ABSTRACT

Objective: To assess the impact of HIV/AIDS on hospitalization and mortality patterns in Canada.

Methods: Hospitalizations and deaths due to HIV/AIDS were compared with select causes of morbidity and mortality among men and women across provinces, regions and select cities between 1987-94. Patterns of hospitalization and mortality were characterized by calculating age-specific, standardized rates, rate ratios and potential years of life lost before 65 years.

Results: A total of 28,462 hospitalizations (26,153 in men and 2,309 in women) and 8,739 deaths (8,192 in men and 547 in women) were attributed to HIV/AIDS during the study period. Rates of HIV/AIDS hospitalization were highest for men in Ontario, Quebec and British Columbia, and in Montreal, Toronto and Vancouver; while among women they were highest in Quebec and in Montreal, Toronto and Vancouver. Mortality rates followed a pattern similar to the rates found for hospitalization.

Conclusions: Our analysis reveals the considerable impact of HIV/AIDS on patterns of morbidity and mortality in Canada.

ABRÉGÉ

Objectif : Mesurer l'impact du VIH/sida sur les tendances des hospitalisations et de la mortalité au Canada.

Méthodes : On a comparé les hospitalisations et la mortalité associées au VIH/sida et à d'autres grandes causes de morbidité et de mortalité chez les hommes et les femmes selon les provinces, les régions et certaines villes, entre 1987 et 1994. Les tendances des hospitalisations et de la mortalité ont été évaluées par le calcul des taux standardisés, des taux par tranche d'âge et des ratios de taux, et le calcul des années potentielles de vie perdues avant l'âge de 65 ans.

Résultats : En tout, 28 462 hospitalisations (26 153 hommes; 2 309 femmes) et 8 739 décès (8 192 hommes; 547 femmes) ont été attribués au VIH/sida au cours de la période de l'étude. Les taux d'hospitalisation associés au VIH/sida chez les hommes ont été les plus élevés en Ontario, au Québec et en Colombie-Britannique, et dans les villes de Montréal, Toronto et Vancouver; tandis que chez les femmes, les taux d'hospitalisation associés au VIH/sida ont été plus élevés au Québec et dans les villes de Montréal, Toronto et Vancouver. Les taux de mortalité ont suivi la même tendance que les taux d'hospitalisation.

Conclusions : Selon notre analyse, l'impact du VIH/sida sur la situation de la morbidité et de la mortalité au Canada est considérable.

Morbidity and Mortality Related to Human Immunodeficiency Virus in Canadian Men and Women, 1987-94

Amy E. Weber,¹ Robert S. Hogg^{1,2}

Over the last decade, HIV infection has emerged as a leading cause of premature morbidity and mortality in many industrialized nations including the United States of America, Canada, much of Western Europe and parts of Oceania. Despite a recent decline in mortality attributed to antiretroviral therapy in the United States, HIV remains the most common underlying cause of death among those aged 25-44 years, accounting for 19% of deaths from all causes in 1996 in this age group.¹ Similar rates of high mortality have been reported in men and women in France, Spain, and Italy and in the cities of Amsterdam and London.²⁻⁷ In Australia, high rates of mortality have been reported in young adults.⁸

We have shown the considerable impact of HIV/AIDS on patterns of mortality in Canadians, especially among young adults living in large urban centres.^{9,10} This work updates our previous research efforts by characterizing the recent as well as the historical impact of HIV/AIDS on mortality and hospitalization. In an effort to better understand these recent trends, we have characterized gender and regional differences in HIV/AIDS morbidity and mortality in Canada over an eight-year period

and compared these patterns to those exhibited by other leading causes of death and hospitalization.

