International Journal of Health Geographics

Research

Geographic disparity in premature mortality in Ontario, 1992–1996

Chris A Altmayer*[1], Brian G Hutchison[2,3,4], Vicki L Torrance-Rynard[3], Jeremiah Hurley[2,3,5], Stephen Birch[2,3] and John D Eyles[2,3,6]

Address: [1]Health Research Methodology Program, McMaster University, Hamilton, Ontario, Canada (previous affiliation), [2]Centre for Health Economics and Policy Analysis, McMaster University, Hamilton, Ontario, Canada, [3]Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario, Canada, [4]Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada, [5]Department of Economics, McMaster University, Hamilton, Ontario, Canada and [6]School of Geography and Geology, McMaster University, Hamilton, Ontario, Canada

Email: Chris A Altmayer* - chris@hpdhc.com; Brian G Hutchison - hutchb@mcmaster.ca; Vicki L Torrance-Rynard - rynardv@mcmaster.ca; Jeremiah Hurley - hurley@mcmaster.ca; Stephen Birch - birch@mcmaster.ca; John D Eyles - eyles@mcmail.cis.mcmaster.ca

* Corresponding author

Published: 25 September 2003

International Journal of Health Geographics 2003, **2**:7

Received: 30 July 2003
Accepted: 25 September 2003

This article is available from: http://www.ij-healthgeographics.com/content/2/1/7

Abstract

Background: Standardized mortality ratios are used to identify geographic areas with higher or lower mortality than expected. This article examines geographic disparity in premature mortality in Ontario, Canada, at three geographic levels of population and considers factors that may underlie variations in premature mortality across geographic areas. All-cause, sex and disease chapter specific premature mortality were analyzed at the regional, district and public health unit level to determine the extent of geographic variation. Standardized mortality ratios for persons aged 0–74 years were calculated to identify geographic areas with significantly higher or lower premature mortality than expected, using Ontario death rates as the basis for the calculation of expected deaths in the local population. Data are also presented from the household component of the 1996/97 National Population Health Survey and from the 1996 Statistics Canada Census.

Results: Results showed approximately 20% higher than expected all-cause premature mortality for males and females in the North region. However, disparity in all-cause premature mortality in Ontario was most pronounced at the public health unit level, ranging from 20% lower than expected to 30% higher than expected. Premature mortality disparities were largely influenced by neoplasms, circulatory diseases, injuries and poisoning, respiratory diseases and digestive diseases, which accounted for more than 80% of all premature deaths. Premature mortality disparities were also more pronounced for disease chapter specific mortality.

Conclusion: Geographic disparities in premature mortality are clearly greater at the small area level. Geographic disparities in premature mortality undoubtedly reflect the underlying distribution of population health determinants such as health related behaviours, social, economic and environmental influences.

Background

Mortality statistics are an important means of describing and monitoring population health status. [1,2] This report describes the geographic disparity in all-cause, sex and disease chapter specific premature mortality in Ontario, Canada, at the regional, district health council and public health unit levels. Analyses of geographic variations in population health status can help to guide policies that address the economic, social and environmental determinants of health, identify needs for health care services and assist health planners to target and prioritize health promotion and disease prevention programs within geographic areas. Our objectives were to examine the extent of geographic disparity in premature mortality and to consider factors that may underlie variations in premature mortality across geographic areas.

Results

Table 1 presents all-cause SMRs for Ontario planning regions, district health councils and public health units from 1992–1996. Results from this table are discussed below by region. Table 2 shows Ontario average annual premature mortality rates per 100,000 by ICD-9 chapter, total number of premature deaths and the percentage of total premature deaths attributable to each disease chapter from 1992–1996. Information in this table is required to understand the impact of variations in disease chapter SMRs on variation in total premature mortality. Neoplasms and circulatory system diseases were the dominant causes of premature mortality among Ontarians aged 0–74. These two disease chapters accounted for 64% and 69% of all premature deaths among males and females respectively. Injuries and poisonings, respiratory system diseases, and digestive system diseases accounted for an additional 19% (males) and 15% (females). Overall, the five leading disease chapters accounted for over 80% of all premature deaths. Table 3 (see additional file 1) and Table 4 (see additional file 2) present SMRs for males and females by disease chapter at the public health unit level.

