THE PREVALENCE OF COAL WORKERS' PNEUMOCONIOSIS

by

Earle P. Shoub[1]

INTRODUCTION

This discussion will describe two current studies of the prevalence of coal workers' pneumoconiosis among working coal miners at underground mines in the United States. In both cases, the chest X-ray is the instrument for determining and categorizing the disease. Because the two studies differ materially in the composition of the sample, in the procedures for obtaining a final interpretation of the X-ray, and in the quality of the films, it is not surprising that there are some differences in the results. More important is that these differences are sufficient to make it highly inadvisable to consider merging the results in their present form.

A historical background for both studies is to be found in the work of Lainhart and others (2-3)[2] of the Public Health Service carried out from 1963 to 1965. At that time, the ILO (1958) system for classifying pneumoconiosis was generally accepted as the appropriate means of categorizing the disease. There were two features to this system which have a bearing on any effort to compare these results with subsequent studies. First, there was a "Z" or suspect category. Second, the "1" or irregular opacities were not to be considered in evaluating the profusion of disease. In more recently adopted systems for classifying pneumoconiosis, the suspect category has been eliminated and irregular opacities are included in the evaluation of profusion.

Another difference which may have a bearing was in the method of selecting the sample. For the 1963-65 studies, a roster of the working coal miners at Union mines was obtained and a random sample selected from it. Participation, although voluntary, was well over 90 percent.

Overall, at that time (table 1) it was reported that 85.5 percent were negative, 6.1 percent suspect, and 8.3 percent had definite disease. Subsequently, a reexamination of a sample of the X-rays in the suspect category indicated that about one-half were negative. This seems to mean that between 11 and 11-1/2 percent of the men examined had coal workers' pneumoconiosis to some degree.

The Bureau of Mines was aware of and provided some assistance to the Public Health Service in carrying out this prevalence study. Also, while it was going on, the Bureau of Mines, in 1965, assessed the methods of dust measurement and the exposure standards in many countries (5). It was

---

[1] Deputy director, Appalachian Laboratory for Occupational Respiratory Diseases, Morgantown, W. Va.

[2] Underlined numbers in parentheses refer to items in the list of references at the end of this paper.

concluded at that time that gravimetric sampling was desirable with portable devices which would measure the fraction of the airborne particles accepted as significant by the 1959 Johannesburg Pneumoconiosis Conference (5). Also, in April 1968, a study was initiated to evaluate the dust exposure of miners in various categories of work in underground coal mines employing various mining methods. In all, 29 mines (1) were studied in depth. Dust levels were frequently found to be in excess of 3 milligrams of respirable dust per cubic meter of air especially among face workers.

TABLE 1. - 1963-65 study, bituminous mines only

Area	Number in selected sample	Percent participation	Category, percent			
			0	Suspect Z	Simple 1,2,3	Complicated
Appalachia	2,751	92.7	84.9	5.3	6.8	3.0
Illinois-Indiana	520	91.7	78.5	15.4	4.6	1.5
Utah	591	97.5	94.3	1.9	3.1	0.7
Total	3,862	93.5	85.5	6.1	5.9	2.4

The 29 mines were chosen by the Bureau of Mines after consultation with the Public Health Service, whose Bureau of Occupational Safety and Health (now the National Institute for Occupational Safety and Health) was planning a new prevalence study at as many of the same selected mines as would meet its criteria. This National Study of Coal Workers' Pneumoconiosis would, for the first time, have available to it, gravimetric dust measurements for comparison with the occurrence of disease and, more important, would be the basis for a continuing study in the same mines of the progression of pneumoconiosis in the miners in terms of elapsed time and dust exposures.

NATIONAL STUDY OF COAL WORKERS' PNEUMOCONIOSIS

The National Study of Coal Workers' Pneumoconiosis was begun in August 1969, more than 4 months before the Federal Coal Mine Health and Safety Act of 1969 became law. Thirty-one underground coal mines, including two anthracite mines, in 10 States were selected. About 20 of the mines in this study were among the 29 mines at which dust measurements were made by the Bureau of Mines. The lack of congruence was due to some mines having been closed or expecting to be closed, a desire to include mines in a few additional States, and a desire to concentrate on larger mines (over 100 employees).

