate.33 Hence we measured FEV1, and forced vital capacity (FVC) in our study population. Because of the size of the workforce studied, it was not possible to perform spirometry across the shift, or measure ventilatory function at the same time of the day or on the same day of the working week. Every attempt was made to measure ventilatory function in the early part of the shift. The same Vitalograph-S model spirometer was used throughout the study. Before a visit to a mill the spirometer was calibrated with a precision 1 l syringe. Upon arrival in the mill, the instrument was left unused for 2 hours. A record of room temperature was kept. The forced expiratory manoeuvre was explained to the worker. Usually the subject required two or three practice measurements while any errors were corrected. The operative was encouraged to exhale for as long as he or she could. A nose clip was used only if the technique was unsatisfactory. Care was taken to avoid the Valsalva manoeuvre, obstruction by tongue, cough, or early termination. The acceptability of the manoeuvre was determined by satisfactory start and end of test criteria and a minimum exhalation time of 6 seconds. Three forced expiratory manoeuvres within 5% of each other were obtained in the standing position. The greatest values for FEV1, and FVC were read off the scale at atmospheric temperature and pressure at saturation (ATPS), regardless of whether or not they occurred on the same curve. These values were later corrected for temperature.

For white workers, predicted spirometric values were derived from the summary equation of reference values.34 To calculate predicted lung function variables for Asians, correction factors were used as suggested by Cotes—that is, for Asian men 0.7 l and 0.45 l were subtracted from the predicted FVC and FEV1, of age and height matched white men; for Asian women the corresponding figures were 0.6 l and 0.4 l. The variables (FEV1, FVC) were then stored as the percentage of predicted values.

DUST SAMPLING
Personal breathing zone dust was measured with the sampler developed by the Institute of Occupational Medicine, Edinburgh (IOM).35 Its performance is close to inspirability over a

### Table 1 Number of people sampled and total number of samples in each mill

<table>
<thead>
<tr>
<th>Mill</th>
<th>Total seen</th>
<th>People sampled (n)</th>
<th>People sampled twice (n)</th>
<th>Total samples (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>261</td>
<td>39</td>
<td>35</td>
<td>74</td>
</tr>
<tr>
<td>2</td>
<td>144</td>
<td>23</td>
<td>NIL</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>32</td>
<td>12</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>99</td>
<td>21</td>
<td>19</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>64</td>
<td>21</td>
<td>18</td>
<td>39</td>
</tr>
<tr>
<td>6</td>
<td>29</td>
<td>13</td>
<td>NIL</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
<td>71</td>
<td>15</td>
<td>NIL</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>34</td>
<td>11</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>9</td>
<td>30</td>
<td>16</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>10</td>
<td>93</td>
<td>20</td>
<td>NIL</td>
<td>20</td>
</tr>
<tr>
<td>11</td>
<td>80</td>
<td>12</td>
<td>58 (0.57)</td>
<td>25</td>
</tr>
<tr>
<td>12</td>
<td>79</td>
<td>19</td>
<td>NIL</td>
<td>19</td>
</tr>
<tr>
<td>13</td>
<td>19</td>
<td>11</td>
<td>NIL</td>
<td>11</td>
</tr>
<tr>
<td>14</td>
<td>19</td>
<td>8</td>
<td>NIL</td>
<td>8</td>
</tr>
<tr>
<td>15</td>
<td>39</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>16</td>
<td>232</td>
<td>41</td>
<td>32</td>
<td>73</td>
</tr>
<tr>
<td>Total</td>
<td>1295</td>
<td>302</td>
<td>169</td>
<td>471</td>
</tr>
</tbody>
</table>

### Table 2 Mean (SD) dust concentrations in the mills (mg/m³)

<table>
<thead>
<tr>
<th>Mill</th>
<th>Workers sampled (n)</th>
<th>Total dust (mg/m³)</th>
<th>Total dust less fly (manually removed) (mg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39</td>
<td>2.38 (1.44)</td>
<td>1.42 (0.94)</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>2.61 (1.96)</td>
<td>2.27 (2.0)</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>2.49 (1.72)</td>
<td>1.82 (0.93)</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>2.24 (1.13)</td>
<td>1.98 (0.93)</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>1.52 (1.09)</td>
<td>1.29 (0.79)</td>
</tr>
<tr>
<td>6</td>
<td>13</td>
<td>1.10 (0.52)</td>
<td>1.04 (0.50)</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>1.26 (1.04)</td>
<td>1.08 (0.90)</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>1.03 (0.29)</td>
<td>0.73 (0.20)</td>
</tr>
<tr>
<td>9</td>
<td>16</td>
<td>2.59 (1.17)</td>
<td>2.11 (0.77)</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>0.62 (0.57)</td>
<td>0.56 (0.43)</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td>2.77 (0.99)</td>
<td>2.04 (0.46)</td>
</tr>
<tr>
<td>12</td>
<td>19</td>
<td>2.28 (1.23)</td>
<td>1.94 (1.10)</td>
</tr>
<tr>
<td>13</td>
<td>11</td>
<td>2.08 (1.18)</td>
<td>1.82 (0.96)</td>
</tr>
<tr>
<td>14</td>
<td>8</td>
<td>6.67 (3.32)</td>
<td>5.48 (2.95)</td>
</tr>
<tr>
<td>15</td>
<td>20</td>
<td>2.69 (1.60)</td>
<td>2.41 (1.56)</td>
</tr>
<tr>
<td>16</td>
<td>41</td>
<td>1.24 (0.62)</td>
<td>1.00 (0.62)</td>
</tr>
</tbody>
</table>

