

What is causing the rise in black lung disease?

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Silica exposure is a driving force behind rising rates of coal workers'

pneumoconiosis, according to a new study published by occupational health experts at the University of Illinois Chicago and their collaborators.

The study is the first to compare the pathology and mineralogy of the disease, which is commonly called black lung disease, across generations. It is also the first to offer scientific evidence explaining why progressive massive fibrosis, the most severe form of black lung disease, is occurring more frequently and among younger coal workers in West Virginia, Virginia and Kentucky.

Before 2005, when the increase was first reported, the incidence of black lung disease had been on the decline since the '70s, when modern coal dust controls were put in place. Subsequent investigations have reported that black lung cases have tripled and that tenured [miners](#) in central Appalachia, the epicenter of the disease, have experienced a tenfold increase in severe black lung disease.

"We've known that silica is highly toxic and exposure contributes to coal workers' pneumoconiosis, but we haven't known why coal workers were suddenly experiencing more disease and more severe forms of it. Regulations have remained in place, minerals in the Earth have not changed, and there is no evidence suggesting people have become more vulnerable to [coal dust](#), so the rise in cases among young workers that started in the late '90s was baffling," said Dr. Robert Cohen, clinical professor of environmental and occupational health sciences and director of the Mining Education and Research Center at UIC.

To better understand this phenomenon, Cohen and his collaborators collected lung tissue samples from coal miners with severe black lung disease. They compared the samples from miners who were born between 1910 and 1930 with those from miners who were born in or after 1930, historical and "contemporary" coal miners respectively.

The researchers looked at the samples' pathology—the physical characteristics of the diseased lungs. Tissues that had more than 75% silicotic nodules, which are round with whirls of pinkish scar tissue, were classified as having silica-type disease; tissues with fewer silicotic nodules and a greater number of grey or black-pigmented nodules were classified as coal-type (less than 25%) or mixed-type (25%-75%). They also looked for other lesions, like mineral dust-related alveolar proteinosis, which presents as fluid-like material on lung tissue and is caused by silica exposure.

Advanced analytic techniques like scanning electron microscopy and X-ray spectroscopy were used to measure the chemistry, crystal structure and physical properties of the mineral particles in the samples.

Cohen and his team found a clear link between silica exposure and severe black lung disease in contemporary miners:

- Contemporary miners had significantly higher rates of silica-type disease compared with their historical counterparts (57% vs. 18%). In contrast, historical miners had a significantly higher proportion of both coal-type (50% vs. 17%) and mixed-type (33% vs. 26%) diseases.
- Mineral dust alveolar proteinosis was more common in contemporary miners (70% vs. 37%).
- The percentage (26% vs. 18%) and concentration (4.7 vs. 2.6 billion particles per cubic centimeters) of silica particles were significantly greater in contemporary miners.
- The concentration of silica particles was significantly greater (more than 50%) when silica-type severe black lung, mineral dust alveolar proteinosis, silicotic nodules or immature silicotic nodules were present.

"These findings provide the first direct evidence that silica is a causative

agent behind the increasing incidence of progressive massive fibrosis—severe [black lung disease](#). This is critical information that can be used to determine health-protective permissible exposure limits for coal miners," Cohen said.

He attributes silica-driven resurgence as likely due to changes in mining technology like the mechanized coal extraction devices introduced in the U.S. in the 1950s, when miners born in or after 1930 would have begun their careers. "Silica is a mineral found in rock and technology that allows for more mining below and above the coal seam, which is profitable, means more cutting through rock and more silica exposure," he said.

"Our findings underscore the importance of controlling workplace silica exposure to prevent the disabling and untreatable adverse health effects afflicting U.S. coal miners," Cohen and his co-authors write.

In 2019, the Mine Safety and Health Administration initiated a request for information to inform its silica rules, but the standard established in 1969 remains in effect. The rule permits 100 micrograms per cubic centimeter for silica exposure. The Occupational Safety and Health Administration, which sets occupational health standards for nearly all other industries, allows 50 micrograms per cubic centimeter.

The researchers report their findings in the *Annals of the American Thoracic Society* article, "Pathology and Mineralogy Demonstrate Respirable Crystalline Silica is a Major Cause of Severe Pneumoconiosis in US Coal Miners."

Co-authors of the study are Dr. Leonard Go, Kirsten Almberg and Cayla Iwaniuk of UIC.

More information: Robert A Cohen et al, Pathology and Mineralogy

Demonstrate Respirable Crystalline Silica is a Major Cause of Severe Pneumoconiosis in US Coal Miners, *Annals of the American Thoracic Society* (2022). [DOI: 10.1513/AnnalsATS.202109-1064OC](https://doi.org/10.1513/AnnalsATS.202109-1064OC)

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