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REGIONAL COPPER-NICKEL STUDY
MORTALITY EXPERIENCE OF NORTHEAST MINNESOTA

Minnesota Environmental
Quality Board

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ABSTRACT

Mortality experience of a population is often used as an indicator of health status. By this criterion, northeast Minnesota compares unfavorably with the state of Minnesota, but is very similar to the United States.

For all causes of death, northeast Minnesota had higher age-specific mortality rates than the State for each of six age groups and higher age-adjusted mortality rates for all ages combined in both 1975 and 1970. In addition, northeast Minnesota had higher age-adjusted mortality rates than the state for each of the twelve leading causes of death. Infant mortality rates for northeast Minnesota were higher than the state in both 1975 and 1970, but were lower than the United States.

A detailed analysis of mortality rates for nine noncommunicable diseases in the years 1968-1973 showed northeast Minnesota to have the highest rates in five cases and second highest in two others of the eight regions of the State. All four counties, Carlton, Cook, Lake, and St. Louis had high cancer mortality rates; however, the specific components of these rates varied among counties: in some cases, males had higher rates, while in others, females had higher rates and in some counties rates were high for some cancers and low for other cancers, while in other counties, the opposite was true.

An index for productive years of life lost, which gives more weight to deaths in young age groups, gave results consistent with the observations noted above for both 1975 and 1970.

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

Mortality experience of a population is generally the first area examined when questions concerning health status are discussed. While this approach is sound, the implementation of the idea is often unsatisfactory. Advantages of using mortality data include: the data for all causes of death is reliable because virtually all deaths in this country are recorded; collection of the data is relatively easy and inexpensive; and the data do provide information concerning the health of a population. Problems with mortality data, which usually arise in the analysis of the data may include: lack of comparability in definitions; deficiencies in reporting; inaccuracies in reported data; lack of comparability in mortality and population statistics; changing procedures in processing and tabulating; and differing methods of analysis of mortality statistics.

This paper will present mortality data for northeastern Minnesota, along with a discussion of possible sources of error and limitations. A glossary of terms is presented in the Appendix.

GENERALIZED MORTALITY EXPERIENCE

Total deaths for the twelve leading causes of death in Minnesota in 1975 are presented in Table 1 for the State, northeast Minnesota, and Carlton, Cook, Lake, and St. Louis Counties. These numbers are intended to give the reader some idea of the major causes of death and the relative magnitude of deaths among these areas.

It may be concluded from the data in Table 1 that the major causes of death

in northeast Minnesota are generally similar to those for the rest of the state. In addition, because St. Louis County accounts for approximately two-thirds of the deaths for the Northeast region, possible trends in the other counties may be obscured when included with the trends for St. Louis County. Lastly, only one of the top twelve causes of death can be attributed to communicable diseases (influenza and pneumonia). This last point is interesting because noncommunicable diseases are in many cases thought to be caused by more than one factor, many of which may be affected by environmental conditions.

SPECIFIC MORTALITY EXPERIENCE

General Adjusted Death Rates

To make valid comparisons between different regions, death rates are usually adjusted. Crude death rates are often calculated for the total population; however, specific characteristics of the population are not taken into account. For example, the crude death rate of a population with 90% of the people over 65 will be much higher than that of a population with 90% of the people under 20, because older people are more likely to die than younger people. Therefore, the age distribution of the population must be considered. Similar statements can be made for sex, race, and a number of other factors. Adjustments for each factor generally make the comparisons more valid. When making a large number of adjustments one needs a large population base. This section will present data that is adjusted for age and, in some cases, sex.

Mortality experience due to all causes is presented in Table 2. Northeast Minnesota had a higher mortality rate than the State in 1975. Moreover, when broken down by county, mortality rates for most of the age groups are higher than those for the State as a whole. These figures represent only one year's experience; so care should be taken to avoid overanalysis. However, it is

interesting to note that similar relationships were evident in 1970 (Table 3).

