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# Earnings Implications of Person Years Lost Life Expectancy Among First Nations Peoples

## INTRODUCTION

According to the OECD (1999), Canada ranks third among developed countries in life expectancy, behind Japan and Switzerland. This enviable situation does not hold, however, for Aboriginal people in Canada. Canada's First Nations communities have different demographic profiles than the general Canadian population along several dimensions. First Nations communities tend to have a higher percentage of youth, they have a higher rate of population growth, and they have a much higher rate of mortality, particularly in the earlier years. First Nations also have a markedly higher fertility rate than the Canadian population. In 1996 the rate was 69% higher. There were 491 children under the age of five for every 1,000 Aboriginal women in 1996 in comparison to 290 children for every 1,000 women in the general population (Statistics Canada, 1998).

The gap in life expectancy between First Nations people and other Canadians has diminished in the past three decades, but remains close to seven years. The gap is even larger for people living on reserve. In 1990, the life expectancy of First Nations people living on reserves was 62 years for men and 69.6 years for women. The corresponding figures for all Canadians was 74.6 years for men and 80.9 years for women. An examination of age-specific mortality indicates that the gap between Aboriginal and non Aboriginal populations is very wide for age groups between 15-44 years (Frideres, 1998: 180-81). While

infant mortality rates have fallen from 28 to 11 per 1,000 live births in the 1979 to 1993 period, it remains nearly twice the national average (Indian and Northern Affairs Canada, 1997).

A recent study by Health Canada (1996) reports that mortality among registered Indians aged 1 to 4 years in 1993, was four times higher than the national rate. This study also indicates that, for registered Indians in 1993, crude death rates are 4.7 per 1,000 for women and 6.4 per 1,000 for men. The markedly different age structures of the First Nations and the general Canadian populations make a direct comparison of crude rates misleading. Controlling for age structure, the overall age-standardized mortality rate among registered Indians is 10.8 per 1,000 population, but only 6.9 per 1,000 for the general Canadian population. Significant sex differences are also evident with the age-standardized rate for registered Indian women being 10.0 per 1,000 whereas for men it is 11.5 per 1,000 population. Among all Canadians, the corresponding rates of mortality are 6.3 for women and 7.4 for men. While the gap between genders has decreased for the general Canadian population since the 1970s, it increased for the First Nations population between 1975 and 1980. Since then, it has stayed relatively stable.

This combination of a higher concentration of the population in the younger ages and a higher rate of mortality among younger people, suggests that the First Nations populations suffer from many more person years of lost life in comparison to the broader population. That is to say, First Nations experience a much greater amount of unfulfilled life expectancy. While most of the epidemiological and demographic research on person years lost life focusses on the causes of differential mortality, this study seeks to illustrate some consequences of that pattern of differential mortality. In particular, this study attempts to quantify the potential cost to First Nations communities in terms of lost income.

## REVIEW OF LITERATURE

Registered Indians not only have higher overall rates of mortality, but, they also have higher rates of mortality among the younger members of that population. The largest differential in age-specific mortality is to be found among children and infants. Among infants, most of the difference is due to post neonatal (beyond twenty-eight days) mortality. In 1997, the neonatal death rate was nearly twice the national neonatal death rate and the post neonatal death rate was nearly 5 times the national average (Statistics Canada, 1997). Epidemiologically, child mortality and post neonatal mortality are more sensitive to variations in lifestyle and socioeconomic conditions than variations in health care resources (Indian Affairs and Northern Development, 1999: 11, 24). Lifestyle and socioeconomically related causes of death are also the primary determinants of mortality among older members of the population. The mortality pattern for the First Nations population shows marked differences from the general population. In Canada, diseases of the circulatory system are the main cause of death with cancer, injuries and poisoning following in that order (Statistics Canada, 1998c). Among Registered Indians, the primary causes of mortality are injury and poisoning, diseases of the circulatory system, neoplasms (cancer), and diseases of the respiratory system (Indian Affairs and Northern Development, 1999).

Variations in lifestyle and socioeconomic circumstances, one might suggest, are also influenced by some of the same factors affected by high numbers of person years of lost life. That is to say, losses in the potential development of human capital has implications for labour force participation and earnings. Thus, we would argue, there is some reciprocality at both the individual and community level between cause of death and socioeconomic circumstances over the life course of families and communities.

Many studies have catalogued the difference between aboriginal and non Aboriginal education attainment. In 1996, 54% of the Aboriginal population did not have highschool certificates while only 35% of the non-Aboriginal population was in that position (Statistics Canada, 1998b). Labour force participation and unemployment levels differ for the populations as well. Unemployment on reserves is conservatively estimated at nearly three times the national average (Indian Affairs and Northern Development, 1999). Clatworthy et al. (1995) found mean income for workers of Aboriginal origin to be $17,367 but they also found variation between the various Aboriginal groups. Non Status Indians had a mean income of $21,035, registered Indians $15,791, Métis, $18,467 and Inuit, $15,690. They conclude that while the gap for those with full time/full year employment (40+ weeks) is smaller than those with other employment statuses, the earnings of registered Indians and Inuit were behind all other Aboriginals and even further behind the Canadian labour force as a whole. In 1997 the social services dependency rate of First Nations was four times the Canadian average rate (Indian Affairs and Northern Development. 1999b).

