Non-communicable Disease and Injury-related Mortality in Rural and Urban Places of Residence

A Comparison between Canada and Australia

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ABSTRACT

Background: Few published studies looking at cross-national comparisons of rural-urban health status are available. As a first step towards addressing the lack of information on how rural populations in Canada compare with rural populations elsewhere in the world, this paper examines and contrasts Canadian mortality risks of selected diseases in rural and urban areas with those of Australia.

Methods: Age-standardized mortality ratios for selected causes of deaths were calculated at the national level and broken down into place of residence categories using country-specific definitions of rurality (Metropolitan Influence Zones in Canada and the Australian Standard Geographical Classification [ASGC] Remoteness in Australia).

Results: Patterns of rural-urban mortality risk were mostly similar in both countries. However, depending on the causes of death examined, important differences were found. Mortality from motor vehicle accidents, suicide and a few cancer sites showed similar urban-rural gradients in both Canada and Australia. Notable differences were found for diabetes, all cancers combined, as well as lung and colorectal cancer. Rural Australians were at higher risk of dying from these diseases than their urban counterparts, whereas rural Canadians were at lower risk than urban Canadians.

Discussion: Overall, the patterns that have emerged from this comparison of Canadian and Australian mortality risks suggest that health status disparities between rural and urban populations are not limited to a specific country or region of the world. However, there are also important differences between the two countries, as the geographic mortality patterns varied according to sex and according to disease category. This analysis is an initial step in promoting discussion of rural health in an international context.

MeSH terms: Rural health; urban health; Canada; Australia; chronic disease; injury; mortality

La traduction du résumé se trouve à la fin de l'article.

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The term "place" embodies a lot of things. It is a shorthand way of describing a host of geographically circumscribed factors that may have health consequences for communities, populations, families and individuals. Before the 1990s, research on the effect of place on health was scarce, partly because of concerns about the ecological fallacy and a lack of methodological and computing techniques. Another reason was the unavailability of data or suppression of the release of small numbers. Place was often treated as a residual category: an unspecified black box of somewhat mystical influences on health that remain after investigators have controlled for a range of factors.¹ Since the early 1990s, there has been greater interest in the role of place in shaping people's health experiences. It is now generally recognized that "place" should have a special status in the population health debate as an important explanatory variable.²⁻⁷

One important aspect of place is its degree of rurality, and this is the focus of the present study. Rural communities seem to have unique characteristics with respect to health determinants, including demographic, economic, social and cultural factors, as well as physical environment factors.^{8,9} Most rural communities have a high dependency ratio, an aging population, a low proportion of immigrants and visible minorities¹⁰ and relatively high proportions of Aboriginal people as compared with urban centres.¹¹ Rural Canadians tend to have lower levels of formal education, employment, income and access to goods and services. In addition, they are more likely to engage in primary industry occupations, such as farming, logging, mining and fishing. These factors may contribute to rural Canadians having specific health vulnerabilities, such as poorer health status, lower life expectancy, higher accident and injury rates and higher levels of disability, than urban Canadians.^{12,13}

International context of rural-urban health

Few published studies looking at cross-national comparisons of rural-urban health status are available. The studies that have used a cross-national perspective focus mainly on issues related to health care resources or health services delivery,¹⁴⁻¹⁷ or specific issues such as cardiovascular diseases or road accidents.^{18,19}

Studies published in the United States and in Australia have shown higher overall mortality rates among people living in rural areas and small towns,^{20,21} but in the United Kingdom studies have shown that urban areas have higher mortality rates.²² Such findings may mask more subtle variations in smaller geographic areas within countries. For example, in the United Kingdom, some rural northern districts have higher mortality rates than urban districts in the south, and the most remote rural districts have higher and more rapidly increasing mortality rates than less remote areas.²²

Mortality rates for ischemic heart disease have been reported to be higher among men but lower among women living in rural communities compared with their urban counterparts in the United States,²¹ higher in both sexes living in rural and remote areas in Australia²³ and lower in both sexes living in rural Quebec.²⁴ As with cardiovascular mortality, cancer mortality shows variations when analyzed by place of residence. Geographic differences in cancer mortality seem to vary according to sex and cancer site. In Australia, all-cancer mortality is higher among males living in rural and remote areas, but female rates are similar across all rural-urban categories.²⁰ Breast cancer mortality is either similar or lower in rural areas of these three countries, and deaths rates for cervical and lung cancer appear higher in rural and remote areas.^{20,24,25}

Injuries, motor vehicle accidents and suicide are increasingly recognized as major health problems in rural areas. All studies examined show that mortality from unintentional injury, motor vehicle accidents and suicide rise sharply with increasing rurality.^{20,21,24,26,27} Specific rural subgroups at higher risk of injuries that have been previously studied include farmers,²⁸ children²⁹ and males.^{21,24,26,27}

These studies, though presenting valuable information on specific health conditions of rural populations in each of their respective countries, are unable to inform us about how the health situation of rural populations in Canada compares with the health situations of rural populations elsewhere in the world. As a first step towards addressing this gap in knowledge, this paper compares Canadian mortality risks of selected diseases in rural and urban areas with those of Australia.