Age-adjusted mortality rates for the twelve leading causes of death are shown in Table 4 to illustrate differences between northeast Minnesota and both the State as a whole and the United States as a whole. Note that these rates are adjusted for age but not for sex, and are expressed as number of deaths per 100,000 population; instead of the population base of 1,000 used in Tables 2 and 3. In addition, Pine County has not been included in the category for "northeast Minnesota" in Table 4, but was included in Tables 2 and 3.

Examination of Table 4 reveals that not only did northeast Minnesota have a higher age-adjusted death rate for all causes of death than Minnesota as a whole, it also had higher age-adjusted death rates than the State for each of the twelve leading causes of death in 1975. Differences between northeast Minnesota and the United States were very small, although again northeast Minnesota had slightly higher death rates than the United States for 10 of the 12 causes of death presented.

These data suggest that northeast Minnesota has higher mortality rates than the rest of the State. To make a more conclusive statement would require the study of data from other years and adjustments of the data for sex, race and other variables of possible importance.

Perinatal Mortality Experience

Mortality experience around the time of birth, particularly the infant mortality rate, is often used as an indicator of health status. Some commonly used statistics are presented in Table 5. Northeast Minnesota compared favorably with the State for fetal and perinatal death rates in 1975.

However, northeast Minnesota had slightly higher rates for neonatal deaths and the major indicator of infant deaths. These generalizations were not

uniform when broken down by county; however, natural variation and the small numbers involved may be responsible for these differences. Similar data for the year 1970 are given in Table 6. In that year, northeast Minnesota compared unfavorably with the State in all four categories. While these data lend supporting evidence to the existence of a higher infant mortality rate in northeast Minnesota than in the State as a whole, the data clearly illustrate typical variation between years.

Nationally, infant mortality rates have been declining over the past fifty years (Public Health Service, 1976). The data presented in Tables 5 and 6 are consistent with this trend. Infant mortality rates for the United States were 16.1 and 20 for the years 1975 and 1970, respectively (Public Health Service, 1976). Both the entire State and the northeast region had infant mortality rates below the national in both 1975 and 1970.

Noncommunicable Diseases

Recently, a study of mortality statistics was conducted by the Minnesota Department of Health (1977c). Mortality data for the years 1968-1973 were collected for a number of noncommunicable diseases. Average annual mortality rates adjusted for age and, when appropriate, sex were calculated for: the State as a whole, each of eight regions, each of the 87 counties, and the cities of Duluth, Minneapolis, and St. Paul. Some of these data are presented in Tables 7-12.

Cancer

Data For Both Sexes Combined

Table 7 contains the annual age and sex-adjusted mortality rates for all cancers and eight different types of cancer for the years 1968-1973. In addition to the northeast region having the highest rates in the State, three

of the four counties in the table ranked in the top 10, with St. Louis County having the highest rates of all. Most of the excess can be attributed to digestive and respiratory cancers. St. Louis County heavily influences the regional experience, and can obscure differences among some of the other counties: for example, Cook County ranked 81 for respiratory cancers. Mortality experience varied widely among the counties: Lake and Cook ranked very high for breast and lymphoma, yet they were very different in the cases of genital (Cook high) and urinary (Lake high) cancers. Carlton and St. Louis tend to show similar trends to each other, but are often different from Cook and/or Lake.

Data for Each Sex Separately

Mortality experience due to selected cancers for the years 1968-1973 is presented in tables 8 and 9 for males and females, respectively. In general, males tended to have higher rates than females, although there were a few exceptions, most notably in Cook and Lake Counties. Within counties, there are a number of huge disparities between the ranking of the rates for each sex. These include: Cook and Lake females ranked 1 and 2, respectively for all cancers, while the males ranked 86 and 59, respectively; Carlton and St. Louis males ranked 4 and 2, respectively, for cancers, while the females ranked 34 and 17, respectively; digestive, respiratory and lymphoma in Lake County; leukemia in Carlton County; and lymphoma in Cook County. Genital cancers, while not strictly comparable between sexes, are interesting in that Carlton and Cook females ranked very high in the State, while males ranked quite low; and yet Lake County males ranked high and females, low.