Personal years of life lost (PYLL) is a concept that researchers have employed in a variety of instances to illustrate the impact of differential mortality rates. Developed in 1944 by Hersch, the concept has been valuable in a range of applications (Panush and Peritz 1996). PYLL is useful because it allows for the calculation of lost life expectancy attributable to specific causes of death. It also places greater emphasis on deaths that occur at earlier, rather than later, ages. The application PYLL analysis to First Nations provides researchers and those concerned with public policy with a unique indicator of some of the problems facing First Nations communities. This type of analysis can also be used over time as a barometer for a variety of social, economic and health problems in the population.

## USING PERSONAL YEARS OF LIFE LOST

*Personal years of life lost* is defined as the number of years that an individual might have lived in the absence of a defined factor (e.g., cardiovascular disease or homicide). Premature mortality obviously has social and emotional implications, but it also has economic and productivity implications.

Researchers started to use PYLL extensively in the 1970s to investigate public health issues. For example, the costs associated with lost productivity due to premature death associated with heart and cerebrovascular diseases were examined extensively. That trend has continued and remains a major approach for studying the socioeconomic impact of disease. A recent California study using PYLL calculations, for example, suggests that cardiovascular related deaths result in more than 6.4 billion dollars in productivity losses (Fox et al., 1999).

The concept has also gained acceptance in criminology and ethnic studies with several studies of the African-American population (Rose, 1979). Throughout the 1980s and the 1990s, PYLL continued to be useful in quantifying the losses due to the exceptionally high rates of homicide among African-American males in US cities. These studies concluded that interpersonal violence was emerging as the key cause of death for African-Americans in younger age brackets (Martinez-Schnell and Waxwieler 1989). Furthermore, from an economic perspective, the African-American community is affected disproportionately by violence-related mortality among those under the age of 65 (Ammons, 1997).

PYLL has applications in other contexts. Some studies have examined at income distribution and mortality (McIsaac and Wilkenson, 1997). These studies suggested a strong negative correlation between the share of income and PYLL from all causes of death among the poorer deciles of the population and a strong positive correlation among the wealthier deciles. The PYLL approach to assessing the effects of

contributions to mortality has been useful in less dramatic situations such as the relationship between social class and mortality. Because it weights losses in terms of the age of death, PYLL can reveal patterns that other analytical approaches do not express as dramatically. In mortality differential studies relating to social class, the common approach is to construct standardized mortality ratios. When these studies are extended to include PYLL before age 75, however, the picture of what are the most important causes of death become much clearer (Beer et al., 1993).

**Personal Years of Life Lost: A Window on Problems**

What are we looking at when we measure the years of lost life in community? First, we are measuring loss of resources available to a community. Second, we are making a forecast of future difficulties that a community may face given those losses. Third, we are quantifying losses to a community in a manner that can be used to track changes over time and used in the monitoring of the possible impact of policy changes.

Examining the life course from a community resources perspective, we can see that there are several distinct phases involved. The first phase involves dependency. At this stage, a community cares for its young by investing in them. In a real sense, young people are an economic and social burden on the community. In the second phase of the life course, young adults start to pay back that community investment through their economic productivity. As adults, they invest resources into the community by financially supporting and socializing the young. The third stage occurs when people are older and, again, the community is expected to provide some elements of support. Unlike investments in the very young, however, the resource flow is not unidirectional since the elderly also continue make social contributions. Sometimes these contributions are in less economically tangible commodities such as when the community

benefits from the knowledge and wisdom of the elderly. When a life is cut short in the teen years, the community does not see a return on its social and economic investment in that person. Fewer resources are available for care of the elderly and for the nurturing, socializing and care of the young. In this way, PYLL is a gauge of a community's losses.

**Why use PYLL to look at First Nation's populations?**

First Nations communities lose potential years of productivity and potential income as a result of the higher rates of mortality in the younger years. PYLL estimates allow us to compare the social burden of premature mortality between First Nations and non First Nations communities. The construction of PYLL estimates from the recent life tables also allow us to calculate the loss of potential productive years and the loss of potential income for the First Nations communities.

The demographic profiles of First Nations communities vary considerably from those of the general population. It is important, therefore, that this study assesses the potential lost income and potential lost work years productive work years with income standardized to the general Canadian population. This gives us the chance to observe how excess mortality contributes to increasing disparities between First Nations and the rest of rest of the Canadian population. It allows us to gage the additional losses to the First Nations as a whole given projected improvements in income over one's lifespan if there were fewer PYLL.

**DATA**

The data for this analysis are drawn from several sources. National mortality is obtained from the $q_x$ column of Statistics Canada's estimated life table for 1990-1992.[1] Mortality rates for Registered Indians are obtained from a special estimate supplied by Statistics Canada. Data relating to age-sex-specific population counts and estimated income for Registered Indians are obtained from the individual 1996 public use sample file (PUMF) based on the 1996 Census of Canada.