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Table 4 Factors associated with high dust concentrations (univariate analysis)

<table>
<thead>
<tr>
<th>Factor</th>
<th>t Value</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dust:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton rather than man made fibre</td>
<td>~7.2</td>
<td>0.001</td>
</tr>
<tr>
<td>Work in sewing room</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Work with medium cotton grade</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Work with starch size</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Work with looms other than waterjet looms</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Total dust with fly manually removed:</td>
<td>~4.3</td>
<td>0.001</td>
</tr>
<tr>
<td>Work in sewing room</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Work with medium cotton grade</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Work with starch size</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Work with looms other than waterjet looms</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Table 7  Factors associated with reduced lung function (univariate analysis)

<table>
<thead>
<tr>
<th>Factor</th>
<th>t Value</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV1 (% predicted):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present smoker</td>
<td>−3.33</td>
<td>0.02</td>
</tr>
<tr>
<td>Cotton rather than man made fibre</td>
<td>−2.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Work in preparation room</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Work with starch size</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Asian ethnicity</td>
<td>2.31</td>
<td>0.02</td>
</tr>
<tr>
<td>Male sex</td>
<td>−1.24</td>
<td>NS</td>
</tr>
<tr>
<td>FVC (% predicted):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton rather than man made fibre</td>
<td>−2.4</td>
<td>0.016</td>
</tr>
<tr>
<td>Work in preparation room</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Work with starch size</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Medium grade cotton</td>
<td>ANOVA</td>
<td>0.05</td>
</tr>
<tr>
<td>Asian ethnicity</td>
<td>2.3</td>
<td>0.03</td>
</tr>
<tr>
<td>Male sex</td>
<td>−1.59</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table 8  Work related symptoms associated with reduced lung function (univariate analysis)

<table>
<thead>
<tr>
<th>Factor</th>
<th>t Value</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV1 (% predicted):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic phlegm production</td>
<td>−3.34</td>
<td>0.001</td>
</tr>
<tr>
<td>Non-specific chest tightness</td>
<td>−2.66</td>
<td>0.01</td>
</tr>
<tr>
<td>Nasal symptoms</td>
<td>2.8</td>
<td>0.005</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>−4.26</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Persistent cough</td>
<td>−2.43</td>
<td>0.019</td>
</tr>
<tr>
<td>Wheezing</td>
<td>−4.05</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>FVC (% predicted):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-specific chest tightness</td>
<td>−2.09</td>
<td>0.04</td>
</tr>
<tr>
<td>Nasal symptoms</td>
<td>2.14</td>
<td>0.033</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>−2.96</td>
<td>0.006</td>
</tr>
<tr>
<td>Persistent cough</td>
<td>−2.38</td>
<td>0.021</td>
</tr>
<tr>
<td>Wheezing</td>
<td>−3.35</td>
<td>0.001</td>
</tr>
</tbody>
</table>

univariate and multivariate analyses, log normally distributed data were log transformed.

Results
Of the 1295 workers interviewed with a questionnaire, 302 participated in dust sampling. Seven mills (454 workers) did not agree to a second dust sampling exercise. Hence, only 169 of the 302 workers could be sampled twice. This gave a total of 471 dust samples (weaving shed 179, preparation 51, sewing room 35, cloth inspection 37). The number of workers sampled in each mill are given in table 1. The percentage of workers sampled in each workroom were: weaving 25.3%, preparation 26.7%, sewing 13.4%, and cloth inspection 30.3%. Table 2 lists the mean dust concentrations in each mill. Dust concentrations in the workrooms and occupations are shown in table 3. The highest dust concentrations were encountered in operatives of the sewing room. Dust concentrations in workers employed in the rest of the workrooms were very similar to each other. Factors associated with total inhaling dust (univariate analysis) are listed in table 4. These factors are similar for pd1 and pd2. Significantly higher dust concentrations were generated when cotton rather than man made fibre was being used, medium grade cotton was being woven, and when starch size was used. The lowest concentrations of dust were generated by water jet looms (mean pd1 0.27 mg/m³, pd2 0.23 mg/m³). Next dust were air jet looms (mean pd1 1.49 mg/m³, pd2 1.13 mg/m³). They were significantly less dusty than the other loom types. The two dust fractions correlated well with each other (r=0.94, p<0.0001). No respiratory symptoms except work related persistent cough were associated with high concentrations of dust (pd1, pd1). Work related ocular symptoms were associated with lower concentrations of dust (table 5).