South West Region

The South West region had higher than expected all-cause premature mortality, with SMRs of 1.07 (95% CI 1.0711–1.0714) for males and 1.06 (95% CI 1.059–1.060) for females. High SMRs of 1.12 (95% CI 1.119–1.120) for males and 1.11 (95% CI 1.106–1.108) for females in Essex-Kent-Lambton (district health council) contributed to high regional SMRs. At the public health unit level, Chatham-Kent had the highest all-cause SMRs of 1.26 (95% CI 1.255–1.259) for males and 1.29 (95% CI 1.289–1.296) for females, which contrasted with other South West public health unit areas whose SMRs ranged from 0.95 to 1.12. Windsor-Essex and Elgin-St. Thomas also had substantially elevated all-cause SMRs: 1.10 and 1.12 for males and 1.10 and 1.07 for females, respectively. Chatham-Kent had particularly high SMRs for circulatory system diseases (1.44 for males and 1.50 for females), but SMRs were also elevated for the other leading causes of premature mortality: neoplasms, injuries and poisonings, respiratory system diseases and digestive system diseases. Endocrine, nutritional and metabolic diseases and immunity disorders SMRs were substantially higher than expected in Elgin-St. Thomas and in Chatham-Kent among females.

Central South Region

The Central South region also had higher than expected all-cause premature mortality, with SMRs of 1.06 (95% CI 1.0561–1.0564) for males and 1.07 (95% CI 1.0678–1.0683) for females. High SMRs of 1.10 (95% CI 1.103–1.104) for males and 1.12 (95% CI 1.115–1.118) for females in Grand River (district health council) contributed to high regional SMRs. Public health unit area SMRs ranged from 1.03 (95% CI 1.026–1.027) for males and 1.04 (95% CI 1.039–1.040) for females in Niagara to 1.13 (95% CI 1.126–1.130) for males and 1.14 (95% CI 1.140–1.146) for females in Brant, demonstrating greater geographic disparity than at the regional and district health council levels.

Brant had high SMRs for all five leading disease category causes of premature death. SMRs were particularly high (greater than 1.20) for both males and females for circulatory system, respiratory system and digestive system diseases and for injuries and poisonings in males. Haldimand-Norfolk also had substantially elevated SMRs for circulatory system diseases: 1.26 and 1.21 for males and females, respectively.

Central West Region

The Central West region demonstrated the lowest all-cause premature mortality with SMRs of 0.85 (95% CI 0.8511–0.8513) for males and 0.89 (95% CI 0.8910–0.8913) for females. District health council area SMRs ranged from 0.79 (95% CI 0.7896–0.7899) for males and 0.84 (95% CI 0.844–0.845) for females in Halton-Peel to 0.96 (95% CI 0.9588–0.9595) for males and 0.97 (95% CI 0.970–0.971) for females in Waterloo Region-Wellington-Dufferin. Standardized mortality ratios at the public health unit level were similar to those at the district health council level.

With the exception of neoplasms among females in Halton, Halton and Peel public health unit SMRs were among the lowest in the province for neoplasms, circulatory system diseases, injuries and poisonings, respiratory system diseases, and digestive system diseases.

