Mortality Experience Among Minnesota Taconite Workers

Elizabeth M Allen, Bruce H Alexander, Jeffrey H Mandel, Gurumurthy Ramachandran, Richard F MacLehose
University of Minnesota School of Public Health, Minneapolis MN

BACKGROUND

Minnesota's Taconite Mining industry:

- Minnesota is largest producer of iron ore and taconite in the United States.
- Industry contributes $1.8 billion to state's economy.

Health Concerns:

- Workers are exposed to respirable dusts containing silica and elongated mineral particles with no clear understanding of the risk to human health.
- In 1997, Minnesota Department of Health reported excess of mesothelioma in northeastern region of the state.
- Concerns remain over the possible link between excess of mesothelioma and other occupational diseases and the taconite mining industry.

Purpose:

- In response to health concerns among taconite workers, we evaluated the mortality experience in this population with specific reference to mesothelioma and lung cancer.

MATERIALS AND METHODS

Study population:

Company employment records were gathered from seven mines in operation in 1983 and a cohort of all individuals who had ever worked in the mining industry between the 1930s and 1983 was created. From this cohort, 44,161 taconite workers born in 1920 or later were identified, 31,017 of whom had at least one year of documented employment and were included in the analysis.

Vital Status Determination:

The vital status of cohort members as of December 31, 2007 was ascertained through several sources including the Social Security Administration, the National Death Index (NDI), Minnesota Department of Health (MDH), and other state health departments. MDH provided causes of death for workers who died in Minnesota. For those who died outside of Minnesota, vital status information and causes of death were provided by NDI for individuals who died in the year 1979 or later. For individuals who died before 1979, death certificates were obtained from the state health department from the state in which the individual died. Death certificates were reviewed by a nosologist and causes of death were recorded using the International Classification of Disease (ICD) version in effect at the year of death. Vital status information for mesothelioma cases became available after 1999 when ICD version 10 was introduced.

Analysis:

Person years for each worker were computed from the start date of employment until the date of death or the end of the follow-up period (December 31, 2007). Standardized mortality ratios (SMRs) were estimated by computing the ratio of the observed to expected number of deaths using age, calendar time, and cause-specific mortality rates for the state of Minnesota. NIOSH Life Table Analysis System was used to estimate SMRs and 95% confidence intervals.

RESULTS

Table 1: Characteristics of the study population

	Duration of Employment					
	Worked < 1 year		Worked ≥ 1 year		Total	
	N	%	N	%	N	%
WORK YEARS						
< 1	13144	100.0	.	.	13144	29.76
1-4	.	.	13180	42.49	13180	29.85
5-9	.	.	7385	23.81	7385	16.72
10-14	.	.	3658	11.79	3658	8.28
15-19	.	.	1890	6.09	1890	4.28
20-24	.	.	1443	4.65	1443	3.27
25+	.	.	3461	11.16	3461	7.84
SEX						
Male	12317	93.71	28811	93.89	41128	93.13
Female	819	6.23	2201	7.10	3020	6.84
Unknown	8	0.06	5	0.02	13	0.03
VITAL STATUS						
ALIVE	8891	67.64	21950	70.77	30841	69.84
DEAD	4253	32.36	9067	29.23	13320	30.16
TOTAL	13144	100.0	31017	100.0	44161	100.0

Table 2: SMRs for Minnesota Taconite workers with ≥ 1 year employment

Underlying Cause of Death	Obs	Expected	SMR	95% CI
All Causes	9065	8,748.32	1.04	1.01-1.06
All Cancers	2701	2,604.95	1.04	1.00-1.08
Buccal & pharynx	40	50.85	0.79	0.56-1.07
Digestive & peritoneum	619	638.58	0.97	0.89-1.05
Respiratory	977	845.11	1.16	1.08-1.23
Larynx	26	23.79	1.09	0.71-1.60
Trachea, bronchus, lung	**945**	**814.10**	**1.16**	**1.09-1.24**
Pleura	1	1.81	0.55	0.01-3.08
Mesothelioma	**30**	**10.80**	**2.78**	**1.87-3.97**
Heart diseases	2668	2,431.00	1.10	1.06-1.14
Hypertension w/heart disease	61	34.10	1.79	1.37-2.30
Ischemic heart disease	2180	1,961.01	1.11	1.07-1.16
Cerebrovascular disease	390	383.58	1.02	0.92-1.12
Hypertension w/o heart disease	33	52.70	0.63	0.43-0.88
Respiratory Diseases	581	620.01	0.94	0.86-1.02
COPD	362	369.19	0.98	0.88-1.09
Asbestosis	1	2.89	0.35	0.01-1.93
Silicosis	1	1.09	0.91	0.02-5.10
Digestive system diseases	340	328.27	1.04	0.93-1.15
Cirrhosis & other liver disease	178	165.60	1.07	0.92-1.24

Table 1 shows the characteristics of the study population by years of employment and Table 2 shows the SMRs of selected causes of death and 95% confidence intervals for those who had at least one year of documented employment.

- The majority of taconite employees in this cohort worked less than four years.
- Among the 31,017 workers included in the analysis, 9,067 were deceased as of December 31, 2007.
- Mortality from all causes was greater than expected in the Minnesota population (SMR = 1.04, 95% Confidence Interval (CI): 1.01-1.06).
- Of the 9,065 deaths, 945 were from lung cancer, and 30 were mesothelioma.
- Mortality from lung cancer was higher than expected with and SMR of 1.16 (95% CI: 1.09-1.24).
- Mortality from mesothelioma was higher than expected with and SMR of 2.78 (95% CI: 1.87-3.97)
- Mortality from heart diseases was higher than expected in Minnesota (SMR = 1.10, 95% CI: 1.06-1.14).

CONCLUSIONS

This preliminary analysis suggests taconite workers in Minnesota have an increased risk for lung cancer and mesothelioma. The extent to which mining-related exposures contribute to this excess are being explored. The elevated SMRs for all cause mortality and cardiovascular disease suggest lifestyle factors, such as smoking, can play a role in mortality.

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University of Minnesota
School of Public Health

Contact information:

Elizabeth M. Allen, MPH
gasto020@umn.edu
University of Minnesota
420 Delaware St SE
Minneapolis MN 55455