Composite Measures/Indices of Health and Health System Performance

August 2009

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How to cite this report:

Metge C, Chateau D, Prior H, Soodeen R. De Coster C, Barré L. Composite Measures/Indices of Health and Health System Performance. Winnipeg, MB: Manitoba Centre for Health Policy, August 2009.

Legal Deposit:
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ISN 978-1-896489-49-0

1st Printing (August 2009)

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 (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, enables 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 and Healthy Living (MHHL). In addition, our researchers secure external funding by competing for 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, Europe and Australia.

We thank the University of Manitoba, Faculty of Medicine, and Health Research Ethics Board for their review of this project. MCHP 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 MHHL.

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:

Colleagues at MCHP for their valuable input throughout the life of this project: Pat Martens, Alan Katz, Randy Fransoo, Marni Brownell, Bogdan Bogdanovic, Matt Dahl, Marina Yogendran, Randy Walld, Shahab Savari, and Lisa Lix. Jo-Anne Baribeau, Wendy Guenette, Angela Bailly and Carole Ouelette provided administrative support.

The insightful and project working group: Dr. Susan Roberecki (Manitoba Health and Healthy Living, Deputy Chief Medical Officer of Health), Dr. Robert Penfold (at the time with Winnipeg Regional Health Authority), Tannis Erickson (Interlake Regional Health Authority) and Robert Shaffer (Manitoba Health and Healthy Living, Consultant, Accountability Support Branch).

Our external reviewers were Dr. John S. Millar (Executive Director, Population Health Surveillance for the Provincial Health Services Authority in British Columbia, Canada) and Dr. Nicholas Steel (Senior Lecturer in Primary Care, School of Medicine, Health Policy and Practice, University of East Anglia in the United Kingdom).

On delivery, the authors also had an internal meeting with Manitoba Health and Healthy Living internal stakeholders. The attendees' assistance with interpreting the indices we developed was helpful in formulating this final report.

Although authors, a special thank you is due to Dr. Carolyn De Coster and Louis Barré. Carolyn began this project as its PI. Her ability to plan and outline this report that builds on previous MCHP deliverables and her comments on the project's penultimate version of this report are greatly appreciated. Louis Barré (at the time of this project with Manitoba Health and Health Living as Director, Health Information Management) was engaged as a co-investigator on this project because of his enthusiasm and insight into the importance of investigating composite indices for reporting more succinctly on the status of the health care system. Louis has kept in contact with the project and also offered his comments on a penultimate version of this report.

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Executive Summary

Why This Report?

At the outset of this study, we were charged by Manitoba Health and Healthy Living (MHHL) with producing a dashboard of gauges or composite indices that would show, at a glance, how Manitoba's health was faring and how its healthcare system was performing. A composite index would combine separate measures of health or healthcare, such as the number of Papaniculaou (Pap) tests and mammograms being completed in a population, in order to provide a summary assessment of performance of a health system. Composite indices are meant to integrate a large amount of information in a format that is easily understood and, therefore, convey an assessment of how things are going in priority areas of health and healthcare delivery. Would it not be helpful then to have a set of such indices with which to summarily review Manitoba's health and healthcare system?

The intent of this work was to provide a detailed characterization of the development of several composite indices using data commonly available to MHHL: its own administrative data and data on health behaviours in Manitoba from the Canadian Community Health Survey, a nationally-gathered, self-report survey from Statistics Canada. In order to develop these indices, we completed the following objectives:

- Conduct a literature review to identify and assess:
  - Previous research on composite indices of health and health system use
  - Previous research on methods to develop and implement composite indices
- Determine the information needs required to develop composite indices for Manitoba
- Establish criteria to select and develop the most feasible and desirable set of composite indices
- Report on a select set of composite indices for MHHL

The Composite Indices

A composite index is a mathematical combination of several indicators or measures in order to form a single number. This single index can be used to describe an entire set of indicators, and allows for an examination of differences between places (e.g., Regional Health Authorities (RHAs) and Winnipeg Community Areas (CAs)) and across time (three-year periods).

This project has, through a literature review, expert consultation, and previous experience using indicators, constructed composite indices in four areas: illness prevention and screening, healthy living, surgical wait times, and overall health status. We were unable to develop indices for quality of primary care, quality of pharmaceutical use, and burden of chronic disease. The composite indices are reported for Manitoba regions (RHAs and Winnipeg CAs) over two time periods, where possible: April 1, 2000 to March 31, 2003 (Time 1) and April 1, 2003 to March 31, 2006 (Time 2).

Summary of Composite Indices Developed

Building and Interpreting Composite Indices:

- A statistically viable wellness composite index (*prevention and screening*) shows how rates of mammograms, Pap tests, flu shots for older adults, and immunizations for two-year-olds work together to give a picture of how a region prevents and screens for cancer and infection.

- Another viable wellness composite index *(healthy behaviours*) identifies how health-promoting behaviours like healthy eating and physical activity and risky behaviours like smoking and binge alcohol use affect premature death from preventable diseases: cardiovascular, respiratory, cancer and diabetes.

- A statistically viable composite index of *surgical wait times* for six elective procedures provides a picture of how long a region's residents wait for surgery relative to other regions.

- A viable composite index combining eight measures of *health status* was created.

- We attempted to build two *quality of care* composite indexes to identify how effectively we use proven care initiatives like prescribing a beta-blocking agent after a heart attack to monitor how efficiently and effectively physicians are delivering the best possible care for the best possible outcomes. Our a priori hypothesis about indicators of quality of care "working together" as an index was not accepted.

- Building a composite index for measuring the *prevalence of chronic disease* would help us to monitor how effectively we are preventing the transition from being well to having chronic disease. Although a mathematical combination was possible, the index lacked enough 'face validity' for useful interpretation.

Despite the apparent success in developing these composite indices, there are numerous concerns in using them:

- The indicators in the prevention and screening index do not all behave similarly over time—some increase and some decrease. Looking at only the composite index scores one would not know that important areas of illness prevention and screening may need work.

- Data for the composite index of health-promoting and health-risk behaviours rely on surveys conducted by Statistics Canada and particular questions in those surveys that may or may not continue in the future.

- For all of the indices, policy changes that affect only some of the indicators may make them less valid in the future.

- Many of the indicators used in the overall health status index would work just as well as the index itself and are more readily understood by end-users and the public. There is simply no need for a composite index in this area.

Policy Implications

For the reasons listed above, the effort required to construct, validate, and update composite indices does not seem to be worth the outcome. Even if a composite index were easy to construct and update, a policy-maker in an RHA or a Manitoba government official looking at the scores would still want to know "what to do when scores are going up and/or down over time." In order to do this, one needs to look behind the composites and examine each of the individual measures or rates that went into building the composite index, making the composite index redundant. While there may be specific instances in which a composite measure may be needed or desired, as a general rule, health systems appear to be difficult to measure in an overall way that can be used to direct specific policy.

Chapter 1: Introduction and Background

1.1 Introduction

The primary purpose of this study was to create composite indices (also referred to as 'indices') in seven areas of health and healthcare: (1) prevention and screening, (2) healthy behaviours, (3) surgical wait times, (4) quality of pharmaceutical care, (5) quality of primary care, (6) burden of chronic illness, and (7) measures of overall health. To accomplish this goal we defined four specific objectives:

1. Conduct a literature review to identify and assess:
   - Previous research on composite measures of health and healthcare use
   - Previous research on methods to develop and implement composite indices
2. Determine the information needs required to develop composite indices
3. Establish criteria to select and develop the most feasible and desirable set of composite indices
4. Report on a select set of composite indices for Manitoba's **Regional Health Authorities**[1] **(RHAs)** and **Winnipeg Community Areas (CAs)** for two time periods.

Although there are hundreds of indicators that measure specific aspects of health, use of health services, and health system performance, there is a lack of high quality composite indices in key strategic areas. For example, there are no single measures that tell us the state of the "burden of chronic diseases," "surgical waiting times," or "quality of care" within Manitoba, nor are there summary measures that report across different regions of the province.

Composite indices can be used to summarize these complex or multi-dimensional issues with a view to support decision-makers and a communication channel for the general public. When successful, the indices can provide a "big picture" of the issues and, therefore, can be easier to interpret than trying to find a trend in many separate indicators. They would also facilitate the task of comparing RHAs/CAs on complex issues as well as helping us to see progress over time. On the other hand, while indices may help us to state that "things are getting better or worse," they rarely give us an indication of the "right rates" for indicators underlying the index. At the population or system-wide level, composite indices can be useful for strategic planning and reporting. In addition, composite indices may also provide an opportunity for the identification of areas for interventions and action.

1.2 A Backgrounder on Composite Indices

1.2.1 What do composite indices tell us?

At some level, society and healthcare services provision are changing so fast that we need to know as soon as possible when things are going in the wrong direction. Consider how you answer the question, "How is the weather?" The answer is actually a composite of several related indicators of the weather, such as temperature, humidity, visibility (cloud cover), precipitation, and wind speed.

[1]Throughout this report, terms in bold typeface and acronyms are defined in the glossary located at the end of the report.

The answer is also relative to the environment in which it is asked; good weather in January would be bad weather in July. Composite indices that summarize the provision of healthcare services and/or the extent of some health behaviours might help us give a "weather report" of our implemented policies and further direct our efforts to improve the health and healthcare of Manitobans.

For the purposes of this deliverable and the following background information, a **composite index** is a mathematical combination of individual indicators or measures that represent different aspects of a single but larger concept (Saisana & Tarantola, 2002).

At the beginning of our work to develop Manitoba-based indices, we made a list of both health status and health services concepts that might be amenable to being constructed as composite indices. For example, we considered indices around burden of illness, cancer, patient safety, and health service use. This report is an overview of how we decided to develop the indicators we did; the decisions were based largely upon the development of a priori criteria. We also recognized that the development of composite indices for Manitoba might be a starting point for initiating discussion and attracting public interest about some dimensions of health or healthcare in the province. We predicted that the construction of composite indices would be fraught with methodological challenges and that the presentation and interpretation of the indices would have to be clear and transparent.

Before outlining in detail the processes we took to develop Manitoba-specific indices, the following describes where others stand on the development of composite indices as they pertain to health or healthcare.

1.2.2 Canadian Demand for Composite Indices

There has been increasing international interest in developing and reporting indicators of health system performance. For example, the 2005 federal budget allocated $110 million over five years (to 2010) to be used by the **Canadian Institute for Health Information (CIHI)** to report health performance information (Department of Finance Canada, 2005). In their 2004 ten-year plan for healthcare, the First Ministers of Canada agreed to report on health system performance. Health performance indicators have also been reported by the United Kingdom (Healthcare Commission, 2004; National Health Performance Committee, 2004), the United States (Zaslavsky, Shaul, Zaborski, Cioffi, & Cleary, 2002), and Australia (National Health Performance Committee, 2004). CIHI has issued three health indicator reports (2002; 2003; 2004). Manitoba, along with all other provinces and territories, issued its own indicator reports in 2002 and 2004 (Province of Manitoba, 2004).

In addition, there are numerous potential indicators for monitoring population health and health system performance. For example, the framework developed by CIHI and Statistics Canada comprises four domains, 19 dimensions, and 120 indicators (2004). The Federal-Provincial-Territorial Comparable Indicators report includes 70 indicators and 81 sub-indicators (Province of Manitoba, 2004). While all of the indicators are useful for specific purposes, the large number of indicators makes it difficult to get an overall picture of how specific geographic areas are performing,

or how their performance is evolving over time. Thus, there is a thirst for summary or composite indicators that would "roll up" data from several related indicators.

1.2.3 Constructing Composite Indices: World-wide Appeal for Difficult Measures

Composite indices have a general appeal—think of the popularity of the Consumer Price Index. There are, however, a number of challenges in developing and implementing indices. How does one bring together several measures in a way that is meaningful as an aggregate measure? What would be the impact of a composite index on the entities being measured or other affected parties? Would enough information be available and valid to focus efforts to improve index scores?

The construction of a composite index is not straightforward as foreshadowed by the following quotation:

> *"... (some) statisticians tend to resent composite indicators, whereby a large amount of work in data collection and editing is 'wasted' or 'hidden' behind a single number of dubious significance." However, "the temptation of stakeholders… to summarize complex and sometimes elusive processes… into a single figure to bench-mark performance for policy consumption seems likewise irresistible"* (Saisana, Tarantola, & Saltelli, 2005, p.308).

Table 1.1 summarizes some pros and cons of constructing and using composite indices (Nardo, Saisana, Saltelli, & Tarantola, 2005).

Composite indices have been most often developed in the areas of the economy (e.g., Composite of Leading Indicators since the 1980s from the OECD[2]), the environment (e.g., Environmental Sustainability Index (ESI) from the World Economic Forum[3]), society (e.g., Human Development Index (HDI) from the United Nations[4]), and innovation and technology (e.g., Summary Innovation Index from the European Commission[5]). In addition, using composite indices in these areas

[2] Organisation for Economic Co-operation and Development (OECD): Statistics Directorate. More information on the development of this composite index can be found at http://www.oecd.org/std/cli (Organisation for Economic Co-operation and Development, 2008).

[3] The Environmental Performance Measurement Project aims to shift environmental decision-making to firmer analytic foundations using environmental indicators and statistics. In collaboration with the Center for International Earth Science Information Network at Columbia University and the World Economic Forum, the project produces a periodically updated Environmental Sustainability Index (ESI). The ESI is a composite index tracking a diverse set of socioeconomic, environmental, and institutional indicators that characterize and influence environmental sustainability at the national scale. More information on the development and use of the ESI can be found at: http://www.yale.edu/esi/ (Yale Center for Environmental Law and Policy, 2008).

[4] The first Human Development Report was introduced in 1990 and offered a new way of measuring development by combining indicators of life expectancy, educational attainment, and income into a composite human development index, the HDI. The breakthrough for the HDI was the creation of a single statistic which was to serve as a frame of reference for both social and economic development. The HDI sets a minimum and a maximum for each dimension, called goalposts, and then shows where each country stands in relation to these goalposts, expressed as a value between 0 and 1. This is one of the longest standing indices and more information can be found at: http://hdr.undp.org/en/statistics/indices/hdi/ (United Nations Development Programme, 2008).

[5] The European Innovation Scoreboard (EIS) is the instrument developed at the initiative of the European Commission, under the Lisbon Strategy, to evaluate and compare the innovation performance of the EU Member States. The EIS 2006 includes innovation indicators and trend analyses for the EU25 Member States, plus the two new Member States: Bulgaria and Romania, as well as for Croatia, Turkey, Iceland, Norway, Switzerland, the US and Japan. The Annex includes tables with definitions as well as comprehensive data sheets for every country. The EIS report and its annexes, accompanying thematic papers and the indicators' database are available at http://www.proinno-europe.eu/inno-metrics.html (Pro Inno Europe & European Commission, 2008).

Table 1.1: Pros and Cons of Using Composite Indices

Pros	Cons
• Summarize complex or multi-dimensional issues which help to support decision makers	• May send misleading policy messages if they are poorly constructed or misinterpreted
• Are easier to interpret than trying to find a trend in many separate indicators	• May invite the drawing of simplistic policy conclusions if not used in combination with the indicators
• Facilitate the task of ranking regions on complex issues (e.g., benchmarking exercise)	• May lend themselves to inappropriate use if the various stages (e.g., selection of indicators, choice of model) are not transparent and based on sound statistical or conceptual principles
• Assess regions over time on complex issues	
• Reduce the size of a set of indicators	
• Place issues of region performance and progress at the centre of policy considerations	• Selection of indicators and weights could be the target of political challenge
• Facilitate communication with ordinary citizens and promote accountability	• May disguise serious failing in some dimensions of the phenonmenon and, thus, increase the difficulty in identifying the proper remedial action
	• May lead to wrong policies if the dimensions of performance that are difficult to measure are ignored

Source: Manitoba Centre for Health Policy, 2009

(economic, business, societal development, and healthcare) provides measures for benchmarking the mutual and relative progress of countries and regions of countries in a wide variety of policy domains.

Given this importance, as well as the proliferation and publishing of composite orderings throughout society, careful attention to their construction is especially important. Essentially, the construction of composite indices involves subjective judgment on the selection of indicators, the choice of aggregation model, and on the weights of the indicators in the construction of the composite measure.

Our literature review of composite indices and the methods used to construct them alerted us to the most common reason for developing indices—to produce a simplified or aggregated means to present individual health system performance measures. Specifically, countries and regions of countries are interested in ordering healthcare organizations (e.g., hospitals). For example, a composite developed by World Health Organization (WHO) was based on five key dimensions of healthcare performance—effectiveness, efficiency, access, responsiveness (respect for and satisfaction of patients), and equity.

To help us understand how indices are developed and their essential attributes, we examined existing composite indices from a variety of fields and developers, and intended for different purposes, with the following questions in mind (see Appendix 1 for indices reviewed):

- Were the components of the index clearly defined and valid?

- Did the index measure the outcome in a quantitative, objective, and multi-dimensional manner?
- Did the index compare the outcome across space (geography) and time? And, in an absolute or relative manner?
- Did the index measure the outcome in terms of input ('means') or output ('ends')?
- Was the index clear and simple in its content, purpose, method, and comparative application and focus?
- How relatively flexible is the index in allowing for changes in content, purpose, method, comparative application, and focus?

With this information, an assortment of methods and processes for developing composite indices could be considered when attempting to construct composite indices of health and the healthcare system in Manitoba.

1.2.4 Composite Indices in Healthcare

Using performance indicators to promote better accountability in health systems across the world has become almost universal (Murray, Lauer, Tandon, & Frenk, 2000). In addition to wanting to report better accountability to the populace, governments want to promote stronger governance, improve the community's understanding of the country's health system, and improve service quality. Also, given that indicators are the basis for building composite indices of any of the attributes of health and healthcare, we identified three existing composite indices for further consideration in our building of Manitoba indices. However, when developing any composite measure or index of health or healthcare, it is critical to know the data needs and gaps, the implications of the gaps in the data, the methods used, and the assumptions underlying the methods.

The first index is the Overall Health System Attainment Index (OHSAI), developed by the WHO for ordering countries' healthcare systems according to three characteristics: effectiveness, responsiveness to users, and progressiveness of their funding (World Health Organization, 2000). Orderings were greatly publicized in the media. However, the report has been criticized for having methods that were unsubstantiated by evidence but heavily influenced by ideology (Navarro, 2001; Deber, 2004). The second index we explored was developed by the National Health Service (NHS) of the United Kingdom to assess the performance of the nation's many health authorities. The third composite index is the HDI, utilized by the United Nations Development Program. Although not restricted to health outcomes, **life expectancy** is included, and other components are related to health status (e.g., education, gross domestic product (GDP)). Like the OHSAI, it is primarily meant to compare nations to one another.

Appendix 2 outlines the key attributes of these indices with respect to construction, variable treatment (e.g., scaling), aggregation method (e.g., additive or functional), presentation method, and interpretation. We also noted the contribution of each index to our understanding for constructing composite indices of health and healthcare for Manitoba.

We learned the following from our literature review of the development and use of health and healthcare indices:

1. What aspect of health or healthcare did the index measure? In Appendix 2 the answer to this is found under the headings "scope of index" and "description of variables." The HDI, for example, measures a "long and healthy life" using life expectancy at birth, knowledge (adult literacy rate and school enrolment), and decent standard of living (GDP per capita). The HDI's scope is clear in its intent. The scope of WHO's OHSAI is also clear (performance of a health system) but the rationale for the measures used—good health (disability-adjusted life expectancy), distribution of good health (child survival index), responsiveness (e.g., patients treated with respect) and equity (proportion of a household's income spent on health) – is less obvious. NHS' performance composite indicator was developed as a measure of how well the 120 health authorities in the UK were performing. The indicators used in its construction are less intuitive but are considered rough measures of performance in terms of process, output, and outcome.

2. How were the indicators selected? Once the scope or goal of the index was defined, the number and nature of the indicators making up the index need to be determined. Across the literature on composite indices, such selection appears to have been based largely upon theoretical frameworks, empirical analysis, pragmatism, opinion, intuitive appeal, or some combination thereof. Political and policy considerations also figure in the selection insofar as some indices were developed with a view to informing particular audiences regarding certain issues. For example, the NHS' composite aims to measure the performance of 120 health authorities in the UK using six measures that were chosen by researchers working for the King's Fund. The six were chosen because it was thought that they "best reflected various dimensions of NHS performance (i.e., process, output, and outcome or health status)" (Appleby & Mulligan, 2005). The HDI continues to undergo methodological adjustments but its core of indicators has remained unchanged since 1990. Indicators of the attainment of the goals of health systems (OHSAI) were based on the opinions of health systems experts and other individuals with an interest in health system performance. They were elicited via a web-based survey to WHO staff and to other interested individuals working outside of the WHO. In other words, indicators are the measured preferences of informed individuals—i.e., those with an interest and knowledge of the field.

3. Did indicators need to be scaled before they were aggregated? Booysen (2002) describes scaling of indicators (variables) for inclusion in a composite index as the "ordering of things in some meaningful way" (he compares it to the labelling of a thermometer). Scaling helps to point out the relation among certain objects, how far apart they are and in what direction they lie relative to each other. In Appendix 2, the scaling method (if used) for each index is described under the heading "preliminary variable treatment." Scaling can be addressed in one of four ways. The first option is to not scale variables, especially where variables are

already scaled in percentages. Using **standardized scores** (z and t values) is also popular. Normalized t values are ideal for indexing as they have a mean of zero and a standard deviation of one. Another option is to transform variables using an ordinal response scale. This entails some judgment as ordinal responses to items can be put on a scale by experts helping to construct the index. Finally, a linear scaling transformation method can be used to make the range of different indicators equal. The HDI scaled its variables from 0 to 1. Variables for the OHSAI were scaled between 0 and 100. Many of the variables making up the NHS' performance index were skewed and were therefore transformed using the square root; two variables were not skewed and, hence, not transformed.

4. Were the indicators weighted before being aggregated into a composite index? Implicit weights are often introduced during scaling. Explicit weights, however, can be introduced during aggregation. Weights are used to reflect the relative importance of each variable and/or components of an index. Again, the first option is to do "nothing"; that is, not to employ explicit weights. This has been called an attributes-based weighting scheme (Slottie, 1991). All of the indices summarized in Appendix 1 used a weighting scheme. The conventional practice has been one of selecting weights following consultation with experts. WHO's OHSAI used this method because their weights were based on a survey of preferences of informed individuals. The NHS' performance index used a version of a survey to assign weights: 1,000 persons were randomly selected from throughout the UK to determine how "deaths from cancer" (set at 1.0) differed from rates of heart disease, for example. The HDI weighted each component equally (life expectancy 1/3, education 1/3, and GDP 1/3) after scaling them (the implicit weights). Multivariate techniques have also been used, albeit not frequently, as a relatively more objective option for weight selection. For example, in **principal components analysis**, components are weighted with the proportion of variance in the original set of variables explained by the first principal component. The downside of this 'objectivity' is that the investigator then has no control over the selection and weighting of components, giving multivariate techniques the reputation of being rigid.

   Since different weighting systems imply that different results with the composite might be obtained and, given the subjectivity inherent in some weighting schemes (e.g., the researchers' perceptions of the attitude of policy-makers as to what indicator should have more weight), no weighting scheme appears to be above criticism. Therefore, it has been argued that equal weighting should be the norm and that the burden of proof should fall on those proposing to use differential weighting.

5. What aggregation method was used? Once variables and indicators have been selected, scaled and weighted, all that is left is to aggregate them into an index (see section entitled "aggregation method" in Appendix 2). The aggregation method can be in either an additive or functional form. All of the indices outlined in Appendix 2 use the additive format. This means that either an average of scaled indicators is undertaken (e.g., HDI) or a linear aggregation of components is reported (e.g., OHSAI and the NHS performance index) after a weighting scheme has been applied.

1.3 Focus and Organization of This Report

Our review of the literature helped us determine our approach to developing made-in-Manitoba composite indices. Fortunately, we were able to follow an open and consultative process to determine areas of interest and then to use indicators that were well-known and already available for selection to a composite index. Manitoba Health and Healthy Living (MHHL) had expressed an interest in several areas, including chronic disease, patient safety, quality of care, waiting lists, hospital performance, primary healthcare, overall health of Manitobans, health of children, health of older adults, and healthy lifestyles. Thus, we explored the feasibility of including measures of the following factors:

- Health status and outcomes such as living longer (e.g., life expectancy and **premature mortality rates**) or living healthier (e.g., **prevalence** of chronic diseases)
- Determinants of health (e.g., fruit and vegetable intake, physical activity, and risky patterns of alcohol consumption)
- Health system performance:
    - effectiveness (e.g., participation in breast cancer and **cervical cancer** screening)
    - appropriateness (e.g., quality indicators of primary care and pharmaceutical use)
    - accessibility and responsiveness (e.g., number of healthcare practitioners per 100,000 and wait times for common surgical procedures)
    - safety, continuity, and capability (e.g., adverse events or use of electronic health records)
    - sustainability (e.g., healthcare workforce retirements)
    - health inequalities (e.g., in premature mortality, **socioeconomic status**, s**ocial/material deprivation**)

After further consideration and despite their significance, measures of sustainability of the healthcare system and continuity of care could not be developed as part of this project. No definitions of either an index or potential indicators for these topics currently exist. Developing reliable and valid measures of these complex subjects was beyond the scope of this project, but is recommended for future research.

Methodologically, the richness of Manitoba data meant that most of our indicators did not require scaling as they were already reported as percentages or rates. Furthermore, since we did not have access to an a priori established weighting scheme for the composite indices that we constructed, an objective aggregation method was used (a statistical functional form called principal components analysis), rather than a weighted average or sum.

The methods used to conduct this research are outlined in Chapter 2. A discussion and our conclusions are presented in Chapter 9. Each of the remaining chapters (3-8) present the development process, findings, and conclusions for each composite index we developed (or attempted to develop):

- Chapter 3 addresses the composite index that reflects on the population's use of Manitoba's screening and prevention facilities for mammograms, **Papaniculaou (Pap)** tests, childhood immunizations, and influenza vaccinations for older adults.
- Chapter 4 addresses the index that summarizes Manitoban's participation in health-promoting behaviours and health-risk behaviours.
- Chapter 5 addresses the index that summarizes Manitoba's wait times for several common elective surgical procedures.
- Chapter 6 addresses the attempt to summarize the quality of both primary care and pharmaceutical use.
- Chapter 7 addresses the attempt to develop an index to describe the prevalence of chronic disease in Manitoba.
- Chapter 8 outlines the development of an index of health status.

In addition, there are five appendices:

- Appendix 1: Table of references for general composite indices reviewed
- Appendix 2: Summary of three key published health indices
- Appendix 3: The technical definitions and codes used to develop the indicators used in the study
- Appendix 4: The crude rate tables used as a basis for the "adjusted" rates presented in the chapters
- Appendix 5: A technical support document for building composite indices using data available to MHHL (e.g., administrative claims, **Canadian Community Health Survey (CCHS)** findings)

Chapter 2: Methods

2.1 An Overview of the Methods Used in this Report

The majority of composite indices developed in this report were based on an analysis of regional rates of health and health services use. These rates were calculated using data from the Population Health **Research Data Repository (Repository)**, and adjusted for differences in age and sex so that the rates of one region could be fairly compared to another region. These rates were then submitted for further analysis to determine if they could be sensibly combined into a single score, or a composite index, using a statistical method called **factor analysis**.[6] Further analyses determined whether the composite index remained stable over the two time periods examined in this study (see Appendix 5 for details).

2.2 Data Sources Used in this Research

This study used administrative data contained in the Repository housed at the Manitoba Centre for Health Policy (MCHP). Most of these data are derived from administrative claims data that are collected in order to administer the universal healthcare system within Manitoba. The Repository includes information of key interest to health planners, and includes person-level data such as birth and mortality, contacts with physicians and hospitals, pharmaceutical dispensing, use of home care services and nursing homes, and area-level data such as average household income by **dissemination area** from the Canadian Census. We also used data for Manitoba residents from the CCHS conducted by Statistics Canada.

The data in the Repository are anonymized by MHHL prior to data transfer and do not contain any identifying information such as patient or provider name or street address. A unique identifier is assigned to each record, allowing person-level data to be linked across data files within the Repository. Strict regulations are enforced at MCHP to ensure the Repository's data security, and the data are kept private and confidential.

In general, the study period and construction of the indices spanned the **fiscal years** of April 1, 2000 to March 31, 2006. Individual indices are reported for two time periods where possible (Time 1: April 1, 2000 to March 31, 2003 and Time 2: April 1, 2003 to March 31, 2006). Time 1 was considered to be the baseline period so that indices from different three-year time periods could be related to it. There are two exceptions to these study periods: the Healthy Living Index is based on a merging of the results of CCHS 2.1 (2003) and 3.1 (2005), and the Surgical Wait Times Index covers two three-year time periods where ICD[7] -9-CM codes were still being used (April 1, 1998 to March 31, 2001 and April 1, 2001 to March 31, 2004). After 2004, the use of ICD-10-CA/CCI as a new coding scheme came into effect.

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[6] Factor analysis is a statistical method used to describe variability among observed variables in terms of fewer unobserved variables called factors. The observed variables are modeled as linear combinations of the factors, plus "error" terms. The information gained about the interdependencies can be used later to reduce the set of variables in a dataset.

[7] **ICD – International Classification System**

Files from the following Repository databases were accessed for this report:

- **Hospital Abstract Database** (ICD-9-CM data until March 31, 2004 and ICD-10-CA/CCI data commencing April 1, 2004)
- Medical Services Database (**physician claims** (ICD-9-CM))
- Drug Database (**Drug Program Information Network**)
- **Manitoba Immunization Monitoring System**
- Personal Care Home and Home Care Databases
- Manitoba Health Insurance Registry Files (records of the time an individual is registered for health insurance benefits through the Manitoba Health Services Insurance Plan, as well as their date of birth, sex, and postal code)
- Vital Statistics (deaths and causes of death)
- 2001 Canadian Census Public Use Files
- Statistics Canada's CCHS (cycles 1.1, 2.1 (2003), and 3.1 (2005))

All data management, programming, and analyses were performed using SAS® Statistical Analysis Software, versions 8.2 & 9.1.

2.3 An Overview of the Indicators and Composite Indices

The focus of this report is to give multiple indicators of health and healthcare services a chance to speak with a single voice or index. By being able to look at a few indices, decision-makers will have a picture of what health and healthcare "look like" over time, from year to year, and by regions—RHAs and Winnipeg CAs. Composite indices facilitate the task of ordering health regions/areas on complex issues as well as helping us to see change over time. A composite index helps us state that "things are getting better or worse" but they rarely give us an indication of the "right rates" underlying the index.

In this report, indicators are the individual measures (presented as age- and/or sex-adjusted rates or median waits for the surgical wait times indicators); composite indices aggregate these indicators to yield a single number about the specific aspect of health or healthcare under study (e.g., prevention and screening, or healthy living). We used factor analysis to mathematically combine these indicators and calculate this single number, or 'index score'.

We used four principles to guide our selection of indicators and possible indices. These can be found in the next section and include such considerations as using only readily available data for topics thought to directly address health status or healthcare services, indicators that held together statistically over time and space (different geographical regions), and indicators that could be clearly defined and "made sense".

Appendix 3 (Table A3.1) provides a list of the indicators and their definitions that we used in the construction of seven indices. Only four of the indices actually "worked" (i.e., were statistically viable) as possible single number summaries of health behaviours, health status, or aspects of the health care system:

1. The Prevention and Screening Index comprises rates of childhood immunization, influenza vaccination for older adults, Pap tests, and **mammography**.
2. The Healthy Living Index has two dimensions, health-promoting and health-risk behaviours, and includes the following indicators: positive changes to health behaviours, positive food choices, physical activity, smoking, and binge alcohol use.
3. The Surgical Wait Times Index reflects the 'time to surgery' for six common elective surgical procedures: total **cholecystectomy**, **hernia repair**, excision of breast lesions, stripping/ligation of varicose veins, **carpal tunnel release**, and **tonsillectomy and adenoidectomy**.
4. The Health Status Index combines several measures of health in the population: premature mortality rate (PMR), **life expectancy**, **potential years of life lost (PYLL)**, self-rated health from the CCHS, **Socioeconomic Factor Index (SEFI)**, and social and material deprivation.

The three indices that were attempted, but could not be constructed, measured:

1. Quality of primary care using indicators of asthma care (use of a long-acting anti-inflammatory inhaler), potentially inappropriate prescribing of benzodiazepines, depression care (follow-up of a prescription for an antidepressant), diabetes care (eye examination), and **post-acute myocardial infarction (AMI)** care (with **beta-blockers**).
2. Quality of pharmaceutical care using indicators of potentially inappropriate prescribing of benzodiazepines for older adults, post-AMI care (with beta-blockers), application of the **Beers** appropriateness **criteria** of pharmaceutical care for older adults, and polypharmacy (use of multiple different medications) among older adults.
3. Prevalence of chronic illness as a measure of "burden" using indicators of the prevalence of **arthritis, asthma, diabetes, hypertension,** and **ischemic heart disease**.

2.3.1 Decisions Undertaken in the Development of Manitoba Composite Indices

Based on our literature review, and in order to conceptualize Manitoba-specific composite indices, we decided to constrain our construction process based on the following practical considerations:

1. We would use only readily available data. In other words, we would not develop new definitions of indicators nor would we use definitions that could not be reproduced by MHHL for examining the stability of three-year rolling indices. Data for indicators related to cancer, patient safety and acute illness could not be readily developed.
2. We would limit indices to topics normally thought of as directly addressing health status or health care services.

3. We would use definitions of indicators that had face validity and were well-defined.
4. We would construct an index only if its indicators held together statistically over time (longitudinal comparisons) and space (regional comparisons), and it made sense. We would include an explanation of composite indices that were attempted but were not possible to construct.

2.3.2 Adjusted Rates, Crude Rates and Statistical Testing of Rates

For the majority of indicators in this report, rates (or prevalence) were generated for Manitobans by their RHA and Winnipeg CA of residence for two time periods of three fiscal years: 2000/01-2002/03 and 2003/04-2005/06. Due to the rarity of events for some indicators such as premature mortality, rates were generated using five fiscal years in two overlapping time periods: 1998/99-2002/03 and 2001/02-2005/06. For the CCHS indicators, survey data from cycles 2.1 and 3.1 were combined to generate rates. For rates using more than one year of data, the values shown are annualized to report the rate for an average year. For prevalence indicators using more than one year of data, the values shown are a period prevalence over the number of years indicated.

Most of the graphs contain age- and sex-adjusted rates of indicators in order to allow for a fair comparison among regions with different age and sex distributions. Appendix 4 contains tables with the crude rates and counts of events reported by RHA and Winnipeg CA for each indicator. Rates were suppressed where the counts on which the rates were based represent five or fewer events or persons (except true zeroes, which are shown).

To estimate and compare most adjusted rates of events in this report, the count of events for each indicator was modelled using a **generalized linear model**. This type of model is used to model non-normal data, such as count data. Essentially, when data follows a non-linear distribution, a link function transforms the data so that the non-linear response can be analysed using linear regression techniques. Non-linear distributions chosen to model data in this report were the **Poisson distribution, negative binomial distribution**, or binomial distribution, depending on which distribution provided the best fit to the data.

Covariates included in the model varied depending on the indicator under study, but all models contained covariates describing geography (reference=Manitoba) and time (reference=first time period), as well as, the geography by time interaction. If appropriate, models also included covariates to control for age (linear and quadratic terms) and/or sex (reference=female).

To generate the adjusted rates, relative risks were estimated for each region and time period. To estimate relative risks of rates rather than events, the log of the population count in each stratum was included in the model as an offset. Relative risks were calculated from the parameter estimates of the model for each region, as well as for each time period within each region. Contrasts were used to compare the relative risks between time periods within a region and to compare the relative risks between a region and the province as a whole. The values obtained from the contrasts were a linear combination of the natural logarithm of the parameter estimates, so an exponential transformation

was necessary to obtain estimates of relative risk of events in their original scale. Finally, the adjusted rates were calculated by multiplying the Manitoba crude rate by the appropriate relative risk estimate.

Statistical testing was done to indicate whether an area's rate was statistically higher or lower than the provincial average in a given time period or if a rate had statistically significantly increased or deceased between two time periods within an area. Statistical comparisons were tested at a significance level of 0.01; to control for the multiple comparisons performed for each indicator, we used a stricter level of significance than the usual 5% **Type I error** rate to control the familywise error rate. Statistical significance indicates how much confidence to put in the difference between two rates. If a difference is statistically significant, then we are 99% confident that this difference is not just due to chance. Statistical significance between the two times periods was tested at a significance level of 0.05, as no correction was needed for multiple comparisons.

CCHS rates were age- and sex-adjusted using a direct standardization method as opposed to age- and sex-adjustment within a modelling framework. All CCHS rates were standardized to the population-weighted CCHS sample aged 12 and older from CCHS cycles 2.1 and 3.1 (Note: CCHS data excludes First Nations people living on reserves). Rates were calculated from the CCHS sample and then weighted to the entire Manitoba population aged 12 and older using the full sample weights provided by Statistics Canada. **Confidence intervals** were calculated for rates from the **standard errors** estimated using the 500 bootstrap weights. Comparisons between rates were performed by first calculating the difference between two rates using the full sample weights, then **bootstrapping** that difference using the 500 bootstrap weights to obtain an estimate of the error of the difference. Then, the 99% confidence interval of the difference was calculated using the bootstrapped standard error. If the confidence interval of the difference did not contain zero, then there was a significant difference between the rates for the indicator under study.

For the Surgical Wait Times Index, adjusted median wait times, rather than rates, were calculated and analysed. The focus for the indicators in that Index was on the length of time from the date of a patient's pre-surgery visit with the surgeon to the elective surgical procedure. Methods for calculating adjusted median wait times are described in Chapter 5.

2.3.3 Constructing the Composite Indices

As outlined in the introduction, a composite index is a mathematical combination of several indicators in order to form a single number. This index can be used to describe an entire set of indicators and allow for global differences between places and across time to be assessed.

The indices were developed using a procedure known as factor analysis. The basic premise of factor analysis is fairly straightforward; indicators (i.e., rates) that tend to vary together are grouped together. That is, when comparing the different rates that make up an index (e.g., Pap and **mammography** rates in the Prevention and Screening Index), one might find relationships (i.e., correlations) between the RHAs, which would suggest the two rates have something in common. The methods employed for creating a composite index look for this common variance among the indicators.

The theory behind factor analysis is that two (or more) indicators are correlated because of an underlying 'factor' causing the performance on the two indicators to be related. The factor cannot be measured directly, but is only seen in the indicators (i.e., rates) that can be measured. If the results of the analysis indicate that there is one underlying factor, then a single factor score could be used to describe the entire set of indicators. Because this factor influences all rates, a region's rate for one indicator can tell you something about their rates on the other related indicators.

The output of a factor analysis provides a mathematical combination of the indicators that is similar to a regression formula, where a certain portion of each indicator contributes to an overall factor score. The degree to which each indicator contributes to the composite index depends on the degree of commonality with the entire set of indicators. The contribution of an indicator to a factor is known as a factor loading, and can range from -1 to +1. The larger the absolute size, the greater the variance of the indicator explained by the factor.

Factor loadings indicate whether or not an index can be reasonably or validly constructed. The rule of thumb we used to decide if an indicator was associated with (or part of) the factor is a factor loading of at least ±0.40. In some instances, the indicators included in a factor analysis may form two or more distinct dimensions. In these cases, the factor loadings would indicate the factor, or composite index, to which an indicator belongs. For further technical details on the methods used to construct the composite indices, please see Appendix 5.

2.3.4 How Factor Analyses were Determined to be Satisfactory Across Regions and Over Time

A three-step process was employed to construct and test the adequacy of the composite indices developed through factor analysis. The initial step was to calculate the age- and sex-adjusted region rates for the indicators. The second step was to conduct an initial factor analysis of the indicators for the first time period. If a single factor composed of the majority of the indicators emerged or if multiple factors encompassing the majority of the indicators emerged, then a third step—a second confirmatory factor analysis—was conducted using the data from the second time point. For this analysis, the loadings for the indicators were constrained to be equal to the loadings from the first analysis. This constraint forces the calculation of the factor scores to be identical, and allows for comparisons over time. It also enables a test of whether the factor structure itself remains stable over time; if the results of the second factor analysis are different, this means that the structure does not hold together.

2.4 What's in this Report: The Types of Graphs, Tables and Analyses

Chapters 3 through 8 have a consistent set of text, graphs, and tables that provide a number of perspectives for the indicators that make up the index. When an index was successfully developed, a second set of graphs and tables for the index as a whole were included.

Data in the graphs and tables are ordered by increasing "premature" mortality rate (PMR). PMR is a standardized (age- and sex-adjusted) rate of 'premature' death, or death before the age of 75 years. PMR is highly correlated with morbidity and with self-rated health, as well as with socioeconomic

risk factors (Martens, Frohlich, Carriere, Derksen, & Brownell, 2002). This leads to the assumption that populations with a high PMR would most likely require more health care services than other populations. Some health researchers have suggested that this is the best single indicator of health status and need for health care (Carstairs & Morris, 1991; Eyles, Birch, Chambers, Hurley, & Hutchinson, 1991; Eyles & Birch, 1993).

In each chapter, you will find the following:

- Section 1 briefly outlines the intent of the index.
- Section 2 identifies the indicators used to construct the index.
- Section 3 explains the rationale for developing the index, supported by a brief review of the relevant literature.
- Section 4 presents the adjusted rates we combined into an index. Two bar graphs for each indicator are shown—one by RHA and the other by Winnipeg CA. Each bar graph includes the overall Winnipeg and Manitoba rates as well as aggregate groupings; the RHA graphs include the rates for the northern RHAs and the southern rural RHAs, and the Winnipeg CA bar graph includes the rates for Winnipeg's Most Healthy, Average Healthy, and Least Healthy aggregate areas. The statistical differences between each area's rate and the Manitoba average, and within each area between the two time periods are also indicated.
- Section 5 presents the factor loadings for each indicator.
- Section 6 is included when composite indices were successfully created. Index scores for each region are presented in a bar graph; scores higher than the Manitoba average (i.e., greater than zero) indicates regions above the Manitoba average. Conversely, scores lower than the Manitoba score (i.e., less than zero) indicate regions lower than the overall average in Manitoba.
- Section 7 highlights the key findings for the indicators and the index, and compares them to other findings.
- Section 8 at the end of each chapter summarizes our key findings from the rates and offers an interpretation of the index.

Chapter 3: Prevention and Screening Behaviours

Building and Interpreting the Composite Index

A statistically viable composite index of prevention and screening identified how rates of mammography, Pap tests, flu vaccines for older adults, and immunizations for two-year-olds work together to give a picture of how a region prevents and screens for cancer and infection.

3.1 Intent of the Index

Would a combination of the rates of prevention and screening activities for a variety of conditions provide a 'picture' of how a region's population undertakes these actions? By examining how cancer and selected infections can be prevented, identified early, or ameliorated by screening and individual behaviour, we are able to report on our supposition that prevention and screening actions within a population can be combined into a single measure showing the effectiveness of these public health programs.

3.2 Indicators Used to Construct the Index

The following indicators were used to construct the Prevention and Screening Index (see Table A3.1 of Appendix 3 for more detailed definitions):

- Influenza vaccinations for older adults aged 65 (at least one vaccine in a three-year period; annualized average rate over the three years)
- Childhood immunizations (complete immunizations for two-year-olds; annualized average rate over three years)
- Breast cancer screening (at least one mammogram for breast cancer in a two-year period)
- Cervical cancer screening (at least one Pap test in a three-year period for women who had not had a hysterectomy)

3.3 Rationale for the Index

A variety of conditions, including cancer and infection can be prevented, identified early, or ameliorated by screening the population. Although we have access to a number of rates of activities that would prevent or screen for disease, four were chosen to represent "open-access" screening available in Manitoba at the end of 2006. Open-access screening is defined as being user led—the screened population is considered to be self-selected despite being asked to participate through a province-wide reminder system. The following is the rationale for developing a prevention and screening index.

The two prevention activities included in this composite index, influenza vaccines and childhood immunizations, can mitigate against the ravages of infectious diseases. Influenza vaccines have convincingly been shown to be effective in preventing influenza infection in healthy adults (Demicheli, Rivetti, Deeks, & Jefferson, 2001). Current policy in Manitoba and at a national level emphasizes flu vaccination for older adults 65 years of age and older (for example, see MHHL's flu facts for seniors website at http://www.gov.mb.ca/health/flu/seniors.html and a pan-Canadian portal for policy recommendations about influenza at http://www.fightflu.ca/index-eng.html). The uptake

of this prevention activity was measured in this analysis through the availability of the **Manitoba Immunization Monitoring System**. It was established to register all influenza shots given to older adults since 2002; records are derived from physician billing claims and from manual entry of public health-provided immunizations.

Recently, public health policies that continue to target influenza vaccination efforts only at those at high risk for severe outcomes (e.g., hospitalization and death) have been questioned (Simonsen et al., 2005; Rizzo, Viboud, Montomoli, Simonsen, & Miller, 2006). It is thought that vaccinating only older adults might not provide as strong protection as previously thought. Thus, one option suggested is to indirectly protect them by increasing vaccination of transmitter (younger) populations (Glezen, 2006; Menec et al., 2001). A change in policy would affect the stability of this rate in the Index.

The benefits of childhood immunizations are well-documented (Public Health Agency of Canada, 2006). It is generally accepted that children who have not been immunized have a much greater chance of getting a vaccine-preventable disease. Manitoba follows the *Canadian Immunization Guide* and, therefore, complete immunizations for two-year-olds includes publically-funded vaccinations against: diphtheria, pertussis, tetanus, polio, Haemophilus influenze type b, measles, mumps, and rubella (Manitoba Health, 2007). The immunization schedule used in this study can be found in Appendix 3 (Table A3.2).

Two screening activities were included in this index: mammograms for breast cancer and Pap tests for cervical cancer. Clinical breast exams and breast self-examination as screening techniques were not included. Breast cancer is the most common form of cancer in women in Canada, affecting one in nine women during their lifetime (Canadian Cancer Society/National Cancer Institute of Canada, 2007). For screening to be cost-effective and presumably lead to reduced mortality, the uptake of mammography among the eligible population may be the single most important determinant to reduce breast cancer in the screened population (Day, Williams, & Khaw, 1989). The Canadian standard for screening is that a mammogram should be done every one to two years for women aged 50 to 69 years. In Manitoba, the overall rate in 2004/05-2005/06 was 61.4%.