Other Communicable Diseases

Data For Both Sexes Combined

Table 10 contains the average annual age and sex-adjusted mortality rates for selected causes of death for the years 1968-1973. In four of the eight

categories, the northeast region had the highest mortality rates in the state; and in two other categories, the region ranked second. The northeast region ranked highest in cancer as well (see Table 7). These data, then, support the tentative conclusions reached in previous sections of this paper using data for 1975 that the northeast region of the state tends to have higher mortality rates than the rest of the State.

Several observations can be made by examining data for each individual county. First, in some cases such as suicide, all four counties have high rankings; while in other cases such as heart disease, the rankings are somewhat variable. Secondly, each county has widely variable rankings for different causes of death; for example, Lake County ranked first for bronchitis and emphysema, but only 72nd for heart disease. Finally, the mortality rates for the northeast region are heavily influenced by the experience of St. Louis County which, as noted above, accounts for about two-thirds of the deaths for the region.

Data For Each Sex Separately

Tables 11 and 12 contain the average annual age-adjusted mortality rates due to selected causes for males and females, respectively for the years 1968-1973. Males in northeast Minnesota similar to the combined data for both sexes, in general had higher mortality rates than males in the rest of the State. With the exception of diabetes and cerebrovascular disease, mortality rates for males were higher than those for females; in some cases these rates were more than twice those for females. Females, in general, also experienced mortality rates exceeding the state rates.

Comparisons of rates for each sex might be expected to show similar rankings within each county and this is sometimes the case: for example, heart disease in St. Louis County, males ranked 11 and females, 10. On the other hand, some wide disparities exist such as diabetes in Lake County where males ranked 9 and

females, 78 and cirrhosis in Cook County where males ranked 67 and females, first.

The "Productive Years of Life Lost" Concept

An alternative method for analysis of mortality rates is the "productive years of life lost" concept (Kleinman, 1977). The rationale behind this concept is that each individual should be expected to live 70 productive years of life. Therefore, each death is weighted according to 70 minus the age at death and all deaths over age 65 are excluded from the calculations. Based upon this concept, a years-of-life-lost index can be calculated using total years of life lost in the region for the numerator and applying a standard set of age-specific death rates (such as those for the state) to the population of the region for the denominator (for more detail see Kleinman, 1977). If the mortality experience of the region is worse than the reference area, the index would be greater than one; and conversely a better mortality experience would produce an index value less than one.

Years-of-life-lost index values have been calculated for the years 1975 and 1970 (Table 13). Lake County had a mortality experience better than the state in both years; while the northeast region, Carlton County, St. Louis County, and Duluth had a worse mortality experience in both years. Cook County had the lowest index value in 1975, but the highest in 1970. Much of the fluctuation for Cook County can probably be attributed to the small population.

In general, the data presented in Table 13 support the findings and conclusions in other sections of this paper. Several cautions should be noted in using this data, however. Kleinman (1977) determined that the years-of-life lost index "provided reasonably stable estimates for nearly all counties above 25,000 population and most counties between 10,000 and 25,000." Unlike the calculations in Table 13, Kleinman used the data for a three year interval and based his conclusions on the use of three years of data. Secondly, it should be kept in mind

that the population for six of the seven counties is less than 40,000 and small populations are more susceptible to wide variations in the index.

DISCUSSION

Mortality experience is a key consideration in evaluating health status of a region. If mortality experience is used as the sole indicator of health status, northeastern Minnesota, and specifically the counties of Carlton, Cook, Lake and St. Louis would be judged unfavorably compared to the rest of the state. However, the mortality experience of the northeast region appears to closely approximate that of the United States as a whole for most causes of death, and in the important area of infant mortality, it does somewhat better than the country as a whole. Thus, it is important to make clear one's reference point when generalizing about the health status of a population. For the purposes of this paper, the Minnesota state experience will be used as a reference.

Having determined that northeast Minnesota has higher mortality rates than the state, it is logical to try to determine what specific causes are responsible for the increase. In this case, northeastern Minnesota has had higher mortality rates than the rest of the state for almost all major causes of death (Table 4). When mortality rates were examined for each age group, it was shown that excesses were observed in all age groups (Table 3). When the data are further examined for each county and by sex, some differences start to show up. However, the observed excess mortality was due to different causes for each county and, in some cases, for each sex.