**Assumptions**

Life tables

The life tables used in this analysis are standard cross-sectional life tables, and are subject to the normal assumptions. The primary restriction is the assumption that the age-sex-specific rates of mortality will apply over the lifetimes of the individuals included in the analysis. Recent experience suggests that mortality rates are not stationary, however, and that life expectancies are generally increasing for both the Aboriginal and non Aboriginal populations in Canada.

Registered Indians

The target population for this study is identified as those individuals who identified themselves as Registered Indians on the 1996 PUMF. Unfortunately, there is a substantial undercount of

[1] Statistics Canada (199x) Life tables, Canada and the Provinces, 1990-1992. Ottawa: Supply and Services, Cat No. 84-537. Table 2: Detailed life table, Canada, 1990-1992.

Registered Indians on the file as a consequence of underenumeration.[2] The number of infants (under 1-year of age) is also probably underestimated since we do not have a count of the total number of births for the year.

Income

Age and sex-specific income estimates are also obtained from the 1996 PUMF for registered Indians. Two indicators of income are used: income due to wages and salaries, and total personal income. Both are self-reported gross estimates provided by the census respondents. Mean income is evaluated for each five year age group, including those persons with zero reported income.

For this study, it was decided to focus on the earnings of those people who are generally considered to be "labour market eligible." Thus, only those between the ages of 20 and 64 inclusive are incorporated into the analysis. Consideration has been given to including those between the ages of 15 and 19; however, the large proportion of individuals still in school is problematic. Those 65 years of age and older are also excluded from the analysis. The reason for this exclusion is the high proportion of people 65 years and over whose primary income is due to pensions. Since it is clear that some people outside the range 20-64 have labour force earnings, the totals of the estimates provided are likely be conservative.

## DETAILED CALCULATIONS

[2] We considered augmenting these data with estimates from other sources; however, obtaining reliable age-sex-specific counts to perform the augmentation was not possible within the time allocated for this study.

**Estimating excess mortality**

Our estimates of "excess mortality" contain three components. The first component consists of those people who died in a specific 5-year age interval because they were exposed to the First Nations mortality regime as opposed to the national mortality regime. The estimate is based on the difference between the expected proportion of deaths for each 5-year group[3] multiplied by the estimated number of people within that interval.

The second component consists of those who were likely "excess mortality" from the prior intervals. These are people who would have survived if they had been exposed to the national mortality regime at earlier ages. This group is discounted by the national mortality regime since it would be expected that some of this carry over group would die regardless.

The third component involves a determination of potential years of lost life that takes into account that the data are aggregated into five-year age intervals. Since we are dealing with 5-year age intervals, it is clear that not everyone would die either at the beginning or the end of the interval. We have assumed, therefore, that the deaths would be proportionately staggered over the five years contained in the interval. In order to obtain an estimate of the total potential years of lost life for any five year age group, we assume that, on average, those dying within the interval would have survived for an average of three years. Consequently, those in the first group (excess age-specific mortality), and those in the second group (carry over) who were expected to die in the interval, were weighted by three. The remainder of the carry over group (those not expected to die within

[3] Specifically, the $q_x$ values from the Registered Indian and national life tables.

the interval) are weighted by the full five years of potential survival. Those values are summed in order to generate an estimate of the number of potential years of lost life for the interval.

The total number of potential years of lost life is determined by summing over all of the age intervals. Values are not estimated beyond age 85 because of the small number of people in the Registered Indian population over that age.

### Estimating lost income

One of the objectives of this study is to estimate the amount of lost income due to excess mortality in the Registered Indian population. To obtain this estimate, the average earnings for those alive within the interval is used as an estimate of potential lost income. Mean wage and salary income, and total personal income are used in the analysis. Once the mean income for the interval is estimated, that value is multiplied by the potential years of lost life to obtain an estimate of the total amount of potential earnings lost.

Two of the main assumptions behind this calculation are that the earnings of people within the interval are homogeneous and that death is instantaneous. That is, we have not discounted the earnings for any morbidity effects prior to death.

## RESULTS

The first step in this analysis is to estimate the amount of excess mortality as a consequence of the Registered Indian population having a mortality regime different from the Canadian population at large. The value of that excess mortality can then be estimated in terms of lost income.

**Excess mortality**

Excess mortality is the product of the difference between the mortality experience of Registered Indians and that of other Canadians. Excess mortality for each category of age is summed to produce an estimate of the person years of lost life.

*Males*. In all age categories, Registered Indian men have higher rates of mortality than the Canadian experience for men. The differences in mortality generally increases across increasing categories of age. The total person years of lost life is 106,705 for men (Table 1).

*Females*. In all age categories, Registered Indian women have higher rates of mortality than the Canadian experience for women. The differences in mortality generally increase across increasing categories of age. The total years of lost life is 76,721 (Table 2).

These differences can also be observed by examining Figure 1, which presents the differences across groups in terms of their raw scores, and in Figure 2, which plots the logarithms of these values.

**Lost income**

Lost income is calculated for persons between the ages of 20 and 65. Before 20, some persons are students and after 65 many persons receive pension income. Both of these categories we excluded so as to remove potential distortions. Lost income is calculated by multiplying the person years of lost life in each age category by the average (sex specific) income for Registered Indians in that age category.

