

MORBIDITY IN NORTHEAST MINNESOTA  
Regional Copper-Nickel Study

Minnesota Environmental Quality Board

Author: Peter Ashbrook

June, 1978

TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT	i
INTRODUCTION TO REGIONAL COPPER-NICKEL STUDY	ii
INTRODUCTION	1
MORBIDITY STUDIES	2
Congenital Anomalies	2
Cancer	3
Gastrointestinal Cancer	4
Lung Cancer	5
Mesothelioma	5
Respiratory Disease	6
Other Morbidity Information	6
DISCUSSION	8
TABLES	9
REFERENCES	12

## ABSTRACT

Morbidity data consist of information about the existence of disease in a population as measured by determining how many people are sick or have died from specific diseases. Because of this definition, morbidity data are generally believed to be more meaningful indicators of health status than mortality data, which consist only of deaths attributed to specific diseases. Morbidity studies are relatively expensive and often technically demanding, hence they are few in number compared to mortality studies.

A twenty-year study of congenital anomalies (1951-1970) found that the experience of northeast Minnesota was similar to the State as a whole. An ongoing morbidity study of gastrointestinal and lung cancers has found Duluth residents to have rates similar to residents of Minneapolis and St. Paul for the years 1969-1974. Similar data have been collected for some North Shore communities. Cases of mesothelioma in Duluth for the years 1969-1974 have been no greater than expected. A study of chronic respiratory disease among taconite workers is currently in progress.

## INTRODUCTION TO THE REGIONAL COPPER-NICKEL STUDY

The Regional Copper-Nickel Environmental Impact Study is a comprehensive examination of the potential cumulative environmental, social, and economic impacts of copper-nickel mineral development in northeastern Minnesota. This study is being conducted for the Minnesota Legislature and state Executive Branch agencies, under the direction of the Minnesota Environmental Quality Board (MEQB) and with the funding, review, and concurrence of the Legislative Commission on Minnesota Resources.

A region along the surface contact of the Duluth Complex in St. Louis and Lake counties in northeastern Minnesota contains a major domestic resource of copper-nickel sulfide mineralization. This region has been explored by several mineral resource development companies for more than twenty years, and recently two firms, AMAX and International Nickel Company, have considered commercial operations. These exploration and mine planning activities indicate the potential establishment of a new mining and processing industry in Minnesota. In addition, these activities indicate the need for a comprehensive environmental, social, and economic analysis by the state in order to consider the cumulative regional implications of this new industry and to provide adequate information for future state policy review and development. In January, 1976, the MEQB organized and initiated the Regional Copper-Nickel Study.

The major objectives of the Regional Copper-Nickel Study are: 1) to characterize the region in its pre-copper-nickel development state; 2) to identify and describe the probable technologies which may be used to exploit the mineral resource and to convert it into salable commodities; 3) to identify and assess the impacts of primary copper-nickel development and secondary regional growth; 4) to conceptualize alternative degrees of regional copper-nickel development; and 5) to assess the cumulative environmental, social, and economic impacts of such hypothetical developments. The Regional Study is a scientific information gathering and analysis effort and will not present subjective social judgements on whether, where, when, or how copper-nickel development should or should not proceed. In addition, the Study will not make or propose state policy pertaining to copper-nickel development.

The Minnesota Environmental Quality Board is a state agency responsible for the implementation of the Minnesota Environmental Policy Act and promotes cooperation between state agencies on environmental matters. The Regional Copper-Nickel Study is an ad hoc effort of the MEQB and future regulatory and site specific environmental impact studies will most likely be the responsibility of the Minnesota Department of Natural Resources and the Minnesota Pollution Control Agency.

## INTRODUCTION

Morbidity data consist of information about the existence of disease in a population as measured by determining how many people are sick or have died from specific diseases. Because of this definition, morbidity data are generally believed to be more meaningful indicators of health status than mortality data, which consist only of deaths attributed to a specific disease. Morbidity rates may reflect either the incidence of disease (the number of newly diagnosed cases in a given time period) or the prevalence of disease (the number of cases existing in a population at a given point in time).

There are some limitations to morbidity data. First of all, morbidity studies are usually relatively expensive. Hence, such studies are often not readily available. The investigator must devise methods for accurately determining all cases of disease and avoid undercounting or overcounting. The definition of what constitutes a case is important in interpreting studies, particularly for some of the chronic diseases.

This paper will discuss the morbidity information which may be helpful in assessing potential impacts on the health of the residents of northeastern Minnesota. As will be seen, there are very few morbidity studies available.