There are a number of factors which probably affect the observed excesses in the northeast region. Natural variation in rates is one such factor. Contributing to this natural variation is the small population in several of the counties: most of the rates are expressed as deaths per 100,000 population, yet Carlton, Cook,

and Lake Counties each have less than 30,000, hence one death can make a large difference in rates. This problem can be somewhat overcome by averaging the mortality experience over a number of years as was done in Tables 7-12. Other possible contributing factors affecting the mortality rates include ethnic practices arising from different mores; genetic differences; and climate. Lastly, and most significantly for the purposes of assessing potential health impacts due to copper-nickel development, are the manmade environmental factors, such as air and water pollutants. Environmental pollutants would be expected to have the greatest effect on respiratory diseases (such as bronchitis and emphysema), cancers (especially digestive and respiratory cancers), and heart disease, although the latter is an extremely complex situation. These environmental factors might be expected to have similar effects on mortality rates for each sex in each county, yet in some cases, males and females in the same county had very different rates relative to their counterparts in the rest of the State. Effects of environmental pollutants often take 10 to 20 years to be reflected in mortality statistics.

If environmental pollutants are responsible for a significant portion of the observed increased mortality, addition of more pollutants---be it from copper-nickel development, power plants, or the taconite industry---could aggravate an already undesirable situation.

Mortality rates have a number of limitations, some of which will be addressed here. These rates can have considerable natural variation. In this case, the experience of St. Louis County heavily influences the regional experience. Beyond that, Duluth accounts for approximately half the St. Louis County experience. Data for Duluth have been included where available, and, in many cases, appear to have been almost totally responsible for the excesses observed in St. Louis County. Although the Duluth data were not discussed, the reader can examine the figures.

It would be interesting to determine the St. Louis County mortality rates if Duluth were excluded. Other limitations of mortality data include variations in definition of diseases and ability to accurately diagnose cause of death. In terms of determining how healthy people are, mortality data gives little information about the health of individuals while they are alive.

Mortality experience can be used as an indicator of the health of a population. However, it should be remembered that this is a negative indicator and that just because people have not died does not mean that they are healthy. The determinants of mortality are numerous and complex; attributing the mortality experience presented in this paper to one or two major factors would be presumptuous at best.

TABLE 1. Number of deaths for the twelve leading causes
in selected areas of Minnesota - 1975.

	Minnesota	Northeast Minnesota*	Carlton	Cook	Lake	St. Louis
Total deaths	32,686	3,393	285	33	104	2,300
Heart disease (390-398,402,404,410-429)**	12,378	1,367	120	5	42	921
Cancer (140-209)	6,448	667	50	8	25	462
Cerebrovascular disease (430-438)	3,958	380	27	7	8	245
Accidental deaths (800-949)	1,814	196	19	3	9	132
Influenza and Pneumonia (470-474,480-486)	1,130	115	7	1	5	86
Arteriosclerosis (440)	549	58	9	4	1	35
Diabetes (250)	531	68	1	-	3	54
Suicide (950-959)	448	61	4	1	1	39
Bronchitis, Emphysema and Asthma (490-493)	418	50	6	1	-	31
Certain causes of Perinatal mortality (760-779)	405	37	3	-	-	25
Cirrhosis of the liver (571)	382	46	2	-	1	34
Congenital Anomalies (740-759)	256	23	3	-	-	18

*Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis Counties

**Numbers in parentheses refer to the International Classification of Disease (ICD) Number.

SOURCE: Minnesota Department of Health (1977a,b)

TABLE 2. ADJUSTED MORTALITY RATES PER 1000 POPULATION
FOR SELECTED REGIONS OF MINNESOTA* - 1975

	Minnesota	Northeast Minnesota	Carlton	Cook	Lake	St. Louis	Duluth
Age-and sex-adjusted death rate ----->	8.3	9.1	9.6	7.0	8.6	9.5	10.6
Sex-adjusted rates for specific age groups:							
Under 5 years	3.3	3.5	5.0	-	-	4.0	4.5
5-14 years	0.3	0.6	0.6	-	0.4	0.7	0.7
15-24 years	1.1	1.1	1.4	1.6	1.6	1.2	1.0
24-44 years	1.3	1.9	1.4	1.3	1.3	2.0	1.6
45-64 years	8.2	9.7	8.6	6.7	7.5	10.5	10.9
65 and over	52.5	55.1	60.5	44.7	57.6	56.1	66.3

* Rates are adjusted to the estimated population for Minnesota in 1975.

** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, Pine and St. Louis Counties.

SOURCE: Minnesota Department of Health (1977b).

TABLE 3. ADJUSTED MORTALITY RATES PER 1000 POPULATION
FOR SELECTED REGIONS OF MINNESOTA* - 1970

	Minnesota	Northeast Minnesota**	Carlton	Cook	Lake	St. Louis	Duluth
Age-and sex-adjusted death rate ----->	8.9	9.9	9.1	12.6	10.3	10.4	11.3
Sex-adjusted rates for specific age groups							
Under 5 years	4.2	4.7	5.6	7.6	5.5	4.8	4.8
5-14 years	0.4	0.5	0.3	1.5	0.6	0.5	0.6
15-24 years	1.1	1.2	1.3	-	0.5	1.3	1.2
25-44 years	1.6	1.9	2.3	3.9	0.9	2.0	2.4
45-64 years	9.4	10.9	10.9	12.7	7.6	11.2	12.4
65 and over	57.0	62.3	53.1	77.3	73.8	65.2	70.8

* Rates are adjusted to the population for Minnesota in 1970.

** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, Pine and St. Louis Counties.

SOURCE: Minnesota Department of Health (1971)

TABLE 4. AGE-ADJUSTED MORTALITY RATES PER 100,000 POPULATION
FOR SELECTED REGIONS* - 1975

Cause of Death	Northeast Minnesota**	Minnesota	United States
TOTAL - ALL CAUSES	921.8	832.7	917.5
Heart disease	364.0	315.3	350.4
Cancer	178.8	164.3	175.7
Cerebrovascular disease	102.1	100.8	96.0
Accidental deaths	59.3	46.2	48.9
Influenza and Pneumonia	31.0	28.8	27.3
Arteriosclerosis	15.5	14.0	14.5
Diabetes	18.5	13.5	17.2
Suicide	19.3	11.4	12.6
Bronchitis, Emphysema and Asthma	13.2	10.6	12.4
Certain causes of Perinatal Mortality	11.4	10.3	11.9
Cirrhosis of the liver	12.7	9.7	14.6
Congenital Anomalies	7.0	6.5	6.0

* Rates are adjusted to the estimated population for Minnesota in 1975.

** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake and St. Louis Counties.

SOURCE: Minnesota Department of Health (1977a)

SELECTED NATALITY STATISTICS FOR REGIONS OF MINNESOTA - 1975

Category	Minnesota	Northeast Minnesota*	Carlton	Cook	Lake	St. Louis	Duluth
Fetal death rate**	8.5	7.0	2.5	0	10.6	6.8	7.7
Neonatal death rate	10.3	11.1	20.2	0	0	11.7	15.5
Perinatal death rate	18.8	18.1	22.7	0	10.6	18.6	23.2
Infant mortality rate	13.7	14.9	22.7	0	0	15.9	17.6
Number of live births	56,463	5,021	396	46	188	3,069	1,421

* Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, Pine and St. Louis Counties.

** Rates are expressed as deaths per 1,000 live births. See Appendix for definitions.

SOURCE: Minnesota Department of Health (1977b)

TABLE 6

SELECTED NATALITY STATISTICS FOR REGIONS OF MINNESOTA - 1970

Category	Minnesota	Northeast Minnesota*	Carlton	Cook	Lake	St. Louis	Duluth
Fetal death rate**	10.3	12.2	8.3	0	14.0	15.1	15.3
Neonatal death rate	13.8	15.1	20.8	35.7	27.9	14.5	13.6
Perinatal death rate	24.1	27.4	29.1	35.7	41.9	29.5	28.9
Infant mortality rate	17.6	19.4	22.9	35.7	27.9	19.4	18.0
Number of live births	68,449	5,554	481	56	215	3,452	1,832

* Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, Pine and St. Louis Counties.