The examinations, in this case, included chest X-rays (two views), simple breathing tests, and a detailed medical and occupational history. The X-rays were to be classified by the newly developed 1968 UICC-Cincinnati Classification system by each of three nationally recognized physicians. This system, it will be recalled, includes both regular and irregular opacities when estimating profusion of disease on a 12-point scale. This scale is depicted in table 2 in an abbreviated fashion. The interpretation relied upon, in each case, was based on agreement between at least two of the physicians. In a small percentage of the cases, a fourth interpretation was necessary to secure agreement between two readers of a film.

TABLE 2. - UICC-Cincinnati Classification system

Profusion	Categories			
Major.....	0	1	2	3
Minor.....	0/-, 0/0, 0/1	1/0, 1/1, 1/2	2/1, 2/2, 2/3	3/2, 3/3, 3/4

Fortunately, the protocol for the National Study of Coal Workers' Pneumoconiosis included all the details of the examinations authorized when the Federal Coal Mine Health and Safety Act of 1969 was enacted. The operators of the 31 mines were told that, as long as they made provisions for examining new miners employed after participating in the National Study of Coal Workers' Pneumoconiosis, it was not necessary for them to repeat the examinations under the regulations issued in accordance with the Act. As a result, the data collected in this study does not overlap similar data from another current study described later in this seminar.

It was recognized at the outset that part of the reliability of this study rested on securing a large voluntary participation by the miners. It was determined that an overall participation of 80 to 85 percent would be essential for reliable statistics. Table 3 shows the distribution of the mines and the degree of participation. It is gratifying to see that the total participation amounted to over 90 percent.

TABLE 3. - Distribution of mines and degree of participation
National Study of Coal Workers' Pneumoconiosis

State	Number of mines	Number of employees	Number of men examined	Percent participation
Pennsylvania, anthracite.....	2	608	523	86.0
Pennsylvania, bituminous.....	6	1,517	1,461	96.3
West Virginia.....	9	3,000	2,565	85.5
Virginia.....	2	613	560	91.4
Kentucky.....	3	1,035	959	92.7
Alabama.....	2	799	777	97.2
Indiana.....	1	297	274	92.3
Ohio.....	1	474	450	94.9
Illinois.....	2	671	524	78.1
Colorado.....	1	219	219	100.0
Utah.....	2	799	764	95.6
Total.....	31	10,032	9,076	90.5

The high rate of voluntary participation was the direct result of a concerted effort on the parts of the Public Health Service, the operators, and the United Mine Workers of America (UMWA). Numerous separate and combined meetings were held with mine officials, District and Local UMWA officers, and the men to be examined.

Final results (that is consensus readings), are now available for the 31 mines. Table 4 shows the prevalence of the disease by States found in the National Study of Coal Workers' Pneumoconiosis.

TABLE 4. - Prevalence of coal workers' pneumoconiosis, National Study of Coal Workers' Pneumoconiosis

State	Category of pneumoconiosis, percent				
	0	1	2	3	Complicated
Pennsylvania, anthracite	40.0	23.7	17.6	4.4	14.3
Pennsylvania, bituminous	53.1	31.8	11.7	1.1	2.3
West Virginia	72.0	19.8	5.3	0.4	2.5
Virginia	71.8	22.5	3.6	0.2	2.0
Kentucky	71.0	23.7	3.2	0.2	1.9
Alabama	83.3	12.7	2.7	0.1	1.2
Indiana	65.0	29.9	4.0	-0-	1.1
Ohio	68.2	24.9	5.8	0.4	0.7
Illinois	84.9	13.9	1.0	-0-	0.2
Colorado	95.4	4.6	-0-	-0-	-0-
Utah	88.7	10.3	0.3	-0-	0.7
Total bituminous	72.0	21.0	4.9	0.4	1.7
Total anthracite and bituminous	70.1	21.1	5.7	0.6	2.4

