Standardized Incidence Ratios for Mesothelioma in Taconite Workers

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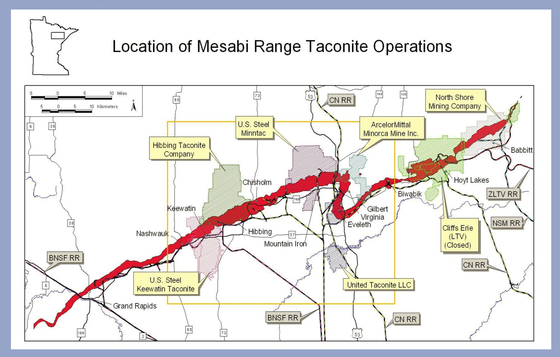
Abstract

Exposure to naturally occurring amphibole asbestiform fibers, cleavage fragments, and commercial asbestos are potential occupational hazards for miners working in Minnesota's taconite industry. In a cohort of 47,579 miners we identified 63 cases of malignant mesothelioma diagnosed from 1988-2009. We estimated standardized incidence ratios (SIR) of mesothelioma for the entire cohort and accounting for out-migration based on the proportion of out-of-state decedents. The SIR for mesothelioma for the entire cohort was 1.43, and 1.63 when estimating impact of out-of-state migration. These preliminary findings of an excess of mesothelioma suggest a significant exposure to asbestos fibers in this population. The asbestiform material may arise from several potential sources, including naturally occurring amphibole asbestiform fibers and commercial asbestos.

Taconite Worker Cohort

- Cohort enumerated by the University of Minnesota in 1984 (Mineral Resources Health Assessment Program, MRHAP)
- Work records from seven taconite companies, in total over 88,000 records and 68,737 individuals
- 47,579 eligible for follow-up for this analysis



Taconite Cohort and MCSS

- Linkage of the cohort to the Minnesota Cancer Surveillance System (MCSS) has identified 63 cases of malignant mesothelioma

	47,579 in cohort N (%)	63 cases N (%)
Sex		
Male	31,801 (66.8)	63 (100.0)
Female	1506 (3.2)	
Missing	14272 (30.0)	
Year of Birth		
1869-1919	6871 (14.4)	12 (19.0)
1920-1929	9940 (20.9)	25 (39.7)
1930-1939	9933 (20.9)	22 (34.9)
1940-1949	9376 (19.7)	3 (4.8)
1950-1959	10719 (22.5)	1 (1.6)
1960-1963	694 (1.5)	
Missing	46 (.1)	
Year of Death		
1988-1998	8444 (17.8)	18 (28.6)
1999-2009	8818 (18.5)	45 (71.40)
Alive	30317 (63.7)	

The Taconite Industry

- Taconite is a lean iron ore used in steel production
- Taconite mining on the Mesabi Range started in the 1950s
- Taconite must be crushed and processed with magnetic separators to increase its iron ore concentration

From left: taconite rock collected from open pits, rock is crushed into powder, powder made into pellets and fired

Methods

- Cohort followed from January 1, 1988, year MCSS established, through to an individual's death or the end of the study, defined as December 31, 2009
- SIRs estimated using Life Table Analysis System and age-specific mesothelioma rates from MCSS
- SIRs estimated for five-year age strata, and separate SIRs estimated that account for out-of-state migration, based on year of birth proportion of death certificates from Minnesota
- Separate analyses conducted with the cohort restricted to workers born in 1920 or later, a total of 40,662 individuals, to capture workers more likely to have worked in taconite operations only and not earlier hematite mining

Results

- The SIR for mesothelioma for the entire cohort was 1.43 and 1.83 when the cohort was restricted to individuals born during or after 1920
- The SIR for mesothelioma for when accounting for out-of-state migration is 1.63 and 2.04 when the cohort was restricted to individuals born during or after 1920

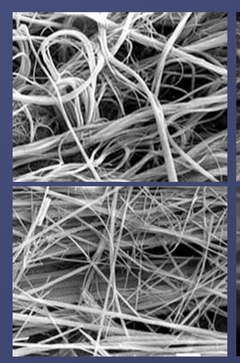
Group	Observed	Expected	SIR	95% CI
Entire cohort	63	44.11	1.43	1.08-1.78
Adjusted cohort	63	38.57	1.63	1.23-2.04

Sources of Asbestos

- The preliminary finding of elevated SIRs suggests that this population of taconite miners has had significant asbestos exposure
- Potential sources of asbestiform material include amphibole asbestiform fibers present at the eastern end of the Iron Range, commercial asbestos used in the taconite industry, and exposure to asbestos during military service or in other occupations
- Ore bodies in eastern Mesabi Range include amphibole species from the grunerite-cummingtonite and ferroactinolite-tremolite series
- Ore bodies in western Mesabi Range contain phyllosilicates like Minnesotatite but no amphiboles
- Cleavage fragments of mineral fibers produced during processing

Taconite Workers Health Study

- The Minnesota Taconite Workers Health Study was initiated to examine whether there are health risks associated with exposure to dust from taconite mining and processing
- Occupational exposure assessment of historical and current levels of respirable silica, asbestiform fibers, and mineral cleavage fragments
- Case-cohort study of mortality and cancer incidence
- Respiratory survey of prevalent lung disease in taconite workers and their spouses with chest X-ray, spirometry, and DLCO



Clockwise from top left: chrysotile, amosite, tremolite, and croccidolite asbestos fibers

Finished product: taconite pellets for use in steel production

Acknowledgements

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