*Males*. The total value of lost (potential) income for males is $1,248,799,491 (Table 3).

*Females*. The total value of lost (potential) income for females is $567,347,113 (Table 4).

## DISCUSSION

The results indicate the following: Registered Indians experience excess mortality in all age categories; excess mortality is greater for men in all age categories up to 70-74; total person years of lost life is greater for men (106,205) than for women (76,721); the total number of years of lost life is estimated to be 187,426; the estimated income that is lost to excess mortality for persons between the age of 20 and 65 is $1.8 billion ($1.2 billion for men and $0.6 billion for women).

Lost income is, of course, only one of many costs associated with excess mortality. It is presented here because it is one of the easier costs to estimate and because it provides an opportunity to appreciate the magnitude of the difference that is actually involved by what may appear to the layperson as small differences in the mortality experience of two populations. The differences between Registered Indians and other Canadians are not small, but this is best appreciated by totalling, as we have done here, the person years of lost life and the potential income that is associated with those years.

**Figure 1**

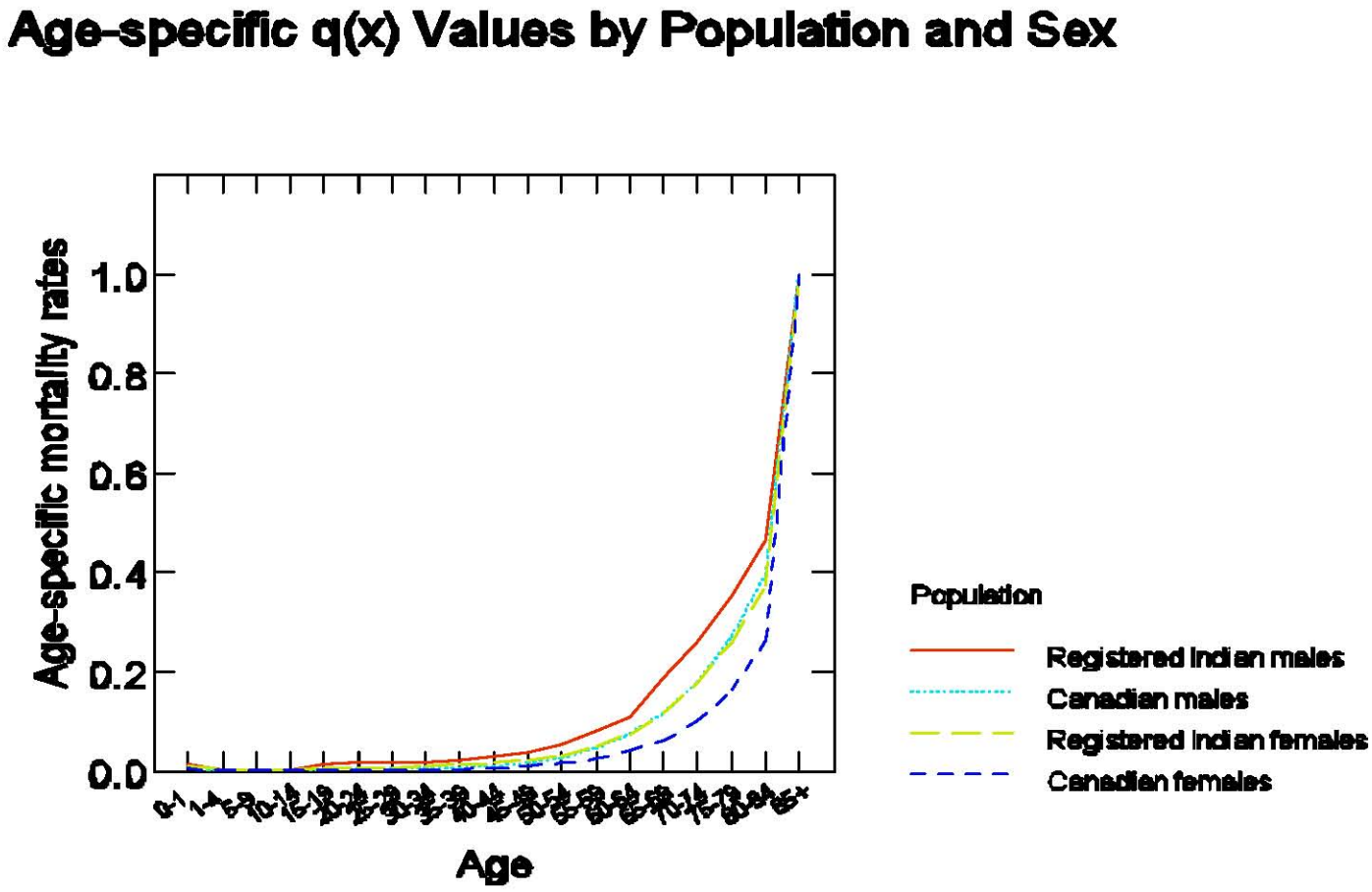
Age-specific q(x) Values by Population and Sex
Age-specific mortality rates
1.0
0.8
0.6
0.4
0.2
0.0
Age
Population
Registered Indian males
Canadian males
Registered Indian females
Canadian females