** Rates are expressed as deaths per 1,000 live births. See Appendix for definitions.

SOURCE: Minnesota Department of Health (1971)

Table 7

Average Annual Age-and Sex-adjusted Mortality Rates
Per 100,000 Population for Selected Cancers*

Males & Females

1968 - 1973

Region	All Cancers	Digestive	Respiratory	Breast	Genital	Urinary	Lymphoma	Multiple Myeloma	Leukemia
Carlton	174.4 (9)**	58.0 (9)	31.5 (6)	13.8 (56)	24.4 (21)	9.2 (23)	5.9 (75)	1.1 (77)	11.0 (17)
Cook	167.7 (18)	65.6 (3)	14.9 (81)	21.6 (6)	27.7 (8)	2.6 (84)	11.2 (9)	0 (-)	1.9 (86)
Lake	181.7 (3)	57.2 (10)	21.5 (48)	25.9 (2)	21.7 (42)	15.3 (1)	11.6 (7)	1.6 (68)	8.0 (52)
St. Louis	185.4 (1)	60.6 (5)	34.3 (2)	14.4 (52)	23.6 (25)	8.1 (38)	7.2 (64)	3.3 (27)	9.2 (36)
Duluth	205.5	63.3	38.6	15.5	29.3	8.8	8.3	3.8	10.7
Minnesota	160.8	49.7	26.0	15.3	21.3	7.9	8.0	2.7	8.4
NE***	177.4 (1)	57.8 (1)	32.2 (1)	14.3 (5)	22.6 (1)	8.2 (5)	7.4 (8)	2.8 (2)	8.7 (6)

* Adjusted to the 1970 Minnesota population.

** Numbers in parentheses for counties are the rank among the 87 counties of Minnesota. The northeast region is ranked among eight regions of the state.

*** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis Counties.

SOURCE: Minnesota Department of Health (1977c)

Table 8

Average Annual Age-adjusted Mortality Rates
Per 100,000 Population for Selected Cancers*

Males

1968 - 1973

Region	All Cancers	Digestive	Respiratory	Genital	Urinary	Lymphoma	Multiple Myeloma	Leukemia
Carlton	200.9 (4)**	64.9 (7)	54.1 (6)	19.7 (64)	11.0 (43)	9.7 (38)	1.0 (71)	16.6 (8)
Cook	123.8 (86)	64.2 (8)	21.2 (83)	12.8 (83)	5.3 (77)	0 (87)	0 (-)	3.9 (81)
Lake	160.7 (59)	42.1 (78)	31.5 (64)	28.5 (14)	21.3 (2)	7.0 (65)	0 (-)	9.6 (57)
St. Louis	212.5 (2)	67.4 (5)	56.1 (1)	24.2 (38)	12.2 (25)	8.3 (50)	3.9 (28)	11.1 (36)
Duluth	239.9	71.0	64.9	31.3	12.4	9.5	5.3	13.5
State	176.2	54.7	42.7	22.7	10.7	8.9	2.9	10.2
****	198.0 (1)	64.3 (1)	52.0 (1)	22.2 (6)	11.3 (3)	8.6 (5)	3.2 (2)	10.3 (5)

* Adjusted to the 1970 Minnesota population.

** Numbers in parentheses for counties are the rank among the 87 counties of Minnesota. The northeast region is ranked among eight regions of the state.

*** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis Counties.

SOURCE: Minnesota Department of Health (1977c)

Table 9

Average Annual Age-adjusted Mortality Rates
Per 100,000 Population for Selected Cancers*