Australia has been chosen as the comparative country because it has many common characteristics with Canada as well as differences in other aspects. Both countries have a large land mass and low population density; very uneven distribution of population; unequal distribution of health care resources and difficulties in accessing some health services; similar demographic and health characteristics (e.g., people aged 0-14 years: 20.2% of the population in Australia, 18.5% in Canada; aged 65+: 12.7% in Australia, 12.9% in Canada; infant mortality: 4.83 deaths/1,000 live births in Australia, 4.88 deaths/1,000 live births in Canada; life expectancy at birth: 77.3 for men and 83.1 for women in Australia, and 76.4 for men and 83.4 for women in Canada). They also have similar, though not identical, health care systems: both countries have a universal health insurance system or Medicare; the principal objective of Medicare in both countries is to remove financial barriers to access to essential health care services, particularly hospital and physician services; and about two-thirds of total health expenditure in both countries is derived from government tax revenue.³⁰

METHODS

Mortality has been chosen as the health indicator for cross-national comparisons for three reasons: (1) the data are readily available in both countries at the rural/urban level; (2) it is a standardized and reliable indicator of disparities; and (3) it is a widely used indicator at the global level.

Canadian data

Mortality records from the Canadian Annual Mortality Database for the period 1986-1996 were aggregated to the Census Subdivision (CSD) level. In an effort to address and minimize the problems associated with the changing of boundaries of territorial units over time, CSDs were standardized to the 1996 census boundaries. The CSD data were then assigned to a Metropolitan Influenced Zone (MIZ) category in order to classify urban and rural place of residence. They were, in turn, aggregated to the national level. The causes of death were selected using the 9th edition of the *International Classification of Disease*

(ICD-9). The following non-communicable diseases/injuries were chosen: circulatory diseases; diabetes; lung, cervical, breast, colorectal and prostate cancers; motor vehicle accidents; and suicide. Those causes were chosen on the basis of their importance as public health issues and their acknowledged burden on health care systems. All-cause and cause-specific standardized mortality ratios (SMRs) were stratified by rural and urban category, age group and sex. The statistical significance of the SMRs was tested using the Byar's method and was based on the assumption of a Poisson distribution.³¹

The MIZ classification distinguishes rural communities with less access to the labour markets of urban centres from those with greater access.^{32,33} Access to urban labour markets is used as a proxy for access of a population to services such as health and educational facilities, financial institutions, shopping and cultural centres, and sports facilities. The MIZ classification reflects the relative influence of an urban centre on a rural area. This classification system is applied at the CSD level and disaggregates non-Census Metropolitan Areas/Census Agglomerations (CMA/CAs)* into four zones of metropolitan influence (Strong MIZ, Moderate MIZ, Weak MIZ, No MIZ), primarily defined on the basis of commuting flows of the employed labour force to and from CMAs/CAs.³³ Strong MIZ areas comprise CSDs where 30% or more of the employed labour force work in any CMA/CA. Moderate MIZ areas refer to CSDs where between 5% and 30% of the employed labour force work in any CMA/CA. Weak MIZ areas are CSDs where between 1% and 5% of the employed labour force work in any CMA/CA. Finally, the No MIZ areas include all CSDs that have a small employed labour force (less than 40 people) as well as any CSD that has no commuters to a CMA/CA urban core.

* In Canada, Census Metropolitan Areas (CMAs) have urban core populations greater than 100,000 and include all neighbouring municipalities where 50% or more of the work force commutes into the urban core. A Census Agglomeration (CA) is a large urban area, known as the urban core. CAs have urban core populations of between 10,000 and 100,000 and include all neighbouring municipalities where 50% or more of the work force commutes into the urban core. Non-CMA/CAs are those areas with less than 10,000 population and where less than 50% of the work force commutes to an urban area.

Australian data

We relied on data published by the Australian Institute of Health and Welfare on mortality in regional and remote areas.²⁰ This report uses mortality data from the Australian National Mortality database covering the period of 1997-1999 and contains detailed information on causes of death, analytic procedures, statistical testing and population data. Rurality is defined using the Australian Standard Geographical Classification (ASGC) Remoteness structure and is allocated on the basis of the post code of the residential address of the deceased. Causes of death are classified using ICD-10 codes.

The ASGC Remoteness classification is a six-level categorization of remoteness in Australia based on the Accessibility/Remoteness Index of Australia (ARIA+).^{34,35} The ARIA+ is a continuous variable that assigns to each populated location a remoteness score of between 0 (high accessibility) and 15 (extreme remoteness). It is a geographic index that defines remoteness as accessibility to goods and services and opportunities for social interaction across Australia, based on road distance from populated towns. The ASGC Remoteness classification groups these ARIA+ scores into six categories (Major Cities,* Inner Regional, Outer Regional, Remote, Very Remote and Migratory). Inner Regional areas are made up of Census Collection Districts (CDs) with an average ARIA+ index value greater than 0.20 and less than or equal to 2.40. Outer Regional areas consist of CDs with an average ARIA+ value greater than 2.4 and less than or equal to 5.92. Remote areas comprise CDs with an average ARIA+ value greater than 5.92 and less than or equal to 10.53. Outer Regional areas consist of CDs with an average ARIA+ value greater than 10.53. Migratory areas are areas composed of off-shore, shipping and migratory CDs and were not included in this analysis.