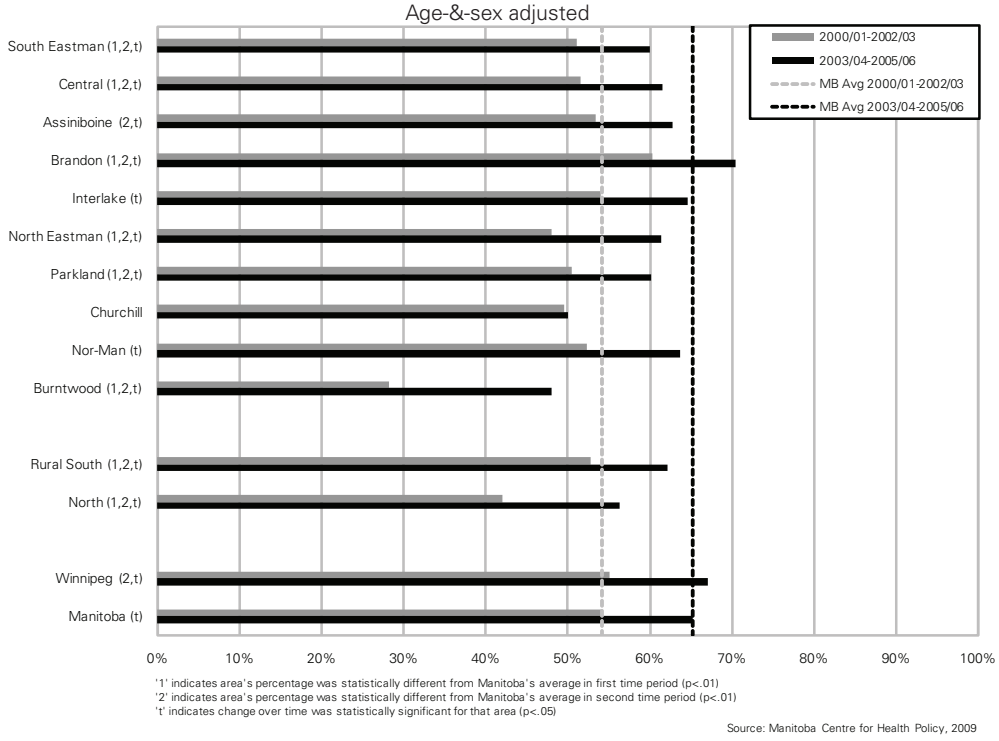
We included screening for cervical cancer done by a Pap test. We excluded women who had undergone a complete hysterectomy. Cervical cancer incidence and mortality rates have been declining for many decades, largely due to widespread regular use of Pap test screening (Liu, Semenciw, Probert, & Mao, 2001; Demers, Harrison, Musto, Decker, & Lotocki, 2004). In Manitoba, Pap tests are usually offered every two years to women aged 20-65 who have had three negative Pap tests in a row. Often, a Pap test is taken during the annual physical examination; this is allowed by MHHL.

CancerCare Manitoba oversees provincial screening programs for breast cancer, cervical cancer, and, recently, colorectal cancer. The feasibility and acceptability of an organized approach to colorectal cancer screening using the fecal occult blood test was begun province-wide in Manitoba in April 2007, a year after the end of our study period. At the time the analyses ended, CancerCare Manitoba was still indicating that there was insufficient evidence to undertake population-based screening of asymptomatic men for prostate cancer with prostate-specific antigen.

3.4 Adjusted Rates of the Indicators Used to Construct the Index

Figures 3.1 to 3.10 present the adjusted rates for each of the indicators, by RHA and Winnipeg CA, for both the time periods. The crude rates can be found in Tables A4.1-4 of Appendix 4.

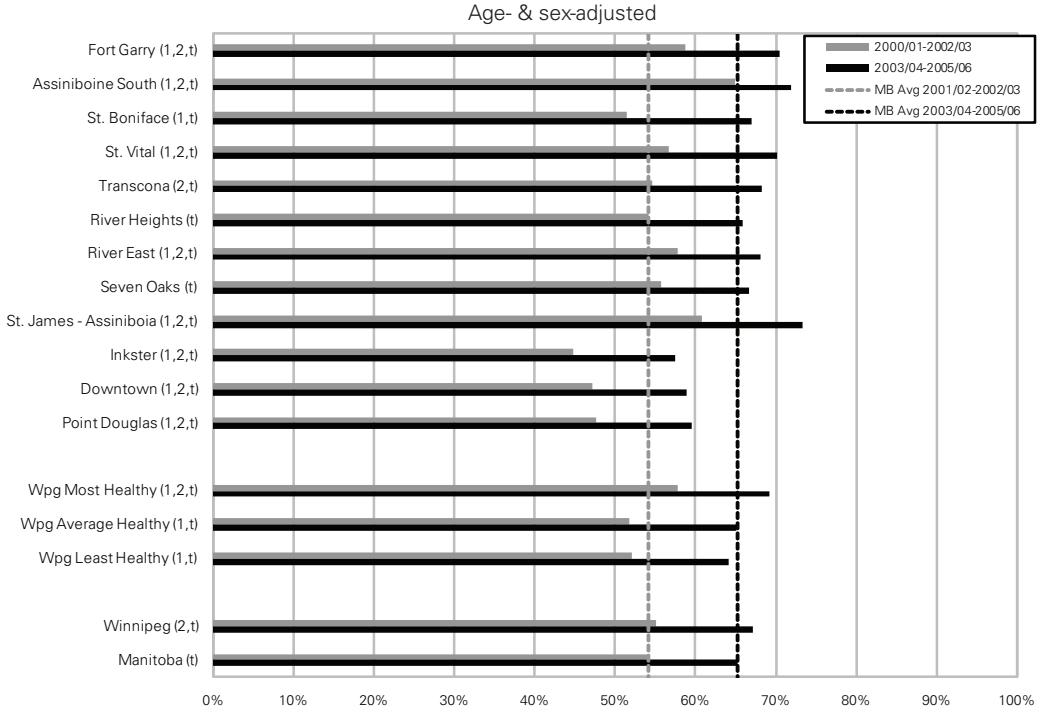
Figure 3.1: Percentage of Older Adults Aged 65+ Who Received an Influenza Vaccine, by RHA



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 3.2: Percentage of Older Adults Aged 65+ Who Received an Influenza Vaccine, by Winnipeg Community Area

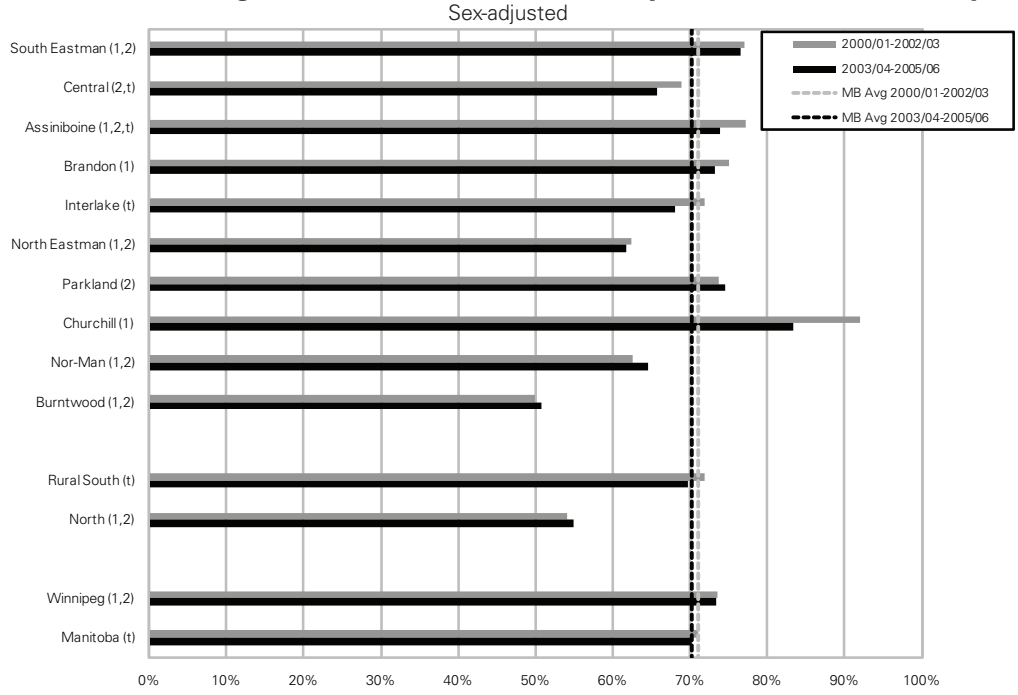


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 3.3: Percentage of Two-Year-Olds with Complete Immunizations, by RHA

Sex-adjusted

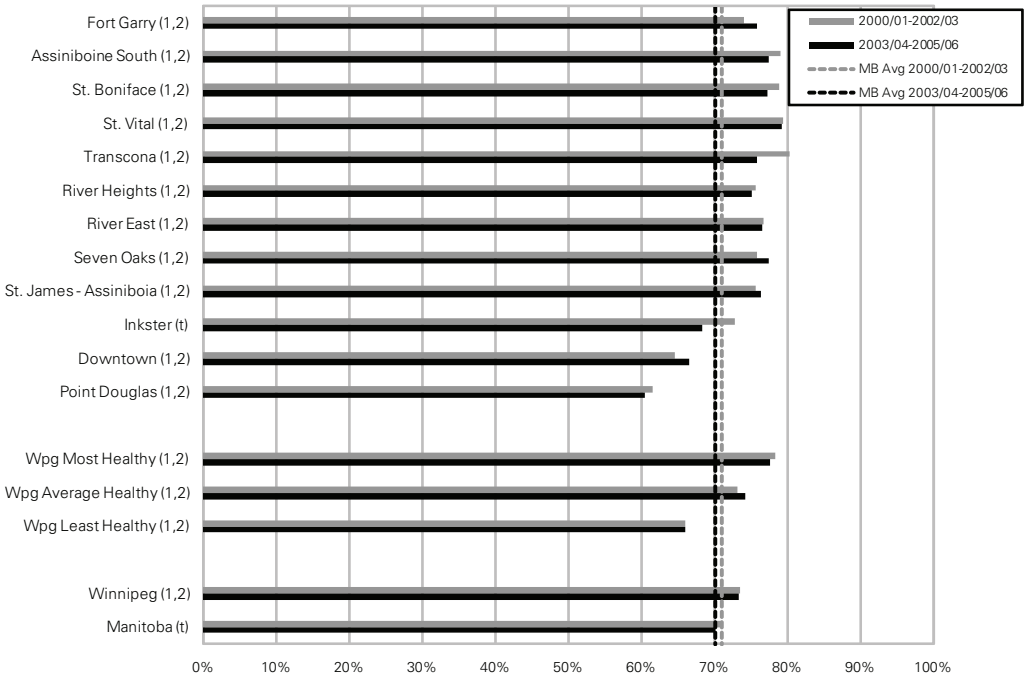


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 3.4: Percentage of Two-Year-Olds with Complete Immunizations, by Winnipeg Community Area

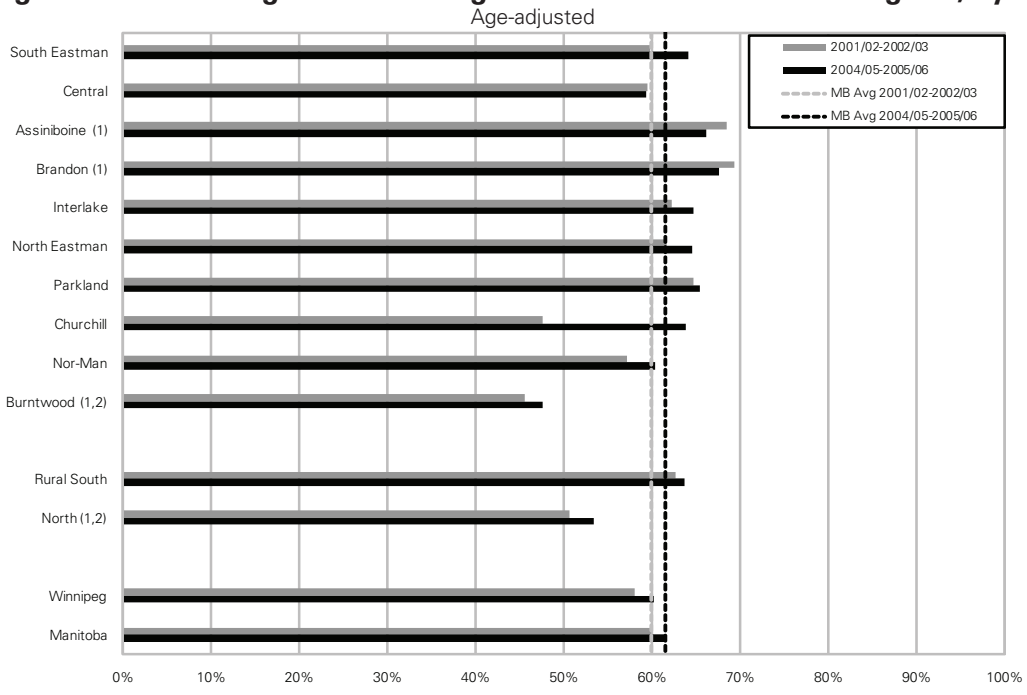
Sex-adjusted



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

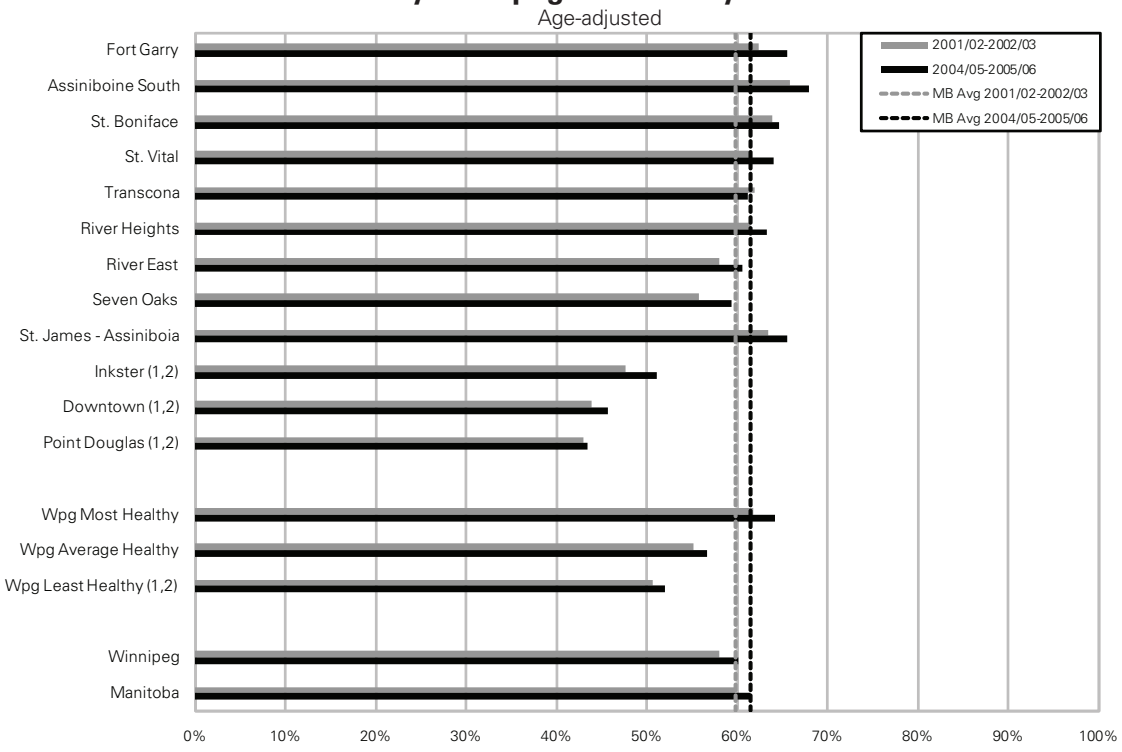
Figure 3.5: Percentage of Women Aged 50-69 Who had a Mammogram, by RHA



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)

Source: Manitoba Centre for Health Policy, 2009

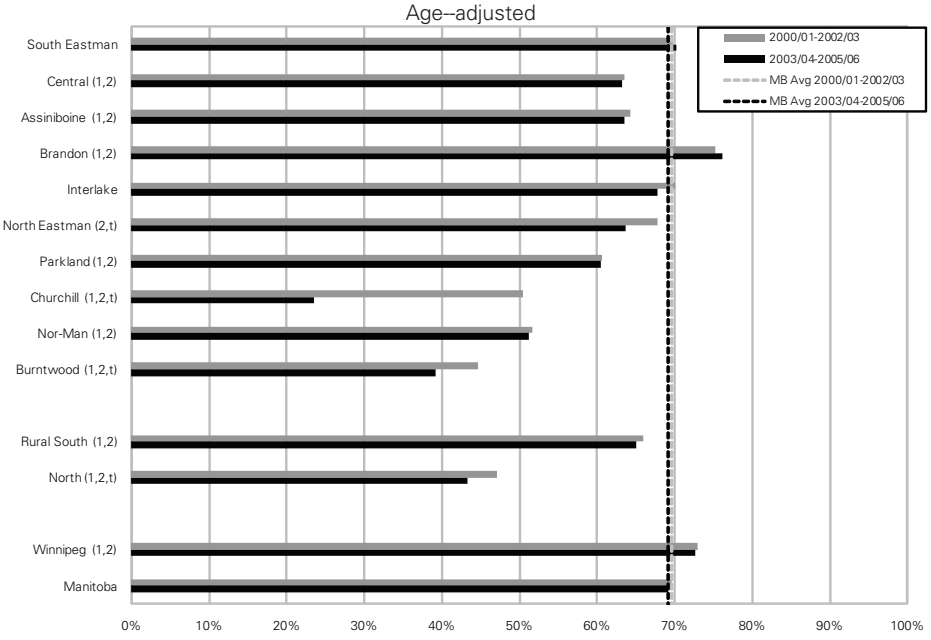
Figure 3.6: Percentage of Women Aged 50-69 Who had a Mammogram, by Winnipeg Community Area



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)

Source: Manitoba Centre for Health Policy, 2009

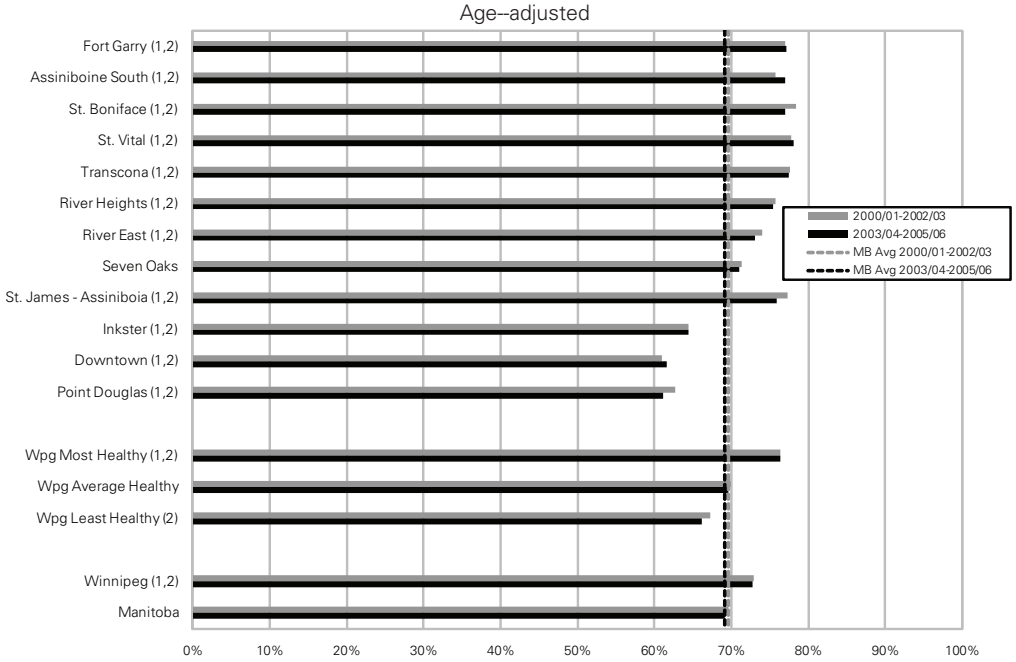
Figure 3.7: Percentage of Women Aged 18-69 Who had a Pap Test, by RHA



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 3.8: Percentage of Women Aged 18-69 Who had a Pap Test, by Winnipeg Community Area



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)

Source: Manitoba Centre for Health Policy, 2009

3.5 Combining the Rates into an Index

The adjusted rates for each of the indicators were combined using confirmatory factor analysis to obtain factor loadings.

Table 3.1: Factor Loading for the Prevention and Screening Composite Index

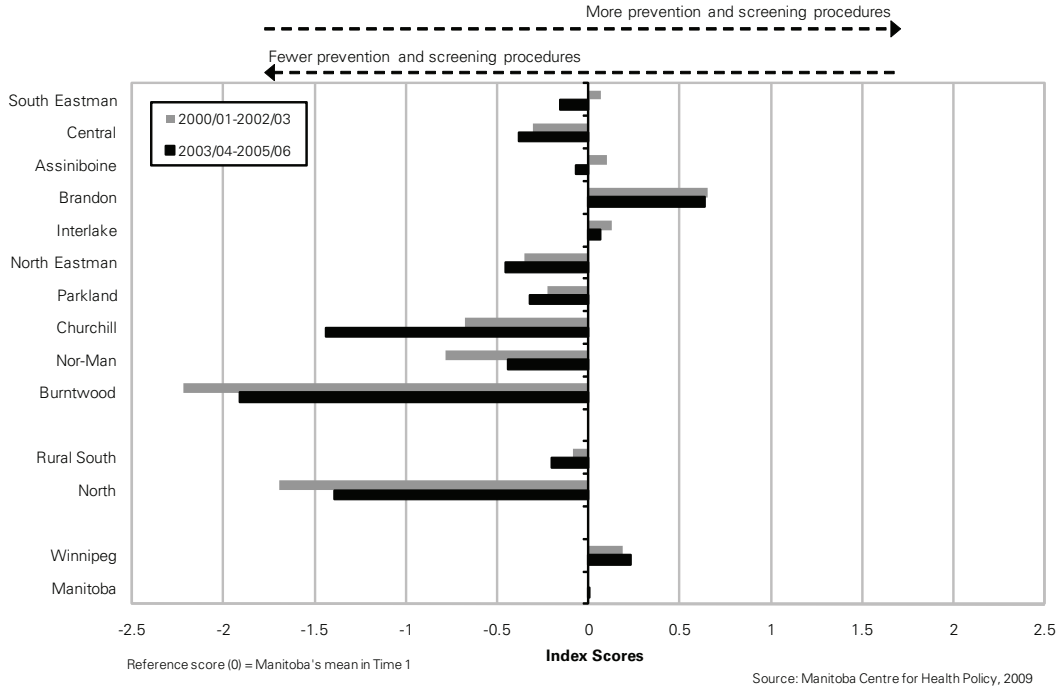
	Time 1: 2000/01 – 2002/03	Time 2: 2003/04 – 2005/06
Indicator	**Factor 1**	**Factor 1**
Flu Shots for Seniors	0.86	0.95
Pap Tests	0.89	0.83
Childhood Immunizations	0.75	0.74
Mammograms	0.78	0.79

Source: Manitoba Centre for Health Policy, 2009

Table 3.1 shows that over the two time periods (2000/01-2002/03 and 2003/04-2005/06), the four indicators work together to form a composite index reflecting the relative performance of RHAs in regards to key prevention and screening activities.

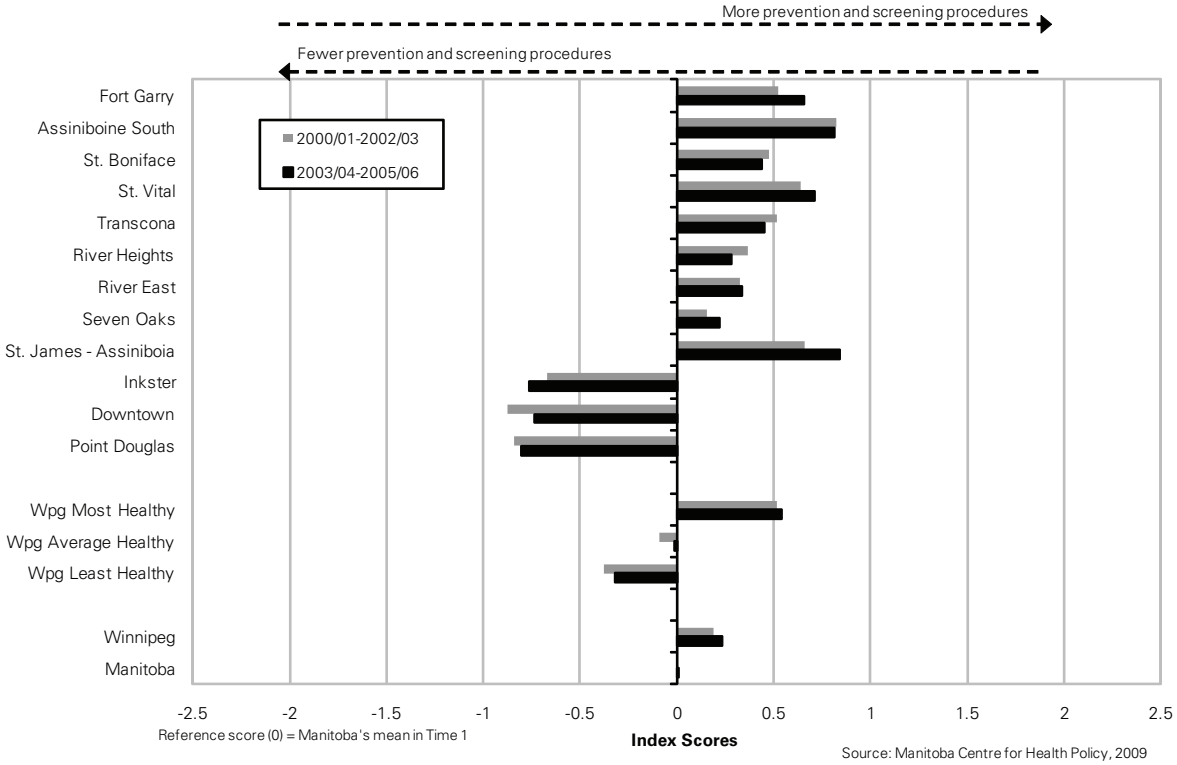
3.6 Prevention and Screening Index Scores

Figure 3.9: Prevention and Screening Composite Index Scores, by RHA



Source: Manitoba Centre for Health Policy, 2009

Figure 3.10: Prevention and Screening Composite Index Scores, by Winnipeg Community Area



Source: Manitoba Centre for Health Policy, 2009

In Figures 3.9 and 3.10, the Index scores are shown as two sets of bars (one for each time period, Baseline: April 1, 2000 to March 31, 2003, and Time 2: April 1, 2003 to March 31, 2006) by RHA and Winnipeg CA, respectively, and compared to the Manitoba average in the first time period.

Scores higher than the Manitoba average (i.e., greater than zero) indicate that more individuals in those areas participated in prevention and screening activities. Conversely, scores lower than the Manitoba average (i.e., less than zero) indicate that fewer individuals in that area were availing themselves of these activities.

3.7 What does this Composite Index Mean?

The fact that this composite index could be constructed indicates that across regions there was a lot in common amongst these four indicators. Where one indicator was relatively high, so were the others. The confirmatory factor analysis indicated that this was true for both time periods. Using the Index, one would conclude that for Manitoba as a whole, there was no change in prevention and screening behaviours over the two time periods (see Figure 3.9). However, two of the northern RHAs, Nor-Man and Burntwood, did show improvement. Many of the other RHAs showed a potential worsening. Within Winnipeg, several CAs, including the two least healthy CAs (Downtown and Point Douglas), improved over time. The Index provides the big picture of prevention and screening activities overall in Manitoba; however, to find the actual details and changes over time requires looking at the individual indicators as well.

3.7.1 What do the individual indicators mean?

The rates for the individual indicators are useful for helping to determine how and where to direct intervention efforts. For example, the childhood immunization rates decreased over time in some of the healthier RHAs and remained well below the provincial average in the least healthy RHAs, indicating the possible need for interventions in these areas. To support this finding, consider that the National Advisory Committee on Immunization has identified the following as factors most frequently associated with low immunization coverage levels: missed opportunities for administering vaccine, resource shortfalls in the healthcare delivery system, inadequate access to healthcare services, and lack of public awareness of the benefits of immunization (Public Health Agency of Canada, 2006). The other prevention indicator, influenza vaccination for older adults, showed the most improvement of all the indicators in this index; rates increased in nearly all RHAs and Winnipeg CAs over time possibly due to an increase in public awareness through the media and greater access to the vaccine through family physician offices.

For the breast screening indicator, age-adjusted rates of mammograms increased substantially across the province with the exception of the Burntwood RHA where rates remained stable between the two time periods (45.5% and 47.6%, respectively) but substantially below the provincial average of 59.8%. A similar profile was found in three Winnipeg CAs (Inkster, Downtown, and Point Douglas) where rates of mammography increased but still remained below the provincial average. The difference in the age-adjusted rates of mammography was maintained around 12% between Winnipeg Most Healthy (64.2%) and Winnipeg Least Healthy (52.1%) in both time periods. The improvement in mammography rates for the entire population of the city would indicate that there was considerable improvement that could be made, and that the program was highly effective in this region.

A different pattern was found for cervical cancer screening. For most RHAs, rates did not change significantly over the two time periods (69.6% in 2000/01-2002/03 and 69.1% in 2003/04-2005/06). Two exceptions are Churchill and Burntwood, where rates dropped substantially. However, caution must be exercised as these rates in northern and remote RHAs may be underestimated since nurse practitioners, nursing station staff, and some **salaried physicians** do not record in the physician billing claims data. In Winnipeg, most of the CAs remained significantly higher than the provincial average, but there was no change within the CAs over time. Seven Oaks remained close to the average, and the three least healthy CAs stayed lower than the overall Manitoba average.

3.7.2 Comparisons to Other Findings

Rates of flu vaccination increased significantly and are likely the driver of the increase in the Prevention and Screening Index scores. Most rates across Manitoba significantly improved between the two time periods and the vaccination coverage approached 70% overall. However, these remained below the Canadian targets which were raised in 2005 to 80% for adults aged 65 or older (Kwong, Rosella, & Johansen, 2007).

The Center for Disease Control's Mortality and Morbidity Weekly reported that the U.S. was also not meeting its targets as recently as the 2006/2007 influenza season (2007). They noted the need for comprehensive intervention strategies including: (1) promoting vaccine-seeking behaviour by consumers, (2) increasing demand for vaccinations among groups targeted for influenza vaccination, (3) increasing access to vaccination at non-traditional sites (e.g., pharmacies, churches and senior centres), (4) increasing the use of reminder-recall systems, (5) increasing targeted media promotions and educational programs, (6) expanding the use of standing orders, and (7) implementing more comprehensive provider-based or system-based interventions. As well, it has been suggested that vaccination registries be developed to facilitate monitoring trends in vaccine uptake; this would help to inform policy-making at the population level for vaccine programs (Public Health Agency of Canada, 1998).

The proportion of two-year-olds with complete immunizations remained remarkably stable over the two time periods at about 70% coverage. This level of coverage is similar to that reported by Martens et al. (2008) over time (1984-2004). Using a slightly different definition, Avis, Tan, Anderson, Tan, and Muhajarine (2007) found similar coverage in Saskatoon in 2002. In keeping with Avis et al. (2007) and Brownell et al. (2008), our data also showed a gradient from Winnipeg Most Healthy to Least Healthy. A recent Government of Canada report set 2010 target immunization coverage rates for two-year-olds at over 90% (Manitoba Health, 2007). The WHO has also stated that all countries should achieve a 90% national immunization coverage rate by 2010 (The Secretariat for the Intersectoral Healthy Living Network in partnership with the F/P/T Healthy Living Task Group and the F/P/T Advisory Committee on Population Health and Health Security (ACPHHS), 2005). As indicated by the Manitoba rates, we have a long way to go.

The Manitoba Breast Screening Program has been in existence since July 1998. At the time, it included rural and remote opportunities for mammograms via mobile screening units. Its success is reflected in the rates of rural utilization which started out at 12.6% in 1991, rose to 52.7% in 1999, and now can exceed 60%, the overall rate for Manitoba (Rizzo et al., 2006). Although we do not know the "right" rate for mammography screening, Manitoba rates appear to be somewhat lower than the Canadian rate (73% in 2004) (Schoen et al., 2004) and substantially less than that reported in the UK (75.9% in 2006) (The NHS Information Centre, 2007).

We found that rates improved in Winnipeg Average Healthy and Least Healthy over the two time periods. While not directly using overall health status to stratify results, previous analyses of Winnipeg rates up to and including 1999, found that Winnipeg's lower income areas, which are strongly related to poor health status, were not adequately accessing screening programs for breast cancer (Gupta, Roos, Walld, Traverse, & Dahl, 2004). While the rates are increasing in this analysis, it is minimal and not significant. Martens et al. (2008) reported increased screening for all RHAs, but over a longer time period, which suggests that our analysis may have insufficient statistical power. More efforts are also probably needed in the less healthy Winnipeg CAs (Downtown, Inkster, and Point Douglas) to ensure access to Manitoba's Breast Cancer Screening program, as their rates are far below the Manitoba average. Others have also found that lower income women with favourable prognoses (that is, a low probability of dying within five years) are at risk of not receiving mammograms when they are most likely to benefit (Williams, Lindquist, Sudore, Covinsky, & Walter, 2008).

Urban rates for Pap tests remained significantly higher than the Manitoba rate whereas rural rates have stayed below it. Rates in the late 1990s hovered between 45% and 53%, depending on rural or urban residence; since then, the overall proportion of women aged 18-69 in Manitoba having a Pap test every three years has grown to almost 70% (Gupta et al., 2004). This is consistent with rates of Pap testing in other countries (Schoen et al., 2004). Recently however, rural Pap testing appears to be failing to keep pace with the province's slight increase over time (Martens et al., 2008). We found that screening rates in three RHAs (North Eastman, Churchill, and Burntwood) actually decreased, but remained the same (and significantly lower than the provincial average) in the other RHAs and all Winnipeg CAs. Time will tell whether the recent introduction of a provincial Pap testing program for cervical cancer leads to reduced inequalities like it has in the province's breast cancer screening program.

3.8 Conclusion

A statistically viable composite index reflecting preventive and screening activity was constructed from **administrative data** of rates of influenza vaccines for older adults, complete immunizations for two-year-olds, mammography, and Pap tests. Although the Index demonstrates how these rates work together to give a picture of how a region prevents and screens for cancer and infection, in those RHAs where any change over time appears, it is driven primarily by a single indicator. In some cases, an apparent minor change over time (e.g., North Eastman) reflects competing increases in one indicator (influenza vaccines) and decreases in another indicator (Pap tests). So, while the geographic comparisons are stable over time, the increases or decreases over time are not consistent for all indicators. For this reason alone, relying on a composite index may not be appropriate for assessing the effectiveness of prevention and screening activities in the province.

Chapter 4: Healthy Living

Building and Interpreting the Composite Indices:

Attempts to build a composite index resulted in the creation of two statistically viable indices that identified patterns of health-promoting behaviours, including healthy eating and physical activity, and of the health-risk behaviours, smoking and binge alcohol use.

4.1 Intent of the Index

Would combining rates of healthy eating and physical activity (health-promoting behaviours) with rates of smoking and binge alcohol use (health-risk behaviours) provide a picture of how a region's residents are approaching the concept of healthy living? Examining a region's relative scores for these types of health behaviours could help us understand where promotion and prevention efforts are most effective and allow us to learn from them. Our objective was to produce indices that could be easily examined comparatively by health region, for both health-promoting and health-risk behaviours. Health-risk behaviours such as smoking and binge alcohol use have been proposed as reactions to stress and ways to alleviate frustration, whereas healthy eating and participation in physical activity are lifestyle choices that the more socially advantaged can make (Marmot & Wilkinson, 1999).

4.2 Indicators Used to Construct the Index

Population-based data of any health behaviour associated with healthy or unhealthy living practices are difficult to access. Behaviours such as healthy eating, physical activity, smoking, and binge alcohol use are not associated with any billable medical services, so information about preventable health activities is not routinely collected for the entire population. Instead, population-based surveys, such as the CCHS conducted by Statistics Canada, provide this type of information at a provincial and sub-provincial (e.g., health region) level. The primary objective of the CCHS is to provide timely cross-sectional estimates of health determinants, health status, and health system utilization. The target population includes household residents (aged 12 years and older) in all provinces and territories; excluded populations include those living on First Nations communities, on Canadian Forces Bases, in institutions such as personal care homes and prisons, and in some remote areas. Béland, Bailie, Catlin, and Singh (2000) provide details about the sampling and data collection methods for the CCHS.

Data from Manitobans in cycles 2.1 (2003, n=7,632) and 3.1 (2005, n=7,352) were used to compile a composite index around the concept of "healthy living". The CCHS data from cycles 2.1 (2003) and 3.1(2005) were used to describe the following sets of behaviours:

Health-promoting behaviours:

- Changes made to improve health (percent of respondents who indicated that they had done things to improve their health in the previous month).
- Positive food choices (a variable derived from a series of questions about whether respondents make healthy choices about food due to certain health concerns)

- Physical activity (a variable derived from a series of questions about leisure-time physical activities, expressed as hours per week)

Health-risk behaviours:

- Current smoking (derived from a series of questions about respondents' smoking habits; includes daily smoker, occasional (former daily) smoker, always an occasional smoker, former daily smoker, and former occasional smoker)
- Binge alcohol use (percent of respondents who indicated they drank five or more drinks on one occasion at least once in the previous 12 months)

4.3 Rationale for the Index

We know that health-promoting behaviours combined with health-risk behaviours may affect premature death through cardiovascular and respiratory disease, diabetes, and, possibly, some cancers. It would be interesting to reflect on the extent to which changes in these four behaviours would affect a region's incidence of premature death and prevalence of morbidity. A composite index would help us to observe these behaviours collectively, over time in the regions across Manitoba and within Winnipeg.

In September 2002, the Federal/Provincial/Territorial (F/P/T) Ministers of Health agreed to work together on an Integrated Pan-Canadian Healthy Living Strategy (The Secretariat for the Intersectoral Healthy Living Network in partnership with the F/P/T Healthy Living Task Group and the F/P/T Advisory Committee on Population Health and Health Security, 2005). The goals of the Strategy were to improve overall health outcomes and to reduce health disparities by addressing the common preventable risk factors—namely physical inactivity and unhealthy eating. The Strategy aimed to target all Canadians with a special focus on children and youth, Aboriginal peoples, and other vulnerable groups.

4.3.1 Health-Promoting Behaviours

Changes made to improve health

Health Canada encourages Canadians to take a more active role in their health by making positive choices that enhance their physical, mental, and spiritual health. Some healthy choices suggested by Health Canada include eating nutritionally and following Canada's Food Guide, integrating physical activity into everyday life, and choosing not to smoke and reducing stress. For example, "It's Your Health (IYH)" is a series of articles, or fact sheets, that cover a wide range of health issues (Health Canada, 2009).

In the CCHS, all respondents were asked the question, "*In the past 12 months, did you do anything to improve your health? (For example, lost weight, quit smoking, increased exercise).*" In this report, the crude and adjusted weighted proportions of respondents who made changes to improve their health, were calculated by taking the ratios of the number of respondents who answered 'yes' to the question

to the number of all respondents. Respondents who answered 'don't know', 'not stated', or refused to answer the question were assumed to have not made any changes to improve their health.

Choosing or avoiding foods because of health concerns

Healthy eating is fundamental to good health and is a key element in healthy human development from the prenatal and early childhood years to later life stages. It is equally important in reducing the risk of many chronic diseases (Health Canada, 2007c). Choosing healthy foods more often or avoiding unhealthy foods enables individuals to maintain a healthy diet and meet the daily nutritional requirements recommended by Canada's Food Guide. Canada's Food Guide states that the benefits to eating well include better overall health, looking and feeling better, lower risk of disease, more energy, a healthy body weight, and stronger muscles and bones (Health Canada, 2007b).

Over the past decade, rapid expansion in a number of relevant scientific fields and, in particular, in the amount of population-based epidemiological evidence has helped to clarify the role of diet in preventing and controlling morbidity and premature mortality resulting from non-communicable diseases including cardiovascular and respiratory diseases, diabetes, and some cancers (World Health Organization, 2003).

Changes in the world food economy are reflected in shifting dietary patterns; for example, increased consumption of energy-dense diets that are high in fat, particularly saturated fat, and low in unrefined carbohydrates (De Haen, Stamoulis, Shetty, & Pingali, 2003). These patterns are combined with a decline in energy expenditure that is associated with relatively sedentary lifestyles, for example, the use of motorized transport, labour-saving devices in the home, the phasing out of physically demanding manual tasks in the workplace, and leisure time that is preponderantly devoted to physically undemanding pastimes (Willett et al., 2006). Because of these changes in dietary and lifestyle patterns, chronic non-communicable diseases are becoming increasingly associated with disability and premature death and are placing additional burdens on already strained health budgets. The National Institutes of Health's National Heart, Lung and Blood Institute outlines these risks clearly in a web-based series of evidence-based health information for the public and health professionals. Topics such as asthma, obesity, hypertension, and cholesterol are addressed and include information for different segments of the US population (U.S. Department of Health & Human Services, 2009). Canada's equivalent resource for consumers and health professionals can be found on the Public Health Agency of Canada's website here: http://www.phac-aspc.gc.ca/cd-mc/index-eng.php.

Healthy eating, however, is coming to the fore as a modifiable determinant of chronic disease, with scientific evidence increasingly supporting the view that alterations in diet have strong effects, both positive and negative, on health throughout life (Adams et al., 2006; Giugliano, Ceriello, & Esposito, 2008). Most importantly, dietary adjustments may not only influence present health, but may be a factor on whether or not an individual develops such conditions as cancer, cardiovascular disease, and diabetes much later in life (Calle, Rodriguez, Walker-Thurmond, & Thun, 2003; Orchard et al., 2005; Hu & Willett, 2002; Prentice et al., 2007).

In the CCHS, 'positive food choices' is a derived variable that indicates whether respondents chose or avoided certain types of foods because of one or more of the following health concerns: body weight, heart disease, cancer, and osteoporosis. Respondents were asked a series of questions about their eating habits, such as, "*Do you choose certain foods or avoid others because you are concerned about your body weight?*" Possible responses include 'yes', 'no', or 'not stated'. This variable was calculated for all respondents.

In this report, the crude and adjusted weighted proportions of respondents who made healthy choices about foods due to certain health concerns were calculated as ratios of the number of respondents who answered 'yes' to at least one of the required questions used to calculate the derived variable to the number of all respondents. Respondents who did not answer 'yes' to at least one required question used to calculate the derived were assumed not to choose or avoid certain foods due to health concerns.

Physical activity frequency

Physical activity also improves health and well-being. It reduces stress, strengthens the heart and lungs, increases energy levels, helps you maintain and achieve a healthy body weight, and improves one's outlook on life. Additionally, there is a need to discuss sufficient physical activity alongside the complex of diet, nutrition, and health. Research shows that physical inactivity can also contribute to premature death, chronic disease, and disability (Bianchini, Kaaks, & Vainio, 2002; Swinburn, Caterson, Seidell, & James, 2004).

Energy expenditure through physical activity is an important part of the energy balance equation that determines body weight. A decrease in energy expenditure through decreased physical activity is likely to be one of the major factors contributing to the global epidemic of obesity (World Health Organization, 2000). Physical activity has great influence on the body's composition of fat, muscle, and bone tissue. To a large extent, physical activity and nutrients share the same metabolic pathways; therefore, they can interact in various ways to influence the risk and pathogenesis of several chronic diseases (Vainio & Bianchini, 2002).

Cardiovascular fitness and physical activity have been shown to reduce significantly the effects of overweight and obesity on health. Physical activity and food intake are interacting behaviours that are influenced partly by the same measures and policies. Lack of physical activity is already a global health hazard and is a prevalent and rapidly increasing problem, particularly among poor persons in large cities. In order to achieve the best results in preventing chronic diseases, the strategies and policies that are applied must fully recognize the essential role of diet, nutrition, and physical activity (Vainio & Bianchini, 2002).

Canada's *Physical Activity Guide to Healthy Active Living* recommends that Canadians accumulate 30 to 60 minutes of moderate physical activity every day to achieve the health benefits from physical activity (Public Health Agency of Canada, 2003). The Guide also states that the benefits of regular physical activity include protection against disease and premature death, enhanced well-being,

optimal childhood growth and development, and continued independent living in later life. In the CCHS, the average monthly frequency of physical activity lasting longer than 15 minutes is a variable derived from a series of questions on time spent on physically active leisure activities (e.g., walking, running, gardening, soccer) by the respondent in the previous three months, such as, *"In the past three months, how many times did you walk for exercise?" "About how much time did you spend on each occasion?"* Responses are reported as the one-month average based on data provided for the three-month period. This variable was calculated for all respondents.

In this report, the crude and adjusted weighted rates of leisure time physical activity were converted from units of 15 minutes per month to hours per week. Respondents who did not answer at least one required question used to calculate the derived variable (i.e., 'don't know', 'refusal', 'not stated') were imputed the median value.

4.3.2 Health-Risk Behaviours

Current Smoking

Smoking tobacco is related to more than two dozen diseases and conditions (Health Canada, 2007d). It has negative effects on nearly every organ of the body and reduces overall health. Smoking tobacco also remains the leading cause of preventable death and has negative health impacts on people of all ages, from unborn babies to older adults (Doll, Peto, Boreham, & Sutherland, 2004; Ezzati & Lopez, 2003; Peto & Lopez, 2001). More than 37,000 people die each year in Canada due to smoking. Of those, more than 300 non-smokers will die of lung cancer and at least 700 non-smokers will die of coronary heart disease caused by exposure to second-hand smoke (Health Canada, 2007d).

A comprehensive, intersectoral approach to tobacco control, including a variety of interventions, such as educating the public about the adverse health effects of tobacco use, advertising restrictions, and increasing taxation, have contributed to significant decreases in its use over the past several decades (U.S. Department of Health and Human Services, 2000; U.S. Department of Health and Human Services, 1994; Farrelly, Pechacek, & Chaloupka, 2003; Pechmann, Dixon, & Layne, 1998).

In the CCHS, 'type of smoker' is a derived variable based on responses to questions such as, "*At the present time, do you smoke cigarettes daily, occasionally or not at all?*" Possible categories include 'daily smoker', 'occasional (former daily) smoker', 'always an occasional smoker', 'former daily smoker', 'former occasional smoker', 'never smoked', or 'not stated'. This variable was calculated for all respondents.