Table 1: All-cause standardized mortality ratios, ages 0–74, 1992–1996*

Planning Region	Males	Females	District Health Council	Males	Females	Public Health Unit	Males	Females
South West	1.07	1.06	Essex-Kent-Lambton	1.12	1.11	Windsor-Essex	1.10	1.10
						Chatham-Kent	1.26	1.29
						Lambton	1.05	0.97
			Thames Valley	1.06	1.03	Middlesex-London	1.06	1.02
						Elgin-St. Thomas	1.12	1.07
						Oxford	1.05	1.04
			Grey-Bruce-Huron-Perth	0.99	1.02	Grey-Bruce-Owen Sound	1.01	1.04
						Huron	0.95	1.00
						Perth	0.98	0.97
Central South	1.06	1.07	Grand River	1.10	1.12	Brant	1.13	1.14
						Haldimand-Norfolk	1.08	1.09
			Hamilton	1.06	1.07	Hamilton	1.06	1.07
			Niagara	1.03	1.04	Niagara	1.03	1.04
Central West	0.85	0.89	Halton-Peel	0.79	0.84	Halton	0.79	0.87
						Peel	0.79	0.83
			Waterloo Region Wellington-Dufferin	0.96	0.97	Waterloo	0.96	0.96
						Wellington-Dufferin-Guelph	0.96	0.98
Toronto	0.99	0.92				Toronto	0.99	0.92
Central East	0.92	0.96	Simcoe-York	0.89	0.94	Simcoe	1.05	1.05
						York	0.78	0.87
			Durham-Haliburton Kawartha-Pine Ridge	0.95	0.99	Durham	0.90	0.98
						Haliburton-Kawartha Pine Ridge	0.98	0.96
						Peterborough	1.04	1.03
East	1.01	1.05	Champlain	0.96	0.99	Ottawa-Carleton	0.88	0.95
						Renfrew	1.08	1.08
						Eastern Ontario	1.14	1.14
			Southeastern Ontario	1.10	1.14	Kingston-Frontenac-Lennox-Addington	1.03	1.06
						Hastings-Prince Edward	1.17	1.20
						Leeds-Grenville-Lanark	1.12	1.16
North	1.21	1.20	Algoma-Cochrane-Manitoulin-Sudbury	1.25	1.23	Algoma	1.18	1.21
						Porcupine	1.32	1.25
						Sudbury	1.27	1.24
			Muskoka-Nippissing-Parry Sound-Timiskaming	1.16	1.13	Muskoka-Parry Sound	1.06	1.01
						North Bay	1.27	1.20
						Timiskaming	1.23	1.31
			Northwestern	1.19	1.20	Thunder Bay	1.14	1.17
						Northwestern	1.28	1.27

Data source: Vital Statistics Records, Office of the Registrar General, Ontario Ministry of Consumer and Commercial Relations. **Notes:** * All standardized mortality ratios are statistically different from 1.00 ($p < 0.05$) except the female Huron SMR

Toronto

Toronto had similar all-cause premature mortality to the province for males with an SMR of 0.99 (95% CI 0.9887–0.9888) and lower than expected premature mortality for females with an SMR of 0.92 (95% CI 0.9199–0.9201). Large geographic disparities in all-cause premature mortality were observed in standardized mortality ratios at the public health unit level (i.e., East York, Etobicoke, North York, Scarborough, Toronto City and York City). However, place of residence miscoding is a significant source of error in calculating vital statistics measures for public health units in Toronto [3] (personal communication, F. Goettler, 2002); therefore, the data are not presented.

Table 2: Ontario average annual mortality rates, number of deaths and percent distribution, ages 0–74, 1992–1996

Disease Chapter (ICD-9)	Males			Females		
	Rate per 100,000	Number of deaths (1992–96)	Percent of deaths	Rate per 100,000	Number of deaths (1992–96)	Percent of deaths
Infectious and Parasitic Diseases	14.22	3,708	3.45	3.45	901	1.34
Neoplasms	137.11	35,751	33.27	114.11	29,714	44.33
Endocrine, Nutritional and Metabolic Diseases and Immunity Disorders	12.62	3,293	3.06	9.04	2,350	3.51
Diseases of Blood and Blood-Forming Organs	1.00	261	0.24	0.87	225	0.34
Mental Disorders	5.20	1,356	1.26	2.25	587	0.88
Diseases of the Nervous System and Sense Organs	8.13	2,123	1.98	6.81	1,775	2.65
Diseases of the Circulatory System	127.78	33,288	30.98	63.93	16,626	24.80
Diseases of the Respiratory System	21.60	5,632	5.24	14.10	3,673	5.48
Diseases of the Digestive System	17.34	4,522	4.21	9.37	2,437	3.64
Diseases of the Genitourinary System	3.87	1,010	0.94	2.90	754	1.12
Complications of Pregnancy, Childbirth and Puerperium	...	...	...	0.18	47	0.07
Diseases of the Skin and Subcutaneous Tissue	0.20	52	0.05	0.15	40	0.06
Diseases of the Musculoskeletal System and Connective Tissue	0.94	244	0.23	1.65	429	0.64
Congenital Anomalies	4.04	1,053	0.98	3.51	915	1.37
Certain Conditions Originating in the Perinatal Period	4.40	1,147	1.07	3.07	798	1.19
Symptoms, Signs and Ill-Defined Conditions	13.59	3,544	3.30	6.82	1,776	2.65
Injury and Poisoning	40.25	10,482	9.75	15.32	3,985	5.94
All Causes	412.28	107,466	100.00	257.53	67,032	100.00

Data source: Vital Statistics Records, Office of the Registrar General, Ontario Ministry of Consumer and Commercial Relations **Notes:** ... Figures not applicable

With the exception of digestive system diseases among males, Toronto SMRs were lower than expected for all of the leading causes of premature deaths: neoplasms, circulatory system diseases, injuries and poisonings, respiratory system diseases, and digestive system diseases. However, infectious and parasitic disease SMRs were substantially higher than expected in Toronto among both sexes (especially among males).

