Why is the Health Status of Some Manitobans Not Improving?
The Widening Gap in the Health Status of Manitobans

March 2003

Manitoba Centre for Health Policy
Department of Community Health Sciences
Faculty of Medicine, University of Manitoba

Marni Brownell, PhD
Lisa Lix, PhD
Okechukwu Ekuma, MSc
Shelley Derksen, MSc
Suzanne De Haney, MSc
Ruth Bond, MA
Randy Fransoo, MSc
Leonard MacWilliam, MSc, MNRM
Jennifer Bodnarchuk, MA

ISBN: 1-896489-11-7

Ordering Information

If you would like to receive a copy of this or any other of our reports, contact us at:

Manitoba Centre for Health Policy
University of Manitoba
4th Floor, Room 408
727 McDermont Avenue
Winnipeg, Manitoba, Canada R3E 3P5
Order line: 204-789-3805
Fax: 204-789-3910

Or you can visit our WWW site at:
http://www.umanitoba.ca/centres/mchp/reports.htm

ACKNOWLEDGEMENTS

The authors wish to acknowledge the contributions of many individuals whose efforts and expertise made it possible to produce this report. We appreciate the assistance of the following, and apologize to anyone we may have inadvertently overlooked:

- Those who provided advice and feedback on specific aspects of the report: Charles Burchill, Allan R. Downs, John Ducas, Ben Edirmanasinghe, as well as employees at the Manitoba Energy and Mines Library, Joel Kettner, Anita Kozyrskyj, Jure Manfreda, Bruce Martin, Rob Reid, Les Roos, Noralou Roos, Jackie Sul and Jack Tu.

- Colleagues who provided feedback on an earlier draft of this report: Carolyn De Coster, Patricia Martens, Noralou Roos, Evelyn Shapiro and Fred Toll.

- Our external reviewers who provided detailed and insightful comments on the report: Russell Wilkins and Nazeem Muhajarine.

- CancerCare Manitoba for providing us with cancer incidence data. We also want to thank Wendy Fonseca-Holt for preparing the cancer data and Donna Turner for facilitating the provision of data and providing feedback on sections of this report that pertain to cancer mortality and incidence.

- Shannon Lussier for preparing the final report, including text, tables and graphs.

The authors are indebted to Health Information Services, Manitoba Health and the Office of Vital Statistics in the Agency of Consumer and Corporate Affairs for the provision of data.

We acknowledge the financial support of the Department of Health of the Province of Manitoba. The results and conclusions are those of the authors and no official endorsement by Manitoba Health was intended or should be inferred. This report was prepared at the request of Manitoba Health as part of the contract between the University of Manitoba and Manitoba Health.

THE MANITOBA CENTRE FOR HEALTH POLICY

The Manitoba Centre for Health Policy (MCHP) is located within the Department of Community Health Sciences, Faculty of Medicine, University of Manitoba. The mission of MCHP is to provide accurate and timely information to health care decision-makers, analysts and providers, so they can offer services which are effective and efficient in maintaining and improving the health of Manitobans. Our researchers rely upon the unique Population Health Research Data Repository to describe and explain patterns of care and profiles of illness, and to explore other factors that influence health, including income, education, employment and social status. This Repository is unique in terms of its comprehensiveness, degree of integration, and orientation around an anonymized population registry.

Members of MCHP consult extensively with government officials, health care administrators, and clinicians to develop a research agenda that is topical and relevant. This strength along with its rigorous academic standards enable MCHP to contribute to the health policy process. MCHP undertakes several major research projects, such as this one, every year under contract to Manitoba Health. In addition, our researchers secure external funding by competing for other research grants. We are widely published and internationally recognized. Further, our researchers collaborate with a number of highly respected scientists from Canada, the United States and Europe.

We thank the University of Manitoba, Faculty of Medicine, Health Research Ethics Board for their review of this project. The Manitoba Centre for Health Policy complies with all legislative acts and regulations governing the protection and use of sensitive information. We implement strict policies and procedures to protect the privacy and security of anonymized data used to produce this report and we keep the provincial Health Information Privacy Committee informed of all work undertaken for Manitoba Health.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ix

1.0 INTRODUCTION 1
1.1 Background 1
1.2 What's In This Report? 3

2.0 METHODS 5
2.1 Data Sources 5
2.2 Study Period and Population 5
2.3 Regional Groupings 5
2.4 Analytic Approaches 7

3.0 RESULTS 11
3.1 Analyses of Trends in Mortality Rates Across Time: Overall Provincial Trends, Regional Trends, and Age and Sex Differences 11
3.1.1 Overall Provincial Trends (How much has mortality changed in the province between 1985 and 1999?) 12
3.1.2 Region Specific Trends (Is the gap in health status actually widening and by how much?) 13
3.1.3 Age- and Sex-Specific Trends (Do we find that the gap is widening for both males and females equally? Are there specific age groups where the gap is widening more so than for others?) 16
3.1.4 Infant Mortality 18
3.1.5 Summary of Mortality Trends 19
3.2 The Impact of Migration on Changes in Health Status . .20
3.2.1 Impact of Migration on Mortality 21
3.2.2 Impact of Migration on Morbidity 22
3.3 Exploring the Contribution of Specific Causes of Mortality and Morbidity to the Widening Gap in Health Status . . .23
3.3.1 Cause-Specific Mortality 23
3.3.2 Cause-Specific Morbidity 39
3.4 Changes in Socioeconomic Factors 59
3.4.1 Analytic Approaches 59
3.4.2 Income 60
3.4.3 Education 61
3.4.4 Employment 62
3.4.5 Family Structure 63
3.5 Changes in Utilization of Hospital Services Over Time. 64

4.0 DISCUSSION 70
4.1 Limitations 72

5.0 CONCLUSIONS 73

REFERENCES 75

APPENDIX A **80**

APPENDIX B **83**

GLOSSARY **88**

List Of Tables

Table 1: How much has mortality changed across the study period for each age group? 17
Table 2: Summary of overall mortality findings 20
Table 3: SMRs for non-Winnipeg populations adjusting for the impact of migration, 1995-1999 21
Table 4: SMRs for Winnipeg populations adjusting for the impact of migration, 1995-1999 22
Table 5: Per cent residents of Winnipeg populations with major morbidity burden in 1985, by migration status in 1999 23
Table 6: Summary of cause-specific mortality findings 38
Table 7: How much has diabetes treatment prevalence changed across the study period for each age group? (1994-99 / 1985-90) . . .49
Table 8: How much has respiratory disease treatment prevalence changed across the study period for each age group? (1995-99 / 1985-89) 52
Table 9: How much has AMI hospitalization changed across the study period for different age groups? (1995-99 / 1985-89) . .56
Table 10: Summary of cause-specific morbidity findings 57
Table 11: How much has non-Winnipeg hospital utilization changed across the study period for each age group? (1995-99 / 1985-89) 67
Table 12: How much has Winnipeg hospital utilization changed across the study period for each age group? (1995-99 / 1985-89) . . .69

Appendix Tables

Table A1: Number of premature deaths (before age 75 years), 3-year moving averages, 1985-1998 80
Table A2: Populations totals for non-Winnipeg and Winnipeg populations, 1985 and 1999 80
Table A3: Age- and sex-standardized mortality rates, non-Winnipeg and Winnipeg populations, 1985-89 and 1995-99 80
Table A4: Sex-standardized mortality rates by age category and population, 1985-89 and 1995-99, non-Winnipeg and Winnipeg 81
Table A5: Infant mortality rates per 1000 populations, 1985-89 and 1995-99 by non-Winnipeg and Winnipeg populations 81
Table A6: Age-and sex-standardized mortality rates, by cause and popula . . tion, non-Winnipeg and Winnipeg, 1985-89and 1995-99 . . .81
Table A7: Age- and sex-standardized morbidity rates by cause and non-Winnipeg populations, 1985-87 and 1997-99 82
Table A8: Age-and sex-standardized rates of hospital separations and days per 1000, non-Winnipeg and Winnipeg populations, 1985 and 2000 82

LIST OF FIGURES

Figure 1: Non-Winnipeg RHAs Grouped by PMR 6
Figure 2: Neighbourhood Healthiness Groupings for Winnipeg Areas . . 7
Figure 3: Premature Mortality Rates (age-sex standardized) per 1,000 Population, 1985-1998 (rates are 3 yr moving averages) 11
Figure 4: How much has Mortality Decreased in Manitoba Over the Study Period? 12
Figure 5: How much Higher is Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 14
Figure 6: How much Higher is Mortality for the Least Healthy Compared to the Most Healthy Populations in Winnipeg? . . 15
Figure 7: How much has Cancer Mortality Changed Throughout the Study Period? 24
Figure 8: How much Higher is Cancer Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 25
Figure 9: How much Higher is Cancer Mortality for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 26
Figure 10: How much has Heart Disease Mortality Changed Throughout the Study Period? 27
Figure 11: How much Higher is Heart Disease Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 28
Figure 12: How much Higher is Heart Disease Mortality for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 30
Figure 13: How much has Injury Mortality Changed Throughout the Study Period? 31
Figure 14: How much Higher is Injury Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 32
Figure 15: How much Higher is Injury Mortality for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 33
Figure 16: How much has Respiratory Mortality Changed Throughout the Study Period? 34
Figure 17: How much Higher is Respiratory Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 35
Figure 18: How much Higher is Respiratory Mortality for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 36

Figure 19: How much Higher is Hospitalization for Falls for the Least Healthy Compared to Most Healthy non-Winnipeg Populations? 40
Figure 20: How much Higher is Hospitalization for Falls for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 41
Figure 21: How much Higher is Hospitalization for MVCs for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 42
Figure 22: How much Higher is Hospitalization for MVCs for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 43
Figure 23: How much Higher is Hospitalization for Violence for the Least Healthy Areas Compared to the Most Healthy non Winnipeg Populations? 44
Figure 24: How much Higher is Hospitalization for Violence for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 45
Figure 25: How much Higher is Hospitalization for Other Causes of Injury for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 46
Figure 26: How much Higher is Hospitalization for Other Causes of Injury for the Least Healthy Compared to the Most Healthy Winnipeg Populations? .47
Figure 27: How much Higher is Diabetes Treatment Prevalence for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 48
Figure 28: How much Higher is Diabetes Treatment Prevalence for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 50
Figure 29: How much Higher is Respiratory Disease Treatment Prevalence for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 52
Figure 30: How much Higher is AMI Hospitalization for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 54
Figure 31: How much Higher is AMI Hospitalization for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 55
Figure 32: Mean Household Income Adjusted for Inflation, Winnipeg Populations 61

Figure 33: Per cent 25- to 44- Year-Olds with High School Graduation, Winnipeg Populations 62
Figure 34: Per cent Unemployed, Winnipeg Populations 63
Figure 35: Per cent Families with Lone-Parent Status, Winnipeg Populations 64
Figure 36: Hospital Utilization, non-Winnipeg and Winnipeg, 1985 to 1999 65
Figure 37: How much Higher is Hospital Utilization for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations? 66
Figure 38: How much Higher is Hospital Utilization for the Least Healthy Compared to the Most Healthy Winnipeg Populations? 68

EXECUTIVE SUMMARY

A previous report by the Manitoba Centre for Health Policy found that the health status of Manitobans improved over the 14-year period from 1985/86 to 1998/99 (Roos et al., 2001). This same report found that there was a gap in health status between residents of northern areas of the province and the rest of the province, as well as between Winnipeg residents from low-income areas and other areas of the city. Residents of the north were found to have poorer health status than those in the south; likewise, residents from low-income Winnipeg areas were found to have poorer health status than those in other areas of the city. Of particular concern was the observation that these gaps in health status appeared to widen over the 14-year period. The purpose of the current report was to focus on this widening gap in health status and attempt to determine what factors have contributed to it.

Data Sources and Methods

A population-based approach was used to study the health status of Manitoba residents as well as the use of health care resources by these residents. This report used anonymized administrative data from the Manitoba Population Health Research Data Repository. Specific databases analyzed included the population registry, hospital abstracts, physician visits, vital statistics and census data. As well, cancer incidence data were obtained from CancerCare Manitoba. The study focussed on trends in health status across a 15-year period: 1985/86 through 1999/2000. All residents of Manitoba were included in these analyses.

Analyses were carried out separately for non-Winnipeg and Winnipeg residents. Non-Winnipeg Regional Health Authorities (RHAs) were grouped together based on the health status of their populations as measured by premature mortality rates. The result was three separate regional groupings of residents: those from areas with the 1) least healthy, 2) average health, and 3) most healthy populations. The same groupings were constructed for Neighbourhood Clusters (NCs) within Winnipeg. Analyses focus on comparisons between residents of areas with the least compared to the most healthy populations.

Most of the analyses presented in this report use regression techniques to describe longitudinal trends in the data for non-Winnipeg and Winnipeg residents. These analyses were used to accurately characterize changes in mortality or morbidity over the 15-year period, taking into account differences by age, sex, and regional grouping. The analyses focus on the "gap" in health status between residents of areas with the least, compared to the most, healthy populations, and this gap is defined here as the ratio of health outcomes between these populations.

Because the effects of selective migration (e.g., healthier members of the population moving out of areas with the least healthy populations) could result in a widening health status gap between populations, without any actual changes in the health status of the individual members of those populations, we also looked at the impact of migration on changes in health status, using two separate methods.

1) Within each area, we compared mortality rates in the last five years of the study for those people living in the area at the beginning of the study period, to those people living in the area at the end of the study period, to assess the impact of migration on mortality.
2) We compared the initial morbidity burdens of those who eventually migrated, to those who did not migrate, using the Adjusted Clinical Group (ACG) case-mix adjustment system to determine whether those who migrated were sicker or healthier to begin with.

Public-Use Census data were used to obtain area-level measures of income, unemployment, education and lone-parent status, all measures of socioeconomic status thought to be associated with health status. We looked at changes in these measures for each of our regional groupings across the study period and related these to observed changes in the health status gap between our regional groupings.

Findings

Overall Trends

• Between 1985/86 and 1999/2000, the gap (measured using rate ratios) in health status between residents from areas with the least healthy populations and areas with the most healthy populations widened, in both non-Winnipeg and Winnipeg analyses.

• The widening of the health status gap appears to be due to improvements in health for residents of areas with the most healthy populations, whereas the health status for residents of areas with the least healthy populations has remained unchanged.

• This widening gap in health status has been greater for males than for females. Manitoba males, in general, have experienced greater improvements in health status over the past 15 years compared to Manitoba females; however, the gains in health status for males have been greater for residents of areas with the most healthy populations compared to the least healthy populations.

• The widening gap in health status between the least and most healthy non-Winnipeg and Winnipeg populations evidenced across the time period does not seem to be driven by any particular age group.

The Impact of Migration

• The widening health status gap does not appear to be due to migration.

Cause-Specific Trends

• When specific causes of mortality were examined we found similar health status gaps for almost all categories studied: higher mortality rates for residents of the areas with the least healthy populations compared to those from areas with the most healthy populations. Although most of these gaps remained stable across the 15 years of the study, none narrowed, and for some the health status gap widened.

• Health status gaps for specific causes of mortality were examined separately by age categories and by sex. The greatest changes in terms of the growing gap between those from the least and most healthy populations appear to have occurred in heart disease and respiratory disease mortality; however, there was some evidence of a growing health status gap for each of the categories studied.

• As was found for the overall analyses, for the disease-specific mortality analyses most of the widening of the gap can be attributed to residents of areas with the most healthy populations showing improvements in health status over time, whereas residents from areas with the least healthy populations showed no change (and sometimes declines) in health status over time.

• When specific causes of illness (as measured by treatment prevalence) were examined we found a similar health status gap for almost all categories studied: higher treatment prevalence rates for residents of areas with the least healthy compared to the most healthy populations. None of these gaps narrowed over the 15 years, and some widened.

• For some of the illness categories studied (diabetes, respiratory disease), residents of all regional groupings experienced an increase in treatment prevalence, and the widening gap in health status observed can be attributed to greater increases in treatment prevalence for residents of areas with the least healthy populations.

- For other categories of illness (AMI), residents of all regional groupings experienced a decrease in treatment prevalence, and the widening gap in health status observed can be attributed to smaller decreases in treatment prevalence for residents of areas with the least healthy populations.

Socioeconomic Factors

- When area measures of socioeconomic status were examined, we found that the growing gap in health status observed between residents of the areas with the least and most healthy populations appears to be related to changes in income and unemployment, but not education and lone-parent status.

Hospital Utilization

- Although we found a somewhat larger decrease in hospital separations for residents of non-Winnipeg areas with the least healthy populations compared to the most healthy populations, analyses suggest that this is unrelated to mortality rates.

It would be an oversimplification to attribute the growing gap in health status observed in this study to behavioural factors. Although rates of smoking and being overweight (factors associated with poorer health) are higher in areas with the least healthy populations, research shows that health status differences remain even when these behavioual factors are taken into consideration, and that socioeconomic differences have an effect on health status above and beyond differences in health-related behaviours.

Conclusion

Despite overall improvements in the health status of Manitobans over the 15-year study period, the gap in health status between residents of areas with the least healthy compared to the most healthy populations increased significantly.

This widening health status gap does not seem to be restricted to one or two specific diseases or age groups, nor is it the result of migration or changes in hospital utilization. For the most part, the widening gap in health status appears to be due to improvements in health status for those already enjoying the best health, with no corresponding improvements for those already in the poorest health. Further examination of factors that contribute to health status, particularly socioeconomic conditions such as income level and employment, are necessary to determine why residents of areas with the least healthy populations have not enjoyed the same improvements in health as those in the rest of the province.

1.0 INTRODUCTION

Between 1985/86 and 1998/99 fewer people in Manitoba died before the age of 75 years, and life expectancy increased; residents of northern Manitoba and low-income neighbourhoods in Winnipeg did not appear to share these improvements in health status.

Analyses of trends in health status over the 14-year period from 1985/86 to 1998/99, revealed that the health of most Manitobans improved over the time period: fewer people died before the age of 75 years, and life expectancy increased a full 2.6 years for males and one year for females (Roos, Shapiro, Bond et al., May 2001). These improvements were not experienced by all residents of Manitoba, however. The health status of residents of northern Manitoba (Burntwood, Nor-Man and Churchill Regional Health Authorities[1]) appeared to fall over the same time period: more northern residents died before the age of 75 years, and life expectancy decreased one-and-a-half years for females and only increased one-third of a year for males. What made this apparent decline even more concerning is that residents of northern Manitoba had poorer health status to begin with. For instance, the average life expectancy for males from northern Manitoba in 1985 was 71.2 years, whereas males in southern regions of the province were expected to live 73.9 years, 2.7 years longer than their northern counterparts. By 1998, this gap in health status had widened: males from the south could expect to live to 76.7 years, 5.1 years longer than their northern counterparts. For females, the average life expectancy for those residing in the north in 1985 was 77.8 years, whereas females from the southern regions of the province were expected to live 81 years, 3.2 years longer than their northern counterparts. By 1998, the health status gap between females living in the northern and southern regions of the province had also widened: females from southern regions of the province could expect to live to 82.4 years, a full 6.1 years longer than their northern counterparts. The widening health gap observed between those in the north and residents of the rest of the province was also found in Winnipeg, where residents of the poorest neighbourhoods did not show the same gains in health status experienced by residents of the wealthiest neighbourhoods.

The purpose of the current study was to attempt to understand why residents of northern Manitoba and of the poorest neighbourhoods in Winnipeg seem not to have enjoyed the same recent gains in health status as those experienced by other Manitoba residents.

1.1 Background

There is much evidence that inequalities in health status are associated with income, education, and employment status.

Geographic disparities in health status have been documented in Manitoba (Roos and Shapiro, 1995) as well as elsewhere, including the United States (Ross, Wolfson, Dunn et al., 2000), and the United Kingdom (Mitchell, Dorling and Shaw, 2000; Shaw, Dorling, Gordon and Davey Smith, 1999). What this work tends to reveal is a strong relationship between inequalities in health status and socioeconomic factors, such as income, education and employment. Lower socioeconomic status is associated with poorer health outcomes, and there is a graded effect of this relationship such that with

[1] These RHAs also tend to have lower socioeconomic status than the rest of the province (Martens, Frohlich, Carriere et al., 2002), as will be discussed in more detail in a subsequent section of this report.

each increase in level of socioeconomic status there is an increase in health status. A large body of work shows that inequalities in health status are associated with income (Lynch, Davey Smith, Kaplan et al., 2000; Benzeval and Judge, 2001; Wolfson, Kaplan, Lynch, et al., 1999; Kaplan, Pamuk, Lynch, et al., 1996; Kennedy, Kawachi, Prothrow-Smith, 1996; Fiscella and Franks, 1997), education level (Marmot et al., 1997; Pappas et al., 1993; Olshansky and Wilkins, 1998; Power, Manor, Matthews, 1999), employment status (Morris, Cook and Shaper, 1994; Mathers and Schofield, 1998; Jin, Shah, Svoboda 1996) and family structure (Benzeval, 1998; Wyke and Ford, 1992; Leach et al., 1999; Lipman et al., 2002; Sauvola et al., 2001).

- Focussing on mortality across income groups in larger Canadian cities, Wilkins and colleagues (Wilkins et al., 1989; Wilkins et al., 2002) reported income-related disparities in health status from 1971 through 1996. These income disparities existed for overall mortality rates as well as for specific disease categories including circulatory disease, cancer, respiratory disease and injuries. In 1996, an estimated 23% of the potential years of life lost before the age of 75 in Canada was attributable to income differences, higher than that attributable to injuries (19%) and cardiovascular diseases (18%) and second only to cancer (31%) (Wilkins et al., 2002).

- A recent examination of data from the U.S. Longitudinal Study of Aging, shows clearly that the more educated not only live longer, but do so for a longer period in a disability-free state (Olshansky and Wilkins, 1998).

- A review of studies conducted in the 1980s and '90s looking at the relationship between employment and health status concluded that unemployment in both men and women is associated with higher rates of overall mortality, and deaths due to cardiovascular disease and suicide (Jin, Shah and Svoboda, 1995). Risk for mortality tends to be greater in times and regions of higher unemployment (Moser et al., 1987) and is also higher for those with lower status occupations (Marmot et al., 1991).

- Family structure can have an impact on both children and adults, with lone parents having poorer health status than parents living in couples (Benzeval, 1998; Wyke and Ford, 1992) and children in lone-parent families also being at greater risk for health problems (Leach et al., 1999; Lipman et al., 2002; Sauvola et al., 2001).

Recent evidence from various countries suggests that disparities in health status may be widening. Evidence for this widening gap in health status between different geographic regions and/or socioeconomic groups has been documented in the United Kingdom (Shaw, Dorling, Gordon, Davey Smith, 1999), and the United States (Pappas et al., 1993). In a study of residents of urban metropolitan areas in Canada, Wilkins et al. (2002) looked at changes in income disparities over the 25-year period, 1971-1996, and found that for the majority of causes of death, mortality had decreased and the gradient between income groups, though persistent, tended to decline. For many of the mortality causes, however, the decreases in mortality as well as the narrowing of the income disparities were greatest during the first half of the 25-year study period, and for some causes of death, the disparities actually increased, particularly during the last 10 years (1986 to 1996) of the study period.

Recent research suggests that the "gap" in health status between different socioeconomic groups is widening; this widening disparity has been linked to changes in socioeconomic circumstances.

Not surprisingly, because of the association between health inequalities and socioeconomic circumstances, the widening disparities in health between different geographic regions and/or socioeconomic groups have been largely attributed to changes in socioeconomic circumstances (Phillimore, Beattie, Townsend, 1994; Shaw et al., 1999; Pappas et al., 1993; Wilkins et al., 2002). Another plausible explanation for the widening disparities in health status is selective migration (Veugelers and Guernsey, 1999). Healthier individuals may be more likely to migrate from certain areas that have unhealthy populations to areas with healthier populations, for socioeconomic or other reasons. For example, selective migration may occur when industries close down, leading to migration of the more able and employable members of the community to seek employment opportunities elsewhere. Because these individuals are also likely to be healthier, this could have the apparent effect of lowering the overall health status of the subgroup left behind and/or elevating the overall health status of the population in the area to which they migrated, either of which would create the appearance of a widening gap in health status.

1.2 What's in this Report?

In the first section of the Results we confirm that the gap in health status is actually widening in Manitoba, and quantify this. We also investigate whether this widening gap is developing in particular groups, or more generally across these populations: Do we find that the gap is widening for both males and females equally? Are there specific age groups where the gap is widening more so than for others?

We then explore the answers to a number of questions in an attempt to understand why the gap in health status is widening. Our first focus is on determining whether the widening gap is real, or an illusion produced by migration patterns.

Having established that not much of the widening gap can be explained by migration, in the third section of the Results we look at specific causes of mortality and morbidity in an attempt to further understand why the gap in health status is widening: Is the widening gap in health status due to changes in one or two specific diseases or is it a more general pattern?

The fourth section of the Results looks at differences in socioeconomic factors across Manitoba regional groupings and changes in these differences across the study period. For example, is there a relationship between the widening gap in health status and changes over time in: average family incomes? employment levels? education levels? family structure?

The fifth section of the Results explores the relationship between the widening gap in health status and hospital utilization. Roos et al (2001) found that hospitalization rates changed over the time period 1985/86 to 1998/99, with greater decreases in hospital utilization for those groups showing decreases in health status. In the current report we explore whether declining rates in utilization contribute to the growing gap in health status.

2.0 METHODS

2.1 Data Sources

This report used anonymized administrative data from the Manitoba Population Health Research Data Repository, housed at the Manitoba Centre for Health Policy (MCHP). Repository databases analyzed included the population registry, hospital abstracts, physician billing abstracts, vital statistics and census data. In addition, we obtained cancer incidence data from the registry maintained by CancerCare Manitoba.

2.2 Study Period and Population

This report focuses on trends in health status over a 15-year period: 1985 to 1999.[2] A population-based approach was used to study the health status of Manitoba residents as well as the use of health care resources by these residents. This approach attributes the health care use of patients according to their region of residence, regardless of where they received health care services. Population figures are taken from the Manitoba Repository registration files and are based on the Manitoba population in December of the year in question. All residents of Manitoba, including Registered First Nations residents were included in these analyses. No separate analyses were done by Registered First Nations grouping.

2.3 Regional Groupings

Analyses were carried out separately for non-Winnipeg and Winnipeg residents. We set out to divide both non-Winnipeg and Winnipeg areas each into three distinct groupings based on the health status of the populations residing in these areas. To do this we used the premature mortality rate (PMR) which is the rate of deaths occurring in the 0- to 74-year-old population.[3] PMR is considered the best single measure of the health of a group of people and their need for health care services (Carstairs and Morris, 1991; Eyles, Birch, Chambers et al., 1991; Eyles and Birch, 1993). PMR is highly related to a measure of socioeconomic well-being developed at MCHP called the Socioeconomic Factor Index (SEFI)[4]: the Pearson rank order correlation between SEFI and PMR for all non-Winnipeg and Winnipeg regions was 0.85 in 1994 through 1998 (Martens et al., 2002). What this means is that the areas of Manitoba with the poorest health status also tend to be the areas with higher unemployment levels, poorer housing and lower income levels. Thus, our regional groupings reflected not only differences in health status across populations, but also differences in socioeconomic well-being.

For non-Winnipeg areas, non-Winnipeg Regional Health Authorities (RHAs) were grouped together based on their PMRs for the period 1995 through 1999. RHAs whose populations had PMRs that were significantly[5] higher than the provincial average (indicating poorer health and therefore the expec-

---

[2] All analyses are based on fiscal years (April 1 to March 31) unless otherwise specified, but will be shown as one year (i.e., fiscal year 1985/86 will be written as 1985).

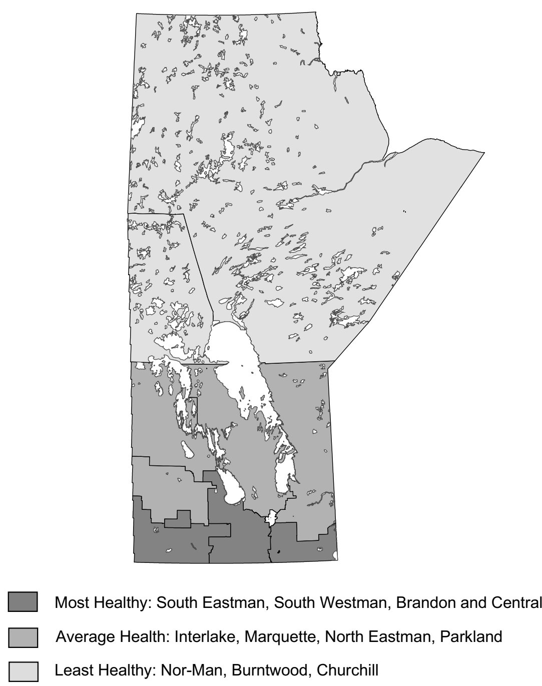
[3] For the PMR analyses, calendar years, rather than fiscal years, were used.

[4] SEFI is based on Census measures of environmental, household and individual conditions associated with poor health (Martens, Frohlich, Carriere et al., 2002).

[5] Statistical significance was assessed using t-test methodology developed by Carriere and Roos (1997).

tation of greater demands on the health care system) were designated "least healthy." These RHAs include Nor-Man, Burntwood and Churchill. RHAs whose PMRs did not differ significantly from the provincial average were given the designation "average health": Marquette, Parkland, North Eastman and Interlake. And RHAs whose PMRs were significantly lower than the provincial average (indicating better health status) were designated "most healthy": South Eastman, South Westman, Brandon and Central. Figure 1 shows the location of these regional population groupings within the province of Manitoba; it is clear that they follow not only a PMR pattern, but also a geographic pattern, with the least healthy populations being the furthest north and the most healthy populations being furthest south in the province.[6]

Figure 1: Non-Winnipeg RHAs Grouped by PMR

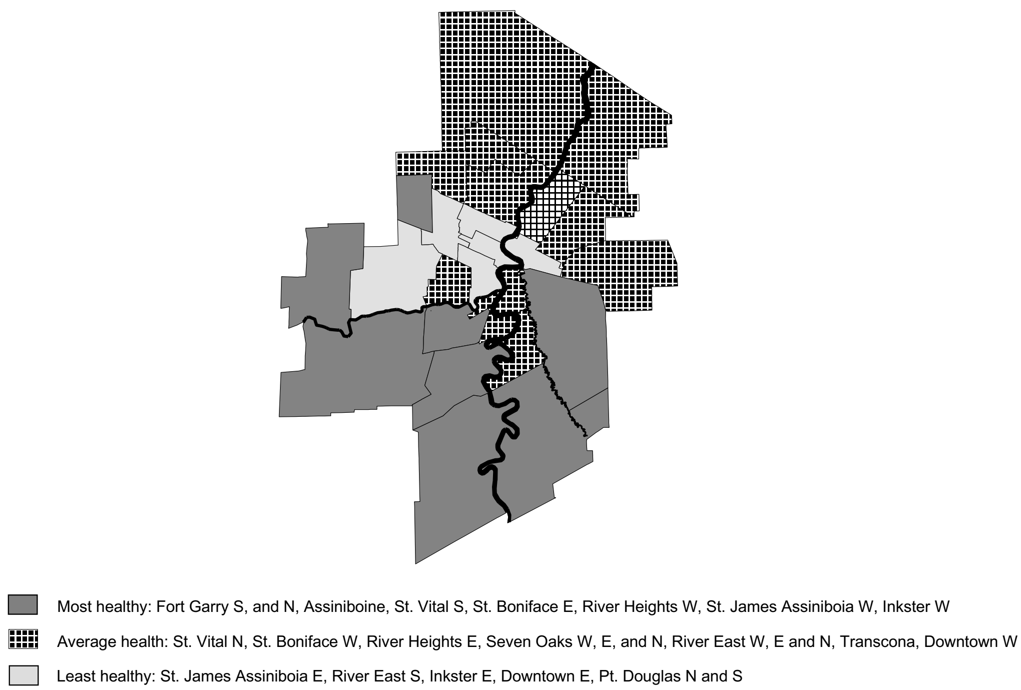


The Winnipeg RHA can be broken down into 25 neighbourhood clusters (NCs). PMRs based on data from 1995 through 1999 were calculated for each NC and the NCs were then grouped together into least (St. James Assiniboia E., River East S., Inkster E., Downtown E., Pt. Douglas N. and S.), average (St. Vital N., St. Boniface W., River Heights E., Seven Oaks W., E. and N., River East W., E. and N., Transcona, Downtown W.) and most healthy (Fort Garry S. and N., Assiniboine, St. Vital S., St. Boniface E.,

[6] When we say that the areas with the least healthy populations tend to be found in the more northern areas of the province whereas the most healthy populations tend to live in more southern areas of the province, we are talking about population averages. There will certainly be variation within these populations, and sub-populations may show very different patterns. For example, a recent MCHP report "The Health and Health Care Use of Registered First Nations People Living in Manitoba: A Population-Based Study" found that for First Nations populations the trend was opposite to the entire population of the province: that is, First Nations populations in the north tend to be healthier than those in the southern part of the province.

River Heights W., St. James Assiniboia W., Inkster W.) as outlined above for the non-Winnipeg RHAs. Figure 2 shows the location of these NC population groupings within the city of Winnipeg. As was the case for the non-Winnipeg RHAs, it is clear that these groupings follow not only a PMR pattern, but also a geographic pattern, with the least healthy populations tending to be closest to the city centre and the most healthy populations generally toward the south and outskirts of the city. Recall that health status is highly related to socioeconomic well-being for both Winnipeg and non-Winnipeg areas, meaning that the areas with the least healthy populations also have higher rates of unemployment, lower income levels, and generally poorer socioeconomic conditions.

Figure 2: Neighbourhood Healthiness Groupings for Winnipeg Areas



Population counts for the regional groupings described in this section can be found in Table A2, Appendix A.