Altogether, 1295 operatives completed the questionnaire, and 33 were unable to comply with American Thoracic Society guidelines. Hence ventilatory function test results of 1262 workers are presented. Mean values by mill are listed in table 6. Univariate analysis of factors associated with reduced lung function are given in table 7. Both FEV1 and FVC were significantly reduced in smokers, those handling predominantly cotton rather than man made fibre, starch size, and employees in the preparation room. Percentage predicted FEV1 and FVC were lower in Asians than their white counterparts. The presence of work related chest symptoms was associated with reduced FEV1 and FVC (table 8). For work related nasal symptoms, this was not the case. On multiple regression analysis (table 9), cumulative smoking emerged as the strongest predictor of a reduced FEV1. Other factors predicting a reduction of this variable were greater age, male sex, and Asian ethnicity. Higher concentrations of total dust in the personal breathing zone predicted reduced FEV1. A low FEV1 was also associated with employment in workrooms other than weaving. Smoking habit was not an independent predictor of reduced FVC. Other predictors for this variable were similar to those for FEV1.

Discussion
LUNG FUNCTION
A large body of data suggests that cotton operatives are susceptible to acute chronic respiratory disability. An accelerated decline in lung function is also found in asymptomatic cotton workers and in exposed cotton workers. However, there is a paucity of lung function data for weavers. Because of the study design, changes in ventilatory function across the shift could not be assessed in our study. However, measurements were predominantly made at the beginning of the shift to minimise variation across the shift in the results.

White workers had higher values of FEV1 and FVC compared with Asians. Ethnicity emerged as an independent factor on carrying out regression for FEV1 and FVC. In their study of Lancashire spinners, however, Cinkotai et al and Fishwick et al described lower values of ventilatory function in the white workforce compared with Asians. They attrib-
uted this to a shorter duration of exposure to the cotton industry in the case of Asians. However, these studies used a different correction factor for Asian people. The use of a correction factor to calculate predicted ventilatory function values in Asians was essential but may not be accurate. It has been suggested that predicted values for normal ventilatory function should ideally be computed from healthy members (unexposed) of the same community. This was not possible in this study as the number of Asians was small and all were exposed—that is, there were no controls. Local geographic and social factors influencing the Asian population may affect the suitability of a given correction factor. Thus, these findings cannot be accepted as indicating an increased susceptibility of Asians.

Male sex and increasing age emerged as significant independent predictors of reduced FEV\(_1\), despite standard correction attempted for both of them when calculating predicted values. The effect of age may also highlight the inadequacy of the predicted values currently in use, or may be an effect of cumulative occupational exposure.

The pattern of sex distribution across various occupations and workrooms is quite distinctive. Men usually carry out most of the work with high exposure to dust—such as loom maintenance, loom sweeping, etc. Also, with the exception of beaming and creeling, the preparation department is almost exclusively manned by men. Employees of this workroom had the lowest values for lung function. Interestingly, on regression analysis, not working in the weaving shed was associated with lower values of FEV\(_1\) and FVC. The preparation department is the next most dusty workroom after the spinning room.

Those exposed to starch size had significantly reduced FEV\(_1\) compared with polyvinyl alcohol size. The starch size consists of organic matter and may be more bioactive. However, size did not emerge as an independent factor on regression. Contrasting with the findings of Roach\(^{22}\) and Mekky\(^{9}\) we did not find exposure to a particular grade of cotton to be associated with reduced ventilatory function. Overall, those exposed to predominantly cotton fibre had significantly lower FEV\(_1\) (p = 0.027) and FVC (p = 0.016) compared with those exposed to fibres other than cotton. Accelerated loss of lung function has been shown in cotton operatives (compared with man made fibre operatives) by other research workers.\(^{10-14}\) In the present study (which documented predictors of reduced FEV\(_1\), rather than a decline in FEV\(_1\)) work with cotton (rather than man made fibre) did not emerge as an independent predictor for FEV\(_1\).