METHODS

This analysis was based on data for all hospitalizations and deaths in Canada attributed to HIV/AIDS and other select causes for the years 1987 through 1994. Hospitalization records attributed to these causes were compiled by Statistics Canada in fiscal years and information on deaths were categorized by calendar year. In order to limit the effect of small numbers, data from the four Atlantic provinces (Newfoundland, Prince Edward Island, Nova Scotia, and New Brunswick) and the 3 prairie provinces (Manitoba, Saskatchewan, and Alberta) were combined. In-depth local area analysis was limited to the cities of Montreal, Toronto and Vancouver, because they were known a priori to have high prevalence of HIV/AIDS. Censal and post-censal annual estimates of the Canadian population were used to generate age- and gender-specific local, regional, and national population figures.^{11,12}

Patterns of HIV/AIDS mortality and morbidity in this analysis were compared with those trends exhibited by five other select causes of morbidity and mortality often attributed to men and women during early and middle adulthood. For both men and women, hospitalizations and deaths due to HIV/AIDS (ICD-9 042-044) were compared with those deaths attributed to lung cancer (ICD-9 162), coronary heart disease (ICD-9 410-414), motor vehicle accidents (ICD-9 E810-E819), and suicides (ICD-9 E950-E959). In the hospital statistics, motor vehicle accidents and suicides were lumped with other external

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causes into the category injury and poisonings (ICD-9 176-191), because of the lack of more detailed classification of hospitalizations. Finally, among women, trends of breast cancer (ICD-9 174) morbidity and mortality were examined.

Hospitalization and mortality patterns attributed to HIV/AIDS and other select causes were characterized by calculating age-specific, standardized rates and ratios of observed to expected rates. Standardized rates were calculated by directly adjusting age-specific rates for the eight-year study period to the Canadian age-structure in 1991.¹³ Once rates were standardized, period rate ratios were constructed by comparing observed Canadian morbidity and mortality rates with those rates exhibited by the provinces and select cities. Confidence intervals around rate ratios were calculated using multipliers based on Byar's approximations of the exact Poisson limits.¹⁴ Finally, potential years of life lost (PYLLs) were calculated to determine the impact of premature mortality prior to 65 years. Age-specific and standardized rates were expressed as rates per hundred thousand population. Rates of hospitalization were expressed over a fiscal year, which starts on April 1st in a given year and ends on March 31st of the following year.

RESULTS

For the period April 1, 1987 to March 31, 1994, Statistics Canada recorded a total of 28,462 hospitalizations attributed to HIV/AIDS. Of these, 26,153 hospitalizations (92%) occurred in men and 2,309 (8%) in women. In comparison, during the same eight-year calendar period from 1987 to 1994, Statistics Canada documented 8,739 deaths (8,192 in men and 547 in women) due to HIV/AIDS. The majority of these cases and deaths occurred in the provinces of Ontario (14,839 hospitalizations and 3,433 deaths), Quebec (12,122 hospitalizations and 2,887 deaths) and British Columbia (6,392 hospitalizations and 1,543 deaths). In these three provinces, the majority of deaths and hospitalizations occurred in the cities of Montreal, Toronto and Vancouver (21,403 out of 33,353 hospitalizations and 4,305 out of 7,863 deaths).

TABLE I
Number of Cases and Bed Days, Age-specific Hospitalization Rates* for Ages 25 to 44 Years, and Average Length of Stay for HIV/AIDS and Other Select Causes of Hospitalization in Canada, by Gender, 1987/88-1993/94

Causes	Cases of Hospitalization	Bed Days	Average Length of Stay (in days)	Age-specific Hospital Rate (25-44 years)
Males				
HIV/AIDS	26,153	376,652	13.9	74
Heart Disease	56,828	703,304	12.0	160
Lung Cancer	3,199	38,276	10.7	9
Injury/Poisoning	347,297	255,603	46.5	980
All Causes	1,965,022	1,601,530	37.1	5,548
Females				
HIV/AIDS	2,309	36,540	15.5	6
Heart Disease	11,488	157,960	14.7	32
Lung Cancer	3,459	46,224	10.8	10
Breast Cancer	20,363	15,760	86.6	57
Injury/Poisoning	192,937	1,223,500	5.6	542
All Causes	5,112,391	28,619,322	5.3	14,370

* Expressed as rates per 100,000 population.

