

## Helmet Use Among Motorcyclists Who Died in Crashes and Economic Cost Savings Associated With State Motorcycle Helmet Laws — United States, 2008–2010

In 2010, the 4,502 motorcyclists (operators and passengers) killed in motorcycle crashes made up 14% of all road traffic deaths, yet motorcycles accounted for <1% of all vehicle miles traveled (1,2). Helmet use consistently has been shown to reduce motorcycle crash-related injuries and deaths, and the most effective strategy to increase helmet use is enactment of universal helmet laws (3). Universal helmet laws require all motorcyclists to wear helmets whenever they ride. To examine the association between states' motorcycle helmet laws and helmet use or nonuse among fatally injured motorcyclists, CDC analyzed 2008–2010 National Highway Traffic Safety Administration (NHTSA) data from the Fatality Analysis Reporting System (FARS), a census of fatal traffic crashes in the United States (1). Additionally, economic cost data from NHTSA were obtained to compare the costs saved as a result of helmet use, by type of state motorcycle helmet law. The findings indicated that, on average, 12% of fatally injured motorcyclists were not wearing helmets in states with universal helmet laws, compared with 64% in partial helmet law states (laws that only required specific groups, usually young riders, to wear helmets) and 79% in states without a helmet law. Additionally, in 2010, economic costs saved from helmet use by society in states with a universal helmet law were, on average, \$725 per registered motorcycle, nearly four times greater than in states without such a law (\$198).

Motorcyclist death data for operators and passengers were obtained from FARS. To be included in FARS, a crash must result in the death of at least one person (occupant of a vehicle or a nonmotorist) within 30 days of the crash. Percentages of fatally injured motorcyclists who were not wearing a helmet were calculated as a proportion of all motorcyclist fatalities by state for 2008–2010. Percentages were suppressed for states with fewer than 10 fatalities involving motorcyclists who were not wearing helmets.

Information on economic costs saved from helmet use (e.g., medical and productivity costs saved) was obtained from NHTSA (NHTSA, unpublished data, 2012). The methods used to estimate 2010 costs were first used to calculate 2008 cost estimates.\* For 2010, the number of fatally injured motorcyclists who wore helmets was derived from FARS, and estimates of the number of helmeted motorcyclists who were injured were obtained from NHTSA's General Estimates System, a nationally representative sample of nonfatal traffic crashes.† These values were divided by 1 minus the corresponding effectiveness estimate for preventing motorcycle crash fatalities and injuries§ (4) to obtain estimates of the

\*Additional information available at <http://www-nrd.nhtsa.dot.gov/pubs/811433.pdf>, and at <http://www-nrd.nhtsa.dot.gov/pubs/809861.pdf>.

†Additional information available at [http://www.nhtsa.gov/Data/National+Automotive+Sampling+System+\(NASS\)/NASS+General+Estimates+System](http://www.nhtsa.gov/Data/National+Automotive+Sampling+System+(NASS)/NASS+General+Estimates+System).

§37% for preventing fatal injuries to riders and 41% for passengers, 13% for preventing serious injuries to riders and passengers, and 8% for preventing minor injuries to riders and passengers.

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## Pneumoconiosis and Advanced Occupational Lung Disease Among Surface Coal Miners — 16 States, 2010–2011