As the two countries use different terms for each of their rural-urban categories, common generic categories were created for data presentation purposes:

* In Australia, Major Cities are Census Collection Districts (CDs) with an average ARIA+ index value of 0-0.2; CDs are the smallest building block of Australian Bureau of Statistics geography.

TABLE I

Standardized Mortality Ratios for All-Cause Mortality by Sex and Place of Residence, Canada 1986-1996 and Australia 1997-1999

Place of Residence*	Canada		Australia	
	Men	Women	Men	Women
Urban	Reference	Reference	Reference	Reference
Rural 1	0.92 (0.91, 0.93)†	0.95 (0.94, 0.96)†	1.07 (1.06, 1.08)†	1.04 (1.03, 1.05)†
Rural 2	1.04 (1.03, 1.04)†	1.03 (1.03, 1.04)†	1.11 (1.10, 1.13)†	1.07 (1.06, 1.09)†
Rural 3	1.04 (1.03, 1.04)†	1.02 (1.02, 1.03)†	1.17 (1.13, 1.21)†	1.09 (1.04, 1.13)†
Rural 4	1.12 (1.10, 1.14)†	1.06 (1.04, 1.08)†	1.49 (1.42, 1.56)†	1.51 (1.42, 1.60)†

* Place of residence category:

Canada: Urban = CMA/CA, Rural 1 = Strong MIZ, Rural 2 = Moderate MIZ, Rural 3 = Weak MIZ, Rural 4 = No MIZ;

Australia: Urban = Major cities, Rural 1 = Inner Regional, Rural 2 = Outer Regional, Rural 3 = Remote, Rural 4 = Very remote

† Significantly different from 1 (rates statistically different from reference group [urban area]) at $p < 0.05$

Data sources: Canadian Annual Mortality Data 1986-1996, Statistics Canada; Australian Institute of Health and Welfare, 2003

TABLE II

Standardized Mortality Ratios for Circulatory Disease Mortality by Sex and Place of Residence, Canada 1986-1996 and Australia 1997-1999

Place of Residence*	Canada		Australia	
	Men	Women	Men	Women
Urban	Reference	Reference	Reference	Reference
Rural 1	0.95 (0.94, 0.97)†	1.01 (0.99, 1.02)	1.08 (1.07, 1.10)†	1.06 (1.04, 1.07)†
Rural 2	1.04 (1.03, 1.05)†	1.05 (1.04, 1.06)†	1.10 (1.08, 1.13)†	1.08 (1.06, 1.10)†
Rural 3	1.04 (1.03, 1.05)†	1.03 (1.02, 1.04)†	1.10 (1.04, 1.17)†	1.04 (0.98, 1.12)†
Rural 4	1.07 (1.04, 1.09)†	1.06 (1.03, 1.09)†	1.36 (1.26, 1.48)†	1.18 (1.06, 1.31)†

* Place of residence categories:

Canada: Urban = CMA/CA, Rural 1 = Strong MIZ, Rural 2 = Moderate MIZ, Rural 3 = Weak MIZ, Rural 4 = No MIZ;

Australia: Urban = Major cities, Rural 1 = Inner Regional, Rural 2 = Outer Regional, Rural 3 = Remote, Rural 4 = Very remote

† Significantly different from 1 (rates statistically different from reference group [urban areas]) at $p < 0.05$

Data sources: Canadian Annual Mortality Data 1986-1996, Statistics Canada; Australian Institute of Health and Welfare, 2003

- Urban: corresponds to CMA/CA in the Canadian classification and to Major Cities in the Australian classification;
- Rural 1: corresponds to Strong MIZ in the Canadian classification and to Inner Regional in the Australian classification;
- Rural 2: corresponds to Moderate MIZ in the Canadian classification and to Outer Regional in the Australian classification;
- Rural 3: corresponds to Weak MIZ in the Canadian classification and to Remote in the Australian classification;
- Rural 4: corresponds to No MIZ in the Canadian classification and to Very Remote in the Australian classification.

The Laurentian University Research Ethics Board reviewed and approved this project. Access to national data is granted to the Public Health Agency of Canada through agreements with Statistics Canada.

RESULTS

All-cause mortality

Patterns for all-cause mortality risks were similar in both Australia and Canada

(Table I). Mortality risks increased with increasing rurality. However, for the Rural 1 category (which refers to areas that are relatively close to urban centres), the pattern was different for each country. Mortality risks in this category were lower than in the urban category among Canadian men and women but were significantly higher compared with urban areas among Australian men and women. Differences in age-specific risks did not explain the different patterns for Rural 1 areas (data not shown).