TABLE II
HIV/AIDS Hospitalization Cases, Standardized Rates* per 100,000 Population, Rate Ratios (RR) and Confidence Intervals (95% CI), by Gender, for Canada, the Provinces or Regions, and Select Cities, 1987/88-1993/94*

Province, Region or City	Cases of Hospitalization	Standardized Rate†	RR	95% CI‡
Males				
Canada	34,424	37.1	1.00	—
Province/ region				
British Columbia	5,979	54.0	1.47	(1.43 - 1.50)
Prairies	3,002	18.0	0.51	(0.50 - 0.53)
Ontario	13,818	40.9	1.09	(1.07 - 1.11)
Quebec	10,352	44.0	1.15	(1.13 - 1.18)
Atlantic	8,214	12.1	0.34	(0.32 - 0.36)
Cities				
Montreal	8,214	210.9	5.16	(5.05 - 5.28)
Toronto	4,486	277.3	6.32	(6.27 - 6.47)
Vancouver	6,860	243.2	5.80	(5.64 - 5.98)
Females				
Canada	3,584	3.8	1.00	—
Province/ region				
British Columbia	413	3.7	0.97	(0.88 - 1.07)
Prairies	208	1.4	0.37	(0.32 - 0.42)
Ontario	1,021	2.9	0.76	(0.71 - 0.81)
Quebec	1,770	7.3	1.90	(1.81 - 1.99)
Atlantic	172	2.6	0.71	(0.62 - 0.81)
Cities				
Montreal	1,302	37.8	8.05	(7.62 - 8.50)
Toronto	329	13.8	3.03	(2.71 - 3.37)
Vancouver	211	11.5	2.81	(2.44 - 3.21)

* Source: Canadian Centre for Health Statistics, Statistics Canada, Ottawa.

† Rate was standardized to the total Canadian population in 1994.

‡ Number of observed to expected cases when rates for Canada were applied.

Table I compares male and female rates of hospitalization and average lengths of stay for those individuals aged 25 to 44 years. In this group, HIV/AIDS was the third-leading cause of hospitalization among men, surpassing lung cancer over the study period. Among women, hospital-

ization due to HIV/AIDS had the lowest number of cases reported over the study period compared to other select leading causes. The average length of stay in hospital for HIV/AIDS cases was 13.9 days in men and 15.5 days in women. For men, the average length of stay for HIV/AIDS-

related cases exceeded the length of stay for heart disease and lung cancer. In women, the length of time spent in hospital for HIV/AIDS was second only to the number of days recorded for breast cancer.

As shown in Table II, hospitalization rates for men for the fiscal years 1987/88 to 1993/94 were significantly higher than the Canadian average in the provinces of British Columbia (Rate ratio [RR] 1.47; 95% CI: 1.43, 1.50), Ontario (RR 1.09; 95% CI: 1.07, 1.11), and Quebec (RR 1.15; 95% CI: 1.13, 1.18), and in the cities of Montreal (RR 5.16; 95% CI: 5.05, 5.28), Toronto (RR 6.32; 95% CI: 6.27, 6.47), and Vancouver (RR 5.80; 95% CI: 5.64, 5.98). Women exhibited a lower rate of hospitalization than men, exceeding the Canadian average only in the province of Quebec (RR 1.90; 95% CI: 1.81, 1.99) and in the cities of Montreal (RR 8.05; 95% CI: 7.62, 8.50), Toronto (RR 3.03; 95% CI: 2.71, 3.37) and Vancouver (RR 2.81; 95% CI: 2.44, 3.21).

Figure 1 illustrates the age-specific hospitalization rates for males and females aged 25 to 44 years for HIV/AIDS and other major causes of morbidity. Hospitalization due to HIV/AIDS has increased for both males and females. Between 1987/88 and 1993/94, the rate of hospitalization for males rose from 45.1 to 106.1 per 100,000 population. During the same time period, the hospitalization rate for females increased from 2.9 to 13.2 per 100,000 population. Among men, hospitalizations due to HIV/AIDS were second only to heart disease and surpassed the rates attributed to lung cancer. Women were hospitalized at a lower rate for HIV/AIDS than for breast cancer, heart disease and until 1992, lung cancer. As of 1993, HIV/AIDS surpassed lung cancer as a major cause of morbidity in women aged 25 to 44 years.