Central East Region

The Central East region had lower than expected all-cause premature mortality with SMRs of 0.92 (95% CI 0.9186–0.9188) for males and 0.96 (95% CI 0.9639–0.9643) for females. At the public health unit level, York's SMRs of 0.78 (95% CI 0.7776–0.7782) for males and 0.87 (95% CI 0.870–0.871) for females contrasted with Simcoe's SMRs of 1.05 (95% CI 1.051–1.052) for males and 1.05 (95% CI 1.045–1.047) for females, demonstrating greater geographic disparity in premature mortality at the small area level. York public health unit also demonstrated SMRs among the lowest in the province for neoplasms, circulatory system diseases, injuries and poisonings, respiratory system diseases, and digestive system diseases.

East Region

The East region all-cause premature mortality was similar to the province for males, with an SMR of 1.01 (95% CI 1.008–1.009), and higher than expected for females, with an SMR of 1.05 (95% CI 1.0479–1.0484). However, geographic disparity in premature mortality at the public health unit level revealed SMRs ranging from 0.88 (95% CI 0.883–0.884) for males and 0.95 (95% CI 0.9465–0.9474) for females in Ottawa-Carleton to 1.17 (95% CI 1.169–1.171) for males and 1.20 (95% CI 1.203–1.207) for females in Hastings-Prince Edward. All-cause SMRs were also substantially higher than expected for Leeds-Grenville-Lanark and Eastern Ontario public health unit areas.

Ottawa-Carleton had low SMRs for circulatory system diseases, injuries and poisonings, and respiratory system diseases for both males and females. Conversely, Hastings-Prince Edward and Leeds-Grenville-Lanark had high SMRs in each of the five leading disease chapters for both males and females. Eastern Ontario public health unit also had high SMRs for both males and females for neo-

plasms, circulatory system diseases, injuries and poisonings, and respiratory system diseases.

North Region

The North region had the highest SMRs, indicating approximately 20% greater than expected all-cause premature mortality relative to the province; 1.21 (95% CI 1.2105–1.2110) for males and 1.20 (95% CI 1.1956–1.1964) for females. All public health unit areas within the North region, except for Muskoka-Parry Sound, had substantially higher than expected premature mortality, ranging from 14% to 32% higher among males and 17% to 31% higher among females. Public health unit level all-cause SMRs were highest for Northwestern (1.28 for males and 1.27 for females) and Porcupine (1.32 for males and 1.25 for females).

All public health unit areas except Muskoka-Parry Sound and Thunder Bay had high neoplasm SMRs for both males and females. Circulatory system SMRs were also elevated for all public health unit areas for both males and females except Muskoka-Parry Sound and Northwestern. Respiratory system SMRs were elevated for all public health unit areas except Thunder Bay and Northwestern. Standardized mortality ratios for injuries and poisonings were substantially higher than expected in all public health units, ranging from 1.34 to 3.17 for males and 1.23 to 3.58 for females. Because neoplasms and circulatory system diseases together account for approximately two-thirds of all deaths, high SMRs in these disease categories account for most of the higher all-cause SMRs in the North region.

Discussion

There were significant disparities in the risk of premature mortality among geographic areas in Ontario during the period 1992–1996. The North region demonstrated approximately 20% higher than expected all-cause premature mortality among both sexes relative to the province. Some public health unit areas in the North had greater than 25% higher than expected premature mortality. South West, Central South and East regions had higher than expected premature mortality at the regional level; however, there was significant variation at the district health council and public health unit level. Central West, Toronto and Central East all had lower than expected premature mortality. However, despite lower than expected all-cause premature mortality at the regional level, substantial disparities existed at the public health unit level.