## MORBIDITY STUDIES

### Congenital Anomalies

Congenital anomalies are deformities with which an infant is born. These anomalies include such things as clubfoot, cleft palate, and congenital heart disease. Because human embryos have much weaker defenses against agents of disease than adults or children, adverse effects of environmental pollutants are believed to often appear as congenital anomalies. Agents which are known to cause congenital anomalies are called teratogens.

A study of congenital anomalies in Minnesota was conducted by the Minnesota Department of Health (1973) for the years 1951-1970. Two types of congenital anomaly rates will be used in this discussion: the live birth congenital anomaly rate is the incidence of congenital anomalies reported on the live birth confidential medical supplement per 1000 live births; and the fetal death congenital anomaly rate is the incidence of fetal deaths, with congenital anomalies coded as the underlying cause of death, per 1000 fetal deaths during the corresponding calendar year (Minnesota Department of Health, 1973). For the combined years of 1967-1970, northeast Minnesota (Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, Pine, and St. Louis counties) had a live birth congenital anomaly rate of 14.1 and a fetal death congenital anomaly rate of 85. Comparable rates for all of Minnesota were 13.3 and 118, respectively. In the years 1951-1970, northeast Minnesota had higher live birth congenital anomaly rates than the state as a whole in 17 of the 20 years.

Recent statistics about congenital anomalies are presented in Table 1. Because the numbers used to derive these data were so small, they will not be discussed in the text.

These data have been presented to give the reader some idea about what is happening in northeastern Minnesota. Conclusions from these data, if any are possible, would be that the area has a few more congenital anomalies in live births than would be expected from state rates, and a few less congenital anomalies causing fetal deaths than expected from state rates.

Congenital anomalies can sometimes be difficult or impossible to observe at birth and may not become apparent for several years. The ability and diligence of physicians in looking for congenital anomalies varies by geographic location. Definitions and reporting practices of congenital anomalies often change every few years.

### Cancer

At the present time, there is an ongoing morbidity study of gastrointestinal and lung cancers in the residents of Duluth, Two Harbors, Beaver Bay and Silver Bay. Data for the years 1969-1974 have been collected and analyzed in two phases (Levy et al. 1976; Sigurdson et al. 1977). Each phase consisted of a three-year period. Morbidity rates were adjusted for age and sex where appropriate, using the 1970 Minnesota population as a standard and the 1970 populations for the four cities to calculate the desired rates. Comparisons of rates were made between Duluth and the Twin Cities of Minneapolis and St. Paul using data collected from the Third National

Cancer Survey in the latter cases. The finding of asbestos-like fibers in Duluth tap water, the source of which is Lake Superior, provided the stimulus for this study.

### Gastrointestinal Cancer

Gastrointestinal cancer statistics for Duluth are presented in Tables 2 and 3. As can be seen in Table 2, the numbers of newly diagnosed gastrointestinal cancers varied considerably over the six year period for both specific sites and total cancers. In an attempt to minimize these fluctuations, the numbers were grouped into three year intervals for analysis. Comparisons of rates between the two intervals for Duluth and Minneapolis and St. Paul for 1969-1971 are presented in Table 3. Very few statistically significant differences are observed in any of these comparisons. The authors (Sigurdson et al. 1977) even suggest that the differences for "Pancreas" and "Gastrointestinal Tract not Otherwise Specified" may be due to chance. It appears that at the present time, Duluth residents are experiencing gastrointestinal cancer to the same degree as residents of St. Paul and Minneapolis.

Crude gastrointestinal cancer incidence data for Two Harbors, Beaver Bay, and Silver Bay are presented in Table 4. Morbidity rates for these three cities were not adjusted for age or sex because there were so few cases that the rates which have been calculated are rates per 100,000 population and that the populations of these cities in 1970 were 4,437; 362; and 3,504 for Two Harbors, Beaver Bay and Silver Bay, respectively (United States Bureau of the Census, 1977). At the present time, it appears that

residents of these three cities are experiencing gastrointestinal cancer at rates less than or equal to those living in Minneapolis and St. Paul.

### Lung Cancer

Adjusted incidence rates of lung cancer for Duluth are shown in Table 5. In the years 1969-1971, Duluth males experienced more lung cancer than males in Minneapolis and St. Paul, while Duluth females experienced less than those in the Twin Cities. When data for both sexes are combined, Duluth had slightly higher rates than Minneapolis and St. Paul. For the years 1972-1974, lung cancer incidence rates dropped for males, but rose for females, an observation which is consistent with national trends. Combining the data for both sexes produced a rate higher for 1972-1974 than that of the previous three years (44.50 vs. 39.71). Sigurdson et al. (1977) suggested that changing smoking habits probably is the dominant factor affecting lung cancer rates in Duluth. Crude incidence rates for Two Harbors, Beaver Bay and Silver Bay are shown in Table 4. Like the situation of gastrointestinal cancer, the rates for these cities were similar to or less than those for Minneapolis and St. Paul.

