THE NATIONAL COAL WORKERS' AUTOPSY STUDY

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The National Coal Workers' Autopsy Study (NCWAS) and Disaster Plan was initiated under section 203(D) of the Federal Coal Mine Health and Safety Act of 1969 and is now conducted under the amendment to the 1969 Act, known as The Federal Mine Safety and Health Act of 1977. The purpose of the program is threefold: 1) to provide evidence for Black Lung claims; 2) to conduct research into the epidemiology and pathogenesis of coal workers pneumoconiosis (CWP); and 3) to provide forensic assistance to the Mine Safety and Health Administration (MSHA) in the event of a mine disaster. The program is voluntary and is restricted to former underground coal workers. Since its implementation in 1971, through 1980, approximately 3600 autopsies have been included from 27 states. The average age of the NCWAS population is 62 $\pm$ 12 years (SD) with an average work period of 26 $\pm$ 14 (SD) years underground. All are male, 94% of whom are white; 74% had smoked cigarettes at some time, with an average pack year consumption of 24 $\pm$ 20 (SD). Table I shows the distribution of autopsies by state. The majority of submissions were received from the Appalachian coal states of Pennsylvania, West Virginia, and Kentucky.

TABLE I

NCWAS SUBMISSIONS BY STATE 1971 - 1980*

STATE	NUMBER	PERCENT
Pennsylvania	1460	46
West Virginia	948	30
Kentucky	214	7
Virginia	159	5
Ohio	114	4
Illinois	95	3
Wyoming	45	1
Colorado	42	1

*Only states with 1% or more of the total submission are included.

Of the total population 46% had been primarily employed at the coal mine face and only 10% had been largely employed in surface work. The NCWAS population is probably representative of all underground miners as it is similar with regard to geographic distribution, smoking status, and mining job category to active miners in the NIOSH National Coal Workers' Study. The relative frequencies of major causes of death are shown in Table II. These are similar to those observed in the general United States male population except in regard to pneumoconiosis and accidental death which are increased in the miners.

TABLE II

RELATIVE FREQUENCIES OF MAJOR CAUSES OF DEATH IN NCWAS, 1971 - 1980

		PERCENT
Diseases of Circulatory System (all)		48
Ischemic Heart Disease	38	
Aortic Aneurysm	1	
Cerebrovascular Disease	4	
Rheumatic Heart Disease	1	
Pulmonary Embolus/Infarction	2	
Malignant Neoplasms (all)		19
Lung Cancer	8	
Large Bowel	2	
Lymphatic and Leukemia	2	
Pancreas	1	
Prostate	1	
Stomach	1	
Diseases of Respiratory System (all)		8
Pneumoconiosis	4	
Chronic Bronchitis/Emphysema	2	
Respiratory Infections	2	
Cirrhosis of Liver		2
External Causes of Injury (all)		7
Transportation Accidents	1	
Suicide	1	
Homicide	0.5	
Mine Accidents	3	
All Other Causes		16

Between 1971 and 1983, 15 mine disasters occurred. The sites of the disasters, number of miners killed, and type of accident are given in Table III. Autopsies were performed on 73 of the victims. The majority of the deaths resulted from burns and carbon monoxide poisoning sustained in methane explosions. Fatalities also resulted from fire, flooding, roof falls and black damp. In addition to providing evidence of cause of death the forensic investigation also provides information on the cause of the accident through the

TABLE III

Name & Place of Accident	Date	Number Killed	Autopsied	Type of Accident
Farmington #9 Carmichael, Pennsylvania	03/26/71	2	2	Fire. Bodies recovered 1 1/2 years later
Blacksville #1 Mine Blacksville, West Virginia	07/22/72	9	7	Explosion
Itmann #3 Coal Mine Beckley, West Virginia	12/16/72	5	1	Explosion
Scotia Coal Mine Oven Fork, Kentucky	03/09/76 03/11/76	15 8	9	Explosion. Bodies recovered 8 months later
Porter Tunnel Mine Tower City, Pennsylvania	03/01/77	9	2	Flooding
P & P Coal Co. St. Charles, Virginia	07/07/77	4	4	Explosion
Clinchfield Coal #3 Dante, Virginia	04/03/78	5	2	Asphyxiation from Black Damp
Beatrice Mine, Keen Mountain Grundy, Virginia	04/13/78	3	3	Roof Fall
Ferrell #17 Mine Clothier, West Virginia	11/07/80	5	5	Explosion
Dutch Creek #1 Mine Redstone, Colorado	04/15/81	15	15	Explosion
Stillhouse #1 Mine Bergoo, West Virginia	12/04/81	3	2	Roof Fall
Adkins #11 Coal Mine Kite, Kentucky	12/07/81	8	8	Explosion
Grundy #21 Coal Mine Jasper, Tennessee	12/08/81	13	0	Explosion
R.F.H. #1 Coal Mine Craynor, Floyd Co., KY.	01/20/82	7	7	Explosion
Clinchfield #3 Mine McClure, Virginia	06/21/83	7	6	Explosion

study of factors such as injury kinetics, toxicology, pre-existing natural disease processes and blood methane levels. The forensic scientist can further provide MSHA officials information on survival times and the efficacy of self rescue equipment.