Previous work has demonstrated geographical variation in other measures of mortality within Ontario. From 1988–1992, life expectancy varied among public health units by as much as 6.0 years for males and 4.3 years for females.[4] In 1996/97, age standardized premature (age 0–64) mortality rates ranged from 141 to 239 per 100,000 population among district health councils.[5] The current work examined premature mortality at three geographic levels of population simultaneously and clearly identifies greater disparity in premature mortality at the small area level. Geographic disparities in premature mortality undoubtedly reflect the underlying distribution of population health determinants such as health related behaviours, and social, economic and environmental influences.

High neoplasm SMRs were common among public health units in the North region. Tobacco use as a risk factor has been suggested to account for the majority of cancer deaths.[6] Data from the 1996/97 National Population Health Survey indicated that the prevalence of regular smoking was significantly higher than the provincial rate among all North Region health areas, which may contribute to high neoplasm SMRs revealed in the present study (Table 5) (see additional file 3).[7] However, due to the lag time required to develop cancer, this potential association assumes that a higher smoking rate is not a new phenomenon, but a characteristic of the resident population over time. Health areas in the South West (Essex), Central South (Brant, Haldimand-Norfolk), and East (Hastings-Prince Edward and Leeds-Grenville-Lanark) also demonstrated smoking prevalence rates which were greater than the provincial average, potentially leading to higher than expected neoplasm SMRs. However, other important risk factors for neoplasm SMRs must be considered, such as diet, occupation, family history and alcohol.[6] Furthermore, research in Ontario has also shown significant associations between high neoplasm SMRs for males and decreased environmental protection expenditures, which remained significant after controlling for conventional risk factors such as smoking.[8]

High circulatory system disease SMRs were common in South West, Central South, East and North region public health units. Conditions or risk factors associated with circulatory system disease deaths include hypertension, diabetes, smoking, high body mass index, inactivity and high stress. Data from the 1996/97 National Population Heath Survey (Table 5) (see additional file 3) [7] and the 1990 Ontario Health Survey indicate that prevalence rates for many of these conditions were higher than provincial averages in Kent-Lambton, Eastern Ontario and in Northern Ontario.[9] High circulatory system disease SMRs in the areas identified in the present study may be related to higher prevalence of these conditions or risk factors.

High respiratory system disease SMRs were common in the South West, East and North region public health units. Data from the 1996/97 National Population Health Survey indicated that the prevalence of regular smoking was significantly higher than the provincial rate among all

North region public health units which may contribute to high respiratory system disease SMRs. Prevalence of regular smoking was also significantly higher in Essex; Brant, Haldimand-Norfolk; and Hastings-Prince Edward and Leeds-Grenville-Lanark. High respiratory system disease SMRs may be related to higher prevalence of smoking in these areas.

Conventional risk factors such as smoking and low physical activity may be related to observed premature mortality for neoplasms, circulatory and respiratory system diseases. However, determinants of health also include factors such as social class, income and education.[10] Geographic distribution of these social and economic determinants of health may also influence premature mortality in Ontario. For example, a comparative analysis of ten Ontario regional municipalities examined a variety of indicators including work hierarchy and organization, unemployment, social networks, health choices and social rank.[11] Municipalities whose indicators were consistently lower than average (Hamilton-Wentworth, Niagara, and Sudbury) demonstrated high SMRs in the current research. Municipalities with determinants of health indicators consistently higher than average (Halton and York) demonstrated low SMRs in the current research. Current results also indicated public health units with the highest SMRs (North region) had higher than provincial rates of unemployment, economic families classified as low income, and residents aged 15+ with less than grade 9 education (Table 5) (see additional file 3).[12] Conversely, public health units with the lowest SMRs (Halton, Peel and York) had lower than provincial rates of unemployment, economic families classified as low income, and residents aged 15+ with less than grade 9 education. Previous research in Ontario has shown education to be an important variable in understanding premature mortality.[8] This could be a direct effect of greater knowledge of potential health threats, or mediated through higher income, allowing better nutrition and housing. Although figures on unemployment, education and income represent data from the 1996 Census, it is important to note that social and economic determinants influence health over a lifetime.

Standardized mortality ratio ranges widened from region to district health council to public health unit (more so for disease chapter specific than all-cause SMRs), indicating greater geographic variation in premature mortality at the public health unit level. Although the wider range in standardized mortality ratios observed at the small area level may be attributable in part to smaller numbers of observed deaths resulting in less stable estimates, it is important to note that all standardized mortality ratios (except for Huron females) were significantly different from 1.00. In most cases, standardized mortality ratios were based on very large numbers of expected and observed deaths leading to very narrow confidence intervals.