### Mesothelioma

Mesothelioma is a rare form of cancer which is usually associated with asbestos exposure. Based upon data collected in the Third National Cancer Survey one case of mesothelioma would be expected in Duluth each year (Sigurdson et al. 1977). Table 6 shows that over the period 1969-1976, there have been seven cases of mesothelioma, which is about what one would

expect. Although most of the cases occurred in the latter half of this time period, it is not possible to determine whether this is due to natural fluctuation or some environmental factor.

### Respiratory Disease

Preliminary results of a study comparing breathing patterns in taconite workers to a control group of Duluth school teachers have been reported in the press (Minneapolis Tribune, 1977). Two physicians at the Duluth Clinic Limited (Drs. Clark and Harrington) studied 307 male employees with at least 20 years of experience in the taconite open pit mine or processing plant of Reserve Mining Company. Thirty-five male school teachers living in Duluth with no history of exposure to taconite dust and matched for age and smoking habits were used as controls. Information was collected by means of a standard questionnaire for general health, detailed smoking history, and respiratory symptoms such as cough, phlegm, and shortness of breath. Chest x-rays and measurements of breathing ability were also taken. No significant difference in respiratory symptoms or breathing ability was observed between the two groups. Details have not been available; however, the reader should be aware of this study.

### Other Morbidity Information

This author had several conversations concerning morbidity information which may be of assistance to the reader. No specific references will be given in this section because the information consists of professional opinions and impressions rather than scientific studies and because of possible misinterpretation of conversations. 6

It is widely believed that mental stress or tension may have adverse effects on an individual's health. Two sources of stress have recently been present for the residents of Babbitt and Silver Bay. One was the threatened closing of Reserve Mining Company in the dispute over disposal of taconite tailings and the other was the steelworkers' strike commencing August 1, 1977. Both situations produced stress on the entire population of each city because both cities are dependent on Reserve for their economic livelihood. In the first instance of a potential shutdown, the stress produced by a potential loss of jobs may have been subtle, but it was present for many months. In the case of the strike, the workers' incomes dropped precipitously. Conversations with physicians from Babbitt and Silver Bay elicited the opinions that there had been increased incidence of heart disease (produced by mental stress) during the period of court cases to clear up the dispute about disposal of taconite tailings. However, it was felt that the strike had an even greater effect because of the actual loss of income compared with the threat of income loss in the first case.

Two of the physicians were asked if they had seen any cases of silicosis. Between the two of them, one case had been observed and this had been in a pre-employment examination of a man who was being transferred from another state to Minnesota. Questions concerning the observation of increased incidence of other respiratory diseases elicited negative responses. One physician noted that normal levels of respiratory disease are not well enough known to make a judgment about increased incidence. Another physician estimated that at least 75 percent of taconite workers are smokers, a fact which if true, would probably be responsible for an

increased incidence of respiratory diseases, cancer, and heart disease in that region.

#### DISCUSSION

Morbidity information for northeastern Minnesota is very limited. Perhaps the most important conclusion from the studies which are available is that little is really known about the incidence and prevalence of disease in northeast Minnesota. The study of congenital anomalies was somewhat ambiguous in that one way of examining the data showed an excess of cases, while another method showed fewer cases than expected. Gastrointestinal and lung cancer rates for Duluth seem to be similar to Minneapolis and St. Paul, while the same rates for some North Shore communities appear to be lower. A study of respiratory disease in taconite workers employed by Reserve Mining Company is currently in progress. The author is unaware of any additional studies of iron ore and taconite miners in northeastern Minnesota.

Table 1

Percent of live births with congenital anomalies in northeast Minnesota,  
1970 and 1975

	Minnesota	Northeast	Aitkin	Carlton	Cook	Itasca	Koochiching	Lake	St. Louis	Duluth
1970	1.3	1.4	4.1	2.5	1.8	1.2	1.2	2.9	1.0	0.8
1975	1.4	1.3	1.4	1.5	0.0	1.1	1.7	0.6	1.3	0.9

SOURCES: Minnesota Department of Health (1971,1977)

Table 2. THE NUMBER OF GASTROINTESTINAL CANCERS  
DIAGNOSED IN DULUTH RESIDENTS DURING 1969-1974

<u>Site</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>Total</u>
Esophagus	4	2	6	6	5	8	31
Stomach	17	22	14	18	17	19	107
Small Intestine	2	4	2	2	1	2	13
Large Intestine	38	41	54	53	28	39	253
Rectum/Rectosigmoid	19	21	13	19	16	27	115
Liver	2	5	1	4	2	1	15
Gall Bladder	4	7	5	5	5	6	32
Pancreas	18	22	17	13	11	12	93
Peritoneum, Retroperitoneum, and Abdomen, not Otherwise Specified	1	2	1	3	1	1	9
GI Tract, not Otherwise Specified	<u>3</u>	<u>0</u>	<u>5</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>12</u>
TOTAL	108	126	118	125	87	116	680