Coal workers' pneumoconiosis (CWP) is a chronic occupational lung disease caused by long-term inhalation of dust, which triggers inflammation of the alveoli, eventually resulting in irreversible lung damage. CWP ranges in severity from simple to advanced; the most severe form is progressive massive fibrosis (PMF). Advanced CWP is debilitating and often fatal. To prevent CWP, the Coal Mine Health and Safety Act of 1969 established the current federal exposure limit for respirable dust in underground and surface coal mines. The Act also established a surveillance system for assessing prevalence of pneumoconiosis among underground coal miners, but this surveillance does not extend to surface coal miners. With enforcement of the exposure limit, the prevalence of CWP among underground coal miners declined from 11.2% during 1970–1974 to 2.0% during 1995–1999, before increasing unexpectedly in the last decade, particularly in Central Appalachia (1,2). Exposure to respirable dust is thought to be less in surface than underground coal miners. Although they comprise 48% of the coal mining workforce, surface coal miners have not been studied since 2002 (3,4). To assess the prevalence, severity, and geographic distribution of pneumoconiosis among current surface coal miners, CDC obtained chest radiographs of 2,328 miners during 2010–2011 through the Coal Workers' Health Surveillance Program of the National Institute for Occupational Safety and Health (NIOSH). Forty-six (2.0%) of 2,257 miners with  $\geq 1$  year of surface mining experience had CWP, including 37 who had never worked underground. Twelve (0.5%) had PMF, including nine who had never worked underground. A high proportion of the radiographs suggested silicosis, a disease caused by inhalation of crystalline silica. Surface coal mine operators should monitor worker exposures closely to ensure that both respirable dust and silica are below recommended levels to prevent CWP. Clinicians should be aware of the risk for advanced pneumoconiosis among surface coal miners, in addition to underground coal miners, to facilitate prompt disease identification and intervention.

During 2010–2011, the Coal Workers' Health Surveillance Program mobile surveillance unit traveled to 16 of the 17 states\* with active surface coal mines to offer chest radiographs to miners. Site selection was based on accessibility

and cooperation of surface coal mine operators, who are not required to offer chest radiographs to their employees. All participants provided written informed consent.

Work histories, including tenures in surface and underground coal mining, were collected from each miner. Radiographs were classified for changes consistent with CWP, according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconiosis (5). At least two NIOSH B Readers<sup>†</sup> who had no knowledge of miners' work history, performed the classifications (5). Identification of CWP required agreement between two readers that small pneumoconiotic opacities were present at an ILO profusion subcategory of  $\geq 1/0$  (range: 0/0–3/+). An ILO profusion subcategory of  $\geq 2/1$  was considered advanced pneumoconiosis. Identification of PMF required reader agreement on the presence of large ( $> 1$  cm) pneumoconiotic opacities (A, B, or C) (5). B Readers also recorded the presence of r-type radiographic opacities (rounded opacities, 4–10 mm in diameter), which have been associated with inhalation of crystalline silica, a common exposure in mining (6). If the classifications of the presence or severity of pneumoconiosis by two B Readers were not in agreement, the radiograph was sent for classification to a third B Reader.

The crude prevalences of CWP, PMF, advanced pneumoconiosis, and r-type opacities among participating surface coal miners were calculated. Prevalences of diseases among miners from the three Central Appalachian states (Kentucky, Virginia, and West Virginia) were compared with prevalences among miners from the 13 other mining states; prevalence ratios were calculated using log binomial regression, adjusting for important confounders.

Radiographs from 2,328 surface coal miners (approximately 7% of active U.S. surface coal miners) were evaluated and classified. Among participants, 95% were men, and 83% were non-Hispanic whites. Of 2,257 (97%) miners who reported  $\geq 1$  year of surface mining tenure, 46 (2.0%) had CWP (Table), including 37 who reported no underground mining experience; 12 (0.5%) had CWP that had progressed to PMF (Table), including nine who had never worked underground. Among the 46 miners with CWP, 17 (37%) were classified as having

<sup>†</sup>A "B Reader" is a physician certified by NIOSH as demonstrating proficiency in the use of ILO classification of radiographs of pneumoconiosis. B Readers must successfully complete a certification examination and be recertified every 4 years. Additional information available at <http://www.cdc.gov/niosh/topics/chestradiography/breader.html>.

\*Alabama, Arizona, Colorado, Illinois, Indiana, Kentucky, Maryland, Montana, New Mexico, North Dakota, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wyoming. Texas, which also has active surface coal mines, was not included in the survey.