Sections of lung tissue were reviewed in a 12% sample of all cases received (disaster and routine) in order to obtain an estimate of the prevalence of CWP. The lesions of simple CWP were categorized according to the criteria developed by the Pneumoconiosis Committee of the College of American Pathologists in conjunction with NIOSH (1). Fibrotic pigmented lesions measuring greater than 1 cm in diameter were classified as progressive massive fibrosis (PMF). The overall prevalence of coal workers' pneumoconiosis (all types) in the sample population was 64%. The severity of the pneumoconiosis was judged severe in 17%, moderate in 23% and mild in 60%. The overall prevalence of PMF in the sample was 6%. Lesions of classical silicosis, often in conjunction with the lesions of simple CWP, were seen in 12% of the sample. The prevalences of other, non-malignant, lung diseases are shown in Table IV.

TABLE IV

PREVALENCE OF PULMONARY DISEASE IN 12% SAMPLE OF NCWAS

DISEASE	PERCENT
Emphysema	49.7
Pneumonia	16.4
Interstitial Fibrosis	15.9
Chronic Bronchitis	8.9
Infarct	6.5
Granulomas	2.4

The NCWAS population was studied to determine whether coal mine dust exposure increases the risk of lung cancer. Full details of case selection, tumor typing and data analysis can be obtained in Reference 2.(2) 9.9% (331) of the miners in the program had lung cancer. No relationship was found between mining tenure and the risk of lung cancer. The pathological features of lung cancer in the coal workers were similar to those reported in male cigarette smokers in the general population. An expected strong relationship between risk of lung cancer and smoking status and pack years of smoking was demonstrated in the coal miners.

DISCUSSION

The NCWAS is a unique autopsy program in that participation is voluntary. It therefore does not suffer from a bias seen in autopsy programs in other countries (e.g. the United Kingdom) where inclusion is limited to cases receiving compensation (3). Moreover, our findings indicate no major shifts in trends of reporting ancillary data. The results of the autopsy are confidential; unless release is approved by the next of kin. Requirements for submission to the program have been published (4) or can be obtained directly from the National Institute for Occupational Safety and Health, NCWAS, 944 Chestnut Ridge Road, Morgantown, WV 26505. An acceptable case includes a completed consent, release and history form, an autopsy report, and a minimum of three blocks and slides of lung tissue. A recent chest roentgenograph is an optional requirement. The case has to be submitted within 180 days of performing the autopsy. The federal government will reimburse the participating pathologist up to $200, with the certification that no payment has been made by the decedent's family or estate.

Analysis of the data through 1980 indicates that in this population the mortality from pneumoconiosis is relatively low (4%). Whilst mortality is low, the estimated prevalence (based on a 12% sample) of CWP is high (64%). This high prevalence in an older workforce ($\bar{x}$=62 yrs) with long work tenure ($\bar{x}$=26 yrs) is not unexpected as it largely reflects high exposures received before the introduction of the respirable coal dust standard of 3 mg/m^3 in 1970 with further reduction to $2mg/m^3$ in 1973. It is therefore likely that mortality and morbidity from CWP will decrease in future decades and the NCWAS program will serve a valuable role in monitoring these changes.

An important finding in this study is the relatively high estimated prevalence of silicosis. This indicates that United States miners have been receiving biologically significant concentrations of silica dust in the underground mining environment. Based on these findings NIOSH is initiating environmental, epidemiologic, and toxicologic studies into the effects of silica exposure in coal mines.

References

1. Kleinerman J, Green FHY, Laqueur W, Taylor T, Harley R, Pratt P, Wyatt J and Naeye R. Pathology Standards for Coal Workers' Pneumoconiosis. Arch. Pathol Lab Med 1979; 103:375-432.
2. Vallyathan V, Green FHY, Rodman N, Boyd C and Althouse R. The histopathology of lung cancer in coal workers. Arch Pathol Lab Med. In Press.
3. Ryder R, Lyons JP, Campbell H, Gough J. Emphysema in Coal Workers' Pneumoconiosis. Br Med J 1970; 3:481-487.
4. Cassidy EP. The National Coal Workers Autopsy Study. Arch Pathol 1972; 94:133-136.

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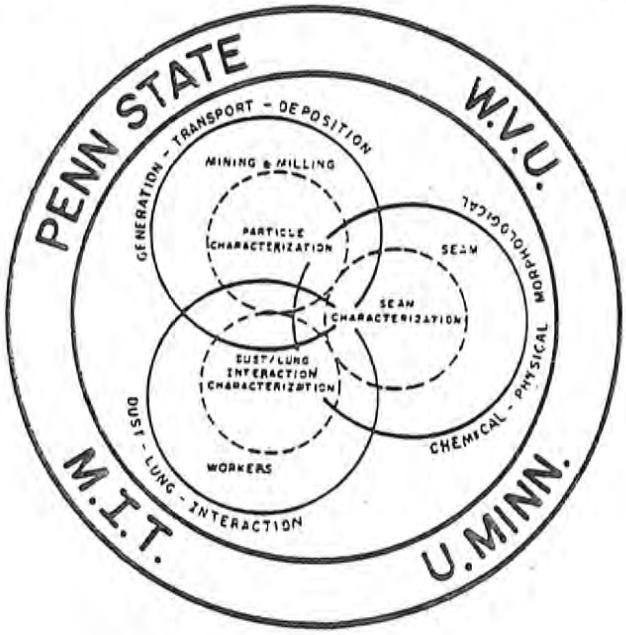

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