2.4 Analytic Approaches

There are a number of different approaches that could be used in an attempt to both quantify the gap in health status between the least and most healthy populations and measure changes in the gap over time. One of the most commonly used approaches for making comparisons across populations involves comparing age- and sex-standardized rates of the outcome (e.g., mortality) in question. Age- and sex-standardization allows us to determine what the rate of the outcome would be if the population we are examining had the same age and sex structure of some standard (e.g., the provincial average) population. This approach therefore permits us to make a "fair" comparison across populations. Unfortunately, standardized rates are sensitive to variations in age-specific rates in small populations and will therefore sometimes show substantial variability from one year to the next. This sensitivity to variations makes standardized rates less useful in monitoring changes across populations over time.

For this reason, for most of the analyses presented in this report, regression techniques were used, instead of age- or sex-standardized rates, to examine trends over time across and within non-Winnipeg and Winnipeg regional groupings. These analyses were used to accurately characterize changes in mortality or morbidity over the period from 1985 to 1999 (the most current year for which mortality data were available for the entire province), taking into account differences by age, sex, and regional grouping. This is the primary advantage of a regression model over standardized rates: interactions among variables that are known or presumed to have an impact on health status can be investigated. An interaction means that the effect of one variable on health status is not constant for every value of a second variable. For example, for childhood injury mortality, age and sex interact such that below 10 years of age there is little difference in injury deaths between males and females; above this age group males have significantly higher rates of injury deaths (Brownell et al., 2002).

In this report the "gap" in health status refers to the ratio of the outcomes for the least healthy populations compared to the most healthy populations.

In this report, results from the regression analyses are presented as relative risks (or rate ratios) as opposed to absolute differences in rates. A relative risk is the probability of some outcome for one population relative to the outcome for some reference group. For example, it might be the risk of death for those in the least healthy populations relative to the risk of death for those in the most healthy populations. Risk ratios, then, are basically ratios of the outcome for one group compared to another. Thus, rather than expressing results as the absolute difference in, say, number or rate of deaths, between the least and most healthy populations, results are expressed in terms of how many times higher (or lower) the death rate is for the least compared to the most healthy populations. Although most of the results in this report are based on regression analyses and expressed as relative rates, in the interest of demonstrating to the reader the absolute rates of the various conditions, as well as the absolute differences in the rates between the areas with the least and most healthy populations, standardized rates for the earliest and most recent years of data are presented for key analyses[7], in Appendix A.

7 It is important for the reader to keep in mind that results may be dissimilar for standardized rates and regression models. The regressions attempt to model the structure of age- and sex-specific mortality rates, meaning that we are averaging over (or controlling for) the effects of age and sex when we talk about relative risks for particular populations. In contrast, with age/sex standardized rates, we are weighting age- and sex-specific rates to correspond with the distribution of some other population, which could have a very different age distribution than a regional population. Hence, there will be differences in the results that are obtained for these two approaches.

For the mortality data, relative risk was estimated from the longitudinal data for a particular population (least, average or most healthy) or age group using Poisson regression with generalized estimating equations (GEE). Further information about these analyses can be found in Appendix B and in the Glossary.

Interpreting graphs and tables in this report. Recall that a relative risk is really a ratio of outcomes for one group or year compared to another (the reference group). A relative risk of 1.00 means that there is no difference between the outcome for the group in question and the reference group. Relative risks greater than 1.00 indicate higher risk (and consequently poorer health status) for the group in question relative to the reference group, whereas relative risks less than 1.00 indicate lower risk (and consequently better health status) for the group in question.

There are two types of graphs depicting relative risks in this report:

- the first shows changes over time, and the comparison is between the first year of the study period and other years
- the second also shows changes over time, however the comparison is between the outcomes for the least healthy populations compared to the most healthy populations.

For the first type of graph, the data point for each year is a ratio of the overall (combining least, average and most healthy populations) outcomes for that year to the outcomes for 1985. That is, our reference category is 1985. For example, a relative risk of .90 in 1990 would mean that the risk of the outcome in 1990 was .90 times (or 10% lower than) what it was in 1985. A relative risk of 1.10 in 1995 would mean that the risk of the outcome in 1995 was 1.10 times (or 10% higher than) what it was in 1985. Figure 4 in Section 1 of the Results is an example of this first type of graph.

For the second type of graph the data point for each year is a ratio of the outcomes for the least healthy populations compared to the most healthy populations for that year. That is, our reference category is the most healthy populations. For example, a relative risk of 1.80 in 1990 would mean that in 1990, the risk of the outcome was 1.80 times higher (or 80% higher) for the least healthy populations than the most healthy populations. In essence, this is what is referred to in this report as the "gap" in health status between the least and most healthy populations. Figure 5 is an example of this second type of graph, showing the gap between the least and most healthy non-Winnipeg populations for each year of the study period.

For each of these types of analyses, we were interested in whether there were statistically significant changes over time: 1) changes over time for the outcome in question for all populations (first type of graph), and 2) changes over time in the gap between the least and most healthy populations (second type of graph). Rather than just compare the first and last years of the study period, we used five-year time periods to test for significant changes over time. Thus, most of the results are presented by comparing data from the end and beginning time periods: 1995-1999 is compared with 1985-1989. We used five-year time periods to test for differences or changes for two reasons: (1) we were more interested in whether there were changes in outcomes over broad segments of time, not just from one year to the next, and, (2) for rare events (such as death) there is a lot of variability in the data from one year to the next. This variability can result in random fluctuations from year to year that make it difficult to detect real changes in outcomes. By looking at five-year time periods, it is possible to reduce, or smooth out, the influence of these annual fluctuations.

Additional analytic approaches used in this report that differ from those detailed above are described in the relevant sections below.

3.0 RESULTS

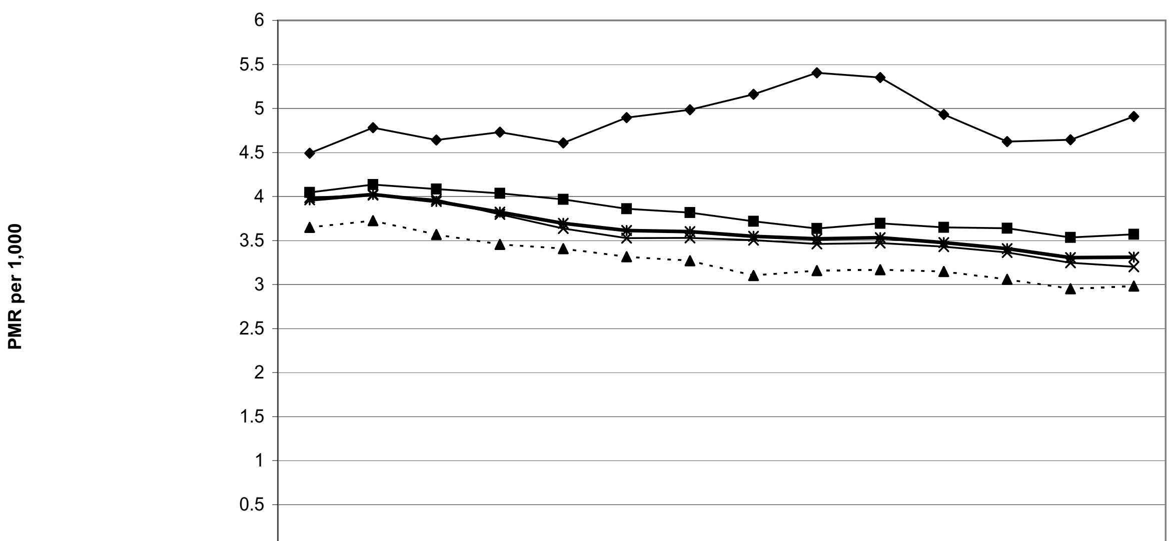
3.1 Analyses of Trends in Mortality Rates Across Time: Overall Provincial Trends, Regional Trends, and Age and Sex Differences

Questions addressed in this section:

- *How much has mortality changed in the province between 1985 and 1998?*
- *Is the gap in health status between the least and most healthy populations actually widening?*
- *How much has the health status gap changed over the time period 1985-1999?*
- *Do we find that the gap is widening for both males and females equally?*
- *Are there specific age groups where the gap is widening more so than for others?*

Figure 3, an updated figure from Roos et al. (2001), shows premature mortality rates (PMR) by the three non-Winnipeg populations of RHAs: least, average and most healthy. These are the data that prompted this report. It appears from this graph that for residents of the areas with the least healthy populations, PMR increased, then decreased, then increased again, suggesting that overall, health status was becoming poorer for this group, whereas the PMR for residents of the areas with the most healthy populations decreased steadily over the time period, suggesting improving health.

Figure 3: Premature Mortality Rates (age-sex standardized) per 1,000 Population, 1985-1998 (rates are 3 yr moving averages)



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Least Healthy non-Wpg	4.491	4.782	4.64	4.73	4.609	4.896	4.986	5.16	5.404	5.351	4.931	4.624	4.643	4.908
Average Health non-Wpg	4.046	4.134	4.085	4.035	3.966	3.859	3.817	3.717	3.635	3.694	3.649	3.639	3.534	3.569
Most Healthy non-Wpg	3.649	3.725	3.568	3.456	3.408	3.316	3.269	3.103	3.158	3.169	3.148	3.059	2.952	2.983
Winnipeg	3.988	4.014	3.965	3.796	3.635	3.526	3.528	3.503	3.461	3.472	3.429	3.365	3.248	3.202
Manitoba	3.963	4.023	3.944	3.822	3.695	3.612	3.6	3.546	3.519	3.532	3.476	3.408	3.305	3.31

Data source: Population Research Repository. Data are based on fiscal years.

* A table with the actual number of premature deaths represented by these rates is found in Appendix A (Table A1).

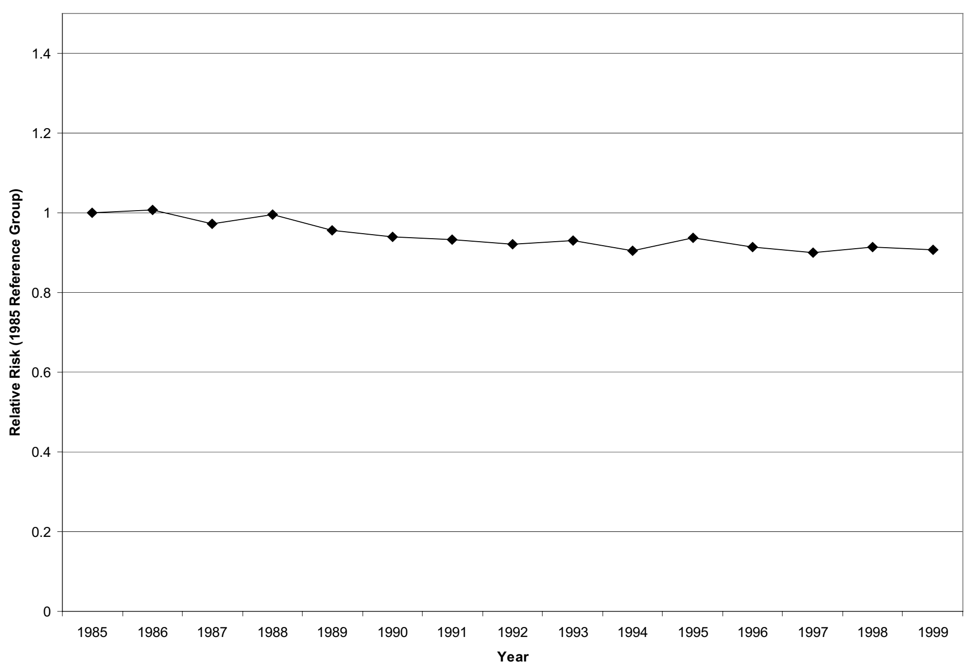
In this section we look at the gap in health status between the areas with the least and most healthy populations and use analytic techniques appropriate for examining change across time,[8] to explore whether this gap has widened over the study period, and to quantify and describe these changes.

3.1.1 Overall Provincial Trends (How much has mortality changed in the province between 1985 and 1999?)

Risk of mortality for Manitobans decreased significantly between 1985 and 1999.

Mortality for the province as a whole declined in the 15-year period from 1985 to 1999. Figure 4 shows the mortality risk for each year relative to 1985. Analysis of changes by five-year periods confirmed what appears evident in the figure: the risk of mortality for Manitobans decreased significantly over the study period ($p<.0001$). The greatest change in mortality risk was between the first (1985-1989) and second (1990-1994) five-year periods ($p<.0001$), whereas the change between the second (1990-1994) and the third (1995-1999) five-year period was smaller and non-significant ($p=.2255$).

Figure 4: How much has Mortality Decreased in Manitoba Over the Study Period?



Data source: Population Research Repository. Data are based on fiscal years.

Mortality rates decreased significantly over time for all age groups with the exception of those 25-44 years.

When broken down by age categories (results not shown here), for both Winnipeg and non-Winnipeg residents, mortality rates decreased between the first and last five-year time periods for all age groups with the exception of the 25- to 44-year-old age group. In this age group, mortality rates were stable over the period for non-Winnipeg residents and increased slightly for Winnipeg residents.

---

8 Because mortality is a relatively rare event in any given year, rates can fluctuate from year to year, making it difficult to determine trends over time. The statistical techniques used here are designed to overcome the limits of the previous methods.

The difference in mortality rates between males and females narrowed significantly over the study period.

Whereas mortality decreased for both males and females over the 15-year period, the drop was greater for males than for females. Males had higher mortality rates throughout the study period (over one-and-a-half times higher), however this difference narrowed significantly between the 1985-1989 and 1995-1999 time periods (p<.0001). This narrowing of the gap between sexes corresponds to a national trend that shows that from 1990 to 1997 the decline in mortality rates was twice as great for males (8%) as for females (4%) (Statistics Canada, 2001).

3.1.2 Region Specific Trends (Is the gap in health status actually widening and by how much?)

In order to more accurately estimate whether the gap in health status between the least and most healthy populations has widened over time, we focussed on comparing the risk of mortality for the regions of Manitoba (and Winnipeg) with the least healthy populations relative to those regions with the most healthy populations. Population totals for each of the populations are found in Table A2, Appendix A. Age- and sex-standardized mortality rates for the earliest and most recent 3-year period for these populations are given in Table A3, Appendix A.

Non-Winnipeg Findings: Figure 5 shows the mortality risk for residents of the non-Winnipeg areas with the least healthy populations (regions in the north) relative to the areas with the most healthy populations (regions in the south) across the 15-year period, and thus allows us to examine the change in the health status gap over time. Note in the figure that at the start of the study period (1985) the mortality risk for the least healthy populations is higher (1.2 times higher) than the risk for the most healthy populations, and this pattern is evident throughout the study period. (Note that this graph is like the second type of graph described in "Analytic Approaches" and therefore the reference category is different in this graph than in the previous graph. In the previous graph each subsequent year was compared to 1985. In the current graph, for each year, the least healthy populations are compared to the most healthy populations.)

The gap in health status between residents of the non-Winnipeg areas with the least and most healthy populations increased significantly across the study period.

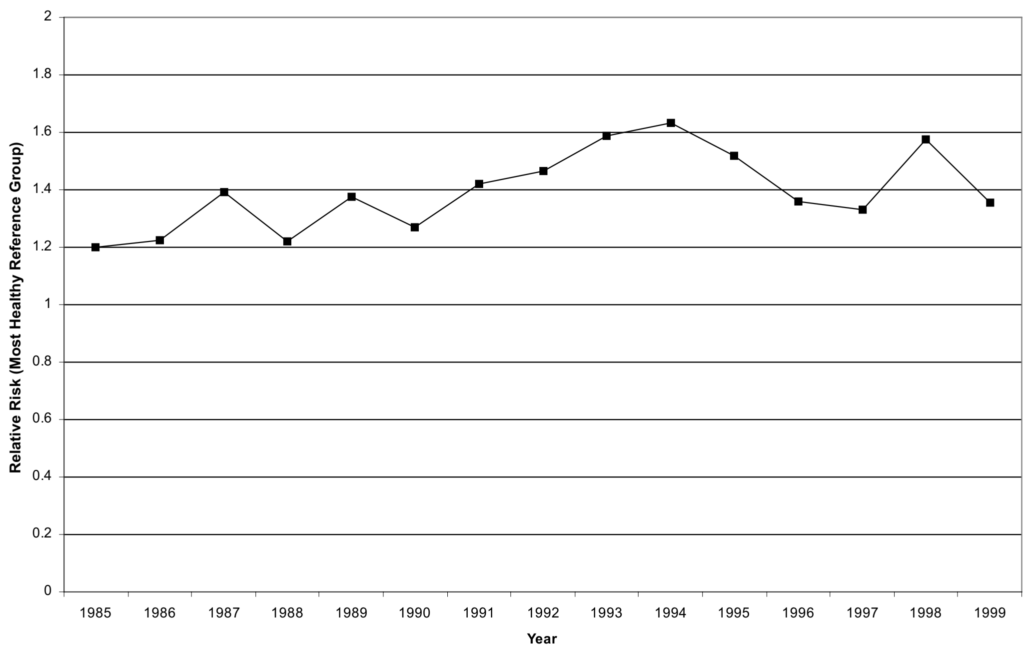
In the 1985-1989 time period, the risk of mortality was 1.27 times greater for the least healthy populations compared to the most healthy populations, and this disparity increased to 1.41 times by 1995-1999. In other words, the degree of disparity between the least and most healthy populations was 11% greater in the last five years of the study than in the first five years (p=.0258) even after controlling for differences in population composition (i.e., age and sex) in these two areas of the province. Thus, the gap in health status between residents of the non-Winnipeg areas with the least and most healthy populations increased significantly across the study period.

The analyses also help us to understand why the health status gap between these two groups is widening. This increasing gap is due to a drop in mor-

This increasing gap is due to a drop in mortality risk for those from the most health populations; in contrast, the mortality risk for the least healthy populations remained relatively constant over the study period.

tality risk for those from the most healthy populations (p=.0015). In contrast, the mortality risk for the least healthy populations remained relatively constant between the two five-year time periods (p=.437). Thus, it is not that the health of the residents of the non-Winnipeg areas with the least healthy populations (i.e., the north) is worsening; rather, it is staying the same. The health of the residents of the non-Winnipeg areas with the most healthy populations (i.e., the south) is improving and those with the least healthy populations are not enjoying similar gains in health status.

Figure 5: How much Higher is Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

Winnipeg Findings. The same analyses were conducted to compare the mortality rates across time for residents of the Winnipeg areas with the most healthy (southern and outer areas of Winnipeg) and least healthy (core area) populations. These results are shown in Figure 6. From this figure it is once again evident that mortality risk was higher throughout the study period for the least healthy compared to the most healthy populations.

The gap in health status between the residents of the Winnipeg areas with the least and most healthy populations also increased significantly across the study period.

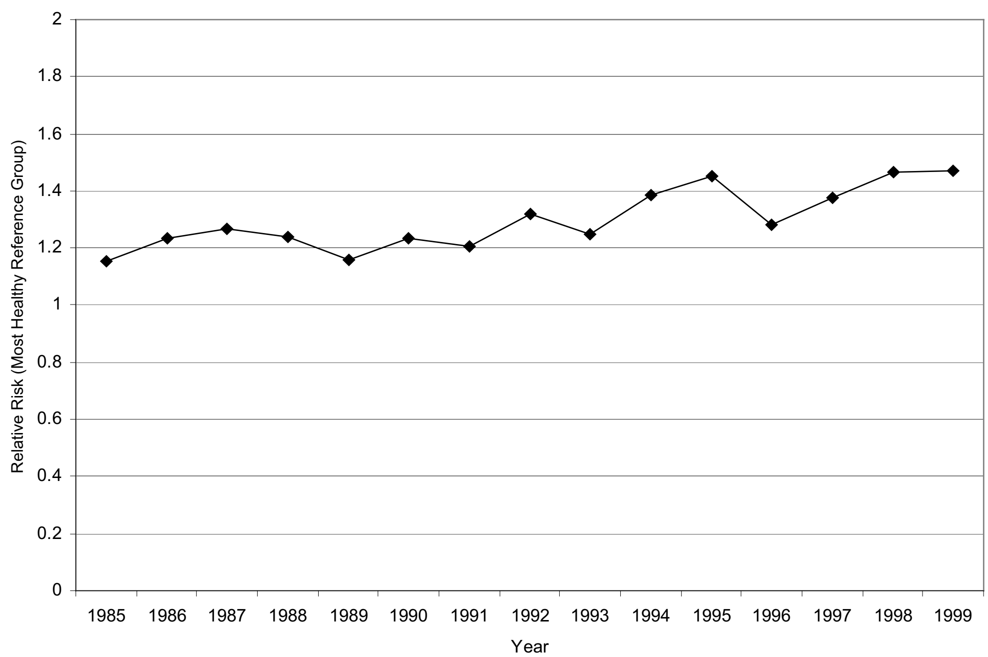
Mortality risk in 1985-1989 was 1.21 times greater for the least healthy populations compared to the most healthy, and this disparity increased to 1.41 times in 1995-1999. This analysis revealed that the degree of disparity between the least and most healthy populations was 16% greater in the last five years of the study compared to the first five years (p<.0001) after controlling for changes in the age and sex distribution of the population over time and between regions. Thus, the gap in health status between residents

The health of the residents from the Winnipeg areas with the least healthy populations is not actually declining; residents of these areas are not experiencing the same gains in health status experienced by residents of areas with the most healthy populations.

of the Winnipeg areas with the least and most healthy populations also increased significantly across the study period.

Similar to the non-Winnipeg analyses, we observed that the least healthy population of Winnipeg showed no difference in mortality risk between the two five-year time periods (p=.6206), whereas the most healthy population experienced a decrease in mortality risk (p<.001). Thus, the health of the residents from the Winnipeg areas with the least healthy populations is not actually declining; residents of these areas are not experiencing the same gains in health status experienced by residents of areas with the most healthy populations.

Figure 6: How much Higher is Mortality for the Least Healthy Compared to the Most Healthy Populations in Winnipeg?



Data source: Population Research Repository. Data are based on fiscal years.

To summarize, there has been an improvement in health status among residents of areas with the most healthy populations, but no improvement in health status among residents of areas with the least healthy populations.

To summarize, for both the Winnipeg and non-Winnipeg analyses, similar patterns are observed. There has been an improvement in health status among residents of areas with the most healthy populations, but no improvement in health status among residents of areas with the least healthy populations; the results for the average health populations are intermediate between the two.[9] Thus the largest health gains in the province over the last 15 years have been concentrated among residents of selected areas of Winnipeg (Fort Garry S and N, Assiniboine, St. Vital S, St. Boniface E, River Heights W, St. James Assiniboia W, Inkster W), and southern regions of the province (South Eastman, South Westman, Brandon and Central).

---

9 Throughout this report, some tables depict findings for areas with the average health populations, along with the least and most healthy. Because the main focus of this report is the comparison in health status between residents of the areas with the most and least healthy populations, discussion of results for the residents of areas with average health populations is limited.

3.1.3 Age- and Sex-Specific Trends (Do we find that the gap is widening for both males and females equally? Are there specific age groups where the gap is widening more so than for others?)

We know that the growing gap in health status is due to improvements in health for residents of the areas with the most healthy populations without corresponding improvements for those from areas with the least healthy populations. In this section we explore whether this trend is similar for both sexes and across all age groups.

The gap in health status between the least and most healthy non-Winnipeg populations widened for both males and females, but more so for males.

Trends by Sex. We attempted to determine whether the growing gap observed in health status between the least and most healthy populations was observed for both males and females. For non-Winnipeg males, in 1985-1989, the risk of mortality was 1.27 times greater for the least healthy populations than the most healthy populations, and this disparity increased to 1.57 times by 1995-1999. The degree of disparity between males in the least and most healthy non-Winnipeg populations was 24% greater in the last five years of the study compared to the first five years ($p<.0001$). Results were similar for non-Winnipeg females. In 1985-1989, the risk of mortality for non-Winnipeg females was 1.14 times greater for the least healthy populations than the most healthy populations, and this disparity increased to 1.27 times in 1995-1999. The degree of disparity between females in the least and most healthy non-Winnipeg populations was 11% greater at the end compared to the beginning of the study period ($p=.0172$). *Thus the gap in health status between the least and most healthy non-Winnipeg populations widened for both males and females, but more so for males.*

The gap in health status between the least and most healthy Winnipeg populations widened only for males.

For Winnipeg males, in 1985-1989, the risk of mortality was 1.26 times greater for the least healthy populations than the most healthy populations, and this disparity increased to 1.44 times by 1995-1999. Thus, the degree of disparity between males in the least and most healthy Winnipeg populations increased by 14% over the study period ($p=.0296$). For Winnipeg females, in 1985-1989 the risk of mortality was 1.28 times greater for the least healthy populations than for the most healthy populations, and this increased only slightly, to 1.38 for 1995-1999. In other words, the disparity between females in the least and most healthy Winnipeg populations increased by only 8%, a non-significant change ($p=.1523$). *Thus the gap in health status between the least and most healthy Winnipeg populations widened only for males.*

The gap between the least and most healthy populations appears to be widening more for males than for females. As described in section 3.1.1 "Overall provincial trends" previously, it appears that Manitoba males have enjoyed greater improvements in health status than females over the past 15 years. Further analyses suggest that these improvements were greater for males resident in areas with the most healthy populations, compared to males resident of areas with the least healthy populations. In Winnipeg, whereas there were significant decreases in the degree of disparity between males and females for both least and most healthy populations (p=.0334 and p=.0001, respectively), the magnitude of the decrease was greater for the healthiest populations (a 17% decrease for most healthy, compared to an 8% decrease for least healthy). Outside of Winnipeg, the data reveal that there were no significant changes in the magnitude of the disparity between males and females in the least healthy populations over time (p=.2387), whereas there was a significant decline for the most healthy populations (p<.0001).

Age trends. We also attempted to determine if the patterns we observed, that is, health improving among residents of areas with the healthiest populations but not improving among residents of areas with the least healthy populations, held true for every age group. The change in mortality risk between 1985-1989 and 1995-1999 for each age group, for both non-Winnipeg and Winnipeg residents is found in Table 1. Here, the comparison, or ratio, is between 1995-99 amd 1985-89. Thus for each population at each age group, a value of less than 1.00 indicates a decrease in the risk of mortality over time, whereas a value greater than 1.00 represents an increase in the risk of mortality over time. Statistically significant changes are shown in bold.

Table 1: How much has mortality changed across the study period for each age group? (1995-99 / 1985-89)

	Least Healthy	Average Health	Most Healthy
Non-Winnipeg			
0-24 years	1.02 (.85, 1.22)	.97 (.80, 1.17)	**.84** (.81, .88)*
25-44 years	.96 (.76, 1.20)	**.89** (.80, .99)*	1.02 (.89, 1.18)
45-64 years	.94 (.80, 1.11)	**.86** (.79, .93)*	**.88** (.84, .93)*
65-74 years	1.12 (1.00, 1.26)	.94 (.86, 1.03)	**.84** (.77, .92)*
75+ years	1.08 (.97, 1.21)	.97 (.91, 1.02)	.97 (.92, 1.01)
Winnipeg			
0-24 years	.88 (.74, 1.05)	.89 (.72, 1.10)	**.68** (.55, .84)*
25-44 years	**1.15** (1.05, 1.25)*	1.10 (.96, 1.27)	1.06 (.97, 1.16)
45-64 years	1.02 (.87, 1.21)	**.83** (.77, .88)*	**.84** (.72, .99)*
65-74 years	1.00 (.98, 1.03)	**.87** (.83, .92)*	**.78** (.69, .89)*
75+ years	1.02 (.97, 1.08)	.98 (.95, 1.01)	**.89** (.82, .97)*

Note: 95% confidence intervals are shown
* = statistically significant at α = .05

For those from non-Winnipeg areas, improvement in health status is evident for those from the most healthy populations at all age groups except the 25- to 44-year and the 75+ year age groups. That is, for residents of areas with the most healthy populations there was a significant drop in mortality over the study period for those 0 to 24 years, 45 to 64 years and 65 to 74 years, but for those 25 to 44 years and those 75 years and older, the mortality rates in 1995-1999 did not differ significantly from those in 1985-1989. Similar improvements are not evident for those from the least healthy populations, where health status remained stable across all age groups across the study period.

For residents of the Winnipeg areas, improvements in health status are evident for those from areas with the most healthy populations for all age groups except the 25- to 44-year age group. For the least healthy populations, no such improvements were evident in any of the age groups, and a decrease in health status (indicated by a 15% increase in mortality risk) was found for those from the 25- to 44-year age group.

The increasing gap in health status between the least and most healthy populations evidenced across the time period does not seem to be driven by any particular age group.

At most ages, the widening gap was a function of the improving health for residents of the areas with the most healthy populations, with no similar improvements experienced by those from the least healthy populations.

Thus the increasing gap in health status between the least and most healthy populations evidenced across the time period does not seem to be driven by any particular age group. For non-Winnipeg residents, the health gap between the least and most healthy populations increased for all but the 25- to 44-year and 75+ year age groups. For Winnipeg residents the health gap increased for all age groups. For the most part, the same dynamic is in operation as was observed when all age groups were analyzed together: *the widening gap is a function of the improving health for residents of the areas with the most healthy populations, with no similar improvements experienced by those from the least healthy populations.* The only group experiencing an actual decline in health status were Winnipeggers aged 25 to 44 years who were residents of the areas with the least healthy populations. Sex-standardized mortality rates broken down by population and age group are given in Table A4, Appendix A.

3.1.4 Infant Mortality

To further examine age-specific mortality changes, we looked at infant mortality rates across the study period. Other research in Canada suggests that infant mortality rates have declined, with the gap between the lowest and highest income quintile residents narrowing between 1971 and 1996, particularly in the earlier part (1971-1985) of the time period (Wilkins et al., 2002). Table A5 in Appendix A shows the crude infant mortality rates for the earliest and most recent five-year periods. It is evident in this table that the areas with the least healthy populations in both non-Winnipeg and Winnipeg have higher infant mortality rates than those from the areas with the most healthy populations.

We examined neonatal (<29 days) and post-neonatal (29+ days) infant deaths separately, for both non-Winnipeg and Winnipeg populations using Poisson regression. The impact of sex and population health status (least, average, most healthy) were taken into consideration, and as with previous analyses, the data were combined into three five-year time periods and the differences between the first five years of the study and the last five years of the study were tested. The analyses were conducted both including and excluding extremely low birth weight infant deaths (i.e., infants weighing less than 500 grams). The number of extremely low birth weight babies born alive has changed over time and because a high proportion of these babies die in the first year of life, this is a potentially confounding factor in longitudinal analyses. (See Appendix B for further details.)

Infant mortality is not driving the pattern of the widening gap in health status between the least and most healthy non-Winnipeg and Winnipeg populations.

Regardless of the birthweight exclusions, there were very few detectable changes in infant mortality risk over time. For the non-Winnipeg areas, there was a decrease in post-neonatal mortality within the least healthy populations between the two time periods of the study; however, this result is associated with a change of only four deaths over the two time periods. Within Winnipeg, there was a statistically significant decline in the risk of neonatal mortality in the least healthy populations when extremely low birthweight babies were retained in the analysis. When this weight class was removed, however, no difference was observed. The areas with the most healthy populations in Winnipeg experienced a statistically significant decrease in neonatal mortality when the extremely low birthweight babies were excluded, with no corresponding decrease in the areas with the least healthy populations. Thus, although there was some evidence of both widening and narrowing gaps in infant mortality across the study period, the small number of deaths raises questions regarding the stability of these trends and suggests that *infant mortality is not driving the pattern of the widening gap in health status between the least and most healthy non-Winnipeg and Winnipeg populations.*

3.1.5 Summary of Mortality Trends

We found evidence of a widening gap in health status between both non-Winnipeg and Winnipeg residents of areas with the least compared to the most healthy populations (see Table 2). This widening gap appears to be due to improvements in health for residents of areas with the most healthy populations, whereas the health status for residents of areas with the least healthy populations has remained unchanged. This widening gap in health status has been greater for males than for females and does not seem to be driven by any particular age group.[10]

[10] Analyses on trends in mortality rates conducted in this section of the report were repeated examining trends in Potential Years Life Lost (PYLL). These analyses produced results that were largely consistent with the results from the mortality analyses. The results of these analyses are available upon request.

Table 2: Summary of overall mortality findings

Indicator	Change Across Time (all populations)	Change in Gap Between Least and Most Healthy		
		Overall	By Age	By Sex
Non-Winnipeg				
Overall mortality	Decreased	Gap increased Most healthy getting healthier, least healthy staying the same	Gaps increased for: 0 to 24 years 45 to 64 years 65 to 74 years	Gap increased for both males and females; more so for males
Winnipeg:				
Overall mortality	Decreased	Gap increased Most healthy getting healthier, least healthy staying the same	Gaps increased for: 0 to 24 years 25-44 years 45 to 64 years 65 to 74 years 75+ years	Gap increased for males only

3.2 The Impact of Migration on Changes in Health Status

Question addressed in this section:

Does migration explain or contribute to this widening gap?

The previous section confirms that the gap in health status between residents living in areas with the most and least healthy populations is widening. And the widening gap is due mainly to improvements in the health status of residents of the areas with the most healthy populations, with no corresponding improvement for residents of areas with the least healthy populations. It is possible that migration is a contributing factor to the widening gap in health status observed over time. For example, between 1989 and 2000 the number of mines in northern Manitoba (our areas with the least healthy populations) dropped from 20 to 8 (Northern Miner, 1989; 2000). This could have the effect of driving healthy, able workers to other areas to seek employment. Likewise, within Winnipeg, healthier members of the population may move out of the core area (where the least healthy populations are concentrated), whereas those who are less healthy and unable to maintain employment may move into the core area to seek cheaper housing. Any of these migration patterns could contribute to the appearance of a widening health status gap between the least and most healthy populations, *without any actual change in health status of individuals having occurred*. We assessed the impact of these migration patterns on changes in mortality as well as changes in morbidity over time and across regions.