**Figure 2**

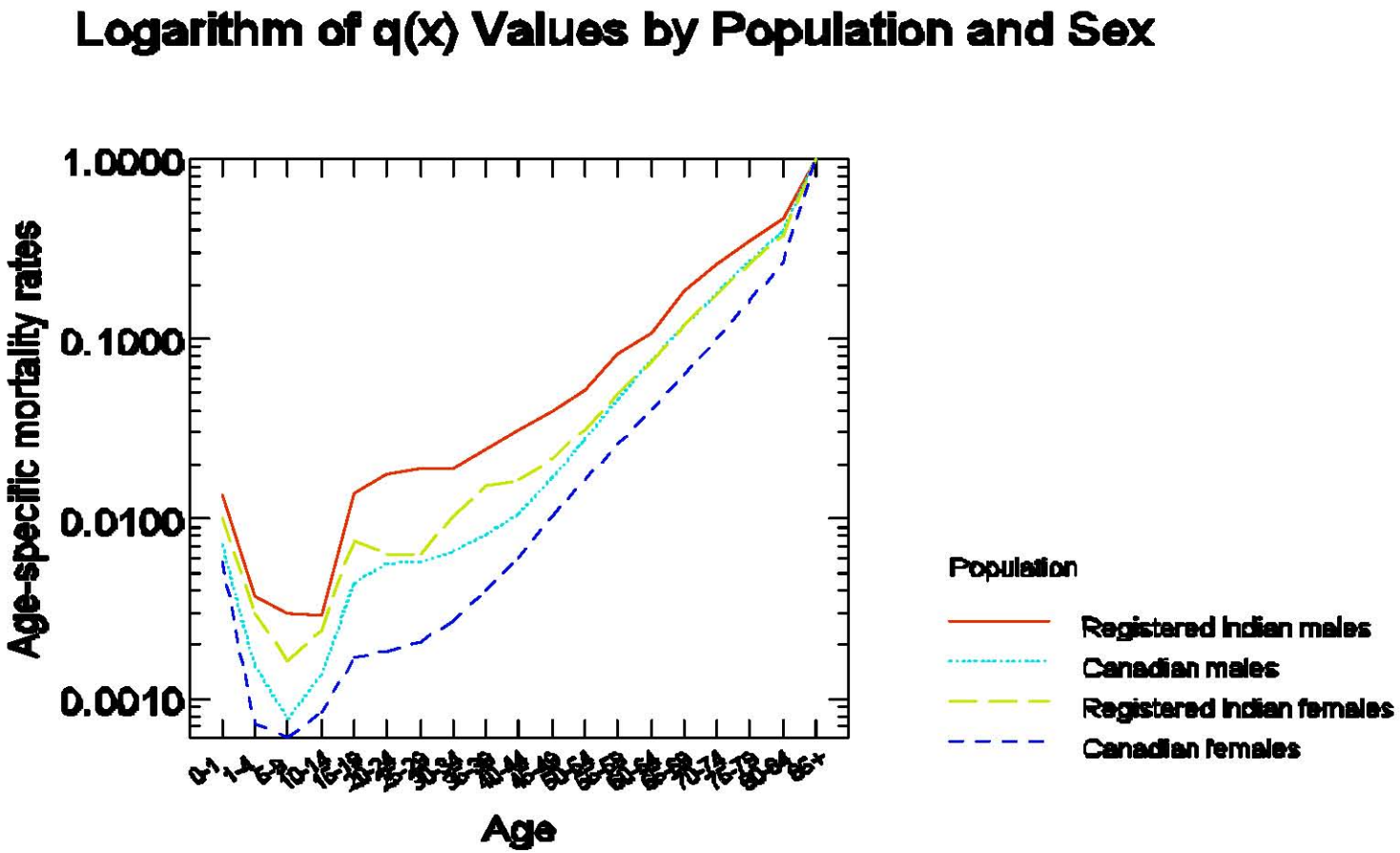
Logarithm of q(x) Values by Population and Sex
Age-specific mortality rates
1.0000
0.1000
0.0100
0.0010
Age
Population
Registered Indian males
Canadian males
Registered Indian females
Canadian females

