intensively and completely investigated, it can be deduced from available figures that 17 babies affected with Down syndrome would be detected each year.

From the various available tables comparing the cost of amniocentesis and the cost of keeping a Down syndrome child in an institution, it is clear that the expense of institutionalizing a child is vastly greater than that of amniocentesis and termination of pregnancy. The cost of screening 500 amniotic fluid specimens would be approximately R92 800 (including α-fetoprotein estimation) (our estimate). According to Hook and Chambers,1 to place in institutions the 17 expected Down syndrome infants born in this group if not screened, would cost about $170 000 (R129 200), or R7 600 a year per child. However, this figure must be multiplied by the number of years each individual stays in an institution, which could be as great as 50.

A comparison over a 10-year period would produce the following figures. Amniocentesis on the 500 women each year would total R928 000. During the same period, however, multiplication of the 17 infants with Down syndrome born each year by the number of years in an institution totals 935 patient-years at R7 600 a year, giving the staggering figure of R7 106 000.

At present very few patients in the 35 - 39-year group are referred for amniocentesis, and the chances of detecting a Down syndrome fetus in this limited number of referrals is slim. It would be more fruitful at present to ignore this sector and concentrate on the women who are 40 years old and over. It would certainly still be cheaper to screen all the 35 - 39-year-old patients and terminate pregnancy when indicated. However, the problem is not so much one of finance as of staffing, both in the obstetric department and in the laboratory, since it would involve amniocentesis and cell culture on approximately 1 500 women each year. In conclusion, it would seem that a greater effort should be made to contact all women aged 40 and over before they are 16 weeks pregnant and to perform amniocentesis on these patients.

I wish to thank Professor P. Beighton and Dr M. M. Nelson for their constructive comments and Dr H. A. van Coeverden de Groot for providing certain statistics.

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Respiratory symptoms and lung function in Black and White mining and non-mining industrial workers in South Africa

G. K. SLUIS-CREMER, W. O. HARRISON, R. C. T. PEARSON

Summary

The results of a number of chronic respiratory disease surveys carried out in the RSA are presented. Data for Whites and Blacks are compared, and the effect of smoking habits in the two ethnic groups is reported. The results are discussed in the light of other reports on ethnic differences in the literature.

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Date received: 7 August 1980.

While circumspection is urged in interpreting the results of chronic respiratory disease surveys carried out by different medical teams, it would seem that the problem in Blacks will increase as they change from pipe smoking to cigarette smoking and when they live in more highly polluted areas.

There is still evidence, however, that at equal levels of cigarette smoking Blacks are less prone to develop symptoms and lose lung function than Whites.


There have been suggestions in the literature that a similar degree of exposure to tobacco smoke causes fewer symptoms and less loss of lung function in Blacks than in Whites.
A number of surveys on Black and White workers in South African mines and other industries have been carried out in recent years. These were not specifically designed to explore ethnic differences, nor were the same age groups investigated in all cases. It is believed, however, that the available data are of value in attempting comparative analyses to determine whether there are significant ethnic differences in response to smoking and, if so, what their causes are.

Subjects and methods

Data from the following studies were used in making the comparisons.

1. A study on the prevalence of respiratory symptoms and lung function in White goldminers aged over 35.1 Miners were compared with a control group of White non-miners. The subjects — miners and controls — were randomly selected from the population of a Witwatersrand mining town (Carletonville), and the whole survey was carried out by one experienced mine hygiene officer. There were 562 miners, and 265 men in the control group.

2. A study that compared Black goldminers and Black non-miners over the age of 35.2 The miners were selected from patients with no other cardiorespiratory disease and with normal chest radiographs seen at a large mine recruiting depot hospital. The controls were Black employees of a medical research institute. The interviewers were two highly trained Black multilingual women with extensive experience in administering questionnaires to Black populations. There were 825 miners and 165 subjects in the non-mining control group.

3. A series of studies on Black and White workers in a number of different types of factories on the Witwatersrand (carried out by the National Research Institute for Occupational Diseases of the South African Medical Research Council).3 The factories included a variety of kinds of woodworks, several ceramic factories, an electrolytic manganese plant, a ferrochrome plant, a small flock factory, a large cement works and a hard-metals plant. All persons available with more than 3 years' service were studied, irrespective of age. The field officers were White doctors, but they received assistance from Black interpreters in questioning the many subjects who understood neither English nor Afrikaans. There were a total of 1 185 Blacks and 326 Whites, of whom 635 and 242 respectively were over the age of 35 years.

In all these studies the British Medical Research Council's long questionnaire on respiratory symptoms was administered. The forced expiratory volume of the first second (FEV₁) and forced vital capacity (FVC) were measured in the White and Black industrial workers. The results of the FEV₁/FVC ratio are presented, because owing to the large difference in normal FEV₁ and FVC between Blacks and Whites this was considered the most appropriate measurement for comparisons between the two groups.