Although death certificate diagnoses and coding practices may lead to classification errors, virtually all deaths in Ontario are registered to comply with reporting requirements [13,14] (incomplete death registration has been noted in certain areas of Ontario).[15] Even though all-cause mortality is not influenced by diagnosis coding errors, assuming complete death registration, systematic variation in underlying cause of death reporting practices among geographic areas could bias the results of disease chapter specific analyses. Similarly, misclassifying the place of residence on death certificates could also bias results.[16]

Conclusions

Significant disparities in the risk of premature mortality among geographic areas exist in Ontario. This research has examined the extent of geographic premature mortality disparity and considered various determinants of health which may underlie observed variation. Knowledge of conventional risk factors such as smoking and physical activity coupled with other determinants of health such as environment, education and social hierarchy are all important to understand health inequalities. Although no simple policy prescription is evident from the results, analyses of geographic variation in premature mortality help generate hypotheses for future research aimed at gaining a better understanding of health determinants. Clearly, an appropriate policy response to premature mortality disparity in Ontario would need to extend well beyond health care to address the wide range of determinants of health that are outside the reach of the health care system.

Methods

Mortality data including place of residence and International Classification of Diseases (ICD)-9 chapter of the underlying cause of death for Ontario residents aged 0–74 for years 1992–1996 were obtained from Vital Statistics Records, Office of the Registrar General, Ontario Ministry of Consumer and Commercial Relations. Deaths for all Ontario residents (regardless of where they occurred) were included in the tabulations; deaths of non-Ontario residents that occurred in Ontario were excluded. Population data for years 1992–1996 were obtained from Statistics Canada inter-censal population estimates.

Standardized mortality ratios (SMRs) compare observed deaths in a local population to the deaths expected if the local population has been subject to provincial average death rates for each age group, sex and where applicable disease chapter. Expected deaths were based on provincial

age group, sex and disease chapter-specific mortality rates. To obtain expected deaths, provincial rates were applied to the seven regional planning areas, 16 district health council areas and 37 public health units in Ontario, giving the expected number of deaths in the area if the age and sex-specific provincial rates were applied to these populations for each disease chapter.[17]

Standardized mortality ratios were calculated as observed deaths divided by expected deaths by geographic level, sex and disease chapter. An SMR value of one for a geographic area indicates the same mortality rate as for the whole of Ontario after accounting for differences in the age distribution of the population between the geographic area and the Ontario population. For example, an SMR of 1.08 indicates that the region experienced mortality 8% higher than expected. Similarly, an SMR of 0.92 indicates that the region experienced mortality 8% lower than expected.

Aggregation of deaths over the five-year period 1992–1996 reduced the impact of year-to-year fluctuations. This was especially important when analyzing less populous geographic areas, as annual mortality rates calculated from small numbers of observed deaths can vary substantially from one year to the next. Ninety-five % confidence intervals on SMRs were calculated.[18] In most cases the SMRs were based on very large numbers of expected and observed deaths leading to very narrow confidence intervals.

Although no single relative mortality measure is preferable for all purposes, premature mortality (death between birth and age 75) was selected to focus on potentially preventable deaths,[19,20] given an Ontario average life expectancy of 78.9 years in 1996.[21]

Standardized mortality ratios were used to examine and focus on opportunities to *reduce geographic disparity in premature mortality* within the determinants of health framework. Had the objective of the study been to examine and focus on opportunities to reduce premature mortality *as a loss to society*, potential years of life lost prior to age 75 may have been a better measure (i.e., deaths at earlier ages result in greater losses to society compared to deaths nearer to the cut-off age).[22]

Authors' contributions

CA and BG drafted the manuscript, participated in the design of the study and the interpretation of results.

VTR participated in the design of the study and performed statistical analysis.

JH, SB, and JE participated in the interpretation of results.

All authors read and approved the final manuscript.

Additional material

Additional File 1

Standardized mortality ratios for males by public health unit, ages 0–74, 1992–1996. This table presents standardized premature (ages 0–74) mortality ratios for males by disease chapter at the public health unit level, 1992–1996.