3.2.1 Impact of Migration on Mortality

In order to assess the potential impact of migration on area mortality we used a method which compares mortality rates with the effects of migration included, to mortality rates where the effects of migration have been removed or controlled for (see Brimblecombe et al., 1999). This analysis uses the Standardized Mortality Ratio (SMR) as a measure of health status, with SMRs below 100 indicating better than average health status, and SMRs above 100 indicating poorer than average health. This analysis controls for the effects of migration both into and out of the different areas. If migration is a contributing factor to the changes in health status observed in this study, then we would expect that the SMRs that control for migration would be different than those where the effect of migration is included. (For more details regarding this method, please refer to Appendix B.)

We found, however, that migration had almost no impact on the observed change in health status in the non-Winnipeg areas, shown by the similarities between SMRs with and without the effect of migration included (Table 3). Minimal impact on health status for Winnipeg areas was observed, and for the areas with the least healthy populations, it was in the direction that would be predicted if migration did have an impact on the growing gap in health status between the least and most healthy populations (Table 4). This is shown by the higher SMRs when the effect of migration is included in Table 4. However, this same effect was observed, though to a lesser extent, for the areas with the most healthy populations. That is, the most healthy populations also had higher SMRs when the effect of migration was included. Apparently, either individuals with poorer health moved into both the areas whose populations were in the poorest health and into the areas whose populations had the best health and/or individuals with better health moved out of both these areas. This means that migration would have the same effect in both types of areas—that of lowering the overall health status of area residents. Because the effect of migration appears to lower health status for both the most and least healthy populations, the contribution of migration to the growing gap in health status between these areas would be minimal. *Thus, migration appears to have made little contribution to the widening gap in health status between the least and most healthy non-Winnipeg and Winnipeg populations.*

Migration appears to have made little contribution to the widening gap in health status between the least and most healthy non-Winnipeg and Winnipeg populations.

Table 3: SMRs for non-Winnipeg populations adjusting for the impact of migration, 1995-1999

Population	Without migration	With migration
Most Healthy	95.1	95.2
Average Health	102.5	102.0
Least Healthy	128.9	128.7

Table 4: SMRs for Winnipeg populations adjusting for the impact of migration, 1995-1999

Population	Without migration	With migration
Most Healthy	85.7	87.4
Average Health	99.4	98.3
Least Healthy	114.9	118.6

3.2.2 Impact of Migration on Morbidity

Because we look not only at changes in mortality across time but also changes in morbidity (as measured by treatment prevalence) in this report, we also assessed the impact of migration using a measure of morbidity. This analysis looked at whether those who moved into or out of each of the regions by the end of the study period had different morbidity burdens at the start of the study period. We used the Adjusted Clinical Group (ACG) case-mix adjustment system (Starfield, Weiner, Mumford et al., 1991) to categorize morbidity. This system uses data on physician visits and hospital stays to determine morbidity, so unlike the mortality data, where there is a record of everyone who dies, these morbidity analyses are based on utilization of the health care system. We found evidence of under-counting of utilization of health care services in northern Manitoba, most probably due in part to the use of nursing stations for some care delivery in these regions, which is not captured in the Repository. For this reason, differences in morbidity between migrants and non-migrants for the least and most healthy populations were assessed only for Winnipeg. (For more details regarding this method, please refer to Appendix B.)

We found that migration patterns differed for residents of areas with the least and most healthy Winnipeg populations. Whereas 43% of those from the most healthy populations did not move over the course of the study period, only 29% of those from the least healthy populations were resident in these areas at both the beginning and end of the study period. Although the per cent of people moving into each of these areas was similar (about 20%), 25% of those from the areas with the least healthy populations had moved out of the area by 1999, whereas only 15% had moved out of the areas with the most healthy populations.

With respect to differences in morbidity burden between populations, about 3.4% of those resident in the areas with the most healthy populations had major morbidity burden in 1985, whereas 5.4% of those in areas with the least healthy populations were classified as such. Table 5 shows the per cent of residents within each of the Winnipeg populations (according to where they lived in 1999) considered to have major morbidity burden in 1985, by their migration status in 1999 (whether they moved out of, into or stayed in the area). Those who moved out of the Winnipeg areas with the most

Morbidity analyses suggest that migration into and out of the different areas of Winnipeg may have had a minor impact on the widening gap in morbidity between the least and most healthy populations.

healthy populations were somewhat sicker overall to begin with (in 1985) than those who stayed, whereas those who moved into the areas with the most healthy populations were slightly healthier overall than those who did not migrate. The differences are very small, however. For the least healthy Winnipeg populations, those who moved out were somewhat healthier to begin with than those who stayed, but so were those who moved into the areas, though to a lesser extent. *These morbidity analyses suggest that migration into and out of the different areas of Winnipeg may have had a minor impact on the widening gap in morbidity between the least and most healthy populations.*

Table 5: Per cent residents of Winnipeg populations with major morbidity burden in 1985, by migration status in 1999

Population	Migrated into	Migrated out of	Did not migrate
Most Healthy	2.28	2.59	2.41
Average Health	2.71	2.87	2.63
Least Healthy	3.78	3.06	4.10

To summarize, despite the small increased propensity we have documented in the tendency of those with major morbidities to migrate to areas with the least healthy populations in Winnipeg, it is clear that migration explains little or none of the widening gap in mortality which we have documented. Thus, migration had little if any effect on the widening gap in mortality between the least and most healthy non-Winnipeg and Winnipeg populations.

3.3 Exploring the Contribution of Specific Causes of Mortality and Morbidity to the Widening Gap in Health Status

Question addressed in this section:
- Is the widening gap in health status observed in only one or two specific diseases or is it a more general pattern?

3.3.1 Cause-Specific Mortality

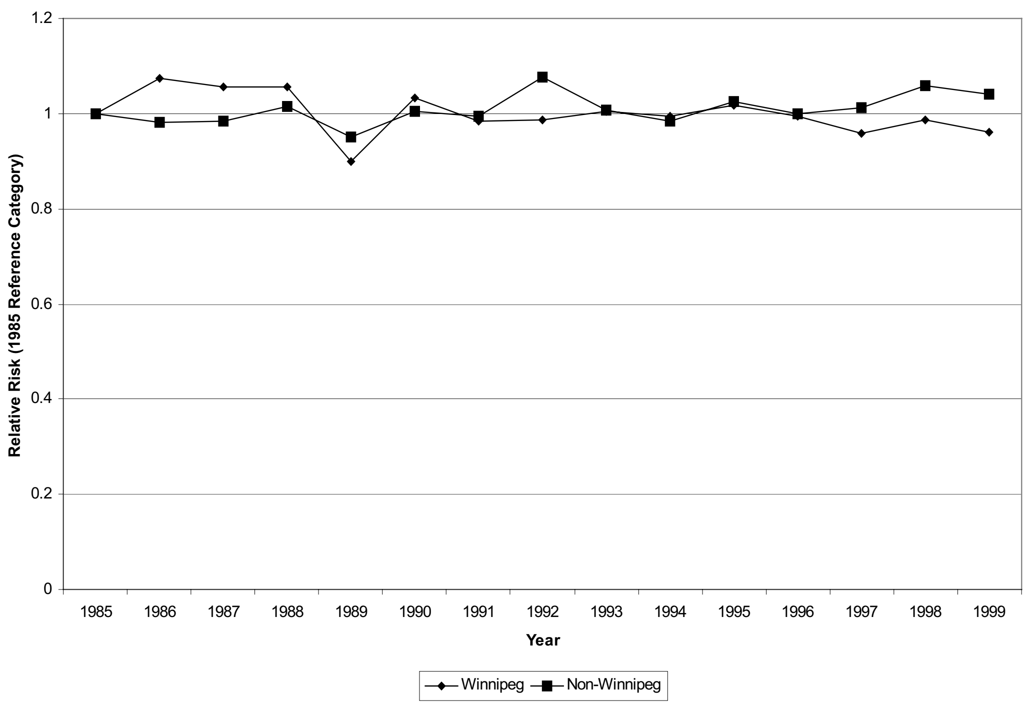
We further investigated the widening gap in health status between residents of the non-Winnipeg and Winnipeg areas with the least and most healthy populations by looking at changes in specific causes of mortality. The intent of these Poisson regression analyses was to determine whether the increasing disparity in mortality between the least and most healthy populations was a function of one specific disease, or evident across disease categories. We chose the four most common causes of death for analysis: cancer, heart disease, injury and respiratory disease. (Definitions of each of these diseases can be found in the Glossary.)

Age- and sex-standardized five-year rates (1985-1989 and 1995-1999) for each of these specific causes of death, for both non-Winnipeg and Winnipeg populations can be found in Table A6 in Appendix A.

Cancer mortality

Overall, cancer mortality changed very little across time for both non-Winnipeg and Winnipeg residents. Figure 7 shows the risk of cancer mortality in each year relative to 1985. Although the figure depicts some year to year changes, these are likely due to random fluctuations rather than meaningful changes in cancer mortality. Analysis comparing the most recent five years (1995-1999) to the first five years (1985-1989) confirmed that there were no significant changes in cancer mortality for either non-Winnipeg (p=.9729) or Winnipeg residents (p=.9712).

Figure 7: How much has Cancer Mortality Changed Throughout the Study Period?



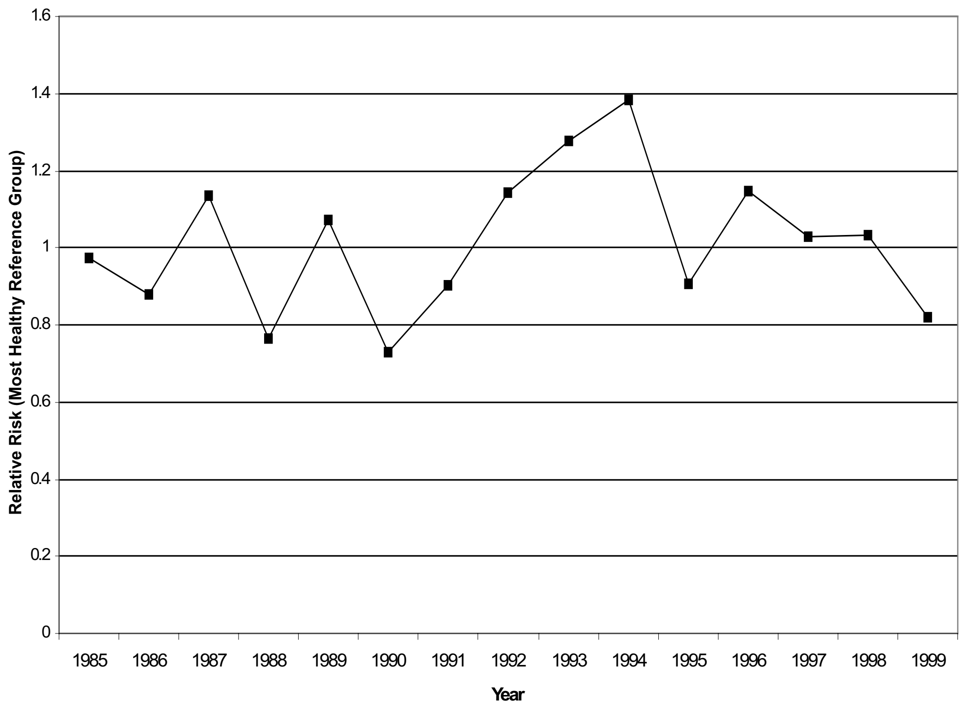
Data source: Population Research Repository. Data are based on fiscal years.

Non-Winnipeg findings: Figure 8 shows the risk of mortality for the non-Winnipeg areas with the least healthy populations relative to the most healthy populations. No clear pattern emerges from this figure: in some years cancer mortality appears to be higher in the least compared to the most healthy populations; in other years it appears to be lower. Year-to-year fluctuations make it difficult to detect any trends across time, and so we focus instead on average change for five-year periods. Overall, for the period from 1985-1989 cancer mortality was .96 times for the least healthy populations compared to the most healthy populations (meaning that the risk of cancer death was very similar for these two populations). The cancer mortal-

There was no evidence of a gap in cancer mortality between the least and most healthy non-Winnipeg populations and this did not change across the study period.

ity risk in 1995-1999 was similar to that of the earlier period (i.e., .99 times) and a statistical test confirmed that there was no significant change in the difference in cancer mortality over time (p=.7024). *Thus, there was no evidence of a gap in cancer mortality between the least and most healthy non-Winnipeg populations and this did not change across the study period.*

Figure 8: How much Higher is Cancer Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

For cancer mortality there was evidence of a widening gap across time between the least and most healthy non-Winnipeg populations for those 75 years and older.

It is possible that analyses grouping all ages together may wash out any effects that may be found at specific ages. That is, it is possible to have no overall change in the health status gap, and at the same time widening gaps at one age level and narrowing or stable gaps at another. Although there was no change over time in the cancer mortality gap between the least and most healthy non-Winnipeg populations overall, we ran separate analyses by age groups to determine if this pattern held true for all age categories. We found that residents from the areas with the most healthy populations in the 45- to 64-year category experienced a drop in mortality, with those from areas with the least healthy populations experiencing a similar, though non-significant, decrease in cancer mortality. For the 75+ year residents, both the least and most healthy populations experienced an increase in cancer mortality. This increase was greater for the least healthy populations and resulted in a significant increase in disparity between the least and most healthy populations over time (p=.0471). *Thus for cancer mortality there was evidence of a widening gap across time between the least and most healthy non-Winnipeg populations for those 75 years and older.*

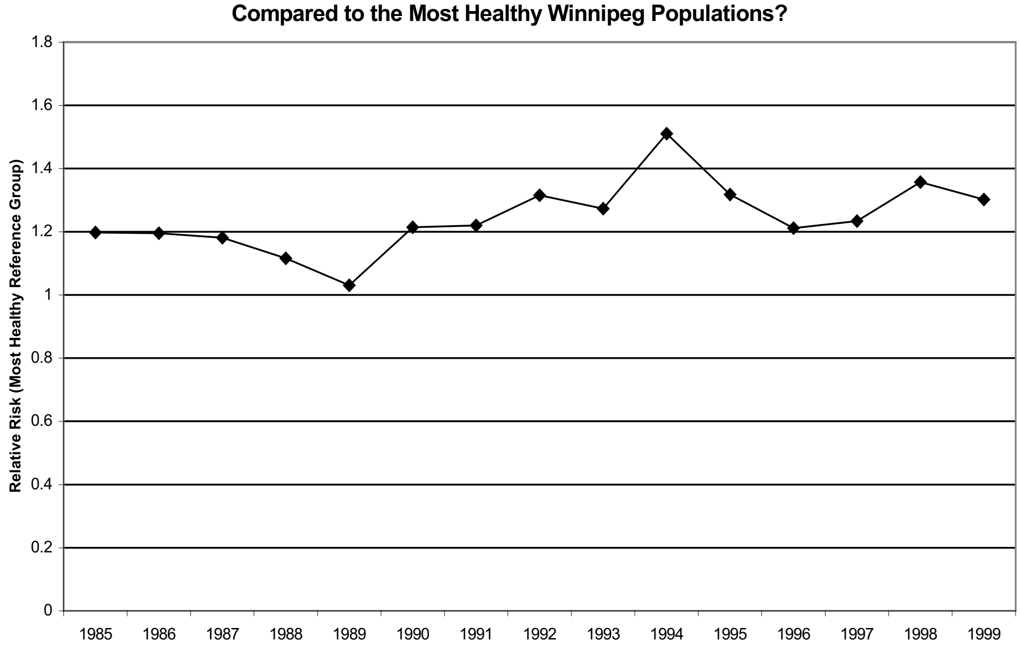
For cancer mortality there was no evidence of a widening gap across time between the least and most healthy non-Winnipeg populations for either males or females.

The gap in cancer mortality between the least and most healthy Winnipeg populations did not change across the study period.

Separate analyses were also run for males and females. Once again, there is no evidence of a consistent gap between the least and most healthy non-Winnipeg populations for either males or females, and this did not change over the study period (p=.6575 for males, p=.9914 for females). *Thus for cancer mortality there was no evidence of a widening gap across time between the least and most healthy non-Winnipeg populations for either males or females.*

Winnipeg findings. Figure 9 shows the risk of mortality for the least healthy Winnipeg populations relative to the most healthy. It is evident from this figure that those from the areas with the least healthy populations had a slightly higher cancer mortality rate than those from the areas with the most healthy populations. At the same time, the magnitude of this disparity did not change appreciably over time; in 1985-1989 the mortality risk was 1.14 times higher for the least compared to the most healthy Winnipeg populations and in 1995-1999 it was 1.28 times higher. This change in the gap between the least and most healthy populations was not significant (p=.0672). *Thus, the gap in cancer mortality between the least and most healthy Winnipeg populations did not change across the study period.*

Figure 9: How much Higher is Cancer Mortality for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

Once again, we ran analyses separately for different age groups to determine if this pattern held true for all age categories. Cancer mortality decreased across time for Winnipeg residents from the areas with the most healthy populations in the 45- to 64-year age group with no corresponding change

The gap in cancer mortality between Winnipeg residents from areas with the least and most healthy populations did not change for any of the age groups.

For cancer mortality there was a widening gap across time between the least and most healthy Winnipeg populations for males only.

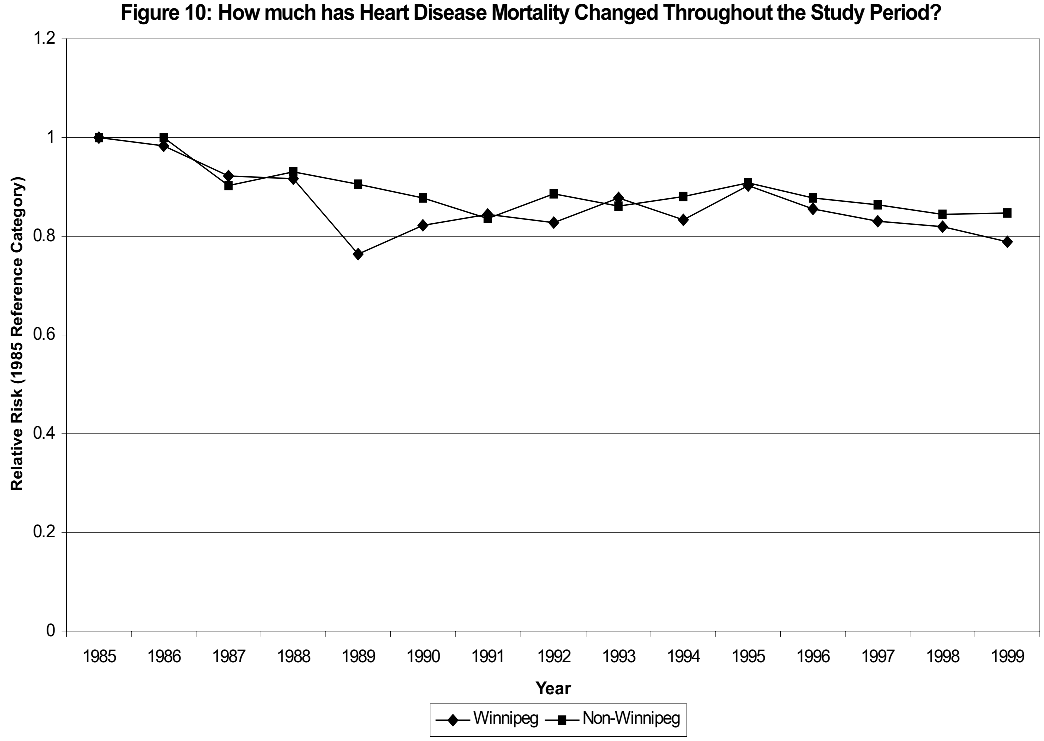
for those from the least healthy populations. However, when we tested whether this change over time for the least and most healthy populations resulted in a widening gap, the result was non-significant (p=.3349). *Thus, the gap in cancer mortality between Winnipeg residents from areas with the least and most healthy populations did not change for any of the age groups.*

Separate analyses were also run by sex. There was evidence of a gap between the least and most healthy Winnipeg populations for males between 1985 and 1999, and analysis comparing the last to first five-year periods revealed that this disparity increased by 20% over the study period, a significant change (p=.0059). The results were very different for females, where there was little evidence of disparity between the least and most healthy Winnipeg populations, and no change in this over time (p=.3340). *Thus for cancer mortality there was a widening gap across time between the least and most healthy Winnipeg populations for males only.*

Heart Disease mortality

Overall, the rate of heart disease mortality declined for both non-Winnipeg and Winnipeg residents between 1985 to 1999 (Figure 10). Figure 10 shows the risk of mortality due to heart disease in each year relative to 1985. Comparing the last five-year time period relative to the first five-year time period, we found the rate of heart disease mortality decreased by about 8.5% for both non-Winnipeg and Winnipeg residents; both results were statistically significant (p=.0072 for non-Winnipeg, p=.0442 for Winnipeg).

Figure 10: How much has Heart Disease Mortality Changed Throughout the Study Period?

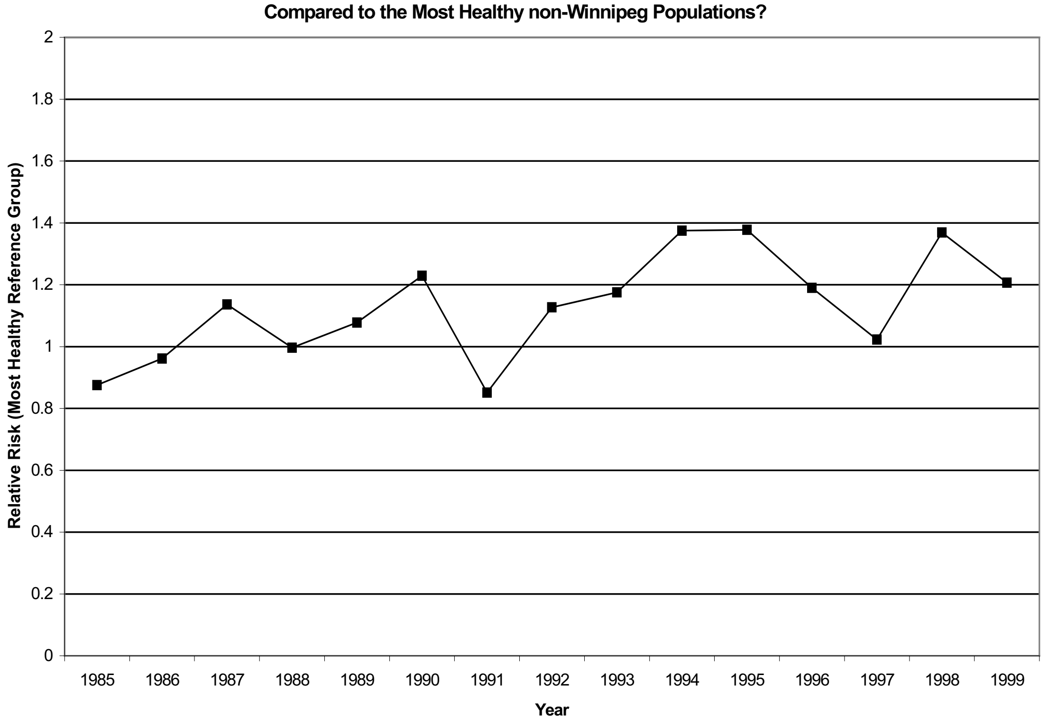


Data source: Population Research Repository. Data are based on fiscal years.

The gap in heart disease mortality between the least and most healthy non-Winnipeg populations increased significantly across the study period.

Non-Winnipeg findings. Figure 11 shows the risk of mortality from heart disease for the non-Winnipeg areas with the least healthy populations relative to the most healthy populations. This figure indicates that heart disease mortality appeared to differ little between the least and most healthy non-Winnipeg populations at the beginning of the study period, but there appeared to be a gap in heart disease mortality by the end of the study period, with those from the least healthy populations at greater risk. Comparisons of the five-year periods confirmed that this gap in heart disease mortality increased significantly across the study period (p=.0035): in 1985-1989 the risk of dying from heart disease was not appreciably larger in the least healthy compared to the most healthy populations (1.01 times); by 1995-1999 the risk was significantly higher (1.23 times). *Thus, the gap in heart disease mortality between the least and most healthy non-Winnipeg populations increased significantly across the study period.*

Figure 11: How much Higher is Heart Disease Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

Further analyses by age categories revealed that residents of the areas with the most healthy populations experienced a drop in heart disease mortality across time for all age groups and that these changes were substantial. For those from the least healthy grouping the only change across time found for heart disease mortality was an increase for those in the 65- to 74-year age group. When we tested the difference in the trend over time for the least and most healthy regions, the results showed evidence of an increase in disparity for the 45-64 (p<.0001), the 65-74 (p<.0001) and the 75+ (p=.0019)

For heart disease mortality there was evidence of a widening gap between the least and most healthy non-Winnipeg populations for all age groups over 44 years.

year age groups. *Thus for heart disease mortality there was evidence of a widening gap between the least and most healthy non-Winnipeg populations for the 45 to 64-, 65- to 74-, and the 75+ year groups.*[11]

The gap in heart disease mortality between the least and most healthy non-Winnipeg populations increased significantly for females over the study period.

Separate analyses were also run for males and females. Although disparities between the least and most healthy non-Winnipeg populations were evident across the study period for both males and females, these disparities widened only for females over time (p=.0598 for males, p=.0034 for females). *Thus the gap in heart disease mortality between the least and most healthy non-Winnipeg populations increased significantly for females over the study period.*

The gap in mortality due to heart disease between the Winnipeg areas with the least and most healthy populations increased significantly across the study period.

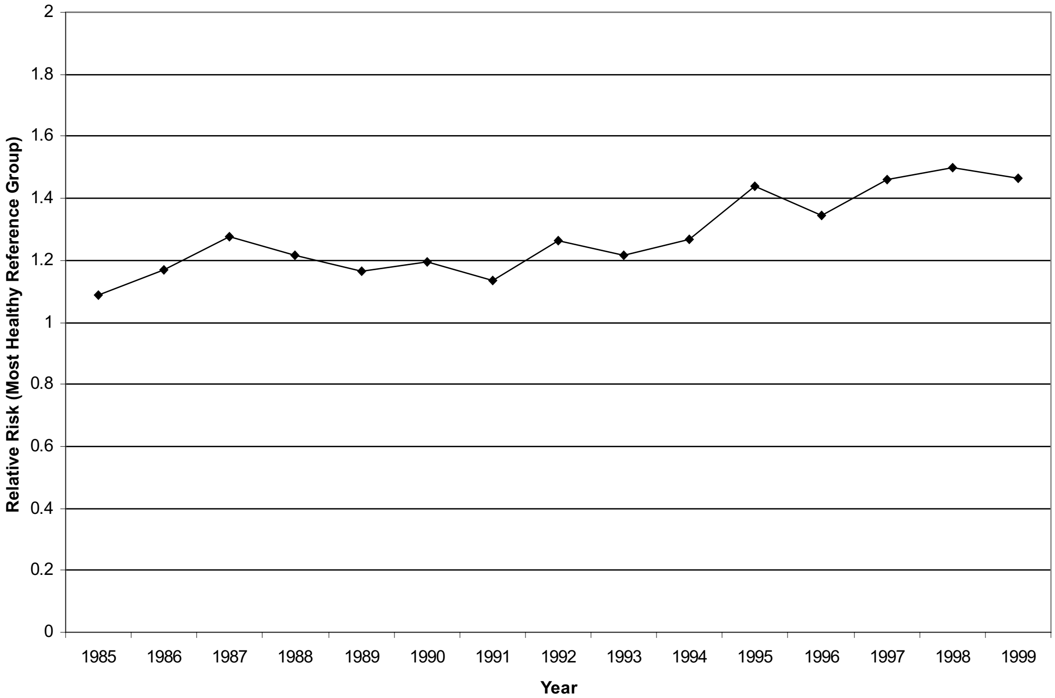
Winnipeg findings. Figure 12 shows the risk of mortality for the Winnipeg areas with the least healthy populations relative to the most healthy populations. It is evident from this figure that those from the least healthy populations had higher heart disease mortality throughout the study period; analyses comparing the first and last five-year periods showed that the disparity between the least and most healthy populations went from 18% higher in 1985-1989 to 44% higher in 1995-1999. This increase in the gap between the least and most healthy Winnipeg populations for heart disease mortality was statistically significant (p=.0027). *Thus, the gap in mortality due to heart disease between the Winnipeg areas with the least and most healthy populations increased significantly across the study period.*

There is evidence of a widening gap in deaths from heart disease between the Winnipeg areas with the least and most healthy populations for the 65-to 74-year and 75+ year age groups.

Subsequent age-specific analyses were used to probe this trend across age groups. Winnipeg residents from the areas with the most healthy populations showed decreases across time for all but the youngest (0 to 44 years) age groups for heart disease mortality, whereas there were no significant changes for those from the areas with the least healthy populations. When we tested the difference between least and most healthy Winnipeg populations at all ages, we found that there had been a significant change in magnitude only for the two oldest age groups (p<.0001 for both results). *Thus there is evidence of a widening gap in deaths from heart disease between the Winnipeg areas with the least and most healthy populations for the 65- to 74-year and 75+ year age groups.*

[11] The mortality risk for the 0- to 44-year age group for the least healthy non-Winnipeg populations could not be estimated due to the small number of deaths.

Figure 12: How much Higher is Heart Disease Mortality for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



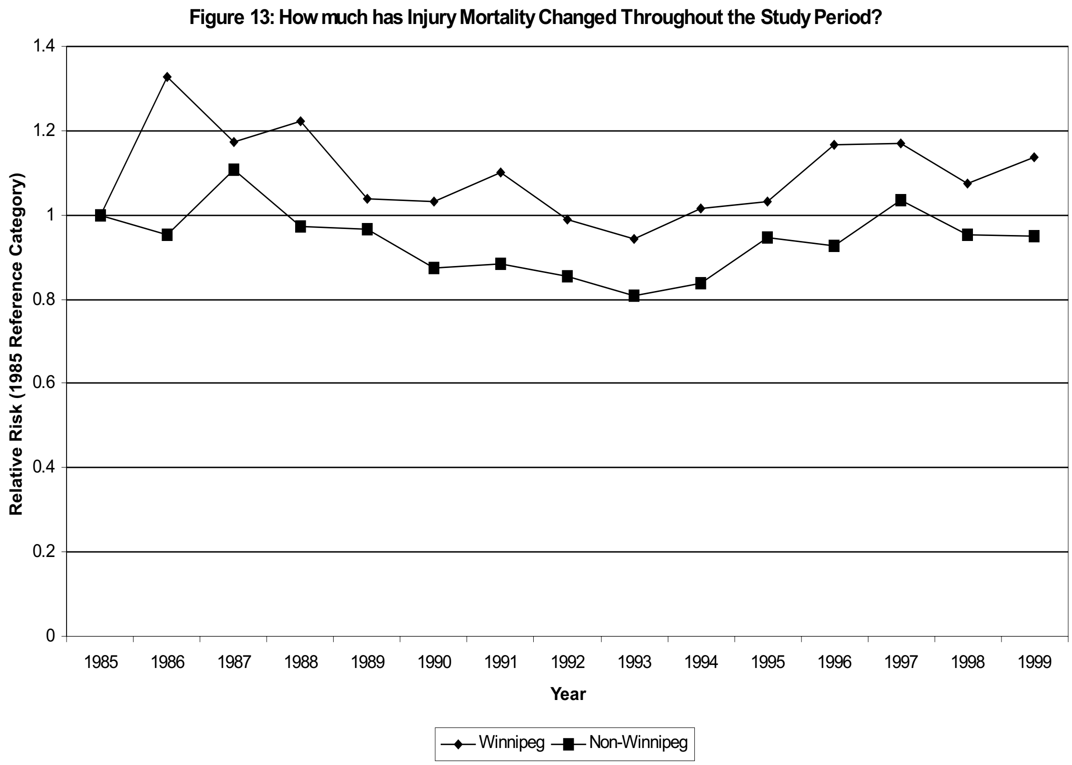
Data source: Population Research Repository. Data are based on fiscal years.

Separate analyses by sex revealed that the disparities in heart disease mortality between the least and most healthy Winnipeg populations increased for both males and females. In 1985-1989, the risk for heart disease mortality for Winnipeg males was 1.20 times higher in the least healthy populations compared to the most healthy populations. This disparity rose to 1.54 times in 1995-1999, which was a significant increase (p=.0102). For Winnipeg females the disparity in heart disease mortality between the least and most healthy populations increased a significant amount, from 1.17 times in 1985 -1989 to 1.36 times in 1995-1999 (p<.0001). *Thus, the gap in heart disease mortality between the least and most healthy Winnipeg populations widened for both males and females.* Interestingly, the patterns of these changes differed for males and females. For males, the widening gap was due to decreases in heart disease mortality for both the least and most healthy populations, with the greatest declines for the most healthy populations. For females, the widening gap was due to a decrease in heart disease mortality for female residents of areas with the most healthy populations at the same time that there was an increase in heart disease mortality for females from areas with the least healthy populations.

The gap in heart disease mortality between the least and most healthy Winnipeg populations widened for both males and females.

Injury mortality

Although injury mortality appeared to fluctuate over the study period (Figure 13) analyses comparing the last five-year period to the first five-year period revealed no significant changes over time for either non-Winnipeg or Winnipeg residents (p=.9664 and p=.9053, respectively).