In this report, the crude and adjusted weighted proportions of respondents who were identified as current smokers was calculated by taking the ratios of the number current smokers to the number of all respondents. Respondents who did not answer questions referring to being current smokers (i.e., don't know, refusal, not stated) were assumed to not be current smokers.

Binge Alcohol Use

Although the majority of Canadians who drink alcohol do so in moderation and without causing harm, alcohol misuse affects too many Canadians (Health Canada, 2007a). It is estimated that four to five million Canadians engage in high risk or binge alcohol use, which is linked to motor vehicle accidents, fetal alcohol spectrum disorder and other health issues, family problems, crime, and violence (Health Canada, 2007a).

Alcohol is different from the other addictive substances like nicotine, as some research has identified potential beneficial effects on disease for certain volume-pattern combinations, most notably coronary heart disease (Rehm et al., 2003; Rehm, Sempos, & Trevisan, 2003). Because of this complexity, it is important to look at a couple of measures that align with the adverse effects of alcohol: average volume of alcohol consumption and patterns of drinking (the latter is a score composed of such components as frequency of binge drinking occasions, drinking other than with meals, and drinking in public places). Both of these can be assessed by questions in the CCHS.

The combination of alcohol and the other risk factors, such as tobacco use, may have an additive or even a multiplier effect in persons; the sum of which could accelerate the pace at which chronic diseases are emerging (Lopez, 1999). A composite index on healthy living may help us to reflect on the strategies and policies we implement to encourage healthy eating and physical activity and discourage tobacco use and unhealthy patterns of alcohol consumption.

CCHS respondents who answered 'yes' or 'don't know', or refused to answer the question, *"During the past 12 months, have you had a drink of beer, wine, liquor or any other alcoholic beverage?"* were then asked the question, *"How often in the past 12 months have you had five or more drinks on one occasion?"* In the CCHS, one drink was defined as: one bottle or can of beer or a glass of draft, one glass of wine or a wine cooler, or one drink or cocktail with 1½ ounces of liquor. Possible responses include 'never', 'less than once a month', 'once a month', '2 to 3 times a month', 'once a week', 'more than once a week', 'don't know', 'not stated' or 'refusal'.

In this report, the crude and adjusted weighted proportions of respondents who were identified as engaging in binge alcohol use were calculated as ratios of the number of respondents who drank five or more drinks on one occasion at least once in the previous 12 months, to the number of all respondents. Respondents for whom this question was not applicable (i.e., those who had previously indicated that they did not drink at all) as well as those who answered 'don't know', 'not stated' or refused to answer the question were categorized as not engaging in binge alcohol use.

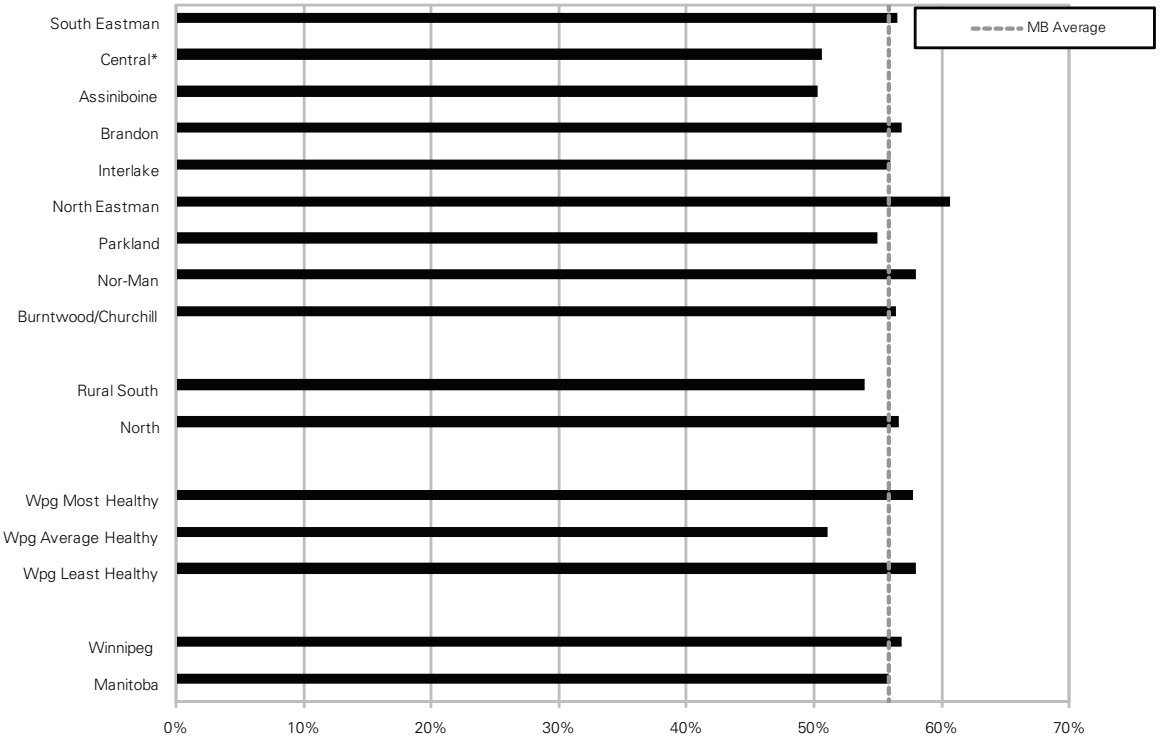
The CCHS included questions about other health-promoting and health-risk behaviours (e.g., illicit drug use) that would have added richness to the Healthy Living Composite Index. However, we were unable to include them because Manitoba chose not to ask them in the two cycles used.

4.4 Adjusted Rates of the Indicators Used to Construct the Index

The adjusted rates for each of the indicators are shown by RHA and Winnipeg aggregated CAs for the two three-year time periods (see Figures 4.1- 4.5). Data for the individual Winnipeg CAs could not be provided due to inadequate sampling size at that level. The crude rates can be found in Tables A4.5-A4.9 of Appendix 4.

Figure 4.1: Percentage of Respondents Who Reported Making Behavioural Changes to Improve Their Health, by Region[1]

Age- & sex-adjusted percentage of weighted sample

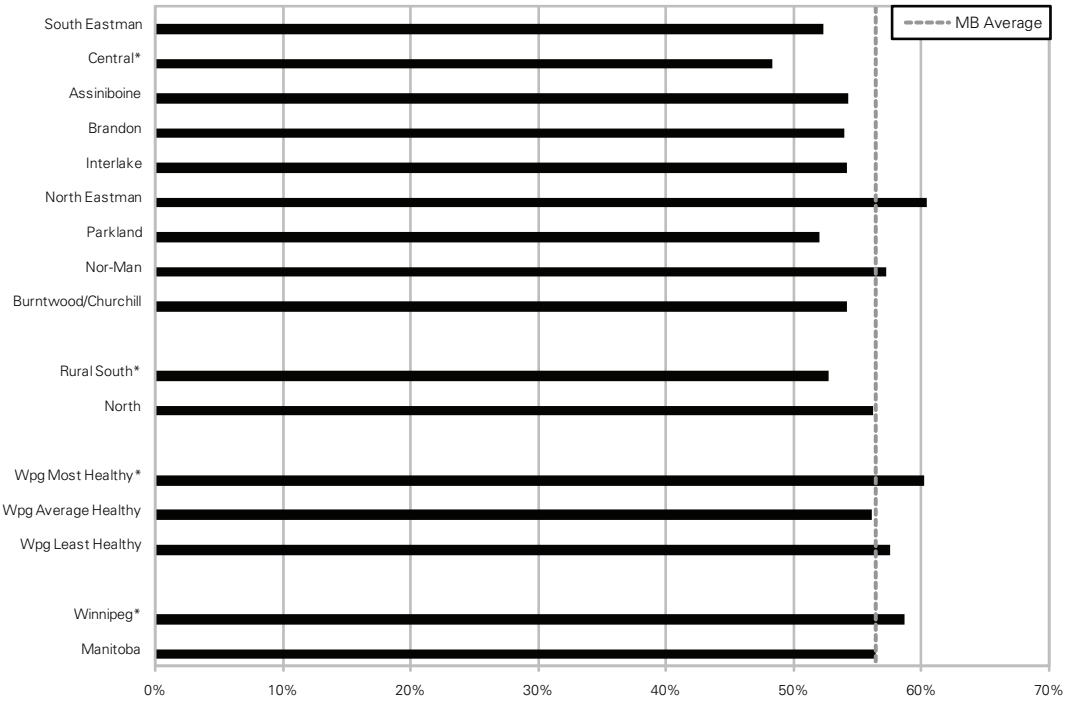


* indicates percentage was statistically different from the Manitoba average
[1] CCHS 2.1 (2003) and 3.1 (2005) combined

Source: Manitoba Centre for Health Policy, 2009

Figure 4.2: Percentage of Respondents Who Reported Making Healthy Food Choices, by Region[1]

Age- & sex-adjusted percentage of weighted sample

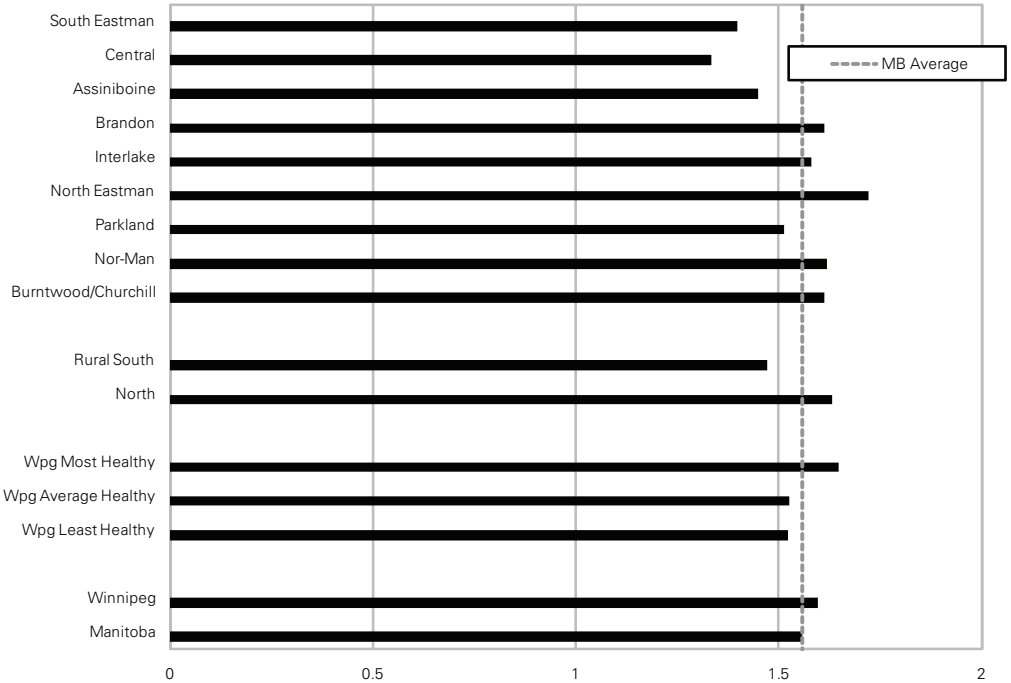


* indicates percentage was statistically different from the Manitoba average
[1] CCHS 2.1 (2003) and 3.1 (2005) combined

Source: Manitoba Centre for Health Policy, 2009

Figure 4.3: Average Number of Hours per Week, per Resident, Spent in Leisure Time Physical Activity, by Region[1]

Age- & sex-adjusted percentage of weighted sample

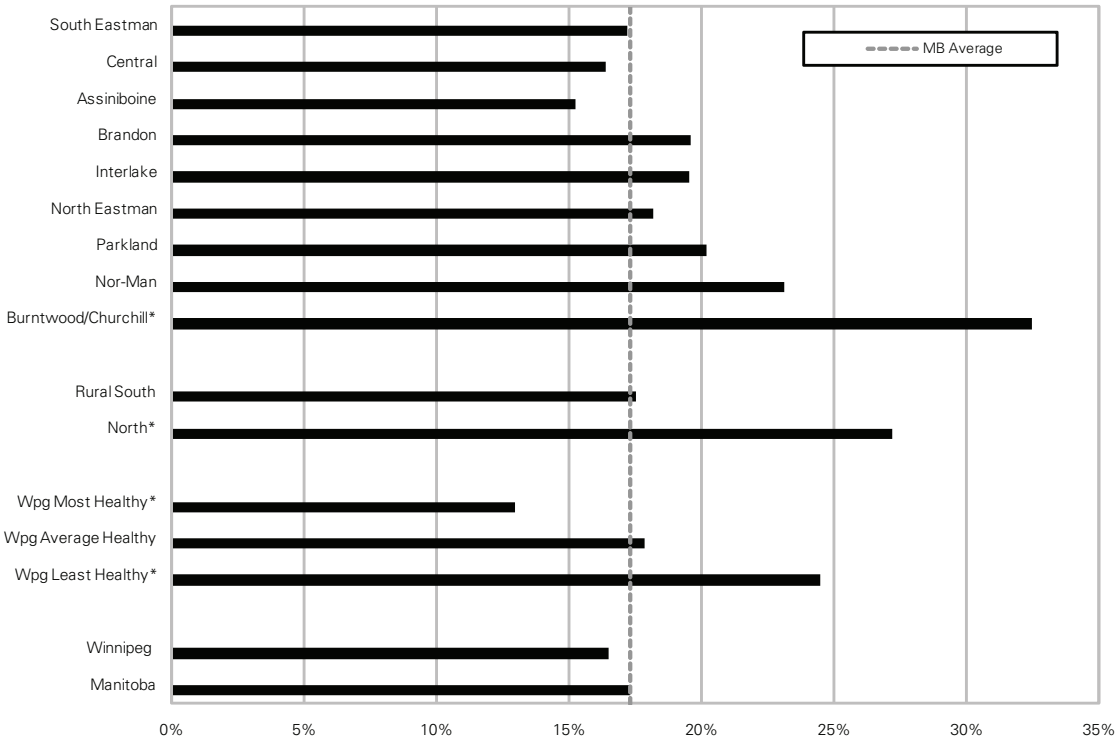


[1] CCHS 2.1 (2003) and 3.1 (2005) combined

Source: Manitoba Centre for Health Policy, 2009

Figure 4.4: Percentage of Respondents Who Reported Being a Current Smoker[1], by Region[2]

Age- & sex-adjusted percentage of weighted sample

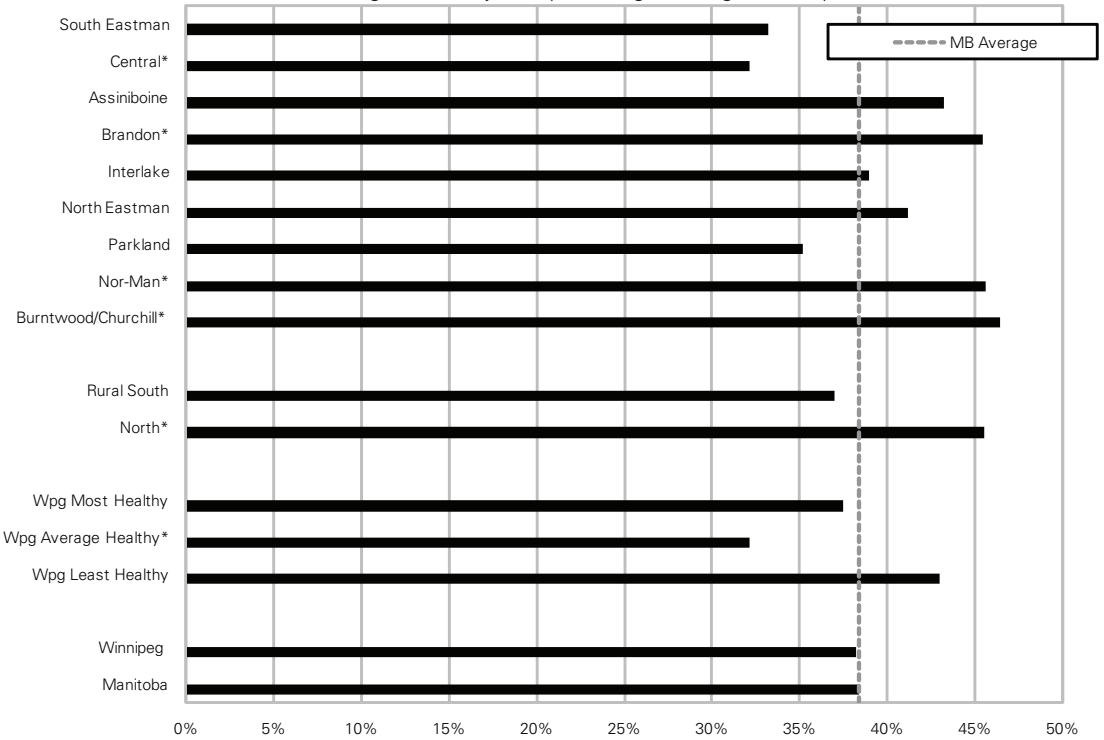


* indicates percentage was statistically different from the Manitoba average
[1]includes Daily Smoker, Occasional (former Daily) Smoker, and Always Occasional Smoker
[2] CCHS 2.1 (2003) and 3.1 (2005) combined

Source: Manitoba Centre for Health Policy, 2009

Figure 4.5: Percentage of Respondents Who Engaged in Binge Alcohol Use (5+ Drinks at One Time) at Least Once in the Previous 12 Months, by Region[1]

Age- & sex-adjusted percentage of weighted sample



* indicates percentage was statistically different from the Manitoba average
[1] CCHS 2.1 (2003) and 3.1 (2005) combined

Source: Manitoba Centre for Health Policy, 2009

4.5 Combining the Rates into an Index

The adjusted rates for each of the indicators were combined using confirmatory factor analysis (see Appendix 5) to obtain factor loadings.

Table 4.1: Factors Loadings for the Healthy Living Composite Index[1]

Indicator	Factor 1	Factor 2
Made Positive Food Choices	**0.59**	-0.17
Engaged in Physical Activity (hours/week)	**0.61**	0.06
Made Changes to Improve Health	**0.75**	0.05
Current Smokers	-0.23	**0.74**
Engaged in Binge Alcohol Use	0.19	**0.78**

[1] CCHS 2.1 (2003) and 3.1 (2005) combined

Source: Manitoba Centre for Health Policy, 2009

The pattern of factor loadings indicates that there is more than one distinct underlying dimension in this set of data. Based on the indicators whose loadings were close to 1, we constructed one composite index for health-promoting behaviours and a second index for health-risk behaviours. Using this type of factor analysis, we can also be sure that the two factors are unrelated; a region's value on the Health-Promoting Behaviours Index does not help in predicting the region's value on the Health-Risk Behaviours Index.

4.6 Healthy Living Indices Scores

Figure 4.6 presents the scores for each of the Healthy Living Composite Indices by RHA for 2003 and 2005. A score higher than the Manitoba average (i.e., greater than zero) for the Health-Promoting Behaviours Index indicates that more individuals in an area engaged in these behaviours than in Manitoba overall. Conversely, a score lower than zero indicates that compared to Manitoba overall, fewer individuals in the region engaged in these types of behaviours. The same interpretation applies to the Health-Risk Behaviours Index.

4.7 What do these Composite Indices Mean?

At first glance, the two factors resulting from this analysis may appear difficult to interpret. The inclusion of the five indicators was based on the expectation that people who are more likely to engage in health-promoting behaviours would be less likely to engage in health-risk behaviours, and vice versa. This pattern did appear for the Winnipeg Most Healthy aggregate area; compared to Manitoba overall, more of these residents engaged in health-promoting behaviours, and fewer engaged in health-risk behaviours. When the other RHAs were examined, however, this expected pattern did not hold up.

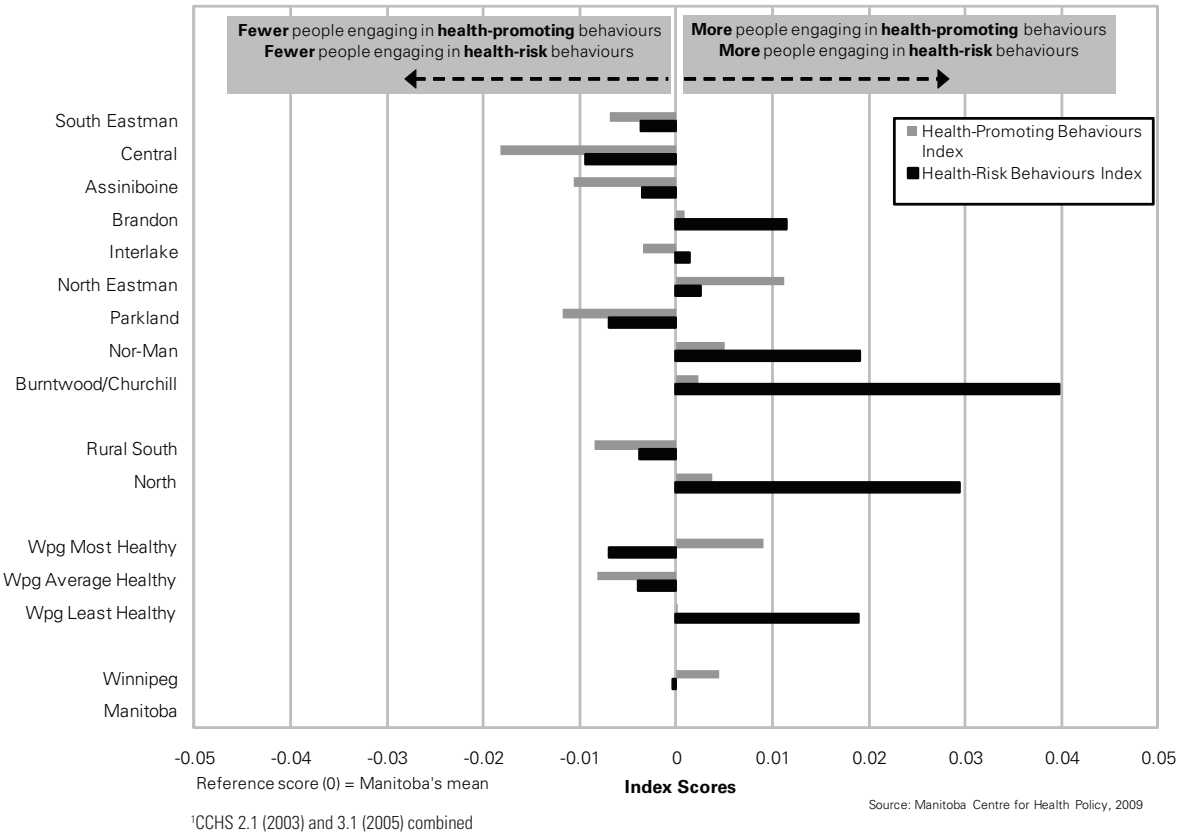
Looking across the RHAs and within Winnipeg, the Health-Risk Behaviour Index scores appeared to be more strongly related to overall health status than did the Health-Promoting Behaviours Index scores. The health-promoting practices did not follow the expected gradient. Three of the RHAs with the lowest PMRs (South Eastman, Central, and Assiniboine) had rates lower than the Manitoba

average whereas three of the more northern and less healthy areas (North Eastman, Nor-Man, and Burntwood/ Churchill) had rates that were higher than the overall provincial average. For the health-risk behaviours, on the other hand, the pattern of results was much closer to the expected gradient. The most healthy RHAs (at the top of the Figure 4.6) had low scores on the Health-Risk Behaviour Composite Index, while the least healthy RHAs, at the bottom, tended to have higher scores on the same Index.

4.7.1 Comparisons to Other Findings

There did not appear to be a gradient for health-promoting practices from the healthiest to the least healthy RHAs. Other researchers, however, have found a gradient for the health-risk behaviours (Lantz et al., 1998; Health Canada, 1999; Lynch, Kaplan, & Salonen, 1997). In our analyses, most of healthier RHAs scored below the Manitoba average for health-promoting practices, while the less healthy regions, with the exception of Parkland, had above average rates of health-risk behaviours.

Figure 4.6: Healthy Living Composite Indices Scores, by RHA[1]



Source: Manitoba Centre for Health Policy, 2009

[1]CCHS 2.1 (2003) and 3.1 (2005) combined

This cross-sectional look at healthy living practices does not tell the whole story about how people in different regions are doing with respect to engaging in health-promoting practices and reducing their health-risk behaviours. The 'accumulation hypothesis', for example, would argue that the health of individuals needs to be examined over time (Ross & Wu, 1996; Dannefer, 2003). Specifically, it has been proposed that health diverges systematically over the life course such that populations of higher socioeconomic status (i.e., with lower premature mortality rates) tend to experience a less rapid decline in health over time (Dannefer, 2003). These different health trajectories have been posited to be due to the cumulative effects of early adoption of healthy lifestyle behaviours and psychosocial factors on health (Holland, Berney, Blane, Davey Smith, & Gunnell, 2000; Marmot et al., 1998). Cumulative effects of healthier living, when coupled with socioeconomic resources, help postpone or, at least, compress morbidity and disability into a shorter period of the last years of life (Prus, 2007). A measure of this could be the subject of further research.

4.8 Conclusion

Two statistically viable composite indices of healthy living – the Health-Promoting Behaviours Index and the Health-Risk Behaviours Index were constructed from Manitobans' responses to two cycles of the CCHS (2.1 and 3.1). By further examining these two indices one obtains an indication of how relative indicators of health-promoting and health-risk behaviours are related to premature death largely from preventable diseases: cardiovascular, respiratory, diabetes, and some cancers. It is apparent that the health-risk behaviours are most strongly linked with overall health status as measured by PMR. Continued emphasis on reducing negative behaviours should likely take precedence over efforts to increase positive behaviours. Given that the Health-Risk Behaviours Index comprises only two indicators (smoking and binge alcohol use) it may be much more straightforward to simply measure rates of these behaviours in the population, rather than to go the extra step of creating a composite index. An additional drawback to consider when evaluating the creation of the Indices is that the indicators depend on survey data from a third party (Statistics Canada), and on very particular questions on the surveys, that may or may not be available in future survey cycles.

Chapter 5: Surgical Wait Times

Building and Interpreting the Composite Index:

A statistically viable composite index comprising wait times for nine elective surgical procedures provides a picture of how long a region's residents wait for surgery relative to other regions.

5.1 Intent of the Index

Would a combination of the wait times for elective surgical procedures provide a picture of the relative wait times for a region's residents? To answer this, wait times for a variety of elective surgical procedures were examined, including some with relatively short wait times (e.g., excision of breast lesions) and some with relatively long wait times (e.g., **cataract** surgery).

5.2 Indicators Used to Construct the Index

The following indicators (surgical procedures), originally developed for a previous MCHP report, by De Coster et al. (2007) were included in this index:

- *Cholecystectomy (removal of gallbladder)*: Main diagnoses were gallstones, cholecystitis or abdominal pain; excluded patients who had surgery for malignancies or for pancreatitis.
- *Hernia Repair:* For inguinal and femoral hernia without gangrene.
- *Excision of breast lesions*: Benign and malignant lesions; excluded breast biopsies.
- *Stripping/Ligation of Varicose Veins*: Removal of varicose veins in the legs only, not esophageal or gastric.
- *Carpal Tunnel Release:* For carpal tunnel syndrome.
- *Tonsillectomy & Adenoidectomy:* For tonsillitis or hypertrophy but not for middle ear infections. We included both tonsillectomy and adenoidectomy, alone or combined.
- *Cataract surgery*: First cataract surgery only. Replacement of lens of the eye to due to cataract formation.
- ***Carotid endarterectomy****:* Removal of plaque from the carotid artery which supplies blood to the brain, thus preventing **stroke**.
- ***Transurethral Prostatectomy***: For benign hyperplasia; excluded all malignancies.

In keeping with De Coster et al. (2007), we used the following decisions regarding inclusions and exclusions:

1. An identifiable pre-operative (pre-op) visit had to be present for all of the persons undergoing the procedure. The pre-op visit had to be made to the surgeon performing the procedure at least four days prior to the surgery. A slightly different algorithm was used for cataract surgery.[8]

[8]In keeping with DeCoster et al. (2007), if there was only one pre-op visit to the surgeon, it was used to estimate the wait times. If the closest visit was for an axial measurement of the eye or if it was within 70 days of surgery, then the second closest visit was used, if there was one. The third closest visit was used only if the second closest visit was for radiology.

2. Only elective procedures were included. Urgent or emergent procedures were excluded.
3. In cases where a second procedure may have been conducted (usually those that are bilateral such as carpal tunnel release), only the first procedure was included.

The wait time for a procedure is the time between surgery date and the date of the patient's last pre-operative visit, as defined above. Median wait times were adjusted by age and sex using parametric survival analysis modelling. This is explained in detail in De Coster et al. (2007).

5.3 Rationale for the Index

Surgical wait times have been identified as a major issue in Canada. The consequences of excessive wait times can be serious, and a great deal of attention has been paid to this issue by politicians, health researchers and administrators, healthcare providers, the public, and the media. In September 2004, the Federal/Provincial/Territorial First Ministers' health accord resulted in the creation of a $4.5 billion fund to reduce wait times throughout Canada. Manitoba received $155 million of this Federal Wait Times Reduction Fund. A means of assessing the effect of this targeted fund would be beneficial. The following description is based on De Coster et al. (2007).

The time periods used for this index are slightly different from those for the previous indices. Due to fundamental changes in the way procedures were reported in the hospital administrative data, the validation of the method for assessing wait times after 2003/04 has not been completed. A transition from reporting diagnoses and procedures using the ICD-9-CM to ICD-10-CA and the CCI took place April 1, 2004. As with any change of this magnitude, the reliability of the data for the transitional period could be questioned. Data was restricted to the period prior to and including 2003/04, which is the period for which validated data from De Coster et al. (2007) were readily available.

For this reason, the two time periods included here were April 1, 1998—March 31, 2001 (Time 1) and April 1, 2001—March 31, 2004 (Time 2). These time periods predate the creation of the fund, so they provide a benchmark for assessing its effectiveness, which is essential to properly evaluating the effectiveness of the fund. If wait times were increasing prior to the creation of the fund, simply 'holding steady' could be interpreted as a success. On the other hand, if wait times were already decreasing, the marginal effect of such a fund might be less obvious.

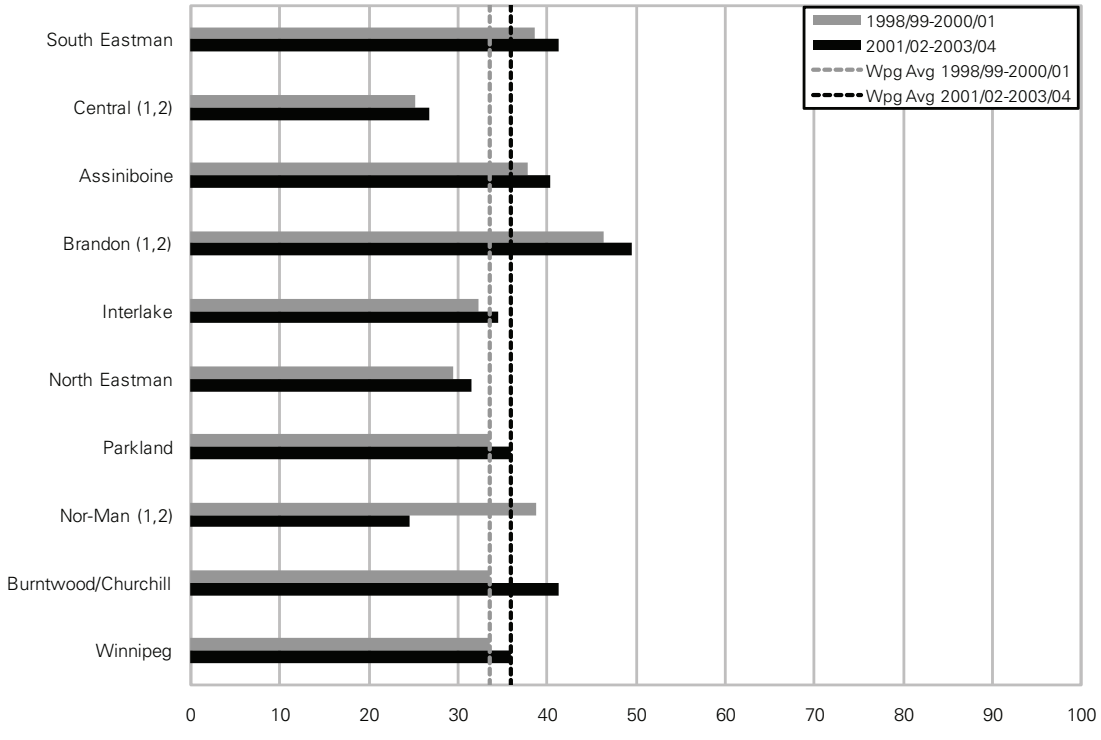
The choice of the nine elective procedures covers a wide range of surgeries typically conducted on different populations (consider those likely to undergo cataract surgery versus tonsillectomy versus hernia repair) and by different surgeons. This diversity was intentional, and provides the opportunity to get a 'big picture' regarding how long patients wait for elective surgery. If a statistically viable composite index could be developed, it might identify RHAs whose residents experience wait times across a whole range of procedures that are either longer or shorter than for residents of other RHAs. A follow-up study could then reveal how those longer wait times could be shortened. As with all the rates presented in this report, wait times for patients were calculated based on where the patient lived, rather than where they received the surgery.

5.4 Adjusted Rates of the Indicators Used to Construct the Index

The adjusted median waits for each of the indicators are shown by RHA for the two time periods. The crude wait times can be found in Tables A4.10-A18 of Appendix 4. As done by De Coster et al. (2007), we used the Winnipeg median wait time as the benchmark for the province. Medians were used rather than mean wait times because of the skewed nature of wait time distributions. A few people have extremely long wait times, thus unduly influencing the mean. The median is the point at which 50% of the patients have had the surgery and 50% are still waiting. For this analysis, Winnipeg was not broken down into separate areas, and Burntwood and Churchill were combined to provide a single adjusted median wait time.

As seen in Figures 5.1-5.9, there was no discernable pattern or relationship with overall population health status (i.e., PMR). This could either be due to the fact that these procedures are conducted on very particular patient populations or to the relative availability of surgical staff and operating rooms across RHAs.

Figure 5.1: Wait Times for Cholecystectomy, by RHA

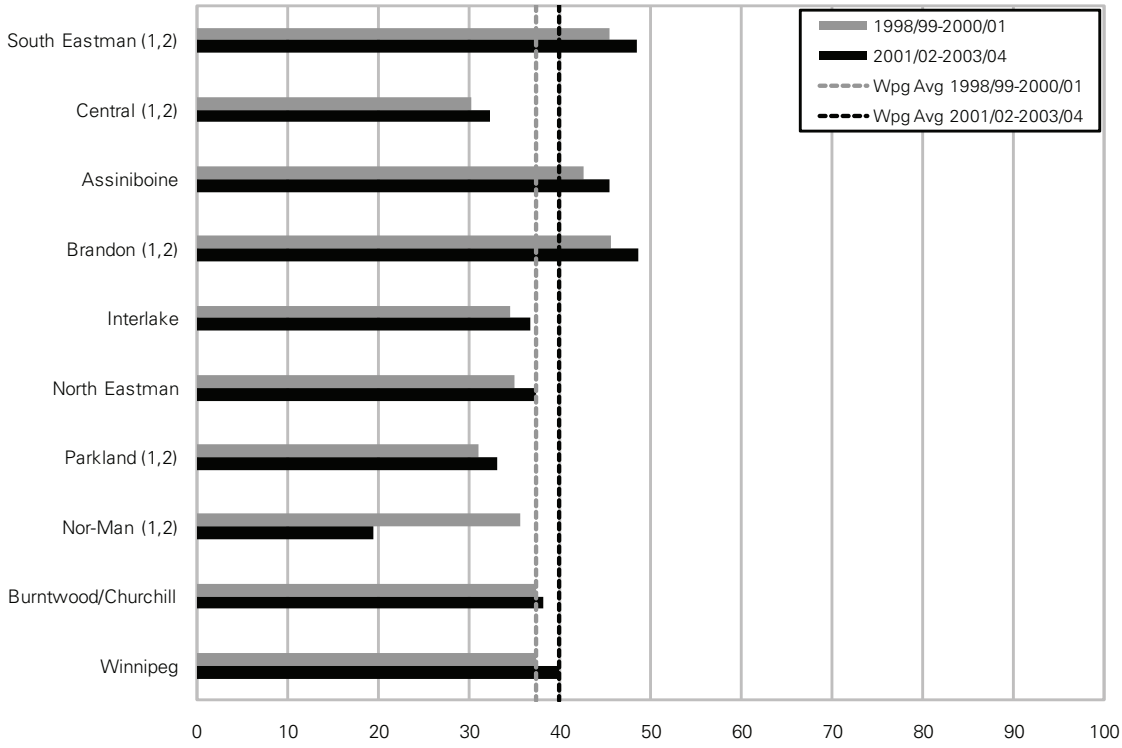


'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)

Source: Manitoba Centre for Health Policy, 2009

Figure 5.2: Wait Times for Hernia Repair, by RHA

Age- & sex-adjusted median waits (days)

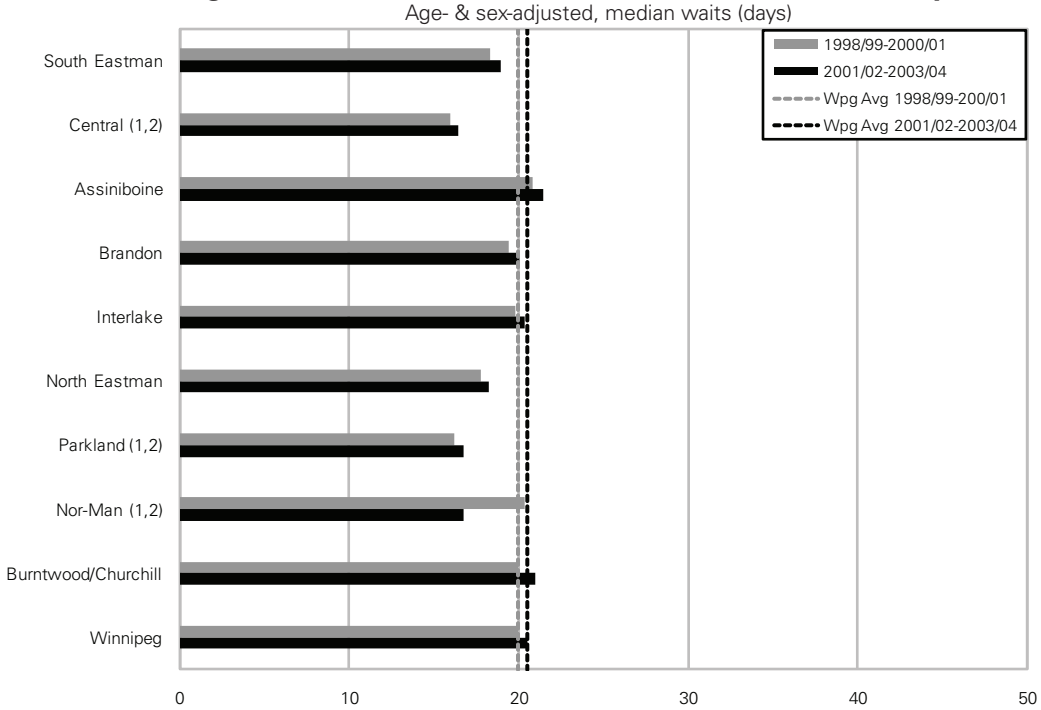


'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)

Source: Manitoba Centre for Health Policy, 2009

Figure 5.3: Wait Times for Excision of Breast Lesions, by RHA

Age- & sex-adjusted, median waits (days)

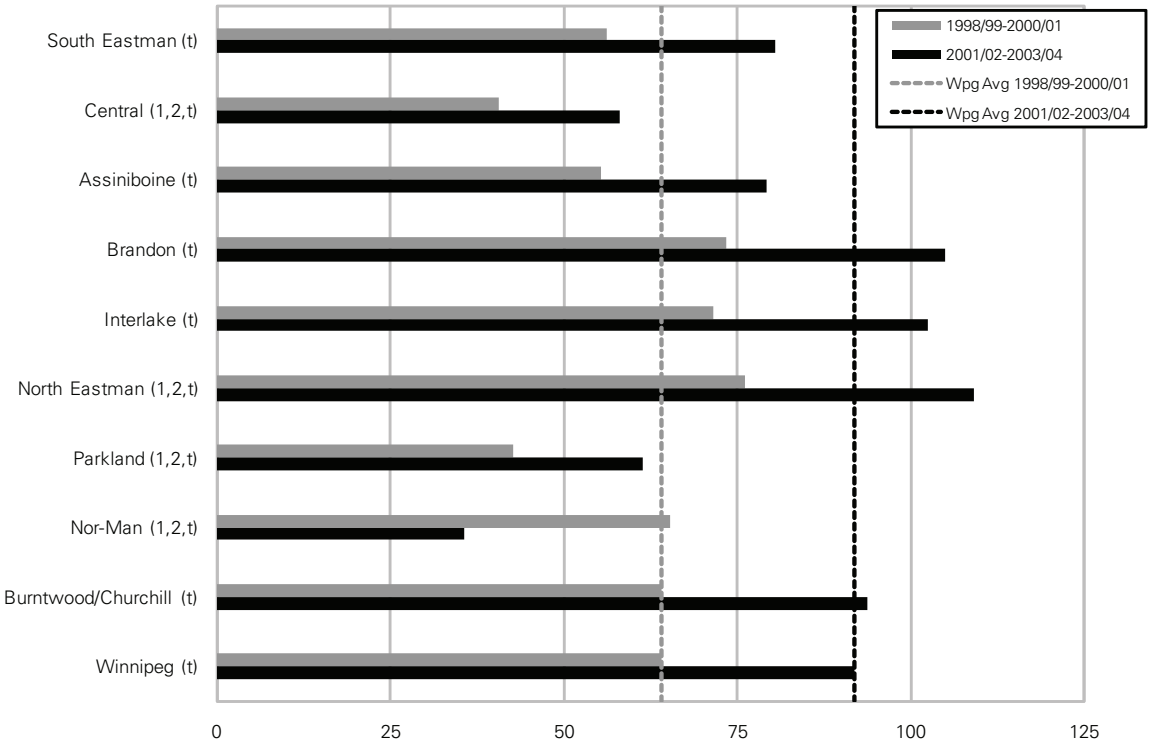


'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)

Source: Manitoba Centre for Health Policy, 2009

Figure 5.4: Wait Times for Stripping/Ligation of Varicose Veins, by RHA

Age- & sex-adjusted median waits (days)

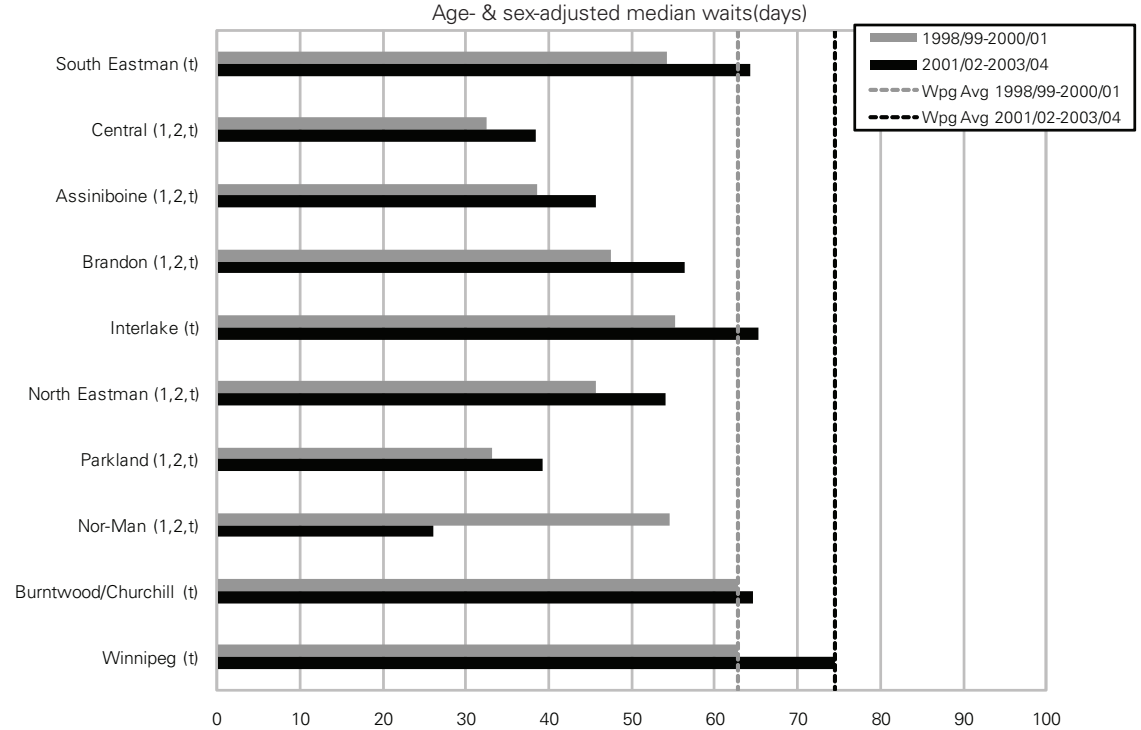


'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 5.5: Wait Times for Carpal Tunnel Release, by RHA

Age- & sex-adjusted median waits(days)