THREE YEAR TOTALS

1969-1971: 352

1972-1974: 328

SOURCE: Sigurdson et al. (1977)

Table 3. GASTROINTESTINAL CANCER INCIDENCE RATES  
RESIDENTS OF DULUTH AND COMPARISON CITIES 1969-1971,  
AND DULUTH 1972-1974

Primary Gastrointestinal Site	Sex	Average Annual Age-Adjusted Rates Per 100,000 Population*			
		1969-1971			1972-1974 Duluth
		Duluth	Mpls.	St. Paul	
Esophagus	Male	5.53	7.01	5.89	7.27
	Female	1.61	2.25	1.96	3.64
	Both	3.36	4.24	3.60	5.31
Stomach	Male	18.88	17.22	14.08	22.04
	Female	9.84	9.03	11.63	8.32
	Both	14.29	12.36	12.58	14.73
Small Intestine	Male	3.53	2.15	1.30	2.20
	Female	1.00	1.32	0.68	0.59
	Both	2.18	1.67	0.95	1.37
Large Intestine	Male	36.15	41.09	43.15	34.06
	Female	36.12	38.79	37.38	31.42
	Both	36.26	39.36	39.46	32.66
Rectum/Rectosigmoid	Male	16.84	18.53	23.04	22.83
	Female	12.30	13.84	12.83	12.29
	Both	14.39	15.69	17.10	17.03
Liver	Male	3.11	3.17	2.51	2.23
	Female	1.51	0.98	2.21	1.70
	Both	2.28	1.92	2.30	1.95
Gall Bladder/ Biliary Tract	Male	2.84	3.17	4.20	2.33
	Female	5.83	3.94	5.31	6.00
	Both	4.40	3.57	4.77	4.32
Pancreas	Male	16.92	14.25	12.57	11.49
	Female	13.80	8.08***	9.91	8.22
	Both	15.28	10.69**	10.94**	9.74**
Peritoneum, Retroperitoneum and Abdomen, not Otherwise Specified	Male	1.72	1.14	1.45	2.26
	Female	0.51	1.27	2.36	0.51
	Both	1.07	1.20	1.96	1.33
Gastrointestinal Tract not Otherwise Specified	Male	2.84	0.23**	0.21**	0.59
	Female	1.53	0.57	0	1.56
	Both	2.16	0.45**	0.09**	1.03
Total of Gastrointestinal Sites	Male	108.16	108.01	108.40	107.29
	Female	84.05	80.03	84.27	74.25
	Both	95.67	91.14	93.75	89.51

\*Male and female rates were age-adjusted; combined rates for both sexes were both age and sex adjusted. Rates were adjusted using the 1970 Minnesota population as the standard.

\*\*Statistically significant difference with Duluth 1969-1971 at the P .05 level or less.

\*\*\*Statistically significant difference with Duluth 1969-1971 at the P .01 level or less.

## REFERENCES

- Levy, B.S. and E. Sigurdson, J. Mandel, E. Laudon and J. Pearson, 1976. Investigating possible effects of asbestos in city water: Surveillance of gastrointestinal cancer in Duluth, Minnesota. American Journal of Epidemiology 103:362-368.
- Minneapolis Tribune, 1977. Study finds no taconite effect on breathing. Minneapolis Tribune. February 20, 1977.
- Minnesota Department of Health, 1971. Minnesota Health Statistics--1970. Center for Health Statistics, Minnesota Department of Health.
- Minnesota Department of Health, 1973. Congenital anomalies in Minnesota. Health Statistics Section and Maternal and Child Health Section, Minnesota Department of Health.
- Minnesota Department of Health, 1977. Minnesota Health Statistics--1975. Center for Health Statistics, Minnesota Department of Health.
- Sigurdson, E.E. and J. Mandel, R. McHugh, B.S. Levy, H. Jagger, R. Knorr, E. Laudon and J. Pearson. Incidence of gastrointestinal and lung cancer in residents of Duluth, Two Harbors, Beaver Bay, and Silver Bay. Unpublished.
- United States Bureau of the Census, 1977. Population estimates and projections, 1973 (revised) and 1975 population estimates and 1972 (revised) and 1974 per capita income estimates for counties, incorporated places, and selected minor civil divisions in Minnesota. Series P-25, No. 671, U.S. Government Printing Office, Washington, D.C.