Circulatory diseases

Table II presents the SMRs for circulatory diseases. The overall pattern of risks increasing with increasing rurality was consistent in both countries and among both men and women. However, there was a protective effect for Canadian men living in Rural 1 areas (SMR 0.95, confidence interval [CI] 0.94-0.97), whereas there was an 8% increased risk among men living in Rural 1 areas of Australia (SMR 1.08, CI 1.07-1.10). Differences in age-specific

TABLE III

Standardized Mortality Ratios for Cancer Mortality by Sex and Place of Residence, Canada 1986-1996 and Australia 1997-1999

Place of Residence*	Canada		Australia	
	Men	Women	Men	Women
All cancers				
Urban	Reference	Reference	Reference	Reference
Rural 1	0.89 (0.88, 0.91)†	0.91 (0.89, 0.92)†	1.05 (1.03, 1.07)†	1.00 (0.98, 1.02)
Rural 2	0.99 (0.98, 1.00)	0.98 (0.97, 0.99)†	1.06 (1.04, 1.09)†	1.00 (0.97, 1.03)
Rural 3	0.97 (0.98, 1.00)	0.96 (0.95, 0.98)†	1.04 (0.97, 1.11)	0.95 (0.87, 1.04)
Rural 4	1.01 (0.98, 1.04)	0.96 (0.92, 0.99)†	1.00 (0.90, 1.11)	1.08 (0.95, 1.24)
Lung cancer				
Urban	Reference	Reference	Reference	Reference
Rural 1	0.89 (0.87, 0.92)†	0.83 (0.80, 0.87)†	1.02 (0.98, 1.05)	0.96 (0.91, 1.02)
Rural 2	1.04 (1.02, 1.05)†	0.87 (0.84, 0.90)†	1.08 (1.03, 1.13)†	0.93 (0.86, 1.01)
Rural 3	0.96 (0.94, 0.98)†	0.88 (0.85, 0.91)†	1.13 (0.98, 1.29)	1.16 (0.92, 1.43)
Rural 4	1.03 (0.98, 1.08)	0.82 (0.75, 0.90)†	1.31 (1.06, 1.62)†	1.43 (1.02, 1.96)†
Colorectal cancer				
Urban	Reference	Reference	Reference	Reference
Rural 1	0.87 (0.83, 0.91)†	0.99 (0.94, 1.04)	1.07 (1.02, 1.12)†	1.09 (1.04, 1.15)†
Rural 2	0.92 (0.89, 0.95)†	1.01 (0.97, 1.04)	1.05 (0.98, 1.13)	1.13 (1.05, 1.22)†
Rural 3	0.84 (0.81, 0.88)†	0.89 (0.85, 0.93)†	1.06 (0.87, 1.27)	0.92 (0.71, 1.17)
Rural 4	0.92 (0.84, 1.01)	0.95 (0.85, 1.06)	0.61 (0.40, 0.89)†	0.82 (0.51, 1.24)
Breast cancer (women)				
Urban	Reference	Reference	Reference	Reference
Rural 1	n/a	0.49 (0.25-0.88)†	n/a	0.99 (0.95, 1.04)
Rural 2	n/a	0.92 (0.65-1.26)	n/a	0.99 (0.93, 1.07)
Rural 3	n/a	0.95 (0.65-1.34)	n/a	0.89 (0.71, 1.10)
Rural 4	n/a	0.54 (0.11-1.53)	n/a	0.81 (0.55, 1.15)
Cervical cancer				
Urban	Reference	Reference	Reference	Reference
Rural 1	n/a	0.93 (0.81-1.07)	n/a	0.95 (0.81, 1.11)
Rural 2	n/a	1.01 (0.91-1.11)	n/a	1.27 (1.03, 1.55)†
Rural 3	n/a	1.14 (1.02-1.26)†	n/a	1.53 (0.85, 2.54)
Rural 4	n/a	1.28 (0.99-1.64)	n/a	3.32 (1.77, 5.68)†
Prostate cancer				
Urban	Reference	Reference	Reference	Reference
Rural 1	0.98 (0.94-1.03)	n/a	1.14 (1.08, 1.19)†	n/a
Rural 2	1.05 (1.02-1.08)†	n/a	1.20 (1.13, 1.28)†	n/a
Rural 3	1.10 (1.07-1.14)†	n/a	1.16 (0.95, 1.40)	n/a
Rural 4	1.09 (1.01-1.18)†	n/a	1.02 (0.73, 1.39)	n/a

* Place of residence categories:

Canada: Urban = CMA/CA, Rural 1 = Strong MIZ, Rural 2 = Moderate MIZ, Rural 3 = Weak MIZ, Rural 4 = No MIZ;

Australia: Urban = Major cities, Rural 1 = Inner Regional, Rural 2 = Outer Regional, Rural 3 = Remote, Rural 4 = Very remote

† Significantly different from 1 (rates statistically different from reference group [urban areas]) at $p < 0.05$

Data sources: Canadian Annual Mortality Data 1986-1996, Statistics Canada; Australian Institute of Health and Welfare, 2003

mortality risks from circulatory disease did not explain the different patterns for Rural 1 areas (data not shown).