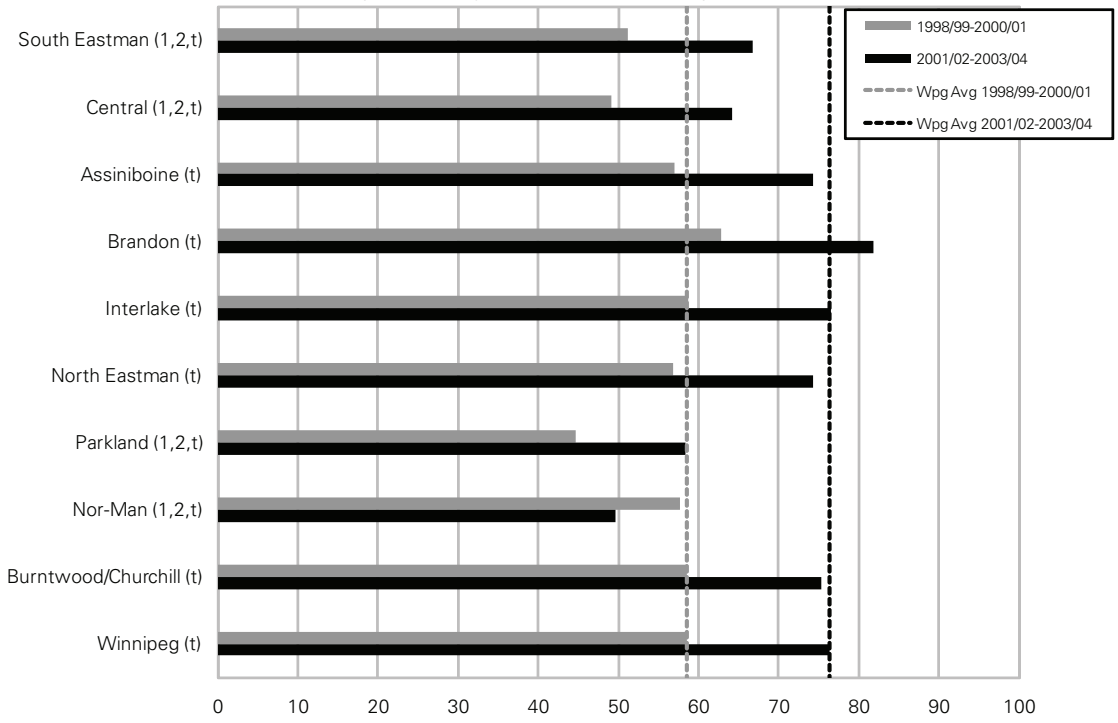


'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 5.6: Wait Times for Tonsillectomy, by RHA

Age- & sex-adjusted median waits (days)

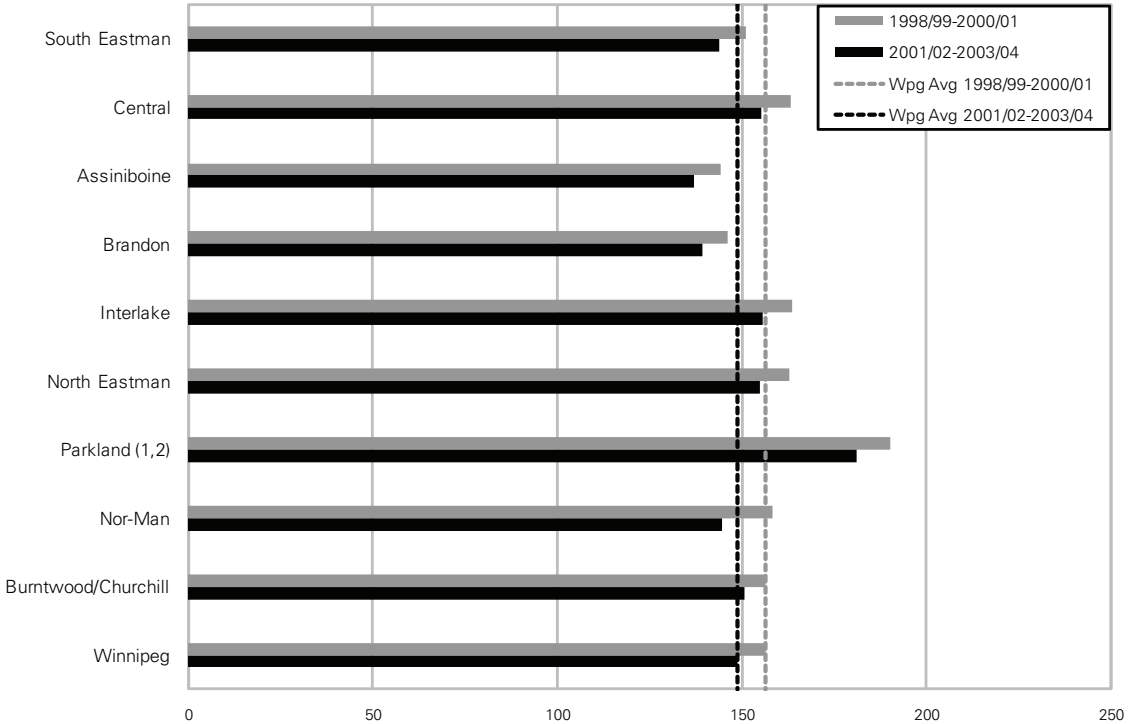


'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 5.7: Wait Times for Cataract Surgery, by RHA

Age- & sex-adjusted median waits (days)

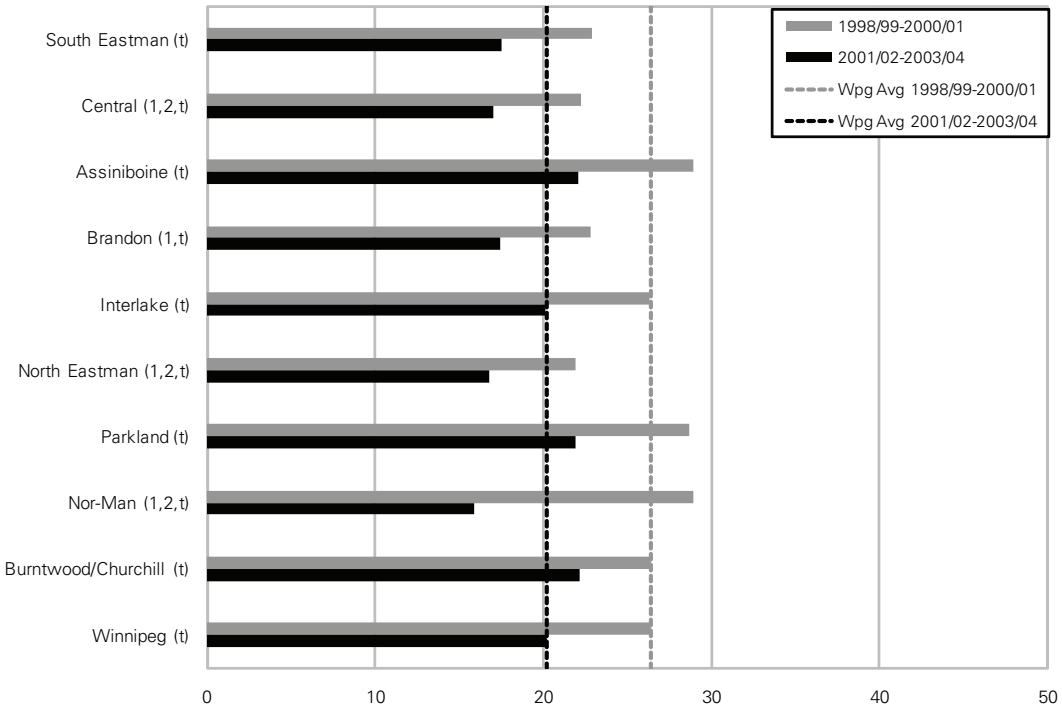


'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)

Source: Manitoba Centre for Health Policy, 2009

Figure 5.8: Wait Times for Carotid Endarterectomy, by RHA

Age- & sex-adjusted median waits (days)

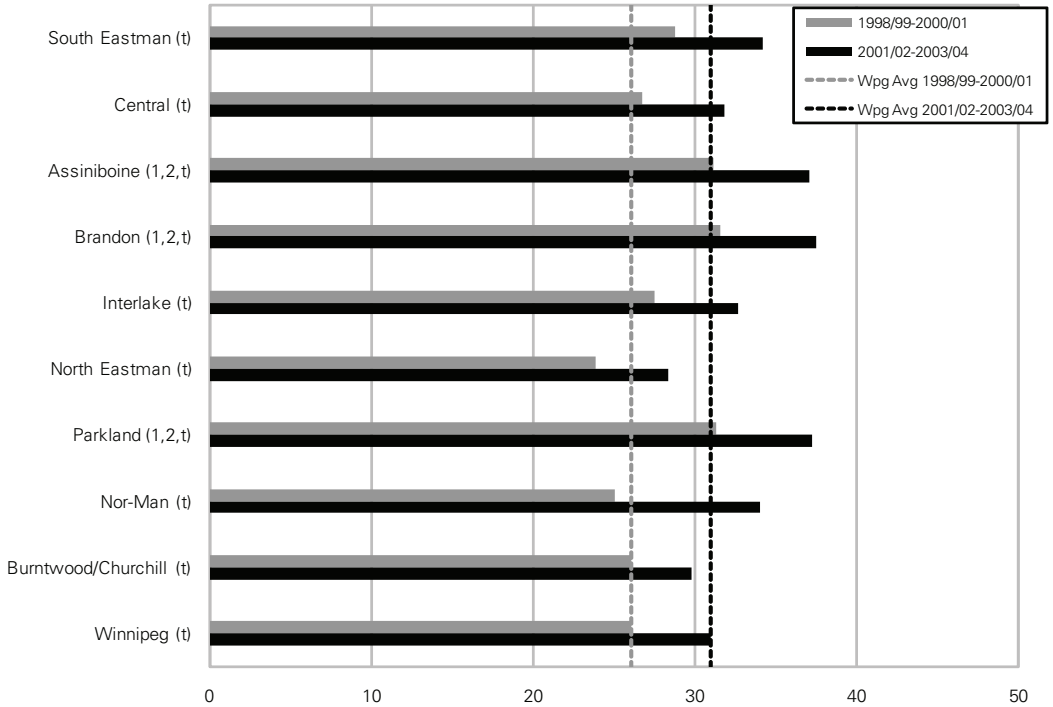


'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 5.9: Wait Times for Transurethral Prostatectomy, by RHA

Age- & sex-adjusted median waits (days)



'1' indicates area's median wait time was statistically different from Winnipeg's average in first time period (p<.01)
'2' indicates area's median wait time was statistically different from Winnipeg's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

5.5 Combining the Rates into an Index

Six procedures contributed to the first component in the factor analysis, with loadings well above the minimum criterion on Factor 1, as presented in Table 5.1. The remaining three procedures did not contribute to the Index (carotid endarterectomy, transurethral prostatectomy, cataract surgery).

Table 5.1: Factor Loadings for the Surgical Wait Times Composite Index*

Indicator	Loadings	Factor 2	Factor 3
Total Cholecystectomy	**0.86**	0.00	-0.24
Hernia Repair	**0.90**	0.09	-0.24
Excision of Breast Lesions	**0.89**	0.03	-0.34
Stripping/Ligation of Varicose Veins	**0.81**	**-0.50**	-0.01
Carpal Tunnel Release	**0.88**	-0.05	0.09
Tonsillectomy	**0.83**	**-0.48**	0.09
Cataract Surgery	-0.06	-0.01	**0.88**
Carotid Endarterectomy	0.04	**0.93**	0.08
Transurethral Prostatectomy	0.24	**-0.49**	**-0.61**

*Time 1(1998/99-2000/01) and Time 2 (2001/02-2003/04) combined

Source: Manitoba Centre for Health Policy, 2009

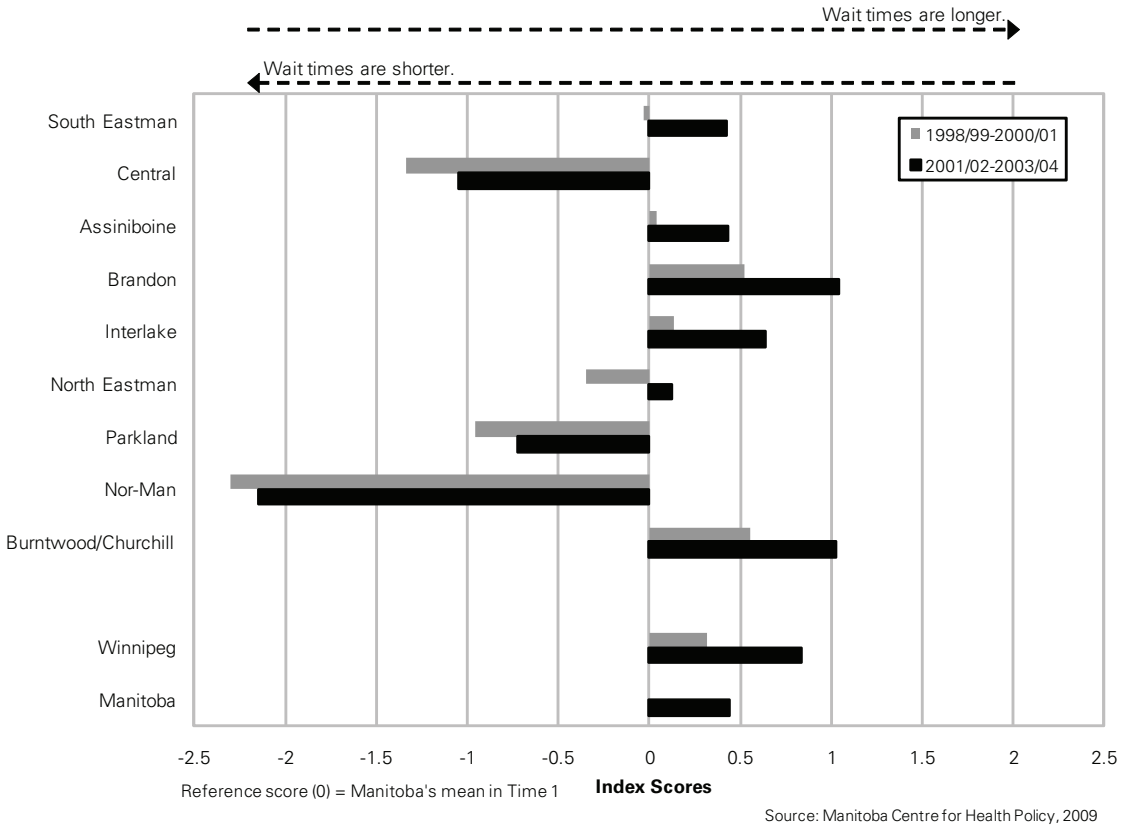
5.6 Index Scores for Wait Times

Weighted factor scores were calculated for each of the RHAs for the two time periods and are presented in Figure 5.10. In the analyses of median wait values above, statistical comparisons could not be made to a Manitoba provincial value, and so it was not presented. For the Index scores, however, we calculated an overall Manitoba value for both time periods and included them in the figure.

A score higher than the Manitoba average (i.e., greater than zero) indicates wait times for the six surgeries were, as a whole, longer than the Manitoba average. For example, in the first time period, the Wait Times Composite Index score is higher for Winnipeg. This difference increased in the second time period. Conversely, a score lower than the Manitoba average Index score (i.e., less than zero) indicates that surgical wait times for the six procedures were shorter than the Manitoba average.

One of the key findings that can be seen in the pattern of the Composite Index scores is that there is no relationship between overall health status and wait times. Wait times are not systematically higher or lower depending on whether the regions are more or less healthy. A second point to be learned from the pattern of the Composite Index scores is that proximity to the hospitals does not appear to influence wait times in any expected way. Patients in Winnipeg had longer than average waits despite the fact that the majority of the procedures were done in Winnipeg, even for residents of other RHAs.

Figure 5.10: Surgical Wait Times Composite Index Scores, by RHA



Source: Manitoba Centre for Health Policy, 2009

5.7 What does this Composite Index Mean?

Wait times in the province increased over the two time periods, as indicated by the increase in the average Index scores for all RHAs. It is also apparent that the wait times for elective surgery did not follow the typical pattern where worse outcomes are associated with higher PMR. Some of the shortest waits were found in RHAs with the highest PMR (Parkland and Nor-Man), whereas Winnipeg had above average waits for both time periods.

5.7.1 Comparisons to Other Findings

For the most part, the wait times reported here are similar to those reported by De Coster et al. (2007). Although the data from which median wait times were derived were identical, the way in which the wait times were reported are very different. The previous report displayed the median wait times by year summed across all RHAs, or by RHA summed across all years. We have described wait times for two time periods within each RHA. In addition, the previous report adjusted wait times for a number of variables in addition to age and sex, such as co-morbidities and socioeconomic status. While these are important factors, to be consistent with the other composite indices developed in this report, the wait times here were only adjusted for age and sex. For these reasons, some subtle differences in the patterns of wait times may be noted.

In our analyses, the wait times for a number of procedures increased over time, whereas in De Coster et al.'s (2007) work, the same procedures were shown to have had flat or slightly declining wait times. The previous report displayed the year by year median wait times and showed that for a number of procedures, the wait times increased during the time corresponding to the first three-year period reported here and then levelled off during the second three-year period. If wait times have in fact stopped increasing is not apparent in the data reported here but is masked by the aggregation of data into three-year chunks. Any conclusions about changes in surgical wait times should rely on as many data sources as possible. The Fraser Institute also calculated wait times for Manitoba for several of the procedures included in this report (Zelder & Wilson, 2000; Esmail & Walker, 2003). Even though their analyses were based on data from surveys of surgeons and their response rates and numbers are quite low, the wait times they reported for 2000 and 2003 are comparable to what we have reported here for the first and second time periods respectively.

Comparable national and international median wait times for these elective procedures were not readily available. Reports on wait times from the CIHI concentrate on other high profile procedures such as joint replacement and various cardiac procedures, or diagnostic procedures (e.g., MRI and CT scans). CIHI did look at wait times for cataract surgery, which is one of the procedures included in the current analysis. According to their data, in 2006, the median wait times in Manitoba were considerably lower than those presented here for the time period ending in 2004, indicating that for at least one procedure, wait times have improved in Manitoba.

5.8 Conclusion

A statistically viable composite index comprising surgical wait times for six elective procedures provides a picture of how long a region's residents wait for surgery relative to other regions. Three additional surgical procedures did not contribute to the Index. The average Index scores for all RHAs increased over time, which means that wait times for the included procedures lengthened. In addition, wait times, as measured by the Index, appeared to be unrelated to the overall health status of the RHA and unrelated to geographical proximity to the institutions where the procedures are conducted.

Chapter 6: Quality of Primary Care and Pharmaceutical Use

Building and Interpreting the Composite Index:

We attempted to build two quality of care composite indices to identify how often physicians use proven care initiatives, such as prescribing a beta-blocking agent after a heart attack, to monitor the delivery of evidence-based care for the best possible outcomes.

6.1 Intent of the Quality of Care Indices

Governments are interested in having an indication of the degree to which the health services provide the likelihood of desired health outcomes and are consistent with current professional knowledge (Lohr, 1990). Health Canada defines "quality health care" as the delivery of the best possible care for the best possible outcomes for people every time they deal with the healthcare system or use its services (Health Canada, 2004a). Essentially, Health Canada defines quality as doing the best possible job with the resources available.

In an effort to obtain summary composite measures of 'quality', we examined two key areas in the healthcare system: the quality of primary care (general practitioner) services and the quality of pharmaceutical use.

6.2 Indicators Used to Construct the Indices

We used quality indicators previously developed at MCHP by Katz, DeCoster, Bogdanovic, Soodeen, and Chateau (2004) and Doupe et al. (2006) to develop two separate quality indices (Table 6.1). The indicators chosen primarily address quality standards for chronic disease care (Katz et al., 2004). We attempted to develop a quality of primary care index using the following indicators:

Table 6.1: Indicators Included in the Indices of Quality of Primary Care & Quality of Pharmaceutical Use

Indicators	Definition	Composite Indices	
		Quality of Primary Care	Quality of Pharmaceutical Use
Antidepressant Prescription Follow-Up	The percentage of patients with a new prescription for an antidepressant associated with a depression diagnosis (within two weeks of each other) who had three subsequent ambulatory visits within four months of the prescription being filled.*	✓	
Asthma Care	The percentage of patients with an asthma diagnosis (defined as one repeat prescription of a beta 2-agonist (B-agonist in the past year) who filled a prescription for medications recommended for long-term contol of asthma (i.e., inhaled corticosteroids or leukotriene modifiers, an alternate anti-inflammatory medication).*	✓	✓
Beers' Criteria	The proportion of persons over 65 years of age who were dispensed medications included in the Beers Criteria list (i.e., higher risk medications that should not be dispensed to older adults, due to their limited efficacy and/or significant contraindications of the drug). Individuals had to have 2+ prescriptions with a 30+ day supply of a Beers medication to be counted. Includes only medications that are considered to be higher risk independent of the prescription dose of the drug or of people's disease. Excludes benzodiazepines from this indicator to reduce confounding with the Benzodiazepine Use indicator.**		✓
Diabetes Care: Eye Examination	The percentage of diabetic patients (defined as those who had at least one drug used to treat diabetes) who saw either an optometrist or ophthalmologist in the same fiscal year as the prescription.*	✓	
Polypharmacy	Identifies a selected level of medications where the number of prescribed or dispensed medications in a given time frame (i.e., per year) is considered to be more than necessary. In this study it was defined as the percentage of patients aged 65+ who filled prescriptions for six or more different medications in 121 days.***		✓
Post-Acute Myocardial Infarction Care: Beta-Blocker Prescribing	The percentage of patients discharged alive from hospital in the preceding three years with a discharge diagnosis of acute myocardial infarction (excluding those with prior diagnosis of asthma, COPD, or perpheral vascular disease) who filled at least one prescription for a beta-blocker within four months of the first infarction.*	✓	✓
Potentially Inappropriate Prescribing of Benzodiazepines for Older Adults	The percentage of patients aged 75 years or older who filled prescription(s) for two or more benzodiazepines or prescriptions for greater than a 30-day supply of medication.*	✓	✓

* Katz et al. (2004), ** Beers (1997), *** Doupe et al. (2006) Source: Manitoba Centre for Health Policy, 2009

✓ - used in the composite index

6.3 Rationale for the Indices

In addition to the Health Canada definition of quality care (Health Canada, 2004b), to choose the indicators for the two quality of care indices we also employed two additional definitions of quality of care. The first was the Institute of Medicine's definition of quality: "The degree to which the health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (Lohr, 1990; p. 21). The second is taken from Campbell, Roland, and Buetow (2000), who identified two important dimensions of quality: access to and effectiveness of care. As with Katz et al, (2004), we focused on process measures, specifically clinical effectiveness, which administrative data allows us to measure.

Antidepressant Prescription Follow-Up

This indicator measures the monitoring of the treatment of depression after initial diagnosis and prescribing to determine if patients' responses to medication are being tracked. Regular follow-up is important because it takes a while after initiating therapy before these medications begin to have a clinical effect (Fochtmann & Gelenberg, 2005). Furthermore, people diagnosed with a major depression may be at risk of suicide which makes follow-up a critical part of treatment for depression (Mann et al., 2005).

Asthma Care

Guidelines for the treatment of asthma recommend that all patients who require the use of acute treatment medication (e.g., beta-agonist) more than once a day should also be treated with long-acting anti-inflammatory medication for long-term control (Becker et al., 2003). However, of the more than three million Canadians of all ages who suffer with asthma, it has been estimated that over 50% of adults with asthma do not have their condition under control (Chapman, Ernst, Grenville, Dewland, & Zimmerman, 2001; FitzGerald, Boulet, McIvor, Zimmerman, & Chapman, 2006). Describing how appropriately we use interventions meant to control asthma and prevent death would help us to examine quality in asthma care.

Beers' Criteria

Up to 30% of hospital admissions for older adults may be associated with drug-related problems or drug toxic effects (Hanlon et al., 1997; Grymonpre, Mitenko, Sitar, Aoki, & Montgomery, 1988). Adverse drug events, such as depression, constipation, falls, immobility, confusion, and hip fractures, have been linked to preventable problems in older patients (Hanlon et al., 1997). As a means of monitoring these types of problems, the **Beers Criteria** was developed. It refers to a list of medications that should not be used by older adults because they may pose more risk than benefit (Beers et al., 1992). The medications are thought to be either ineffective or to have side effects, including significant anticholinergic and sedating properties and would increase older adults' risk of drug addiction and fall (Fick et al., 2003).

Diabetic Eye Exam

People with diabetes may be at risk of damage to the retina (diabetic retinopathy). Diabetic retinopathy would eventually compromise their vision and, without intervention, result in complete loss of vision. Given that diabetic retinopathy can develop without symptoms, a regular examination of a diabetic patient's retinas will help to diagnose retinopathy early. The onset and progression of retinopathy can be slowed through better control of blood sugar levels. Although we cannot directly

determine if they have had this specific 'test', it should be completed in an annual eye exam, which is considered part of routine care. It is important to also note that these are typically done by optometrists or ophthalmologists, so there is a possible data limitation, depending on how complete optometrists are in billing MHHL for the eye exams.

Polypharmacy

Polypharmacy refers to the use of multiple medications by a person and is most commonly seen among older patients. It is an important measure of quality because people on more than one type of medication at the same time are at increased risk of adverse drug reactions (Wyles & Rehman, 2005). The number of medications used to define polypharmacy has varied substantially over the years from two or more to nine or more at a time (Veehof, Stewart, Haaijer-Ruskamp, & Jong, 2000; Jensdottir et al., 2003). We used six or more medications in 121 days. This definition excludes short-term use in order to focus on long-term medication use.

Post-Acute Myocardial Infarction (AMI)—Beta-Blocker Use

It is recommended that most persons be treated with a drug from the beta-blocker class of drugs after suffering an AMI (Krumholz et al., 1998). Use of beta-blocker post-AMI is contraindicated in persons with asthma, chronic obstructive pulmonary disease or heart block (Ryan et al., 1996). Previous research has shown a 14% lower risk of mortality at one year in those patients prescribed beta-blockers after suffering an AMI (Pedersen, 1985).

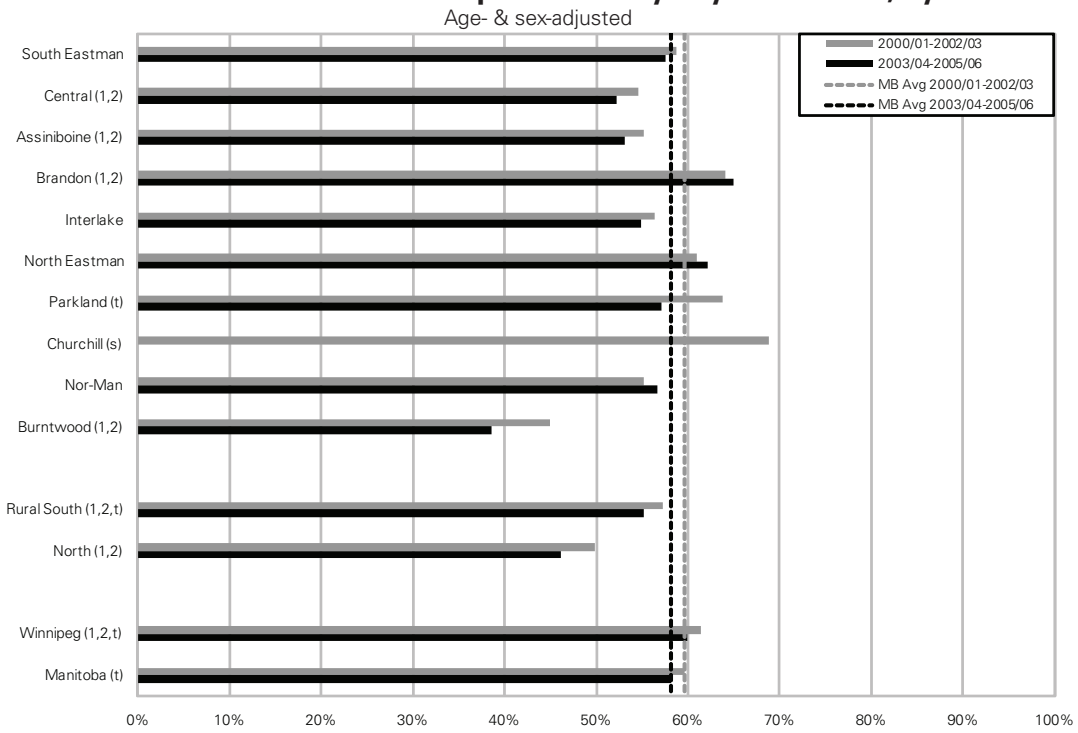
Potentially Inappropriate Prescribing of Benzodiazepines for Older Adults

Long-term use of benzodiazepines is not recommended in older patients (Allard, Hebert, Rioux, Asselin, & Voyer, 2001). Use of these medications has been associated with an increased risk of falls and fractures in older adults and increased patient confusion resulting from dependence and withdrawal (Wagner et al., 2004; Busto et al., 1986; Golombok, Moodley, & Lader, 1988; Tata, Rollings, Collins, Pickering, & Jacobson, 1994). Long-term prescribing of benzodiazepines is also a part of the Beers criteria. The use of benzodiazepines is extensive among Manitoba's older population (Metge, Grymonpre, Dahl, & Yogendran, 2005). Therefore, we separated out the effects of benzodiazepine prescribing as a separate dimension of quality.

6.4 Adjusted Rates of the Indicators Used to Construct the Indices

The adjusted rates for each of the indicators are shown by RHA and Winnipeg CA for two three-year time periods (see Figures 6.1-6.14). The crude rates can be found in Tables A4.19-A4.25 of Appendix 4.

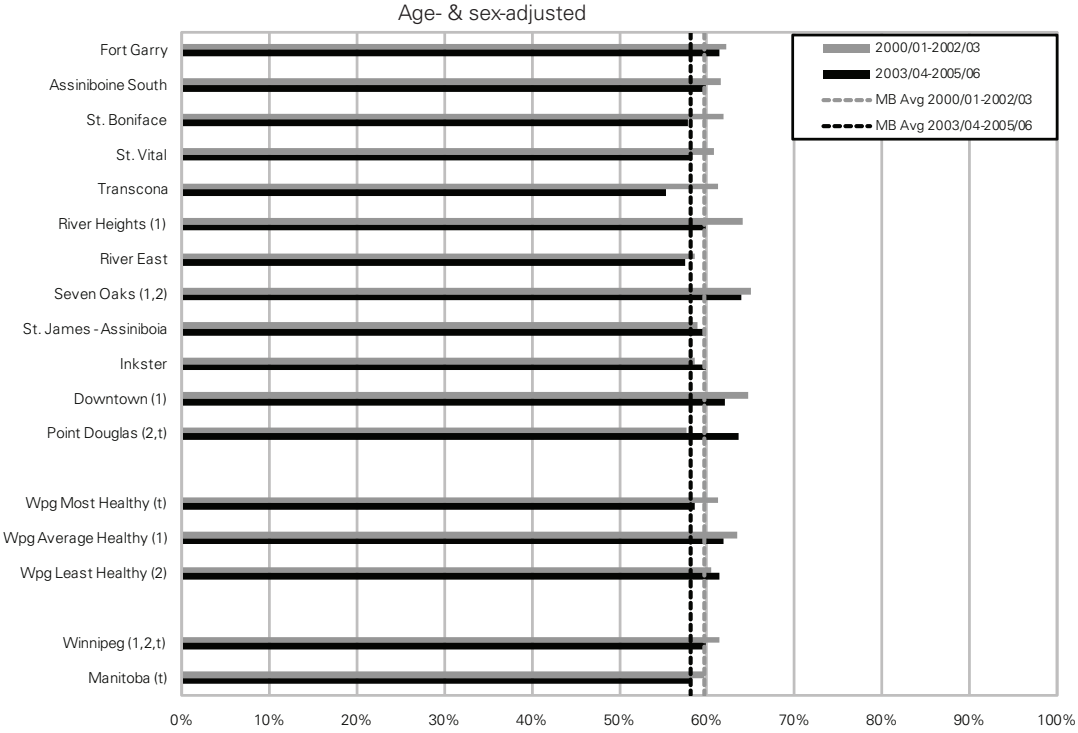
Figure 6.1: Percentage of Patients Who were Newly Diagnosed with Depression and Who had Three Follow-Up Ambulatory Physician Visits, by RHA



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)
's' indicates data suppressed in second time period due to small numbers

Source: Manitoba Centre for Health Policy, 2009

Figure 6.2: Percentage of Patients Who were Newly Diagnosed with Depression and Who had Three Follow-Up Ambulatory Physician Visits, by Winnipeg Community Area

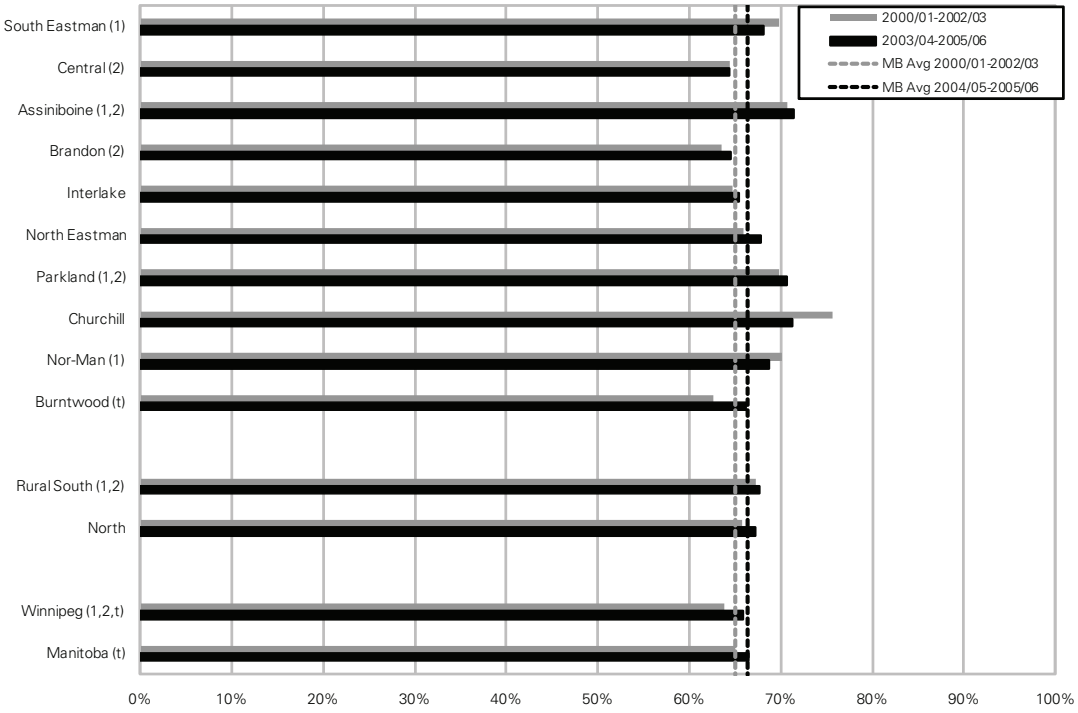


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 6.3: Percentage of Asthmatics Receiving Appropriate Care, by RHA

Age- & sex-adjusted

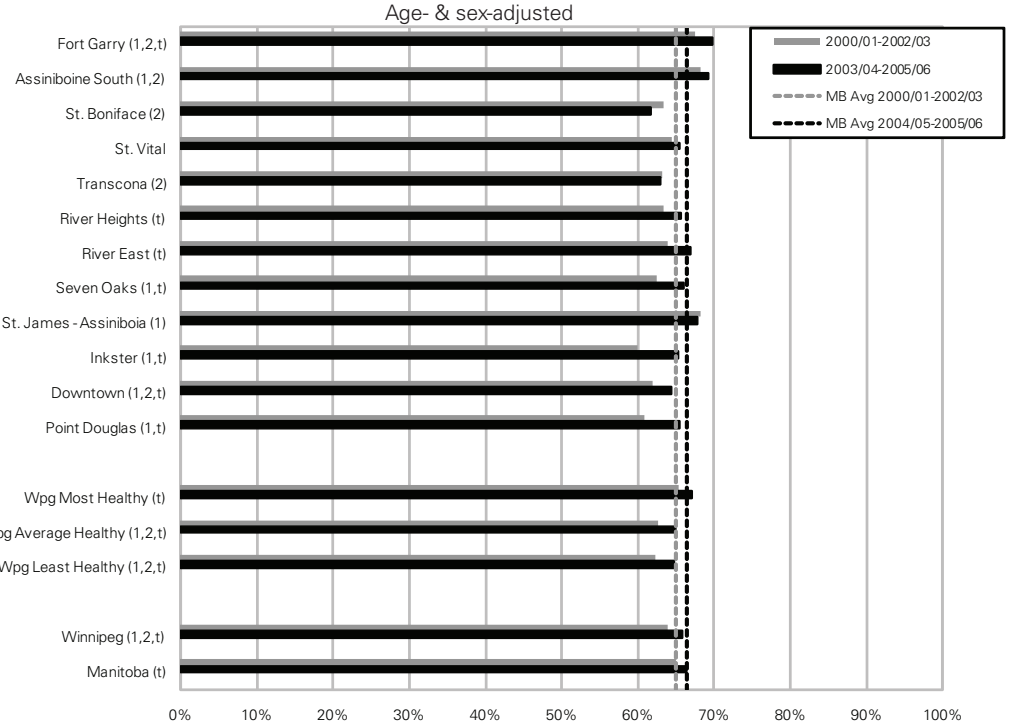


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 6.4: Percentage of Asthmatics Receiving Appropriate Care, by Winnipeg Community Area

Age- & sex-adjusted

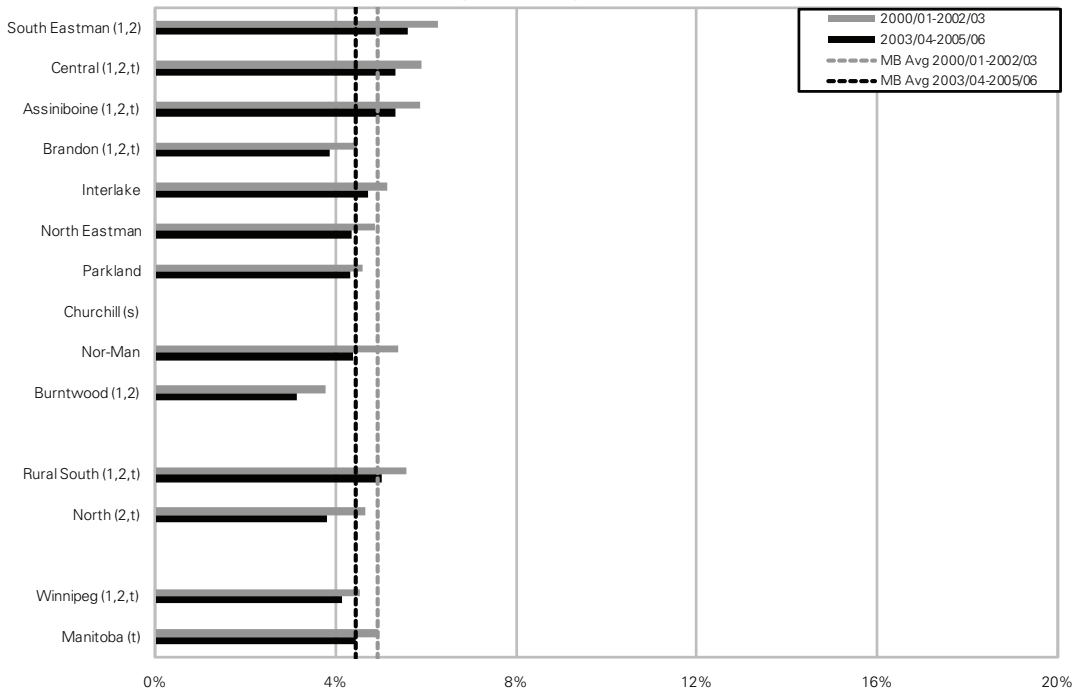


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 6.5: Percentage of Older Adults (65+ years) Who Filled a Prescription for at Least One Beers Criteria Medication, by RHA

Age- & sex-adjusted

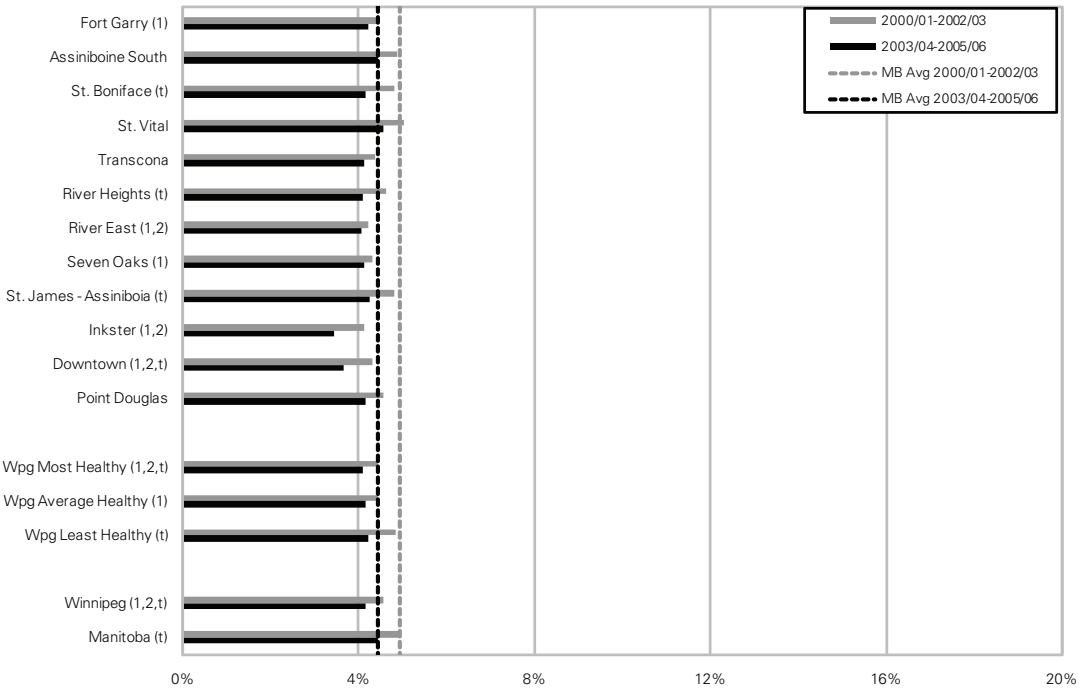


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2009

Figure 6.6: Percentage of Older Adults (65+ years) Who Filled a Prescription for at Least One Beers Criteria Medication, by Winnipeg Community Area

Age-& sex-adjusted

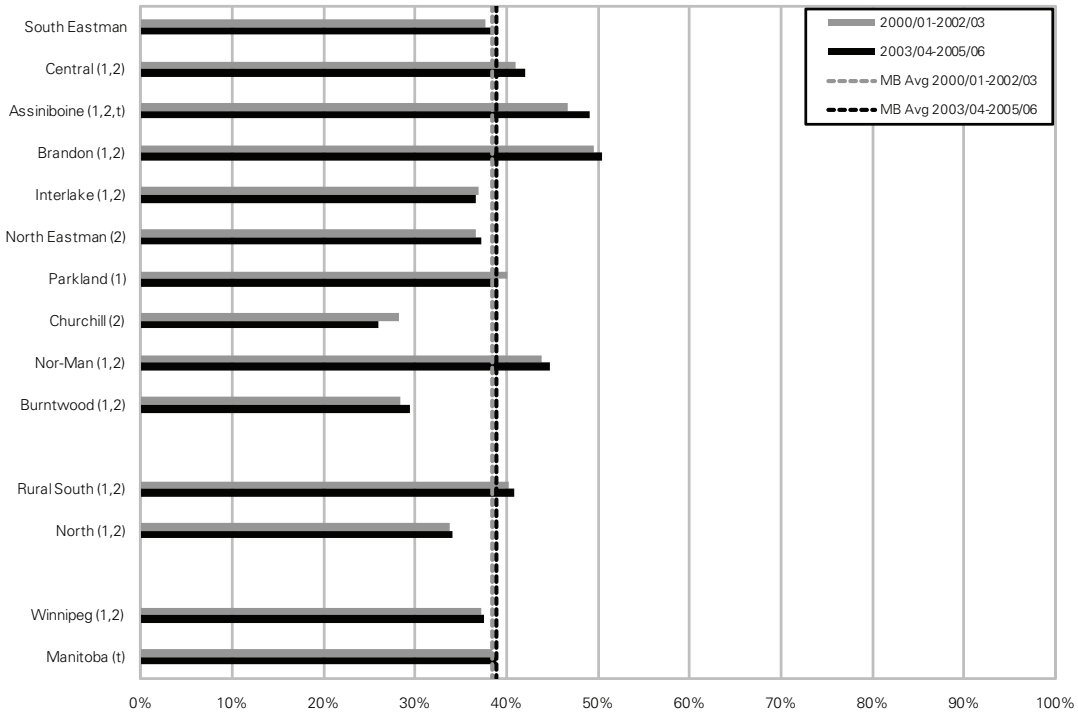


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 6.7: Percentage of Diabetic Patients Who had an Eye Exam, by RHA

Age- & sex-adjusted

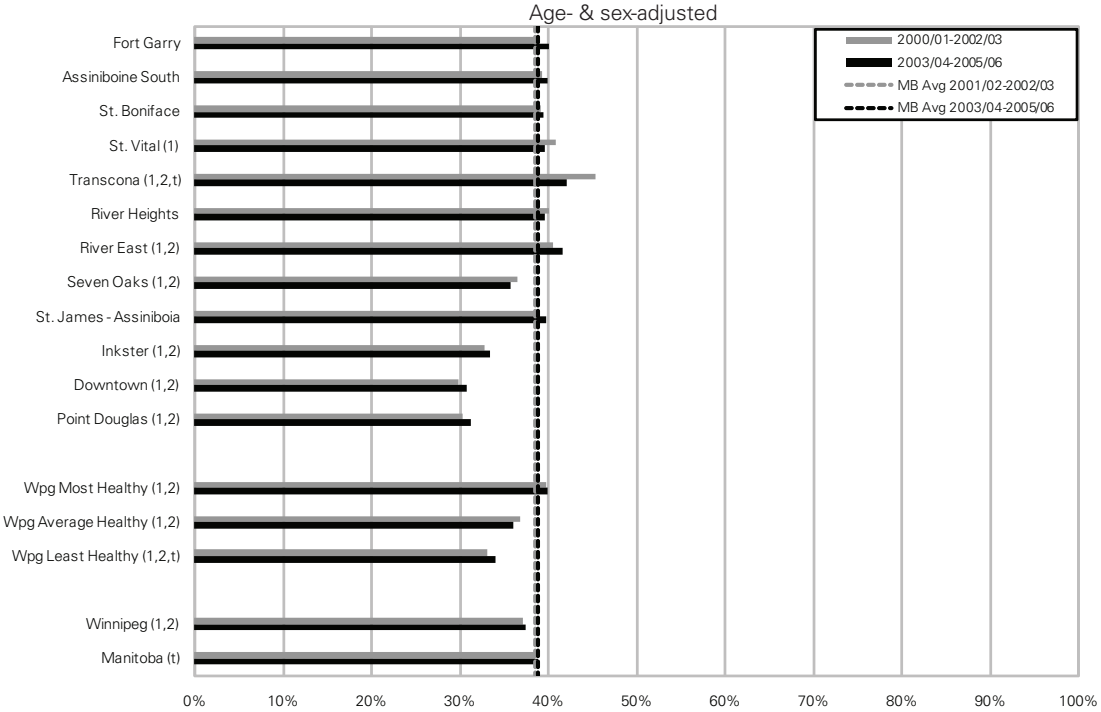


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 6.8: Percentage of Diabetic Patients Who had an Eye Exam, by Winnipeg Community Area