Table III presents the median age of death, age-specific death rates from 25 to 44 years, and potential years of life lost before age 65 years for HIV/AIDS and other selected causes of death. The median age of death from HIV/AIDS for men was 39 years. In the 25-44 age group, HIV/AIDS was the third-leading cause of death among men surpassing both lung cancer and coronary heart disease over the

study period. Of the 4,900,095 PYLLs among men from all causes over the study time interval, HIV/AIDS accounted for 206,137 (4%), motor vehicle accidents for 13%, suicides for 12%, coronary heart disease for 9%, and lung cancer for 4%. Among women, the median age of death from HIV/AIDS was 36 years and HIV/AIDS deaths accounted for 14,840 PYLLs (0.6%) of the 2,618,590 PYLLs from all causes over the study period. In comparison, among women motor vehicle accidents accounted for 9%, breast cancer for 6%, suicides for 5%, lung cancer for 5% and coronary heart disease for 4% of all PYLLs.

Table IV describes male and female death rates and standardized mortality ratios for Canada, the provinces or regions, and the select cities. For males, rates of mortality were significantly higher than the Canadian average in British Columbia, Quebec and Ontario and in the cities of Vancouver, Montreal and Toronto. The rate ratio was highest in British Columbia (RR 1.50; 95% CI: 1.43,1.58) and lowest in the Atlantic region (RR 0.37; 95% CI: 0.32, 0.41). For the three cities, male rate ratios were highest in Toronto (RR 7.51; 95% CI: 7.15, 7.88) and lowest in Montreal (RR 4.91; 95% CI: 4.67, 5.16). Among women, mortality rates were significantly higher than the Canadian average only in the province of Quebec (RR 2.04; 95% CI: 1.81, 2.29) and the cities of Montreal (RR 6.65; 95% CI: 5.60, 7.84), Vancouver (RR 2.07; 95% CI: 1.28, 3.17), and Toronto (RR 1.69; 95% CI: 1.08, 2.52). In all other provinces or regions, rates of death for women were significantly lower than the Canadian average.

Figure 2 compares Canadian male and female age-specific mortality rates from 25 to 44 years for HIV/AIDS and other select causes of death. As shown in Figure 2, HIV/AIDS male age-specific death rates for 25 to 44 years had surpassed those rates attributed to motor vehicle accidents, coronary heart disease and lung cancer. Only the rates of death attributable to suicide for this age group remained higher. In comparison, the death rates among women for the same age group were of similar magnitude to those for coronary heart disease.

TABLE III
Median Age at Death, Age-specific Mortality Rate (ASMR) from Ages 25 to 44 Years, and Potential Years of Life Lost (PYLLs) Before 65 Years from HIV/AIDS and Other Select Leading Causes of Death in Canada, by Gender, 1987-94*

Cause of Death	Observed Deaths†	Median Age at Death	ASMR 25-44 Years	PYLLs 0-64 Years‡
Males				
HIV/AIDS	8,067	39.3	16.4	206,137
Heart Disease	49,185	74.6	12.6	439,937
Lung Cancer	25,702	70.4	3.5	197,034
Motor Vehicle Accidents	17,856	30.3	19.9	611,069
Suicides	19,974	37.6	28.2	565,320
All causes	267,255	75.5	159.7	4,900,095
Females				
HIV/AIDS	513	35.9	0.9	8,335
Heart Disease	13,248	81.8	2.3	76,821
Breast Cancer	12,414	67.5	6.9	149,305
Lung Cancer	13,244	69.5	3.3	122,443
Motor Vehicle Accidents	6,972	36.6	7.0	179,166
Suicides	5,314	41.7	7.6	103,900
All causes	145,495	78.6	74.7	2,618,590

* Source: Canadian Centre for Health Statistics, Statistics Canada, Ottawa.

† Number of observed deaths before 65 years of age.

‡ Number of years of life lost when a person dies before the age of 65 years.