Cancer

Cancer mortality risks were generally lower among both Canadian men and women living in rural areas (Table III), but the patterns were slightly different in Australia, particularly among men. For example, the risk of mortality from lung cancer of Australians was significantly elevated in rural areas compared with urban areas, whereas Canadian men living in rural areas had risks that were either similar to or lower than their urban counterparts. The higher risks in Australia's rural areas were mainly

driven by the risks among people aged 45-64 years (SMR = 2.15, data not shown). In Canada, the lower overall risk in Rural 3 areas masked a higher lung cancer mortality risk in men aged 45-64 years (SMR = 1.15, data not shown). Mortality risk from cervical cancer followed a somewhat dissimilar pattern, with elevated risks in Rural 3 areas in Canada, and in Rural 2 and 4 areas in Australia. Canadian women aged 20-44 years living in Rural 4 areas were at increased risk of dying from cervical cancer (SMR = 2.16, data not shown), but this was not reflected in the overall risks presented here. Prostate cancer risks in Canada were elevated in all rural categories except Rural 1, whereas in Australia the risks were elevat-

ed only in Rural 1 and 2. Age-specific risks did not explain this difference, as the risks were lower in all age groups in Rural 1 areas of Canada and higher in all age groups in Rural 1 areas of Australia. Colorectal cancer mortality risks were generally lower in rural areas of Canada among both men and women but were higher in Rural 1 and Rural 2 in Australia. In both cases, these higher risks were driven by both Australian men and women aged 45-64 years (data not shown). Breast cancer mortality risks were lower among rural residents in both Canada and Australia.

Diabetes

Table IV shows the SMRs for diabetes. Different patterns were found among men in the two countries. In Canada, the risk of dying from diabetes was similar in both urban and rural areas. Australian men living in Rural 2 to Rural 4 areas were at significantly higher risk, 1.25 to 2.82 times higher, of dying from diabetes than their urban counterparts. Differences in age-specific diabetes mortality risks did not explain the different patterns among men (data not shown). Among women, the pattern was similar, with significantly elevated risks in rural areas of Canada and Australia.

Motor vehicle accidents

Similar patterns of mortality risk for motor vehicle accidents were observed for Canada and Australia (Table V). All rural categories for both men and women had elevated mortality risks compared with urban areas. The risks were more than two times higher in rural areas than in urban areas, SMRs ranging from 1.98 to 2.96 in Canada and from 1.65 to 3.81 in Australia.

Suicide

Table VI shows the mortality patterns for suicide. There were considerable differences in patterns of mortality risk between men and women. Rural men had significantly elevated suicide mortality risks, and this was true in Australia and Canada. The risks were 1.5 to 2.0 times higher in rural than urban areas of Canada and 1.3 to 1.7 times higher in rural Australia. Among women, there were no significant differences between urban and rural Australia. Canadian women living in Rural 1, 2 and 3 areas had significantly lower suicide mor-

tality risks, whereas the risk of those living in Rural 4 (which represents the most remote parts of Canada) was 1.5 times higher than that of urban women. The lower risks in Canada's Rural 2 and 3 areas masked significantly higher suicide mortality risks among young women aged 5-19, with SMRs ranging from 1.53 to 6.54.

DISCUSSION

This study is an initial, but necessary, step towards comparing the health status of rural communities in Canada with those in Australia. Cross-national, comparative rural health research has the potential to deepen our understanding of the complexities of the determinants of rural health. An important step in improving the health status of rural Canadians, as well as rural populations in other countries, is to be able to describe their health status patterns and to compare them with those of their foreign counterparts. If there are substantial differences, one could then ask whether they are due to differences in society, culture, health care system and/or rural-related policies. In order to make meaningful comparisons, Australia was chosen as the comparative country because of the many common characteristics of the two countries (including problems of access to services and widely scattered populations), as well as differences in other aspects (such as the health care system).

Overall, the patterns that have emerged from this comparison of Canadian and Australian mortality risks suggest that health status disparities between rural and urban populations are not limited to a specific country or region of the world. However, there are also important differences between the two countries, as the geographic mortality patterns varied according to sex and, in some cases, according to disease category.