Females

1968 - 1973

Region	All Cancers	Digestive	Respiratory	Breast	Genital	Urinary	Lymphoma	Multiple Myeloma	Leukemia
Carlton	149.1 (34)**	51.3 (24)	9.7 (33)	27.1 (55)	29.0 (9)	7.5 (16)	2.2 (31)	1.1 (69)	5.0 (36)
Cook	209.9 (1)	66.9 (3)	8.8 (41)	42.3 (5)	42.0 (1)	0 (-)	21.9 (2)	0 (-)	0 (-)
Lake	201.9 (2)	71.7 (2)	11.9 (16)	50.7 (2)	15.0 (72)	9.5 (6)	16.1 (6)	3.1 (24)	6.5 (34)
St. Louis	159.4 (17)	54.0 (13)	13.4 (8)	28.3 (50)	23.1 (25)	4.2 (56)	6.0 (58)	2.6 (38)	7.3 (39)
Duluth	172.5	55.9	13.3	30.5	27.4	5.4	7.1	2.3	8.1
State	146.1	44.9	10.0	29.8	19.9	5.3	7.1	2.4	6.6
4: ***	157.6 (1)	51.5 (1)	13.2 (1)	28.1 (5)	23.0 (1)	5.2 (4)	6.3 (3)	2.5 (3)	7.2 (3)

* Adjusted to the 1970 Minnesota population.

** Numbers in parentheses for counties are the rank among the 87 counties of Minnesota. The northeast region is ranked among eight regions of the state.

*** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis Counties.

SOURCE: Minnesota Department of Health (1977c)

Table 10

Average Annual Age-and Sex-adjusted Mortality Rates
Per 100,000 Population for Selected Causes of Death*

Male + Female

1968 - 1973

Region	Diabetes	Heart Disease	Cerebro-vascular Disease	Bronchitis & Emphysema	Cirrhosis	Accidents	Suicide	Homicide & Other Violent Deaths
Carlton	18.1 (34)**	348.7 (16)	124.5 (38)	18.0 (6)	12.1 (6)	75.3 (36)	14.8 (10)	3.9 (25)
Cook	32.9 (2)	375.7 (6)	137.5 (23)	11.3 (50)	21.6 (1)	140.0 (1)	15.5 (6)	40.0 (1)
Lake	16.8 (39)	273.4 (72)	111.4 (54)	31.7 (1)	8.2 (33)	59.1 (70)	19.9 (4)	1.4 (61)
St. Louis	21.0 (15)	367.3 (9)	109.3 (60)	14.8 (13)	14.6 (3)	66.0 (59)	14.9 (9)	3.4 (32)
Duluth	18.9	404.0	111.7	15.7	19.2	65.6	15.0	3.1
Minnesota	15.9	312.1	115.3	12.4	9.9	56.6	10.0	5.1
NE***	20.0 (2)	356.9 (1)	113.3 (6)	15.1 (1)	12.4 (1)	70.8 (4)	14.0 (1)	3.9 (2)

* Adjusted to the 1970 Minnesota population.

** Numbers in parentheses for counties are the rank among the 87 counties of Minnesota. The northeast region is ranked among eight regions of the state.

*** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake and St. Louis Counties.

SOURCE: Minnesota Department of Health (1977c)

Table 11

Average Annual Age-adjusted Mortality Rates
Per 100,000 Population for Selected Causes of Death*

Males
1968 - 1973

Region	Diabetes	Heart Disease	Cerebro-vascular Disease	Bronchitis & Emphysema	Cirrhosis	Accidents	Suicide	Homicide & Other Violent Deaths
Carlton	18.6 (22)**	449.0(8)	114.6 (44)	30.2 (9)	13.0 (23)	125.3 (20)	22.7 (16)	2.9 (45)
Cook	15.9 (28)	400.8(25)	109.5 (55)	23.2 (25)	7.2 (67)	151.2 (7)	31.6 (5)	81.7 (1)
Lake	22.6 (9)	348.0(63)	97.8 (70)	53.6 (1)	16.8 (9)	97.1 (57)	38.1 (3)	0 (-)
St. Louis	16.5 (26)	439.8(11)	102.2 (64)	25.7 (20)	20.1 (2)	95.3 (61)	22.6 (17)	4.6 (37)
Duluth	16.6	443.4	103.3	26.9	27.2	90.7	23.0	4.2
Minnesota	14.5	383.6	110.0	21.0	13.2	80.0	15.6	6.9
NE***	15.9 (2)	429.2(1)	108.1 (6)	25.3 (1)	16.6 (1)	103.8 (3)	21.2 (1)	5.5 (2)

* Adjusted to the 1970 Minnesota population.