COAL MINE OPERATOR'S EXAMINATIONS

Section 203 of the Federal Coal Mine Health and Safety Act of 1969 and the regulations of August 19, 1970, issued under it require the operators of underground coal mines to make available to each miner in or at his mines an opportunity to have a chest X-ray at no cost to the miner. It is also provided that each new miner should be given a similar opportunity within 6 months of employment. Additional chest X-rays and other medical examinations specified by the Secretary of Health, Education, and Welfare are required at various intervals specified in the Act as determined by him. When, for any reason, a coal mine operator fails to provide an approvable plan for the examinations, the Act directs the Secretary to arrange for the examinations and to charge the operator the costs thereof.

The regulations required that each operator promptly submit a Coal Mine Operator's Plan for each of his underground mines which met the five following requirements:

1. The examinations be at no cost to the miners.

2. The place, time, and other arrangements for the examinations be convenient for the miners.

3. The results of the examination be kept confidential between each miner and the Government except as the miner might otherwise authorize.

4. The chest X-ray be made at a facility approved for the purpose by the Public Health Service. Facilities were approved if they submitted, as evidence of competence, six chest X-rays of good quality made in their office or clinic.

5. The chest X-ray be interpreted by an approved "A" reader and forwarded with the interpretation to the Receiving Center of the National Institute for Occupational Safety and Health in Morgantown, W. Va. The "A" readers could become approved either by attending one of several special 2-day courses of training or by submitting six chest X-rays of different degrees of pneumoconiosis which, in the opinion of a panel of experts, were properly classified by the applicant.

To provide for those instances in which operators failed to submit an acceptable plan, contracts were made with several organizations operating mobile X-ray units who met the same qualification requirements to take the X-rays for the Public Health Service.

The method of deciding upon the interpretation of the X-rays for pneumoconiosis in this study differs materially from the previously described one in that both the scheme and readers are different. There are about 800 "A" readers almost all of whom qualified by attending one of the 2-day courses. Each X-ray is first interpreted by one of the "A" readers and then the film and interpretation are sent to the Receiving Center. At this point, the film only is forwarded to one of the approximately 20 "B" readers selected on a rotating basis. The "B" readers are members of the Departments of Radiology at three major medical centers of the United States. If the "A" and "B" readers agree as to the major category of pneumoconiosis, the interpretation is accepted and final reports are prepared. On the other hand, when, as occurs in over one-quarter of the cases, these readers do not agree, the film is sent to a "C" reader whose opinion is final. The "C" readers are the department heads in radiology at the same three medical centers.

Not all of the films made by the end of the examining period (December 31, 1971) are completely interpreted. Some required retaking because of poor film quality, others were delayed before reaching the Receiving Center, and some are in transit to and from "C" readers.

All in all, there are about 64,000 films including retakes and duplicates. Some men have been examined more than once by their own choice. The number of miners involved is approximately 60,000. Final data are available on 56,731 men in 19 States as shown in table 5. In this table, there is incorporated an estimate of the category 0 cases represented by new miners and the cases in the same category from examining men who were in the industry when the Act was passed.

TABLE 5. - Prevalence of coal workers' pneumoconiosis coal mine operators' examinations