Mortality patterns: similarities and differences

Similarities

Patterns of mortality risk for motor vehicle accidents were similar in both countries, the risks increasing with increasing rurality. Whether one is driving in the Australian outback or under Canadian wintry conditions, driving long distances on poor roads and in inclement weather conditions seems

TABLE IV

Standardized Mortality Ratios for Diabetes by Sex and Place of Residence, Canada 1986-1996 and Australia 1997-1999

Place of Residence*	Canada		Australia	
	Men	Women	Men	Women
Urban	Reference	Reference	Reference	Reference
Rural 1	0.81 (0.76, 0.86)†	0.98 (0.93, 1.04)	1.01 (0.94, 1.07)	1.11 (1.04, 1.18)†
Rural 2	0.96 (0.92, 1.00)	1.17 (1.12, 1.27)†	1.25 (1.15, 1.35)†	1.44 (1.32, 1.56)†
Rural 3	0.96 (0.92, 1.00)	1.16 (1.11, 1.21)†	1.52 (1.22, 1.86)†	1.93 (1.54, 2.39)†
Rural 4	1.02 (0.91, 1.13)	1.32 (1.20, 1.46)†	2.82 (2.21, 3.56)†	5.48 (4.38, 6.77)†

* Place of residence categories:

Canada: Urban = CMA/CA, Rural 1 = Strong MIZ, Rural 2 = Moderate MIZ, Rural 3 = Weak MIZ, Rural 4 = No MIZ;

Australia: Urban = Major cities, Rural 1 = Inner Regional, Rural 2 = Outer Regional, Rural 3 = Remote, Rural 4 = Very remote

† Significantly different from 1 (rates statistically different from reference group [urban areas]) at $p < 0.05$

Data sources: Canadian Annual Mortality Data 1986-1996, Statistics Canada; Australian Institute of Health and Welfare, 2003

TABLE V

Standardized Mortality Ratios for Motor Vehicle Accidents* by Sex and Place of Residence, Canada 1986-1996 and Australia 1997-1999

Place of Residence†	Canada		Australia	
	Men	Women	Men	Women
Urban	Reference	Reference	Reference	Reference
Rural 1	1.98 (1.90, 2.06)‡	2.01 (1.89, 2.14)‡	1.65 (1.55, 1.76)‡	1.65 (1.50, 1.82)‡
Rural 2	2.35 (2.28, 2.42)‡	2.09 (1.99, 2.14)‡	1.93 (1.77, 2.09)‡	1.85 (1.62, 2.11)‡
Rural 3	2.18 (2.12, 2.26)‡	2.12 (2.01, 2.23)‡	2.42 (2.01, 2.89)‡	2.27 (1.64, 3.07)‡
Rural 4	2.84 (2.64, 3.04)‡	2.96 (2.65, 3.29)‡	3.81 (3.12, 4.61)‡	3.10 (2.08, 4.46)‡

* Off-road accidents were excluded from the analysis in Australia; they are included in Canadian data analysis.

† Place of residence categories:

Canada: Urban = CMA/CA, Rural 1 = Strong MIZ, Rural 2 = Moderate MIZ, Rural 3 = Weak MIZ, Rural 4 = No MIZ;

Australia: Urban = Major cities, Rural 1 = Inner Regional, Rural 2 = Outer Regional, Rural 3 = Remote, Rural 4 = Very remote

‡ Significantly different from 1 (rates statistically different from reference group [urban areas]) at $p < 0.05$

Data sources: Canadian Annual Mortality Data 1986-1996, Statistics Canada; Australian Institute of Health and Welfare, 2003

TABLE VI

Standardized Mortality Ratios for Suicide by Sex and Place of Residence, Canada 1986-1996 and Australia 1997-1999

Place of Residence*	Canada		Australia	
	Men	Women	Men	Women
Urban	Reference	Reference	Reference	Reference
Rural 1	1.11 (1.06-1.16)†	0.70 (0.63-0.79)†	1.27 (1.20, 1.33)†	1.03 (0.92, 1.15)
Rural 2	1.41 (1.37-1.46)†	0.89 (0.82-0.96)†	1.27 (1.18, 1.36)†	0.97 (0.82, 1.13)
Rural 3	1.41 (1.36-1.46)†	0.87 (0.80-0.95)†	1.47 (1.25, 1.72)†	0.86 (0.53, 1.31)
Rural 4	2.07 (1.93-2.23)†	1.50 (1.27-1.77)†	1.65 (1.33, 2.02)†	1.18 (0.66, 1.97)

* Place of residence categories:

Canada: Urban = CMA/CA, Rural 1 = Strong MIZ, Rural 2 = Moderate MIZ, Rural 3 = Weak MIZ, Rural 4 = No MIZ;

Australia: Urban = Major cities, Rural 1 = Inner Regional, Rural 2 = Outer Regional, Rural 3 = Remote, Rural 4 = Very remote

† Significantly different from 1 (rates statistically different from reference group [urban areas]) at $p < 0.05$

Data sources: Canadian Annual Mortality Data 1986-1996, Statistics Canada; Australian Institute of Health and Welfare, 2003

to contribute to an increased mortality risk in rural areas. The higher rates of mortality due to motor vehicle accidents in rural areas may also point to more risky behaviors (e.g., lower rates of seat belt and child safety seat use), as well as delays in discovery and longer response times by emergency medical services.^{28,36,37} Prevention programs that promote the use of safety

equipment may be less available in rural areas or, if they were designed mainly for urban environments, may not appeal to some rural residents.³⁸