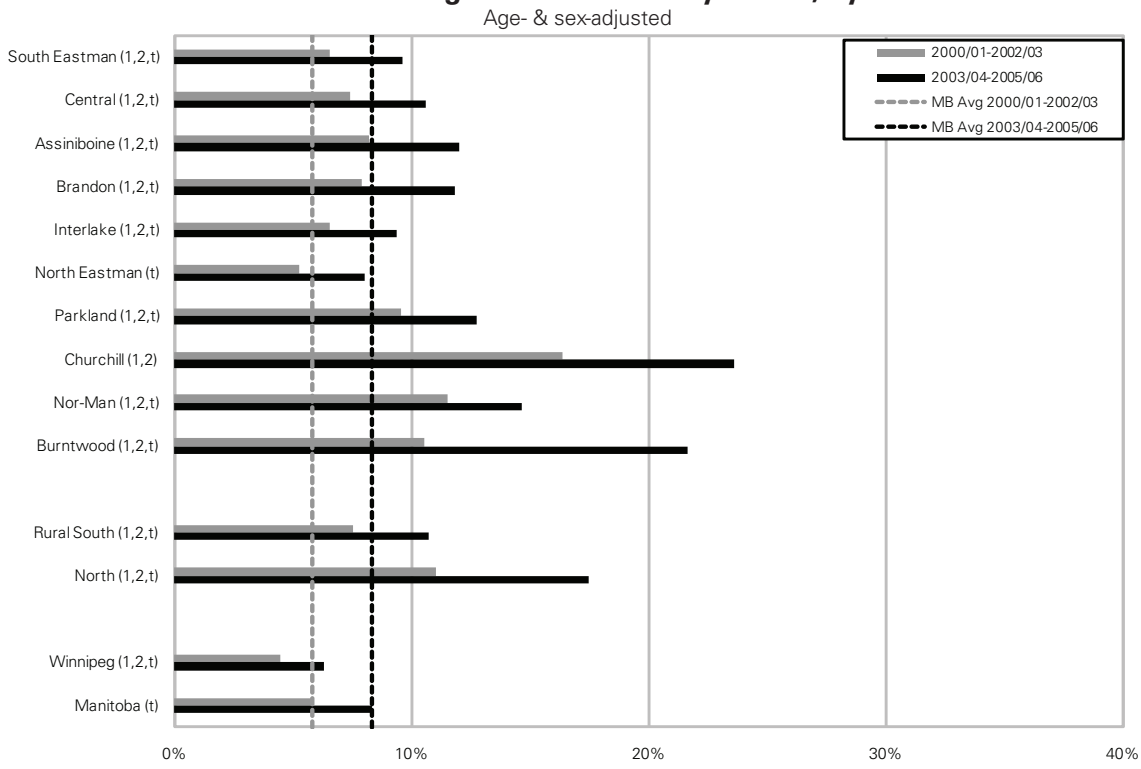
Age- & sex-adjusted



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

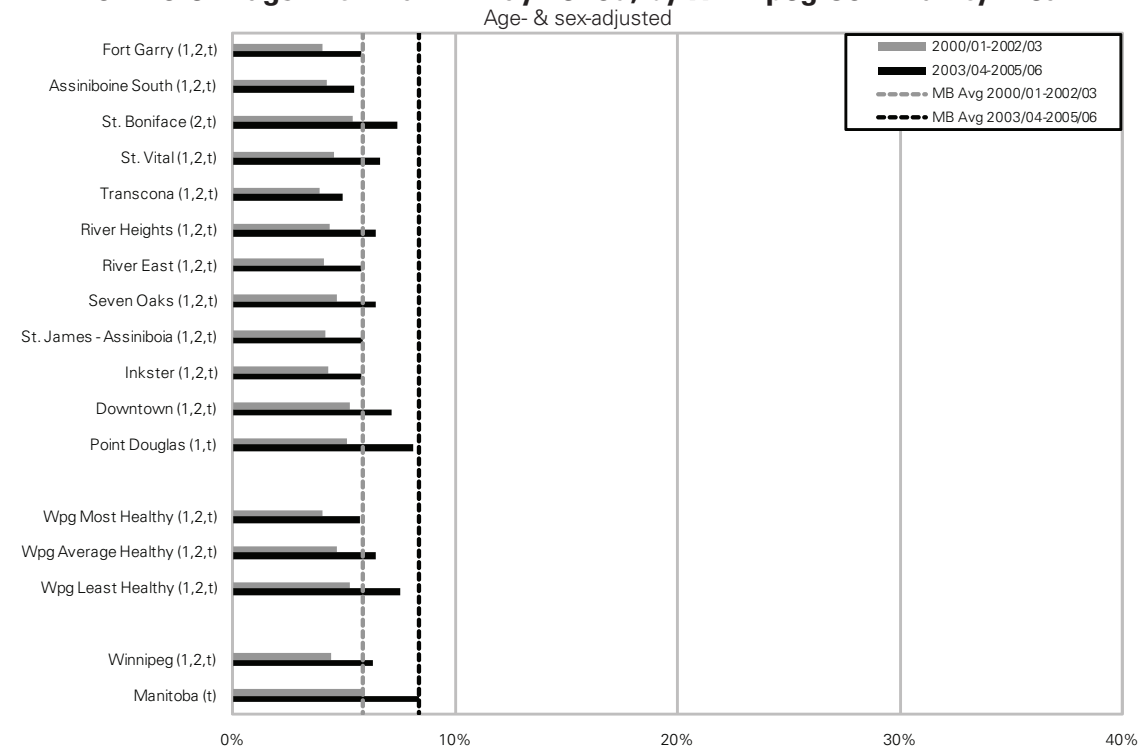
Figure 6.9: Percentage of Older Adults (65+ years) Who Filled Prescriptions for Six or More Drugs within a 121-Day Period, by RHA



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)
'

Source: Manitoba Centre for Health Policy, 2009

Figure 6.10: Percentage of Older Adults (65+ years) Who Filled Prescriptions for Six or More Drugs within a 121-Day Period, by Winnipeg Community Area

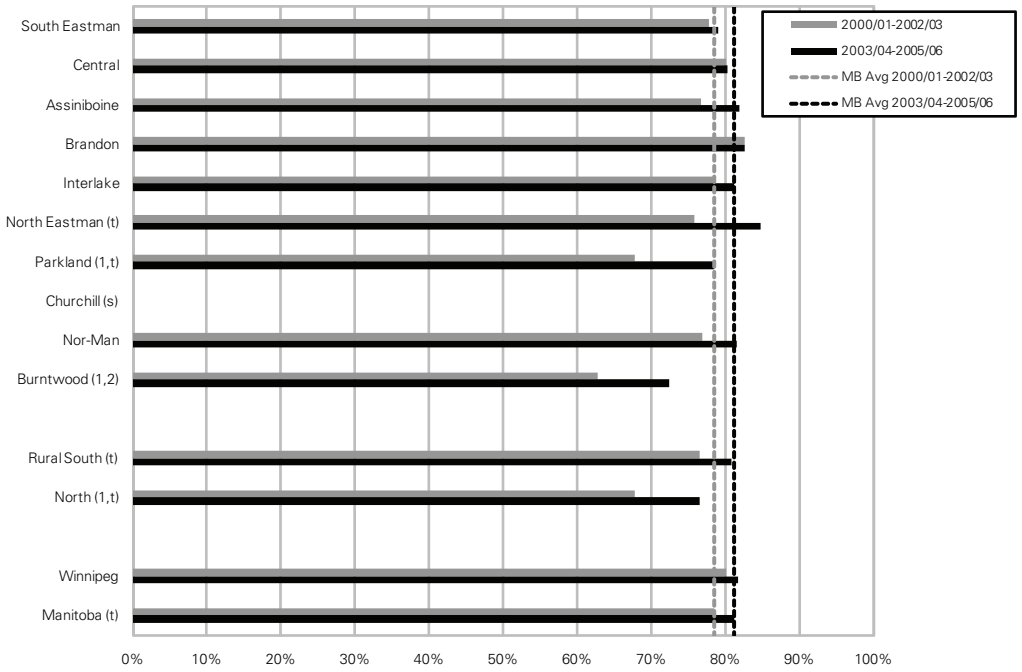


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 6.11: Percentage of Acute Myocardial Infarction (AMI) Patients Who Filled a Prescription for a Beta-Blocker Four Months After Their First AMI, by RHA

Age- & sex-adjusted

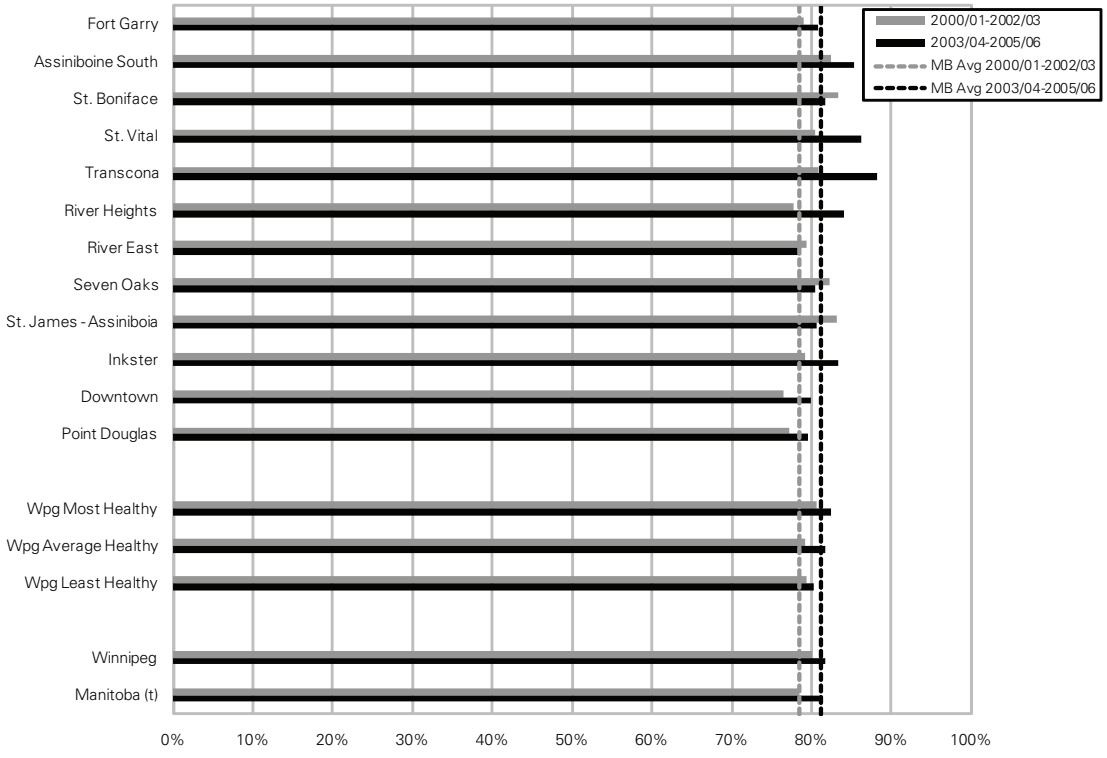


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2009

Figure 6.12: Percentage of Acute Myocardial Infarction (AMI) Patients Who Filled a Prescription for a Beta-Blocker Four Months After the First AMI, by Winnipeg Community Area

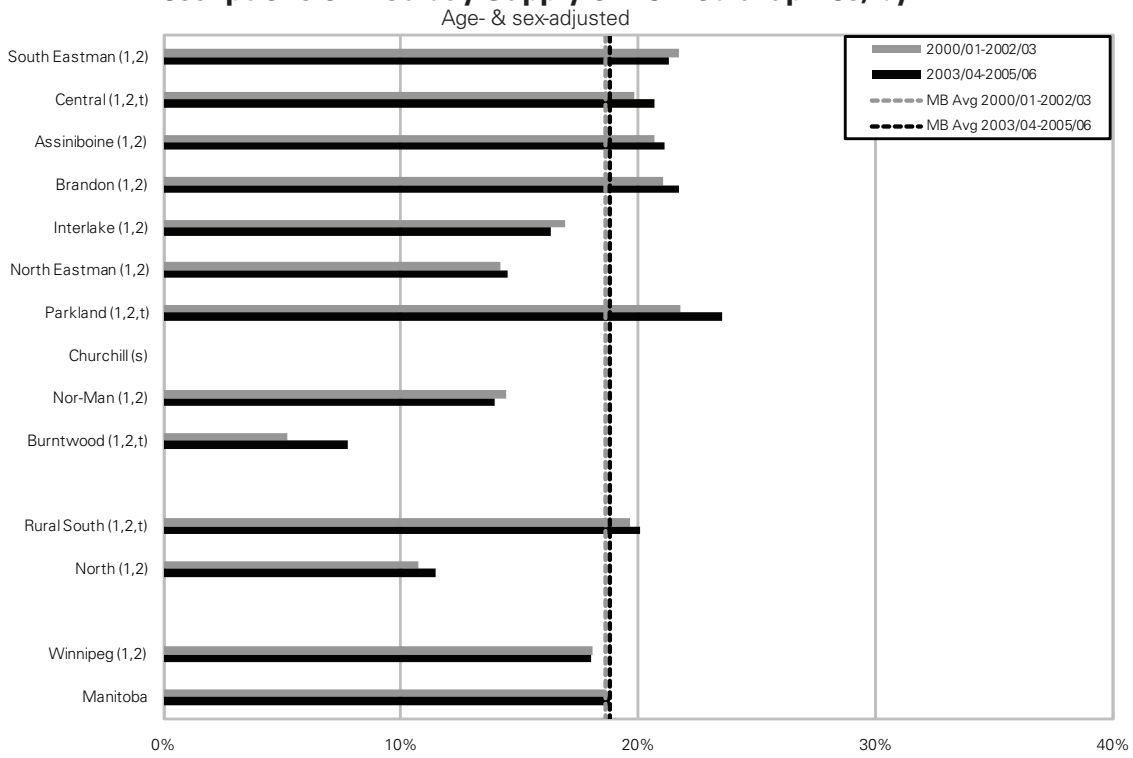
Age- & sex-adjusted



't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

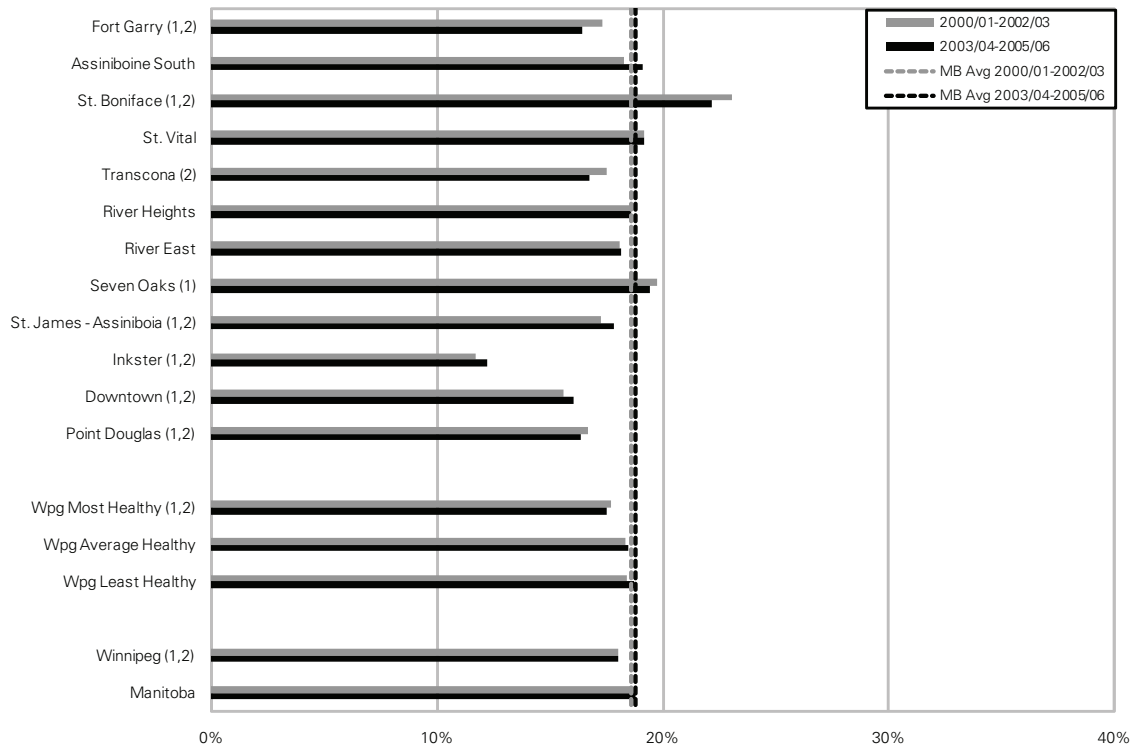
Figure 6.13: Percentage of Older Adults Aged 75+ Who Filled 2+ Prescriptions or > 30-day Supply of Benzodiazapines, by RHA



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2009

Figure 6.14: Percentage of Older Adults Aged 75+ Who Filled 2+ Prescriptions or > 30-day Supply of Benzodiazapines, by Winnipeg Community Area



'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)

Source: Manitoba Centre for Health Policy, 2009

6.5 Combining the Rates into Two Quality of Care Indices

For each of the quality indices, the adjusted rates for the indicators were combined using confirmatory factor analysis to obtain factor loadings.

Table 6.2: Factor Loadings for the Quality of Primary Care Composite Index, 2000/01 - 2002/03

Indicator	Factor 1
Asthma Care	0.22
Benzodiazepine Use	0.89
Post-Acute Myocardial Infarction Beta-Blocker Use	0.43
Depression Care	0.57
Diabetic Eye Exam	0.57

Source: Manitoba Centre for Health Policy, 2009

Table 6.2 shows the factor loadings for the quality of primary care index. All of the loadings are positive and range from quite weak (asthma care) to quite strong (benzodiazepine use). The only one of the five indicators (benzodiazepine use) that had a very high loading on the index should have had a negative association with the other four indicators rather than a positive association, as it indicates inappropriate care. There are two additional indicators that also have good loadings on the index (depression care and diabetic eye exam) and one which is marginal (Post AMI beta-blocker use). In sum although four indicators appear to form an index, one is fairly weakly associated (Post AMI beta-blocker use) and one has an unexpected and inappropriate positive loading (benzodiazepine use).

Table 6.3: Factor Loadings for the Quality of Pharmaceutical Use Composite Index, 2000/01 – 2002/03

Indicator	Factor 1	Factor 2
Asthma Care	0.34	0.24
Beer's Criteria	0.13	0.66
Benzodiazepine Use	-0.12	0.74
Post-Acute Myocardial Infarction Beta-Blocker Use	-0.40	0.46
Polypharmacy	0.99	-0.03

Source: Manitoba Centre for Health Policy, 2009

Table 6.3 presents the factor loadings for the quality of pharmaceutical use index. The indicators loaded on two factors. Only one of the loading values for the first factor (polypharmacy) was acceptable and a single indicator, by definition, does not constitute a composite index. The second factor is comprised of three indicators—two measuring inappropriate prescribing behaviours (Beers' Criteria and benzodiazepine use) and one measuring a positive behaviour— Post-AMI use of a beta-blocking agent. Unfortunately, all three had positive loadings, meaning that better AMI care was associated with high Beers' criteria and benzodiazepine prescribing. This pattern makes the scores difficult to interpret, as a high score means that care is both good and bad depending on the indicator. The same is true for a low score on the factor. Given that the factors resulting from this analysis were either insufficient or not interpretable, composite index scores were not calculated by RHA or Winnipeg CA, and the analysis did not proceed further.

6.6 What does not having composite indices of quality mean?

Quality of Primary Care Index

Our assumption about why this composite index did not work is that physicians may not be providing good quality of care to all patients all of the time. In other words, and for example, some physicians may be very good at providing diabetes care, but not particularly proficient with providing adequate follow-up to those diagnosed with depression.

It is tempting to think that, with the exception of asthma care, the other indicators of quality of primary care appear to work together to exhibit a measure of quality. Over the two time periods, however, several things happened to the included indicators. The proportion of Manitobans with an asthma diagnosis who were prescribed a drug for its long-term control decreased significantly. The proportion of older Manitobans aged 75+ years who were inappropriately dispensed benzodiazepines remained steady at about 18%. In contrast, the proportion of diabetic patients who had an eye exam significantly grew over the two time periods in all RHAs and Winnipeg CAs. A gradient in the uptake of this preventive measure was seen among the Winnipeg CAs: diabetic patients in Winnipeg Most Healthy received an eye exam at a higher percentage than their counterparts in Winnipeg Least Healthy. The proportion of Manitobans with a new prescription for an antidepressant drug who had follow-up visits did not change over time. Finally, the proportion of patients who were discharged from hospital after having an AMI and who were dispensed a beta-blocker within four months of discharge remained stable.

Quality of Pharmaceutical Use Index

This index likely did not work for the same reason as the previous index. Just as some physicians may be better at care in some areas than in others, they may also be better prescribers in some areas than in others.

Observations about the age- and sex-adjusted rates by RHA and Winnipeg CA for the three indicators common to both quality indices are presented in the previous section. Considering the other indicators in this index, the proportion of seniors (aged 65+) having at least one Beers Criteria medication dispensed decreased significantly over the two time periods, while the proportion of this same cohort experiencing polypharmacy increased significantly. Polypharmacy appeared to follow a gradient: compared to healthier areas, the polypharmacy rate was higher for patients in the less healthy areas (e.g., Burntwood RHA and Winnipeg Least Healthy). Katz et al. (2004) also attempted and failed to create a composite index of several quality of care indicators, but at the level of the individual physicians rather than the patient population. Regardless of the approach, the creation of a composite index of quality of care was not successful.

6.6.1 Comparisons to Other Findings

Antidepressant Prescription Follow-Up

Premature discontinuation of antidepressant pharmacotherapy is a major and persistent failure point in depression care. Among patients initiating antidepressant treatment by a primary care physician, 40-50% discontinue treatment within three months, before the acute-phase of treatment is complete

(Dunn, Donoghue, Ozminkowski, Stephenson, & Hylan, 1999). This appears to be true regardless of the severity of the depression (Katon et al., 2000). A differential has been seen between those patients treated by primary care physicians and those treated by psychiatrists (Katzelnick, Kobak, Jefferson, & Greist, 1996). Those treated by psychiatrists, on the other hand, have a significantly higher percentage of treatments of minimum adequate dose and duration (57%) than those treated by non-psychiatrists (47%) (Katzelnick et al., 1996). Our analyses did not make this distinction, and we found that the rate of appropriate treatment significantly decreased over the two time periods. Katz et al. (2004) found that the rates of adherence to depression care does vary across physicians, suggesting the possibility that more appropriate education and follow-up may decrease the probability of premature discontinuation of effective treatment.

Asthma Care

The age- and sex-adjusted rates for Time 1 (2000/01-2002/03) match those found by Katz et al. (2004). FitzGerald et al. (2006) found a 62% rate of use of the asthma maintenance drugs or long-term controller medications (inhaled corticosteroids (ICS), alone or in combination with a long-acting beta-agonist), which is close to the rates we found. Although we do not know the right population rate for taking maintenance medications for asthma control, it should be higher than three out of five patients who are using an ICS to control their asthma. The significant downward trend in treatment of asthma with an ICS is troubling.

Beers' Criteria

We applied the Beers Criteria (minus the benzodiazepine indicator) to our population of seniors 65 years of age and over. Our rates are far below those found by others who also excluded benzodiazepines (14%-21%) (Stuck et al., 1994; Wilcox, Himmelstein, & Woolhandler, 1994). However, if the rate of seniors aged 75 and over who were prescribed benzodiazepines is included, then the Beers criteria rates would more closely align with studies which have applied the list of medications that should be avoided in older adults (Beers, 1997; McLeod, Huang, Tamblyn, & Gayton, 1997).

Diabetes Care—Eye Examination

Manitoba rates increased significantly over our two time periods and became closer to those reported in Ontario (46%) (Harris et al., 2003) and other countries (McCarty, Lloyd-Smith, Stanislavsky, & Taylor, 1998; Saadine, Fong, & Yao, 2008). Part of the increase in Manitoba rates may be an artifact related to changes in billing guidelines for optometrists. Optometrists have the option to enter a diagnosis code in their billing for eye exams for medically necessary exams. Over time this coding has been interpreted and applied differently (Katz et al., 2004). In addition to using ICD-9-CM code for refraction, optometrists may also specify the medical diagnosis (e.g., diabetes) associated with the test. Not all optometrists bill MHHL for eye exams for patients with diabetes, which may also result in spuriously lower rates for this preventive service.

In a study by Saadine et al. (2008), older persons who had a longer duration of diabetes, poorer vision, and more severe retinopathy, were more likely to have a follow-up examination within one year of a retinopathy diagnosis. Additional studies are needed to further understand the barriers to receiving a follow-up eye examination among diabetic patients.

Polypharmacy

The increase in rates of polypharmacy we found between the two time periods is significant (5.8% in Time 1 to 8.3% in Time 2 for Manitoba). This rate is significantly higher than that reported by Veehof et al. (2000)–4% in the older population of the Netherlands. The increase in the rate is likely related to the increase in the prevalence of chronic diseases in the population. As life expectancy increases, more people are living with multiple diseases, many of which have specific pharmaceutical treatment options. This results in higher rates of polypharmacy. Consider the following example:

> *An elderly patient with coronary artery disease requires a beta-blocker, aspirin, a statin, and nitroglycerin. If the patient also has hypertension that remains uncontrolled with the beta-blocker alone, the standard of care is to add a thiazide and, perhaps, another agent. Now the patient is taking six prescribed drugs. If the patient has congestive heart failure or diabetes, three or four more drugs could be added; if both conditions are present, another five or six drugs may then be dispensed. Thus, in this relatively common scenario, it would be considered medically appropriate for the patient to be taking as many as 12 pharmaceutical agents* (Ballentine, 2008, p.41).

Pharmaceutical agents may provide distinct benefits to the health and well-being of older patients; treating symptoms can maintain or improve their functionality and ability to live independently for longer periods of time. There are, however, potential problems when they use multiple medications, namely a greater chance of side effects and drug-drug interactions that in turn may cause further problems. Determining the appropriateness of specific medications, reviewing medication lists to consider whether drugs are still needed, if drugs being taken have a positive response, and having an understanding of the greater potential for adverse drug effects in older persons can help maximize benefit while minimizing harm to the older patients on multiple medications. Specific strategies are available and should be systematically applied in the care of older patients. The goal should be to determine the most appropriate drug regimen for a particular patient given their specific circumstances and health problems.

Post-Acute Myocardial Infarction Care—Beta-Blocker Prescribing

Reports of beta-blocker use after an AMI in the early 2000s appeared to be stalled between 33% and 50% (McCormick et al., 1999). Our findings above this rate are significant but not unusual compared to more recent reports (Kennedy, 2001; Winkelmayer, Bucsics, Schautzer, Wieninger, & Pogantsch, 2008). The rates found over time in this analysis are higher than the 59% rate of prescribing found in Manitoba from 1999 to 2001 (Katz et al., 2004).

In the past, physicians have prescribed beta-blockers for fewer than one-third of their patients and cardiologists for less than half of their patients with an AMI (Winkelmayer et al., 2008). We excluded patients with a history of asthma, peripheral vascular disease, and chronic obstructive pulmonary disease from our analysis as the potential presence of these conditions signals a caution to prescribing them. It is also thought that patients with heart failure may not be getting a beta-blocker even though they are unquestionably beneficial in this condition (Everly, Heaton, & Cluxton, Jr., 2004). Finally, patients with diabetes are not prescribed these drugs because beta-blockers allegedly mask the symptoms of hypoglycaemia (Note: Most diabetics have type 2 diabetes, the treatment for which rarely induces hypoglycaemia).

Potentially Inappropriate Prescribing of Benzodiazepines for Older Adults

The rates of benzodiazepine use among community-dwelling seniors 75 years of age and older align closely with those found in a study of personal care home residents by Doupe et al. (2006). Other researchers have also found similar prescribing rates among insured populations of seniors (Yang, Simoni-Wastila, Zuckerman, & Stuart, 2008; Linden, Bär, & Helmchen, 2004). A meta-analysis of observational studies (Leipzig, Cumming, & Tinetti, 1999) demonstrated a pooled odds ratio for the association between benzodiazepines and falls of 1.40 (95% CI51.11–1.76) in cohort studies, 2.57 (95% CI51.46–4.51) in case-control studies, and 1.34 (95% CI50.95–1.88) in cross-sectional studies. Many approaches to preventing falls are only effective if the underlying risks, such as use of benzodiazepines, are recognized. For example, by using a comprehensive approach to assessing likelihood for falls (e.g., use of medication that contributes to dizziness, evaluating the need for aids/devices, overcoming the fear of falls, and activities of daily living), a more effective intervention can be designed (van Haastregt, Diederiks, van Rossum, de Witte, & Crebolder, 2000).

6.7 Conclusion

We attempted to build two quality of care composite indices to identify how effectively we use proven care initiatives to monitor how we are delivering evidence-based care for the best possible outcomes. Our working assumption that two quality of care indices reflecting quality in primary care and pharmaceutical use could be constructed was not supported by the data. The mixed factor loadings, and in some cases very low loadings, suggest that quality of care is independent within each disease. Any evaluation of quality of care across time or geographies would have to be refer to each individual indicator, rather than attempting to create a composite index.

Chapter 7: Prevalence of Chronic Disease

Building and Interpreting the Composite Index:

Building a composite index for measuring the prevalence of chronic disease would help document differences across areas and monitor trends over time; it could also be used to evaluate the effectiveness of related programs and services for chronic disease. The index developed lacked enough 'face validity' for it to be useful.

7.1 Intent of the Index

It is estimated that over 33% of Canadians 12 years of age and older have at least one chronic disease (Statistics Canada, 2005a). Chronic conditions including cardiovascular disease, respiratory illness, and diabetes have a great effect on both quality of life and morbidity (Morgan, Zamora, & Hindmarsh, 2007). These diseases are generally incurable, are caused by a complex interaction of factors, and usually have a prolonged clinical course (Health Surveillance Coordination Division, 2003). Patra et al. (2007) estimated that the economic burden of such conditions exceeds $80 billion annually. The focus of this chapter is on measuring the prevalence of chronic disease with a composite index.

7.2 Indicators Used to Construct the Index

We used chronic disease prevalence algorithms previously developed by MCHP (Lix et al., 2006). Table 7.1 presents the indicators and algorithms used.

Table 7.1: Algorithms Used to Define Chronic Conditions

Arthritis:

- 1+ hospitalizations with one of diagnosis codes 274, 446, 710-721, 725-729 or 739 in any diagnosis field over 2 years of data, OR,
- 2+ physician claims with one of diagnosis codes 274, 446, 710-721, 725-729 or 739 over 2 years of data, OR,
- 1+ physician claim with one of diagnosis codes 274, 446, 710-721, 725-729 or 739, AND 2+ Rx for arthritis drugs over 2 years of data.

Asthma:

- 1+ hospitalizations with diagnosis code 493 in any diagnosis field over 2 years of data, OR,
- 1+ physician claims with diagnosis code 493 over 2 years of data, OR,
- 1+ Rx for asthma drugs over 2 years of data.

Diabetes:

- 1+ hospitalizations with diagnosis code 250 in any diagnosis field over 2 years of data, OR,
- 2+ physician claims with diagnosis code 250 over 2 years of data, OR,
- 2+ Rx for diabetes drugs over 2 years of data.

Hypertension:

- 1+ physician claims with one of diagnosis codes 401, 402, 403, 404 or 405 over 2 years of data

Ischemic Heart Disease (IHD):

- 1+ hospitalizations with one of diagnosis codes 410, 411, 412, 413, or 414 in any diagnosis field over 2 years of data, OR,
- 2+ physician claims with one of diagnosis codes 410, 411, 412, 413, or 414 over 2 years of data, OR,
- 1+ physician claim with one of diagnosis codes 410, 411, 412, 413, or 414 AND 2+ Rx for IHD drugs over 2 years of data.

Source: Manitoba Centre for Health Policy, 2009

7.3 Rationale for the Index

The burden of chronic disease is high and growing nationally and in Manitoba. Estimates indicate that about one-third of Manitobans experience at least one chronic disease; this increase to over 70% of residents aged 60 years and older (Broemeling, Watson, & Prebtani, 2008). Although we are generally living longer healthier lives, over 12% of us are living with multiple chronic diseases (Statistics Canada, 2005a).

Public health departments have been urged to "adjust to the epidemiological transition from communicable to chronic disease" (Frieden, 2004, p.2059). Public health's traditional role—surveillance—could be used to determine the burden of chronic diseases and how the healthcare system might be affected and might respond. Surveillance would also help us to understand how successful we have been in trying to prevent or delay the onset of chronic disease.

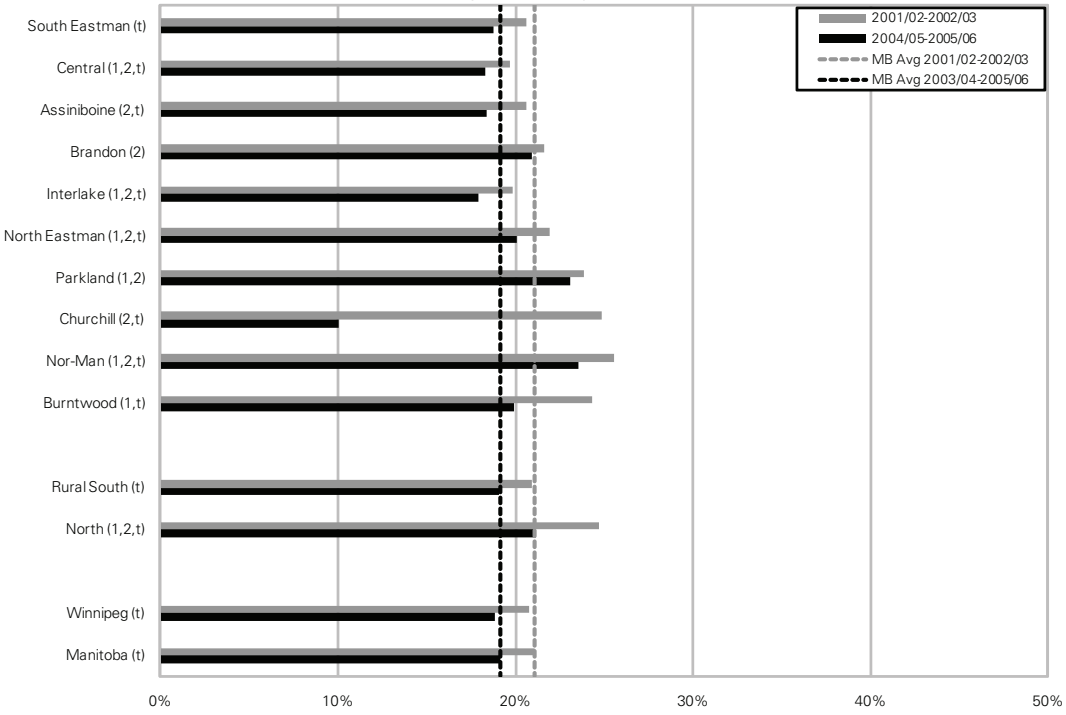
Assessing the prevalence of chronic disease can be important for planning and care delivery, as poor management of disease can be costly (McGlynn et al., 2003). Extrapolation to the entire U.S. population of findings from an American study of 6,712 randomly selected residents showed, for example, excessive cases of kidney failures and blindness from lack of blood sugar control in persons with type 2 diabetes. As well, there were additional heart attacks when heart attack survivors are not prescribed needed medications for preventing another heart attack. In a seven-country study comparing chronic care delivery in primary care, Canada ranks last in chronic disease prevention and management. This has been attributed to Canada's lack of national vision or direction to ensuring that standards of chronic care are implemented, integrated, and coordinated (Schoen et al., 2006) possibly through better organization of primary care.

7.4 Adjusted Rates of the Indicators Used to Construct the Index

In Figures 7.1 to 7.10, the adjusted rates for each indicator are shown by RHA and Winnipeg CA for two three-year time periods. The crude rates can be found in Tables A4.26-A4.30 of Appendix 4.

Figure 7.1: Percentage of Residents with Arthritis, by RHA

Age- & sex-adjusted

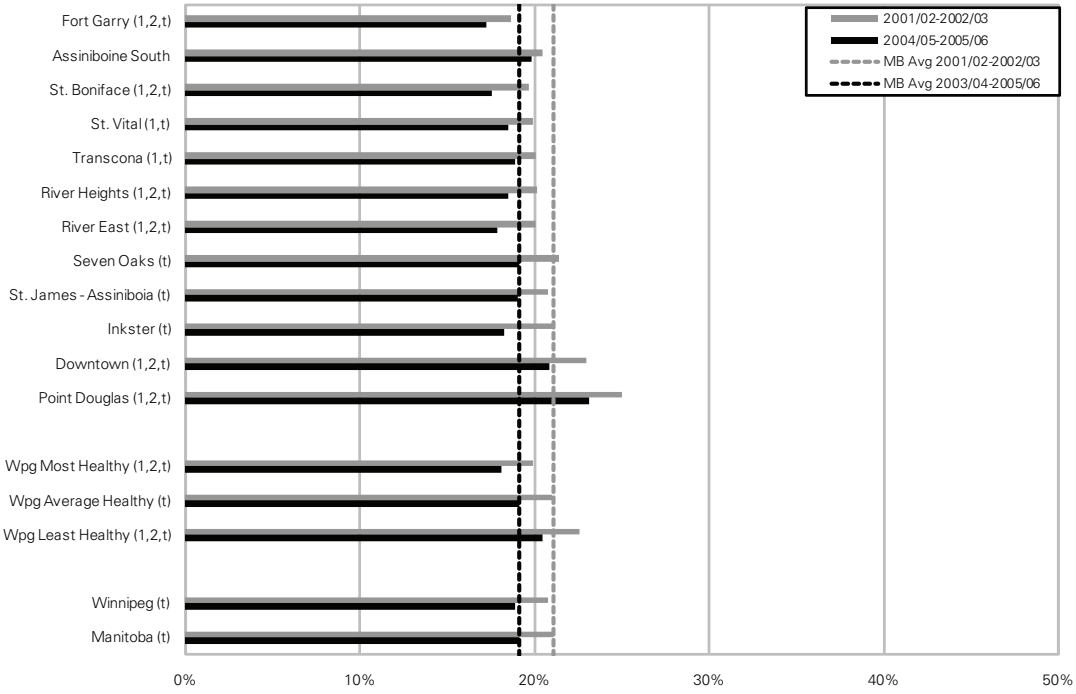


'1' indicates area's percentage was statistically different from Manitoba's average in first time period (p<.01)
'2' indicates area's percentage was statistically different from Manitoba's average in second time period (p<.01)
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 7.2: Percentage of Residents with Arthritis, by Winnipeg Community Area

Age- & sex-adjusted



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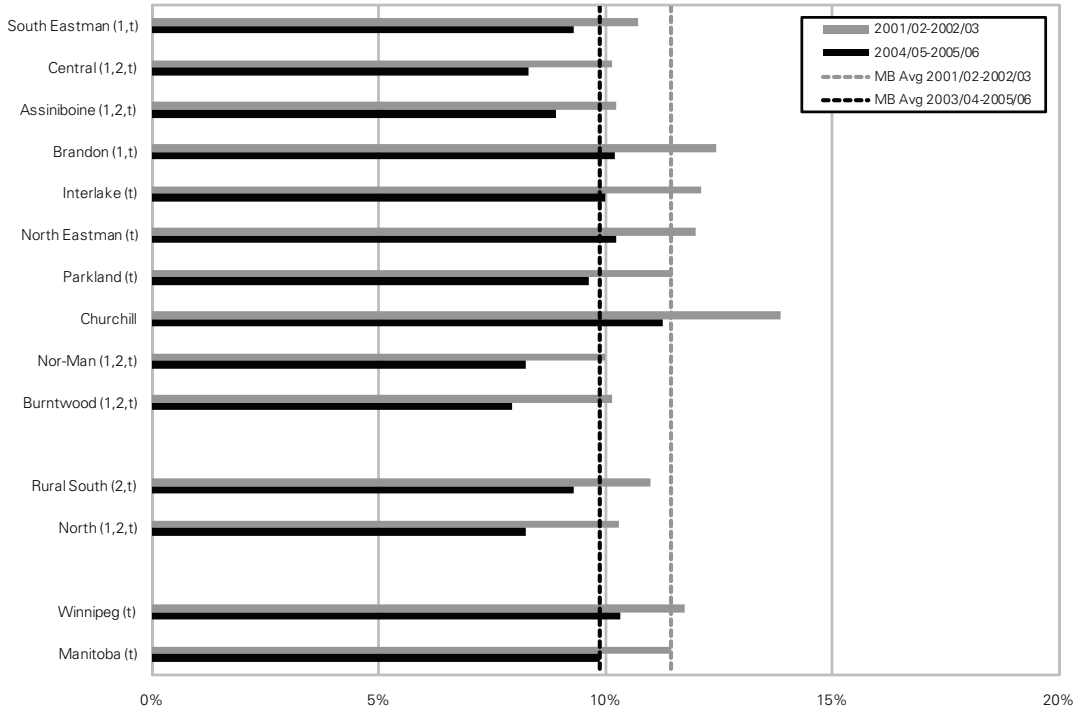
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 7.3: Percentage of Residents with Asthma, by RHA

Age- & sex-adjusted



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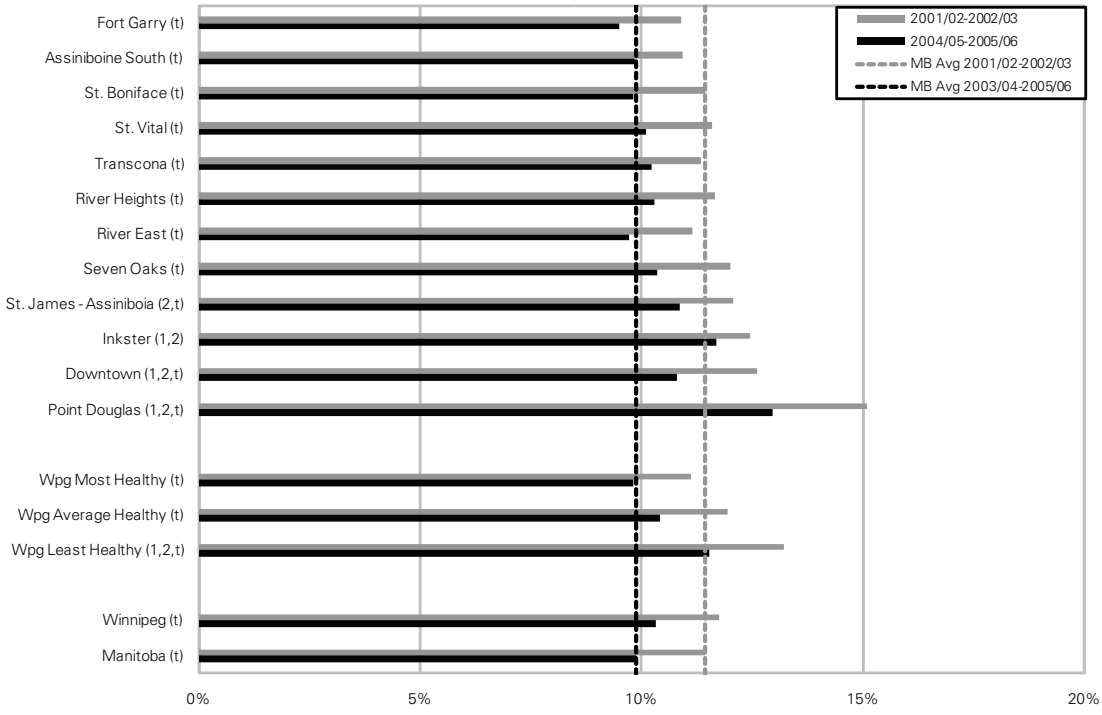
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 7.4: Percentage of Residents with Asthma, by Winnipeg Community Area

Age- & sex-adjusted



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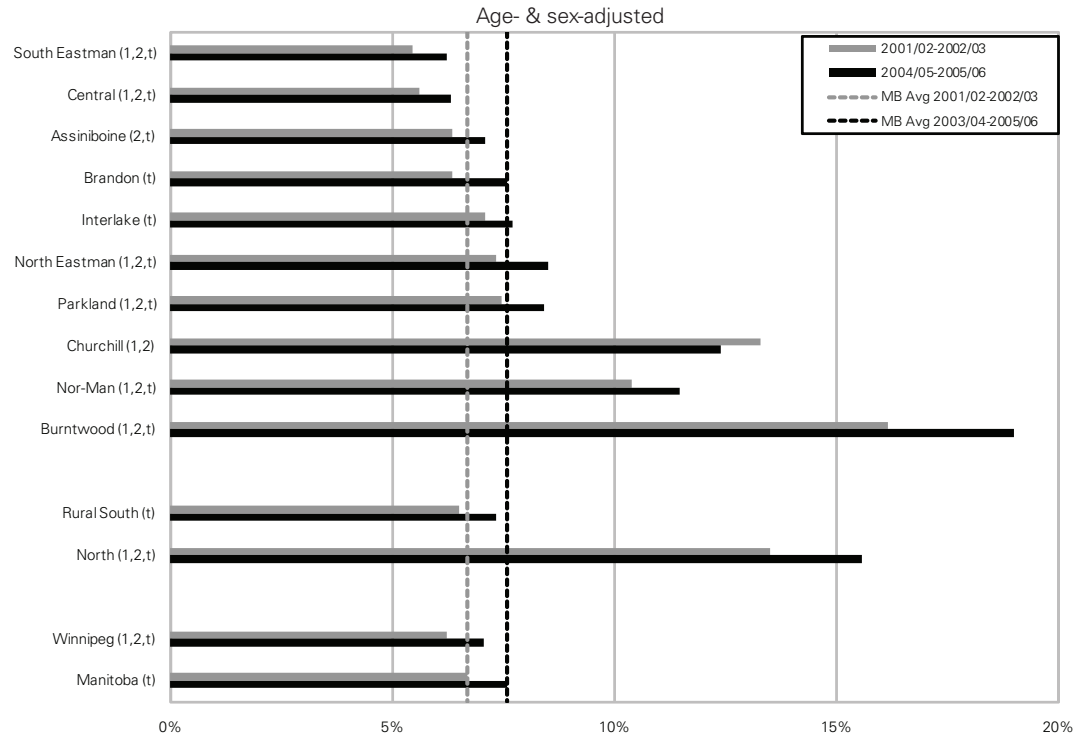
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy,