**Table 1: Excess mortality among male, Registered Indians**

| Age interval (A) | Registered Indian population[a] (B) | Canadian mortality (C) | Registered Indian mortality (D) | Difference (E) | Excess mortality[b] (F) | Cumulative excess[c] (G) | Person years lost life[d] (H) |
|---|---|---|---|---|---|---|---|
| 0-1 | 6,552 | 0.00709 | 0.01335 | 0.00626 | 41 | 41 | 41.0 |
| 1-4 | 27,252 | 0.00152 | 0.00371 | 0.00219 | 60 | 101 | 384.2 |
| 5-9 | 31,824 | 0.00077 | 0.00297 | 0.00220 | 70 | 171 | 713.6 |
| 10-14 | 26,136 | 0.00135 | 0.00289 | 0.00154 | 40 | 211 | 974.2 |
| 15-19 | 23,580 | 0.00439 | 0.01371 | 0.00932 | 220 | 430 | 1,711.6 |
| 20-24 | 19,872 | 0.00563 | 0.01779 | 0.01216 | 242 | 669 | 2,868.2 |
| 25-29 | 20,304 | 0.00576 | 0.01922 | 0.01346 | 273 | 938 | 4,156.0 |
| 30-34 | 18,576 | 0.00657 | 0.01897 | 0.01240 | 230 | 1162 | 5,369.4 |
| 35-39 | 18,144 | 0.00816 | 0.02405 | 0.01589 | 288 | 1441 | 6,657.5 |
| 40-44 | 12,420 | 0.01066 | 0.03076 | 0.02010 | 250 | 1675 | 6,657.5 |
| 45-49 | 10,044 | 0.01684 | 0.03994 | 0.02310 | 232 | 1879 | 9,016.5 |
| 50-54 | 8,280 | 0.02754 | 0.05219 | 0.02465 | 204 | 2032 | 9,904.7 |
| 55-59 | 4,716 | 0.04612 | 0.08209 | 0.03597 | 170 | 2107 | 10,479.2 |
| 60-64 | 4,464 | 0.07580 | 0.10785 | 0.03205 | 143 | 2091 | 10,647.2 |
| 65-69 | 3,168 | 0.11729 | 0.18635 | 0.06906 | 219 | 2064 | 10,620.1 |
| 70-74 | 2,628 | 0.17943 | 0.25950 | 0.08007 | 210 | 1904 | 10,212.4 |
| 75-79 | 936 | 0.27133 | 0.35231 | 0.08098 | 76 | 1463 | 8,716.0 |
| 80-84 | 756 | 0.39625 | 0.46300 | 0.06675 | 50 | 934 | 6,309.0 |
| 85+ | 396 | 1.00000 | 1.00000 | 0.00000 | | | |
| **Total** | | | | | | | **106,705** |

[a] Estimated from 1996 Census Individual PUMF

[b] Column B times column E.

[c] Column F plus prior row in column G multiplied by 1 minus column C.

[d] See text for detailed explanation

**Table 2: Excess mortality among female, Registered Indians**

| Age interval (A) | Registered Indian population[a] (B) | Canadian mortality (C) | Registered Indian mortality (D) | Difference (E) | Excess mortality[b] (F) | Cumulative excess[c] (G) | Person years lost life[d] (H) |
|---|---|---|---|---|---|---|---|
| 0-1 | 5,256 | 0.00577 | 0.0100 | 0.00427 | 22 | 22 | 22.4 |
| 1-4 | 25,452 | 0.00072 | 0.0030 | 0.00231 | 59 | 81 | 288.4 |
| 5-9 | 30,708 | 0.00061 | 0.0016 | 0.00101 | 31 | 112 | 498.8 |
| 10-14 | 25,488 | 0.00083 | 0.0024 | 0.00154 | 39 | 151 | 677.9 |
| 15-19 | 22,536 | 0.00168 | 0.0075 | 0.00579 | 131 | 281 | 1,146.9 |
| 20-24 | 23,580 | 0.00184 | 0.0064 | 0.00461 | 109 | 390 | 1,732.0 |
| 25-29 | 23,544 | 0.00208 | 0.0063 | 0.00417 | 98 | 487 | 2,240.9 |
| 30-34 | 22,068 | 0.00268 | 0.0104 | 0.00771 | 170 | 656 | 2,942.8 |
| 35-39 | 21,456 | 0.00402 | 0.0152 | 0.01120 | 240 | 893 | 3,994.7 |
| 40-44 | 16,092 | 0.00605 | 0.0164 | 0.01037 | 167 | 1055 | 4,956.9 |
| 45-49 | 11,808 | 0.01027 | 0.0214 | 0.01111 | 131 | 1175 | 5,646.1 |
| 50-54 | 8,568 | 0.01643 | 0.0312 | 0.01472 | 126 | 1282 | 6,215.7 |
| 55-59 | 6,588 | 0.02590 | 0.0491 | 0.02318 | 153 | 1402 | 6,801.9 |
| 60-64 | 5,544 | 0.04032 | 0.0747 | 0.03441 | 191 | 1536 | 7,467.1 |
| 65-69 | 3,564 | 0.06266 | 0.1182 | 0.05555 | 198 | 1638 | 8,080.6 |
| 70-74 | 2,304 | 0.09913 | 0.1753 | 0.07615 | 175 | 1651 | 8,389.5 |
| 75-79 | 2,088 | 0.16251 | 0.2613 | 0.09875 | 206 | 1589 | 8,335.5 |
| 80-84 | 540 | 0.26344 | 0.3728 | 0.10940 | 59 | 1229 | 7,283.3 |
| 85+ | 792 | 1.00000 | 1.0000 | 0.00000 | | | |
| **Total** | | | | | | | **76,721** |

[a] Estimated from 1996 Census Individual PUMF

[b] Column B times column E.

[c] Column F plus prior row in column G multiplied by 1 minus column C.

