
BLOOD GROUPS OF MINERS WITH COAL-WORKERS’ PNEUMOCONIOSIS AND BRONCHITIS

BY

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An unexpected finding in a survey of a random sample of men from the Rhondda Fach valley in South Wales suggested an association between blood group A and coal-workers’ pneumoconiosis. A further and larger sample of 1,250 miners and ex-miners from the same area, covering the same age range of 35 to 64 years, was chosen at random from the population in order to verify this finding. Each man was radiographed and questioned on his history and symptoms of chronic respiratory disease, and samples of blood and of saliva were obtained. The chest radiographs were classified according to the 1953 International Classification of Pneumoconiosis, and ABO and Rh blood groups and the secretor status were determined.

No convincing association between ABO or Rh blood groups or secretor status and either pneumoconiosis or respiratory symptoms associated with bronchitis was found. If an association between the blood groups and pneumoconiosis in fact existed, it would manifest itself as an effect on the response to exposure to dust. Future investigations should therefore be concerned with variations in the dose-response relation rather than with variations in the prevalence of pneumoconiosis.

During the analysis of the results of a field survey in 1958 in the Rhondda Fach, an excess of blood group A and a corresponding deficiency of blood group O were found among miners and ex-miners with pneumoconiosis (Table 1). The random sample of 600 persons consisted of equal numbers of miners and ex-miners and of non-miners divided into three decennial groups in the age range 35 to 64 years (Higgins and Cochrane, 1961; Kilpatrick and Hardisty, 1961). The only publication on blood group frequency in pneumoconiosis is that of Kuroda (referred to by Winkler, 1943), who found blood group B predominant in Japanese miners with silicosis.

This paper describes our studies in 1961 of a larger sample of miners and ex-miners in relation to pneumoconiosis and to bronchitis.

Methods

A sample of 1,250 miners and ex-miners was drawn from the population of the Rhondda Fach (defined by private census in the summer of 1958) by random numbers.

Details of the samples, the largest that could be studied in the time available, are given in Table 2.

All subjects were seen by appointment and samples of blood and saliva were obtained. A questionnaire similar to that approved in 1960 by the Medical Research Council’s Bronchitis Committee was completed. “Chronic bronchitis” was defined as a persistent cough with sputum for some part of the day for at least three months together with one or more “chest illnesses”. “Chest illness” was defined as one sufficiently severe to keep a man off work for a week or more with cough and sputum or an increase in these symptoms if they were usually present. The grades of breathlessness were those advocated by Fletcher (1952).

A 14 × 14 in. (35.56 × 35.56 cm.) postero-anterior radiograph was taken of the chest and classified according to the International Classification (I.L.O., 1953). To avoid variation between observers, all questionnaires were completed, and all chest films were read by the same observer.

Blood grouping was performed using clotted blood samples; these were tested the day after collection. The methods used were those described in the Medical Research Council’s Memorandum on ABO and Rh grouping (1958) and by Drummond (1961).
BLOOD GROUPS OF MINERS WITH PNEUMOCONIOSIS AND BRONCHITIS

Table 1


<table>
<thead>
<tr>
<th>Age Group</th>
<th>Occupation</th>
<th>X-ray Category</th>
<th>Blood Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>35-44</td>
<td>Non-miners</td>
<td>Simple pneumonia</td>
<td>42 (47.7)*</td>
</tr>
<tr>
<td></td>
<td>Miners and ex-miners</td>
<td>Simple pneumonia</td>
<td>16 (44.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P.M.F.</td>
<td>15 (35.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: Miners and ex-miners</td>
<td>34 (39.5)</td>
</tr>
<tr>
<td>45-54</td>
<td>Non-miners</td>
<td>Simple pneumonia</td>
<td>37 (42.0)</td>
</tr>
<tr>
<td></td>
<td>Miners and ex-miners</td>
<td>Simple pneumonia</td>
<td>16 (39.3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P.M.F.</td>
<td>15 (36.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: Miners and ex-miners</td>
<td>36 (37.9)</td>
</tr>
<tr>
<td>55-64</td>
<td>Non-miners</td>
<td>Simple pneumonia</td>
<td>47 (54.7)</td>
</tr>
<tr>
<td></td>
<td>Miners and ex-miners</td>
<td>Simple pneumonia</td>
<td>11 (44.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P.M.F.</td>
<td>15 (37.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: Miners and ex-miners</td>
<td>35 (36.8)</td>
</tr>
<tr>
<td>All ages</td>
<td>Non-miners</td>
<td>Simple pneumonia</td>
<td>126 (48.1)</td>
</tr>
<tr>
<td></td>
<td>Miners and ex-miners</td>
<td>Simple pneumonia</td>
<td>43 (48.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P.M.F.</td>
<td>45 (36.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: Miners and ex-miners</td>
<td>105 (38.0)</td>
</tr>
</tbody>
</table>