As well, rural men were at higher risk of committing suicide in both Canada and Australia. It is worth noting that the same patterns have also been found in the United States.²¹ It has been suggested that

factors such as socio-economic and structural changes within rural communities could contribute to the increased suicide mortality and that those structural changes (such as boom-and-bust economic cycles, higher unemployment and social isolation) could have a greater impact on men.³⁹ Other factors, such as marital status (being divorced) and ethnic origin (being of Caucasian or Aboriginal origin), have been shown to reinforce the positive relationship between a rural place of residence and suicide rates in both sexes.²⁷ Whether those factors are experienced in the same way and lead to an increased risk of suicide among rural Canadians and Australians is not known.

Differences

While all-cancer mortality risks were lower among Canadian rural men compared with urban men, the opposite pattern was observed in Australian men. A similar pattern was found for lung and colorectal cancer. Among women, the patterns were similar between the two countries, with lower lung and breast cancer mortality risks and higher cervical cancer mortality risks in rural areas of both countries.

Another important difference lies in the pattern of mortality risks for diabetes in men. In Australia, men living in rural areas had an elevated risk of dying from diabetes compared with their urban counterparts. In Canada, this risk was either lower among rural men or there was no difference between rural and urban men.

Another interesting finding was the different patterns in the Rural 1 category between the two countries. For several causes of deaths (all-cause mortality, circulatory diseases, all-cancer mortality, colorectal cancer and diabetes), the mortality risks in Rural 1 area in Canada were significantly lower than in urban areas, whereas such a pattern was not found in Australia. Interestingly, a pattern similar to that in Canada has been reported in the United States for all-cause mortality and circulatory diseases.²¹

What could contribute to such similarities and differences between the two countries? While it was not possible to display the age-specific mortality risks for all the causes examined, some of the variations could be explained by differences in age-specific risks within each country. This is

certainly one important factor to consider. However, age-specific variations that could explain the different patterns between the two countries were only found for a few causes and/or for particular rural categories. Several other hypotheses can be brought forward to explain variations in rural-urban mortality patterns between the two countries. For instance, are there differences in the distribution of risk factors related to mortality due to non-communicable diseases between rural Australia and rural Canada? Is there differential access to preventive services in rural Canada and Australia? Are there differences in health care systems that could explain some of these patterns?

Smoking rates, physical activity levels and overweight/obesity rates were all found to be higher in rural areas of both countries.^{23,24,40} According to the results of two studies, 60% and 46% of rural Canadian men and women, respectively, were overweight/obese, and the rates among rural Australian rural men and women were 49% and 37%; smoking rates were similar in both countries.^{23,41} Because of the unavailability of comparative data on risk factors as well as on other important factors, such as cancer survival rates and early detection, one can only speculate that these factors could play a role in explaining the differences in geographic mortality patterns across countries.

Issues concerning accessibility and utilization of health services are also potential considerations. According to existing international studies, Canada and Australia share similar health care challenges. Recruitment, retention and education of health professionals, equitable access to and use of technologies, and funding of health care are a few examples of the challenges faced by the two countries.^{15,17} Whether this contributes to some of the differences in rural-urban mortality patterns is unknown.

Limitations

In Canada, Australia and other countries, there are different definitions of rural. Most definitions used to analyze secondary data are based on population size and density, relationships to urban centres or principal economic activity.^{42,43,44} This study showed that for some causes of death, the mortality pattern for Rural 1 category is

different between Canada and Australia. While this difference could be explained by several factors, such as a different distribution of determinants of health in Rural 1 areas of each country, it is also likely to be an artefact of the geographic classification used. Cross-national comparisons necessarily involve using different definitions and data, making interpretations of findings more difficult, and caution is required when trying to generalize results. In fact, one of the obstacles of doing cross-national comparisons is to identify and describe the context in which rural-urban disparities in health take place.

The use of different diagnostic classifications (ICD-9 in Canada and ICD-10 in Australia) could also affect the patterns, especially the magnitude of the rural-urban differences. However, according to the results of a study published by Statistics Canada on the comparability of causes of death between ICD-9 and ICD-10, the effect of the different classifications used here is expected to be minimal.⁴⁵ The comparability ratios for the causes of deaths examined are all near 1.00 (indicating that the same number of deaths was assigned to cause *i* under both ICD-9 and ICD-10, denoting no net effect of ICD-10 on that particular cause). For each of the selected causes, the comparability ratios were as follows: circulatory diseases 0.997, all cancers 1.01, lung cancer 0.981, colorectal cancer 0.995, breast cancer 1.01, cervical cancer 0.968, prostate cancer 1.03, diabetes 1.04, suicide 1.00 and motor vehicle accidents 0.981.⁴⁵