** Numbers in parentheses for counties are the rank among the 87 counties of Minnesota. The northeast region is ranked among eight regions of the state.

*** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis Counties.

SOURCE: Minnesota Department of Health (1977c)

Table 12

Average Annual Age-adjusted Mortality Rates
Per 100,000 Population for Selected Causes of Death*

Females
1968 - 1973

Region	Diabetes	Heart Disease	Cerebro-vascular Disease	Bronchitis & Emphysema	Cirrhosis	Accidents	Suicide	Homicide & Other Violent Deaths
Carlton	17.6 (43)**	252.3 (29)	133.9(33)	6.3 (13)	11.1 (4)	27.3 (77)	7.2 (6)	4.8 (11)
Cook	49.3 (2)	351.6 (3)	164.3(12)	0 (-)	35.4 (1)	129.3 (1)	0 (-)	0 (-)
Lake	11.2 (78)	201.7 (72)	124.5(43)	10.7 (2)	0 (-)	22.6 (83)	2.4 (50)	2.8 (20)
St. Louis	25.2 (14)	297.6 (10)	116.2(53)	4.4 (33)	9.3 (7)	37.9 (53)	7.6 (5)	2.3 (29)
Duluth	21.2	318.2	119.7	5.0	11.4	41.6	7.4	2.1
Minnesota	17.3	243.4	120.5	4.3	6.7	34.1	4.6	3.3
NE***	23.9 (1)	287.5 (1)	118.3(6)	5.3 (1)	8.4 (2)	39.0 (3)	7.0 (1)	2.3 (4)

* Adjusted to the 1970 Minnesota population.

** Numbers in parentheses for counties are the rank among the 87 counties of Minnesota. The northeast region is ranked among eight regions of the state.

*** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis Counties.

SOURCE: Minnesota Department of Health (1977c)

Table 13

Years-of-life-lost Index for Selected Areas of Minnesota*

Region Year	Northeast Minnesota**	Aitkin County	Carlton County	Cook County	Itasca County	Koochiching County	Lake County	St. Louis County	Duluth
1975	1.20	1.06	1.25	0.71	1.04	0.93	0.81	1.32	1.30
1970	1.15	1.33	1.23	1.68	0.85	1.17	0.93	1.19	1.28

* The index was calculated according to Kleinman (1977) using the Minnesota state mortality experience as the standard.

** Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, Pine, and St. Louis Counties.

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APPENDIX - DEFINITION OF TERMS

Adjustment of rates - the process by which rates for different regions are calculated to reflect identical characteristics of the population, such as age, sex, race, and other factors, in order that meaningful comparisons between the regions can be made.

Communicable diseases - illnesses due to specific infectious agents or their toxic products which arise through transmission of those agents or their products from a reservoir to a susceptible host - either directly as from an infected person or animal, or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment (American Public Health Association, 1970).

Crude death rate - the rate obtained by dividing the number of deaths by the total population and multiplying by 1,000, with no adjustment for age, sex, race or any other variable.

Fetal death - a death prior to the complete expulsion or extraction of a product of conception from his mother, irrespective of the duration of pregnancy. The data in this paper include only fetal deaths of 20 weeks or more (Minnesota Department of Health 1977b).

Infant death - a death under one year of age.

International Classification of Disease (ICD) - deaths were categorized according to the Eighth International Classification of Diseases, Adapted for Use in the United States (Minnesota Department of Health, 1977b). Each cause of death has a specific number (the ICD number).

Neonatal death - a death during the first 28 days of life.

Noncommunicable diseases - illnesses not classified as communicable. Included in this group are the chronic or degenerative diseases, many of which appear to be caused by several factors as opposed to the specific agents causing communicable diseases.

Perinatal deaths - the sum of fetal and neonatal deaths.

Rate - a proportion by which the size of the population is considered in vital statistics. For example, fetal, infant, neonatal, and perinatal death rates are calculated by dividing the number of deaths by the number of live births and multiplying by 1,000. Other death rates are calculated by dividing the number of deaths in the group by the population in the group and usually multiplying by 1,000 or 100,000.