The relative contribution of smoking and employment in the textile industry in the cause of respiratory disability is a subject of much debate. It has been suggested that morbidity among textile workers is due to smoking. However, several investigators have established that the textile environment also causes disability and when smoking is present, the two are additive.\(^{17-42}\) In the present study, smoking has, as expected, emerged as an independent predictor of reduced FEV\(_1\), but not FVC. However, equally important is the finding that two variables of the work environment (total inhalable dust and work not in the weaving shed) are also able to predict a reduced FEV\(_1\), independent of smoking. Equally interesting is the finding of a relation between total inhalable dust concentrations in the personal breathing zone and reduced FVC. The relation was stronger for FVC than FEV\(_1\). Such a relation has also been described for man made fibre.\(^{43}\) Most weaving units process a mixture of cotton and man made fibre. Whether the reduced values of FVC are due to cotton dust or reflect use of man made fibre, size, or some other factor in the environment of the weaving room cannot be concluded from available data.

**DUST CONCENTRATIONS**

Workers participating in the study tolerated the sampling exercise very well. Every attempt was made to carry out dust sampling on a representative sample of people from each occupation and workroom in the mills, so that results of dust sampling in a mill could be extrapolated to the workers of the same occupation or workroom in that mill. However, the potential for bias remains due to refusal of some workers to wear the sampling equipment and due to some workers being sampled once rather than twice.

The samplers measuring total inhalable dust (pd1) in the personal breathing zone of operatives did not have a wire mesh excluding larger particles. Previous studies had measured dust concentrations by prefiltering air through 2 mm wire mesh. Hence, another variable was derived, by manually lifting the fluff off the filter paper (pd2). However, manual removal of these large textile fibres confounds the issue, as it also leads to loss of finer dust trapped therein. Also, this technique depends on the observer, and therefore is less accurate. Mean (SD) pd1 concentration was 1.98 (1.55) mg/m\(^3\). Mean (SD) pd2 concentration was 1.55 (1.30) mg/m\(^3\). The correlation between the two dust fractions was good (r = 0.94, p < 0.0001), but only pd1 was a predictor of reduced FEV\(_1\), and FVC on regression analysis. Presumably, once pd1 had emerged as an independent predictor of loss of ventilatory function, pd2 was rendered less beneficial.

Correlation between FEV\(_1\) and dust concentrations (time weighted, total dust less fly) was carried out by Fox et al.\(^{11}\) The correlation coefficient for non-smokers was -0.08 and for smokers -0.13. Although we were dealing with a different population, and not measuring dust concentrations over time, we had very similar values of the correlation coefficient between dust concentrations and ventilatory function.

When cotton rather than man made fibre was being processed, pd1 and pd2 concentrations were higher. Generally, coarse cotton produces the highest dust concentrations.\(^{15}\) However, we found that pd1 and pd2 concentrations were higher for medium rather than coarse cotton. The pd1 and pd2 produced with starch size were higher than those for polyvinyl
Ventilatory function and personal breathing zone dust in Lancashire textile weavers

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tion between symptoms and dust concentra-

(Cinkotai FF, personal communication). Quite

predictably, although we found a relation

dust concentrations and loss of venti-
latory function. Somewhat similar, we were unable to show a rela-
tion between symptoms and dust concentra-
tions. This is contrary to findings of other
studies1 13 16 in which such a relation was
documented. However, these studies have been

conducted on spinners or cardroom workers.

The only symptom of the lower respiratory tract for which a dose-response relation was

shown was persistent cough. However, even for
this symptom, the strongest predictors were

smoking (p=0.0003), female sex (p=0.0085), fine
grade cotton (p=0.0268), then pd2 (p=0.0246). Persistent cough is probably a
heterogeneous symptom. Some cases could be
forerunners of chronic bronchitis, and hence
related to smoking. Other cases could be due to
an irritant effect. Other irritant symptoms
(ocular or eye irritation) are also more
common in women. Workers exposed to fine
grade cotton also complained of more ocular or
nasal irritation.

Perhaps exposure to dust in weaving is suffi-
ciently irritant that continued exposure over a
long period can cause reduced ventilatory function. However, compared with cotton
spinning, it is not sufficiently harmful to induce acute respiratory symptoms.

In conclusion, therefore, this large study of

weavers shows that the highest dust concentra-
tions are in the weaving room. High concentra-
tions are more likely to be associated with
workroom factors. With the exception of work
related persistent cough, total inhalable dust in
the personal breathing zone is not related to
lower respiratory symptoms. It is, however, an
independent predictor of reduced FEV1. Other

independent factors predicting a reduced FEV1 are
cumulative smoking, male sex, Asian ethnicity, and work in areas other than the
weaving shed. Thus, reduced FEV1 is predicted by
smoking, and personal and environmental factors. A reduced FVC is predicted by the
same factors (except cumulative smoking).

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