[d] See text for detailed explanation

**Table 3: Lost income due to excess mortality among male, Registered Indians**

| Age interval (A) | Person years lost life (B) | Mean wages and salaries[a] (C) | Total for interval[b] (D) | Mean total income[a] (E) | Total for interval[b] (F) |
|---|---|---|---|---|---|
| 0-1 | 41.0 | | | | |
| 1-4 | 384.2 | | | | |
| 5-9 | 713.6 | | | | |
| 10-14 | 974.2 | | | | |
| 15-19 | 1,711.6 | | | | |
| 20-24 | 2,868.2 | 5,618 | 16,113,567 | 8,625 | 24,738,254 |
| 25-29 | 4,156.0 | 10,053 | 41,780,048 | 14,331 | 59,559,322 |
| 30-34 | 5,369.4 | 14,066 | 75,526,012 | 18,817 | 101,036,042 |
| 35-39 | 6,657.5 | 15,740 | 104,789,723 | 20,578 | 136,998,915 |
| 40-44 | 6,657.5 | 17,168 | 136,036,436 | 23,149 | 183,428,906 |
| 45-49 | 9,016.5 | 16,961 | 152,928,736 | 22,119 | 199,435,807 |
| 50-54 | 9,904.7 | 16,001 | 158,484,980 | 21,024 | 208,236,249 |
| 55-59 | 10,479.2 | 11,444 | 119,924,442 | 17,052 | 178,692,029 |
| 60-64 | 10,647.2 | 6,906 | 73,529,760 | 14,715 | 156,673,967 |
| 65-69 | 10,620.1 | | | | |
| 70-74 | 10,212.4 | | | | |
| 75-79 | 8,716.0 | | | | |
| 80-84 | 6,309.0 | | | | |
| 85+ | | | | | |
| **Total** | **106,705** | | **879,113,703** | | **1,248,799,491** |

[a] 1996 dollars

[b] Column B times column C; may be minor differences due to rounding error.

[c] Column B times column E; may be minor differences due to rounding error.

**Table 4: Lost income due to excess mortality among female, Registered Indians**

| Age interval (A) | Person years lost life (B) | Mean wages and salaries[a] (C) | Total for interval[b] (D) | Mean total income[a] (E) | Total for interval[c] (F) |
|---|---|---|---|---|---|
| 0-1 | 22.4 | | | | |
| 1-4 | 288.4 | | | | |
| 5-9 | 498.8 | | | | |
| 10-14 | 677.9 | | | | |
| 15-19 | 1,146.9 | | | | |
| 20-24 | 1,732.0 | 3,161 | 5,474,977 | 7,103 | 12,302,677 |
| 25-29 | 2,240.9 | 6,804 | 15,247,238 | 11,875 | 26,610,957 |
| 30-34 | 2,942.8 | 7,912 | 23,283,818 | 13,602 | 40,028,626 |
| 35-39 | 3,994.7 | 12,213 | 48,786,795 | 16,977 | 67,817,359 |
| 40-44 | 4,956.9 | 12,953 | 64,206,490 | 16,777 | 83,161,606 |
| 45-49 | 5,646.1 | 10,624 | 59,984,111 | 14,642 | 82,670,120 |
| 50-54 | 6,215.7 | 10,531 | 65,457,575 | 14,267 | 88,679,444 |
| 55-59 | 6,801.9 | 7,410 | 50,401,726 | 12,076 | 82,139,169 |
| 60-64 | 7,467.1 | 4,681 | 34,953,280 | 11,241 | 83,937,154 |
| 65-69 | 8,080.6 | | | | |
| 70-74 | 8,389.5 | | | | |
| 75-79 | 8,335.5 | | | | |
| 80-84 | 7,283.3 | | | | |
| 85+ | | | | | |
| **Total** | **76,721** | | **367,796,010** | | **567,347,113** |

[a] 1996 dollars

[b] Column B times column C; may be minor differences due to rounding error.

[c] Column B times column E; may be minor differences due to rounding error.

**Table 5: Lost income due to excess mortality among male, Registered Indians, based on income levels for total Canadian population.**

| Age interval (A) | Excess mortality (B) | Cumulative excess (C) | Mean wages and salaries* (D) | Total for interval (E) | Mean total income* (F) | Total for interval (G) |
|---|---|---|---|---|---|---|
| 0-1 | 41 | 41 | | | | |
| 1-4 | 60 | 101 | | | | |
| 5-9 | 70 | 171 | | | | |
| 10-14 | 40 | 211 | | | | |
| 15-19 | 220 | 430 | | | | |
| 20-24 | 242 | 669 | 10198 | 29,249,938 | 12194 | 34,974,872 |
| 25-29 | 273 | 938 | 20462 | 85,039,624 | 24016 | 99,809,970 |
| 30-34 | 230 | 1162 | 26963 | 144,775,193 | 31954 | 171,573,880 |
| 35-39 | 288 | 1441 | 30769 | 204,845,933 | 36913 | 245,749,876 |
| 40-44 | 250 | 1675 | 32802 | 259,917,705 | 39552 | 313,403,606 |
| 45-49 | 232 | 1879 | 34278 | 309,067,344 | 41371 | 373,021,328 |
| 50-54 | 204 | 2032 | 33827 | 335,046,023 | 41917 | 415,174,983 |
| 55-59 | 170 | 2107 | 25971 | 272,156,386 | 37425 | 392,185,620 |
| 60-64 | 143 | 2091 | 14714 | 156,663,320 | 31195 | 332,140,292 |
| 65-69 | 219 | 2064 | | | | |
| 70-74 | 210 | 1904 | | | | |
| 75-79 | 76 | 1463 | | | | |
| 80-84 | 50 | 934 | | | | |
| 85+ | 0 | 0 | | | | |
| **Total** | | | | **1,796,761,466** | | **2,378,034,427** |