**TABLE. Prevalence of coal workers' pneumoconiosis (CWP) and progressive massive fibrosis (PMF) among surface coal miners, by region, age, CWP status, and total reported years of mining tenure — Coal Workers' Health Surveillance Program, 16 states, 2010–2011**

Region/CWP status	No. tested	Age (yrs)		Total mining tenure (yrs)		Prevalence of disease			
		Median	Range	Median	Range	CWP	PMF		
Surface coal miners	2,257	52	(18–82)	24	(1–58)	46	(2.0)	12	(0.5)
From Central Appalachia*	833	53	(22–78)	28 <sup>†</sup>	(1–56)	31	(3.7)	10	(1.2)
From non-Central Appalachia <sup>§</sup>	1,424	52	(18–82)	20 <sup>†</sup>	(1–58)	15	(1.1)	2	(0.1)
With CWP	46	56	(37–78)	33	(3–42)	—	—	—	—

\* Includes miners from Kentucky, Virginia, and West Virginia only.

† Median tenure for Central Appalachian and non-Central Appalachian surface coal miners is significantly different ( $p<0.001$ ).

§ Includes miners from Alabama, Arizona, Colorado, Illinois, Indiana, Maryland, Montana, New Mexico, North Dakota, Ohio, Pennsylvania, Tennessee, and Wyoming.

advanced pneumoconiosis ( $\geq 2/1$  ILO profusion category), and 17 (37%) were found to have r-type opacities (Table) (6).

Of the participating surface coal miners, 833 were from Central Appalachia, and 1,424 were from the other 13 states. Crude prevalences of CWP (31 miners [3.7%]) and PMF (10 [1.2%]) were higher among the Central Appalachian miners than the non-Central Appalachian miners (15 [1.1%] and two [0.1%], respectively) (Table). In addition, crude prevalences of advanced pneumoconiosis and r-type opacities were higher among the Central Appalachian miners (11 [1.3%] and 14 [1.7%], respectively) than the miners from the other 13 states (six [0.4%] and seven [0.5%], respectively).

The median total mining tenure differed significantly between Central Appalachian (28 years) and other surface miners (20 years) (Table). Adjustment for tenure was performed because the development and severity of CWP is directly related to both duration and concentration of dust exposure. After adjustment, results from a log-binomial regression among 2,102 miners for whom surface mining comprised  $\geq 75\%$  of their total mining tenure indicated that the prevalence of CWP was 2.7 times greater (95% confidence interval = 1.4–5.3) among Central Appalachian miners compared with the other miners (Figure). Tenure-adjusted prevalences of both PMF and r-type opacities also were significantly higher in Central Appalachian miners (Figure).

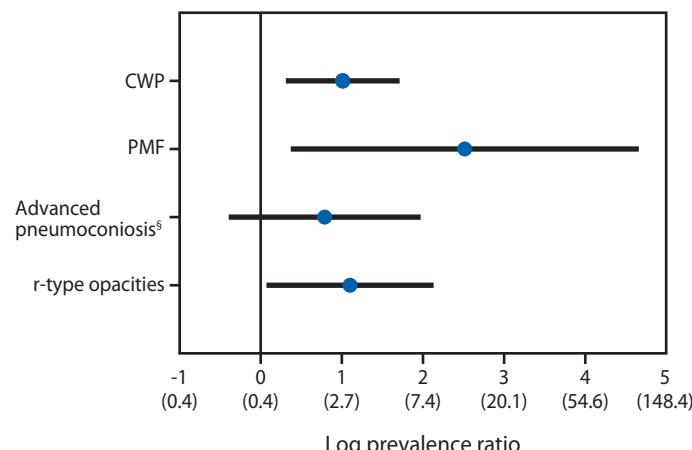
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#### Editorial Note

This analysis indicates that some currently working surface coal miners with little or no underground mining experience suffer from severe preventable respiratory disease, even though

**FIGURE. Prevalence ratios for coal workers' pneumoconiosis (CWP), progressive massive fibrosis (PMF), advanced pneumoconiosis, and r-type opacities, comparing Central Appalachian\* and non-Central Appalachian<sup>†</sup> surface coal miners — Coal Workers' Health Surveillance Program, 16 states, 2010–2011**



\* Includes miners from Kentucky, Virginia, and West Virginia only.

† Median tenure for Central Appalachian and non-Central Appalachian surface coal miners is significantly different ( $p<0.001$ ).