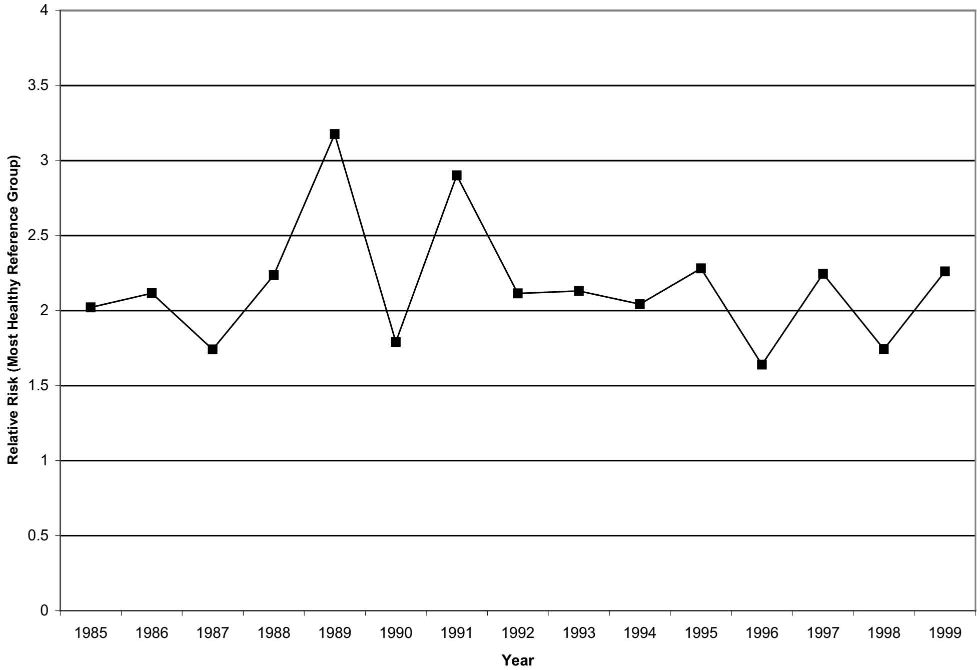
Data source: Population Research Repository. Data are based on fiscal years.

The gap in injury mortality between the least and most healthy non-Winnipeg populations did not change across the study period.

Non-Winnipeg findings: Figure 14 shows the risk of injury mortality for residents of the non-Winnipeg areas with the least healthy populations relative to the most healthy populations. It is evident from this figure that for non-Winnipeg residents, those from the least healthy populations had much higher injury mortality rates throughout the study period—2.26 times higher than the most healthy residents in 1985-1989 and 2.03 times higher in 1995-1999.[12] Analyses comparing the last to first five-year time periods found no significant change in the magnitude of this disparity (p=.513). *Thus, the gap in injury mortality between the least and most healthy non-Winnipeg populations did not change across the study period.*

[12] Caution should be exercised in interpreting these results, due to high variability in the data for injury mortality for non-Winnipeg residents.

Figure 14: How much Higher is Injury Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

There is little evidence of a widening gap in injury deaths between the non-Winnipeg areas with the least and most healthy populations over time.

The data were further broken down into age categories to determine whether the injury mortality gap between the least and most healthy non-Winnipeg populations changed over time for particular age groups. Decreases in mortality across time were found for residents of areas with the most healthy populations in the 0- to 24- and 45- to 64-year age groups. Similar decreases were found for those from the least healthy populations for the 45- to 64-year age group, but these changes were non-significant. When we tested differences over time for the least and most healthy populations, the results were non-significant for all age groups. *Thus there is little evidence of a widening gap in injury deaths between the non-Winnipeg areas with the least and most healthy populations over time.*

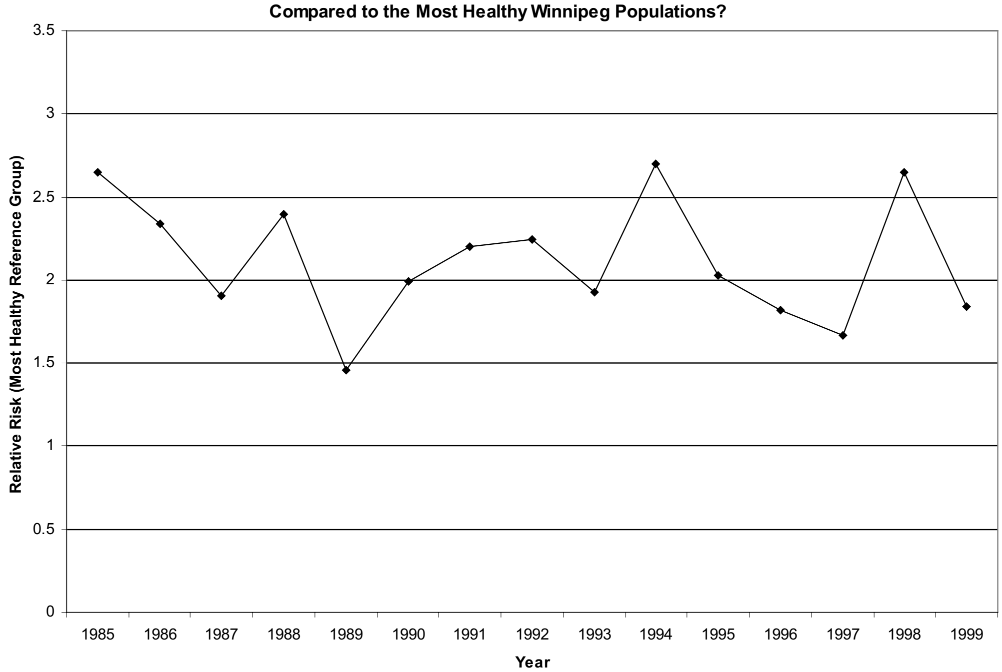
There was no evidence of a widening gap in injury mortality between the least and most healthy non-Winnipeg populations for either males or females.

Analysis by sex revealed the much higher injury mortality for the least healthy compared to the most healthy non-Winnipeg populations was found for both males and females. In 1995-1999 the injury mortality rate was 2.2 times higher for males from the least healthy compared to the most healthy populations, and 1.8 times higher for females from the least compared to the most healthy populations. These disparities were neither larger nor smaller than they had been in 1985-1989, however (p=.7308 for males, p=.7009 for females). *Thus there was no evidence of a widening gap in injury mortality between the least and most healthy non-Winnipeg populations for either males or females.*

The gap in mortality due to injury between Winnipeg residents of areas with the least and most healthy populations did not change across the study period.

Winnipeg findings. Figure 15 shows the risk of injury mortality for residents of the Winnipeg areas with the least healthy populations relative to the most healthy. It is evident from this figure that those from the Winnipeg areas with the least healthy populations had substantially higher injury mortality rates throughout the study period; however analyses comparing 1985-1989 with 1995-1999 revealed that there was no significant change in the disparity between the least and most healthy Winnipeg populations over the time period (p=.6925). *Thus, the gap in mortality due to injury between Winnipeg residents of areas with the least and most healthy populations did not change across the study period.*

Figure 15: How much Higher is Injury Mortality for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

The only evidence of a widening gap in injury deaths between the least and most healthy Winnipeg populations was found for the 0- to 24-year age group, where the least healthy populations showed no change in injury mortality, but the most healthy populations showed a substantial decrease.

The data were further broken down into age categories to determine whether the injury mortality gap between the least and most healthy Winnipeg populations changed over time for particular age groups. Injury mortality for those from the most healthy populations decreased substantially across time for the 0- to 24-year age group but increased for those from the 65+-year age group. For those from the least healthy populations, injury mortality declined for the 45- to 64-year group and increased for the 65+ year age group. When we tested the difference between least and most healthy Winnipeg populations over time, we found that the result was significant for the youngest age group only (p=.0002). *Thus the only evidence of a widening gap in injury deaths between the least and most healthy Winnipeg populations was found for the 0- to 24-year age group, where the least healthy populations showed no change in injury mortality, but the most healthy populations showed a substantial decrease.*

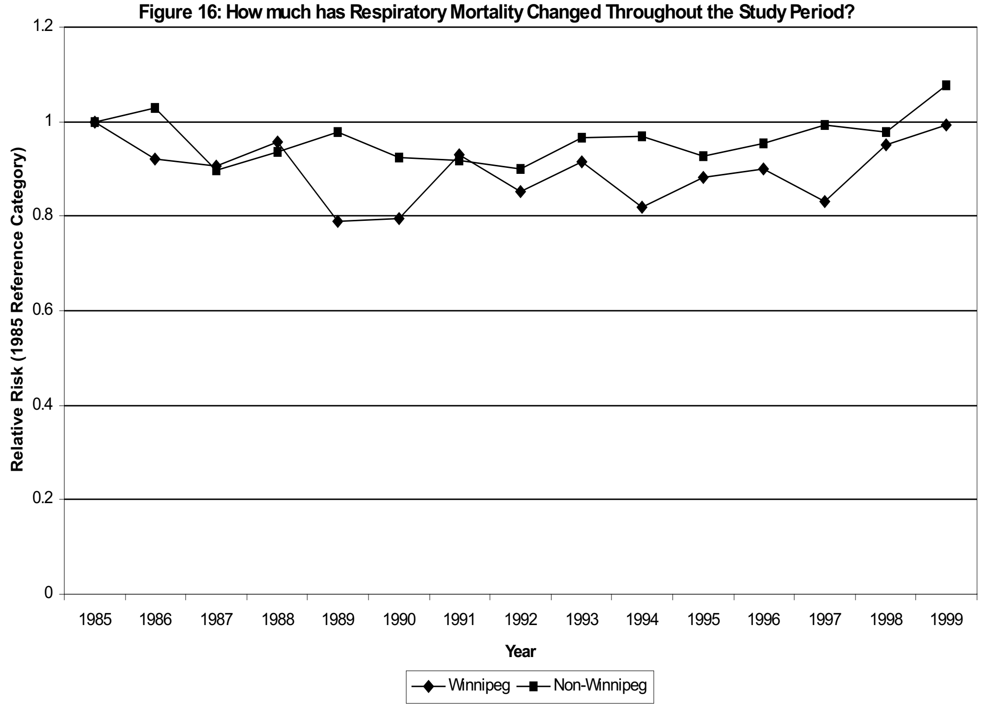
There was no evidence of a widening gap in injury mortality between the least and most healthy Winnipeg populations for either males or females.

Separate analyses by sex revealed significant disparities in injury mortality between the least and most healthy Winnipeg populations for both sexes; however these did not change over time (p=.7162 for males, p=.8676 for females). *Thus there was no evidence of a widening gap in injury mortality between the least and most healthy Winnipeg populations for either males or females.*

Repiratory disease mortality

Overall, respiratory disease mortality showed little change over the period from 1985 to1999 for Winnipeg residents (Figure 16). There was slightly more variation in the data for non-Winnipeg residents, which can be attributed to the smaller numbers of deaths in non-Winnipeg regions. However, statistical tests revealed no significant changes in mortality due to respiratory disease over time for either non-Winnipeg (p=.4903) or Winnipeg (p=.9204) residents.

Figure 16: How much has Respiratory Mortality Changed Throughout the Study Period?



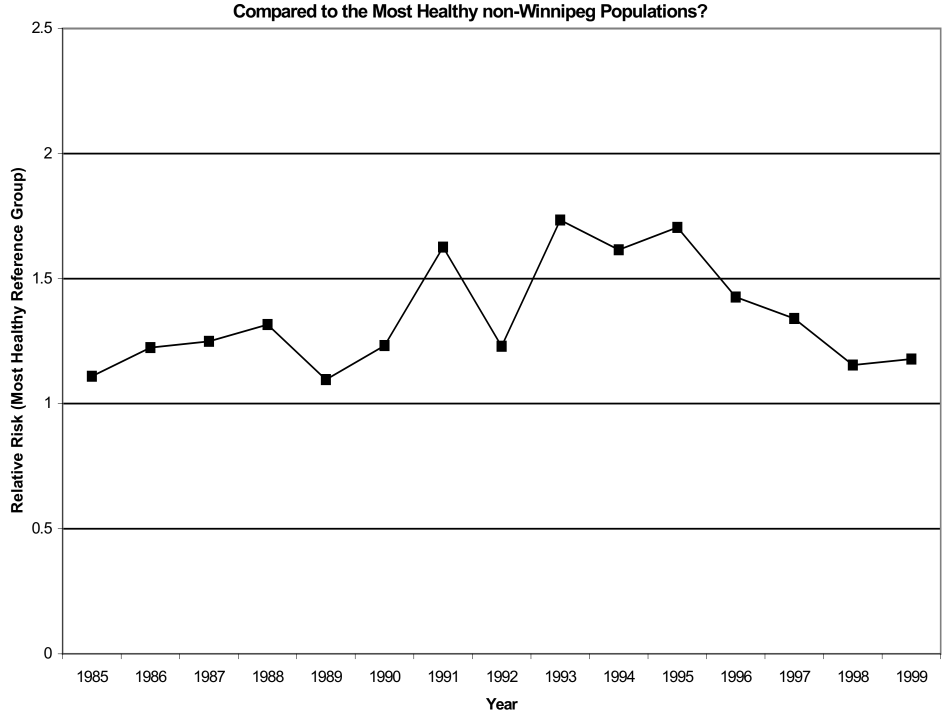
Data source: Population Research Repository. Data are based on fiscal years.

Non-Winnipeg findings. Figure 17 shows the risk of respiratory disease mortality for residents of the non-Winnipeg areas with the least healthy populations relative to the most healthy populations. Those from the least healthy non-Winnipeg populations had higher respiratory disease mortality rates throughout the study period- 1.36 times higher than the most healthy residents in 1995-1999. Analyses comparing the last to the first five-year periods revealed that there was no significant change in this disparity over the

The gap in respiratory disease mortality between the least and most healthy non-Winnipeg populations did not change across the study period.

time period (p=.2252). *Thus, the gap in respiratory disease mortality between the least and most healthy non-Winnipeg populations did not change across the study period.*

Figure 17: How much Higher is Respiratory Mortality for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

There was evidence of a widening gap in deaths from respiratory disease between the least and most healthy non-Winnipeg populations for the 0- to 44-, the 65- to 74-, and the 75+ year age groups, and a narrowing gap for the 45- to 64-year group.

Although there was no change overall in the gap between the least and most healthy non-Winnipeg residents for respiratory disease mortality, we found a different pattern of results when analyses were done by age groups. For those from the most healthy non-Winnipeg populations, respiratory disease mortality decreased across time for all age groups except the 75+ year group. Respiratory disease mortality also decreased for those from the least healthy non-Winnipeg populations for the 45- to 64-year group; however, for those at younger ages there was no change and for those in the 65- to 74-year and 75+ year age groups there was a significant increase in mortality across time. When we tested the difference between the least and most healthy populations over time, we found significant increases in disparity for the 0-to 44-year age group (p=.0241), the 65- to 74-year age group (p<.0001), and the 75+ year age group (.0009). Interestingly, although there were decreases in respiratory mortality for both the least and most healthy 45- to 64-year residents, the decrease for the least healthy populations was greater, resulting in a narrowing of the gap between the least and most healthy populations (p=.0441). *Thus there was evidence of a widening gap in deaths from respiratory disease between the least and most healthy non-Winnipeg populations for the 0- to 44-, the 65- to 74-, and the 75+ year age groups, and a narrowing gap for the 45- to 64-year group.*

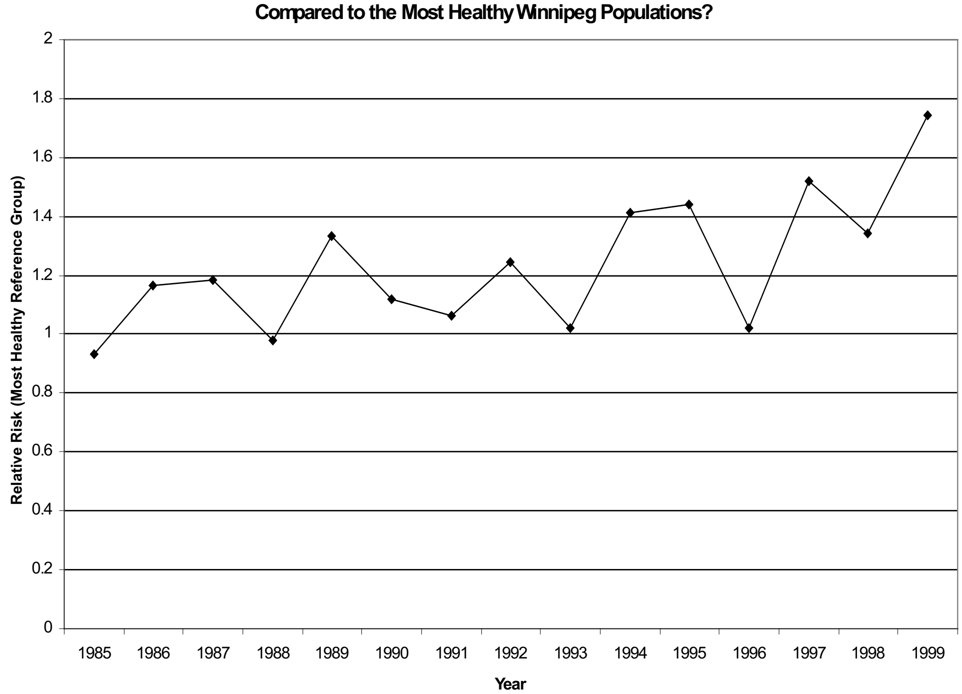
There was no evidence of a widening gap in respiratory disease mortality between the least and most healthy non-Winnipeg populations for either males or females.

The gap in respiratory disease mortality between Winnipeg areas with the least and most healthy populations did not change across the study period.

Separate analyses by sex revealed significant disparities in respiratory disease mortality between the least and most healthy non-Winnipeg residents for both males and females, however these disparities did not change over the study period (p=.1093 for males, p=.4748 for females). *Thus there was no evidence of a widening gap in respiratory disease mortality between the least and most healthy non-Winnipeg populations for either males or females.*

Winnipeg findings. Figure 18 shows the risk of mortality for the Winnipeg areas with the least healthy populations relative to the most healthy. Winnipeg residents from the least healthy populations had substantially higher respiratory disease mortality than residents from the most healthy populations across the study period, 1.24 times higher in 1985-1989. However, analyses of differences in five-year trends revealed that although the disparity between the least and most healthy Winnipeg populations between the first and last time periods appeared to increase, the change was not statistically significant (p=.0959). *Thus, the gap in respiratory disease mortality between Winnipeg areas with the least and most healthy populations did not change across the study period.*

Figure 18: How Much Higher is Respiratory Mortality for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

Age-specific analyses of differences in respiratory disease mortality for Winnipeg residents showed decreases in the 0- to 44-year and 65- to 74-year age groups for those from the most healthy populations, whereas no such decreases were evident for those from the least healthy grouping. In fact, res-

There is evidence of a widening gap in deaths from respiratory disease between the least and most healthy Winnipeg populations for the 0- to 44-year, and the 65- to 74-year age groups.

piratory disease mortality increased in the 65 to 74 year age group for the least healthy populations. For those 75+ years, there was a significant increase in respiratory disease mortality for residents of areas with the least healthy populations, with no corresponding increase for those from the most healthy populations. When we tested the difference in relative risks for least and most healthy Winnipeg populations, we observed a significant difference for both the 0- to 44-year (p=.0004) and 65- to 74-year age groups (p=.0026). *Thus there is evidence of a widening gap in deaths from respiratory disease between the least and most healthy Winnipeg populations for the 0- to 44-year, and the 65- to 74-year age groups.*

There is evidence of a widening gap in deaths from respiratory disease between the least and most healthy Winnipeg populations for both males and females and this widening gap was about equal for the sexes.

Separate analyses by sex revealed that the disparity in respiratory disease mortality between the least and most healthy Winnipeg populations was experienced by both sexes, and increased across the study period for both sexes, by 30% for males (p=.0026) and by 28% for females (p=.0006). *Thus there is evidence of a widening gap in deaths from respiratory disease between the least and most healthy Winnipeg populations for both males and females and this widening gap was about equal for the sexes.*

Summary for Cause-Specific Mortality

For almost all of the disease-specific causes of mortality we examined, residents of the areas with the least healthy populations had higher rates of mortality than those from areas with the most healthy populations, and in some cases the differences were substantial. What is concerning is that none of these gaps in mortality rates between the least and most healthy have narrowed over the 15 years of our study period.

Table 6 summarizes the evidence for the widening gap in health status between the least and most healthy non-Winnipeg and Winnipeg populations for the cause-specific mortality categories discussed in this section. Recall that in Section 1 of this report, when we looked at all mortality (not broken down into specific diseases) we found an increasing gap between the least and most healthy populations in both non-Winnipeg and Winnipeg areas. In contrast, for each of the four specific diseases we examined, only heart disease mortality showed a widening gap, for both non-Winnipeg and Winnipeg residents. When we further broke down the disease categories by age and sex, however, some evidence for significant increases in health disparities began to emerge. The greatest changes in terms of the growing gap between those from the least and most healthy populations appear to have occurred in heart disease and respiratory disease mortality, however there was some evidence of a growing health status gap for each of the categories studied. This growing gap in health status was not completely consistent across age categories, sex, disease categories or regions (non-Winnipeg, Winnipeg), although there was a fairly consistent pattern in the direction of the trends that produced the gap: most of the changes involved residents of areas with the most healthy populations showing improvements in health status over time, whereas residents from areas with the least healthy populations showed no change (and sometimes declines) in health status over time. Whatever has contributed to improving the health status of residents of the areas with the most healthy populations does not appear to have been providing similar benefits to residents of areas with the least healthy populations.

Table 6: Summary of cause-specific mortality findings

Indicator	Change Across Time (all populations)	Change in Gap Between Least and Most Healthy		
		Overall	By Age	By Sex
Non-Winnipeg:				
Cancer mortality	No change	Least similar to most, no change in gap over time	Gap increased for: 75+ years	No change in gap for males or females
Heart disease mortality	decreased	No gap at beginning, least greater than most (about 20%), by end of study period, gap increased over time	Gap increased for: 45 to 64 years 65 to 74 years 75+ years	Gap increased for females only
Injury mortality	No change	Least greater than most (about 2 times), but no change in gap over time	No change in gap for any age group	No change in gap for males or females
Respiratory disease mortality	No change	Least greater than most (about 30%), but no change in gap over time	Gap increased for: 0 to 44 years 65 to 74 years 75+ years Gap decreased for: 45 to 64 years	No change in gap for males or females
Winnipeg:				
Cancer mortality	No change	Least greater than most (about 20%), but no change in gap over time	No change in gap for any age group	Gap increased for males only
Heart disease mortality	decreased	Least greater than most (about 20 to 40%); gap increased over time	Gap increased for: 65 to 74 years 75+ years	gap increased for both males and females
Injury mortality	No change	Least greater than most (about 2 times), but no change in gap over time	Gap increased for: 0 - 24 years	No change in gap for males or females
Respiratory disease mortality	No change	Least greater than most (about 40%), but no change in gap over time	Gap increased for: 0 to 44 years 65 to 74 years	gap increased for both males and females

3.3.2 Cause-Specific Morbidity

It should be noted that analyses relying on hospital and physician claims data reflect treatment prevalence rather than actual prevalence of disease.

Although changes in cause-specific mortality can provide us with an indication of the changing health status across Manitoba populations, they do not tell the whole story. Changes in health status can also be measured by looking at cause-specific morbidity, that is, the illnesses experienced within a population. We further investigated the widening gap in health status between the least and most healthy regional populations by looking at specific causes of morbidity. Poisson regressions were used for these analyses. It should be noted that analyses such as these, relying on hospital and physician claims data, reflect treatment prevalence rather than actual prevalence of disease.[13] Only those individuals presenting at physicians' offices or hospitals for treatment for these diseases will be included in the analyses. Those not seeking treatment or those treated elsewhere will not be included in the analyses. For some Manitobans, especially those in sparsely populated rural areas in the North, nurses assigned to nursing stations are more accessible than physicians and hospitals for treatment. These nurses are trained to provide services ordinarily provided by physicians in more populated areas. The absence of nursing station data from this study results in greater underreporting of treatment prevalence for residents of northern Manitoba.

We chose five common causes of morbidity for analyses: injury hospitalizations, diabetes treatment prevalence, respiratory disease treatment prevalence, AMI hospitalizations and cancer incidence (the number of new cancer cases).[14] (Definitions of these diseases can be found in the Glossary.)

Age- and sex-standardized 3-year rates for each of these specific causes of morbidity for both non-Winnipeg and Winnipeg populations can be found in Table A7 in Appendix A.

Injury

To analyze injury hospitalizations we broke injuries down into four categories representing the main causes of injury hospitalizations: falls, motor vehicle collisions (MVCs), violence (to self and by others), and other, which included all other categories of injury.

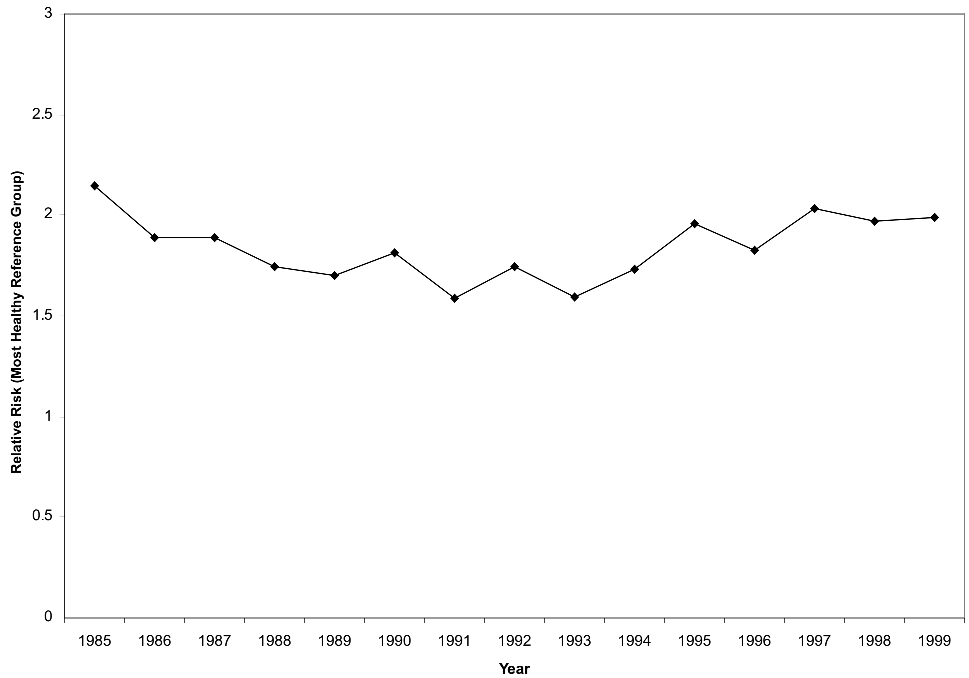
Falls. Analysis comparing the most recent five-year period to the first five-year period revealed that there was a significant decline across the study period in hospitalizations due to falls for both non-Winnipeg (p=.0002) and Winnipeg (p=.0004) residents.

[13] It should be noted that these analyses (with the exception of cancer morbidity) are based on prevalence (number of total cases) whereas the mortality analyses were based on incidence (number of new cases). The analyses of treatment prevalence differ somewhat from the analyses of mortality data: for mortality, analyses were based on counts of the event, whereas for treatment prevalence, analyses were based on average rates of the event.

[14] Because morbidity, as measured by treatment prevalence, is a more common event than mortality, we have a greater number of events with which to conduct our analyses, and therefore more statistical sensitivity to detect changes over time and differences between regions. For this reason, only those tests which showed a statistically significant overall change in regional disparity over time were probed further for age- and sex-specific findings. This was done to minimize the possibility of obtaining results which are spuriously significant due to random variation in the data.

Non-Winnipeg findings. Figure 19 shows the risk of hospitalization due to falls for residents of the non-Winnipeg areas with the least healthy populations relative to residents of the areas with the most healthy populations. Those from the least healthy non-Winnipeg populations had substantially higher hospitalization rates for falls throughout the study period—as high as 2.2 times higher than the most healthy populations in 1985.

Figure 19: How much Higher is Hospitalization for Falls for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

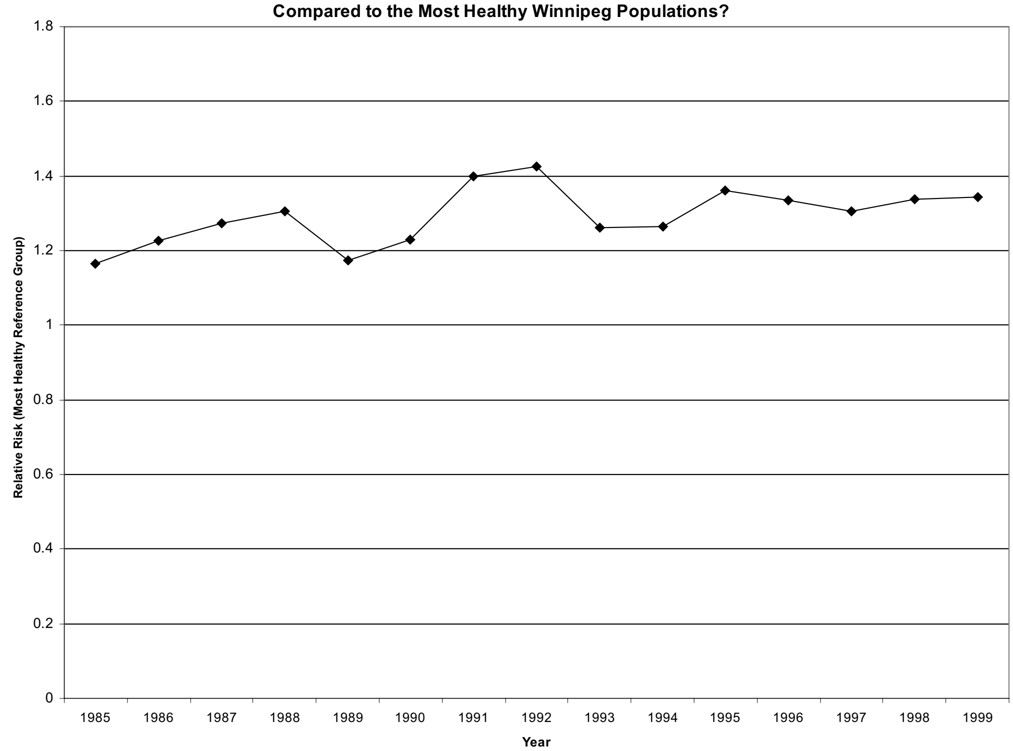
The gap in hospitalizations due to falls between residents of non-Winnipeg areas with the least and most healthy populations did not change across the study period.

Analyses comparing the last to the first five-year period revealed that there was no significant change in this disparity over the time period (p=.5166). *Thus, the gap in hospitalizations due to falls between residents of non-Winnipeg areas with the least and most healthy populations did not change across the study period.*

The gap in fall hospitalizations between the least and most healthy Winnipeg populations did not change across the study period.

Winnipeg findings. Figure 20 shows the risk of hospitalization due to falls for residents of the Winnipeg areas with least healthy populations relative to the most healthy. For Winnipeg, residents of areas with the least healthy populations had higher hospitalization rates due to falls than those with the most healthy populations, 1.34 times higher in 1995-99, but there was little change in this disparity over time. A test of the difference between the first and last five-year time periods revealed that there was no significant change in this disparity over time (p=.1939). *Thus, the gap in fall hospitalizations between the least and most healthy Winnipeg populations did not change across the study period.*

Figure 20 : How much Higher is Hospitalization for Falls for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



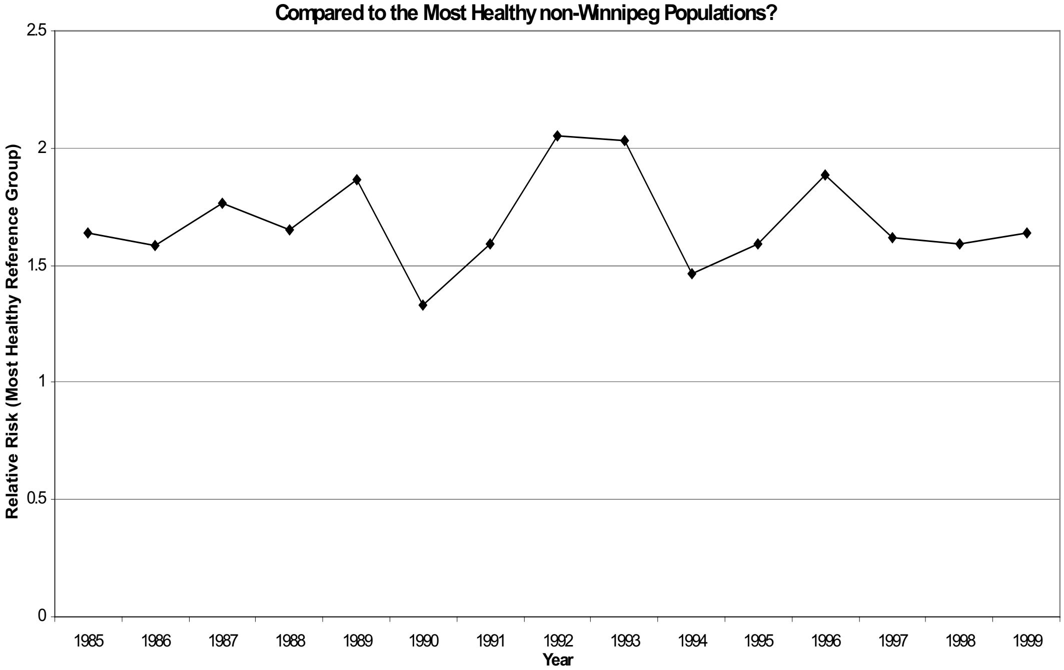
Data source: Population Research Repository. Data are based on fiscal years.

MVCs. Analysis comparing the most recent five-year period to the first five-year period revealed that MVCs decreased significantly over the study period for both non-Winnipeg (p=.0001) and Winnipeg (p=.0001) residents.

