A CASE CONTROL STUDY OF PNEUMOCONIOTIC COAL MINERS IN BRAZIL*

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INTRODUCTION

Coalworkers' pneumoconiosis (CWP) has been known for approximately 150 years. It is one of the respiratory diseases which coal miners are at risk. It is generally accepted that the development of pneumoconiosis depends on a number of variables such as the amount of inhaled dust, the dust composition, the number of years of exposure, the residence time of dust in the lungs and the individual susceptibilities. Except this latter, the other factors are quantifiable, and to date there are reliable studies on the probability of acquiring CWP.[6]

In Brazil, it is known that dust exposure conditions in underground coal mines are critical. Moreover, the dust composition differs from that of the countries where classical studies on CWP were carried out. Brazilian coal has plenty of ashes. Only approximately 60-70% of the mined material is coal. Quartz concentrations are high, often above 10%,[8] making us assume that CWP in Brazil is distinct from classic CWP. The high quartz content makes dose-response relations (dose = quantity of dust retained in the lungs; response = pneumoconiosis) to be not so strong since the pathogeny of classic CWP and silicosis is different.

With the purpose of identifying discriminant variables between pneumoconiotic and non-pneumoconiotic miners a case control study was carried out with the coal miners—studied in the Projeto Mineração, 1984 (Mining Project—Brazil).

METHODS

A random sample of about 50% of the underground miners in six mines (manual, semimechanized and mechanized) was selected. The chosen miners were engaged in different underground jobs. Out of the 956 miners investigated, 816 had their radiographs read independently by three experienced readers in the ILO Radiological Classification of pneumoconiosis.[5]

One hundred and eight (108) radiographs were considered to be inadequate for reading. From the 708 analysed radiographs, 40 cases of pneumoconiosis (Profusion 1/0 or above) were found, and 80 cases of suspicious radiographs were detected (Profusion 0/1). For analysis the cases were divided in two groups:

Group 1: Single job underground miners (pure exposure)
- 1A) Profusion 1/0 or above (cases: 12; controls: 33).
- 1B) Profusion 0/1 or above (cases: 37; controls: 102).

Group 2: Multiple-job underground miners
- 2A) Profusion 1/0 or above (cases: 32; controls: 91).
- 2B) Profusion 0/1 or above (cases: 80; controls: 227).

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These cases were matched in the ratio of 1:3 or 1:2 based in the following parameters:

1. Years worked underground ± 1
2. Age ± 2
3. Control subjects with profusion 0/0
4. Non-repetitive control subjects
5. Control subjects working in the same mine.

Additionally, for groups 1A and 1B, we selected control subjects performing the same job groups, i.e. supervision, face and maintenance.

These matching criteria excluded 20% to 30% of the cases, due to the lack of controls or only one control.

The analysed variables were cough, phlegm, breathlessness, recent acute respiratory episodes (RARE), FEV_1, FVC and FEV_1/FVC. Cough and/or phlegm were considered positive, when present for more than 3 months. Breathlessness was considered positive, if related to great efforts.

The respiratory functional parameters were calculated by using a dry spirometer (Vitalograph, Vitalograph Limited, Buckingham, UK) and transformed into BTPS. Other data were obtained through a questionnaire on respiratory symptoms, adapted from the questionnaire on Chronic Bronchitis (MRC, UK, 1976).

For calculating the differences concerning cough, phlegm, breathlessness and RARE, we used chi-squared tests from contingency tables 2 × 2. For FEV_1, FVC, FEV_1/FVC and pack years, we analysed the difference between the means through the Student "t" value. With both tests we rejected the null hypothesis at the 5% level.

RESULTS

The results are shown in Tables I and II. The mean of pack years of the four subgroups of cases and controls did not differ significantly. In subgroup 1A, only FEV_1 was significantly lower in the cases. In subgroup 2A the FVC was significantly lower in the cases and the occurrence of RARE was more frequent in the cases.

The inclusion of miners having radiographs 0/1 or above as cases (subgroups 1B and 2B) made all the differences among the variables of cases and controls non-significant.

Table I
X^2 Values of Contingency Table of Cases and Controls with Cough, Phlegm, Breathlessness and Recent Acute Respiratory Episodes (RARE)

SUBGROUP	COUGH	PHLEGM	BREATHLESSNESS	RARE
1A	0.02	1.02	1.70	0.50
1B	0.15	0.15	0.01	1.02
2A	0.09	0.69	3.74	4.68*
2B	1.07	1.07	0.47	3.30

* $p \leq 0.05$

Table II
Means and Standard Deviations of Lung Function Parameters +

SUBGROUP		FEV_1	FVC	FEV/FVC
1A	Ca	3.33 ± 0.28] *	4.21 ± 0.66	0.80 ± 0.12
	Co	3.62 ± 0.57]	4.63 ± 0.79	0.79 ± 0.11
1B	Ca	3.69 ± 0.73	4.70 ± 0.78	0.79 ± 0.12
	Co	3.71 ± 0.67	4.67 ± 0.78	0.79 ± 0.11
2A	Ca	3.44 ± 0.59	4.19 ± 0.71] *	0.82 ± 0.11
	Co	3.72 ± 0.62	4.62 ± 0.67]	0.80 ± 0.11
2B	Ca	3.66 ± 0.71	4.59 ± 0.73	0.80 ± 0.11
	Co	3.74 ± 0.66	4.69 ± 0.75	0.81 ± 0.09

* $p \leq 0.05$

+ The number of cases and controls are about 20% less than Table I because of rejected spyrometries.

Ca = Cases

Co = Controls

DISCUSSION

The studied variables were somewhat discriminating as to differentiate pneumoconiotic from non-pneumoconiotic miners. The findings in the group of pure miners (FEV_1) did not repeat in the multiple job undergroup miners, who in their turn presented FVC and the occurrence of RARE different from that of the control. As approximately 20% of the lung function tests in the original group of 956 miners have been rejected,[1] this may have contributed to the inconsistency of the differences found in the FEV_1 and FVC of subgroups 1A and 2A, as miners with rejected tests (188/956), showed a significantly higher mean of years of exposure than those with accepted tests ($p < 0.01$). The presence of breathlessness was nearly significant in subgroup 2A. Breathlessness, together with the number of years of exposure, FEV_1/FVC, and FEV_1, were the variables most closely associated with pneumoconiosis, when subgroup 2A was analysed through a probit regression analysis.[1]

When the suspected subjects (profusion 0/1) were included as cases there was no difference between cases and controls in both groups. This is an indirect indication that they were probably classified correctly as category 0.

Respiratory symptoms are related to both dust exposure and cigarette smoking.[7] The average pack years of the analyzed groups did not differ between cases and control subjects, and the effect of dust exposure was also controlled. The low capacity of discrimination presented by the variables cough and phlegm reinforces that pneumoconiosis is independent of the effects of dust on the bronchial tree.[4]

Autopsy studies on coal miners showed that pneumoconiosis did not correlate with hypertrophy of the bronchial glands, which was related to both cigarette smoking and dust exposure.[2]

Although case control studies are often inappropriate for conclusive analyses of the cause-effect relationships,[3] especially when we are studying high prevalence diseases, these findings concerning pneumoconiosis and respiratory symptoms are in accordance with classic studies on respiratory disease in coal miners.

This group of miners will be followed up in 1989.

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