§  $\geq 2/1$  International Labour Office small opacity profusion category.

surface miners are thought to work in conditions less dusty than the confined work spaces of underground miners. The specific appearance of the abnormalities (r-type opacities) observed on the miners' chest radiographs suggests that inhalation of respirable crystalline silica might be a key exposure. Dusts containing  $>5\%$  respirable crystalline silica are more fibrogenic, and inhalation can lead to accelerated onset and greater severity of lung disease (7,8).

Surface coal miners in Central Appalachia had greater prevalence of both CWP and PMF compared with miners in other regions, independent of mining tenure, age, or underground working experience. Causes for these regional differences are unknown but might reflect differences in mining practices, safety culture, or geology. These findings suggest that current federal permissible dust exposure limits might be insufficient

### What is already known on this topic?

Coal workers' pneumoconiosis (CWP) is a chronic lung disease caused by the inhalation of dust; advanced CWP is debilitating and can be fatal. In the past decade, the prevalence of CWP and progressive massive fibrosis (PMF), a severe form of CWP, have increased among underground coal miners, particularly in Central Appalachia. However, the most recent study of CWP and PMF prevalence among U.S. surface coal miners was completed in 2002, and current disease prevalence in this population is not known.

### What is added by the report?

This study, the first assessment of CWP and PMF in surface coal miners since 2002, found that 46 (2.0%) of 2,257 miners working at surface coal mines during 2010–2011 had CWP, based on chest radiographs. Of those, 37 (80%) had no history of working underground. Twelve (26%) of the 46 had PMF, including nine (75%) who had never worked underground. The prevalences of CWP, PMF, and markers for severe occupational respiratory disease were greater in Central Appalachian miners, even after adjusting for mining tenure.

### What are the implications for public health practice?

Clinicians and miners should be aware of the risk for CWP and PMF in surface coal miners as well as underground miners to facilitate prompt disease identification and preventive interventions. To prevent pneumoconiosis in surface miners, operations should use effective dust monitoring and control methods to reduce respiratory hazards and emphasize the risk for advanced pneumoconiosis in worker training. CDC's National Institute for Occupational Safety and Health recommends that surface coal miners be included in periodic health surveillance.

to protect against disease or are not being adequately controlled to prevent excess dust exposure.

The findings in this report are subject to at least three limitations. First, this study used a sample based on accessibility and cooperation of mine operators and voluntary participation of miners. Whether any selection factors affected miner participation is unclear; therefore, prevalence of CWP might not be representative of all U.S. surface coal miners. Prevalence of CWP might be overestimated or underestimated, depending on whether miners with symptoms were more or less likely to volunteer for chest radiography. Second, age and mining tenure were self-reported, which could affect comparisons of tenure-adjusted disease prevalence. Finally, estimates of the prevalence of CWP and PMF included assessment of miners with underground mining experience, 155 (6.9%) of whom had  $\geq 25\%$  of their total mining tenure in underground mines. Therefore, morbidity in these surface miners cannot be attributed to their work as surface miners alone.

Surface coal miners and the clinicians caring for them should be aware of the risk for CWP and PMF, medical conditions traditionally associated with underground coal mining. Surface

coal mine operators should inform workers of their risk for advanced pneumoconiosis and closely monitor exposures, ensuring that respirable dust and silica exposures are continuously below recommended levels to reduce the risk for pneumoconiosis.

To prevent pneumoconiosis among underground and surface coal miners, the Coal Mine Health and Safety Act established federal exposure limits for respirable silica and coal dust.<sup>§</sup> NIOSH has recommended changes to the manner in which respirable silica and coal dust are measured for compliance and enforcement purposes (9,10). Use of personal continuous dust monitoring devices is recommended to achieve a more accurate and representative assessment of workers' exposure, although these devices currently cannot distinguish between silica and coal dust (10). The NIOSH-recommended exposure limit for respirable silica is  $50 \mu\text{g}/\text{m}^3$ , as a time-weighted average.<sup>¶</sup> (8). Additionally, NIOSH recommends that surface coal miners be included in periodic health surveillance that is similar to that conducted for underground miners (9,10).

<sup>§</sup>Title 30, Code of Federal Regulations, Parts 70 and 71.

<sup>¶</sup>The average exposure over a 10-hour work day and limited to a 40-hour work week.

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