Sputum samples were collected in some of the factory surveys. The sputum sample was expectorated during a 10–15 minute period immediately after the subject had completed the questionnaire, which was done at any time throughout the working day. The mucoid or mucopurulent deposit was measured in a graduated glass test tube after the addition of water.

The amount of tobacco smoked daily is given in grams per day (1 cigarette = 1 g, 1 ounce pipe tobacco = 28 g, one small cigar = 2 g and one large cigar = 5 g).

Results

Table I shows the relationship between actual sputum production and the answers to the questions about sputum production in White and Black non-mining industrial workers. Correlations are not good, but are at least as good for Blacks as for Whites, suggesting that the Blacks understood the questions as well as the Whites and that they gave affirmative replies at a similar level of symptom intensity.

Table II shows the prevalence of cough and sputum present for more than 3 months in the year in men over the age of 35 in relation to smoking category found in the three surveys. The data in the table indicate that there is a moderately high prevalence of these symptoms in Black and White industrial workers, essentially similar to that in White non-miners living in Carletonville. White goldminers have excessive rates, while the prevalence is very low in both the Black mining and the Black control group.

Table III compares the FEV₁/FVC ratio in the Black and White non-mining industrial workers in relation to smoking category. This measurement declines more in Whites than in Blacks with increasing tobacco consumption, but the difference is not statistically significant except in those smoking more than 25 g/d.

Table IV shows the FEV₁/FVC ratio for Black and White factory workers who had respiratory symptoms of short duration (<3 months) or of longer duration (>3 months) in a year. The FEV₁/FVC ratio falls slightly in both ethnic groups only when symptoms of longer duration are present, and the fall is slightly greater in the Whites. The differences are not statistically significant, however.

In Table V the manner of smoking in the Black groups at the time the surveys were carried out is recorded. Table VI shows how small the decrease in FEV₁ with smoking is in Black men (miners and non-miners).

Discussion

In the first instance the possibility that Blacks and Whites interpret the questions about cough and sputum differently or only admit to symptoms at different levels of symptom intensity should be considered. Table I, which shows the correlation between actual sputum production and answers to the relevant questions, does not however suggest that the Blacks are underestimating their symptoms.

Of the White men in Carletonville,1 86% of those (287) who claimed cough and sputum for more than 3 months in the year produced a sputum sample. In another study of White miners (F. J. Wiles and M. H. Faure — unpublished data) it was found that 39% of a group of White South African miners examined at the Medical Bureau for
TABLE II. COUGH AND SPUTUM FOR MORE THAN 3 MONTHS A YEAR IN MEN AGED OVER 35 YEARS

<table>
<thead>
<tr>
<th>Tobacco consumption</th>
<th>Sample size</th>
<th>Sample size</th>
<th>Sample size</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Black industrial workers</td>
<td>273</td>
<td>9</td>
<td>244</td>
<td>10</td>
</tr>
<tr>
<td>White industrial workers</td>
<td>76</td>
<td>7</td>
<td>30</td>
<td>17</td>
</tr>
<tr>
<td>Black goldminers</td>
<td>370</td>
<td>1.9</td>
<td>349</td>
<td>2.3</td>
</tr>
<tr>
<td>Black non-mining controls</td>
<td>168</td>
<td>13</td>
<td>54</td>
<td>43</td>
</tr>
<tr>
<td>White non-mining controls</td>
<td>104</td>
<td>7</td>
<td>30</td>
<td>27</td>
</tr>
</tbody>
</table>

TABLE III. FEV₁/FVC RATIO (%) IN SMOKING GROUPS

<table>
<thead>
<tr>
<th>Tobacco consumption</th>
<th>Never</th>
<th>Ex-smoker</th>
<th>1-14 g/d</th>
<th>15-24 g/d</th>
<th>&gt;25 g/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black industrial workers</td>
<td>334</td>
<td>83</td>
<td>468</td>
<td>97</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>79.2</td>
<td>76.7</td>
<td>76.1</td>
<td>77.0</td>
<td>77.1</td>
</tr>
<tr>
<td></td>
<td>10.4</td>
<td>10.08</td>
<td>7.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White industrial workers</td>
<td>55</td>
<td>51</td>
<td>51</td>
<td>101</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>80.5</td>
<td>76.2</td>
<td>75.9</td>
<td>74.6</td>
<td>72.0</td>
</tr>
<tr>
<td></td>
<td>8.48</td>
<td>9.21</td>
<td>10.5</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NS</td>
<td>P&lt;0.05</td>
<td></td>
</tr>
</tbody>
</table>