State	Coal workers' pneumoconiosis category, percent						
	Number final determinations	New miners 0	Other miners 0	1	2	3	Complicated
Pennsylvania, anthracite	984	-	67.8	18.1	7.7	0.7	5.7
Pennsylvania, bituminous	12,769	16.9	67.4	9.8	4.0	0.3	1.6
West Virginia	20,004	20.0	66.9	7.7	3.8	0.3	1.3
Virginia	4,466	16.3	74.1	6.1	2.2	0.3	1.0
Kentucky	10,185	13.8	77.1	6.8	1.6	0.2	0.5
Alabama	830	3.3	85.4	9.4	1.2	-0-	0.7
Tennessee	266	3.0	85.3	7.9	3.8	-0-	-0-
Maryland	39	10.3	71.8	15.4	2.6	-0-	-0-
Indiana	141	9.2	79.4	7.8	3.6	-0-	-0-
Ohio	2,029	39.3	54.9	4.1	1.2	0.1	0.5
Illinois	3,517	13.8	75.0	8.3	2.0	0.2	0.7
Colorado	722	19.0	76.6	2.8	1.1	0.1	0.4
Utah	593	2.2	89.9	5.7	1.2	-0-	0.8
Arkansas	27	-	77.8	18.5	-0-	-0-	3.7
Iowa	43	4.7	93.0	2.3	-0-	-0-	-0-
Montana	14	-	100.0	-0-	-0-	-0-	-0-
New Mexico	30	-	83.3	10.0	3.3	3.3	-0-
Oklahoma	20	25.0	70.0	5.0	-0-	-0-	-0-
Washington	19	-	100.0	-0-	-0-	-0-	-0-
Wyoming	33	15.2	78.8	3.0	3.0	-0-	-0-
Total bituminous	55,747	17.6	70.4	7.7	3.0	0.2	1.1
Total bituminous and anthracite	56,731	17.3	70.3	7.9	3.1	0.2	1.2

MINERS' RIGHTS UNDER THE ACT

Under the Federal Coal Mine Health and Safety Act and regulations, working coal miners with a sufficient amount of pneumoconiosis or impairment may exercise two rights which are to be called to the attention of each eligible miner by the Secretary of the Interior at the time he reports to the miner the findings with regard to coal workers' pneumoconiosis. One right is described in Title IV of the Act and in regulations issued by the Social Security Administration. It provided, during the period of the recent studies described herein, for the payment of Black Lung Benefits to any miner who applied if he (1) had X-ray evidence of complicated pneumoconiosis, or (2) had positive X-ray evidence of simple pneumoconiosis accompanied by sufficient respiratory impairment. The other right affords the miner, who has shown development of evidence of coal workers' pneumoconiosis, the option of transferring from his position to another position in the mine where the concentration of respirable dust in the mine atmosphere is not more than 2.0 milligrams of dust per cubic meter of air, without a reduction in his rate of pay, provided that the miner is not already working in such an atmosphere.

The Black Lung Benefits Act of 1970, Public Law 92-303, has liberalized the eligibility requirements for Black Lung Benefits. Also, the original Act provides that the 2.0 mg/m^3 limit shall be reduced to 1.0 mg/m^3 effective December 31, 1972. If, however, the 1.0-mg level is not attainable in the mine, the Act permits assigning a miner who has decided to exercise this right to work in a place in the mine where the concentration of respirable dust is the lowest attainable below 2.0 mg/m^3.

In his regulations, the Secretary of Health, Education, and Welfare has defined the points at which coal miners show sufficient evidence of pneumoconiosis to be eligible to exercise the transfer option, as follows:

1. Any miner who shows X-ray evidence of category 2 or 3 simple pneumoconiosis or complicated pneumoconiosis, or

2. any miner who shows X-ray evidence of category 1 simple pneumoconiosis in less than 10 years in coal mining.

There has been a great deal of interest shown in the matter of the number of miners eligible to utilize this option to transfer and how many have decided to take advantage of it. Table 6 presents the current statistics of miners eligible because of X-ray findings. This table does not indicate how many are already working in an atmosphere containing no more than 2.0 milligrams of respirable dust per cubic meter of air.

