

exposure are now eligible for benefits for impaired lung function. In Lapp and colleagues' study the important question, unanswerable from their design, is how many of those with airflow obstruction would not have had this impairment had they not been exposed to coal dust. It is this difficult decision that, in law, is made on the balance of probabilities and where it is necessary to argue from the results of epidemiological studies to the particular cases of sick people.

It is to be noted that 50%, at least, of Lapp and colleagues' subjects were referred to them by employers' representatives. It would be unfortunate if their paper were to mislead these people into thinking that it shows anything other than that coalminers who claim benefits usually smoke.

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- 1 Lapp NL, Morgan WKC, Zaldivar G. Airways obstruction, coalmining, and disability. *Occup Environ Med* 1994;51:234-8.
- 2 Seaton A. Coalmining, emphysema, and compensation [editorial]. *Br J Ind Med* 1990; 47:433-5.
- 3 Leigh J, Driscoll TR, Cole BD, et al. Quantitative relation between emphysema and lung mineral content in coal workers. *Occup Environ Med* 1994;51:400-8.

Author's reply

With reference to Greenberg's comments concerning the International Labour Organisation (ILO) classification of chest radiographs for pneumoconiosis, the classification's usefulness in epidemiological studies of coal workers' pneumoconiosis depends on the direct relation between the coal content of the lung and the radiological category. A major concern of epidemiologists is the number of false positives and negatives that occur with the use of diagnostic tests. Based on the number of false positives and negatives it is possible to calculate the test's predictive value; this being the best index of its usefulness. There is little point in quantifying opacities when they are not related to the inhalation of coal dust! The handbook that accompanies the standard ILO films states "If it is at all probable that all the appearances seen are the result of some other aetiology (ie not dust related) do not classify, but record opinion using appropriate symbols and comments".¹

Greenberg comments on the need for a series of independent readings for epidemiological studies. Many of the readers in our most recent study have been involved in epidemiological studies of coal workers' pneumoconiosis (CWP) and other pneumoconioses, some of which were jointly carried out with the National Coal Board (now British Coal). One of us has participated in studies with the originator of the elaboration of the ILO classification, FDK Liddell. We are therefore well aware of his thoughts on the application of the ILO classification in epidemiological investigations. Moreover, Greenberg should be aware of a series of papers published some years ago by our colleague Reger and his coworkers, which examined epidemiological problems encountered in the interpretation of chest x ray films and appropriate methods for read-

ing progression of the chest x ray films in diseases related to dust.

We were also asked why we ignore certain readers positive interpretations. This is because they differ so consistently and so greatly from the readings of the United States Public Health Service panel of readers. It is difficult not to conclude that their opinion is influenced by whom they were retained.

Greenberg might also consider furthering his crusade against the inappropriate use of the ILO classification by calling Peter Lilley's attention to the fact that the Department of Social Security is going to rely on the radiographic presence of CWP in making awards to British coal miners with airways obstruction.²

Turning now to the proposition that coal mining in the United States entails vigorous physical effort and that most new miners have "pluperfect" lung function, Greenberg is 50 or more years out of date. Nowadays young women are employed at the coal face in certain mines in the United States. Over 20 years ago, Bill Roemmich, estimated the work demands in various jobs in coal mines in the United States.³ His data from working coal miners indicated that 25.8% of them managed to work with a functional residual capacity equal to or less than an oxygen consumption of 1.75 l of O₂/min. This in itself indicates that most jobs in the coal mines of the United States are by no means arduous, at least not since the mines have been mechanised, an event that took place in the 40s and 50s. Similar studies have been carried out by Harber *et al* that indicate how most miners, despite significant impairment, manage to do their jobs without serious problems.⁴ Although disablement depends to some extent on loss of lung function, it is also influenced by the age, sex, and the height of the worker. Thus a 5 ft slender woman of 40 years with normal lung function could not be expected to carry a hundredweight of coal on her back, a 6 ft man aged 26 who has had a lobectomy with the loss of 30% of lung function should be able to manage this without much trouble. The ability to perform a certain task is not related to a specific divergence of lung function from the predicted value, but to the residual lung function that remains.

Greenberg suggests that "we should not be sanguine in the presence of simple CWP". The diagnosis of CWP and the subsequent mortality analysis in the study he quotes were based on the interpretation of the earliest x ray films.⁵ Many men in the study continued to work for a further 15 to 25 years. What was read as category 1/2 in 1956 became category 3/2 stage B by 1978.