* 1996 dollars

**Table 6: Lost income due to excess mortality among female, Registered Indians, based on income levels for total Canadian population.**

| Age interval (A) | Excess mortality (B) | Cumulative excess (C) | Mean wages and salaries* (D) | Total for interval (E) | Mean total income* (F) | Total for interval (G) |
|---|---|---|---|---|---|---|
| 0-1 | 22 | 22 | | | | |
| 1-4 | 59 | 81 | | | | |
| 5-9 | 31 | 112 | | | | |
| 10-14 | 39 | 151 | | | | |
| 15-19 | 131 | 281 | | | | |
| 20-24 | 109 | 390 | 7401 | 12,818,825 | 9303 | 16,113,164 |
| 25-29 | 98 | 487 | 14191 | 31,800,934 | 17310 | 38,790,372 |
| 30-34 | 170 | 656 | 16013 | 47,123,834 | 19776 | 58,197,773 |
| 35-39 | 240 | 893 | 16890 | 67,469,824 | 20954 | 83,704,126 |
| 40-44 | 167 | 1055 | 18806 | 93,219,119 | 22716 | 112,600,526 |
| 45-49 | 131 | 1175 | 19050 | 107,558,106 | 22939 | 129,515,769 |
| 50-54 | 126 | 1282 | 19989 | 124,245,701 | 21020 | 130,654,091 |
| 55-59 | 153 | 1402 | 11118 | 75,622,995 | 16928 | 115,141,757 |
| 60-64 | 191 | 1536 | 5772 | 43,099,836 | 14669 | 109,534,215 |
| 65-69 | 198 | 1638 | | | | |
| 70-74 | 175 | 1651 | | | | |
| 75-79 | 206 | 1589 | | | | |
| 80-84 | 59 | 1229 | | | | |
| 85+ | 0 | 0 | | | | |
| **Total** | | | | **602,959,173** | | **794,251,794** |

* 1996 dollars

**Future research**

Two sets of questions about excess mortality are of considerable interest, but beyond the scope of this paper other than to mention them and set them out for future research. The first set has to do with the causes of excessive mortality and the second has to do with the consequences of excessive mortality.

*Causes*. The causes of excessive mortality are important for two major reasons. First, causes of death are clearly implicated with such factors as age of death and whether death is fairly sudden or follows a long period of illness. Younger people are more likely to die from violent causes than are older persons and older persons are more likely to die after having experienced a lengthy illness. The current analysis and the estimates that it generates are based on the assumption that death is instantaneous which means not preceded by reduced income due to illness. As we learn more about the actual causes of death it will be possible to refine these estimates.

Second, they have implications for the disruption to the lives of families and communities and different causes may require different interventions for dealing with consequences or preventing the excess mortality. While Registered Indians are known to have higher rates of infectious diseases than other Canadians, it is not the rampant spread of such conditions that produce the large differences in excess mortality. Registered Indians have significantly higher rates of violent death than other Canadians (e.g., homicide, suicide, deathly fire and other accidents). They also have higher rates of deaths that are associated with the use of alcohol and other substances than the non Native population. Disproportionately the persons involved are male and younger. This means that First Nations communities are deprived of younger men at an earlier age than other Canadian communities. The importance of this, as in the case of

the income that is lost, is that many of these communities are very small so the premature loss of even small number of persons can mean an appreciable loss to a community of, say, 2000 people.

That so many of the premature deaths are violent is frequently shocking to the community and when the deaths take the form of suicide[4] there is the, apparently, imitative feature where one suicide is followed by others and the community finds itself in the midst of a "suicide run;" in a few months three, four or five suicides have been experienced.

Violence, which sometimes ends in death, is frequently fuelled by alcohol, and leaves a trail of broken relationships, spousal abuse and neglected or abused children taken into care as wards of the crown.

Premature death also means that families are left incomplete: there are fewer adults to socialize the young, care for children, and contribute to family income. Role models are reduced in number and the human capital of the community is diminished. We cannot tell from the data examined in this paper whether rates of excess mortality are correlated with level of human capital; that will have to await another study.

With respect to income, we can see that First Nations families and communities are deprived of $1.8 billion per year in potential income or about $9.0 billion in a five year period. Whatever multiplier effect that would have in reserve communities is also lost. The economic base of most First Nations communities is already precarious and economic development has been difficult and slow. The loss of income flow through families, in particular, and communities in general, as well as the attendant loss of

[4] The incidence of suicide for non Aboriginal persons in Canada is done 20/100,000 population per year. For Aboriginal Canadians it is at least 50/100,000 population per year.

human capital means that premature death (excess mortality) is population outcome that reduces financial capacity and inhibits the development of community capacity to develop at rate that could be possible if the mortality experience of Registered Indians mirrored that of the rest of the Canadian population.

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