TABLE 6. - Number of miners eligible for transfer because of X-ray findings

Category of coal workers' pneumoconiosis	National study of coal workers' pneumoconiosis		Coal mine operators' examinations		Total	
	Number of men	Percent of men examined	Number of men	Percent of men examined	Number of men	Percent of men examined
1 in less than 10 years.	183	2.0	495	0.9	678	1.0
2 [illegible].	514	5.7	1,745	3.1	2,259	3.4
3 [illegible].	57	0.6	133	0.2	190	0.3
Complicated.....	219	2.4	668	1.2	887	1.3
Total.....	973	10.7	3,041	5.4	4,014	6.0

Miners who decide to request transfer apply directly to the Bureau of Mines. The Bureau notifies the operator to make the transfer unless the miner is already employed in an atmosphere where the respirable dust level is not in excess of 2.0 milligrams per cubic meter of air. A total of 567 applications from working miners have, so far, been approved. This amounts to less than 1 percent of the 65,807 men reported on herein and slightly over 14 percent of the 4,014 men in the same group who are eligible because of the X-ray findings.

FUTURE PLANS

We are presently in the process of comparing the data assembled in the National Study of Coal Workers' Pneumoconiosis with the dust levels which existed during the working life of the same miners prior to the X-ray examinations. The same data will be related to the miners' age and years in mining.

The Act requires that the miners again be offered an opportunity to have a medical examination, including a chest X-ray, 3 years after the first opportunity. For the mines included in the National Study of Coal Workers' Pneumoconiosis, the second round is, therefore, just starting. The bulk of the miners who should come under Coal Mine Operators' Plans are expected to have their examinations beginning in calendar year 1973. In addition to reporting on their health to the miners and their physicians and to assembling prevalence data, similar to that included above, the second round of examinations in the National Study of Coal Workers' Pneumoconiosis will offer an opportunity to evaluate for each man the change in X-ray appearance over the period between examinations and to compare the results with his exposure to respirable dust during the same period. To provide a sufficient cohort for future examinations, the number of mines in this study is being increased to 39 or 40.

The examinations by the operators are expected to be modified slightly to provide information on the miners' occupational and medical history, as well as pertinent symptoms. It is also anticipated that there will be some simple breathing tests included.

REFERENCES

1. Doyle, H. N. Dust Concentration in the Mines. In Proceedings of the Symposium on Respirable Coal Mine Dust, Washington, D.C., Nov. 3-4, 1969. BuMines Inf. Circ. 8458, 1970, pp. 27-33.

2. Lainhart, W. S., and others. Pneumoconiosis in Appalachian Bituminous Coal Miners. Public Health Service Publication No. 2000, 1969, pp. 31-60.

3. Lainhart, W. S. Roentgenographic Evidence of Chronic Respiratory Diseases Among American Coal Miners in Three Geographic Regions. J. Occupational Medicine, v. 11, No. 8, 1969, pp. 1-16.

4. Orenstein, A. J. (ed. by). Proceedings of the Pneumoconiosis Conference held at the University of Witwatersrand, Johannesburg, Feb. 9-24, 1959, Little, Brown and Co., Boston, Mass., 1959, pp. 1-16.

5. Shoub, E. P. Dust Standards and Measurements. Trans. 53rd National Safety Congress (Coal Mining Session) Presented Oct. 26, 1965, Chicago, Ill., National Safety Council, v. 7, 1965, pp. 619-620.

Information Circular 8568

Coal Mine Health Seminar

A Joint Staff Conference of the Bureau of Mines and the National Institute for Occupational Safety and Health

Compiled by Marilyn K. Hutchison, M.D.

UNITED STATES DEPARTMENT OF THE INTERIOR
Rogers C. B. Morton, Secretary

BUREAU OF MINES
Elburt F. Osborn, Director

This publication has been cataloged as follows:

U.S. Bureau of Mines

Coal Mine Health Seminar: A Joint Staff Conference of the Bureau of Mines and the National Institute for Occupational Safety and Health [Sept. 6, 1972. Washington] U.S. Dept. of the Interior, Bureau of Mines [1972]

44 p. illus., tables. (U.S. Bureau of Mines. Information circular 8568)

1. Coal mines and mining–Safety measures. 2. Coal mines and mining–Congresses. I. U.S. National Institute for Occupational Safety and Health. II. Title. (Series)

TN23.U71 no. 8568 622.06173

U.S. Dept. of the Int. Library