*Percentages in parentheses.

Table 2

RANDOM SAMPLES OF MINERS AND EX-MINERS STRATIFIED BY AGE

<table>
<thead>
<tr>
<th>Age Group</th>
<th>No. in Population at Census*</th>
<th>No. Sampled</th>
<th>Excluded</th>
<th>Left Area</th>
<th>Dead</th>
<th>Refused</th>
<th>Examined</th>
<th>No. in Group after Correcting Ages</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-44</td>
<td>1,137</td>
<td>500 (100.0)</td>
<td>5 (1.0)</td>
<td>27 (5.4)</td>
<td>1 (0.2)</td>
<td>27 (5.4)</td>
<td>440 (88.0)</td>
<td>440</td>
</tr>
<tr>
<td>45-54</td>
<td>1,263</td>
<td>250 (100.0)</td>
<td>1 (0.4)</td>
<td>9 (3.6)</td>
<td>10 (4.0)</td>
<td>23 (9.2)</td>
<td>207 (82.8)</td>
<td>210</td>
</tr>
<tr>
<td>55-64</td>
<td>1,168</td>
<td>500 (100.0)</td>
<td>2 (0.4)</td>
<td>8 (1.6)</td>
<td>39 (7.8)</td>
<td>7 (7.4)</td>
<td>414 (82.8)</td>
<td>411</td>
</tr>
<tr>
<td>Total</td>
<td>3,568</td>
<td>1,250 (100.0)</td>
<td>8 (0.6)</td>
<td>44 (3.5)</td>
<td>50 (4.0)</td>
<td>87 (7.0)</td>
<td>1,061 (84.9)</td>
<td>1,061</td>
</tr>
</tbody>
</table>

*Date of census, June 1, 1958.  †Percentages are given in parentheses.

ABO Grouping.—Cells were tested with A, B, and O grouping sera. Sera were tested against A and B cells and for irregular antibodies, e.g. anti-Rh agglutinins. Tests were done to ensure that weakly reacting A agglutinogen (A₁, etc.) in group A or AB bloods did not escape detection. In bloods initially typed as group B, the cells were further tested with group O serum having strong anti-A and which had been absorbed of its anti-B agglutinin. The sera of bloods typed initially as B were also tested with A₁ and A₂ cells.

Rh Typing.—Cells were tested with two anti-D sera and those giving negative reactions were further tested with anti-C, D, and E sera. The D¹¹ antigen was tested for by the indirect anti-globulin test after treatment of the cells with potent anti-D serum known to react with the D¹¹ antigen. Bloods classified as D-negative were those giving negative reactions with anti-D and anti-D¹¹ sera. D-negative bloods comprise those which lack the C and E antigens or which contain one or other, or both, of these antigens.

Saliva Tests.—All salivas were tested independently by two observers for A, B, and H substances. Anti-H extracted from seeds of Ulex europaea was used. One observer used a single tube technique with suitably diluted antisera. The other observer titrated the salivas. Any discrepancies between the results obtained were checked by repeating the tests if necessary on fresh specimens of saliva.