Figure 7.5: Percentage of Residents with Diabetes, by RHA



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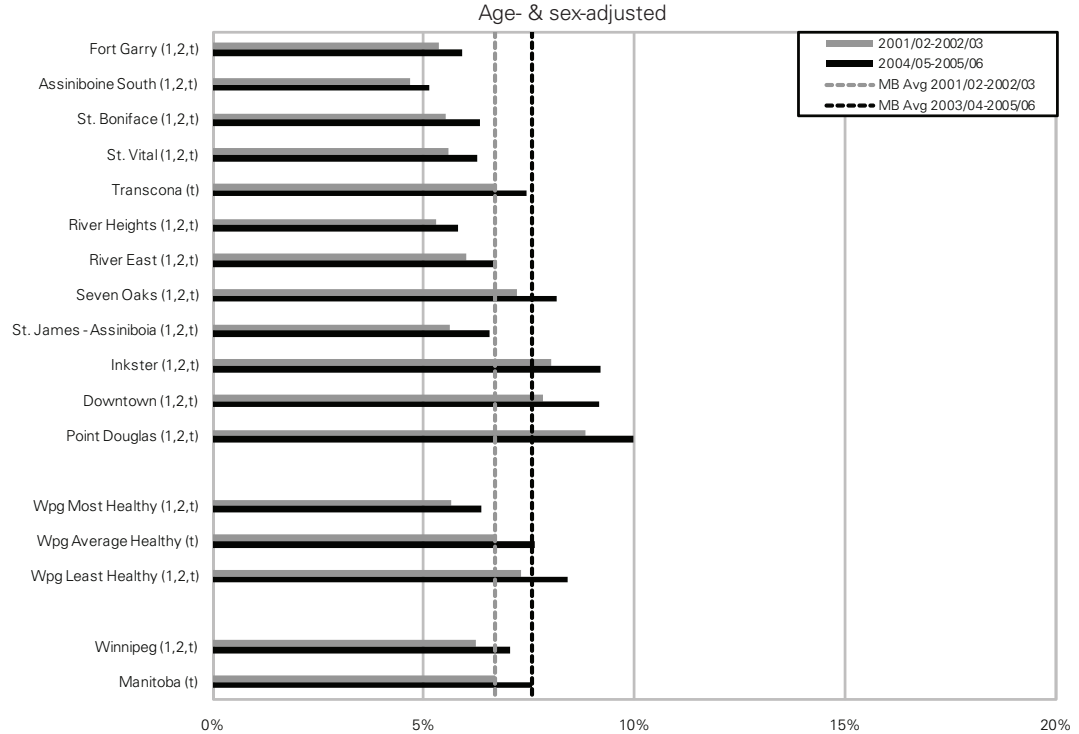
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 7.6: Percentage of Residents with Diabetes, by Winnipeg Community Area



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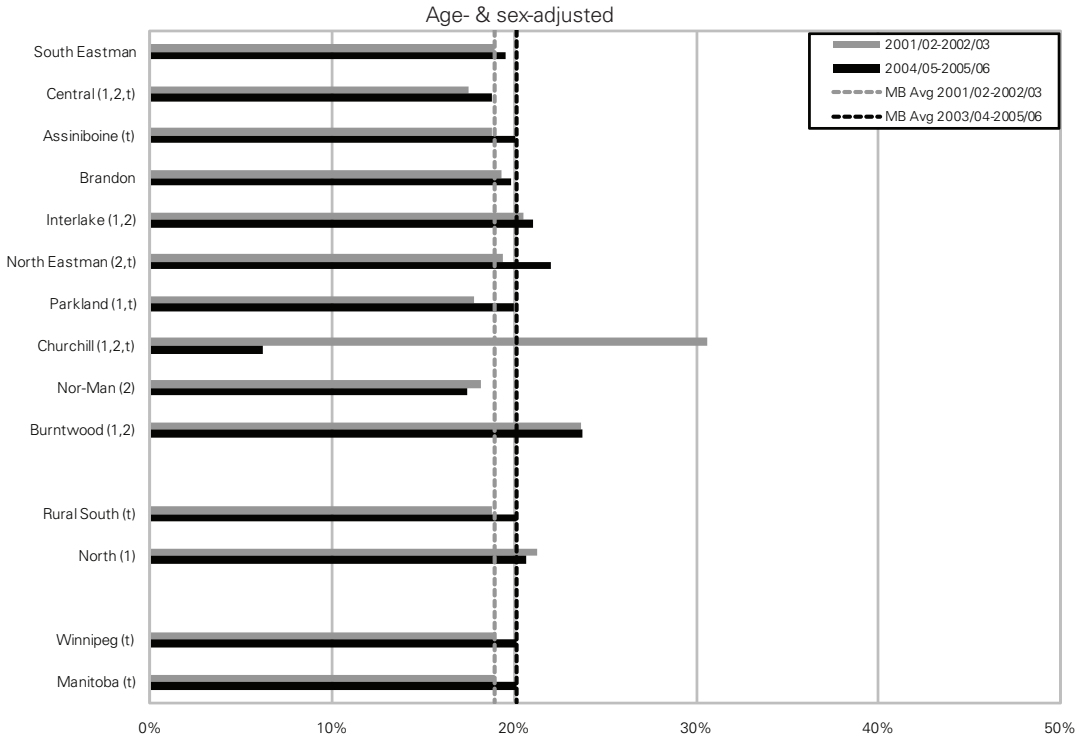
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 7.7: Percentage of Residents with Hypertension, by RHA



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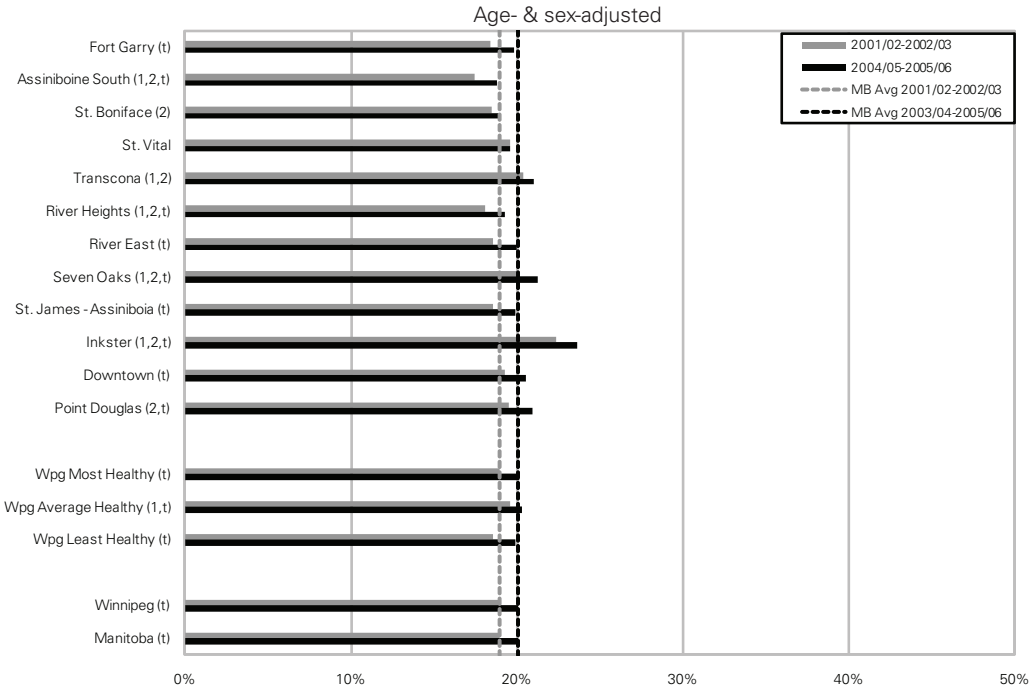
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 7.8: Percentage of Residents with Hypertension, by Winnipeg Community Area



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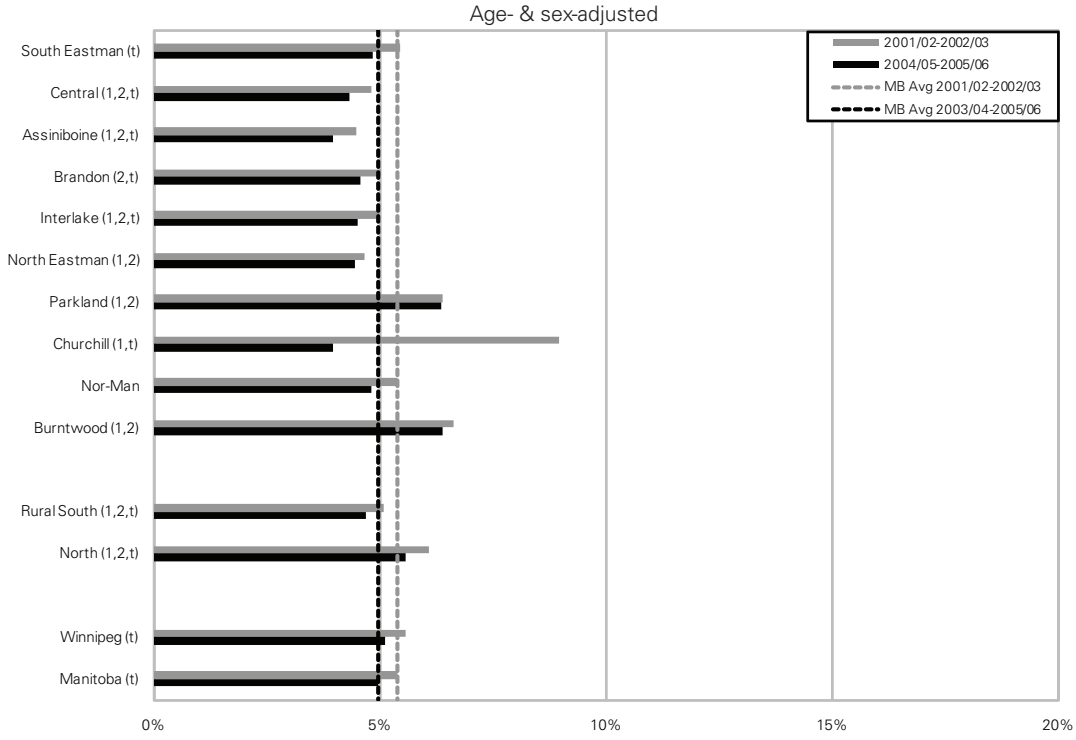
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 7.9: Percentage of Residents with Ischemic Heart Disease, by RHA



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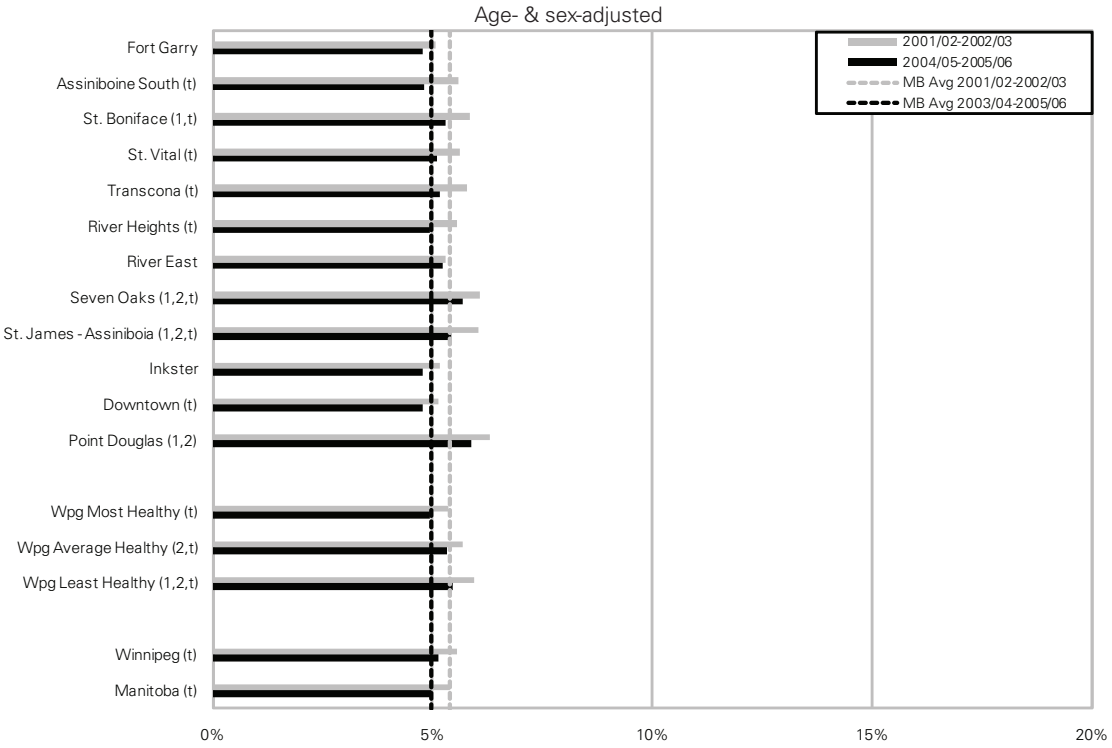
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 7.10: Percentage of Residents with Ischemic Heart Disease, by Winnipeg Community Area



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't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

7.5 Combining the Rates into an Index

The adjusted rates for each of the indicators were combined using confirmatory factor analysis to obtain factor loadings.

Table 7.2: Factor Loadings for Chronic Disease Composite Index

	Time 1: 2000/01 - 2002/03		Time 2: 2003/04 - 2005/06	
Indicator	**Factor 1**	**Factor 2**	**Factor 1**	**Factor 2**
Arthritis	**0.81**	0.07	**0.82**	0.07
Asthma	**0.68**	-0.39	**0.71**	-0.40
Diabetes	0.01	**0.98**	0.01	**0.81**
Hypertension	0.37	0.30	0.33	0.27
Ischemic Heart Disease	0.43	**0.61**	0.47	**0.67**

Source: Manitoba Centre for Health Policy, 2009

Table 7.2 shows the factor loadings for a possible composite index. The five indicators (chronic disease prevalence) split into two factors: 1) asthma and arthritis and 2) ischemic heart disease and diabetes. The hypertension prevalence indicator was not sufficiently associated with either factor.

The value of constructing two indices to assess the prevalence of only four indicators of chronic disease is questionable. In other words, although a statistically valid factor analysis was produced, its results did not reduce the number of indicators sufficiently to be particularly useful.

7.6 What does not having a composite index of the prevalence of chronic disease mean?

One might have concluded that two indices could be created from these data: Factor 1 (asthma and arthritis) to describe 'auto-immune and related disorders' and Factor 2 (diabetes and ischemic heart disease) to describe 'cardiovascular-related disorders'. However, given the necessary steps for validating the indices at each time point, it appears that examining arthritis, asthma, diabetes, hypertension, and ischemic heart disease individually would help us best assess the prevalence of chronic disease across the province and over time. A separate look at the age- and sex-adjusted rates of these chronic diseases could help us to understand the effectiveness of related programs and services for chronic disease.

7.6.1 Comparisons to Other Findings

Our prevalence rates of chronic conditions are similar to those found by the Centers for Disease Control and their Behavioral Risk Factor Surveillance System (Kilmer et al., 2008). They also match those reported by Lix et al. (2006) and by other Canadian and U.S. researchers. For example, our finding that Manitoba's age- and sex-adjusted rate for arthritis in Time 1 (2000/01-2002/03) was 21.1% is very similar to the U.S. rate of 21.6% for 2003-2005 (Hootman & Helmick, 2006).

The U.S. rates are the prevalence of self-reported 'doctor-diagnosed' rates of arthritis. Rates generated from Canadian self-report data for earlier or similar time periods are lower (about 17.6% nationally (Perruccio, Power, & Badley, 2006; Perruccio & Badley, 2004; Statistics Canada, 2005c).

Similar to our findings, some of the U.S. prevalence estimates for chronic disease also appear to follow a gradient but with socioeconomic status (SES). As will be pointed out in the next chapter, there is a strong relationship between SES and health status (i.e., PMR),which makes the results comparable. Using self-report data, asthma prevalence in the U.S. was estimated to be between 4.5% and 10.5% depending on the SES of the geographic location (Moorman et al., 2007); Manitoba's rates in Time 2 ranged from 7.9% in healthier areas to 1.2% in less healthy areas. Self-report rates of asthma prevalence in Manitoba are similar—7.9% (95% CI: 7.0-8.7%) in 2005 (Statistics Canada, 2005b). In contrast to the significant decrease in asthma rates found in this study, physician-reported asthma prevalence appears to have increased over time in the U.S. (from 5.6% in 1995 to 7.2% in 2003) (Moorman et al., 2007).

The prevalence of diabetes we report here closely follows the estimates reported by the National Diabetes Surveillance system (Sanmartin & Gilmore, 2005). The Manitoba estimates from survey data (Statistics Canada, 2005e) are lower (4.4%, 95% CI: 3.8-5.0%) than those found with administrative data algorithms (Hux, Ivis, Flintoft, & Bica, 2002). A recent Ontario study, using a validated diabetes database, found an age- and sex-adjusted rate of 8.8%; this rate is close to our reported rate for the most recent time period (7.6%) (Lipscombe & Hux, 2007).

Previous population estimates for the prevalence of hypertension in Canada have been largely based on in-person surveys with physical measures done in the late 1980s and early 1990s (21.1%) (Joffres, Hamet, MacLean, L'italien, & Fodor, 2001) and on patient self-report surveys (15.2%, 95% CI 14.1-16.3%) (Statistics Canada, 2005f; Statistics Canada, 2005d). Recent hypertension prevalence rates out of Ontario using a physical measures method shows an overall prevalence of 21.3% (Leenen et al., 2008). In Ontario, another study, using administrative data and a validated case definition algorithm for hypertension, found an overall age- and sex-adjusted prevalence of 24.5% (Tu, Chen, & Lipscombe, 2008). This is very close to Manitoba's adjusted rate (20.1% in Time 2) using a similar data source.

Determining the extent of the burden that non-fatal ischemic heart disease places on society is difficult as most databases and studies base the presence of cardiovascular disease (CVD) on the presentation of an acute event such as an AMI or stroke. This makes it difficult to establish the prevalence of asymptomatic disease. Public health surveys have been used to determine the prevalence of CVD in the ambulatory population. North American surveys indicate that CVD is diagnosed more frequently in men than in women who report a prior diagnosis of CVD (5.4% of Canadian men versus 4.6% of women and 8.4% of U.S. men versus 5.6% of women) (Manuel, Leung, Nguyen, Tanuseputro, & Johansen, 2003; Thom et al., 2006). Typically, Canadian statistics have been reported based on estimates of prevalence from self-reports of "heart disease" (Chow, Donovan, Manuel, Johansen, & Tu, 2005). Participants of the surveys are asked if they have ever had a heart attack, angina (chest pain/tightness), or congestive heart failure (inadequate heart beat). Prevalence determined this way is estimated at 5.0% for Canadians over 12 years of age (Frieden, 2004). Our age- and sex-adjusted prevalence was 5.0% in the Time 1.

7.7 Conclusion

We attempted to build a composite index for measuring the burden of chronic disease to help document differences in prevalence of chronic disease across areas and monitor trends over time. Although the index lacked enough face validity for it to be useful, individual indicators of chronic disease could be used to evaluate the effectiveness of related programs and services for chronic disease.

Chapter 8: Overall Health Status

Building and Interpreting the Composite Index:

Combining individual indicators of overall health to portray health status in Manitoba is another means of summarizing the performance of the healthcare system and its effectiveness.

8.1 Intent of the Index

This chapter presents several indicators of the overall health status of a population based on either vital statistics or socioeconomic data. Even though a composite index of the indicators is calculated, the use of a single indicator has some advantages over the index. The main advantages are that the indicators are relatively easy to define and calculate, comparable at the national and international level, well-understood, established, and can be used by others fairly simply. As well, whereas scores from a composite index are not directly interpretable, the scale for a single indicator has direct application. For example, a classic overall health indicator is life expectancy, which is defined as the number of years one is expected to live from birth. Thus, the value of 73 on this measure means that someone born would live for 73 years.

On the other hand, a composite index may better reflect a complex healthcare system in that the scores are typically highly correlated with a number of different measures. If an index and individual indicators are available and both are adequate measures, then the choice of which to use would depend on the objective of the presentation and the intended audience.

In this chapter, PMR and two additional health status indicators derived from vital statistics will be described and presented. The two additional measures are similar in form to PMR. Life expectancy is one that many people may have heard of, but may not be fully aware of its interpretation. Potential Years of Life Lost (PYLL) is based on premature death and takes into account the age at which a person died. In addition to these indicators, a number of SES measures, derived from aggregate census data, will also be presented. The need for healthcare services has been shown to be tied to social and economic conditions. The health status and socioeconomic indicators will be compared to each other and recommendations regarding the use and appropriateness of these indicators will be made.

8.2 Premature Mortality Rate

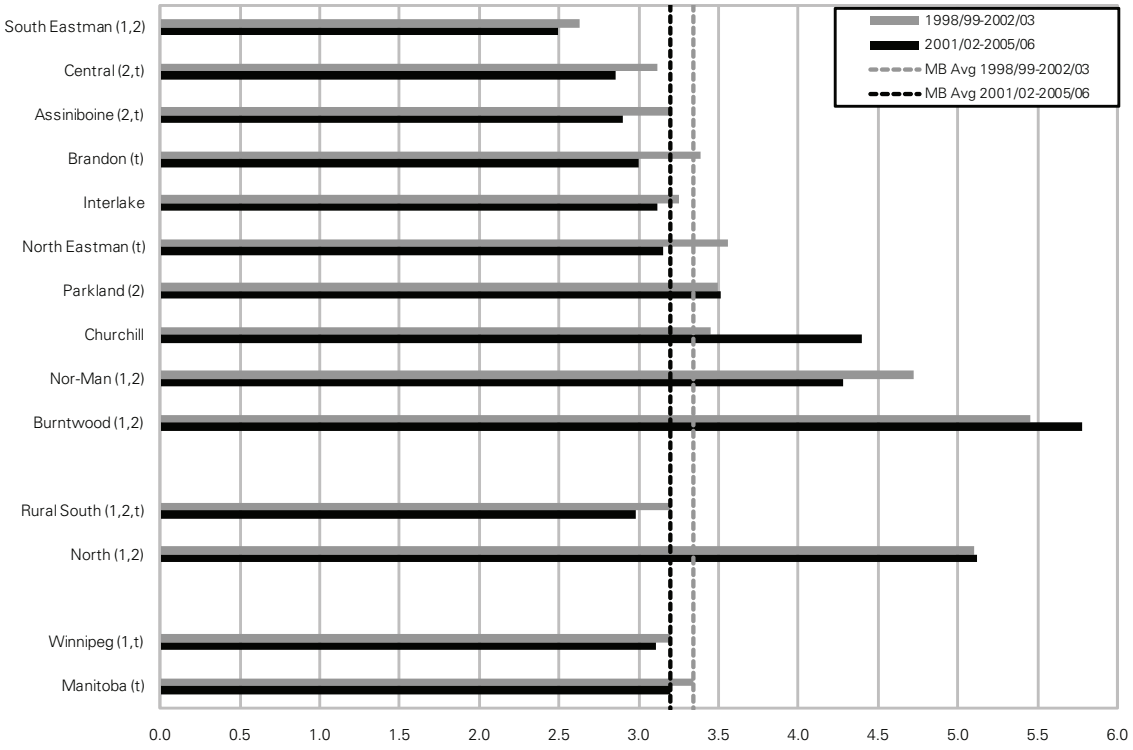
PMRs for the RHAs and Winnipeg CAs are presented Figures 8.1 and 8.2. The crude rates can be found in Table A4.31 of Appendix 4. Consistent with previous analyses of PMR in Manitoba, PMRs declined over time, suggesting an overall improvement in the health status of Manitobans. An exception to this general trend is found in the north, where both Churchill and Burntwood show increases in PMR. This exception was also previously noted by Brownell et al. (2003).

Among the larger geographical aggregations, there were small improvements over time in PMR in both the Rural South and Winnipeg, but there was no change in the north.

In Winnipeg, the core areas of Downtown and Point Douglas were the exceptions to a generally low PMR. The same general improvement in PMR over time was found in nearly all Winnipeg CAs. However, Point Douglas, which has the highest PMR in Winnipeg, showed no improvement. Aggregating Winnipeg CAs into Most Healthy, Average Healthy, and Least Healthy was based on PMR, and therefore showed the expected trend of increasing PMR for areas deemed to be less healthy. Looking at the change over time, the most improvement was seen in the areas that already had the lowest PMRs.

Figure 8.1: Premature Mortality Rates, by RHA

Age- & sex-adjusted rates per 1,000 residents aged 0-74



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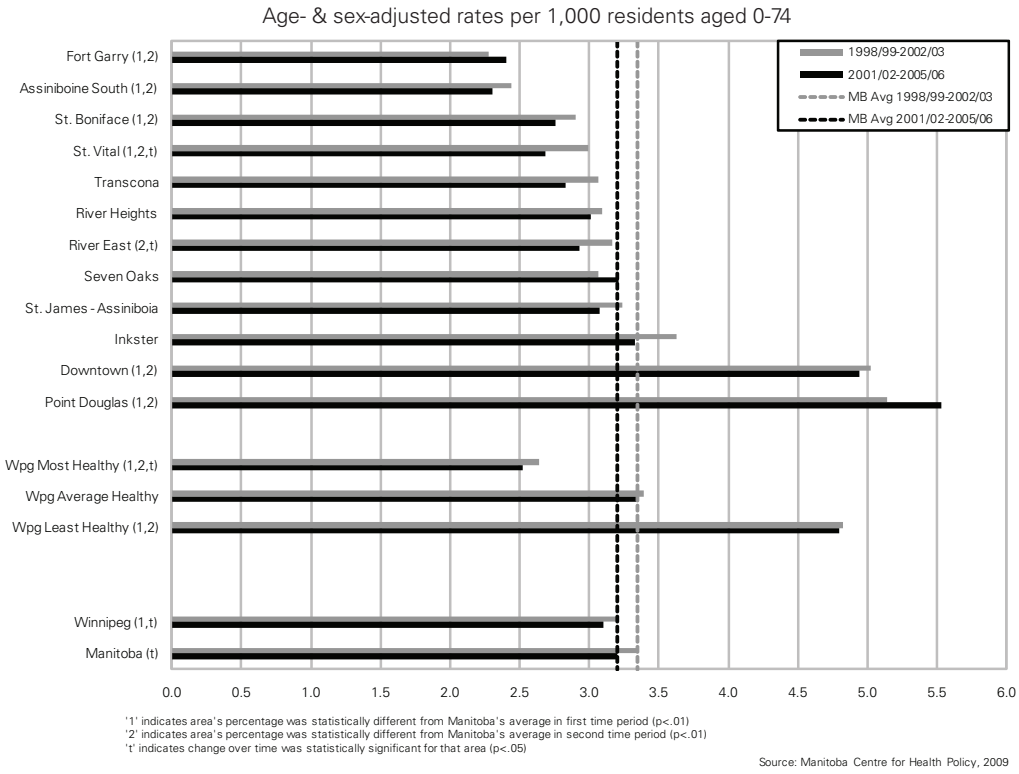
't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

Figure 8.2: Premature Mortality Rates, by Winnipeg Community Area



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't' indicates change over time was statistically significant for that area (p<.05)

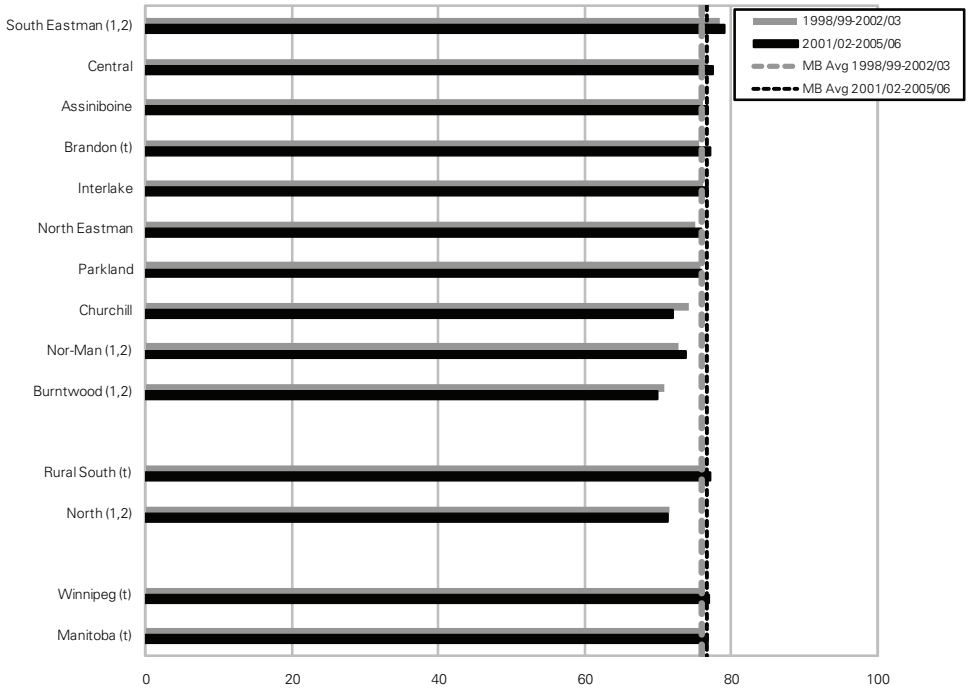
Source: Manitoba Centre for Health Policy, 2009

8.3 Life Expectancy

Life expectancy is the average number of years an individual of a given age is expected to live if current age-sex-specific mortality rates remain stable. Life expectancy is also associated with marital status, female gender, higher income, and urban geographical location (Fransoo et al., 2005; DesMeules, Manuel, & Cho, 2004). In Manitoba, higher life expectancy is associated with better socioeconomic and health conditions (Frohlich & Mustard, 1996). Although life expectancy can be calculated for any age, it is most commonly calculated from birth. Life expectancy at birth for the RHAs and Winnipeg CAs is presented in Figures 8.3-8.6; because of the substantial difference in life expectancy between males and females, it is presented separately for the two sexes.

Life expectancy followed the reverse pattern of PMR; where PMR was lowest, life expectancy was highest. Rural South had the longest life expectancy and showed improvement over time, whereas the north had the shortest life expectancy, and did not show any improvement. The same reverse relationship was found in the Winnipeg CAs.

Figure 8.3: Life Expectancy at Birth for Males, by RHA



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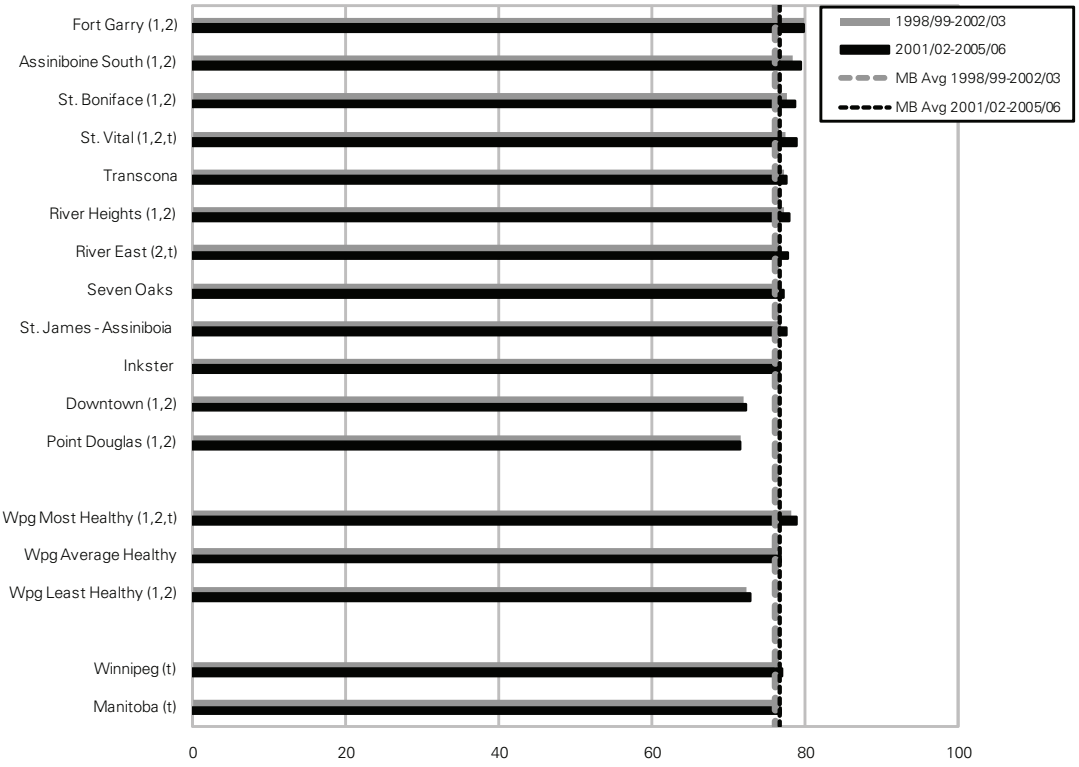
Source: Manitoba Centre for Health Policy, 2009

Figure 8.4: Life Expectancy at Birth for Males, by Winnipeg Community Area



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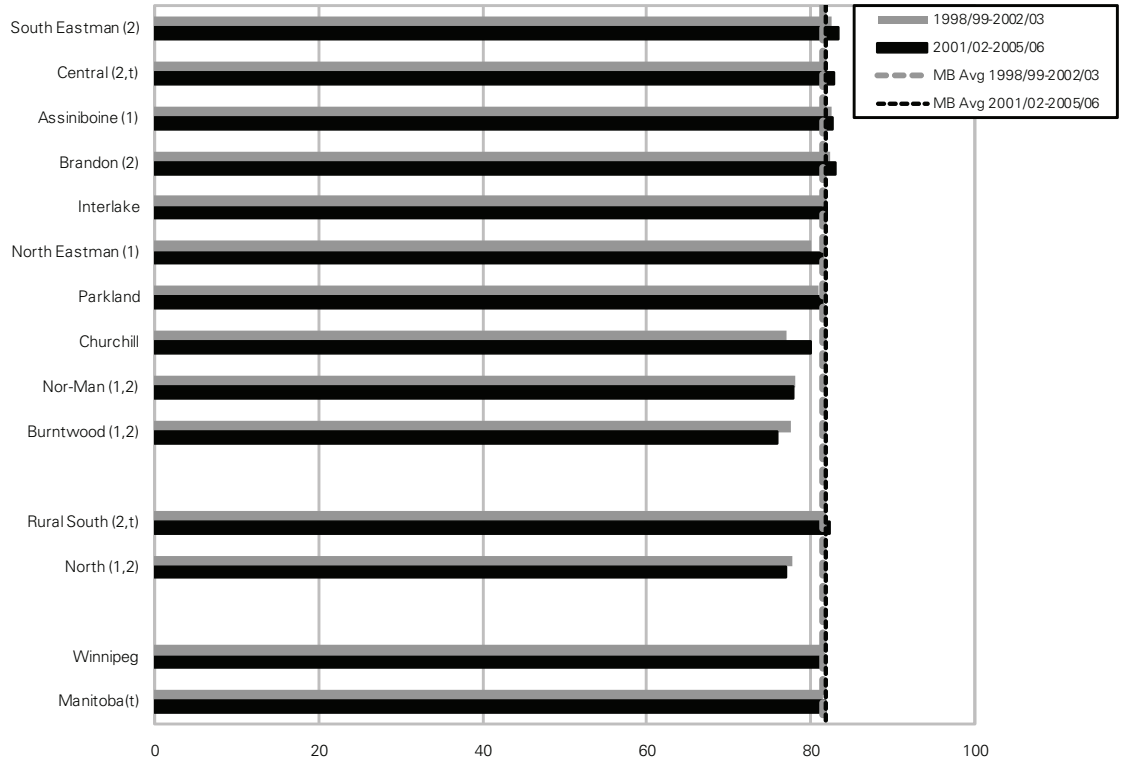
Source: Manitoba Centre for Health Policy, 2009

Figure 8.5: Life Expectancy at Birth for Females, by RHA



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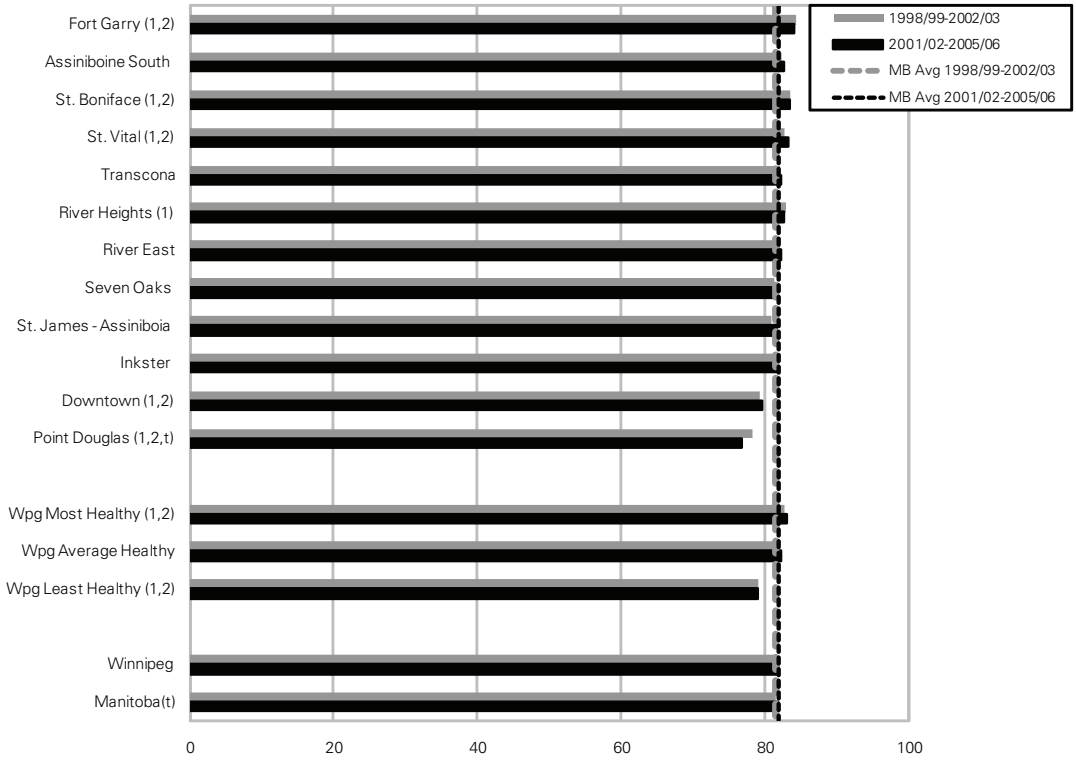
Source: Manitoba Centre for Health Policy, 2009

Figure 8.6: Life Expectancy at Birth for Females, by Winnipeg Community Area



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Source: Manitoba Centre for Health Policy, 2009

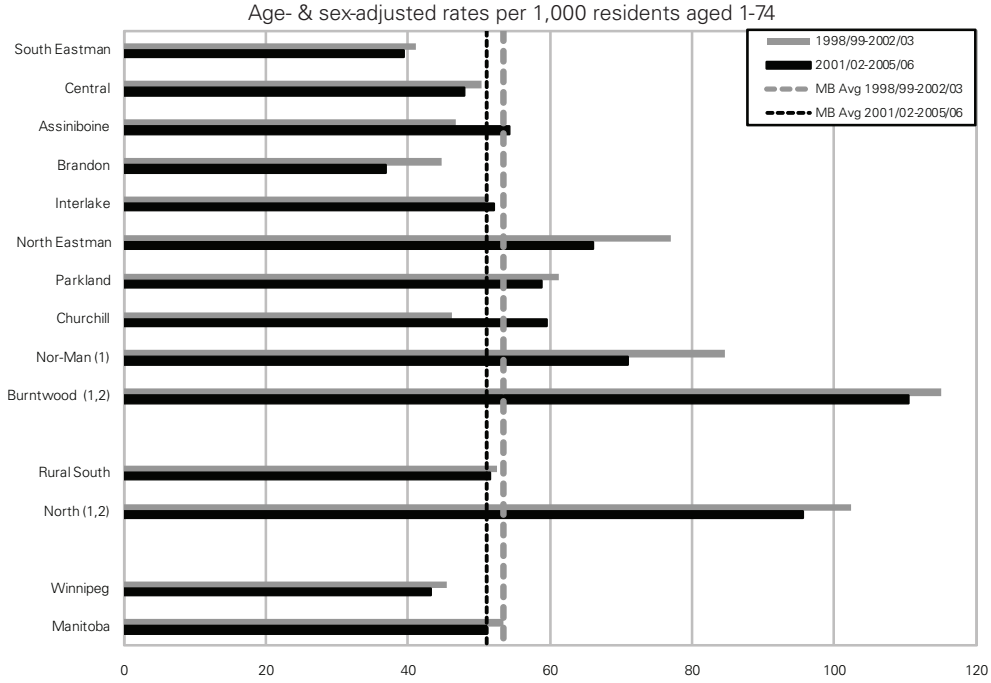
8.4 Potential Years of Life Lost (PYLL)

PYLL measures the number of years of life lost prior to a given age in the population (in this study we used age 75) (Romeder & McWhinnie, 1977). As an alternate measure of premature mortality, PYLL gives greater weight to death occurring at a younger age than to those at older ages. PYLL is calculated by subtracting the actual age of death from age 75 for each person, dividing the total of these values by the total population under age 75; this is presented as 'years lost per thousand people'. By emphasizing the loss of life at an early age, PYLL focuses attention on the need to deal with the major causes of such deaths, including cancer, injuries, suicide, and cardiovascular disease, in order to improve health status. A potential drawback is the inability to determine why PYLL rates between areas or groups of people might be different (or similar), as the death of a one-year-old contributes 74 years of life lost while the death of a 74-year-old contributes only one potential year of life lost. PYLL may be best interpreted in conjunction with PMR; for areas with similar PMR but dissimilar PYLL, the measure can offer an indication of the relative age of premature deaths between the areas. As with life expectancy and PMR, PYLL varies with gender, socioeconomic status, and geographical area.

Rates of PYLL are presented in Figures 8.7 and 8.8. Similar to PMR and life expectancy, the trend of lower rates in the south and higher rates in the north was also found here. Unlike PMR and life expectancy, however, the trends were much less consistent. One RHA with a relatively low PMR, Assiniboine, had a higher than expected PYLL. On its own, this would not be interpretable, but, given its low PMR, we can deduce that mortality amongst younger people was also higher here than in the other areas. As well, in Winnipeg CAs the rates were less consistent with PMR than with life expectancy. The one Winnipeg CA that stands out is Inkster, which had a relatively low PYLL. Also apparent with PYLL, as opposed to both PMR and life expectancy, is that rates did not consistently improve over time among either the RHAs or the Winnipeg CAs.

Figure 8.7: Potential Years of Life Lost, by RHA

Age- & sex-adjusted rates per 1,000 residents aged 1-74



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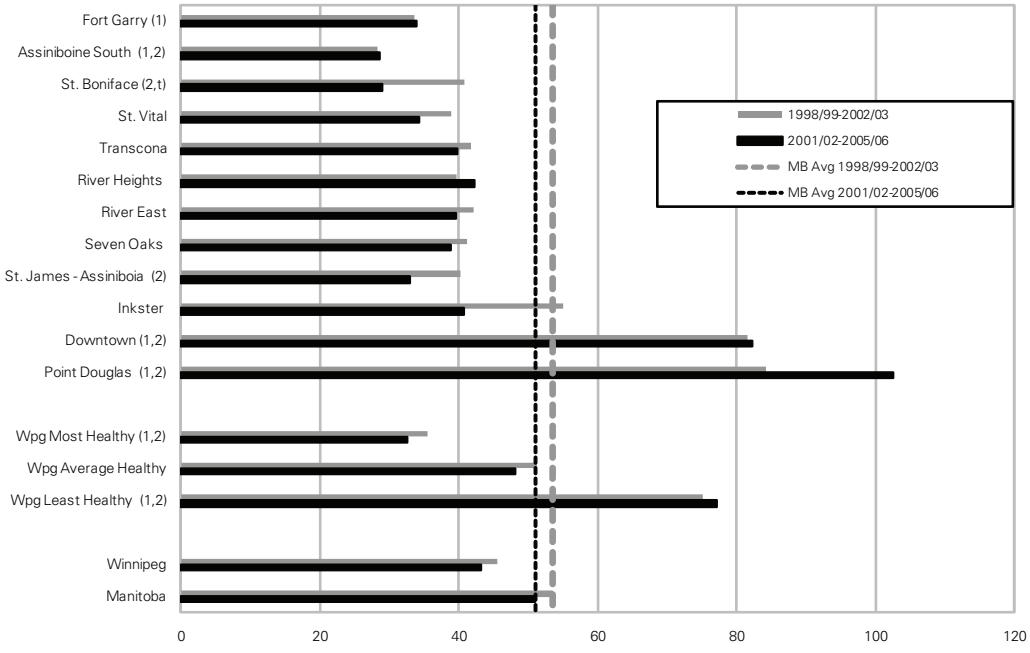
Source: Manitoba Centre for Health Policy, 2009

Figure 8.8: Potential Years of Life Lost, by Winnipeg Community Area

Age- & sex-adjusted rates per 1,000 residents aged 1-74



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't' indicates change over time was statistically significant for that area (p<.05)

Source: Manitoba Centre for Health Policy, 2009

8.5 Self-Rated Health

The last health status indicator to be examined is a subjective measure of health status which we calculated from the CCHS (cycles 1.1, 2.1, and 3.1). Self-rated health was assessed on the survey with the following question:

"*In general, would you say your health is: Excellent? Very good? Good? Fair? Poor?*"

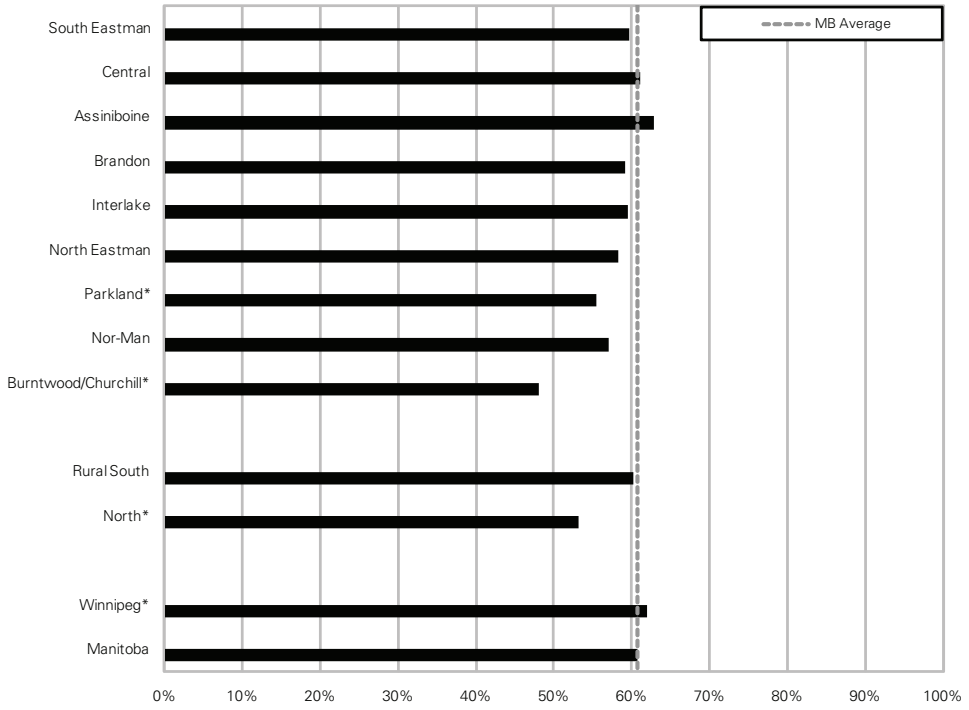
Respondents were told that health referred not only to the absence of disease or physical injury or disability, but also to mental and social well-being.