The gap in hospitalizations due to MVCs between the least and most healthy non-Winnipeg populations did not change across the study period.

Non-Winnipeg findings. Figure 21 shows the risk of hospitalization due to MVCs for the least healthy non-Winnipeg populations relative to the most healthy populations. Those from the least healthy non-Winnipeg populations had higher hospitalization rates for MVCs throughout the study period. Comparing the last to the first five-year period revealed that there was no significant change in this disparity over the time period (p=.8327). *Thus, the gap in hospitalizations due to MVCs between the least and most healthy non-Winnipeg populations did not change across the study period.*

Figure 21: How much Higher is Hospitalization for MVCs for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?

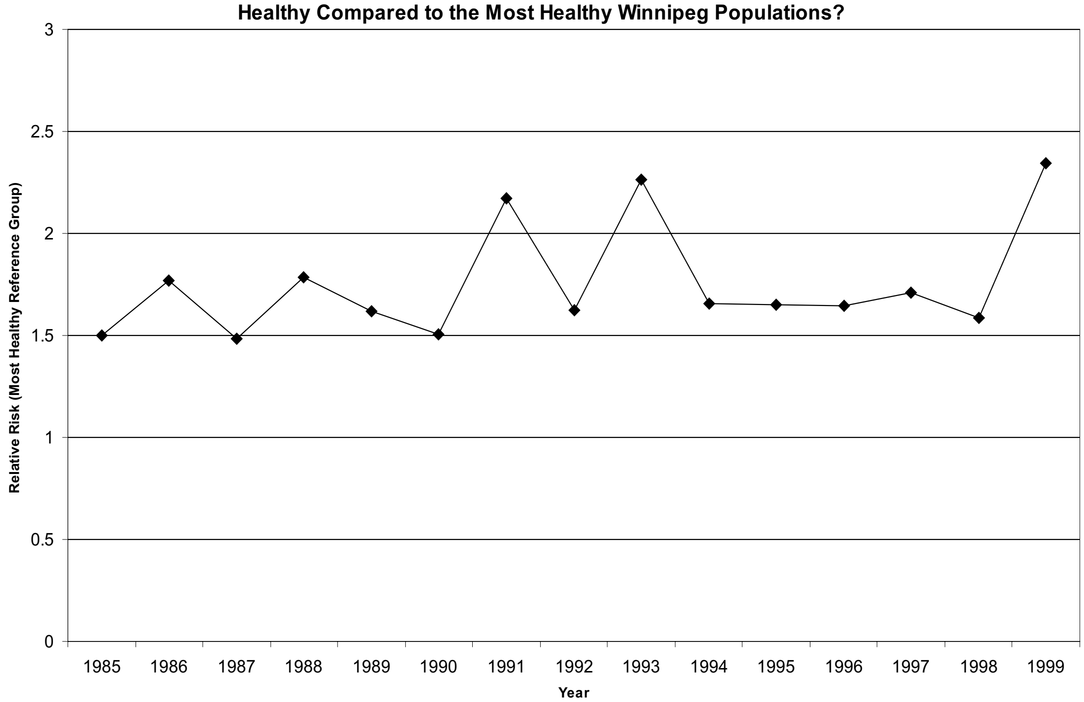


Data source: Population Research Repository. Data are based on fiscal years.

The gap in MVC hospitalizations between the least and most healthy Winnipeg populations did not change across the study period.

Winnipeg findings. Figure 22 shows the risk of hospitalization due to MVCs for residents of the Winnipeg areas with the least healthy populations relative to the most healthy. For Winnipeg, areas with the least healthy populations had higher hospitalization rates due to MVCs than those with the most healthy populations; however, between the first and last five-year periods there was no significant change in disparity (p=.3824). *Thus, the gap in MVC hospitalizations between the least and most healthy Winnipeg populations did not change across the study period.*

Figure 22: How much Higher is Hospitalization for MVCs for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



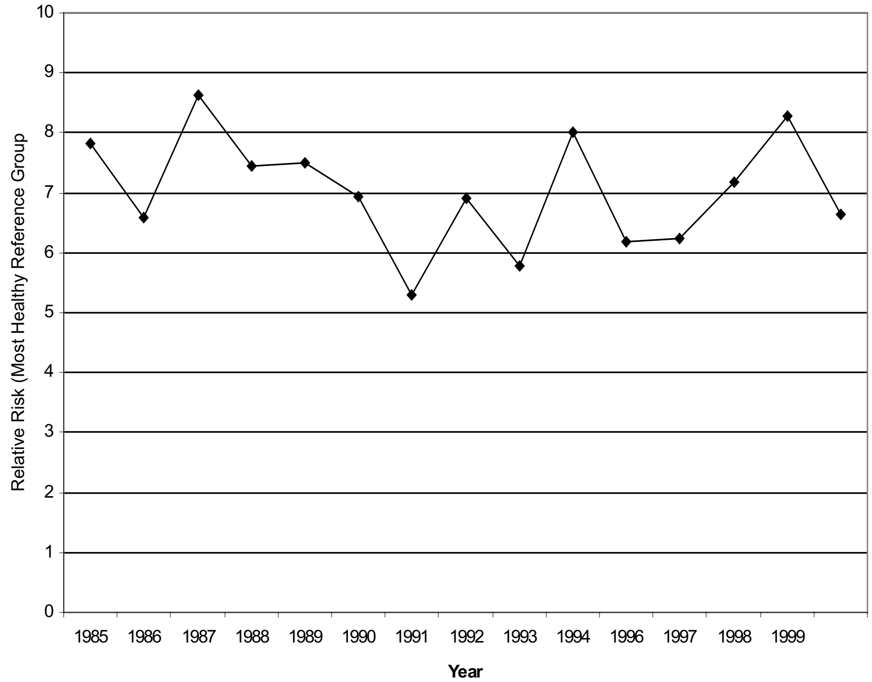
Data source: Population Research Repository. Data are based on fiscal years.

Violence. Analysis comparing the most recent five-year period to the first five-year period revealed no statistically significant changes in rates of hospitalizations for violent injuries for either non-Winnipeg (p=.5515) or Winnipeg (p=.6629) residents.

Although the gap in hospitalizations due to violence between residents of non-Winnipeg areas with the least and most healthy populations is substantial, it did not change over the study period.

Non-Winnipeg findings. Figure 23 shows the risk of hospitalization due to violence for residents of non-Winnipeg areas with the least healthy relative to the most healthy populations. Those from the least healthy non-Winnipeg populations had substantially higher hospitalization rates for violent injuries across the study period—almost seven times higher for the 1995 - 99 period. There was no significant change in disparity between this time period and the 1985 - 1989 period (p=.3187). *Thus, although the gap in hospitalizations due to violence between residents of non-Winnipeg areas with the least and most healthy populations is substantial, it did not change over the study period.*

Figure 23: How much Higher is Hospitalization for Violence for the Least Healthy Areas Compared to the Most Healthy non-Winnipeg Populations?



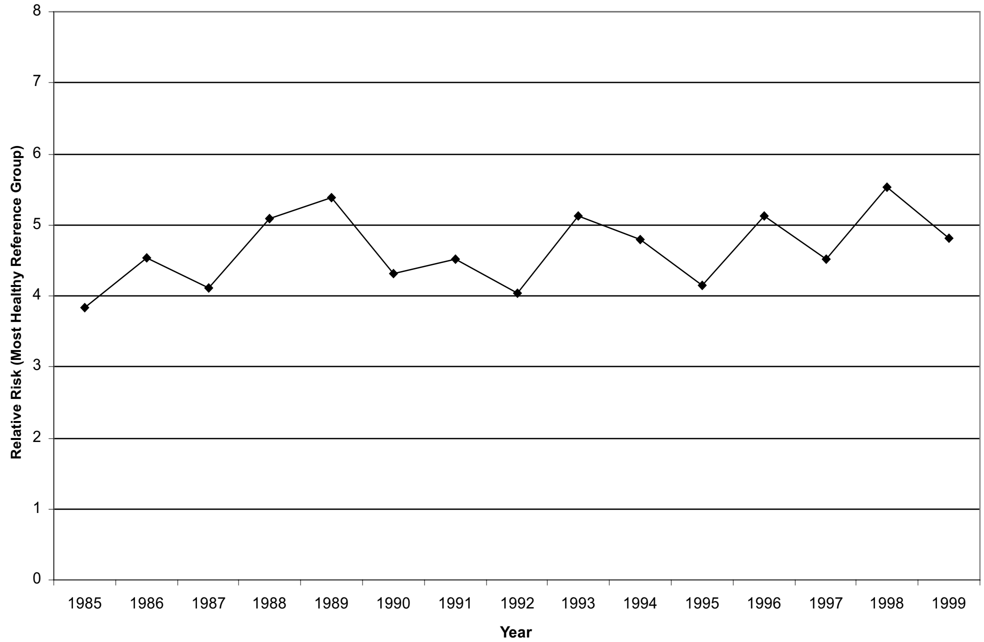
Data source: Population Research Repository. Data are based on fiscal years.

The substantial gap in violence hospitalizations between the least and most healthy Winnipeg residents did not change over time.

Winnipeg findings. Figure 24 shows the risk of injury hospitalization due to violence for the least healthy Winnipeg populations relative to the most healthy populations. Once again, although the Winnipeg areas with the least healthy populations had much higher hospitalization rates due to violence than those with the most healthy populations—over five times higher in 1985-1989—there was little change over time. A test for the difference between the first and last five-year time periods confirmed that there was no significant change in disparity over the study period (p=.3789). *Thus, the substantial gap in violence hospitalizations between the least and most healthy Winnipeg residents did not change over time.*

Other causes of injury. Analysis comparing the most recent five-year period to the first five-year period revealed no significant change over time in hospitalizations for other injuries for non-Winnipeg (p=.0656) but a significant decrease for Winnipeg (p=.0001) residents.

Figure 24: How much Higher is Hospitalization for Violence for the Least Healthy Compared to the Most Healthy Winnipeg Populations?

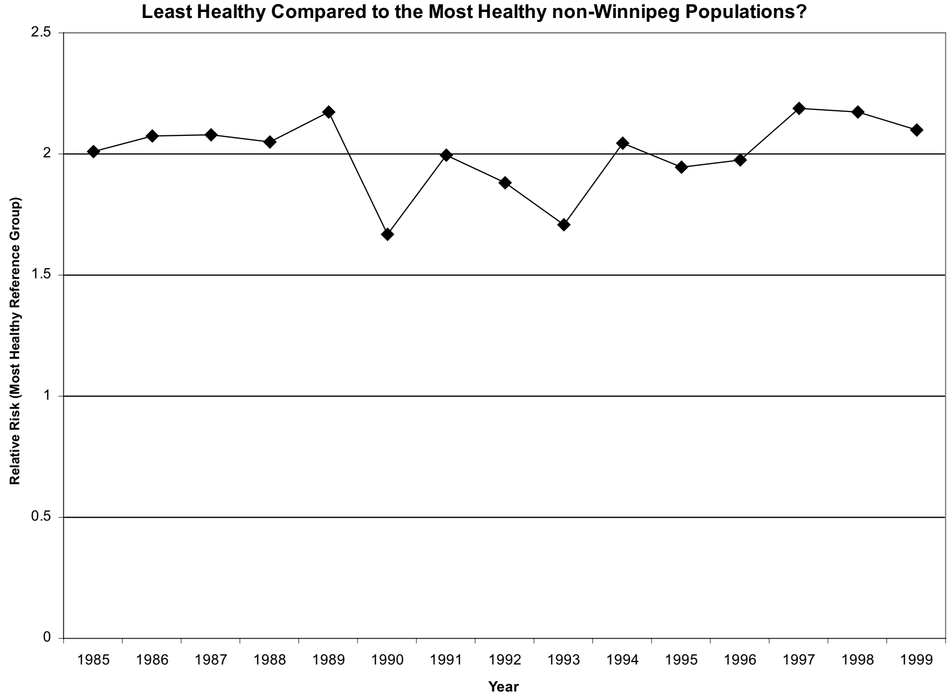


Data source: Population Research Repository. Data are based on fiscal years.

The gap in hospitalizations due to other causes of injury between the least and most healthy non-Winnipeg populations did not change over the study period.

Non-Winnipeg findings. Figure 25 shows the risk of hospitalization due to other causes of injury for residents of the non-Winnipeg areas with the least healthy relative to the most healthy populations. Those from the least healthy non-Winnipeg populations had significantly higher hospitalization rates for other injuries for each year of the study period—two times higher than the most healthy residents in 1995-1999. Analyses comparing the last to the first five-year period revealed that there was no significant change in this disparity over the study period (p=.9763). *Thus, the gap in hospitalizations due to other causes of injury between the least and most healthy non-Winnipeg populations did not change over the study period.*

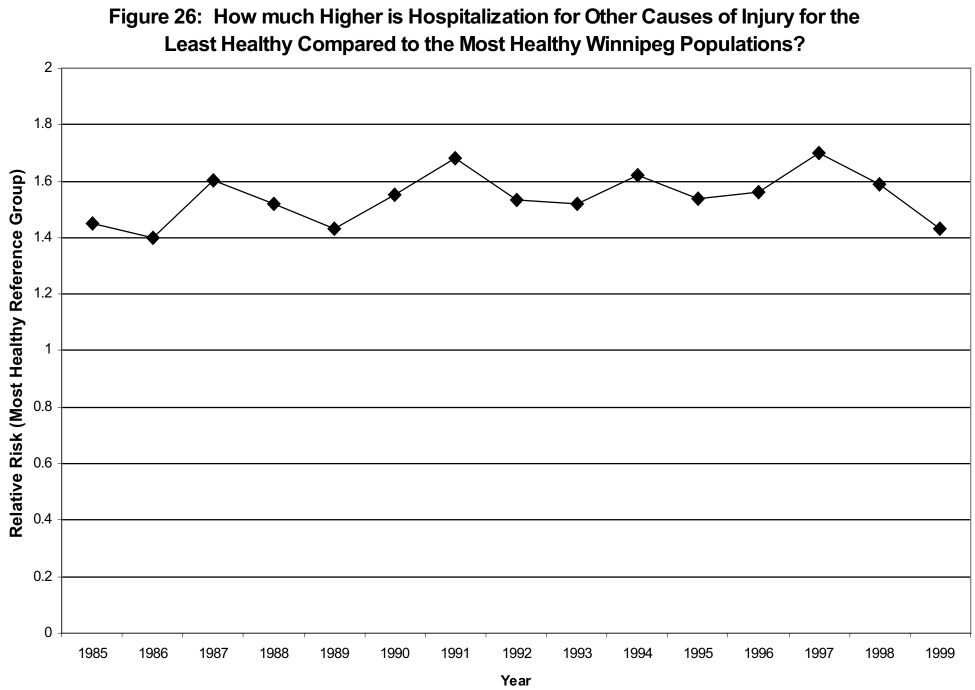
Figure 25: How much Higher is Hospitalization for Other Causes of Injury for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

The gap in other injury hospitalizations between the least and most healthy Winnipeg populations did not change across the study period.

Winnipeg findings. Figure 26 shows the risk of hospitalization due to other causes of injury for residents of Winnipeg areas with the least healthy relative to the most healthy populations. Winnipeg areas with the least healthy populations had significantly higher hospitalization rates due to other causes than those containing the most healthy populations, about one-and-a-half times higher in both 1985-89 and 1995-99. A test of this difference confirmed there was no significant change in disparity over the study period (p=.3779). *Thus, the gap in other injury hospitalizations between the least and most healthy Winnipeg populations did not change across the study period.*



Data source: Population Research Repository. Data are based on fiscal years.

Summary of Injury Hospitalization Analyses. For each of the four causes of injury hospitalization, residents of the areas with the least healthy populations had higher hospitalization rates than those from the most healthy populations. This gap in hospitalizations for injuries between residents of non-Winnipeg and Winnipeg areas with the least and most healthy populations did not change for any of the injury causes over the 15-year study period.

Diabetes Treatment Prevalence

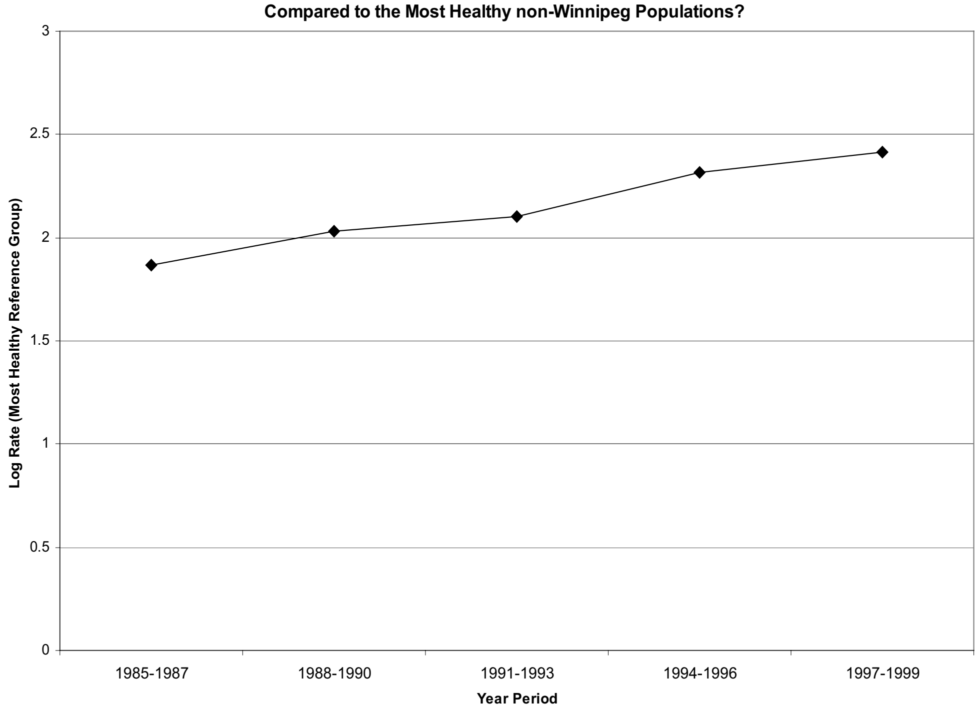
Diabetes treatment prevalence was assessed using both hospital claims and physician visits over three-year time periods. Analysis comparing the most recent six-year period to the first six-year period revealed a statistically significant increase in diabetes treatment prevalence for both non-Winnipeg (p=.0001) and Winnipeg (p=.0001) residents.

The gap in diabetes treatment prevalence between the least and most healthy non-Winnipeg populations widened over the study period.

Non-Winnipeg findings. Figure 27 shows the risk of diabetes treatment prevalence for the least healthy non-Winnipeg populations relative to the most healthy. Those from the least healthy non-Winnipeg populations had significantly higher diabetes treatment prevalence for each year of the study period—1.9 times higher than the most healthy residents in 1985-1987 and 2.4 times higher in 1997-1999. Analyses comparing the last to the first 6-year period[15] confirmed what is evident in Figure 27, that is, a significant increase in the disparity between least and most healthy non-Winnipeg populations over the study period (p<.0001). *Thus, the gap in diabetes treatment prevalence between the least and most healthy non-Winnipeg populations widened over the study period.*

[15] Six-year periods are compared here because diabetes treatment prevalence is based on three-year time periods.

Figure 27: How much Higher is Diabetes Treatment Prevalence for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

To further examine changes in the gap between the least and most healthy populations, age-specific analyses were undertaken. Three age groups were examined: 20 to 39, 40 to 59 and 60 to 79 years. Table 7 shows the changes in diabetes treatment prevalence rates over the study period for these age categories. Recall that for this type of table, the comparison, or ratio, is between the most recent time period (1994-99) and the first time period (1985-90). Thus, for each population at each age group, a value of less than 1.00 indicates a decrease in the risk of mortality over time, whereas a value greater than 1.00 represents an increase in the risk of mortality over time. Statistically significant changes are shown in bold.

The gap between the least and most healthy non-Winnipeg populations widened for the youngest and oldest age groups.

Evident in this table is that for non-Winnipeg populations, there were significant increases in diabetes treatment prevalence for each of the populations at each of the age categories. Analyses comparing the first and last six-year periods revealed that the disparity between the least and most healthy non-Winnipeg populations increased significantly for both the 20- to 39-year age group (p<.0001) and the 60 to 79-year age group (p<.0001). *Thus, the gap between the least and most healthy non-Winnipeg populations widened for the youngest and oldest age groups.*

Table 7: How much has diabetes treatment prevalence changed across the study period for each age group? (1994-99 / 1985-90)

	Least Healthy	Average Health	Most Healthy
Non-Winnipeg			
20-39 years	**1.72** (1.70, 1.73)*	**1.67** (1.63, 1.70)*	**1.32** (1.30, 1.34)*
40-59 years	**1.38** (1.22, 1.56)*	**1.27** (1.24, 1.31)*	**1.25** (1.16, 1.34)*
60-79 years	**1.63** (1.62, 1.64)*	**1.30** (1.22, 1.40)*	**1.26** (1.23, 1.30)*
Winnipeg			
20-39 years	**1.54** (1.32, 1.80)*	**1.48** (1.47, 1.49)*	**1.16** (1.11, 1.22)*
40-59 years	**1.35** (1.30, 1.40)*	**1.29** (1.28, 1.30)*	**1.31** (1.28, 1.35)*
60-79 years	**1.40** (1.34, 1.46)*	**1.32** (1.31, 1.33)*	**1.32** (1.32, 1.32)*

Note: 95% confidence intervals are shown
* - significant at α=0.05

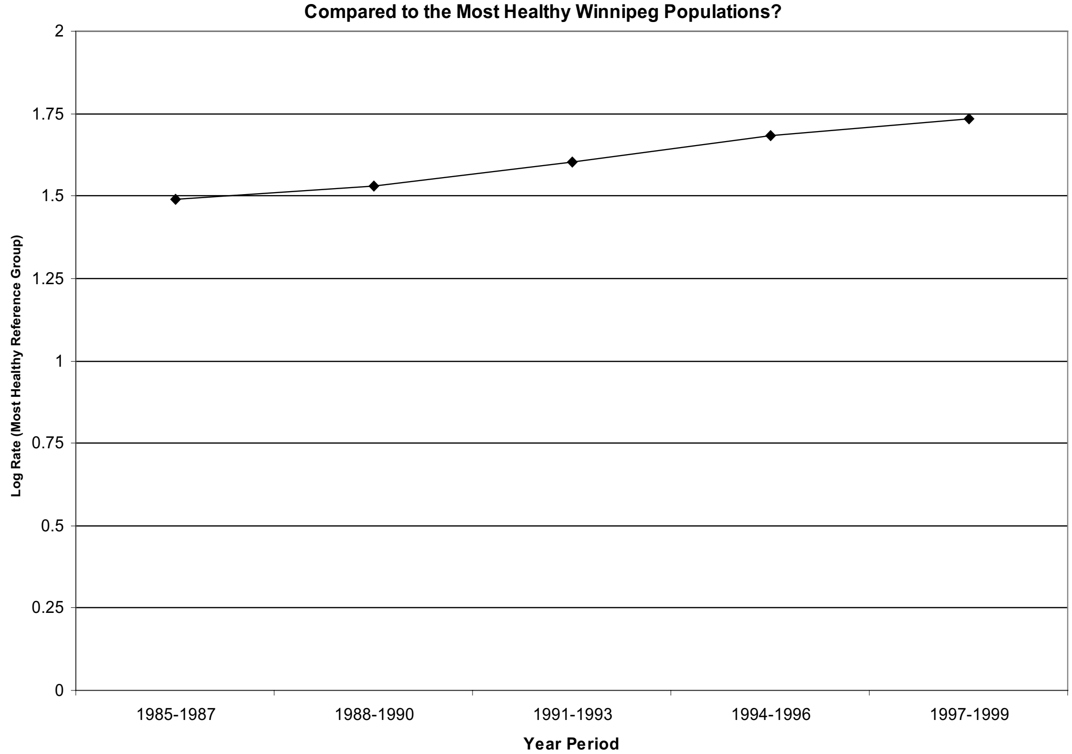
The gap in diabetes treatment prevalence between the least and most healthy non-Winnipeg populations widened for both males and females.

Analyses by sex revealed significant differences between least and most healthy non-Winnipeg populations for both males and females. In 1985-87, the diabetes treatment prevalence rate was 1.44 times higher for males in the non-Winnipeg areas with the least healthy populations than for males from the most healthy populations. For females, the corresponding relative rate was 2.42. For both sexes, the degree of disparity increased between the first and last six-year periods of the study (p=.0045 for males; p=.0202 for females). *Thus, the gap in diabetes treatment prevalence between the least and most healthy non-Winnipeg populations widened for both males and females.*

The gap in diabetes treatment prevalence between the least and most healthy Winnipeg populations widened over the study period.

Winnipeg findings. Figure 28 reveals that the trend for Winnipeg residents was similar to that observed for non-Winnipeg residents. For Winnipeg, those from areas with the least healthy populations had a higher risk of diabetes treatment prevalence compared to the most healthy populations throughout the study period. Comparisons of the first and last six-year time periods confirmed that the disparity between the least and most healthy Winnipeg populations increased significantly over the study period (p=.0047). *Thus, the gap in diabetes treatment prevalence between the least and most healthy Winnipeg populations widened over the study period.*

Figure 28: How much Higher is Diabetes Treatment Prevalence for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

The gap in diabetes treatment prevalence between the least and most healthy Winnipeg populations widened for the youngest and oldest age groups.

Once again, these trends were further explored with age-specific analyses. Table 7 shows significant increases in diabetes treatment prevalence for all age categories for all three Winnipeg populations. As was found for the non-Winnipeg analysis, there was a significant increase in disparity between the least and most healthy Winnipeg populations for the 20- to 39-year age group (p=.0007) and the 60- to 79-year age group (p=.0045). *Thus, the gap in diabetes treatment prevalence between the least and most healthy Winnipeg populations widened for the youngest and oldest age groups.*

The gap in diabetes treatment prevalence between the least and most healthy Winnipeg populations widened for both males and females.

There were also significant differences in diabetes treatment prevalence between the least and most healthy Winnipeg populations for males and females. For males, in 1985-87, the diabetes treatment prevalence was 1.30 times higher in the least healthy populations than in the most healthy populations. For females, the diabetes treatment prevalence for this three-year period was 1.70 times greater for least healthy Winnipeg populations than for most healthy Winnipeg populations. There was a significant increase in the magnitude of these differences between 1985-90 and 1994-99 for both sexes (p=.0246 for males; p=.0105 for females). *Thus, the gap in diabetes treatment prevalence between the least and most healthy Winnipeg populations widened for both males and females.*

Respiratory Disease Treatment Prevalence

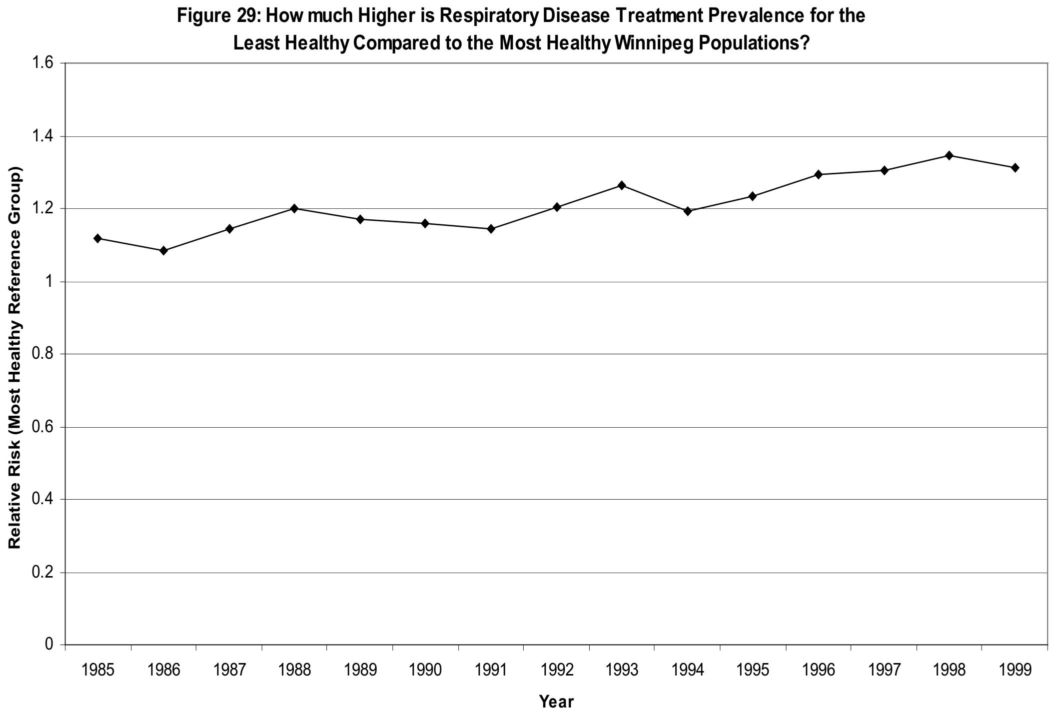
Respiratory disease treatment prevalence results are presented only for Winnipeg populations due to questions about data quality for non-Winnipeg populations.

Total respiratory disease treatment prevalence was assessed using both hospital claims and physician visits. Preliminary analyses revealed that respiratory disease treatment prevalence dropped quite dramatically in the non-Winnipeg areas with the least healthy populations in 1997, 1998 and 1999. The pattern of these drops (i.e., dramatic decreases in more recent years) did not correspond with the pattern of decreases found for hospital and physician rates in the north (Roos et al., 2001). In 1997, there was a shift in physician payment practices in Northern Manitoba, from fee-for-service to salaried claims, the latter of which may have undercounted actual services. Also at this time, coding practices may have changed, with some respiratory conditions previously classified under our total respiratory morbidity definition no longer coded in this manner. Further exploration of these changes and their impact on treatment prevalence rates is warranted; however it was beyond the scope of this project to do so. For these reasons, results for respiratory disease treatment prevalence are presented only for Winnipeg populations.

Analysis comparing the most recent five-year period to the first five-year period revealed a significant increase in respiratory disease treatment prevalence for Winnipeg residents (p=.0001).

The gap in respiratory disease treatment prevalence between the least and most healthy Winnipeg populations increased over the study period.

Figure 29 shows the risk of respiratory disease treatment prevalence for the least healthy Winnipeg populations relative to the most healthy. The least healthy populations had significantly higher respiratory disease treatment prevalence across the study period and the disparity appeared to increase over time. A test for the difference between the first and last five-year time periods confirmed that this increase in disparity between the least and most healthy Winnipeg populations was significant (p=.0184). *Thus the gap in respiratory disease treatment prevalence between the least and most healthy Winnipeg populations increased over the study period.*



Data source: Population Research Repository. Data are based on fiscal years.

The gap in respiratory disease treatment prevalence between the least and most healthy Winnipeg populations increased significantly for those under 35 years of age.

We further explored the nature of this widening gap in health status with age-specific analyses, shown in Table 8. Significant increases in respiratory disease treatment prevalence are evident for all three Winnipeg population groups at all three age levels. Analyses comparing the first and last five-year periods revealed that the disparity between the least and most healthy Winnipeg populations increased significantly for the 0- to 14-year (p<.0001) and the 15- to 34-year (p<.0001) age groups. *Thus the gap in respiratory disease treatment prevalence between the least and most healthy Winnipeg populations increased significantly for those under 35 years of age.*

Table 8: How much has respiratory disease treatment prevalence changed across the study period for each age group? (1995-99 / 1985-89)

	Least Healthy	Average Health	Most Healthy
Winnipeg			
0-14 years	**1.29** (1.28, 1.29)*	**1.21** (1.18, 1.23)*	**1.08** (1.06, 1.10)*
15-34 years	**1.54** (1.52, 1.56)*	**1.39** (1.35, 1.43)*	**1.32** (1.27, 1.38)*
35+ years	**1.28** (1.13, 1.45)*	**1.27** (1.16, 1.39)*	**1.21** (1.16, 1.26)*

Note: 95% confidence intervals are shown
* - significant at α=0.05

The gap between the least and most healthy Winnipeg populations for respiratory treatment prevalence remained stable for males but widened for females.

Separate analyses by sex revealed significant disparities in respiratory treatment prevalence between the least and most healthy Winnipeg populations for both sexes, and for females this gap widened over the time period (males, p=.2588; females, p=.0102). *Thus the gap between the least and most healthy Winnipeg populations for respiratory treatment prevalence remained stable for males but widened for females.*

Cancer incidence

Cancer incidence data analyzed in this section were available in five-year aggregates (1985-89, 1990-94, 1995-99),[16] rather than by individual years, as with the other morbidity and mortality analyses in this study. Analyses comparing 1985-1989 cancer incidence with 1995-1999 revealed different patterns for non-Winnipeg and Winnipeg residents. Residents of the non-Winnipeg areas experienced a 9% increase in the cancer incidence rate over time (p<.0001), whereas residents of Winnipeg areas experienced no change in cancer incidence (p=.9427).

The gap between the least and most healthy non-Winnipeg populations in cancer incidence is in the opposite direction as expected, and this did not change over the study period.

Non-Winnipeg findings. Cancer incidence was 10% lower in the least healthy non-Winnipeg populations compared to the most healthy populations in 1995-99; this was not significantly lower than in the first five-year time period of the study (p=.3645). *Thus the gap between the least and most healthy non-Winnipeg populations in cancer incidence is in the opposite direction as expected, and this did not change over the study period*.

The gap in cancer incidence between the least and most healthy Winnipeg populations did not change over the study period.

Winnipeg findings. For Winnipeg residents, residents of the areas with the least healthy populations had cancer incidence rates which were 10% higher than those residents of areas with the most healthy populations; however this disparity did not change over time (p=.2159). *Thus the gap in cancer incidence between the least and most healthy Winnipeg populations did not change over the study period.*

16\ Calendar years are used for analyses on cancer incidence data.