Finally, the socio-demographic composition in rural/urban Australia and Canada is another issue that needs to be considered. The ethnic composition of each country studied is somewhat similar, especially in terms of the share of Aboriginal people in the total population. However, compared with Australia, Canada has a much larger proportion of visible ethnic minorities, such as Africans, south Asians or people from the Middle East. Few studies have examined the health of rural people from different racial/ethnic backgrounds, in part because of the small proportions of immigrants living in rural areas and the associated difficulties arising from undersampling, data suppression due to privacy concerns and issues of statistical reliability. While such data were available in Australia, it was

not possible to identify Aboriginal peoples in the Canadian mortality data to assess the impact of racial/ethnic background on mortality variations between urban and rural areas. Indian reserves and Inuit and Metis communities form a significant portion of Canada's remote areas. The available literature on Aboriginal people shows that they experience poorer health and have higher rates of smoking, cancer, motor vehicle accidents, circulatory diseases, diabetes, alcoholism and suicide than the general population.⁴⁶⁻⁴⁸ While it is unknown what proportion of rural mortality could be attributable to Aboriginal people, Australian mortality data showed that, for most causes, rates of death are higher in regional and especially remote areas, and that the higher rates in remote areas are almost invariably affected by high overall rates among Aboriginal people.²⁰

The Australian report used in this study was the most recent national report available that described the mortality patterns of Australia's rural and urban residents along a sufficiently detailed continuum of rurality. Owing to differences in the time periods of data collection, geographic classifications and other subtle dissimilarities in data collection, the magnitude of differences in mortality between the countries cannot be directly compared. However, the goal of this study is not to compare the magnitude of the differences but to examine the broad patterns of rural-urban differences in health within and between the two countries. Despite definitional and methodological differences, the mortality patterns of rural communities compared with urban communities are very similar between Canada and Australia, with a few notable exceptions.

CONCLUSION

It can be argued that a cross-national perspective to rural-urban disparities can mask intra-nation variations and render the cross-national comparisons meaningless. We suggest that, for the dimensions that have been examined here, cross-national variations can serve to highlight areas in which one country could learn from another with a view to improving the situation of its rural population. In particular, international studies could be invaluable in comparing how the roles of rural health

determinants may differ in both similar and different rural and remote environments and how similar and different health intervention strategies operate to produce improved health outcomes and to maintain healthy rural communities. Knowledge gleaned from such studies could be useful in future rural health policy formulation and decision-making.

While both countries pay considerable attention to problems confronting rural communities, particularly in relation to the distribution of health care resources, it is not known to what extent the policies in place in both countries contribute to the observed similarities and differences in health status between the two countries. This requires further research that is beyond the scope of the present paper. Nevertheless, there are certainly many lessons in rural health and rural health policy that Canada can learn from Australia, and vice versa.

Comparative studies of rural health could serve to direct and focus the learning from other countries by highlighting and promoting best practices. While this analysis is by no means a comprehensive comparison of the health status of rural populations in Canada and Australia, it is an initial attempt to promote discussion of rural health in an international context. The information can be used to examine the rural phenomenon in greater depth from an international perspective, and it challenges researchers to collaborate, study, develop and refine the foundations of rural research across nations and cultures.

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RÉSUMÉ

Contexte : Rares sont les études publiées qui comparent l'état de santé des populations urbaines et rurales de différents pays. Pour aider à pallier le manque d'information sur les ressemblances et les différences entre les populations rurales du Canada et celles d'autres pays, nous avons analysé et comparé les risques de mortalité de certaines maladies en milieu rural et urbain au Canada et en Australie.

Méthode : Les taux de mortalité selon l'âge pour certaines causes de décès ont été calculés à l'échelle nationale, puis décomposés selon le lieu de résidence à l'aide des définitions de la ruralité utilisées dans chacun des deux pays (les « zones d'influence des régions métropolitaines » au Canada et la définition de l'éloignement de l'Australian Standard Geographical Classification [ASGC] en Australie).

Résultats : La répartition rurale-urbaine des risques de mortalité était généralement semblable dans les deux pays. Toutefois, nous avons relevé des écarts importants dans cette répartition selon les causes de décès examinées. La mortalité due aux accidents de la route, au suicide et à quelques cancers présentait un gradient rural-urbain semblable au Canada et en Australie, mais nous avons observé des différences notables en ce qui a trait aux décès dus au diabète, à tous les cancers combinés, au cancer du poumon et au cancer colorectal. Les Australiens vivant en milieu rural présentaient un plus grand risque de mourir de ces maladies que leurs concitoyens des milieux urbains, tandis qu'au Canada, le risque était moins élevé en milieu rural.

Interprétation : Dans l'ensemble, les tendances qui émergent de cette comparaison des risques de mortalité des Canadiens et des Australiens suggèrent que les disparités dans l'état de santé des populations rurales et urbaines ne se limitent pas à un pays ou à une région du monde en particulier. Il existe néanmoins d'importantes différences entre le Canada et l'Australie, car les structures géographiques de la mortalité varient selon le sexe et les catégories de maladies. Cette analyse est une première tentative d'ouvrir le débat sur la santé rurale dans un contexte international.