Self-rated health is known to be related to premature mortality, but does not depend on health records or contacts with the health system in order to describe health status. The proportion of respondents who indicated that that their health was either excellent or very good was calculated; we combined the three cycles of the CCHS in order to provide greater reliability for smaller geographic regions. These proportions are presented in Figure 8.9 and 8.10. The crude rates can be found in Table A4.33 of Appendix 4.

Self-rated health was highest in regions with lower PMRs and lowest in regions with higher PMRs. This pattern was present across RHAs and across Winnipeg CAs.

Figure 8.9: Percentage of Respondents Who Rated Their Health as 'Very Good' or 'Excellent', by RHA

Age- and sex-adjusted percentages

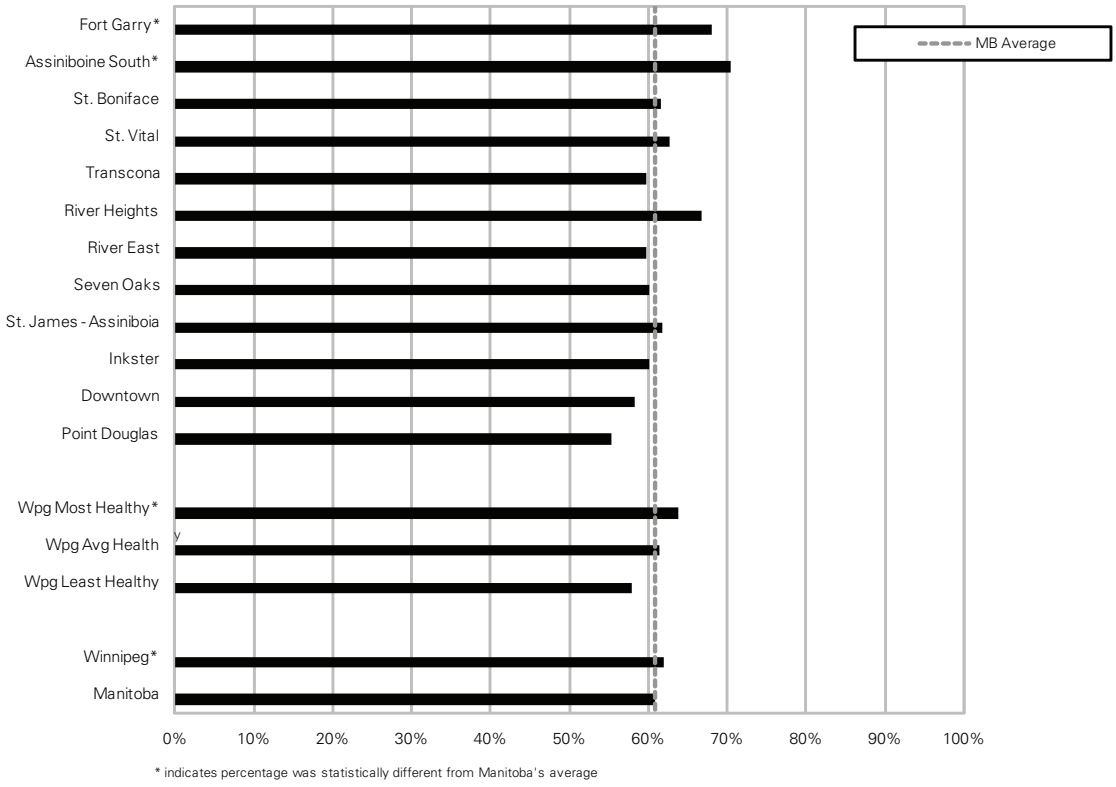


* indicates percentage was statistically different from Manitoba's average

Source: Manitoba Centre for Health Policy, 2009

Figure 8.10: Percentage of Respondents Who Rated Their Health as 'Very Good' or 'Excellent', by Winnipeg Community Area

Age- and sex-adjusted percentages



* indicates percentage was statistically different from Manitoba's average

Source: Manitoba Centre for Health Policy, 2009

8.6 Census-Based Measures of Socioeconomic Status

The relationship between an individual's SES and health has been well established (Mustard, Derksen, Berthelot, Wolfson, & Roos, 1997; Ecob & Smith, 1999). Although it might be considered a precursor or cause of health status versus a direct measure of health status like PMR, SES can be a powerful measure for both research and policy. As already noted, it is very highly correlated with the health status indicators presented in this chapter. For population-based research, the Canadian census has been most useful in providing a rich array of information on social and economic characteristics of people living in relatively small geographic areas. Various measures based on the census have been used over the years, with some researchers considering either income or education as the single most important factor determining SES; while others have also considered aspects such as marital status, household composition, and living conditions. All of these measures incorporate the implicit assumption that some groups of people are "deprived" compared to others, a concept that was well-articulated by Townshend (1987). He proposed that there are two types of deprivation—social and material—that are related to health outcomes.

Typically, measures of deprivation or SES attempt to provide a single indicator. Townshend (1987) developed a single measure of deprivation that encompasses both material and social deprivation. Likewise, the MCHP has developed the Socioeconomic Factor Index (SEFI) (Frohlich & Mustard, 1996), a score, based on census data that reflects non-medical social determinants of health and includes factors such as age, single parent status, female labour force participation, unemployment, and education. Salmond and others (Salmond, Crampton, & Sutton, 1998; Salmond & Crampton, 2002) also developed a measure based on several variables from the New Zealand census. All of these SES measures have been shown to be highly correlated with mortality, indicating that they may also be good measures of overall health status. However, whether they are measures of material deprivation or social deprivation, or some combination of the two, is debatable.

In the following section, four census-based measures of neighbourhood SES are presented; two are single-factor indicators developed by MCHP, and two are based on recent work in Canada developing a separate indicator for material deprivation and social deprivation.

8.6.1 Socioeconomic Factor Index

MCHP has used SEFI for over a decade. SEFI can be calculated for **dissemination areas (DA)**, the smallest areas reported by Statistics Canada for the Canadian census. It was developed as an area-level measure of SES, and is derived from the six aforementioned census measures using factor analysis, similar to the method used to develop the composite indices presented in the previous chapters. The SEFI value for a DA is assigned to the individuals residing in that area. Similar to the composite indices, a value of 0 on the SEFI represents the Manitoba average with 95% of scores falling within ±2 points.

Although the intent of SEFI is to reflect some degree of material and/or social deprivation, it does not include a measure of income or material wealth, primarily due to measurement and reporting issues for income in the censuses conducted prior to 1996. Substituting for income are two highly correlated variables that are also thought to reflect SES in their own right: educational

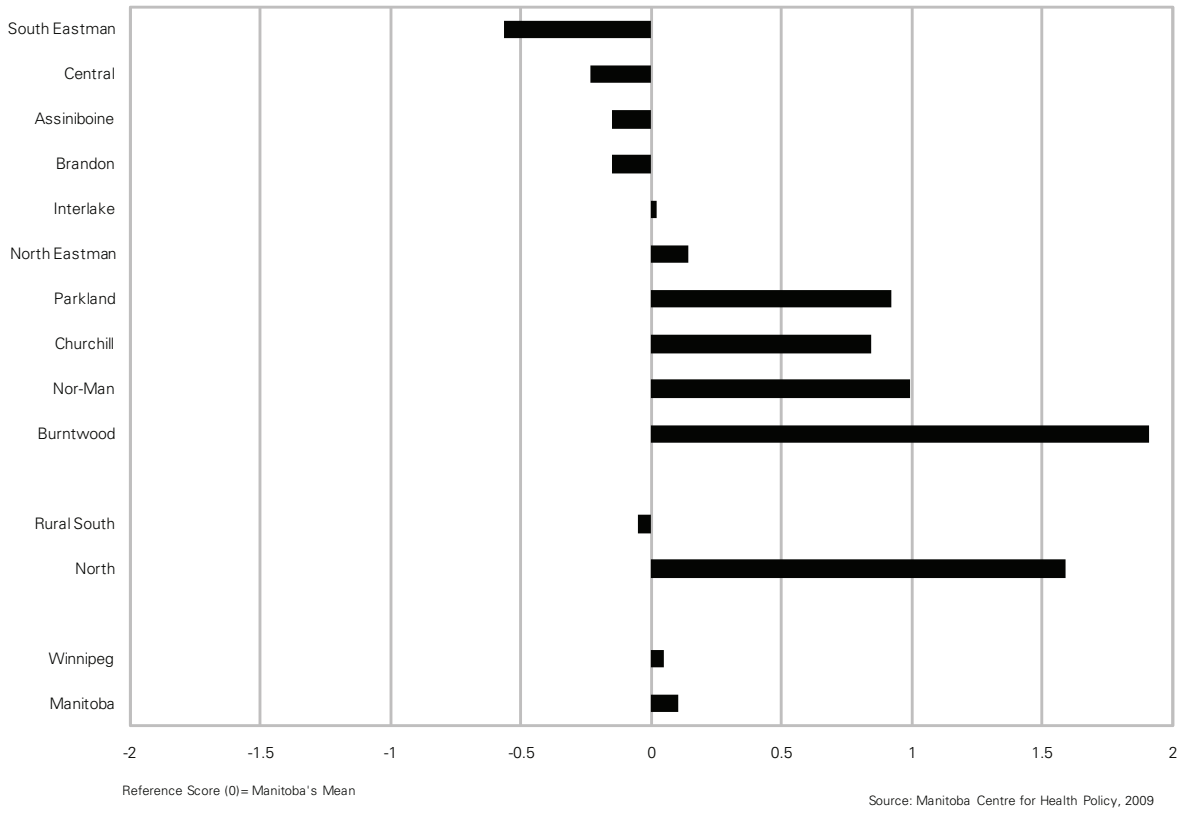
attainment and employment. Both use factor scores derived from an analysis of several age specific rates including high school graduation and employment. In addition to these two measures, the proportion of single-parent families, proportion of female-headed single-parent families, proportion of women in the labour force, and the age dependency ratio (defined as the number of people in an area over the age of 65 divided by the number of people under 65) are included in the calculation of SEFI scores. Several studies and reports have shown a very strong relationship between SEFI and various health outcomes (including PMR) (Frohlich & Mustard, 1994; Frohlich & Mustard, 1996; Frohlich & Carriere, 1997; Martens et al., 2002).

The advantage of SES indicators such as SEFI over health-based indicators is that the SES indicators can be calculated for very small areas and are available every five years. Calculations for PMR and life expectancy require either a much larger population for the same time period (i.e., a larger geographic area), or a much longer time period for a small geographic area due to the rarity of the outcome (death).

As part of the current study, we constructed a modified version of the SEFI, provisionally called **Socioeconomic Factor Index-Version 2 (SEFI-2)**, which incorporates four census variables. From the original SEFI, the overall unemployment rate, the proportion of adults without high school education, and the proportion of single parent families were retained. Average household income (now available due to changes made in the reporting of income on the census, as well as in the way census data is now disseminated) was added. Three variables that were part of the original SEFI were excluded: the age-dependency ratio (its loading on the original SEFI is quite low); the proportion of female-headed single-parent families (deemed redundant since we included the proportion of single parent families and most of these are female-headed); and female labour force (deemed redundant since we included the overall employment rate). SEFI-2 is easier to construct, and by including a measure of income, has greater face validity than the original SEFI as a measure of SES.

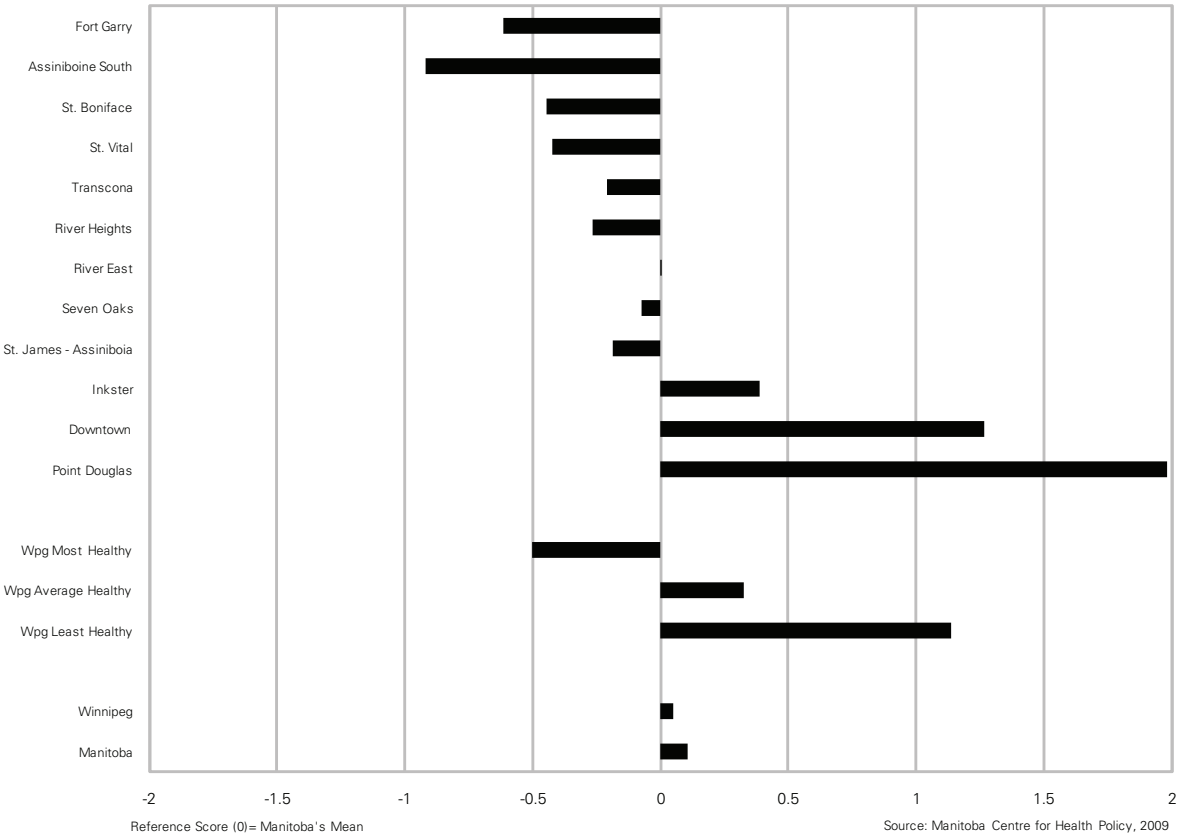
Figures 8.11 and 8.12 present the SEFI scores for the RHAs and Winnipeg CAs. The corresponding scores for SEFI-2 are presented in Figures 8.13 and 8.14. For both measures, there was a strong relationship with PMR. Areas with a higher PMR tended to have higher SEFI and SEFI-2 scores, and areas with lower PMR tended to have lower SEFI and SEFI-2 scores.

Figure 8.11: Socioeconomic Factor Index (SEFI) Scores, by RHA, 2005/06



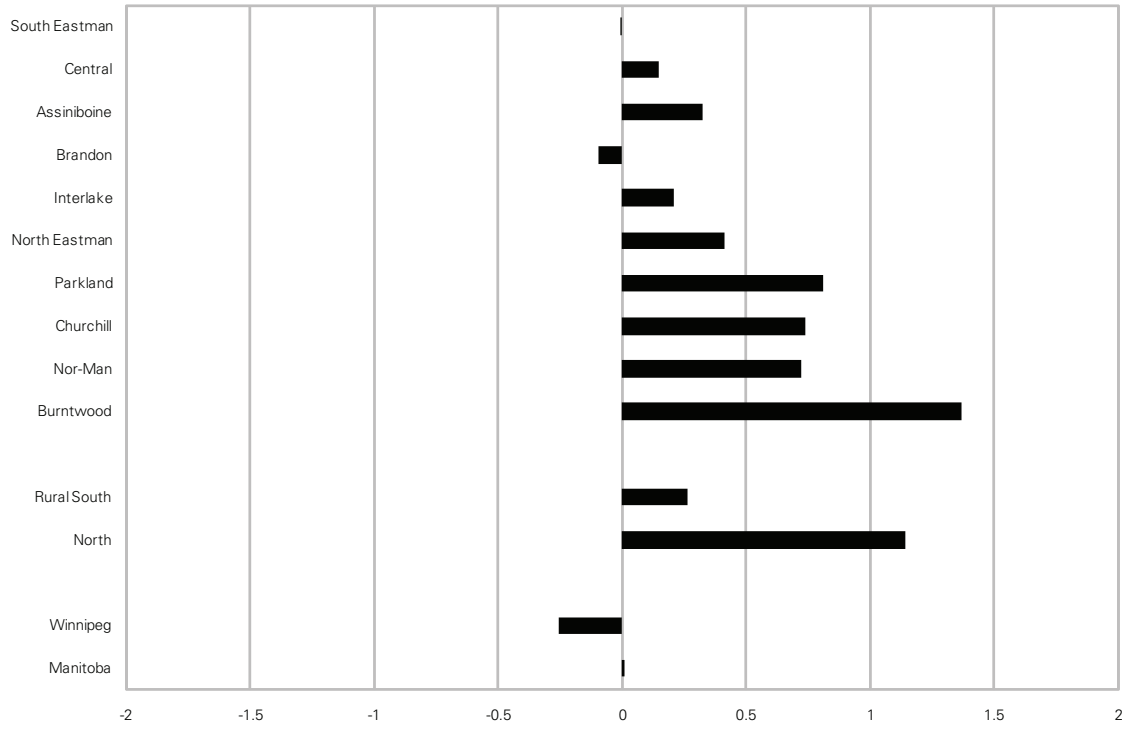
Source: Manitoba Centre for Health Policy, 2009

Figure 8.12: Socioeconomic Factor Index (SEFI) Scores, by Winnipeg Community Area, 2005/06



Source: Manitoba Centre for Health Policy, 2009

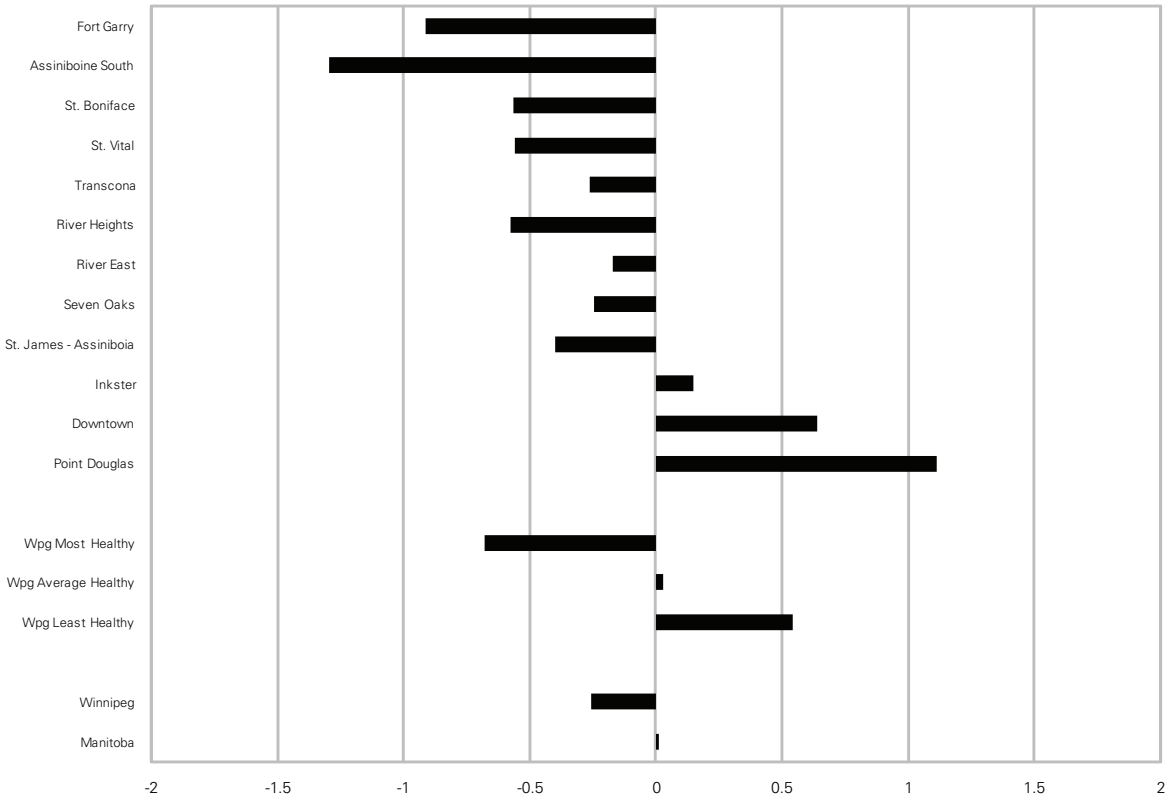
Figure 8.13: Socioeconomic Factor Index - Version 2 (SEFI-2) Scores, by RHA, 2005/06



Reference Score (0)= Manitoba's Mean

Source: Manitoba Centre for Health Policy, 2009

Figure 8.14: Socioeconomic Factor Index - Version 2 (SEFI-2) Scores, by Winnipeg Community Area, 2005/06



Reference Score (0)= Manitoba's Mean

Source: Manitoba Centre for Health Policy, 2009

8.6.2 Social and Material Deprivation Indices

Based on previous research (Pampalon & Raymond, 2000; Philibert, Pampalon, Thouez, & Loiselle, 2002) we selected six census variables that were thought to primarily reflect either material deprivation *or* social deprivation. To measure material deprivation, we used income (average household income), education (proportion of people without high school diplomas), and employment (unemployment rate). To measure social deprivation, three family household measures were used: proportion of people separated, divorced, or widowed; proportion of people living alone; and proportion of people who had moved within the previous five years. As expected, a factor analysis on these six variables indicated that they separated into two distinct groups (see Table 8.1). The factor scores derived from the analysis were used to represent the two components in further analyses. Figures 8.15 and 8.16 present the scores for the **Material Deprivation** and **Social Deprivation Indices** scores for the RHAs and Winnipeg CAs. As with SEFI, a value of 0 on this variable represents the average person, with 95% of scores within ±2 points.

For the RHAs, while material deprivation appeared to increase in areas with a higher PMR, there did not appear to be a consistent trend with social deprivation. The same was generally true for the Winnipeg CAs, although the relationship between social deprivation and PMR appears to be stronger. In addition to these overall trends with PMR, there also appeared to be some differences between Winnipeg and Brandon (urban areas) and the RHAs, with material deprivation being much lower in the two urban areas than in the rural RHAs; the opposite was true for social deprivation.

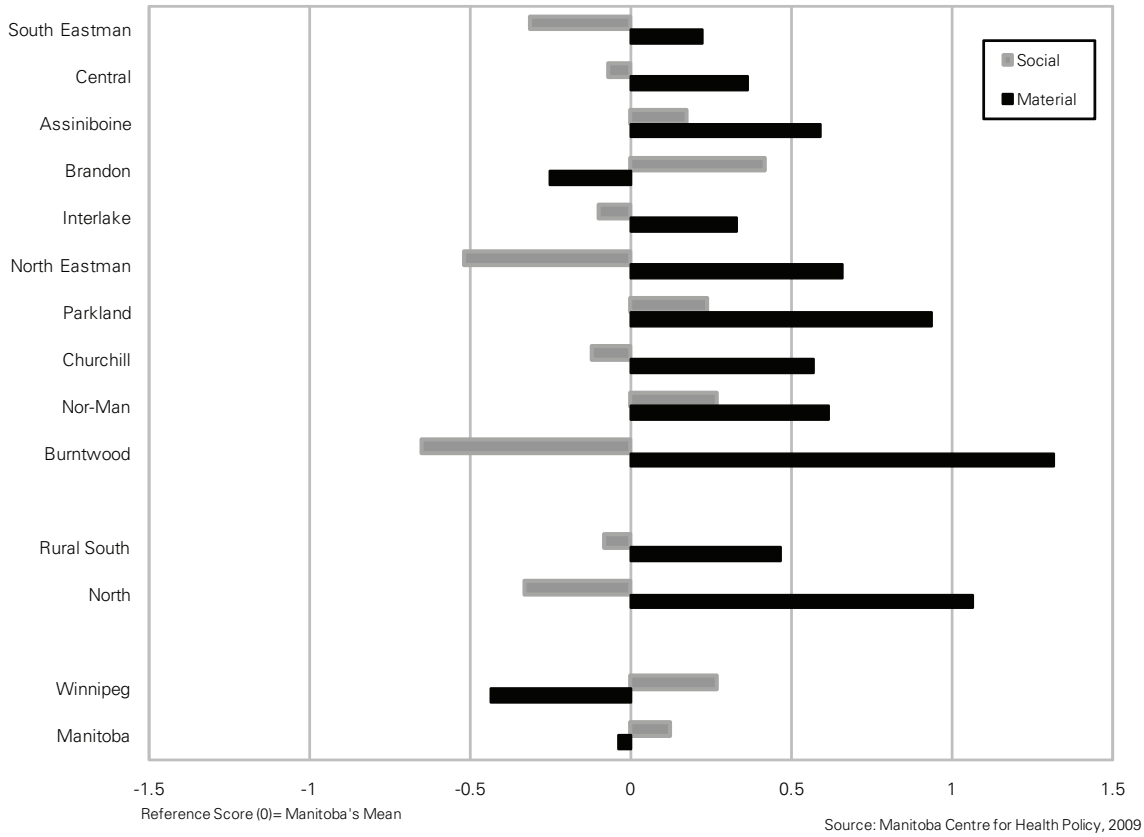
Table 8.1: Factor Loadings for Social and Material Deprivation, Manitoba, 2005/06

Indicators	Social Deprivation	Material Deprivation
Average Household Income	-0.41	**-0.75**
Labour Force Participation	0.05	**0.61**
No High School Graduation	-0.15	**0.89**
Separated, Divorced or Widowed	**0.82**	0.15
Live Alone	**0.87**	0.12
Moved in the Past 5 Years	**0.74**	-0.08

"Labour Force Participation" = Unemployment rate for labour force participation for population aged 15 years and older
"No High School Graduation" = Proportion of population 15 years and older without high school graduation
"Separated, Divorced or Widowed" = Proportion of population 15 years and older separated, divorced or widowed
"Live Alone" = Proportion of population living alone
"Moved in the Past 5 Years" = Proportion of population that moved in the past 5 years

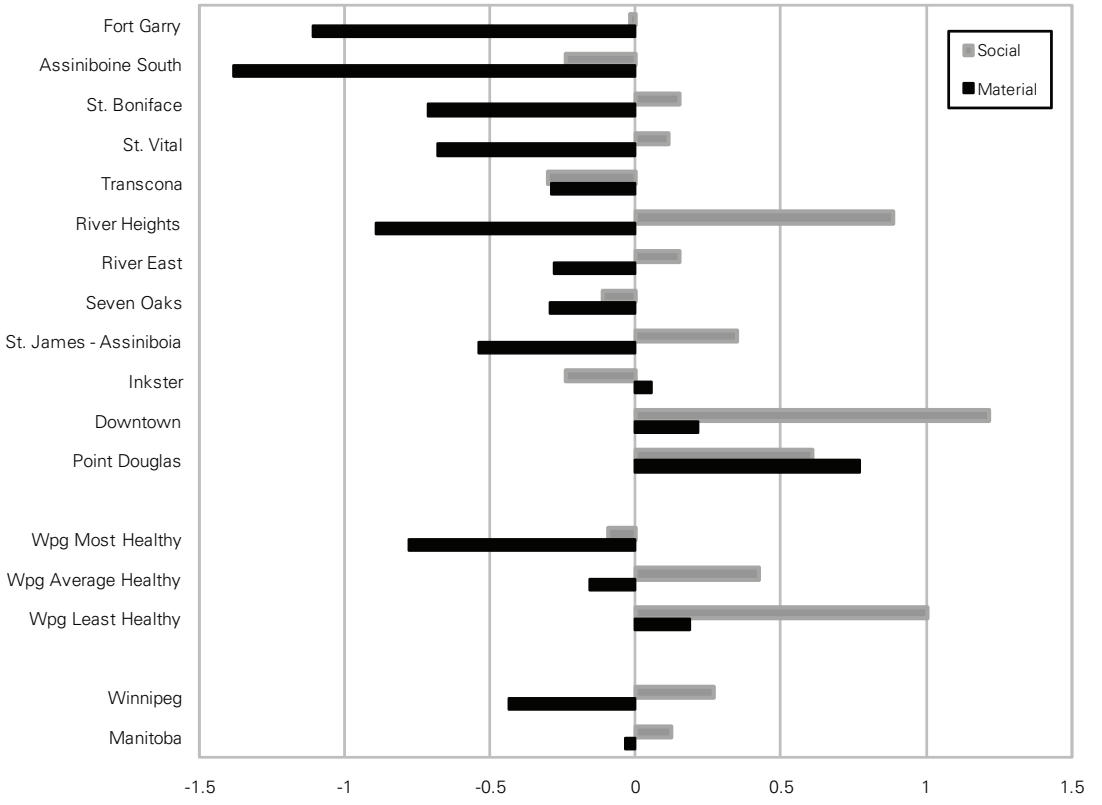
Source: Manitoba Centre for Health Policy, 2009

Figure 8.15: Social & Material Deprivation Indices' Scores, by RHA, 2005/06



Source: Manitoba Centre for Health Policy, 2009

Figure 8.16: Social & Material Deprivation Indices' Scores, by Winnipeg Community Area, 2005/06



Source: Manitoba Centre for Health Policy, 2009

8.7 Comparing the Indicators

The health status indicators presented in this chapter represent some of the most familiar, well-tested, and validated health measures. Although they are all intended to represent general health status of a population, the pattern of values on these indicators across the geographic regions of Manitoba were not identical. Table 8.2 is a correlation matrix of the health and SES indicators presented in this chapter. A correlation of +1 represents a perfect positive relationship (as one indicator increases, the other indicator also increases at a known rate). A correlation of -1 would also be a perfect relationship, but as one indicator increases, the other indicator decreases. A single indicator (average household income) from the census was included in this analysis to look at whether the creation of a composite census indicator was really necessary.

Table 8.2: Correlations between Health and SES Sentinel Indicators: Manitoba

	Spearman Correlation Coefficient							
	PYLL	Life Expectancy†	Excellent/Very Good Self-Rated Health	SEFI	SEFI-2	Material Deprivation	Social Deprivation	Average Household Income
PMR	.86**	-0.93**	-0.54**	0.91**	0.80**	0.66**	0.03	-0.63**
PYLL		-0.86**	-0.47**	0.82**	0.85**	0.76**	-0.07	-0.70**
Life Expectancy†			0.51**	-0.84**	-0.79**	-0.68**	0.06	0.62**
Excellent/Very Good Self-Rated Health				-0.56**	-0.55**	-0.50**	0.28‡	0.37**
SEFI					0.89**	0.75**	0.01	-0.72**
SEFI-2						0.96**	-0.12	-0.89**
Material Deprivation							-0.29*	-0.86**
Social Deprivation								-0.08

†Only life expectancy (calculated at birth) for males was included in this table; correlation patterns were similar for females.
‡ p<.05
* p<.01
** p<.001

Source: Manitoba Centre for Health Policy, 2009

The three health indicators were all highly related in expected ways. As PMR or PYLL increased, life expectancy decreased. The correlation between life expectancy and PYLL was the lowest. This pattern of strong relationships was generally true of the SES indicators as well, with one apparent exception—the Social Deprivation Index score did not correlate well with any of the other SES indicators.

Comparisons between the health and SES indicators reveal that the SEFI and SEFI-2 had the strongest relationships with all three health sentinel indicators, although the Material Deprivation Index was close. SEFI-2 had slightly lower correlations with PMR than the original SEFI. Average household income alone was clearly weaker than SEFI, SEFI-2, or the Material Deprivation Index, suggesting that the composite measures are more desirable than a single indicator from the census. In contrast, social deprivation had an almost nil relationship with the health status indicators.

In fact, its strongest relationship with a health indicator occurred in an unexpected direction—it correlated positively with self-rated health, which means that areas where residents rated their health better were also more likely to have higher rates on the measures that comprise the Social Deprivation Index (i.e., living alone, separated/divorced/widowed, movers). The reason for this still needs to be determined.

The fact that all of these measures were so highly correlated gives each a high degree of convergent validity. Measures such as self-reported health status, PMR, and SEFI are all gathered from different data sources for different purposes, yet are all quite consistent in how Manitoba areas are ranked.

8.8 Combining the Rates into an Index

The health status indicators presented in this chapter can also be compared by creating a composite index. The relative loadings of the indicators to a composite index can indicate how well each of the individual indicators corresponds to a more global measure of health status. Table 8.3 presents the factor loadings for the health status indicators. In addition, average household income was included in order to assess whether a single SES indicator would perform in a manner similar to the derived SES factors (i.e., SEFI and the deprivation indices). Most of the loadings were quite high with three exceptions: social deprivation, average household income, and self-rated health. The remaining measures all had loadings with an absolute value greater than 0.90. Two conclusions can be drawn from this. First, because of the very high loadings, any single one of those measures would be, for practical purposes, as good as a composite measure of health status. Second, the socioeconomic measures derived from the census are as good as the measures derived from the administrative health data as indicators of a region's health status.

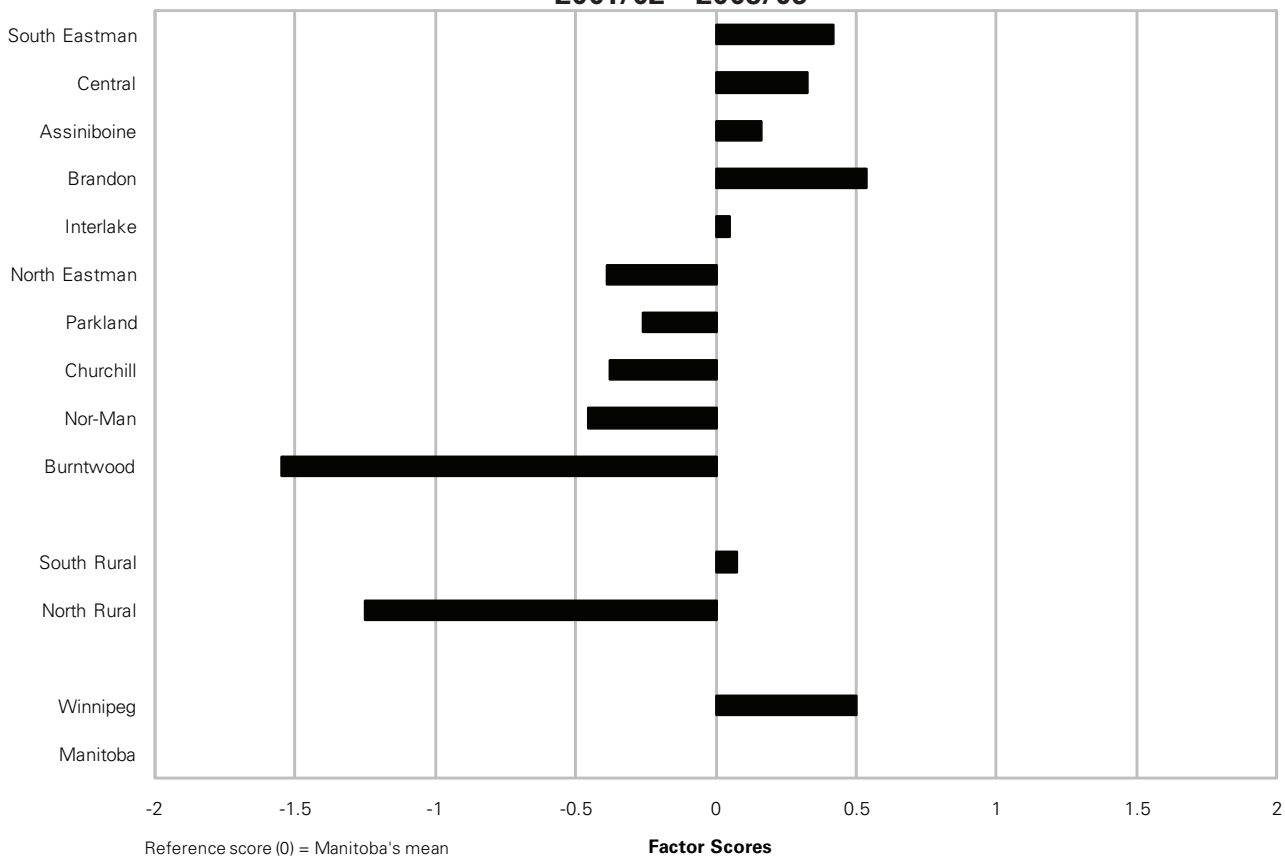
Table 8.3: Factor Loadings for the Health Status Composite Index

Indicator	Factor 1
PMR	0.93
SEFI	0.94
SEFI-2	0.97
PYLL	0.91
Life Expectancy	-0.90
Social Deprivation	-0.26
Material Deprivation	0.92
Self-Rated Health (excellent / very good)	-0.73
Avg Household Income	-0.72

Source: Manitoba Centre for Health Policy, 2009

8.9 Index Scores for Health Status

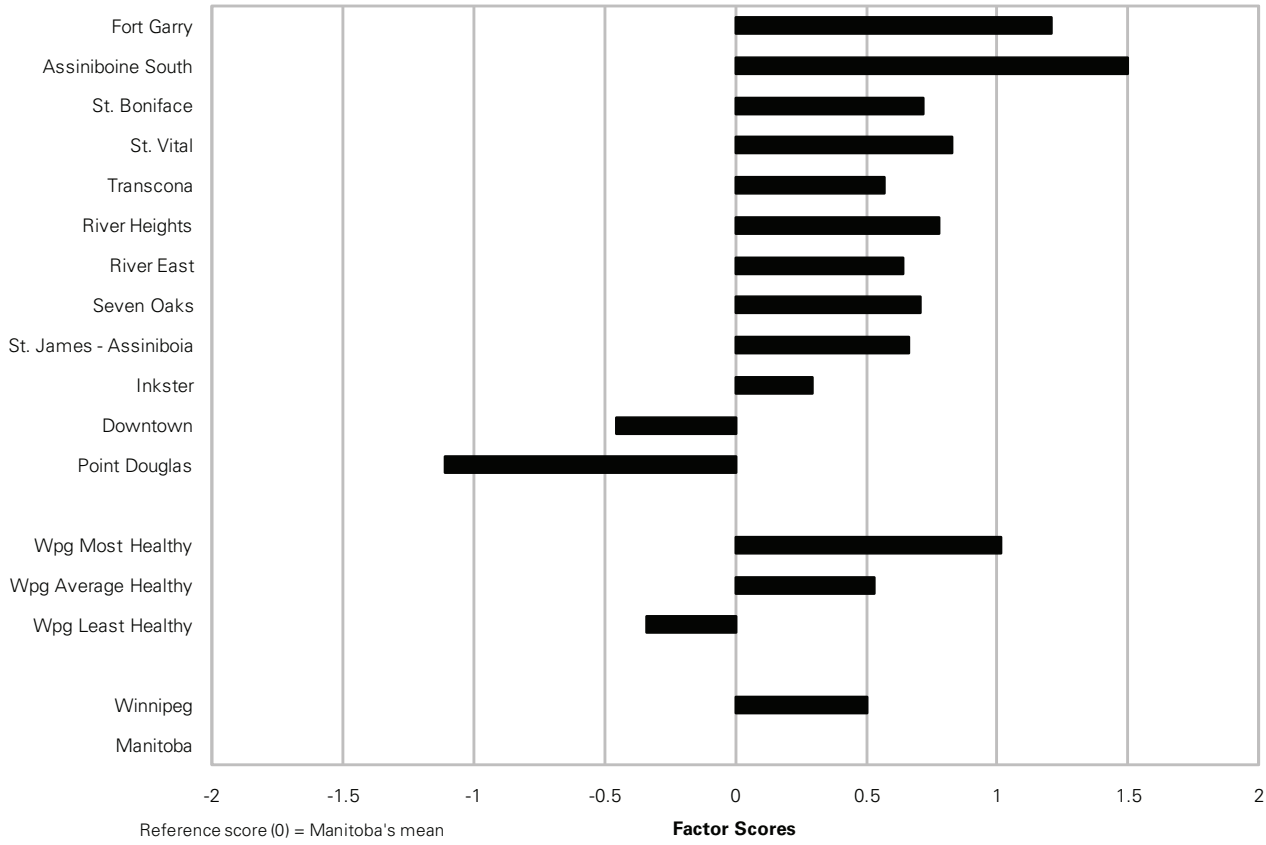
Figure 8.17: Factor Scores for the Health Status Composite Index, by RHA, 2001/02 – 2005/06



Source: Manitoba Centre for Health Policy, 2009

Figure 8.17 and 8.18 display the Health Status Index scores for the RHAs and Winnipeg CAs. Due to the time period required for calculating PMR and the fact that the census is only conducted once every five years, an analysis of multiple time periods was not possible. The pattern for the Health Status Index scores is indistinguishable from that for PMR or the other indicators that had high contributions, such as SEFI-2.

Figure 8.18: Factor Scores for the Health Status Composite Index, by Winnipeg Community Area, 2001/02 – 2005/06



Source: Manitoba Centre for Health Policy, 2009

8.10 Conclusion

As seen in this chapter, there are a number of well-established and validated measures of overall population health status that can be calculated fairly easily for Manitoba RHAs and Winnipeg CAs. They are based on either administrative health data or on readily available census data from Statistics Canada. Although one group of indicators measures vital statistics related to health (i.e., deaths) and another group measures the economic and social characteristics of residents, they both lead to the same results regarding the relative health status of the regions. In fact, measures such as PMR and SEFI-2 are so similar in their assessment of RHAs and CAs that they could be considered interchangeable. In addition, together they form a very strong composite measure.

The need for a composite index, however, is questionable. Six of the indicators loaded so strongly on the index that any of them could substitute for it. Two of these measures (life expectancy and PMR) have a distinct advantage over a composite index. Life expectancy is familiar to a wide audience and requires little or no explanation. PMR is straightforward to explain, and the scale is directly applied and understandable (deaths/1000 persons). Given the similarity between the pattern of results across

RHAs for these two indicators, the choice between PMR and life expectancy as a gauge of overall health may seem inconsequential. The advantage of PMR as a measure is that changes in it over time are much more dramatic than changes in life expectancy, which allows for improvements or declines to become apparent over relatively short periods of time.

A composite index on the other hand, would provide a score somewhere between -3.0 and +3.0. The value on the index has no concrete application or immediate meaning. As a relative measure, it can tell you whether one area is doing better than another area. Given the strong correlation between the Index and its constituent indicators, it would be much more direct to simply use one of the indicators when talking about overall health status.

Chapter 9: Conclusions and Recommendations

9.1 Summary of Findings

The development of composite indices of health system performance presents many challenges. Even when "successful", the application of the composite index scores to policy may be fraught with difficulty. Choosing a statistical method that ensures that each of the indicators in an index is correlated with the index score may make the construction of composite indices more difficult, but it also ensures that there is a high probability that the index scores apply to each and every one of the indicators. This can be contrasted with approaches that simply sum a number of disparate indicators, such that identical scores can be reached by a variety of means. In that case, the index score has little practical meaning for a policy-maker, unless each of the indicators is individually examined. The following is a summary of our findings.

A statistically viable Prevention and Screening Composite Index was constructed from administrative data of rates of mammography, Pap tests, influenza vaccines for seniors, and immunizations for two-year-olds. The Index demonstrates how these rates work together to give a picture of how a region prevents and screens for cancer and infection. While comparisons across RHAs were consistent, the trends over time amongst the four indicators were not consistent. At least one indicator significantly declined over time, but this was masked by increases in the rates for other indicators. The Index scores therefore did not reflect the time trends for each of the individual indicators. This potential pitfall of the Index must be taken into consideration when constructing or applying this composite index.

A statistically viable Healthy Living Composite Index was constructed from Manitobans' responses from cycles 2.1 and 3.1 of the CCHS. Measures of health-promoting behaviours, such as healthy eating and physical activity, and health-risk behaviours, such as smoking and binge alcohol use, were used to build the Index. By examining the two factors comprising the Index, one obtains an indication of how relative rates of health-promoting and health-risk behaviours are related to PMR, an indicator of overall health. The need for a composite index may be questionable, however, given that the Health-Risk Behaviour Index is most strongly related to PMR and consists of only two indicators.

The statistically viable Surgical Wait Times Composite Index comprised wait times for six elective procedures and provides a picture of how long a region's residents wait for surgery relative to other regions. The average index scores for all RHAs increased, which means that wait times for six common surgical procedures increased in length. In addition, waiting times for surgery appeared to be shorter in RHAs with the highest PMRs. This index may be appropriate, but any efforts to influence wait times for select indicators, or substantial changes in wait times for only select indicators, may pose problems for future use. Index scores may no longer reflect the pattern of effects occurring amongst all of the indicators—one of the conditions of a good composite described at the outset.

We attempted to construct two quality of care composite indices in order to identify how frequently proven care initiatives (primary care and pharmaceutical use) are applied to the relevant populations. A viable index would create a summary measure to monitor how efficiently and effectively we are delivering the best possible care for the best possible outcomes. The a priori hypothesis assuming the ability to construct two quality of care indices, reflecting quality in primary care and pharmaceutical use, did not hold up.