Analyses of changes in cancer morbidity incidence for selected types of cancer (breast, colorectal, lung, and prostate) by age and across the time period yielded no significant changes in the gap between least and most healthy populations for non-Winnipeg and Winnipeg areas.

AMI hospitalizations

Analysis comparing the most recent five-year period to the first five-year period revealed a significant decline in AMI hospitalizations for both non-Winnipeg (p=.0001) and Winnipeg (p=.0001) residents over time.

The gap in hospitalizations due to AMI between the least and most healthy non-Winnipeg areas did not change over the study period.

Non-Winnipeg findings. Figure 30 shows the risk of hospitalization due to AMI for the least healthy non-Winnipeg populations relative to the most healthy populations. Residents of non-Winnipeg areas with the least healthy populations had a rate of AMI hospitalizations which was 15% higher than residents of areas with the most healthy populations in 1985-89; thus, the degree of disparity between the two areas was quite small. Analyses comparing the last to the first five-year period revealed that there was no significant change in disparity between the least and most healthy populations over the study period (p=.1266). *Thus, the gap in hospitalizations due to AMI between the least and most healthy non-Winnipeg areas did not change over the study period.*

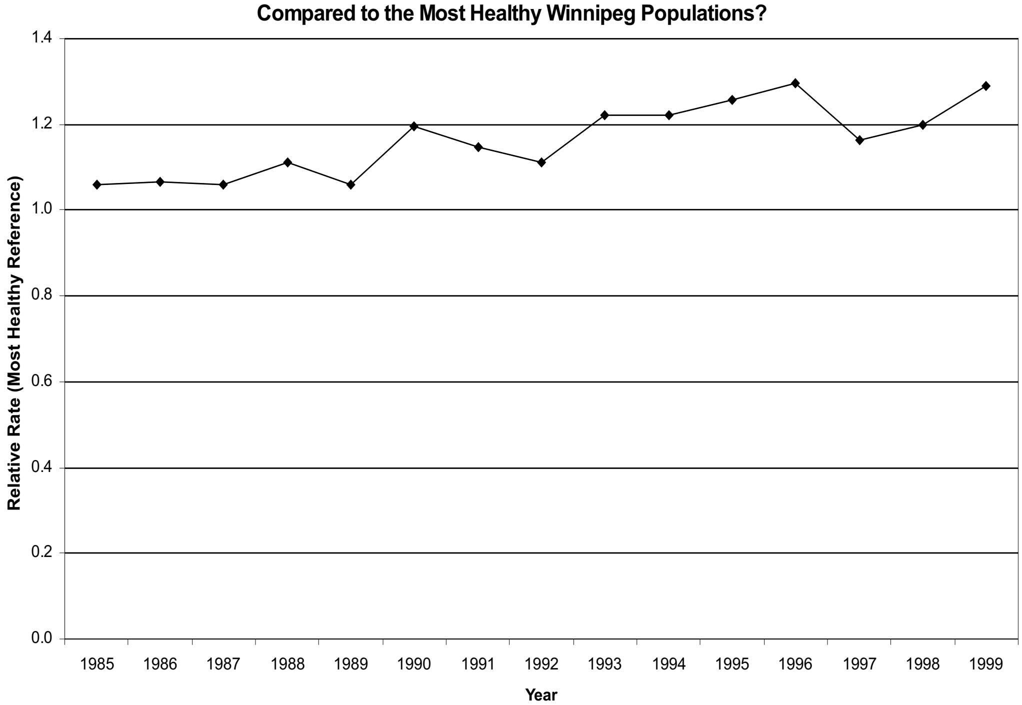
Figure 30: How much Higher is AMI Hospitalization for the Least Healthy Compared to the Most Healthy non-Winnipeg Populations?

Data source: Population Research Repository. Data are based on fiscal years.

The gap in AMI hospitalizations between the least and most healthy Winnipeg populations widened over the study period.

Winnipeg findings. Figure 31 shows the risk of hospitalization due to AMI for the least healthy Winnipeg populations relative to the most healthy populations. Once again, although the Winnipeg areas with the least healthy populations tend to have higher rates of AMI hospitalizations (1.07 times higher in 1985-1989), this disparity is quite small. As suggested by the figure, this disparity did increase significantly over time (p=.0048). Interestingly, all three Winnipeg populations (most, average and least healthy) showed significant decreases in AMI hospitalizations over the study period; however the decreases were not as great for the least healthy populations as for the most healthy populations. *Thus, the gap in AMI hospitalizations between the least and most healthy Winnipeg populations widened over the study period.*

Figure 31: How much Higher is AMI Hospitalization for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

The gap in AMI hospitalization between the least and most healthy Winnipeg populations widened for those between the ages of 20 and 74 years.

The increasing gap in AMI hospitalizations was further explored with age-specific analyses. As can be seen in Table 9, all of the Winnipeg age-specific populations experienced significant decreases in AMI morbidity, with the exception of the 20- to 44-year old residents of the areas with the least healthy populations, which showed no change in AMI over the study period. Analyses comparing the first and last five-year periods revealed significant increases in disparity between the least and most healthy Winnipeg populations for the 20- to 44-year (p=.0198), the 45- to 64-year (p=.0002) and the 65- to 74-year (p=.0016) age groups. *Thus, the gap in AMI hospitalization between the least and most healthy Winnipeg populations widened for those between the ages of 20 and 74 years.*

Table 9: How much has AMI hospitalization changed across the study period for different age groups? (1995-99 / 1985-89)

	Least Healthy	Average Health	Most Healthy
Winnipeg			
20-44 years	.96 (.89, 1.04)	**.91** (.87, .95)*	**.74** (.60, .91)*
45-64 years	**.78** (.70, .88)*	**.76** (.68, .85)*	**.61** (.57, .65)*
65-74 years	.69 (.62, .77)*	**.66** (.57, .76)*	**.53** (.47, .60)*
75+ years	**.63** (.58, .68)*	**.73** (.65, .83)*	**.80** (.70, .92)*

Note: 95% confidence intervals are shown
*- significant at α=0.05

The gap between the least and most healthy Winnipeg populations for AMI hospitalizations widened for males but not for females across the study period.

Separate analyses by sex revealed an increasing gap between the least and most healthy Winnipeg populations for AMI for males (p=.0023); although there was a disparity between least and most healthy Winnipeg populations for females in 1985-89 (1.40 times higher for least healthy female populations than for most healthy female populations in Winnipeg), this gap did not increase across the study period (p=.5088). *Thus the gap between the least and most healthy Winnipeg populations for AMI hospitalizations widened for males but not for females across the study period.*

Summary for Cause-Specific Morbidity

Table 10 summarizes the evidence for the widening gap in health status for the cause-specific morbidity categories discussed in this section. In summary, as was found for the mortality categories, morbidity (as measured by treatment prevalence) tends to be higher for residents of areas with the least healthy populations compared to those with the most healthy populations. Also mirroring the mortality results, for none of the morbidity categories studied did we find decreases in this health status gap across the 15-year study period; in several cases this gap actually widened. The patterns for the morbidity categories were less consistent than our results for mortality, in terms of describing the growing gap in health status. For some disorders (e.g., diabetes treatment prevalence, respiratory disease treatment prevalence), all populations (least, average, most healthy) showed increases in morbidity, with the greatest increases for those from the least healthy areas; likewise, for some disorders (e.g., AMI hospitalizations), almost all populations showed decreases in morbidity with the greatest decreases in the most compared to the least healthy populations.

Injury hospitalizations, though substantially higher for the least compared to the most healthy populations, showed no changes in this disparity over the study period. Injuries due to falls, MVCs, and other causes decreased for both the least and most healthy populations, whereas injuries due to violence remained stable for both the least and most healthy populations.

Table 10: Summary of cause-specific morbidity findings

Indicator	Change Across Time (all populations)	Change in Gap Between Least and Most Healthy: Overall	By Age	By Sex
Non-Winnipeg:				
Injury hospitalizations (falls)	decreased	Least greater than most (almost 2 times), but no change in gap over time	Did not assess further	Did not assess further
Injury hospitalizations (MVCs)	decreased	Least greater than most (about 1 1/2 times), but no change in gap over time	Did not assess further	Did not assess further
Injury hospitalizations (violence)	No change	Least greater than most (about 7 times), but no change in gap over time	Did not assess further	Did not assess further
Injury hospitalizations (other)	No change	Least greater than most (about 2 times), but no change over time	Did not assess further	Did not assess further
Diabetes treatment prevalence	increased	Least greater than most (about 2 times) and this gap increased over time	Gap increased for: 20 to 39 years 60 to 79 years	Gap increased for both males and females
Respiratory disease treatment prevalence	Data problems	Did not assess further	Did not assess further	Did not assess further
Cancer incidence	increased	Most greater than least (by about 10%), but no change in gap over time	Did not assess further	Did not assess further
AMI hospitalizations	decreased	Least greater than most (by about 20%), but no change in gap over time	Did not assess further	Did not assess further
Winnipeg:				
Injury hospitalizations (falls)	decreased	Least greater than most (about 30%), but no change in gap over time	Did not assess further	Did not assess further
Injury hospitalizations (MVCs)	decreased	Least greater than most (about 1 1/2 times), but no change in gap over time	Did not assess further	Did not assess further
Injury hospitalizations (violence)	No change	Least greater than most (about 5 times), but no change in gap over time	Did not assess further	Did not assess further
Injury hospitalizations (other)	decreased	Least greater than most (about 1 1/2 times), but no change over time	Did not assess further	Did not assess further
Diabetes treatment prevalence	increased	Least greater than most (about 1 1/2 times) and this gap increased over time	Gap increased for: 20 to 39 years 60 to 79 years	Gap increased for both males and females
Respiratory disease treatment prevalence	increased	Least greater than most (about 20%) and this gap increased over time	Gap increased for: 0 to 14 years 15 to 34 years	Gap increased for females only
Cancer incidence	No change	Least greater than most (by about 10%), but no change in gap over time	Did not assess further	Did not assess further
AMI hospitalizations	decreased	Least greater than most (by about 15%), this gap increased over time	Gap increased for: 20 to 44 years 45 to 64 years 65 to 74 years	Gap increased for males only

Cancer incidence increased over the study period for non-Winnipeg residents but remained stable for Winnipeg residents. The gap between the least and most healthy populations which is so familiar from other morbidity and mortality categories was in the expected direction for Winnipeg residents, but for non-Winnipeg residents, those from the areas with the least healthy populations actually had slightly lower cancer incidence compared to those from areas with the most healthy populations. The gaps observed did not change over the study period for either non-Winnipeg or Winnipeg residents.

As with heart disease mortality, AMI hospitalizations showed the greatest decreases across the study period, for both the least and most healthy populations. For non-Winnipeg residents, there was no change in the gap between the least and most healthy populations. The results were somewhat different for Winnipeg populations, where despite decreases in AMI hospitalizations for all populations at all ages (except the 20- to 44-year group for the least healthy), the gap in health status between the least and most healthy Winnipeg populations increased significantly overall and for all age groups, except the oldest (75+ years).

It is difficult to determine from these data what is driving the decreases in AMI hospitalizations, but we could speculate that they may be due both to better treatment of heart disease and healthier lifestyles (more exercise and healthier eating habits). Early results from the Canadian Community Health Survey (Statistics Canada, 2002) suggest that the number of Canadians who are physically active increased between 1994 and 2000. At the same time, however, the number of overweight Canadians also increased over the same time period. Although the results by communities are only available for the most recent year (2000/01) they may provide some clues as to possible contributions to disparity between the least and most healthy populations in health status. Whereas a much higher per cent of those from the non-Winnipeg areas[17] with the least healthy populations were physically active, compared to those with the most healthy populations (26.1% and 15.1% respectively), the per cent of smokers was also much higher in the least healthy populations (28% compared to 17.5%) as was the per cent of residents who were overweight (47.2% compared to 37.4%).[18] This is not to suggest that individuals have complete control over health outcomes nor that personal choice is what drives the disparities in health observed for AMI hospitalizations. Indeed, even when behavioural factors such as smoking, physical activity and overweight are controlled for, the risk of heart disease is strongly related to income (Roux, Merkin, Arnett et al., 2001).

Diabetes treatment prevalence showed large increases for all populations, but whether this is due to actual changes in prevalence of the disease or increased detection is impossible to tell from these data. Because diabetes treatment prevalence is based on encounters with the health care system, changes in prevalence may, at least in part, reflect changes in screening and detection as well as changes in physician diagnosing. Guidelines published recently (Meltzer et al., 1998) suggest lowered thresholds for diagnosing diabetes in more recent years. Despite increases in diabetes treatment prevalence for all populations, increases were greatest for the least healthy populations,

[17] CCHS data are available at the RHA level, allowing us to aggregate to our least, average and most healthy population groupings for non-Winnipeg but not for Winnipeg areas.
[18] First Nations communities were not sampled for the CCHS so these results exclude First Nations individuals living on reserve.

leading to a widening gap in diabetes prevalence between the least and most healthy populations. Whether lifestyle factors or socio-structural factors discussed above for AMI hospitalizations may be contributing to this widening gap requires further exploration. It will be important to monitor the rise in diabetes treatment prevalence for all populations, but particularly for those in areas with the least healthy populations, where the increases have been the greatest.

The significant increases observed for respiratory treatment prevalence in all Winnipeg populations may also be at least partly related to practice patterns. That is, changes in screening for, or awareness of respiratory disorders, or changes in physician diagnosing may be contributing to the substantial increases in the treatment prevalence of these disorders. Despite increases for all Winnipeg populations, the gap between the least and most healthy populations widened because of more substantial increases in respiratory disease treatment prevalence for the least health populations.

3.4 Changes in Socioeconomic Factors

Question addressed in this section:
- Is there a relationship between the widening gap in health status and changes in the following socioeconomic factors over time:
- Income level?
- Employment status?
- Education level?
- Family structure?

The previous sections on mortality and disease treatment prevalence suggest that the widening gap in health status observed between the least and most healthy populations in both non-Winnipeg and Winnipeg areas is not confined to one or two specific diseases, but may be a more general pattern. Because health inequalities tend to be associated with socioeconomic circumstances, widening disparities in health status between different geographic regions and/or socioeconomic groups have been largely attributed to changes in socioeconomic circumstances (Phillimore, Beattie, Townsend, 1994; Shaw et al., 1999; Pappas et al., 1993). In this section we explore changes in socioeconomic circumstances for the different population groups. The socioeconomic characteristics examined are income level, education level, employment status and family structure.

3.4.1 Analytic Approaches

Data for this section come from the public use 20% sample from the 1986, 1991 and 1996 Census. Information on mean income, education level, employment status and family structure is available at the level of the enumeration area (EA).[19] Because EAs can be different for each Census year, due to re-drawing of electoral boundaries, analyses by EAs across time were impossible. The EA information was therefore aggregated into our regional

[19]Census data include information from First Nations communities, with the exception of communities with less than 250 people (data from these communities are suppressed) or those communities incompletely enumerated.

populations which are divided according to health status, based on PMR. Information was weighted by total households (for income information), population (for education information), total labor force (for employment information), or by total families with children between the ages of 0 and 14 years (for family structure information). Due to very low statistical power, only descriptive analyses rather than longitudinal statistical analyses are presented in this section.

We found that there was a great deal of variation in socioeconomic characteristics within our population groups, particularly for the least healthy non-Winnipeg populations. Results suggest that much of the intra-regional variation within the non-Winnipeg areas was due to a subgroup within the least healthy non-Winnipeg populations living in small urban areas (e.g., Thompson). This subgroup tends to have high incomes and lower unemployment than other non-Winnipeg populations. Due to this extreme variation in non-Winnipeg areas, we present mostly findings from Winnipeg below. For non-Winnipeg areas, we looked at the socioceconomic characteristics separately for different city/rural area population sizes (see "Population Size" in Glossary), as defined by Statistics Canada, and we comment on these findings following the findings for Winnipeg.

3.4.2 Income

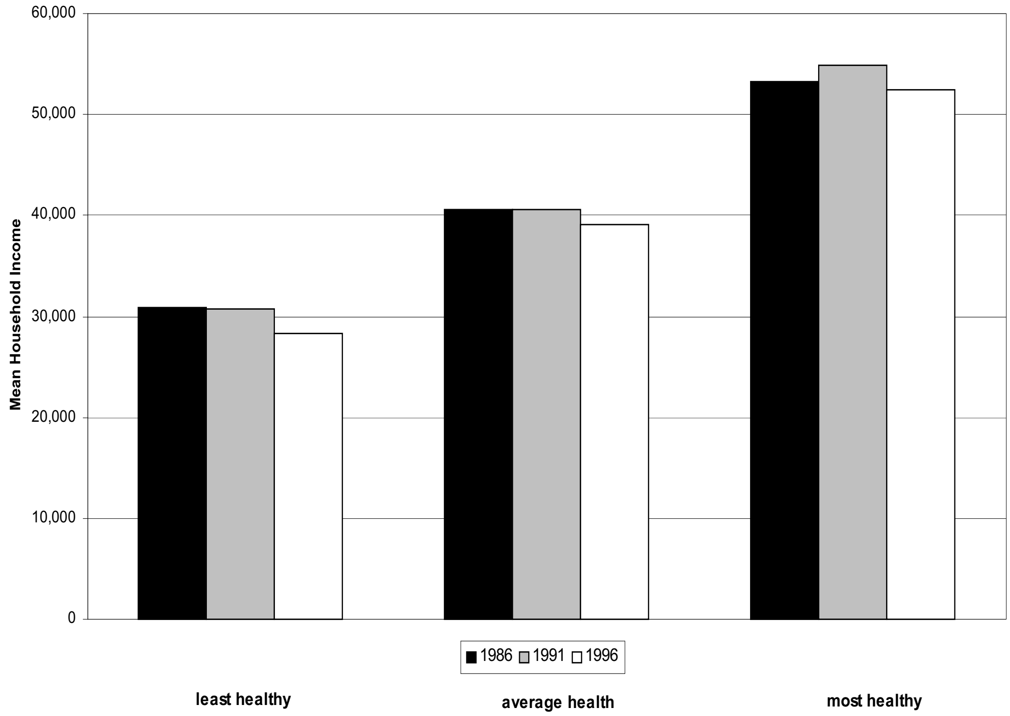
Figure 32 shows the mean household income for Winnipeg residents for 1986, 1991 and 1996, given in 1992 dollars to adjust for inflation. Although all three populations show decreases in mean household income over the time period, the decrease was greatest for those from areas with the least healthy populations (8 1/2% decrease) compared to the average (3 1/2 % decrease) and most healthy (1 1/2% decrease) populations.

For Winnipeg and rural non-Winnipeg populations, we found lower incomes for the least healthy populations compared to the most healthy, with increasing gaps in income between these populations over the study period.

For non-Winnipeg populations, we found a similar pattern to Winnipeg for the rural populations, with the lowest income levels for the least healthy populations; although the least healthy populations saw a 1% decrease in their mean income over the time period, the most healthy rural populations experienced a 7% increase in mean income. The story was very different for the small urban non-Winnipeg populations, where the least healthy populations had the highest income levels and greater increases in income across the study period than the most healthy small urban populations.

Another way of assessing changes in income, is to look at the per cent of residents within an area whose income falls below Statistics Canada's Low Income Cut-Off (LICO). The per cent of households in Winnipeg areas with the least healthy populations that fell below the LICO went from about 30% in 1986 to over 40% in 1996, whereas for the most healthy populations the per cent of households below the LICO was less than 5% in all three years.

Figure 32: Mean Household Income Adjusted for Inflation, Winnipeg Populations



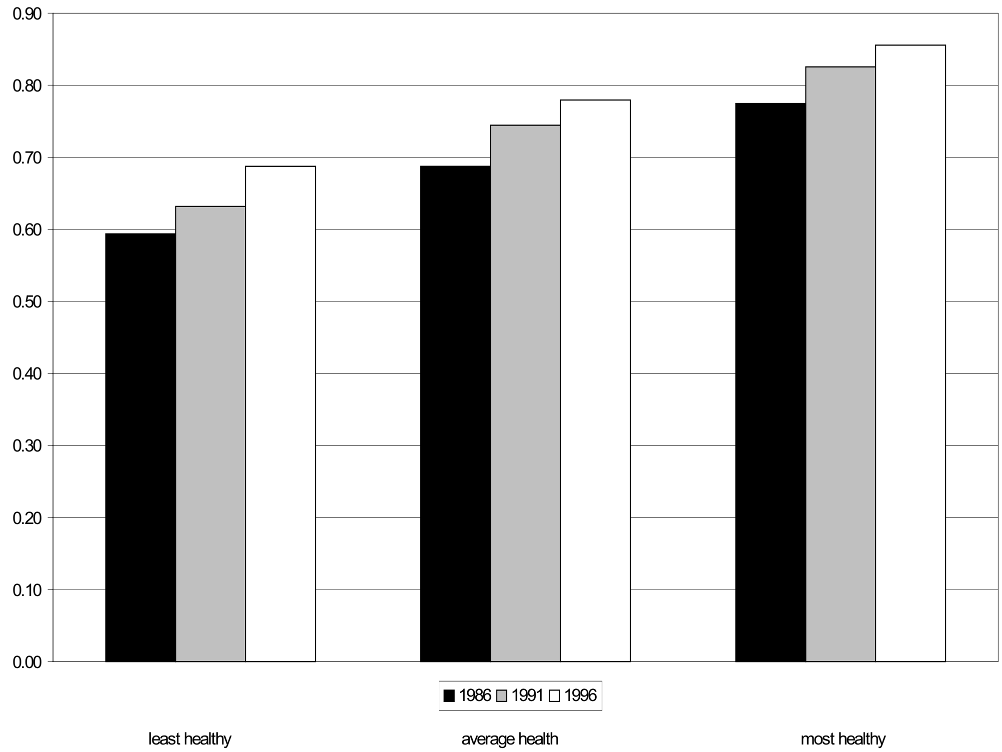
3.4.3 Education

Those from the least healthy populations tend to have lower education levels; however there were inconsistent patterns in these disparities over the study period.

Figure 33 shows the per cent of high school graduates among 25- to 44-year-old residents of Winnipeg populations. The least healthy Winnipeg populations had the lowest per cent of high school graduates throughout the study period; however, for all populations the per cent of high school graduates increased. In Winnipeg the least healthy populations showed the greatest gains in high school graduation (16% increase for the least healthy compared to 11% for the most healthy).

As with the Winnipeg areas, for non-Winnipeg areas, for both the small urban and rural areas, all populations showed increases in the per cent of high school graduates across the study period; however, the least healthy populations showed smaller increases than those found for the most healthy populations. For the rural areas, the least healthy populations had the lowest per cent of high school graduates throughout the study period, whereas for the small urban areas, the least healthy populations had high school graduation levels similar to those found for the average and most healthy populations.

Figure 33: Per cent 25- to 44-Year-Olds with High School Graduation, Winnipeg Populations



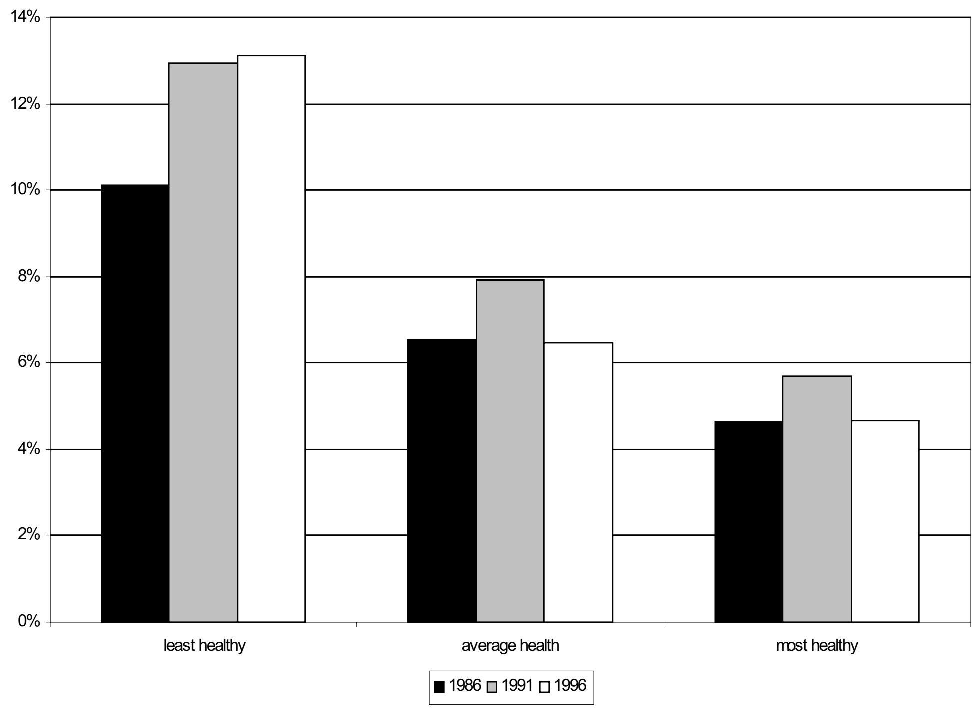
Thus the high school graduation rate rose for all populations examined, with the greatest increases for non-Winnipeg residents in the most healthy compared to the least healthy populations, and the greatest increases for Winnipeg residents in the least healthy compared to the most healthy populations.

Residents of areas with the least healthy populations have higher unemployment rates than those with the most healthy populations, and these disparities widened over the study period.

3.4.4 Unemployment

Figure 34 shows the unemployment rate among 25- to 44-year-old residents for the Winnipeg populations. The areas with the least healthy populations had substantially higher unemployment rates, with the rate increasing from about 10% to 13% unemployed between 1986 and 1996, an almost 30% increase. The unemployment rate for the Winnipeg areas with the most healthy populations was about 5% in both 1986 and 1996, with a slight rise to almost 6% in 1991.

Figure 34: Per cent Unemployed, Winnipeg Populations



For non-Winnipeg areas, similar patterns to Winnipeg were found for both the small urban and rural areas. That is, the least healthy populations had substantially higher unemployment rates compared to the most healthy populations, and changes in unemployment rates were more favourable for the most compared to the least healthy populations. For the rural areas, the unemployment rate increased by 10% for the least healthy populations over the study period, whereas it decreased by 9% for the most healthy populations. For the small urban areas, unemployment decreased by 4 1/2% for the least healthy populations over the study period, but during that same time, the most healthy populations experienced an 18% drop in unemployment.

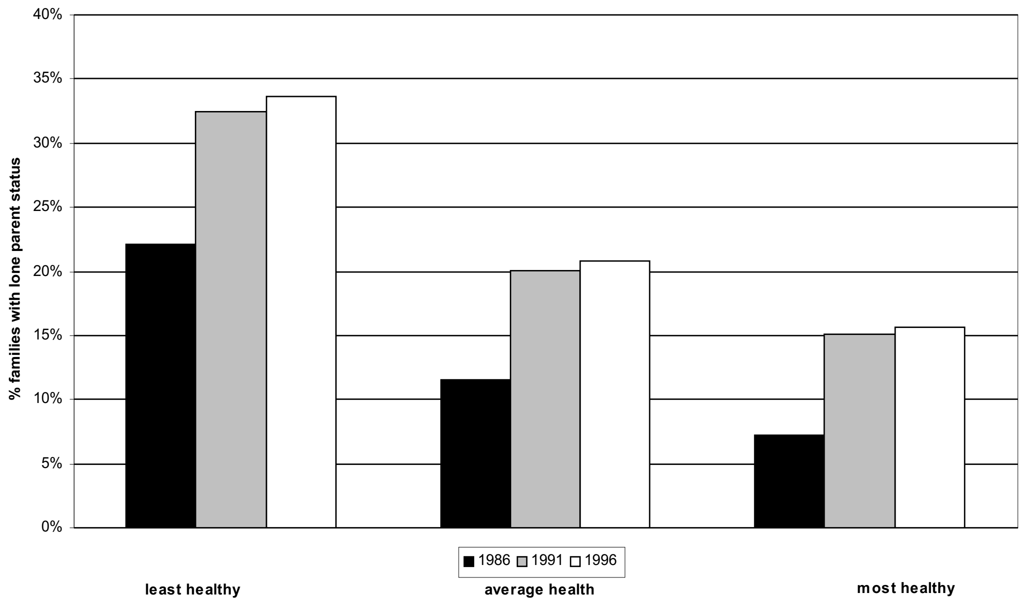
Residents of areas with the least healthy populations tend to have higher rates of lone-parent families than those with the most healthy populations. These disparities tended to narrow somewhat over time.

Thus, unemployment rates increased and the gap appeared to widen between the least healthy and most healthy populations in both non-Winnipeg and Winnipeg areas. Other research has suggested that unemployment and mortality are strongly related in Canada (Sanmartin 2002).

3.4.5 Family Structure

The proportion of lone-parent families increased for all population groups between 1986 and 1996 (Figure 35). The proportion of lone-parent families tends to be higher in both non-Winnipeg and Winnipeg areas with the least healthy populations when compared to areas with the most healthy populations (generally more than twice as high); however, the per cent increases over time in lone-parent status were greater in the most healthy compared to the least healthy populations.

Figure 35: Per cent Families with Lone-Parent Status, Winnipeg Populations



To summarize the findings for the socioeconomic indicators, income and unemployment appear to be related to the growing gap in health status observed between residents of areas with the least and most healthy populations. Income levels tended to be lower and unemployment rates higher in areas with the least healthy populations compared to areas with the most healthy populations, and these gaps widened across the study period. Education levels tend to be lower and lone-parent status higher for the least healthy compared to the most healthy populations but in some cases these gaps narrowed over the study period.

3.5 Changes in Utilization of Hospital Services Over Time

Question addressed in this section:

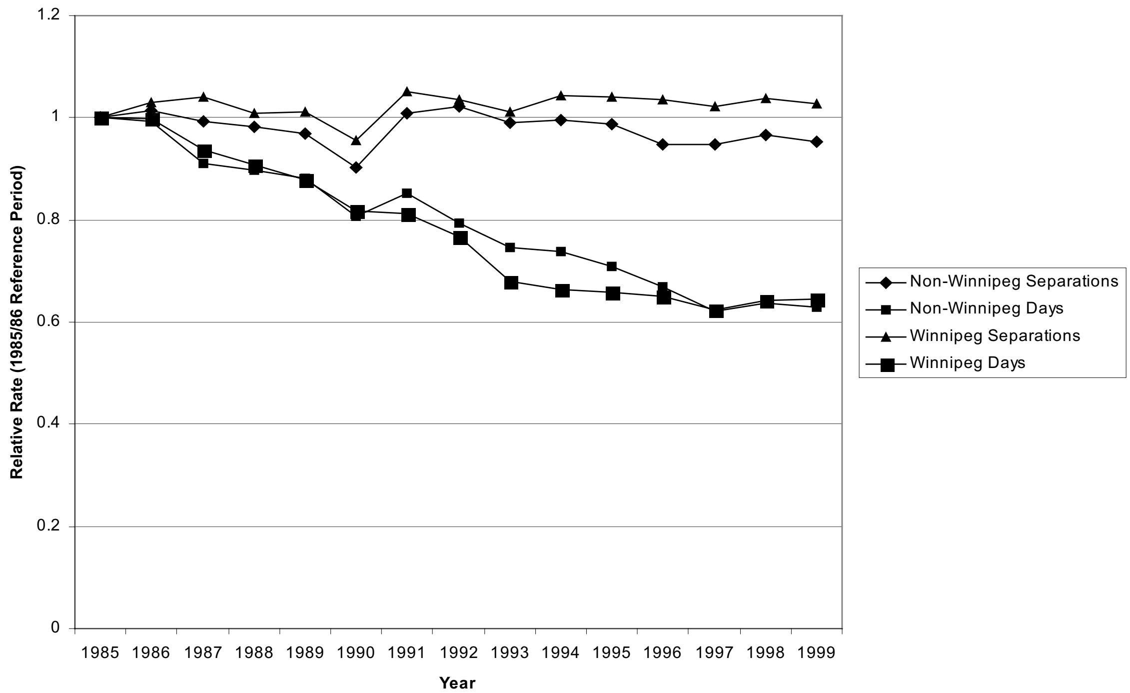
- Is there a relationship between the widening gap in health status and changes in utilization of hospital services over time?

Hospital utilization was measured using separations (the number of hospital contacts) and days spent in hospital. Hospital utilization was attributed to the individual's place of residence regardless of where the actual hospitalization might have taken place. Age- and sex-standardized rates for hospital separations and days (Table A8, Appendix A) show that both separations from and days spent in hospital are higher for residents of areas with the least healthy compared to the most healthy populations. This is expected given the generally poorer health status (and therefore greater need for health services) of residents of areas with the least healthy populations. *Thus,* *If there is a relationship between the widening gap in health status and changes in hospital use, we would expect those changes to show a decrease in utilization by the least healthy populations compared to the most healthy populations.*

if there is a relationship between the widening gap in health status and changes in hospital use, we would expect those changes to show a decrease in utilization by the least healthy populations compared to the most healthy populations.

Changes in the rates of hospital separations and days were analyzed using Poisson regressions (see Figure 36). Looking across the 15 years of the study, and comparing the most recent five-year period (1995-1999) to the first five-year period (1985-1989), we found a small (3%) but significant decrease in separations (p=.0088), along with the dramatic drop in days (p=.0001) for non-Winnipeg residents, and no change in separations (p=.2918) and a dramatic drop in days (p=.0001) for Winnipeg residents.

Figure 36: Hospital Utilization, non-Winnipeg and Winnipeg, 1985 to 1999



Data source: Population Research Repository. Data are based on calendar years.