Click here for file

[http://www.biomedcentral.com/content/supplementary/1476-072X-2-7-S1.doc]

Additional File 2

Standardized mortality ratios for females by public health unit, ages 0–74, 1992–1996. This table presents standardized premature (ages 0–74) mortality ratios for females by disease chapter at the public health unit level, 1992–1996.

Click here for file

[http://www.biomedcentral.com/content/supplementary/1476-072X-2-7-S2.doc]

Additional File 3

Demographic, social, economic and health characteristics for public health units and health areas, 1996. This table presents demographic, social and economic characteristics from the 1996 Statistics Canada Census at the public health unit level and health characteristics from the 1996/97 National Population Health Survey at the health area level.

Click here for file

[http://www.biomedcentral.com/content/supplementary/1476-072X-2-7-S3.doc]

Acknowledgements

This work was completed during a Studentship Program, funded jointly by the Centre for Health Economics and Policy Analysis and the Faculty of Health Sciences, McMaster University, Hamilton, Ontario, Canada.

References

1. Rothman KJ and Greenland S: *Modern Epidemiology* 2nd edition. *United States of America: Lippincott Williams and Wilkins*; 1998.
2. Eyles J, Birch S, Chambers S, Hurley J and Hutchison B: **A needs-based methodology for allocating health care resources in Ontario, Canada: development and application.** *Soc Sci Med* 1991, **33:**489-500.
3. Woodward GL and Ardal S: *Data quality report: effect of residence code errors on fertility rates New Market: Central East Health Information Partnership*; 2000.
4. Manuel DG, Goel V and Williams JI: **Life expectancy at birth at the local level in Ontario.** *Can J Pub Health* 1999, **90:**52-54.
5. Manuel DG and Schultz SE: *Adding years to life and life to years: life and health expectancy in Ontario Toronto: Institute for Clinical Evaluative Sciences*; 2001.
6. Miller AB: **Planning cancer control strategies.** *Chronic Dis Can* 1992, **Suppl 1:**1-40.
7. Statistics Canada: *National Population Health Survey 1996/97 Ottawa: Statistics Canada*; 1998.
8. Jerrett M, Eyles J and Cole D: **Socioeconomic and environmental covariates of premature mortality in Ontario.** *Soc Sci Med* 1998, **47:**33-49.
9. Kirk-Gardner R and Steven D: *An analysis of the Ontario Health Survey from a cardiovascular perspective Toronto: Ministry of Health*; 1994.
10. Evans RG and Stoddart GL: **Producing health, consuming health care.** *Soc Sci Med* 1990, **31:**1347-1363.

11. Pennock M and Foulds R: *Determinants of health in Hamilton-Wentworth: a comparative analysis of Hamilton-Wentworth with other Ontario regional municipalities Hamilton: Regional Municipality of Hamilton-Wentworth*; 1994.
12. Statistics Canada: *Profile of Census Divisions and Subdivisions in Ontario: 1996 Census of Population Ottawa: Statistics Canada*; 1998.
13. Wigle DT, Mao Y, Semenciw R and Davies JW: **Premature deaths in Canada: impact, trends and opportunities for prevention.** *Can J Pub Health* 1990, **81:**376-381.
14. Statistics Canada: *Mortality: Summary List of Causes Ottawa: Statistics Canada*; 1995.
15. Eyles J, Birch S and Chambers S: **Fair shares for the zone: allocating health-care resources for the native populations of the Sioux Lookout Zone, Northern Ontario.** *Can Geogr* 1994, **38:**134-150.
16. Manuel DG, Goel V and Williams JI: **The derivation of life tables for local areas.** *Chron Dis Can* 1998, **19:**52-56.
17. Fleiss JL: *Statistical Methods for Rates and Proportions* 2nd edition. *New York: John Wiley and Sons*; 1981.
18. Armitage P and Berry G: *Statistical Methods in Medical Research* 2nd edition. *Oxford: Blackwell Scientific Publications*; 1987.
19. Last JM: *A Dictionary of Epidemiology* 3rd edition. *Toronto: Oxford University Press*; 1995.
20. Shah CP: *Public Health and Preventive Medicine in Canada* 4th edition. *Toronto: University of Toronto Press*; 1998.
21. Canadian Institute for Health Information: *Health Indicators 2000 Ottawa: Canadian Institute for Health Information*; 2000.
22. Centers for Disease Control: **Premature mortality in New Hampshire.** *Morb Mortal Wkly Rep* 1987, **36:**765-768.