Results

Coal-workers’ Pneumoconiosis.—Table 3 shows the prevalence of the various categories of pneumoconiosis in the sample. The proportion of men with pneumoconiosis was lower in this sample than in the previous one (Higgins and Cochrane, 1961). It seems probable that this is due to observer variation in film classification because in the present study all the radiographs were read by I.T. T.H. whereas in the previous sample all the radiographs were read by Professor A. L. Cochrane. At that time we commented that we had expected to find roughly equal numbers of miners and ex-miners with and without pneumoconiosis, whereas we had in fact found a deficiency of men with normal radiographs. The present findings are more in line with our earlier expectations.
When all category.

The pneumoconiosis and together, group A percentages are excess with degrees of freedom, 0-10 > p > 0-05.

The proportions of Rh positive subjects among the men with pneumoconiosis and the men without vary significantly between the three age groups. Among the men aged 35 to 44 the proportion of Rh positive subjects is somewhat lower when pneumoconiosis was diagnosed than when it was not; among those aged 45 to 54 the proportions are reversed, to an extent which in isolation appears significant (0-02 > p > 0-01); among the men aged 55 to 64 there is no apparent difference. This variation between age groups is unlikely to be due to chance (χ² = 10-18 for two degrees of freedom, 0-01 > p > 0-001).

Table 4 shows the frequency of ABO and Rhesus blood groups according to age and radiological category. When all age groups are considered together, the frequencies of groups O and A are found to be 44-4 and 40-9% in the men without pneumoconiosis and 42-2 and 42-8% in those with pneumoconiosis. The differences between these percentages are quite insignificant. When individual age groups are considered separately there is again no suggestion of an increased frequency of blood group A among miners with pneumoconiosis. Only in the 45-54 group (the smallest) are there differences in the blood group frequency that are at all suggestive. Here there is a deficiency of group A and a corresponding excess of group O among the miners without pneumoconiosis, a result that is in accordance with the findings of the earlier survey. Indeed, the differences between the three age groups in this survey approach a significant level (χ² = 5-12 with two degrees of freedom, 0-10 > p > 0-05).

Respiratory Symptoms and Bronchitis.—Table 5 shows the prevalence of respiratory symptoms in the sample according to age and radiological category of pneumoconiosis. As age advances, symptoms in each category become more frequent. There is a clear relation in this sample between respiratory symptoms and the radiological category of pneumoconiosis. In each group the men with simple pneumoconiosis had a higher prevalence of symptoms than those without though the difference is sometimes small, and those with P.M.F. recorded an even higher prevalence. An
increasing prevalence of respiratory symptoms with increasing radiological category of pneumoconiosis was noted by Rogan, Ashford, Chapman, Duffield, Fay, and Rae (1961) when the findings in six British collieries surveyed by the National Coal Board were combined.

Table 6 shows the prevalence of respiratory symptoms and "chronic bronchitis" according to age and blood group. There is no evidence of any association between symptoms and blood group. This agrees with the observations of Lewis and Woods (1961), who studied the blood groups in six respiratory disorders in patients referred to the Brompton Hospital. They found no evidence of any association between blood group and cases diagnosed as bronchitis and emphysema.
Table 7
PREVALENCE OF SYMPTOMS ACCORDING TO AGE AND SECRETOR STATUS

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Secretor Status</th>
<th>No.</th>
<th>Cough</th>
<th>Sputum</th>
<th>Cough and Sputum</th>
<th>Chest Illness</th>
<th>Breathlessness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Once</td>
<td></td>
</tr>
<tr>
<td>35-44</td>
<td>Positive</td>
<td>316</td>
<td>147</td>
<td>147</td>
<td>115</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>123</td>
<td>56</td>
<td>54</td>
<td>43</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>45-54</td>
<td>Positive</td>
<td>158</td>
<td>90</td>
<td>93</td>
<td>73</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>52</td>
<td>32</td>
<td>30</td>
<td>26</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>55-64</td>
<td>Positive</td>
<td>303</td>
<td>196</td>
<td>177</td>
<td>153</td>
<td>27</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>107</td>
<td>59</td>
<td>60</td>
<td>50</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>Positive</td>
<td>777</td>
<td>433</td>
<td>417</td>
<td>341</td>
<td>78</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>282</td>
<td>147</td>
<td>144</td>
<td>119</td>
<td>23</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 8
BLOOD GROUP FREQUENCIES ACCORDING TO RADIOLOGICAL CATEGORY IN THE 1958 AND 1961 SAMPLES