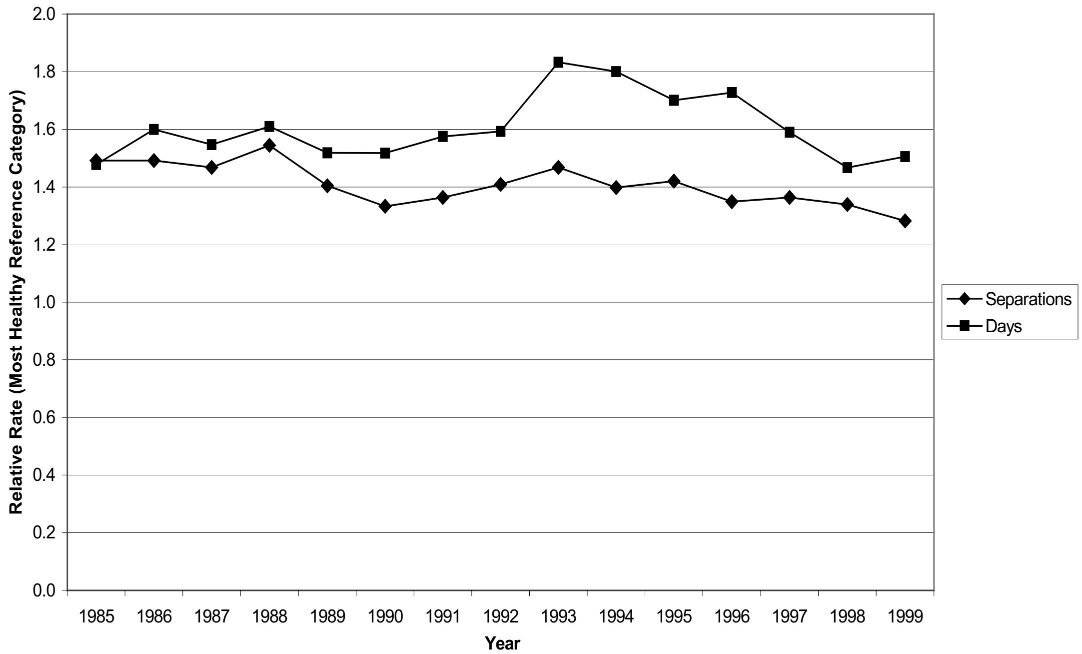
The difference in hospital separations between the least and most healthy non-Winnipeg populations narrowed over the study period, due to a drop in separations for those from the least healthy populations.

Non-Winnipeg findings. Figure 37 shows the risk of hospital separations for the least healthy non-Winnipeg populations relative to the most healthy populations. Those from the least healthy non-Winnipeg populations have higher separation rates, meaning a greater number of hospitalizations than those from the most healthy populations; however this disparity decreased somewhat over the study period, due to a drop in separations for the least healthy populations, with no drop in separations for the most healthy non-Winnipeg populations. Analyses comparing the last to the first five-year period revealed that this change was significant (p=.005). *Thus, the difference in hospital separations between the least and most healthy non-Winnipeg* *populations narrowed over the study period, due to a drop in separations for those from the least healthy populations.*

The difference in days spent in hospital between the least and most healthy non-Winnipeg populations did not change over the study period.

Figure 37 also shows the risk of hospital days for the least compared to the most health non-Winnipeg populations. Once again, those from the least healthy populations have a consistently higher number of days spent in hospital compared to those from the most healthy non-Winnipeg populations. Analyses comparing the last to the first five-year period revealed that there was no significant change in this difference (p=.505). *Thus the difference in days spent in hospital between the least and most healthy non-Winnipeg populations did not change over the study period.*

Figure 37: How much Higher is Hospital Utilization for the Least Healthy Compared to Most Healthy non-Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

Table 11 shows the relative change between the first and last five-year periods for age-specific hospital separations for each of the non-Winnipeg populations. Most notable in this table is that there was a decrease in the separation rate for the 75+ year group in the areas with least healthy populations and at the same time an increase in separations for this age group for the most healthy populations. Analyses comparing the first and last five-year periods indicated significant decreases in the gap between the least and most healthy non-Winnipeg populations for the 35-to 44- year (p=.0303) and 45- to 64-year (p=.0126) groups, with the largest decrease in gap for the 75+ year group (p<0001). *Thus, the differences in separations between the least and most healthy non-Winnipeg populations narrowed for 25- to 44- year-olds*

The differences in separations between the least and most healthy non-Winnipeg populations narrowed for 25- to 64-year-olds due to decreases in separations for the least healthy populations and no changes in separations for the most healthy populations; the differences also narrowed for the 75+ year age group due to decreases in separations for the least healthy populations and increases in separations for the most healthy non-Winnipeg populations.

and 45- to 64-year-olds due to decreases in separations for the least healthy populations and no changes in separations for the most healthy populations; the differences also narrowed for the 75+ year age group due to decreases in the least healthy populations and increases in separations for the most healthy non-Winnipeg populations.

Table 11: How much has non-Winnipeg hospital utilization changed across the study period for each age group? (1995-99 / 1985-89)

	Least Healthy	Average Health	Most Healthy
Separations			
0-24 years	**.81** (.74-.88)*	**.85** (.80-.89)*	**.87** (.86-.89)*
25-44 years	**.98** (.96-.99)*	1.04 (.99-1.09)	1.01 (0.98-1.03)
45-64 years	**.97** (.96-.99)*	1.02 (1.00-1.03)	1.00 (1.00-1.00)
65-74 years	1.03 (.96-1.11)	**1.12** (1.08-1.16)*	**1.05** (1.01-1.08)*
75+ years	**.92** (.90-.95)*	1.02 1.00-1.05)	**1.06** (1.05-1.07)*

Note: 95% confidence intervals are shown
* Statistically significant at α = .05

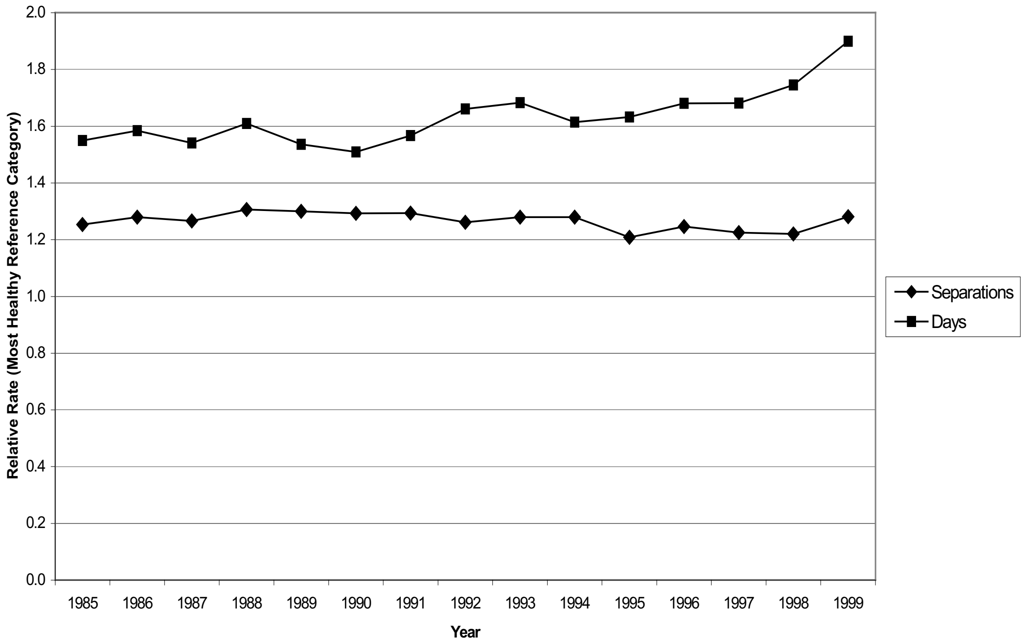
The difference in hospital separations between the least and most healthy Winnipeg populations did not change over the study period.

Winnipeg findings. Figure 38 shows the risk of hospital separations for the least healthy Winnipeg populations relative to the most healthy populations. Those from the least healthy Winnipeg populations have higher separation rates, meaning a greater number of hospitalizations than those from the most healthy populations, and this disparity changed little over the study period. Analyses comparing the last to the first five-year period confirmed that no significant change occurred (p=.2975). *Thus the difference in hospital separations between the least and most healthy Winnipeg populations did not change over the study period.*

The difference in days spent in hospital between the least and most healthy Winnipeg populations increased over the study period, due to a greater drop in days for those from the most healthy compared to the least healthy Winnipeg populations.

Figure 38 also shows the risk of hospital days for the least compared to the most healthy Winnipeg populations. Once again, those from the least healthy populations have consistently higher number of days spent in hospital compared to those from the most healthy Winnipeg populations. Analyses comparing the last to first five-year period revealed that this difference increased over the study period (p=.0039). These analyses also revealed that although days spent in hospital dropped for both the least and most healthy populations, the drops were greater for the most healthy compared to the least healthy Winnipeg populations. *Thus, the difference in days spent in hospital between the least and most healthy Winnipeg populations increased over the study period, due to a greater drop in days for those from the most healthy compared to the least healthy Winnipeg populations.*

Figure 38: How much Higher is Hospital Utilization for the Least Healthy Compared to the Most Healthy Winnipeg Populations?



Data source: Population Research Repository. Data are based on fiscal years.

The differences in days between the least and most healthy Winnipeg populations widened for those over 44 years of age, meaning that residents of areas with the least healthy populations were spending more time in hospital at the end of the study period, relative to their most healthy counterparts.

Table 12 shows the relative change between the first and last five-year periods for age-specific hospital days for each of the Winnipeg populations. Evident in this table is the significant decrease at each age level for each population for days spent in hospital. All populations show decreases, however, the decreases are greater for the most compared to the least healthy Winnipeg populations for the 45- to 64-year group (p=.0161), the 65- to 74-year group (p=.0007) and the 75+ year group (p=.0028). *Thus, the differences in days between the least and most healthy Winnipeg populations widened for those over 44 years of age, meaning that residents of areas with the least healthy populations were spending more time in hospital at the end of the study period, relative to their most healthy counterparts.*

Table 12: How much has hospital utilization changed across the study period for each age group? (1995-99 / 1985-89)

	Least Healthy	Average Health	Most Healthy
Days			
0-24 years	**.69** (.66-.71)*	**.66** (.64-.69)*	**.66** (.66-.67)*
25-44 years	**.69** (.60-.79)*	**.69** (.62-.76)*	**.64** (.64-.64)*
45-64 years	**.67** (.60-.74)*	**.60** (.60-.60)*	**.58** (.57-.60)*
65-74 years	**.83** (.75-.93)*	**.72** (.72-.72)*	**.65** (.60-.72)*
75+ years	**.78** (.71-.85)*	**.81** (.79-.82)*	**.65** (.60-.70)*

Note: 95% confidence intervals are shown
* Statistically significant at α = .05

The decrease in hospital separations for the non-Winnipeg residents of the areas with the least healthy populations did not likely contribute to the widening health status gaps observed in this report.

These results suggest there may be a relationship between the widening gap in health status between those from the least and most healthy areas and changes in hospital utilization. This relationship was found only for the non-Winnipeg areas, and for hospital separations but not days. Because the drop in separations for the least healthy non-Winnipeg areas was small, and because the narrowing of the gap in separations between the least and most healthy non-Winnipeg areas was also slight, the contribution of changes in utilization to the widening gap in health status is probably negligible but was explored further. The contribution of both hospital utilization and demographic factors (e.g., age, sex) to explaining regional variation in overall mortality was assessed on a cross-sectional basis. We did this for a selected number of five-year age groups to minimize the possibility that age effects would overwhelm other smaller effects in the model. These analyses showed that hospital utilization factors were not important predictors of variations in overall mortality for non-Winnipeg areas. *Thus, the decrease in hospital separations for the non-Winnipeg residents of the areas with the least healthy populations did not likely contribute to the widening health status gaps observed in this report.*

4.0 DISCUSSION

Despite overall improvements in the health status of Manitobans, the gap in health status between the least and most healthy populations actually increased over the study period.

This widening gap was due to improvements in health status for the most healthy populations and no change for the least healthy populations.

Mortality for Manitobans declined significantly over the 15-year period between 1985 and 1999. This decline occurred for all age groups except for those 25 to 44 years. The decline in mortality was experienced more for males than for females. Despite these overall improvements in the health status of Manitobans, inequalities in health actually increased over the study period. The gap in health status (as measured by rate ratios) between non-Winnipeg and Winnipeg residents from areas with the least and most healthy populations widened over the study period. This widening gap was not due to declines in health status for residents of areas with the least healthy populations; rather health status improved for those residents from areas with the most healthy populations. In other words, the healthier members of Manitoba are getting healthier, whereas those in poorer health are not experiencing these improvements in health. Whatever factors are contributing to the improved health of residents of areas with the most healthy populations, these are not being experienced by residents of areas with the least healthy populations. The increasing gap in health status cannot be explained by migration.

This health status gap existed for the top four causes of death, and these gaps did not decrease over the study period.

Of the top four causes of death in Manitoba, only heart disease showed an overall decrease, for both non-Winnipeg and Winnipeg residents, over the study period. The risk of death for all Manitobans from cancer, injury and respiratory disease remained stable throughout the study period. For all four causes of death, with the exception of cancer mortality for the non-Winnipeg residents, there were gaps in health status between residents of areas with the least and most healthy populations, with those from areas with the least healthy populations having poorer health status than those from areas with the most healthy populations. These gaps in health status did not decrease over the study period, and for heart disease mortality the gaps increased. When different age categories and males and females were examined separately, there was some evidence of an increase in the health status gap for all four causes of mortality, with no consistent patterns across age or sex.

This health status gap existed for all five treatment prevalence categories studied, and these gaps did not decrease over the study period.

Treatment prevalence for diabetes and respiratory disease increased for all Manitobans over the study period, whereas injuries from falls and MVCs and hospitalizations due to acute myocardial infarction (AMI) declined. For all treatment prevalence categories studied, with the exception of cancer incidence for non-Winnipeg residents, there was a gap in treatment prevalence, with residents of areas with the least healthy populations having higher treatment prevalence than those from areas with the most healthy populations. Gaps in health status increased for diabetes treatment prevalence, respiratory disease treatment prevalence and AMI hospitalizations. The widening gaps were not consistent across age groups or sex.

It is difficult to determine what is driving the increasing health status gaps between residents of areas with the least compared to the most healthy populations. The fact that there is evidence of this growing gap across several different diseases suggests that it is unlikely the result of some specific treatment breakthrough.

Although behavioural factors may contribute to the observed gaps in health status, they probably play a small role compared to income and other socioeconomic factors.

The strongest mortality results were found for heart disease, whereas some of the strongest patterns for disease treatment prevalence were found for AMI, diabetes and respiratory disease. Each of these diseases is associated with risk factors that have behavioural components: smoking, poor diet, and lack of physical activity. Although programs targeted at reducing smoking, improving nutrition and increasing physical activity would certainly benefit the health of any population, even when behavioural factors such as smoking, physical activity and overweight are controlled for, the risk of heart disease is still found to be strongly related to income (Roux, Merkin, Arnett et al., 2001). And many of these behavioural factors in adults are related to childhood socioeconomic levels (Lynch, Kaplan and Salonen, 1997) providing support for the belief that behavioural factors that influence health are more likely due to a "powerful form of social conditioning" than individual choice per se (Evans and Stoddart, 1994). As well, although stressful conditions that are associated with low SES may lead to the adoption of health-threatening behaviours such as smoking, the excessive psychosocial stress and material deprivation associated with low-income themselves damage the cardiovascular system (Raphael, 2002). Indeed, Wilkins et al. (2002) suggest that over 21% of the deaths from circulatory diseases before the age of 75 years can be attributed to income-related differences in health status.

Income levels tended to be lower and unemployment rates higher in the least healthy populations; as well the disparity in both income and unemployment between the least and most healthy populations widened over the study.

In our study, we found that both income and unemployment were related to the observed widening gap in health status. Not only did income levels tend to be lower and unemployment rates higher in the least healthy populations, but the disparity in both income and unemployment between the least and most healthy populations widened over the study period. Interestingly, the widening gaps in income and unemployment showed a different pattern than those we found for health status. That is, rather than income and unemployment remaining stable for residents of the areas with the least healthy populations and improving for residents of areas with the most healthy populations (the pattern found for mortality in this study) the pattern tended to be one of worsening socioeconomic circumstances for the least healthy populations and improving or stable circumstances for the most healthy populations. Whether the stable health status of residents of areas with the least healthy populations in the face of worsening socioeconomic circumstances is due to the social safety net, or some other factors, is a question for future research.

4.1 Limitations

The morbidity analyses were based on encounters with the health care system and may therefore reflect utilization patterns rather than prevalence of the diseases examined.

Our morbidity analyses (including those done for the migration analysis) are based on encounters with the health care system and they may therefore reflect utilization practices rather than prevalence of the diseases examined. Not only is it the case that not everyone with a particular disease seeks medical attention, but changes in diagnostic tests and patterns may also affect changes in rates of treatment prevalence over time. For example, changes in diagnostic criteria for diabetes may contribute to the observed increases over time in the treatment prevalence of this disease (Meltzer al al, 1998). Because of these changes people who may not have been diagnosed in the past may be given a diagnosis of diabetes. We have no reason to suspect that these changes would have differential impact on our least, average and most healthy populations. Thus these changes in diagnostic criteria may affect changes in disease treatment prevalence over time, but not necessarily changes between populations over time.

The report was unable to identify individuals who had immigrated to Canada from elsewhere in the world.

We were unable in our analyses to identify individuals who had immigrated to Canada from elsewhere in the world. Foreign-born residents tend to be concentrated in lower income metropolitan areas and research suggests that they also have lower mortality rates (Chen et al 1996). This "healthy immigrant effect" would likely only affect our analyses of Winnipeg populations, and would have the effect of attenuating our results. That is, the healthy immigrants would raise the health status of our least healthy populations, thereby reducing any observable gap.

The report was unable to assess changes in health status for aboriginal people separately.

Although included in our analyses, we were unable to assess the changes in health status for Aboriginal people separately in this report. An upcoming C.D. Howe Institute study found that the income gap between First Nations and non-First Nations individuals has widened over the last 10 years, with First Nations individuals living on-reserve faring the poorest in terms of income (Janigan, 2002). First Nations people in Canada have much higher rates of cardiovascular disease and risk factors for mortality than Canadians of European ancestry (Anand et al., 2001), and four times the risk of diabetes (Martens et al. 2002). Research examining health status and socioeconomic indicators separately for First Nations populations could shed more light on the reasons for the growing gap in health status in Manitoba.

5.0 CONCLUSIONS

- Mortality rates declined significantly in Manitoba between 1985 and 1999.
- Between 1985 and 1999, the health status gap that exists between residents of Manitoba from areas with the least healthy populations compared to the most healthy populations widened.
- The widening of the health status gap appears to be due to improvements in health for residents of areas with the most healthy populations, whereas the health status for residents of areas with the least healthy populations remained unchanged.
- This widening gap in health status has been greater for males than for females. Manitoba males in general have experienced greater improvements in health status over the past 15 years compared to Manitoba females, however the gains in health status for males have been greater for residents of areas with the most healthy populations compared to the least healthy populations.
- The widening gap in health status between the least and most healthy non-Winnipeg and Winnipeg populations evidenced across the time period does not seem to be driven by any particular age group.
- The widening health status gap does not appear to be due to migration. Examination of both mortality and illness measures for those who migrated compared to those who did not found that migration had little impact on the widening gap in health status observed over the study period.
- Cause-specific mortality analyses revealed a similar health status gap for each of the causes studied: higher mortality rates for residents of the areas with the least healthy populations compared to the most healthy populations. Although some of these gaps remained stable across the 15 years of the study, none narrowed, and for some the health status gap widened.
    - When analyzed by different age categories and by sex, the greatest changes in terms of the growing gap between those from the least and most healthy populations appear to have occurred in heart disease and respiratory disease mortality, however there was some evidence of a growing health status gap for each of the categories studied.
    - As was found for the overall analyses, for the disease-specific mortality analyses most of the widening of the gap can be attributed to residents of areas with the most healthy populations showing improvements in health status over time, whereas residents from areas with the least healthy populations showed no change (and sometimes declines) in health status over time.
- Cause-specific treatment prevalence analyses found a similar health status gap for almost all categories studied: higher treatment prevalence rates for residents of areas with the least healthy compared to the most healthy populations. None of these gaps narrowed over the 15 years, and some widened.

- For some of the illness categories studied (diabetes, respiratory disease), residents of all areas experienced an increase in treatment prevalence, and the widening gap in health status observed can be attributed to greater increases in treatment prevalence for residents of areas with the least healthy populations.
- For other categories of illness (AMI), residents of all areas experienced a decrease in treatment prevalence, and the widening gap in health status observed can be attributed to lesser decreases in treatment prevalence for residents of areas with the least healthy populations.

- The growing gap in health status observed between residents of the areas with the least and most healthy populations appears to be related to changes in income and unemployment levels, but not to changes in education and lone-parent status.
- Days spent in hospital decreased for all populations across the study period. Separations from hospital decreased slightly for residents of the non-Winnipeg areas with the least healthy populations. Further examination revealed that there was no relationship between hospital separations and mortality rates for these residents, suggesting that changes in hospital use did not contribute to the widening gap in health status observed.
- It would be an oversimplification to attribute the growing gap in health status observed in this study to behavioural factors. Although rates of smoking and overweight (factors associated with poorer health) are higher in areas with the least healthy populations, research shows that health status differences remain even when these behavioural factors are taken into consideration, and that socioeconomic differences have an effect on health status above and beyond differences in health-related behaviours.

Despite overall improvements in the health status of Manitobans over the 15-year study period, the gap in health status between residents of areas with the least healthy compared to the most healthy populations increased significantly.

This widening health status gap does not seem to be restricted to one or two specific diseases or age groups, nor is it the result of migration or changes in hospital utilization. For the most part, the widening gap in health status appears to be due to improvements in health status for those already enjoying the best health, with no corresponding improvements for those already in the poorest health. Further examination of factors that contribute to health status, particularly socioeconomic conditions such as income level and employment, is necessary to determine why residents of areas with the least healthy populations have not enjoyed the same improvements in health as those in the rest of the province.

References

Anand SS, Yusuf S, Jacobs R, Davis AD Yi Q etal. Risk factors, atherosclerosis, and cardiovascular disease among Aboriginal people in Canada: The study of health assessment and risk evaluation in Aboriginal peoples. (SHARE-AP). *Lancet* 2001; 358(9288):1147-1153.

Benzeval M, Judge K. Income and health: The time dimension. *Soc Sci Med* 2001;52:1371-1390.

Benzeval M. The self-reported health status of lone parents. *Soc Sci Med* 1998;46:1337-1353.

Brimblecombe N, Dorling D, Shaw M. Mortality and migration in Britain, first results from the British Household Panel Survey. *Soc Sci Med* 1999;49:981-988.

Brownell MD, Friesen D, Mayer T. Childhood injury rates in Manitoba: Socioeconomic influences. *Can J Pub Health* 2002;93(Suppl 2): S50-S56.

Carriere KC, Roos NP, Dover DC. Across time and space. Variations in hospital use during Canadian health reform. *Health Serv Res* 2000;35:467-487.

Carriere KC, Roos LL. A method of comparison for standardized rates of low incidence events. *Med Care* 1997;5(1):57-69.

Carstairs V, Morris R. *Deprivation and Health in Scotland*. Aberdeen, Scotland; Aberdeen University Press, 1991.

Chen J, Ng E, Wilkins R. The health of Canada's immigrants in 1994-95. *Health Rep* 1996;7:33-45.

Erzen D, Carriere KC, Dik N, Mustard C, Roos LL. et al. Income level and asthma prevalence and care patterns. *Am J Respir Crit Care Med* 1997;155:1060-1065.

Evans RG, Stoddart GL. "Producing Health, Consuming Health Care" - 2nd chapter in *Why are Some People Healthy and Others Not? The Determinants of Health of Populations.* Aldine De Gruyter, 1994.

Eyles J, Birch S, Chambers S, et al. A needs-based methodology for allocating health care resources in Ontario: Development and an application. *Soc Sci Med* 1991;33(4):489-500.

Eyles J, Birch S. A population needs-based approach to health care resource allocation and planning in Ontario: A link between policy goals and practice. *Can J Public Health*. 1993;84(2):112-117.

Fiscella K, Franks P. Poverty or income inequality as predictor of mortality: longitudinal cohort study. *BMJ* 1997;314:1724-1727.

Frohlich N, Fransoo R, Roos NP, Martens P. *Comparative Indicators of Population Health and Health Care Use for Manitoba's Regional Health Authorities*. Winnipeg, Manitoba Centre for Health Policy and Evaluation; June 1999.

Janigan M. Native intelligence. *Macleans* 2002;115(4):47.

Jin RL, Shah CP, Svoboda TJ. The impact of unemployment on health: A review of the evidence. *CMAJ* 1995;153:529-540.

Kaplan GA, Pamuk ER, Lynch JW, Cohen RD, Balfour JL. Inequality in income and mortality in the United States: Analysis of mortality and potential pathways. *BMJ* 1996;312:999-1003.

Kennedy BP, Kawachi I, Prothrow-Smith D. Income distribution and mortality cross-sectional ecological study of the Robin Hood index in the United States. *BMJ* 1996;312:1004-1007.

Lantz PM, House JS, Lepkowski JM, Williams DR, Mero. RP et al. Socioeconomic factors, health behaviors and mortality: Results from a nationally representative prospective study of US adults. *JAMA* 1998;279:1703-1708.

Leach CE, Blair PS, Fleming PJ, Smith IJ, Platt MW. et al. Epidemiology of SIDS and explained sudden infant deaths. CESDI SUDI Research Group. *Pediatrics* 1999;104(Oct):e43.

Lipman EL, Boyle MH, Dooley MD, Offord DR. Child well-being in single-mother families. *J Am Acad Child Adolesc Psychiatry* 2002;41:75-82.

Lynch JW, Davey Smith G, Kaplan GA, House JA. Income inequality and mortality: Importance to health of individual income, psychosocial environment, or material conditions. *BMJ* 2000;320:1200-1204.

Marmot M, Ryff CD, Bumpass LL, Shipley M, Marks NF. Social inequalities in health: Next questions and converging evidence. *Soc Sci Med* 1997;44:901-910.

Marmot MG, Smith GD, Stansfeld S, Patel C, North F. et al. Health inequalities among British civil servants: the Whitehall II study. *Lancet* 1991;337:1387-1393.

Martens P, Bond R, Jebamani L, Burchill C, Roos NP. et al. *The Health and Health Care Use of Registered First Nations People Living in Manitoba: A Population-Based Study*. Winnipeg, Manitoba Centre for Health Policy; March 2002.

Martens PJ, Frohlich N, Carriere KC, Derksen S, Brownell M. Embedding child health within a framework of regional health: Population health status and sociodemographic indicators. *Can J Pub Health* 2002;93(Suppl 2):S15-S20.

Mathers CD, Schofield DJ. The health consequences of unemployment: The evidence. *Med J Aust* 1998;168:178-182.

Meltzer S, Leiter L, Daneman D, et al. 1998 clinical practice guidelines for the management of diabetes in Canada. *CMAJ* 1998;159(8 Suppl):S1-S29.

Mitchell R, Dorling D, Shaw M. *Inequalities in life and death: What if Britain were more equal?* Bristol, UK: The Policy Press, 2000.

Morris JK, Cook DG, Shaper AG. Loss of employment and mortality. *BMJ* 1994;308:1135-1139.

Moser KA, Goldbaltt PO, Fox AJ, Jones DR. Unemployment and mortality: Comparison of the 1971 and 1981 longitudinal study samples. *BMJ* 1987;294:86-90.

Northern Miner. *Canadian Mines Handbook 1989-90*. Toronto, Northern Miner Press; 1989.

Northern Miner. *Canadian Mines Handbook 2000-2001*. Giancola D Ed. Don Mills, ON, Southam Mining Publications; 2000.

Olshansky SJ, Wilkins R. Introduction. *J Aging Health* 1998;10:126-125.

Paquet B. *Low Income Cut Offs from 1990 to 1999 and Low Income Measures from 1989 to 1998*. Statistics Canada (75F0002MIE-00017). January 2001.

Pappas G, Queen S, Hadden W, Fisher G. The increasing disparity in mortality between socioeconomic groups in the United States, 1960-1986. *N Engl J Med* 1993;329:103-109.

Phillimore P, Beattie A, Townsend P. Widening inequality of health in northern England, 1981-91. *BMJ* 1994;308:1125-1128.

Power C. Manor O, Matthews S. The duration and timing of exposure: Effects of socioeconomic environment on adult health. *Am J Pub Health* 1999;89:1059-1065.

Reid RJ, Roos NP, MacWilliam L, Frohlich N, Black C. Assessing population health care need using a claims-based ACG morbidity measure: A validation analysis in the province of Manitoba. *Health Serv Res* (in press).

Reid R, MacWilliam L, Roos NP, Bogdanovic B, Black C. *Measuring Morbidity in Populations: Performance of the Johns Hopkins Adjusted Clinical Group (ACG) Case-Mix Adjustment System in Manitoba*. Winnipeg, Manitoba Centre for Health Policy and Evaluation; June 1999.

Robinson JR, Young TK, Roos LL, Gelskey DE. Estimating the burden of disease: Comparing administrative data and self-reports. *Med Care* 1997;35(9):932-947.

Ross NA, Wolfson MC, Dunn JR, Berthelot JM, Kaplan GA. et al. Relation between income inequality and mortality in Canada and in the United States: cross sectional assessment using census data and vital statistics. BMJ, 2000:320;898-902.

Roos NP, Shapiro E, Bond R, Black C, Finlayson G. et al. *Changes in Health and Health Care Use of Manitobans: 1985-1998*. Winnipeg, Manitoba Centre for Health Policy and Evaluation; May 2001.

Roos NP, Shapiro E (Eds.) Health and health care: Experience with a population-based health information system. *Med Care* 1995;33 (12 Suppl):DS132-DS145.

Roux AV, Merkin SS, Arnett D, Chambless L, Massing M. et al. Neighbourhood of residence and incidence of coronary heart disease. *NEJM* 2001;345:99-106.

Sanmartin C, Ross N, Tremblay S, Wolfson M, Dunn J. et al. Labour market inequalities and health. Paper presented at the International Society for Equity in Health Meeting, Toronto, June 2002.

Sauvola A, Rasanen PK, Joukamaa MI, Jokelainen J, Jarvelin MR. et al. Mortality of young adults in relation to single-parent family background. A prospective study of the northern Finland 1966 birth cohort. *Eur J Public Health* 2001;11:284-286.

Shaw M, Dorling D, Gordon D, Davey Smith G. *The widening gap: Health inequalities and policy in Britain*. Bristol, UK: The Policy Press, 1999.

Starfield B, Weiner J, Mumford L, Steinwachs D. Ambulatory care groups: A categorization of diagnoses for research and management. *Health Serv Res* 1991;26(1):53-74.

Statistics Canada. *Canadian Community Health Survey. Health Indicators, May 2002*. (Volume 2002, no. 1) Catalogue no. 82-221-XIE. (http://www.statcan.ca/Daily/English/020508/d020508a.htm)

Statistics Canada. *Health Rep*, Volume 12, Number 3, 2001.

Veugelers PJ, Guernsey JR. Sensitivity analysis of selective migration in ecologic comparisons of health. *Epidemiology*, 1999;10:784-785.

Wilkins R, Adams O, Brancker A. Changes in mortalilty by income in urban Canada from 1971 to 1986. *Health Rep* 1989;1:137-174.

Wilkins R, Berthelot JM, Ng E. Trends in mortality by income in urban Canada from 1971 to 1996. *Health Rep* 2002:13(Supplement):1-27.

Wolfson M, Kaplan GA, Lynch J, Ross N, Backlund E. Relation between income inequality and mortality: Empirical demonstration. *BMJ* 1999;319:953-955.

Wyke S, Ford G. Competing explanations for associations between marital status and health. *Soc Sci Med* 1992;34:523-32.