TABLE IV
HIV/AIDS Deaths, Mortality Rates, Standardized Mortality Ratios (SMR), and Confidence Intervals (95% CI), by Gender, for Canada, the Provinces or Regions, and Select Cities, 1987-1994*

Province, Region or City	Observed Deaths	Mortality Rate†	SMR	95% CI‡
Males				
Canada	8,192	7.65	1.00	—
Province/region				
British Columbia	1,478	11.54	1.50	(1.43, 1.58)
Prairies	588	3.18	0.43	(0.40, 0.47)
Ontario	3,278	8.35	1.09	(1.06, 1.13)
Quebec	2,598	9.63	1.22	(1.17, 1.26)
Atlantic	248	2.68	0.37	(0.32, 0.41)
Cities				
Montreal	1,557	39.97	4.91	(4.67, 5.16)
Toronto	1,620	65.47	7.51	(7.15, 7.88)
Vancouver	941	51.01	6.05	(5.67, 6.45)
Females				
Canada	547	0.50	1.00	—
Province/region				
British Columbia	56	0.43	0.83	(0.65, 1.12)
Prairies	21	0.11	0.23	(0.14, 0.36)
Ontario	155	0.38	0.77	(0.65, 0.90)
Quebec	289	1.03	2.04	(1.81, 2.29)
Atlantic	24	0.25	0.53	(0.34, 0.78)
Cities				
Montreal	142	3.61	6.65	(5.60, 7.84)
Toronto	24	0.97	1.69	(1.08, 2.52)
Vancouver	21	1.13	2.07	(1.28, 3.17)

* Source: Canadian Centre for Health Statistics Canada, Ottawa.

† Rate was standardized to the total Canadian population in 1994. Rates are expressed as deaths per 100,000 population.

‡ Number of observed to expected cases when rates for Canada were applied.

DISCUSSION

Further to our previous analyses, this work reveals the considerable impact of

HIV/AIDS on patterns of hospitalization and mortality in Canada. When compared with select leading causes of morbidity and mortality, HIV/AIDS was found to be the

Figure 2. Panel A: Male age-standardized mortality rates from 25 to 44 years, by select causes of death for Canada, 1987-1994.
Panel B: Female age-standardized mortality rates from 25 to 44 years, by select causes of death for Canada, 1987-1994.

leading cause of hospitalization and death for men and women, especially during early adulthood. For men, morbidity and mortality due to HIV/AIDS was highest in the provinces of Ontario, Quebec and British Columbia and in the cities of Montreal, Vancouver, and Toronto. Hospitalization and death rates for women were considerably lower than for men. The rates of hospitalization and death for women were higher than the Canadian average in the province of Quebec and cities of Montreal, Toronto and Vancouver.

Our findings are consistent with those of other industrialized nations with highly developed vital statistics registration systems. Similar trends of increased HIV/AIDS hospitalization have been documented in the United States.¹⁵⁻¹⁷ Published studies of national mortality trends also reveal similar patterns of HIV/AIDS mortality to those exhibited in Canada.²⁻⁸ In the future, regional and local patterns of morbidity and mortality will likely decline in Canada because of the introduction and widespread use of newer and more effective combination antiretroviral therapy regimens.¹⁸⁻²²

As with all studies based on administrative data sources, this analysis is subject to the limitations in data accuracy due to under reporting. For example, it is well known that deaths attributable to HIV/AIDS are under reported, particularly with respect to underlying or antecedent causes of death.^{23,24} In this country, it is estimated from a study conducted in Quebec that AIDS deaths are underestimated by 10 to 20%.²⁵ Furthermore, deaths related to HIV/AIDS may not be counted as such, because the deceased person may have never been diagnosed with HIV infection. These limitations imply that using information recorded on death certificates confers a conservative limitation. Finally, records of hospitalization likely confer similar types of limitations to our estimates of cases attributed to HIV/AIDS in this study.

In summary, our analysis reveals that premature morbidity and mortality resulting from HIV infection and AIDS among Canadian men and women is currently on par with levels associated with other lead-

ing causes of premature morbidity and mortality. With the introduction of viral-driven antiretroviral therapy, rates of HIV/AIDS morbidity and mortality in Canada will most likely decline in the future.

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