<table>
<thead>
<tr>
<th>Radiological Category</th>
<th>Year</th>
<th>Blood Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>1958</td>
<td>43 (48.9)</td>
</tr>
<tr>
<td></td>
<td>1961</td>
<td>240 (44.4)</td>
</tr>
<tr>
<td>Pneumoconiosis</td>
<td>1958</td>
<td>62 (33.0)</td>
</tr>
<tr>
<td></td>
<td>1961</td>
<td>220 (42.2)</td>
</tr>
<tr>
<td>Total</td>
<td>1958</td>
<td>105 (38.0)</td>
</tr>
<tr>
<td></td>
<td>1961</td>
<td>460 (43.4)</td>
</tr>
</tbody>
</table>

Table 7 indicates that secretor status also appears to be unimportant in this respect. The age standardized prevalence of respiratory symptoms is the same in both secretor-positive and secretor-negative groups.

Discussion

The impression of an association between blood groups O and A and pneumoconiosis suggested by the small sample drawn in 1958 has not been strongly supported by the larger sample, drawn from virtually the same population, in 1961. Table 8 brings the relevant results together. The excess of group A in men with pneumoconiosis (and a corresponding deficiency of group O) is still present but is extremely small, and the combined evidence from the two samples only attains the 10% level of significance. There is no convincing evidence of heterogeneity of the two samples (p = 0.08), so it appears that the play of chance may well have been responsible for the differences between them.

Associations between characteristics observed in samples in which many such characteristics have been recorded will appear, by chance, with a frequency larger than that suggested by a single test of significance. If it were known how many pairs of characteristics had been examined for association, the chance frequency could be calculated; in practice, the suggestion of Fraser Roberts (1955) that a significance level of 1/1,000 should be demanded in blood group work before an association is accepted provides a reasonable safeguard.

When the hypothesis of a particular kind of association has been formed by inspection of sample data not specifically collected with this hypothesis in mind, it is well not to accept the result of a conventional test of significance but to explore the hypothesis by means of a new sample, as we have done in this case with the suggested association between pneumoconiosis and the O/A ratio. In the new sample we have now found apparent evidence of heterogeneity in the relation of pneumoconiosis to Rh positivity. It is clear that further studies are necessary before this can be accepted.

It is of some interest to consider what form of association would be expected if there were a connexion between pneumoconiosis and the blood groups. The very extensive evidence that the prevalence of pneumoconiosis can be related to exposure to dust by some form of dose-response curve (Fay and Ashford, 1961) suggests that any effect of the blood group would be in modifying the shape of this curve, the speed of radiological response to dust inhalation, rather than in producing similar differences in prevalence among men of all ages, of widely differing dust exposures. Unless the blood group in some way determines the dust exposure of an
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individual, which seems unlikely, one would expect

differences in prevalence to be small among young

men, to increase with age (and thus dust exposure),

remaining large or perhaps diminishing again among

the oldest men. Alternatively, it may be the risk of

massive fibrosis associated with a given degree of

simple pneumoconiosis which depends on the blood

group. It may therefore be better in future studies to

attempt to distinguish the dose-response curves of

groups of men of different blood groups rather than
to proceed with further studies of prevalence

unrelated to dust exposure.

We are grateful to Drs. N. Pearson and D. C. Morgan,
of the National Coal Board, for urging us to analyse
the blood groups from the first survey in relation to pneu-

moconiosis; to Dr. J. A. Fraser Roberts for advising us to

repeat our observations on a larger sample and, together

with Professor H. Scarborough, for reading and criticizing
the manuscript; to our colleagues at the Pneumoconiosis
and Epidemiological Research Units for their help in
carrying out the surveys.

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