APPENDIX A

Table A1: Number of premature deaths (before age 75 years), 3-year moving averages, 1985-1998

	Least healthy	Average health	Most healthy	Winnipeg	Manitoba
1985	624	2,266	2,235	6,608	11,776
1986	671	2,323	2,292	6,724	12,052
1987	644	2,306	2,201	6,719	11,910
1988	650	2,303	2,130	6,491	11,609
1989	598	2,277	2,092	6,270	11,271
1990	627	2,240	2,036	6,146	11,087
1991	635	2,231	2,011	6,214	11,130
1992	673	2,195	1,935	6,231	11,065
1993	697	2,156	1,989	6,206	11,065
1994	695	2,187	2,017	6,271	11,179
1995	654	2,155	2,006	6,221	11,040
1996	622	2,151	1,951	6,121	10,849
1997	641	2,098	1,885	5,913	10,542
1998	695	2,137	1,912	5,838	10,589

Table A2: Population totals for non-Winnipeg and Winnipeg populations, 1985 and 1999

	Least Healthy	Average Health	Most Healthy	Total
Non-Winnipeg				
1985	74,424	186,650	177,429	438,503
1999	71,363	194,764	185,292	451,419
Winnipeg				
1985	147,025	259,450	217,929	624,404
1999	130,657	266,168	248,317	645,142

Table A3: Age- and sex-standardized mortality rates, non-Winnipeg and Winnipeg, populations, 1985-89 and 1995-99

		Deaths per 1000							
		Least healthy		Average health		Most healthy		Total	
		1985-89	1995-99	1985-89	1995-99	1985-89	1995-99	1985-89	1995-99
Non-Winnipeg	Overall	9.85	10.06	8.83	8.45	8.49	7.78	8.78	8.28
	Male	12.96	11.10	11.39	10.14	11.27	9.30	11.50	9.88
	Female	7.66	7.84	6.94	7.21	6.57	7.08	6.83	7.24
Winnipeg	Overall	10.35	10.12	8.68	7.89	8.75	7.08	9.09	8.04
	Male	13.58	12.50	11.34	9.25	11.88	7.12	12.00	9.17
	Female	7.96	8.81	6.76	6.68	6.68	6.17	7.03	6.94

Table A4: Sex-standardized mortality rates by age category and population, 1985-89 and 1995-99, non-Winnipeg and Winnipeg

		Deaths per 1000							
	Age group	Least healthy		Average health		Most healthy		Total	
		1985-89	1995-99	1985-89	1995-99	1985-89	1995-99	1985-89	1995-99
Non-Winnipeg	0-24	1.36	1.40	0.81	0.77	0.75	0.62	0.89	0.82
	25-44	1.69	1.65	1.33	1.23	0.85	0.93	1.17	1.16
	45-64	7.05	6.46	7.23	5.77	5.94	4.78	6.62	5.40
	65-74	26.55	29.87	22.38	21.40	21.92	18.76	22.40	20.63
	75+	74.28	88.41	78.75	78.23	78.12	78.11	78.21	78.63
Winnipeg	0-24	0.95	0.82	0.60	0.53	0.54	0.36	0.66	0.52
	25-44	1.36	1.70	0.88	1.03	0.68	0.76	0.91	1.08
	45-64	9.55	8.52	6.86	4.98	4.73	3.74	6.69	5.10
	65-74	28.12	29.02	23.90	21.23	20.44	16.17	24.14	21.11
	75+	81.89	85.80	71.73	73.67	85.09	74.01	78.15	76.80

Table: A5: Infant mortality rates per 1000 population, 1985-89 and 1995-99 by non-Winnipeg and Winnipeg populations

	Deaths per 1000							
	Least healthy		Average health		Most healthy		Total	
	1985-89	1995-99	1985-89	1995-99	1985-89	1995-99	1985-89	1995-99
Non-Winnipeg								
Extremely low birth weights excluded	9.46	8.58	6.83	6.37	6.87	6.17	7.42	6.78
Extremely low birth weight included	9.70	9.21	7.30	7.30	7.62	7.13	7.97	7.65
Winnipeg								
Extremely low birth weights excluded	9.22	6.90	6.22	4.89	5.89	4.12	6.87	5.13
Extremely low birth weight included	9.93	8.50	6.57	6.52	6.22	5.28	7.31	6.59

Table A6: Age- and sex-standardized mortality rates, by cause and population, non-Winnipeg and Winnipeg, 1985-89 and 1995-99*

		Deaths per 1000							
Cause of mortality		Least healthy		Average health		Most healthy		Total	
		1985-89	1995-99	1985-89	1995-99	1985-89	1995-99	1985-89	1995-99
Cancer	Non-Wpg	1.83	2.20	2.12	2.19	1.99	2.09	2.04	2.13
	Winnipeg	2.48	2.58	2.30	2.25	2.18	1.99	2.30	2.22
Heart Disease	Non-Wpg	3.96	4.30	4.21	3.79	3.98	3.56	4.09	3.72
	Winnipeg	4.68	4.65	3.85	3.68	3.94	3.22	4.08	3.73
Injury	Non-Wpg	1.01	0.93	0.66	0.62	0.49	0.48	0.63	0.59
	Winnipeg	0.67	0.64	0.40	0.40	0.32	0.33	0.43	0.42
Respiratory disease	Non-Wpg	1.25	1.56	1.02	1.04	1.08	1.10	1.06	1.09
	Winnipeg	1.13	1.30	0.88	0.84	1.04	0.96	0.98	0.98

* Rates are based on fiscal years except for cancer mortality, for which rates are based on calendar years

Table A7: Age- and sex-standardized morbidity rates by cause and non-Winnipeg and Winnipeg populations, 1985-87 and 1997-99

		Per 1000 population							
Cause of morbidity		Least healthy		Average health		Most healthy		Total	
		1985-87	1997-99	1985-87	1997-99	1985-87	1997-99	1985-87	1997-99
Injury hospitalizations due to falls	Non-Wpg	11.26	10.47	5.96	5.36	6.00	5.21	6.58	5.83
	Winnipeg	5.31	4.68	4.14	3.67	4.33	3.56	4.43	3.81
Injury hospitalizations due to Motor Vehicle Collision	Non-Wpg	3.67	2.40	2.36	1.61	2.20	1.36	2.53	1.62
	Winnipeg	1.45	0.89	0.96	0.65	0.91	0.48	1.04	0.63
Injury hospitalizations due to violence	Non-Wpg	6.88	6.14	1.27	1.61	0.86	0.90	2.11	1.99
	Winnipeg	2.17	2.45	0.85	0.91	0.54	0.50	1.03	1.07
Injury hospitalizations due to other cause	Non-Wpg	10.34	8.73	5.81	3.89	4.78	3.22	6.15	4.32
	Winnipeg	4.82	3.00	3.24	1.80	2.60	1.44	3.36	1.92
Diabetes Treatment Prevalence	Non-Wpg	62.60	99.01	40.10	55.73	33.08	43.55	39.29	54.39
	Winnipeg	43.55	63.31	35.22	49.04	29.83	40.12	35.28	48.13
Respiratory Disease Treatment Prevalence	Non-Wpg	105.20	93.38	101.99	130.23	88.94	111.46	96.07	114.79
	Winnipeg	114.82	154.40	102.09	132.18	99.83	118.35	104.27	131.01
Cancer Incidence▪	Non-Wpg	3.63	4.08	4.13	4.60	4.22	4.50	4.13	4.50
	Winnipeg	4.97	4.97	4.61	4.65	4.43	4.36	4.63	4.61
AMI Hospitalization Incidence	Non-Wpg	3.19	3.12	3.03	2.47	2.89	2.31	2.99	2.45
	Winnipeg	3.12	2.32	2.97	2.31	2.88	1.83	3.00	2.14

▪5 year rates, 1985-1989, 1995-1999

Table A8: Age- and sex-standardized rates of hospital separations and days per 1000, non-Winnipeg and Winnipeg populations, 1985 and 2000

	Per 1000 population							
	Least healthy		Average health		Most healthy		Total	
	1985	2000	1985	2000	1985	2000	1985	2000
Non-Winnipeg								
Separations	306.33	250.43	210.43	198.64	200.8	193.55	218.21	202.71
Days	2511.67	1466.28	1682.76	965.79	1787.07	971.46	1817.81	1007.49
Winnipeg								
Separations	171.49	163.83	145.12	142.74	133.99	132.58	147.23	143.07
Days	1925.86	1059.01	1529.10	837.77	1387.28	690.72	1580.95	828.86

APPENDIX B

Methods for Monitoring Inequalities in Health Status

There are a number of different methods that could be used to monitor inequalities in health status, and each of these may produce somewhat different results. Methods can differ in terms of the different measures of population health status used to assess changes in regional disparities over time and also in terms of various analytic techniques used to test the statistical significance of these changes.

Measures of population health status. Measures of population health status that could be used to assess changes in regional disparities over time include cause-specific mortality, premature mortality (overall or cause-specific), potential years of life lost, and life expectancy. Each may result in different interpretations of the phenomenon under investigation because each emphasizes different aspects of the health status of the population. In particular, the "weight" that is assigned to each death will vary with the measure of health status.

Cause-specific mortality, which was selected for this report, focuses on the mortality experience of the entire population; hence it assigns the same weight to each death. Premature mortality (death prior to age 75) focuses on deaths attributable to the younger members of a population and gives the deaths among the 75+ age group a weight of zero. Similarly, Potential Years Life Lost (PYLL) is an indicator of premature mortality that gives greater relative weight to causes of death occurring at younger ages than those occurring at later ages. Life expectancy is the number of years of life remaining after a given age, assuming that observed age-specific mortality rates during a given period remain stable. With each of the measures that assign more weight to deaths at younger ages (premature mortality, PYLL) the sensitivity to detect gaps/effects may be reduced because the analyses are based on fewer deaths. To test whether the results we produced in this report were limited to the measure we chose, we repeated the mortality analyses presented in this report using PYLL. Although there were small differences in the findings (e.g., for some causes of death gaps between the least and most healthy populations were wider, whereas for others they were narrower) the results using PYLL would generally lead us to the same conclusions as described in this report.

Testing statistical significance. In order to assess regional changes in our selected measure of population, tests of statistical significance were adopted. In small populations, random fluctuations can be expected in the number of deaths observed on an annual basis. Without adopting a test of statistical significance, it is impossible to determine if changes over time are due to real changes in the mortality experience of a population or just due to random fluctuations.

We used Poisson regression analysis to model the observed number of deaths in each region for each year of the study period. Our explanatory variables were age, sex, region, and year. Because we modeled the crude rates, we can interpret our least/most relative rates as the relative risk of mortality for the least healthy populations *assuming that age and sex are held constant over time.* Generalized estimating equations with the Poisson regressions were used because we assumed that the number of deaths in each segment of the population are correlated from one year to the next.

The specific hypotheses that we tested with our regression model were of differences between the first and last five-year study time periods. We can interpret these hypotheses as testing whether the slope of the line for the first five years is equal to the slope of the line for the last five years. This is different than if we had tested whether mortality is different in the first and last years of the study period. To test the latter hypothesis equates to testing whether the slope of the line fitted through the first and last year data points is zero. Finally, we tested whether the difference between the first and last five-year time periods was different for the least and most healthy populations. In other words, we were testing for a region by time interaction. This is very different from testing for a time effect, and then inferring from the relative rates whether there is a difference across regional groupings.

Comparing the results produced using Poisson regressions with generalized estimating equations to crude age-specific mortality rates, we found that the patterns were similar using both methods. That is, where crude rates suggested increasing gaps, in most cases the regression results confirmed these statistically. There were some gaps, however, that appeared to increase when looking at crude rates, but were found to be non-significant. The results using Poisson regressions were similar to patterns observed using age- and sex-standardized rates.

Regression Analysis used in this Report

Regression analysis was used instead of age- or sex-standardized rates to examine trends over time across and within non-Winnipeg and Winnipeg regional groupings. The primary advantage of a regression model is that interactions among variables that are known or presumed to have an impact on health status can be investigated; it is not possible to describe interactions using standardized rates. An interaction means that the effect of one variable on health status is not constant for every value of a second variable.

Preliminary analyses were used to determine whether the data conformed to the assumptions that underlie regression analyses. The measures of morbidity and health care utilization revealed skewed distributions; most people will be hospitalized only a few days in a given year or not at all, while a small number of people will be hospitalized for very long periods of time.

Therefore a logarithmic transformation was applied to these data to reduce their skewness and thereby produce a more normal distribution before the regression models were run. The mortality data and some morbidity measures followed either a Poisson distribution or negative binomial distribution; the distributions are appropriate choices for events that occur infrequently in the general population. For example, we know that only a very small proportion of all people die in any given year. The negative binomial distribution is appropriate for events that are not only rare but also highly variable across the entire population, such as diabetes.

For the mortality data, relative risk (RR) was estimated from the longitudinal data for a particular population (least, average or most healthy) or age group using Poisson regression with generalized estimating equations (GEE). Poisson regression is the recommended technique for modeling count data (i.e., counts of the number of deaths in a region). GEEs are used when these count data are correlated over time. Relative risk is the probability of death *relative to some reference group*. For example, looking across the 15-year period, the relative risk would be the probability of death in any given year *compared to the reference year,* which in this case is the first year of the study period, or 1985. A relative risk of 1.00 means that there is no difference between the mortality rate for the group in question and the reference group. If we were comparing mortality in 1999 to mortality in 1985, then a relative risk of 1.00 would mean that the mortality rate in 1999 was the same as it was in 1985. Relative risks greater than 1.00 indicate higher risk (and consequently poorer health status) for the group in question relative to the reference group, whereas relative risks less than 1.00 indicate lower risk (and consequently better health status) for the group in question.

For morbidity measures and health system access measures, either a Poisson or a negative binomial regression model was used for rare events, like hospitalization for injuries due to violence. A negative binomial model is useful when an event is relatively rare, but is highly variable over the entire population; an example is diabetes; some groups have much higher rates of disease and hence variation in diabetes rates across regional groupings can be substantial. For more frequent health events like hospitalization and physician visits for respiratory illness, regression techniques that are appropriate for continuous data were used. In these cases, the natural logarithm of the crude rate was modeled assuming a normal distribution, but still relying on GEEs for correlated data.

Most of the results are presented by comparing data from the end and beginning time periods: 1995-1999 is compared with 1985-1989. Therefore, the earlier time period (1985-1989) becomes the reference period, and the data from the later time period (1995-1999) are shown relative to this reference period. We used five-year time periods to test for differences or changes in the data for two reasons: (1) we were more interested in whether the data show changes over broad segments of time, not just from one year to the next, and; (2) for rare events there is a lot of variability in the data from one year to the next. The number of events, such as death or hospitalization for rare conditions, in an age group within one region of Manitoba or Winnipeg can fluctuate substantially from year to year. Because death is a relatively rare event (compared to, say, heart disease), random fluctuations in mortality within any given year can affect the ability to detect a change in the risk of mortality, particularly when looking across regions. By looking at five-year time periods, it is possible to reduce, or smooth out, the influence of these annual fluctuations.

A chi-square test was used to test for a statistically significant difference between five-year time periods within one regional grouping. A chi-square test was also used to test the statistical significance of the magnitude of the time period difference between the least and most healthy regional groupings. The first test allows us to determine whether health status is changing over time within one regional grouping, while the second allows us to determine whether the changes over time are the same for residents of areas with the least healthy populations compared to the most healthy populations. P-values and 95% confidence intervals (95% CI) are presented throughout the report to provide readers with information on statistical significance, and to provide an indication of the precision of the magnitude of the differences that were observed, respectively. For relative risk/rate analyses, confidence intervals that include 1.00 within their bounds indicate non-significant findings, whereas those for which 1.00 lies outside their bounds indicate significant findings.

Infant mortality. Trends in the rate of infant deaths were examined for the province and the regional groupings . The analyses were conducted both including and excluding extremely low birthweight infant deaths, that is, infant deaths for babies weighing less than 500 grams at birth. We did this because the number of extremely low birth weight babies who are born alive has changed over time and is therefore a confounding factor in the longitudinal analysis of neonatal deaths; a high proportion of these babies will die within the first year of life. While extremely low birthweight infants (< 500 grams) made up 14.9% of the infant deaths that occurred in Manitoba over the 15 years of the study, within the 1995 - 1999 period, 22.0% of all infant deaths occurred in this weight class. This demonstrates the importance of controlling for extremely low birth weight infants in longitudinal analyses of infant mortality. The regression analyses for infant mortality included regional grouping and sex; separate analyses were conducted for neonatal and post-neonatal deaths. (See also "Infant Mortality" in Glossary.)

Analysis of Migration Effects

Mortality. The analysis of migration effects on mortality followed a method described in Brimblecombe, Dorling and Shaw (1999). This method involved identifying a cohort of individuals who were resident of Manitoba in both 1985 and 1995. For non-Winnipeg and Winnipeg areas separately, we identified three different areas based on the premature mortality rates of the populations within those areas (see "Regional Groupings" in Glossary): least, average and most healthy. Standardized Mortality Ratios (SMRs; see Glossary) were calculated based on five-year mortality rates for 1995 to 1999. The impact of migration was assessed by comparing SMRs with the effect of migration removed to SMRs with the effect of migration retained. SMRs with the effect of migration removed were calculated by assigning deaths to the area of residence (least, average, most) in 1985. This has the effect of removing people who by the end of the study period had moved into the area, and putting back in people who by the end of the study period had moved out of the area. SMRs with the effect of migration retained were calculated by assigning deaths to the area of residence in 1995. This has the effect of keeping in those who moved into the area by the end of the study period and removing those who moved out of the area by the end of the study period. Note that for both types of SMRs, the SMR itself was based on 1995-1999 death rates. To determine the impact of migration these two different SMRs are compared. If these two SMRs differ substantially, then it means there is an effect of migration (taking into consideration both movement into and out of an area). Higher SMRs with migration retained would mean the effect of migration operates to increase mortality rates; lower SMRs with migration retained would mean the effect of migration operates to decrease mortality rates. No difference between the SMRs suggests that migration has had no impact on observed mortality rates.

Morbidity. The Adjusted Clinical Group (ACG; see Glossary) system was used to evaluate the impact of migration on population morbidity (as measured by treatment prevalence, including hospital separations and physician visits). For our ACG analysis, we selected a cohort of individuals who were living in Manitoba in both 1985 (for seven consecutive months during the fiscal year) and in 1999. Regional grouping of residence (i.e., least, average, most healthy) was assigned as in other analyses. Migration status was assessed and residents were classified as to whether they stayed in the area (i.e., were living in the same health status area in 1985 and 1999), moved out of the area or moved into the area based on their residence in 1999. We then compared morbidity burden for those who moved into, out of, or stayed in each of the three areas (with the least, average, or most healthy populations). For the purposes of this report, we defined significant morbidity burden as the presence of more than three ADGs in 1985.

GLOSSARY

Acute Myocardial Infarction (AMI). (ICD-9-CM = 410) Hospital claims were used to obtain counts of the number of individuals with at least one AMI diagnosis in a given fiscal year. Preliminary analyses of the data revealed changes in coding practices over time, such that there was greater utilization of ancillary diagnosis fields in the more recent years. As a result, only the Most Responsible Diagnosis (diagnosis most responsible for the patient's hospital stay) was used to identify AMI patients. This will likely result in an undercounting of the actual number of AMI patients in a given year.

Adjusted Clinical Group (ACG). The ACG is a population-based patient case-mix adjustment system developed at Johns Hopkins University (Starfield et al., 1991). The ACG system estimates the burden of morbidity in relation to a population's need for health care services. The ACG system quantifies morbidity by categorizing individuals based on their age, gender and all known medical diagnoses (from both hospital and physician records) for a given period of time. The result is that each individual is assigned to a single, mutually exclusive ACG value, which is a relative measure of that individuals' expected, or actual, consumption of health services. The ACG system has been validated as a measure of population morbidity in Manitoba (Reid et al., 2002).

Age Categories. For the health status measures included in this report, separate analyses were conducted for each of the following age categories: 0-24 years, 25-44 years, 45-64 years, 65-74 years, and 75+ years. For some analyses, however, categories had to be combined or excluded where there were insufficient numbers of health status events (i.e., deaths, hospitalizations) to proceed with analysis.

Ambulatory Diagnosis Group (ADG). ADGs are part of the ACG case-mix system. The first step in assignment of ACGs is to group ICD codes into 32 different ADGs, based on: clinical similarity; the likelihood that the condition will persist or recur over time; the likelihood that the patient will return for a repeat visit or continued treatment; the likelihood of a specialty consultation or referral; the expected need and cost of diagnostic and therapeutic procedures for the condition; the expected need for hospitalization; the likelihood of associated disability; and the likelihood of associated decreased life expectancy. Up to 32 different ADGs are assigned to individuals based on clusters of diagnoses coded on both hospital separation abstracts and physician claims. A crude measure of significant morbidity burden is the presence of three or more ADGs in a given time period (usually one year).

Canadian Community Health Survey (CCHS). The CCHS was conducted by Statistics Canada to provide cross-sectional estimates of health determinants, health status and health system utilization for 133 health regions across Canada, plus the territories. The first cycle of the CCHS was begun in September 2000 and sampled 130,000 households. In the first cycle only those 12 years of age and older were eligible for selection.

Cancer Incidence. (ICD-9-CM =140-208). CancerCare Manitoba provided cancer incidence data (i.e., the number of newly diagnosed cases of cancer) in five-year aggregate time periods. Non-malignant skin cancers were excluded. The CancerCare registry maintains high quality data on this legally notifiable disease. All-site cancer incidence trends were analyzed as well as trends for site-specific lung, breast, prostate, and colorectal cancers. This analysis differs from others in this report in that data for individual years of the study period were not available. The fact that the data were provided in five-year aggregate time periods instead of in single years resulted in a high proportion of unexplained variation. In other words, the regression models fit the data less well than might have been the case if the data had been provided on an annual basis.

Cancer mortality. Obtained from Vital Statistics data for calendar years 1985 though 1999. ICD-9 codes identifying cancer deaths were: 140-208.

Cause-specific morbidity. Cause-specific morbidity data were based on treatment prevalence data available in the hospital and physician claims databases, with the exception of cancer incidence data, which came from the cancer registry maintained by CancerCare Manitoba. For most categories, data were obtained for fiscal years 1985 through 1999. The cause-specific morbidity categories examined in this report include: injury hospitalizations (falls, motor vehicle collisions, violence, other); diabetes treatment prevalence; respiratory disease treatment prevalence; cancer incidence; acute myocardial infarction hospitalizations.

Cause-specific mortality. Cause-specific mortality data were obtained from Manitoba Vital Statistics for the calendar years 1985 through 1999, the latter being the most recent year available at the time the analyses were conducted. The following specific causes of mortality were analyzed in this report: cancer, heart disease, injury, respiratory disease.

Diabetes treatment prevalence. (ICD-9-CM = 250). Diabetes treatment prevalence was defined as the number of individuals with at least one hosptalization or two ambulatory physician visits with a diabetes diagnosis within a three-year period, per thousand population.

Education Level. Education level was based on the per cent of the populations aged 25 to 44 years with no high school, and is based on the 1986, 1991 or 1996 Census using a 20% sample. According to Statistics Canada this refers to persons, excluding institutional residents, who did not hold a secondary school graduation certificate or its equivalent, regardless of whether or not other educational qualifications were held. Education level values were weighted by the same aged population within an area.

Employment status. Employment status was based on employment rates for the populations aged 25 to 44 years, from the 1986, 1991 and 1996 Census using a 20% sample. Statistics Canada defined unemployed persons as those persons, excluding institutional residents, who, during the week (Sunday to Saturday) prior to Census Day (1996), were without paid work and were available for work and either: (a) had actively looked for work in the past four weeks; or (b) were on temporary lay-off and expected to return to their job; or (c) had definite arrangements to start a new job in four weeks or less. Employment values were weighted by the same aged total labor force within an area.

Enumeration Area (EA). Census variables used in this report (household income, education level, employment level, lone-parent status) were available from public use Census data at the level of the EA. EAs have a maximum of 440 dwellings in urban areas and a minimum of 125 dwellings in rural areas. (Statistics Canada, computer file 1998). Income information is suppressed if the total non-institutional population in an EA is less than 250, or if less than 250 people in an EA reported an income.

Exclusions. The following exclusions were made in the analyses presented in this report:

1) Postal codes associated with the Office of the Public Trustee in both Winnipeg and Brandon were excluded. The Office of the Public Trustee has the responsibility of looking after the financial and other affairs of individuals unable to do so for themselves. Because this office has total responsibility for such persons, their address of record in the population Registry is that of the Office of the Public Trustee itself, even though they may not live in the same area as the Public Trustee office. They are therefore excluded from our analysis because we cannot determine their actual region of residence.

2) A number of children in the Manitoba Health registry appear to have Winnipeg Child and Family Services as a mailing address, which may incorrectly place these individuals in the least healthy regional grouping of Winnipeg. For this reason the postal code associated with the Winnipeg Child and Family Services was also excluded.

External Cause of Injury Codes (E-Codes). E-codes are used to define environmental events, circumstances and conditions as the cause of injury, poisoning, and other adverse effects related to injury hospitalizations and mortality. The ICD-9-CM E-code on the hospital claim may be in any one of the 16 diagnosis codes and the first one found going from 1 to 16 is used. The vital statistics record has ICD-9 E-codes listed in the cause of death.

Generalized estimating equations (GEE). Regression analyses with GEEs are the way to analyze longitudinal data sets (Carriere, Roos, & Dover, 2000). If GEEs were not used, the regression coefficients would not be estimated correctly because the data that we are working with are related (i.e., correlated) across time. For a regression analysis to be applied to a set of data, it is usually assumed that the data are independent (i.e., uncorrelated). This problem with independence in inter-correlated data is overcome through the use of a regression that uses GEE. The health status in a particular segment of the population (e.g., age group) in one year is likely to be similar to health status in that same segment of the population in the next year. However, there is not likely to be much association between health status in one age group in one year, and health status in another age group in the same year. One does not influence the other, and we say that these observations are independent.

Heart disease mortality. Heart disease mortality data were obtained from the Vital Statistics for the calendar years 1985 through 1999. The ICD-9 codes used to identify heart disease mortality in this report were: 390-459.

Income level. Income level information is based on total household income, from the 1986, 1991 or 1996 Census using a 20% sample. According to Statistics Canada a household refers to a person or a group of persons (other than foreign residents), who occupy the same dwelling and do not have a usual place of residence elsewhere in Canada. Income values were weighted by the total number of households in an area.

Income quintiles. Differences in mortality risk within the city of Winnipeg were examined across healthiness regions and income quintiles. Small numbers of deaths in some of the income rural quintiles precluded similar analyses for the non-Winnipeg areas. Using the methodology of Roos and Mustard (1997), Winnipeg residents were assigned to five income groups of approximately equal population using Statistics Canada Census data for the years 1986, 1991, and 1996. Briefly, under the income quintile methodology, an individual's residential postal code or municipal code is linked to an enumeration area. Enumeration areas are then ranked from poorest to wealthiest and assigned to quintiles so that approximately 20 per cent of the population is represented in each quintile. The income quintile for that enumeration area is then assigned to the resident. The lowest income quintile was designated Q1 and the highest income was designated Q5. The 1986 Census data were used to derive income quintiles for the years 1985 to 1988, the 1991 data for the years 1989 to 1993, and the 1996 Census data for the years 1994 to 1999. Separate regression models were then developed for each regional grouping. The predictor variables were age, gender, quintile, and year and the interaction of year by quintile.

Infant Mortality. Infant mortality rate is given by the number of deaths among infants under one year of age (at time of death) per 1000 live births, for a given period of time. Because survival of extremely low birth weight and short gestational age infants has increased over the 15-year period of this study and this can have an impact on infant mortality rates, analyses were run both including and excluding extremely low birth weight (< 500 gm.) infants. Gestational age information was not used due to data quality problems (many records are missing this information).

Injury hospitalizations. (ICD-9-CM = E800-E999, excluding E870-E879 and E930-E949). Hospital claims data were used to identify the number of separations with a relevant E-code. Analyses were conducted for each of the following cause-specific categories:
- Falls: E880-E888
- Motor vehicle crash: E810-E825
- Violence: to self - E950-E959; by others - E960-E969
- Other: all remaining E-codes, excluding injuries resulting from misadventures during surgical or medical care and adverse drug reactions (E870-E879; E930-E949).

Injury mortality. Injury mortality data were obtained from Vital Statistics for the calendar years 1985 through 1999. ICD-9 codes used to identify mortality from injuries included: E800-E999.

Lone-Parent Family. Statistics Canada defined a lone-parent family as a mother or a father, with no spouse or common-law partner present, living in a dwelling with one or more never married sons and/or daughters, where never married sons and/or daughters are defined as blood, step, or adopted children of any age.

Low-Income Cut Off (LICO). LICO is a measure developed by Statistics Canada to distinguish low-income families from other families. LICOs are set according to the proportion of annual family income spent on food, shelter and clothing. A LICO is an income threshold below which a family will likely devote a larger share of its income to the necessities of food, shelter and clothing than an average family would. LICOs used for this report were taken from a report providing LICOs for 1990 to 1999 (Paquet, 2001).

The LICOs used for analyses in this report were based on after tax, base 1992, family of four*, and are as follows:

Population Size	1986	1991	1996
500,000+	$20,058	$25,315	$27,194
30,000-99,999	$16,634	$20,995	$22,552
<30,000	$15,200	$19,185	$20,608
rural	$13,152	$16,598	$17,829

Information on population size divisions can be found under "Population Size" in this glossary.

Negative Binomial Regression. Regression analyses for data that follow a negative binomial distribution, which occurs when an event is relatively rare, but is highly variable over the entire population.

Neighbourhoold Clusters (NCs). Winnipeg can be divided into 25 NCs based on Census Divisions, 23 of which are within the boundaries of the City of Winnipeg and 2 additional divisions (East and West St. Paul) just outside the city boundaries.

Poisson Regression. Regression analyses for data that follow a Poisson distribution. Poisson regression is the best choice for very rare events, such as death; we know that only a very small proportion of all people die in any given year.

Population size. For analyses of socioeconomic characteristics using Census data, we sub-divided non-Winnipeg areas according to population size, as defined by Statistics Canada. Brandon was removed from this analysis, as it was the only city with a populations between 30,000 and 99,999. The remaining non-Winnipeg Enumeration Areas were placed into:
1) "small urban" if the population of the urban area was less than 30,000. These small urban areas have minimum population concentrations of 1,000 and a population density of at least 400 people per square kilometre, based on the previous census population counts.
2) "rural" if they were considered sparsely populated areas lying outside of urban areas. Rural areas would include small towns, villages and other populated places with less than 1,000 population according to the previous census, remote and wilderness areas, and agricultural lands. All territory outside urban areas is considered rural.

Potential Years Life Lost (PYLL). PYLL was defined as the difference between age at death and an upper bound of 75 years; infants (children less than 1 year of age) were excluded from the calculation. Regression analyses

* LICOs vary according to family size. We have used the cut-offs for a family of four to apply to all families in our analyses, and the results should be interpreted with this in mind.

were used to examine provincial, regional grouping, and age-specific trends in PYLL.

Premature Mortality Rate (PMR). PMR is the number of deaths of people aged 0-74 years, divided by the number of residents between 0 and 74 in the area. The values are standardized to account for age/sex differences in populations. This is considered the best single measure to reflect the healthiness of a group of people, and their need for health care services (Carstairs and Morris, 1991; Eyles et al., 1991; Eyles and Birch, 1993).

Region of Residence. Residents of Manitoba were identified and region of residence was assigned using the Manitoba municipal code on the Manitoba Repository registry file as of December 31 of a specified year, except for Treaty First Nations residents. For these individuals, postal code information was used to assign region of residence. The latter procedure was used in order to locate more accurately those not living in the First Nations community to which they are registered. Where municipal code information was unavailable, assignment to regions was based on postal code. For counting events (deaths, treatment prevalence) the same process was used, however, the date of service was used rather than December 31.

Regional Groupings. Regional groupings refer to the way non-Winnipeg Regional Health Authorities (RHAs) and Winnipeg Neighbourhood Clusters (NCs) were aggregated for analyses in this report. RHAs (or NCs - this grouping was done separately for RHAs and NCs) were each assigned to one of three groupings according to population health status (i.e., least healthy, average health, most healthy), which was based on 5-year Premature Mortality Rates (PMRs). With one exception, non-Winnipeg Regional Health Authorities (RHAs) with PMRs that were significantly higher than the provincial mean were classified as "least healthy", those with PMRs significantly lower than the provincial mean were classified as "most healthy" and those with a PMR not different significantly from the provincial mean were classified as "average health." The PMR for Churchill RHA was not significantly higher than that of the entire province in 1995-99, due to the large variance in PMR for that region (i.e., the PMR was much higher than the provincial average; however it did not reach statistical significance). Because Churchill's PMR was significantly higher in previous five-year periods, Churchill was retained in the "least healthy" category. Winnipeg Neighbourhood Clusters (NCs) were classified in a similar fashion; however 5-year PMRs were compared to the Winnipeg mean rather than to the provincial mean. The result was three separate regional groupings each for non-Winnipeg and Winnipeg: least, average, and most healthy.

Regional Health Authorities (RHAs). The province of Manitoba was divided into 12 RHAs that had responsibility for providing for the delivery and administration of health services to residents within their geographic boundaries.

Relative risk (RR). Relative risk, also know as the risk ratio, is the ratio comparison of two risk estimates. For example when we talk about the relative risk of mortality for males using females as the reference group, we are simply talking about the risk ratio of male mortality to female mortality. The selection of a reference group is based on theory/epidemiological methods for our analyses. For example, we know that overall, females have a longer life expectancy than males. Therefore, it makes sense, when describing male mortality, to do so in relation to female mortality. If male mortality is decreasing relative to female mortality then we can say, in a sense, that the health status of males is "catching up" to females. As well, if we are interested in describing the change in mortality over time, then it makes sense to do so using the first year of the study (e.g., the base year) as the reference group; this way we can talk about how much health status has changed since the beginning of the study.

Respiratory disease mortality. Respiratory disease mortality data were obtained from Vital Statistics for the calendar years 1985 through 1999. The ICD-9 codes used to identify deaths due to respiratory disease included: 460-519.

Respiratory disease treatment prevalence. Respiratorydisease treatment prevalence was defined based on the work of Erzin et al., (1997). This concept captures episodes of health care utilization for asthma or related conditions. The following ICD-9-CM diagnoses are used to define respiratory disease episodes: asthma (493), acute bronchitis/bronchiolitis (466), bronchitis not otherwise specified (490), chronic bronchitis (491), emphysema (492), and chronic airways obstruction (496). Respiratory disease episodes are based on physician office visits, referrals for consultation, and hospitalizations. Hospitalizations were included only if the Most Responsible Diagnosis (diagnosis most responsible for the patient's stay) included one of these ICD-9-CM diagnosis codes. Consultations were confined to those that occurred in ambulatory settings.

Standardized Mortality Ratio (SMR). SMR is the ratio of the observed age- and sex-standardized mortality rate to the expected age-sex-standardized mortality rate. For the migration anaylses the expected age- and sex-standardized mortality rate was based on the rate for the entire cohort resident in Manitoba in both 1985 and 1995.

Standardized Rates. Standardized rates are rates that are adjusted to reflect the overall age and sex distribution of the entire Manitoba population in 1996. Mortality and morbidity rates were standardized for age and sex using the direct method of standardization. Standardized rates are given for the most recent year (1999/2000) or years (1997/98 to 1999/2000).

Socioeconomic Factor Index (SEFI). A score that reflects non-medical determinants of health, based on Census measures of environmental, household and individual conditions associated with poor health.