In reply to Seaton, we accept that emphysema is found more frequently in coal miners with pneumoconiosis than it is in the general population, but it hardly seems necessary to cite recent work from Australia when this point was made 30 to 40 years ago by Gough⁶ and also in the first edition of a text of which Seaton was a coeditor.⁷ What is at issue is whether the type of emphysema found in non-smoking miners is associated with airways obstruction. The question of how frequently emphysema occurs in non-smoking miners is put in perspective in an Institute of Occupational Medicine monograph that was published during the time Seaton was the Institute's Director.⁸ The text reads,

"This suggests that nonsmokers with the highest life time exposure in British collieries have a lower risk of developing centriacinar emphysema than a smoker with minimal dust exposure". We subscribe to the view, as it seems does Ruckley and coworkers,⁹ that coal miners have slightly more airways obstruction than does a comparable control group, but we maintain that disabling airways obstruction in non-smoking coal miners is exceedingly uncommon and can seldom, if ever, be attributed to dust alone in the absence of progressive massive fibrosis.

Seaton poses the question, "How many of those with airflow obstruction would not have been obstructed had they not been exposed to coal dust?" Had he posed the question slightly differently and asked how many would *have had* disabling obstruction had they not smoked?, the answer would have been none that we could identify. Thus of the 9076 miners included in the first round of the national coal study who were over 50 years of age, 20% of coal miners met the Department of Labor's (DOL) disability criteria whereas 25.3% of a similar non-mining population qualified.¹⁰

Seaton states that at least 50% (we wrote in "around 50%") of the claimants are referred to us by employers' representatives and although this is true it needs to be pointed out that over 90% of the claimants had previously been referred for disability evaluation to a DOL approved facility at one or other of the several medical schools in Appalachia. Referral was not predicated on the fact that they were smokers. If airways obstruction is as common in British coal miners as Seaton implies, perhaps this is related to the fact that only 13.2% of the population of the Pneumoconiosis Field Research Coal Board Study were lifelong non-smokers,¹¹ whereas 20% of the United States National coal study of miners were lifelong non-smokers.¹¹

- 1 *Guidelines for the use of the ILO international classification of radiographs of pneumoconiosis. Revised edition.* Geneva: ILO, 1980. (Occupational safety and health series. No 22 (Rev 80).)
- 2 New industrial injuries [headlines]. *BMJ* 1993;307:464.
- 3 Roemmich W, Blumenfeld HL, Moritz H. Evaluating remaining capacity to work in miner applicants with simple pneumoconiosis under 65 years of age under Title IV of Public Law 91-173. *Ann NY Acad Sci* 1972;200:608-16.
- 4 Harber P, Tamimie J, Emory JS. Estimation of exertion requirements in coal mining work. *Chest* 1984;85:226-31.
- 5 Miller RG, Jacobsen M. Dust exposure, pneumoconioses, and coal miners' mortality. *Br J Ind Med* 1985;94:723-33.
- 6 Gough J. The pathogenesis of emphysema. In: Liebow A, Smith DT, eds. *The lung*. Baltimore: Williams and Wilkins, 1968: 109-33.
- 7 Morgan WKC. In: Morgan WKC, Seaton A, eds. *Occupational lung diseases*. Philadelphia: Saunders WB, 1975:149-215.
- 8 Ruckley VA, Fernie JM, Campbell SJ, Cowie HA. *Causes of disability in coal miners: a clinico-pathological study of emphysema, airways obstruction and massive fibrosis*. Edinburgh: Institute of Occupational Medicine, 1984. (Report No TM/89/051).
- 9 Morgan WKC, Reger RB, Handlesman L. Black lung benefits. *JAMA* 1973;30:217-26.
- 10 Rogan JM, Attfield MD, Jacobsen M, Rae S, Walker DD, Walton WM. Role of dust in the working environment of chronic bronchitis in British coal miners. *Br J Ind Med* 1973;30:217-26.
- 11 Kibelstis JA, Morgan EJ, Reger RB, Lapp NL, Seaton A, Morgan WKC. Prevalence of bronchitis and airway obstruction in American bituminous coal miners. *Am Rev Respir Dis* 1973;108:886-93.