TABLE IV. FEV₁/FVC RATIO (%) IN RELATION TO DURATION OF SYMPTOMS IN NON-MINING INDUSTRIAL WORKERS OF ALL AGES

<table>
<thead>
<tr>
<th>Tobacco consumption</th>
<th>Blk</th>
<th>White</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>size</td>
<td>size</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>No cough and sputum</td>
<td>788</td>
<td>251</td>
</tr>
<tr>
<td>Cough and sputum &lt;3 months</td>
<td>115</td>
<td>14</td>
</tr>
<tr>
<td>Cough and sputum &gt;3 months</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

Occupational Diseases and who did not complain of symptoms produced sputum, while 61% of those who had symptoms produced sputum; 84% of those who claimed sputum production for more than 3 months in the year were able to produce a sputum specimen. These figures are similar to those for Black industrial workers reported in Table I. Fletcher et al. report similar rates of actual production of sputum in those claiming to produce sputum.

A factor which may greatly influence the eliciting of symptoms is the training, personality and approach of the interviewers. The Black and White non-mining industrial groups reported here were examined by the same medical officers, but in the former group the doctors often had to be assisted by a number of Black interpreters.

The fact that the FEV₁/FVC ratio falls in those Blacks with symptoms prolonged for more than 3 months and not in those with a shorter duration of symptoms, just as with the Whites,

TABLE VI. FEV₁ IN BLACK MEN BY SMOKING CATEGORY

<table>
<thead>
<tr>
<th>Tobacco consumption</th>
<th>Never or ex-smoker</th>
<th>1 - 14 g/d</th>
<th>&gt;15 g/d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample size</td>
<td>FEV₁ (ml/s)</td>
<td>Sample size</td>
</tr>
<tr>
<td>35 - 39 yrs</td>
<td>177</td>
<td>2.96</td>
<td>172</td>
</tr>
<tr>
<td>40 - 49 yrs</td>
<td>159</td>
<td>2.74</td>
<td>172</td>
</tr>
<tr>
<td>50 - 59 yrs</td>
<td>72</td>
<td>2.63</td>
<td>50</td>
</tr>
</tbody>
</table>
also supports the view that valid answers were obtained (Table IV).

Table II indicates that Black industrial workers, White industrial workers and White control subjects residing at Carletonville have a moderate prevalence of prolonged symptoms, which are related to tobacco consumption. The differences between Black and White industrial workers in the 1-14 g and 15-24 g groups are in fact not statistically significant. This is particularly important, since these two groups were examined by the same medical field staff under comparable conditions.

The question arises why there is such a low prevalence of symptoms in the Black miners and the Black control group. Two well-educated Black women who both had extensive experience in administering questionnaires to Black populations were employed to carry out that particular survey. It is therefore not likely that the large differences between the prevalence of symptoms in both Black miners and controls and those found in other surveys can be attributed purely to observer variation. Other differences were therefore looked for.

Ninety per cent of both the Black miners and the Black controls had lived in rural areas until the age of 15, while 25% of the Black industrial workers had lived purely in urban areas. However, no consistent differences in the prevalence of prolonged symptoms was found between the rural and urban groups for any smoking category.

A very significant factor may relate to the mode of smoking. Table V shows that the majority of the Black miners and nearly half the Black controls were pipe smokers. The prevalence of respiratory symptoms has been found to be far lower in this group, 7 who usually inhale very little or not at all (unless they have previously been cigarette smokers, which is not likely to have been the case in these Black populations).

The finding of such a low prevalence of prolonged respiratory symptoms in a Black population is not unique. In a respiratory symptom survey on Rhodesian Blacks living in a small town Cookson and Mataka 8 also found a low prevalence of symptoms. In that survey only 1.2% of males over the age of 20 experienced persistent cough with sputum, which agrees with Paul's 9 findings of persistent cough and sputum in 0.1% of 3500 Black Zambian copper miners and none of 1815 Black non-miners.

The fact that the prevalence of symptoms in Black industrial workers is almost as high as in White industrial workers is probably largely due to the fact that they are predominantly cigarette smokers (Table V). In addition, they live in industrialized urban areas and may be exposed to more air pollution than Black miners, who generally work in unpolluted areas away from the big cities.

As striking as the low prevalence of respiratory symptoms in Black miners is the high prevalence in White miners for each smoking category. The prevalence of symptoms in Black miners and White non-smokers is also significantly more frequent than in Black miners. Ninety per cent of both the Black miners and the Black controls had lived purely in urban areas (Table II), as has occurred in the case of Black industrial workers. As Black miners increasingly take to cigarette smoking their respiratory symptoms and lung function loss will approach those of White miners, as has occurred in the case of Black industrial workers.

Professor Ian Webster is thanked for giving permission to publish data from the reports on industrial surveys cited.

REFERENCES