We also attempted to construct a composite index of the prevalence of chronic disease to help monitor overall patterns amongst a set of diseases (arthritis, asthma, diabetes, hypertension, and ischemic heart disease). The index would help identify when measures for prevention or control might be working. The five diseases did not vary together in a systematic manner. Any score on such an index would not be particularly useful to policy planners as it would be impossible to tell which diseases may be responsible for increasing or decreasing index scores; and in fact, a stable score across time could be the result of two reverse trends in diseases.

Finally, we constructed a statistically viable Health Status Composite Index comprising several indicators of health and SES. These indicators were all highly correlated across Manitoba, as reflected in the very high factor loadings found in the analysis. This result attests to their value as measures of the overall health status of the population. At the same time, however, this high correlation calls into question the need to aggregate them into a composite index; any one of the indicators would provide as accurate a comparison of the RHAs as would the Index.

9.2 Limitations of Composite Indices

In addition to some of the concerns about specific composite indices raised above, another potential limitation of using them is that they would still leave a policy-maker in an RHA or a Manitoba government official wondering what to do when scores go up and/or down over time. Part of the answer to this is with the underlying indicators. It may be that only one or two of the indicators are responsible for the change in the index scores. In this case, programs or evaluations could be put into place to improve performance where needed, or policy-makers could further examine areas where improvement is apparent. This need to examine the individual indicators even when a composite index is valid and reliable, however, makes the very development of an index a questionable endeavour. If the intent of a particular composite index is simply to rank or grade regions without regard to the means by which the areas attain a particular overall score, then perhaps it is appropriate.

One index that may be more directly applicable, given the nature of recent national and provincial policy, is the Surgical Wait Times Index. This Index can serve as a bellwether for assessing the impact of the CIHI target times for more high profile procedures (i.e., hip and knee replacement and cardiac surgical procedures) on the wait times for less high profile procedures that are included in the Index. Changes in this index can indicate whether an emphasis on the procedures reported to CIHI has resulted in increased waiting times for these elective procedures, due to demand for surgical staff and space. On the other hand, if the Index remains constant or declines over time, it would suggest that the system is capable of handling any increased demand due to effective policy or system modifications.

This exercise in creating composite indices for healthcare or population health status, has highlighted the problems related to these measures. Depending on the intent of the indices, they may or may not be appropriate. In the current context, the application of summary measures of health system performance or population health status appears to be of limited utility for one of several reasons: the indicators are too divergent to be meaningfully combined, the trends over time in the indices may mask opposing trends within the indicators, or the result of the index may not be worth the effort (e.g., where an index is composed of only two indicators or the loadings are uniformly very high). Due to these concerns, a summary measure of healthcare may simply be impractical. The current use of individual indicators such as PMR, life expectancy, or SEFI is recommended for an overall health status measure. In most cases, for separate components of the healthcare system, approaches that consider individual indicators appear to be preferable to composite indices.

Reference List

Adams KF, Schatzkin A, Harris TB, et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. *N Engl J Med.* 2006;355(8):763-778.

Allard J, Hebert R, Rioux M, Asselin J, Voyer L. Efficacy of a clinical medication review on the number of potentially inappropriate prescriptions prescribed for community-dwelling elderly people. *CMAJ.* 2001;164(9):1291-1296.

Appleby J, Mulligan J. *How well is the NHS performing? A composite performance indicator based on public consultation*. London, UK: King's Fund; 2005.

Avis K, Tan L, Anderson C, Tan B, Muhajarine N. Taking a closer look: An examination of measles, mumps, and rubella immunization uptake in Saskatoon. *Can J Public Health.* 2007;98(5):417-421.

Ballentine NH. Polypharmacy in the elderly: Maximizing benefit, minimizing harm. *Crit Care Nurs Q.* 2008;31(1):40-45.

Becker A, Lemière C, Bérubé D, et al. Summary of recommendations from the Canadian Asthma Consensus Guidelines. *CMAJ.* 2003;173(6):S3-S11.

Beers MH. Explicit criteria for determining potentially inappropriate medication use by the elderly: An update. *Arch Intern Med.* 1997;157(17):1531-1536.

Beers MH, Ouslander JG, Fingold SF, et al. Inappropriate medication prescribing in skilled-nursing facilities. *Ann Intern Med.* 1992;117(8):684-689.

Béland Y, Bailie L, Catlin G, Singh MP. CCHS and NPHS - An Improved Health Survey Program at Statistics Canada. In: *Proceedings of the American Statistical Association Meeting, Survey Research Methods Section*. Indianapolis: American Statistical Association; 2000:677-682.

Bentler, PM, Bonett, DG. Significance tests and goodness-of-fit in the analysis of covariance structures. *Psychological Bulletin*, 1980; 88: 588-600.

Bianchini F, Kaaks R, Vainio H. Weight control and physical activity in cancer prevention. *Obes Rev.* 2002;3(1):5-8.

Booysen F. An overview and evaluation of composite indices of development. *Soc Indic Res.* 2002;59:115-151.

Broemeling AM, Watson DE, Prebtani F. Population patterns of chronic health conditions, co-morbidity and healthcare use in Canada: Implications for Policy and Practice. *Healthcare Quaterly.* 2008;11(3):70-76.

Brownell M, De Coster C, Penfold R, Derksen S, Au W, Schultz J, Dahl M. *Manitoba Child Health Atlas Update*. Manitoba Centre for Health Policy. 2008. http://mchp-appserv.cpe.umanitoba.ca/reference/Child_Health_Atlas_Update_Final.pdf. Accessed September 18, 2008.

Brownell M, Lix L, Ekuma O, Derksen S, Dehaney S, Bond R, Fransoo R, MacWilliam L, Bodnarchuk J. *Why is the Health Status of Some Manitobans Not Improving? The Widening Gap in the Health Status of Manitobans*. Manitoba Centre for Health Policy. 2003. http://mchp-appserv.cpe.umanitoba.ca/reference/hlthgap.pdf. Accessed September 18, 2008.

Busto U, Sellers EM, Nuranjo CA, et al. Withdrawal reaction after long term therapeutic use of benzodiazepines. *N Engl J Med.* 1986;315(14):854-859.

Calle EE, Rodriguez C, Walker-Thurmond K, Thun MJ. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *N Engl J Med.* 2003;348(17):1625-1638.

Campbell SM, Roland MO, Buetow SA. Defining quality of care. *Soc Sci Med.* 2000;51(11):1611-1625.

Canadian Cancer Society/National Cancer Institute of Canada. Canadian Cancer Statistics 2007. http://www.cancer.ca. Accessed October 14, 2007. Last edited 2007.

Canadian Institute for Health Information. *Health Indicators, 2002*. Ottawa, ON: Canadian Institute for Health Information; 2002.

Canadian Institute for Health Information. *Health Indicators, 2003*. Ottawa, ON: Canadian Institute for Health Information; 2003.

Canadian Institute for Health Information. *Health Indicators, 2004*. Ottawa, ON: Canadian Institute for Health Information; 2004.

Canadian Institute for Health Information. *Waiting for Health Care in Canada: What We Know and What We Don't Know*. Ottawa, Ontario: Canadian Institute for Health Information; 2006.

Canadian Institute for Health Information. http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=profile_e. Accessed June 2, 2009. (Last updated May 22, 2009)

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

Centers for Disease Control and Prevention. State-specific influenza vaccination coverage among adults aged > or =18 years—United States, 2003-04 and 2005-06 influenza seasons. *MMWR Morb Mortal Weekly Rep.* 2007;56(37):953-959.

Chapman KR, Ernst P, Grenville A, Dewland P, Zimmerman S. Control of asthma in Canada: Failure to achieve guideline targets. Asthma Guidelines Update - 2001. *Can Respir J.* 2001;8(Suppl A):35A-40A.

Chow CM, Donovan L, Manuel D, Johansen H, Tu JV. Regional variation in self-reported heart disease prevalence in Canada. *Can J Cardiol.* 2005;21(14):1265-1271.

Dannefer D. Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *J Gerontol.* 2003;58:S327-S337.

Day NE, Williams DR, Khaw KT. Breast cancer screening programmes: The development of a monitoring and evaluation system. *Br J Cancer.* 1989;59(6):954-958.

De Coster C, Chateau D, Dahl M, Soodeen RA, McKeen N. *Waiting Times for Surgery, Manitoba 1999/2000 to 2003/04*. Manitoba Centre for Health Policy. 2007. http://mchp-appserv.cpe.umanitoba.ca/reference/swt_3web.pdf. Accessed September 18, 2008.

De Haen H, Stamoulis K, Shetty P, Pingali P. The World Food Economy in the Twenty-first Century: Challenges for International Co-operation. *Development Policy Review.* 2003;21:683-696.

Deber R. Why did the World Health Organization rate Canada's health system as 30th? Some thoughts on league tables. *Longwoods Review.* 2004;2(1):2-7.

Demers A, Harrison M, Musto G, Decker K, Lotocki R. *Cervical cancer and Pap test utilisation in Manitoba, 1970-1999*. Winnipeg, Manitoba: Manitoba Cervical Cancer Screening Program, CancerCare Manitoba; 2004.

Demicheli V, Rivetti D, Deeks JJ, Jefferson TO. Vaccines for preventing influenza in healthy adults. *Cochrane Database Syst Rev.* 2001;(4):CD001269.

Department of Finance Canada. The Budget Plan 2005. http://www.fin.gc.ca/budget05/pdf/bp2005e.pdf. Accessed November 15, 2007. Last edited 2005.

DesMeules M, Manuel D, Cho R. Mortality: Life and health expectancy of Canadian women. *BMC Womens Health.* 2004;4 Suppl 1:S9.

Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. *BMJ.* 2004;328(7455):1519.

Doupe M, Brownell M, Kozyrskyj A, Dik N, Burchill C, Dahl M, Chateau D, DeCoster C, Hinds A, Bodnarchuk J. *Using Administrative Data to Develop Indicators of Quality Care in Personal Care Homes*. Manitoba Centre for Health Policy. 2006. http://mchp-appserv.cpe.umanitoba.ca/reference/pch.qi.pdf. Accessed September 18, 2008.

Dunn RL, Donoghue JM, Ozminkowski RJ, Stephenson D, Hylan TR. Longitudinal patterns of antidepressant prescribing in primary care in the UK: comparison with treatment guidelines. *J Psychopharmacol.* 1999;13(2):136-143.

Ecob R, Smith GD. Income and health: What is the nature of the relationship? *Soc Sci Med.* 1999;49(5):693-705.

Esmail N, Walker MA. *Waiting Your Turn: Hospital Waiting Lists in Canada (13th edition)*. Vancouver, BC: Fraser Institute; 2003.

Everly MJ, Heaton PC, Cluxton RJ. Beta-blocker underuse in secondary prevention of myocardial infarction. *Ann Pharmacother.* 2004;38(2):286-293.

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.

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

Ezzati M, Lopez AD. Estimates of global mortality attributable to smoking in 2000. *Lancet.* 2003;362(9387):847-852.

Farrelly MC, Pechacek TF, Chaloupka FJ. The impact of tobacco control program expenditures on aggregate cigarette sales: 1981-2000. *J Health Econ.* 2003;22(5):843-859.

Fick DM, Cooper JW, Wade WE, et al. Updating the Beers criteria for potentially inappropriate medication use in older adults: Results of a US consensus panel of experts. *Arch Intern Med.* 2003;163(22):2716-2734.

FitzGerald JM, Boulet LP, McIvor RA, Zimmerman S, Chapman KR. Asthma control in Canada remains suboptimal: the Reality of Asthma Control (TRAC) study. *Can Respir J.* 2006;13(5):253-259.

Fochtmann LJ , Gelenberg AJ. *Guideline Watch: Practice Guideline for the Treatment of Patients With Major Depressive Disorder*. Arlington, VA: American Psychiatric Association; 2005.

Fransoo R, Martens P, Burland E, Prior H, Burchill C, Chateau D, Walld R. *The Need to Know Team. Sex Differences in Health Status, Health Care Use, and Quality of Care: A Population-Based Analysis for Manitoba's Regional Health Authorities*. Manitoba Centre for Health Policy. 2005. http://mchp-appserv.cpe.umanitoba.ca/reference/sexdiff.pdf. Accessed September 18, 2008.

Frieden TR. Asleep at the switch: Local public health and chronic disease. *Am J Public Health.* 2004;94(12):2059-2061.

Frohlich N, Carriere KC. *Issues in Developing Indicators for Needs-Based Funding*. Manitoba Centre for Health Policy and Evaluation. 1997. http://mchp-appserv.cpe.umanitoba.ca/reference/allocate.pdf. Accessed September 18, 2008.

Frohlich N, Mustard C. A regional comparison of socioeconomic and health indices in a Canadian province. *Soc Sci Med.* 1996;42(9):1273-1281.

Frohlich N, Mustard CA. *Socio-Economic Characteristics (Population Health Information System 1991/92-1986 Census Version)*. Manitoba Centre for Health Policy and Evaluation. 1994. http://mchp-appserv.cpe.umanitoba.ca/deliverablesList.html. Accessed September 18, 2008.

Giugliano D, Ceriello A, Esposito K. Are there specific treatments for the metabolic syndrome? *Am J Clin Nutr.* 2008;87(1):8-11.

Glezen WP. Influenza control. *N Engl J Med.* 2006;355(1):79-81.

Golombok S, Moodley P, Lader M. Cognitive impairment in long-term benzodiazepine use. *Psychol Med.* 1988;18(2):365-374.

Gorsuch RL. Factor Analysis. Hillsdale, NJ: Lawrence Erlbaum Associates; 1983.

Grymonpre RE, Mitenko PA, Sitar DS, Aoki FY, Montgomery PR. Drug-associated hospital admission in older medical patients. *J Am Geriatr Soc.* 1988;36(12):1092-1098.

Gupta S, Roos LL, Walld R, Traverse D, Dahl M. Delivering equitable care: Comparing preventive services in Manitoba. *Am J Public Health.* 2004;93(12):2086-2092.

Hanlon JT, Schmader KE, Kornkowski MJ, et al. Adverse drug events in high risk older outpatients. *J Am Geriatr Soc.* 1997;45(8):945-948.

Harris SB, Stewart M, Brown JB, et al. Type 2 diabetes in family practice. Room for improvement. *Can Fam Physician.* 2003;49:778-785.

Health Canada. *Toward a healthy future: Second report on the health of Canadians*. Ottawa, ON: Health Canada; 1999.

Health Canada. Health Care System. http://www.hc-sc.gc.ca/hcs-sss/qual/index_e.html. Accessed September 25, 2008. Last edited October 1, 2004a.

Health Canada. Quality of Care definition. http://www.hc-sc.gc.ca/hcs-sss/qual/index-eng.php. Accessed January 2, 2009. Last edited January 10, 2004b.

Health Canada. Alcohol. http://www.hc-sc.gc.ca/hl-vs/alc/index_e.html. Accessed November 2, 2007. Last edited 2007a.

Health Canada. Eating Well with Canada's Food Guide. http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index-eng.php. Accessed February 1, 2009. Last edited December 20, 2007b.

Health Canada. Healthy Eating. http://www.hc-sc.gc.ca/hl-vs/eat-aliment/index_e.html. Accessed November 2, 2007. Last edited 2007c.

Health Canada. Smoking and your body. http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/body-corps/index_e.html. Accessed November 2, 2007. Last edited 2007d.

Health Canada. It's Your Health (IYH). http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/about-apropos-eng.php. Last edited 2009.

Health Surveillance Coordination Division. *Chronic Disease Surveillance in Canada: A Background Paper*. Ottawa, ON: Centre for Surveillance Coordination, Population and Public Health Branch, Health Canada; 2003.

Healthcare Commission. 2004 performance ratings. http://ratings2004.healthcarecommission.org.uk/. Accessed May 3, 2007. Last edited 2004.

Holland P, Berney L, Blane D, Davey Smith G, Gunnell D. Life course accumulation of disadvantage: Childhood health and hazard exposure during adulthood. *Soc Sci Med.* 2000;50:1285-1295.

Hootman JM, Helmick CG. Projections of US prevalence of arthritis and associated activity limitations. *Arthritis & Rheumatism.* 2006;54(1):226-229.

Hu FB , Willett WC. Optimal diets for prevention of coronary heart disease. *JAMA.* 2002;288(20):2569-2578.

Hux JE, Ivis F, Flintoft V, Bica A. Diabetes in Ontario: Determination of prevalence and incidence using a validated administrative data algorithm. *Diabetes Care.* 2002;25(3):512-516.

Jensdottir AB, Rantz M, Hjaltadottir I, et al. International comparison of quality indicators in United States, Icelandic and Canadian nursing facilities. *Int Nurs Rev.* 2003;50(2):79-84.

Joffres MR, Hamet P, MacLean DR, L'italien GJ, Fodor G. Distribution of blood pressure and hypertension in Canada and the United States. *Am J Hypertension.* 2001;14(11):1099-1105.

Katon W, Rutter CM, Lin E, et al. Are there detectable differences in quality of care or outcome of depression across primary care providers? *Med Care.* 2000;38(6):552-561.

Katz A, DeCoster C, Bogdanovic B, Soodeen R, Chateau D. *Using Administrative Data to Develop Indicators of Quality in Family Practice*. Manitoba Centre for Health Policy. 2004. http://mchp-appserv.cpe.umanitoba.ca/reference/quality_wo.pdf. Accessed September 18, 2008.

Katzelnick D, Kobak K, Jefferson J, Greist JH. Prescribing patterns of antidepressant medications for depression in an HMO. *Formulary.* 1996;31:374-388.

Kennedy HL. Current utilization trends for ß-blockers in Cardiovascular Disease. *Am J Med.* 2001;110(5A):2S-6S.

Kilmer G, Roberts H, Hughes E, et al. Surveillance of certain health behaviors and conditions among states and selected local areas--Behavioral Risk Factor Surveillance System (BRFSS), United States 2006. *MMWR Morb Mortal Weekly Rep.* 2008;57(7):1-188.

Krumholz HM, Radford MJ, Wang Y, et al. National use and effectiveness of beta-blockers for the treatment of elderly patients after acute myocardial infarction: National Cooperative Cardiovascular Project. *JAMA.* 1998;280(7):623-669.

Kwong JC, Rosella LC, Johansen H. Trends in influenza vaccination in Canada, 1996/1997 to 2005. *Health Rep.* 2007;18(4).

Lantz PM, House J, Lepkowski JM, et al. Socioeconomic factors, health behaviours, and mortality: results from a nationally representative prospective study of US adults. *JAMA.* 1998;279(21):1703-1708.

Last JM, (ed). A Dictionary of Epidemiology. Fourth Edition. New York, NY: Oxford University Press; 2001.

Leenen FH, Dumais J, McInnis NH, et al. Results of the Ontario Survey on the Prevalence and Control of Hypertension. *CMAJ.* 2008;178(11):1441-1449.

Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: a systematic review and meta-analysis: I. Psychotropic drugs. *J Am Geriatr Soc.* 1999;47(1):30-39.

Linden M, Bär T, Helmchen H. Prevalence and appropriateness of psychotropic drug use in old age: Results from the Berlin Aging Study (BASE). *Int Psychogeriatr.* 2004;16(4):461-480.

Lipscombe LL, Hux JE. Trends in diabetes prevalence, incidence, and mortality in Ontario, Canada 1995-2005: A population-based study. *Lancet.* 2007;369(9563):750-756.

Liu S, Semenciw R, Probert A, Mao Y. Cervical cancer in Canada: Changing patterns in incidence and mortality. *Int J Gynecol Cancer.* 2001;11(1):24-31.

Lix L, Yogendran M, Burchill C, Metge C, McKeen N, Moore D, Bond R. *Defining and validating chronic diseases: An administrative data approach*. Manitoba Centre for Health Policy. 2006. http://mchp-appserv.cpe.umanitoba.ca/reference/chronic.disease.pdf. Accessed September 18, 2008.

Lohr KN, ed. *Medicare - A Strategy for Quality Assurance. Volume I.* Washington, D.C.: National Academy Press; 1990.

Lopez A. Alcohol and smoking as risk factors. In: Chamie J, Cliquet J, eds. *Health and mortality:Issues of global concern. Proceedings of the Symposium on Health and Mortality, Brussels, 19-22 November 1997*. New York, NY: United Nations Department of Economic and Social Affairs; 1999:374-411.

Lynch JW, Kaplan GA, Salonen JT. Why do poor people behave poorly? Variation in adult behaviours and psychosocial characteristics by stages of the socioeconomic life course. *Soc Sci Med.* 1997;44(6):809-819.

Manitoba Health, Centre for Disease Control. Manitoba' Routine Childhood Immunization Schedule for Infants and Children. http://www.gov.mb.ca/health/publichealth/cdc/schedule.html. Accessed November 2, 2007.

Mann JJ, Apter A, Bertolote J, et al. Suicide prevention strategies: A systematic review. *JAMA.* 2005;294(16):2064-2074.

Manuel DG, Leung M, Nguyen K, Tanuseputro P, Johansen H. Burden of cardiovascular disease in Canada. *Can J Cardiol.* 2003;19(9):997-1004.

Marmot M, Fuhrer R, Ettner S, et al. Contribution of psychosocial factors to socioeconomic differences in health. *Milbank Quarterly.* 1998;76(3):403-448.

Marmot M, Wilkinson RG. *Social determinants of health*. Oxford: Oxford University Press; 1999.

Martens P, Fransoo R, The Need to Know Team, Burland E, Prior H, Burchill C, Romphf L, Chateau D, Bailly A, Ouelette C. *What Works? A First Look at Evaluating Manitoba's Regional Health Programs and Policies at the Population Level*. Manitoba Centre for Health Policy. 2008. http://mchp-appserv.cpe.umanitoba.ca/reference/fullwwreport.pdf. Accessed September 18, 2008.

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 Public Health.* 2002;93(2 Suppl):S15-S20.

McCarty CA, Lloyd-Smith CW, Stanislavsky YL, Taylor HR. Use of eye care services by people with diabetes: The Melbourne Visual Impairment Project. *Br J Ophthalmol.* 1998;82(4):410-414.

McCormick D, Gurwitz JH, Lessard D, et al. Use of aspirin, beta-blockers, and lipid-lowering medications before recurrent acute myocardial infarction: Missed opportunities for prevention? *Arch Intern Med.* 1999;159(6):561-567.

McDonald, RP. An index of goodness-of-fit based on noncentrality. *J Classification*. 1989; 6:97-103.

McDonald, RP, Marsh, HW. Choosing a multivariate model: Noncentrality and Goodness of fit. *Psychol Bulletin.* 1990; 107:247-255.

McGlynn EA, Asch SM, Adams J, et al. The quality of health care delivered to adults in the United States. *N Engl J Med.* 2003;328(26):2635-2645.

McLeod PJ, Huang AR, Tamblyn RM, Gayton DC. Defining inappropriate practices in prescribing for elderly people: A national consensus panel. *CMAJ.* 1997;156(3):385-391.

Menec V, Black C, MacWilliam L, Aoki F, Peterson F, Friesen D. *The Impact of Influenza-Like Illness on the Winnipeg Health Care System: Is an Early Warning System Possible?* Manitoba Centre for Health Policy. 2001. http://mchp-appserv.cpe.umanitoba.ca/reference/flu-like.pdf. Accessed September 18, 2008.

Metge C, Grymonpre R, Dahl M, Yogendran M. Pharmaceutical use among older adults: Using administrative data to examine medication-related issues. *Can J Aging.* 2005;24 Suppl 1:81-95.

Moorman JE, Rudd R, Johnson CA, et al. National Surveillance for Asthma–United States, 1980-2004. *MMWR.* 2007;56(SS08):1-15.

Morgan MW, Zamora NE, Hindmarsh MF. An inconvenient truth: A sustainable healthcare system requires chronic disease prevention and management transformation. *Healthc Pap.* 2007;7(4):6-23.

Murray CJL, Lauer J, Tandon A, Frenk J. *Overall health system achievement for 191 countries*. Geneva, Switzerland: World Health Organization; 2000.

Mustard CA, Derksen S, Berthelot J-M, Wolfson MC, Roos LL. Age-specific education and income gradients in morbidity and mortality in a Canadian province. *Soc Sci Med.* 1997;45(3):383-397.

Nardo M, Saisana M, Saltelli A, Tarantola S. Tools for composite indicators building. http://composite-indicators.jrc.ec.europa.eu/Document/EUR%2021682%20EN.pdf. Accessed September 29, 2007. Last edited 2005.

National Health Performance Committee. *National Report on Health Sector Performance Indicators 2003*. Canberra, Australia: Australian Institute of Health and Welfare; 2004.

Navarro V. The new conventional wisdom: An evaluation of the WHO report, Health Systems: Improving Performance. *Int J Health Serv.* 2001;31(1):23-33.

Orchard TJ, Temprosa M, Goldberg R, et al. The effect of Metformin and intensive lifestyle intervention on the metabolic syndrome: The Diabetes Prevention Program randomized trial. *Ann Intern Med.* 2005;142(8):611-619.

Organisation for Economic Co-operation and Development. Statistics Directorate. Leading Indicators. http://www.oecd.org/std/cli. Accessed September 18, 2008. Last edited 2008.

Pampalon R, Raymond G. A deprivation index for health and welfare planning in Quebec. *Chronic Dis Can.* 2000;21(3):104-113.

Patra J, Popova S, Rehm J, et al. *Economic Cost of Chronic Disease in Canada, 1995-2003*. Ottawa, ON: Public Health Agency of Canada; 2007.

Pechmann C, Dixon P, Layne N. An assessment of US and Canadian smoking reduction objectives for the year 2000. *Am J Public Health.* 1998;88(9):1362-1367.

Pedersen TR. Six-year follow-up of the Norwegian Multicenter Study on Timolol after Acute Myocardial Infarction. *N Engl J Med.* 1985;313(17):1055-1058.

Perruccio AV, Badley EM. Proxy reporting and the increasing prevalence of arthritis in Canada. *Can J Public Health.* 2004;95(3):165-168.

Perruccio AV, Power JD, Badley EM. Revisiting arthritis prevalence projections—it's more than just the aging of the population. *J Rheumatol.* 2006;33(9):1856-1862.

Peto R, Lopez AD. Future worldwide health effects of current smoking patterns. In: *Critical Issues in Global Health*. San Francisco: Jossey-Bass; 2001:154-161.

Philibert M, Pampalon R, Thouez JP, Loiselle C. Are local services reaching deprived groups in Quebec? Poster presented at: 2nd Conference of the International Society for Equity in Health; June 14 - 17, 2002; Toronto, ON.

Prentice RL, Thomson CA, Caan B, et al. Low-fat dietary pattern and cancer incidence in the Women's Health Initiative Dietary Modification Randomized Controlled Trial. *J Natl Cancer Inst.* 2007;99(20):1534-1543.

Pro Inno Europe and European Commission. Inno Metrics. http://www.proinno-europe.eu/index.cfm?fuseaction=page.display&topicID=5&parentID=51. Accessed September 25, 2008. Last edited 2008.

Province of Manitoba. *Manitoba's Comparable Health Indicator Report: A Federal/Provinicial/Territorial Agreement on Comparable Indicator Reporting Reached by First Ministers and Developed by the Conference of Deputy Ministers*. Winnipeg, MB: Province of Manitoba; 2004.

Prus S. Age, SES, and health: A population level analysis of health inequalities over the lifecourse. *Soc Hlth Illness.* 2007;29(2):275-296.

Public Health Agency of Canada. *Canadian Consensus Conference on a National Immunization Records System*. Canada Communicable Disease Report; 1998.

Public Health Agency of Canada. Physical Activity Guide to Healthy Active Living. http://www.phac-aspc.gc.ca/pau-uap/paguide/index.html. Accessed November 2, 2007. Last edited 2003.

Public Health Agency of Canada. Canadian Immunization Guide. Seventh Edition. http://www.phac-aspc.gc.ca/publicat/cig-gci/pdf/cig-gci-2006_e.pdf. Accessed November 2, 2007. Last edited 2006.

Rehm J, Room R, Graham K, et al. The relationship of average volume of alcohol consumption and patterns of drinking to burden of disease: An overview. *Addiction.* 2003;98(9):1209-1228.

Rehm J, Sempos CT, Trevisan M. Average volume of alcohol consumption, patterns of drinking and risk of coronary heart disease: A review. *J Cardiovasc Risk.* 2003;10:15-20.

Rizzo C, Viboud C, Montomoli E, Simonsen L, Miller MA. Influenza-related mortality in the Italian elderly: No decline associated with increasing vaccination coverage. *Vaccine.* 2006;24(42-43):6468-6475.

Romeder JM, McWhinnie JR. Potential years of life lost between ages 1 and 70: An indicator of premature mortality for health planning. *Int J Epidemiol.* 1977;6(2):143-151.

Ross C, Wu C. Education, age, and the cumulative advantage in health. *J Hlth Soc Behavior.* 1996;37:104-120.

Ryan TJ, Anderson JL, Antman EM, et al. ACC/AHA guidelines for the management of patients with acute myocardial infarction. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). *J Am Coll Cardiol.* 1996;28(5):1328-1428.

Saadine JB, Fong DS, Yao J. Factors associated with follow-up eye examinations among persons with diabetes. *Retina.* 2008;28(2):195-200.

Saisana M, Tarantola S. State-of-the-art Report on Current Methodologies and Practices for Composite Indicator Development. http://composite-indicators.jrc.ec.europa.eu/Document/state-of-the-art_EUR20408.pdf. Accessed September 29, 2007. Last edited 2002.

Saisana M, Tarantola S, Saltelli A. Uncertainty and sensitivity techniques as tools for the analysis and validation of composite indicators. *J Roy Stat Soc.* 2005;168(2):1-17.

Salmond C, Crampton P. Heterogeneity of deprivation within very small areas. *J Epidemiol Community Health.* 2002;56(9):669-670.

Salmond C, Crampton P, Sutton F. A New Zealand index of deprivation. *Aust N Z J Public Health.* 1998;22(7):835-837.

Sanmartin C, Gilmore J. Diabetes care in Canada: Results from selected provinces and territory, 2005. http://www.statcan.ca/english/research/82-621-XIE/2006002/tables/diabete/table01.htm. Accessed September 26, 2008. Last edited 2005.

Schoen C, Osborn R, Huynh PT, et al. Primary care and health system performance: Adults' experiences in five countries. *Health Aff (Milwood).* 2004;(W4):487-503.

Schoen C, Osborn R, Huynh P, et al. On the front lines of care: Primary care doctors' office systems, experiences and views in seven countries. *Health Aff (Milwood).* 2006;25(6):w555-w571.

Simonsen L, Reichert TA, Viboud C, et al. Impact of influenza vaccination on seasonal mortality in the US elderly population. *Arch Intern Med.* 2005;165(3):265-272.

Slottie DJ. Measuring the quality of life across countries. *Rev Econ Stats.* 1991;79:684-693.

Spasoff RA. Epidemiologic Methods for Health Policy. New York, NY: Oxford University Press ; 1999.

Statistics Canada. *Canadian Community Health Survey (Cycle 3.1)*. Ottawa, ON: Statistics Canada; 2005a.

Statistics Canada. CANSIM Table 105-0401. http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?Lang=E&ArrayId=1050401&Array_Pick=1&RootDir=CII/&ResultTemplate=CII/CII. Accessed on September 18, 2008. Last edited 2005b.

Statistics Canada. CANSIM Table 105-0402. http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?Lang=E&ArrayId=1050402&Array_Pick=1&RootDir=CII/&ResultTemplate=CII/CII. Accessed on September 18, 2008. Last edited 2005c.

Statistics Canada. CANSIM Table 105-0410. http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?Lang=E&ArrayId=1050410&Array_Pick=1&RootDir=CII/&ResultTemplate=CII/CII. Accessed on September 18, 2008. Last edited 2005d.

Statistics Canada. CANSIM Table 105-0411. http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?Lang=E&ArrayId=1050411&Array_Pick=1&RootDir=CII/&ResultTemplate=CII/CII. Accessed September 18, 2008. Last edited 2005e.

Statistics Canada, Canadian Institute for Health Information. *Health Indicators*. Ottawa, ON: Statistics Canada; 2004.

Statistics Canada Health Statistics Division. *Your Community, Your Health: Findings from the Canadian Community Health Survey (CCHS). Smoking and Diabetes Care: Results from the CCHS Cycle 3.1 (2005)*. Ottawa, ON: Statistics Canada; 2005f.

Statistics Canada. Definition of Dissemination Area. http://www12.statcan.ca/english/cenus01/Products/Reference/dict/geo021.htm. Accessed on July 31, 2007.

Stuck AE, Beers MH, Steiner A, et al. Inappropriate medication use in community residing older persons. *Arch Intern Med.* 1994;154(19):2195-2200.

Swinburn BA, Caterson I, Seidell JC, James WP. Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutr.* 2004;7(1A):123-146.

Tata PR, Rollings J, Collins M, Pickering A, Jacobson RR. Lack of cognitive recovery following withdrawal from long term benzodiazepine use. *Psychol Med.* 1994;24(1):203-213.

The NHS Information Centre. Breast Screening Programme 2005/06 [NS]. http://www.ic.nhs.uk/statistics-and-data-collections/screening/breast-cancer/breast-screening-programme-2005-06-ns. Accessed August 25, 2008. Last edited March 23, 2007.

The Secretariat for the Intersectoral Healthy Living Network in partnership with the F/P/T Healthy Living Task Group and the F/P/T Advisory Committee on Population Health and Health Security (ACPHHS). Integrated Pan-Canadian Healthy Living Strategy. http://www.phac-aspc.gc.ca/hl-vs-strat/pdf/hls_e.pdf. Accessed November 2, 2007. Last edited 2005.

Thom T, Haase N, Rosamond W, et al. Heart disease and stroke statistics–2006 update: A report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation.* 2006;113(6):e85-e151.

Townshend P. Impact of intensive care. *Midwives Chron.* 1987;100(1194):194-196.

Tu K, Chen Z, Lipscombe LL. Prevalence and incidence of hypertension from 1995 to 2005: A population-based study. *CMAJ.* 2008;178(11):1429-1435.

U.S. Department of Health & Human Services. Health information for public health. http://www.nhlbi.nih.gov/health/index.htm. Accessed September 18, 2008. Last edited 2009.

U.S. Department of Health and Human Services. *Preventing Tobacco Use amongst Young People. A Report of the Surgeon General*. Atlanta, Georgia: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 1994.

U.S. Department of Health and Human Services. *Reducing Tobacco Use: A Report of the Surgeon General*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2000.

United Nations Development Programme. Human Development Index (HDI). http://hdr.undp.org/en/statistics/indices/hdi/. Accessed September 18, 2008. Last edited 2008.

Vainio H , Bianchini F. *Weight control and physical activity. IARC handbook of cancer prevention*. Lyon, France: IARC Press; 2002.

van Haastregt JC, Diederiks JP, van Rossum E, de Witte LP, Crebolder HF. Effects of preventive home visits to elderly people living in the community: Systematic review. *BMJ.* 2000;320(7237):754-758.

Veehof L, Stewart R, Haaijer-Ruskamp F, Jong BM. The development of polypharmacy. A longitudinal study. *Fam Pract.* 2000;17(3):261-267.

Velicer, WF, Jackson, DN. "Component analysis versus common factor analysis: Some issues in selecting an appropriate procedure." *Multivariate Behavioral Research.* 1990; 25(1):1-28.

Wagner AK, Zhang F, Soumerai SB, et al. Benzodiazepine use and hip fractures in the elderly: Who is at greatest risk? *Arch Intern Med.* 2004;164(4):1567-1572.

Wilcox SM, Himmelstein DU, Woolhandler S. Inappropriate drug prescribing for the community-dwelling elderly. *JAMA.* 1994;272(4):292-296.

Willett WC, Koplan JP, Nugent R, et al. Prevention of Chronic Disease by Means of Diet and Lifestyle Changes. In: *Disease Control Priorities in Developing Countries*. New York: Oxford University Press; 2006:833-850.

Williams BA, Lindquist K, Sudore RL, Covinsky KE, Walter LC. Screening mammography in older women: Effect of wealth and prognosis. *Arch Intern Med.* 2008;168(5):514-520.

Winkelmayer WC, Bucsics AE, Schautzer A, Wieninger P, Pogantsch M. Use of recommended medications after myocardial infarction in Austria. *Eur J Epidemiol.* 2008;23(2):153-162.

World Health Organization. *World Health Report 2000: Health Systems: Improving Performance*. Geneva, Switzerland: World Health Organization; 2000.

World Health Organization. *Diet, Nutrition and the Prevention of Chronic Diseases: Report of a Joint WHO/FAO Expert Consultation*. Geneva, Switzerland: WHO; 2003.

Wyles H, Rehman HU. Inappropriate polypharmacy in the elderly. *Eur J Intern Med.* 2005;16(5):311-313.

Yale Center for Environmental Law and Policy. Environmental Performance Measurement Project. www.yale.edu/esi/. Accessed September 18, 2008. Last edited 2008.

Yang HW, Simoni-Wastila L, Zuckerman IH, Stuart B. Benzodiazepine use and expenditures for Medicare beneficiaries and the implications of Medicare Part D exclusions. *Psych Serv.* 2008;59(4):384-391.

Zaslavsky AM, Shaul JA, Zaborski LB, Cioffi MJ, Cleary PD. Combining health plan performance indicators into simpler composite measures. *Health Care Financ Rev.* 2002;23(4):101-115.

Zelder M, Wilson G. *Waiting Your Turn: Hospital Waiting Lists in Canada (10th edition)*. Vancouver, BC: Fraser Institute; 2000.

Glossary

Acronyms used in this report:

AMI	Acute myocardial infarction
CA	Community Area
CCHS	Canadian Community Health Survey
CIHI	Canadian Institute for Health Information
CVD	Cardiovascular disease
HDI	Human Development Index
ICD-9-CM	International Classification of Diseases 9th Revision with Clinical Modifications
ICD-10-CA/CCI	International Classification of Diseases 10th Revision with Canadian Enhancements / Canadian Classification of Health Interventions
MCHP	Manitoba Centre for Health Policy
MHHL	Manitoba Health and Healthy Living
OHSAI	Overall Health System Attainment Index
Pap	Papanicolaou
PMR	Premature mortality rate
PYLL	Potential years of life lost
Repository	Population Health Research Data Repository
RHA	Regional Health Authority
SEFI	Socioeconomic Factor Index
SEFI-2	Socioeconomic Factor Index–Version 2
WHO	World Health Organization

Acute Myocardial Infarction (AMI)

Also known as a heart attack, a myocardial infarction occurs when the heart muscle (the myocardium) experiences sudden (acute) deprivation of circulating blood. The interruption of blood is usually caused by narrowing of the coronary arteries leading to a blood clot. The clogging frequently is initiated by cholesterol piling up on the inner wall of the blood vessels that distribute blood to the heart muscle. See Table A3.1 for the codes used to identify this condition.

Administrative Data

Information collected "usually by government, for some administrative purpose (e.g., keeping track of the population eligible for certain benefits, paying doctors or hospitals), but not primarily for research or surveillance purposes" (Spasoff, 1999). MCHP research uses administrative data from hospital discharge summaries, physician billing claims, claims for prescription drugs, and other health related data. Using these data, researchers can study the utilization of health resources over time and the variations in rates within and across the provinces.

Arthritis

Inflammation of one or more joints which causes pain or impaired function. See Table A3.1 for the codes used to identify this condition.

Asthma

A disease in which inflammation of the airways causes airflow into and out of the lungs to be restricted. See Table A3.1 for the codes used to identify this condition.

Beers' Criteria

A list of drugs, compiled and updated by expert review panels, that should be avoided for use by older adults as they are generally thought to be ineffective or to place older adults at an unnecessary high risk of experiencing adverse events. These medications typically have strong anticholinergic and sedating properties or place older adults at an increased risk of drug addiction and falls.

Benzodiazepines

Benzodiazepines belong to the group of medicines called central nervous system depressants (medicines that slow down the nervous system). See Table A3.1 for the codes used to identify these medications.

Beta-Blocker

Beta-blockers, properly known as beta-adrenergic blocking drugs, have been shown to lower the risk of subsequent heart attacks. See Table A3.1 for the codes used to identify this medication.

Bootstrapping

"A technique for estimating the variance and the bias of an estimator by repeatedly drawing random samples with replacement from the observations at hand. One applies the estimator to each sample drawn, thus obtaining a set of estimates. The observed variance of this set is the bootstrap estimate of variance. The difference between the average of the set of estimates and the original estimate is the bootstrap estimate of bias" (Last, 1995).

Canadian Community Health Survey (CCHS)

The CCHS was conducted by Statistics Canada to provide regular and timely cross-sectional estimates of health determinants, health status and health system utilization for 136 health regions in Canada, including the territories. Survey respondents were sampled from 11 regions in Manitoba. Respondents were 12 years of age and older; the sampling methodology was designed to ensure over-representation of youth under 19 years of age and seniors 65 years of age and older. The survey excludes populations living on Indian Reserves, Canadian Forces Bases, in some remote areas, and those not living in households.

Canadian Institute for Health Information (CIHI)

"An independent, not-for-profit organization that provides essential data and analysis on Canada's health system and the health of Canadians" (CIHI, 2009).

Carotid Endarterectomy

Also called carotid artery surgery, it is the surgical removal of plaque from the carotid artery to improve blood flow to the brain. See Table A3.1 for the codes used to identify this procedure.

Carpal Tunnel Release

Surgical release of pressure on the nerve in the carpal tunnel in the wrist. See Table A3.1 for the codes used to identify this procedure.

Cataract

Clouding of the normally clear lens of the eye, thereby preventing light from passing through. This results in blurred and distorted vision, sensitivity to light and glare, and increasing nearsightedness. Surgery involves replacing the lens of the eye with an artificial lens. See Table A3.1 for the codes used to identify this procedure.

Cervical Cancer

Cancer of the uterine cervix, the portion of the uterus attached to the top of the vagina. **Papaniculaou (Pap) tests** screen for—but do not diagnose—pre-cancerous changes and cancer. See Table A3.1 for the codes used to identify this condition.

Cholecystectomy

Surgical removal of the gallbladder. It can be done through an abdominal incision (open cholecystectomy) or through smaller incisions using a small video camera on a tube called a laparoscope (laparoscopic cholecystectomy). See Table A3.1 for the codes used to identify this procedure.

Composite Index

A mathematical combination of individual indicators or measures that represent different aspects of a single but larger concept (Saisana & Tarantola, 2002).

Confidence Interval

An interval, calculated from data, which contains a population parameter, such as the population median or mean, with specified probability. For example, a 95% Confidence Interval (written as 95% CI) would have a 95% probability of containing the true population value.

Diabetes

A chronic condition in which the pancreas no longer produces enough insulin (type I diabetes) or when cells stop responding to the insulin that is produced (type II diabetes), so that glucose in the blood cannot be absorbed into the cells of the body. See Table A3.1 for the codes used to identify this condition.

Dissemination Area (DA)

"A small, relatively stable geographic unit composed of one or more blocks. It is the smallest standard geographic area for which all census data are disseminated. DAs cover all the territory of Canada." As of 2001 the DA replaces the enumeration area as a basic unit for dissemination (Statistics Canada, 2007).

Drug Program Information Network (DPIN)

An electronic, on-line, point-of-sale prescription drug database. Initiated in 1994, it connects Manitoba Health and Healthy Living (MHHL) and all pharmacies in Manitoba to a central database maintained by MHHL. Information about pharmaceutical dispensations is captured in real time for all Manitoba residents (including Registered First Nations), regardless of insurance coverage or final payer. DPIN facilitates payment administration for eligible drug costs, incorporating functions such as real-time adjudication, and collects high-quality data on all prescriptions issued to Manitobans such as drug, dosage, and prescription date. Data from prescription drug claims are contained in the Drug Database at MCHP.

Factor Analysis

A statistical procedure that identifies the common variance amongst a set of observed variables (i.e., indicators), and creates a factor (i.e., index) comprised of that common variance. The factor scores are calculated with a linear equation that incorporates a weighted contribution of each of the variables that are included in the analysis. The contribution (i.e., weight) of each variable is relative to the amount of variance in common with the other variables.

Fee-for-Service

A method of payment whereby physicians bill for each service rendered, according to a pre-arranged schedule of fees and services. Physicians who are paid on a fee-for-service basis file a claim for each service rendered and are responsible for their operating costs.

Fiscal Year

For most Canadian government agencies and health care institutions this is defined as starting April 1 and ending the following year at March 31. For example, the 2005/06 fiscal year would be April 1, 2005 to March 31, 2006, inclusive.

Generalized Linear Model

A unified class of models for regression analysis of independent observations of a discrete or continuous response. A characteristic feature of GLMs is that a suitable non-linear transformation of the mean response is a linear function of the covariates. GLMs provide a unified method for analyzing diverse types of univariate responses (e.g., continuous, binary, counts). GLMs are actually collections of regression models; they include as special cases the standard linear regression for normally distributed continuous outcomes, logistic regression models for a binary outcome, and **Poisson** or **negative binomial regression** models for counts.

Hernia Repair

Surgical repair of a hernia (i.e., protrusion of underlying tissue through a weakness in a muscular wall—usually of the lower abdomen). See Table A3.1 for the codes used to identify this procedure.

Hospital Abstract Database

Database containing hospital discharge abstracts, which are computerized records containing information taken from patients' medical charts that are created at the time of discharge from an acute care hospital.

Hypertension

Primary hypertension is often referred to as high blood pressure. The "tension" in hypertension describes the vascular tone of the smooth muscles in the artery and arteriole walls. It accounts for over 90% of all cases of hypertension in the U.S. and develops without apparent causes. Hypertension is a major health problem, especially because it often has no symptoms. If left untreated, hypertension can lead to heart attack, stroke, enlarged heart, or kidney damage. See Table A3.1 for the codes used to identify this condition.

International Classification of Diseases (ICD)

A classification system of diseases, health conditions, and procedures developed by the World Health Organization, which represents the international standard for the labeling and numeric coding of diseases and health related problems. Within this system, all diseases / conditions are assigned numbers in hierarchical order. There are several versions of the ICD coding system, including ICD-8, ICD-9, ICD-9-CM (Clinical Modifications), ICD-O (Oncology), ICD-10 and ICD-10-CA (Canadian Enhancements).

Ischemic Heart Disease

Heart problems caused by narrowed heart arteries. When arteries are narrowed, less blood and oxygen reaches the heart muscle. Also called coronary artery disease and coronary heart disease. See Table A3.1 for the codes used to identify this condition.

Life Expectancy

The average number of years an individual of a given age is expected to live if current age-sex-specific mortality rates remain stable. Life expectancy is a commonly accepted indicator of population health. Typically calculated at birth, this indicator has the advantage of describing the experience of all people in the population, not just those 0-74 (as for the premature mortality measure). May also be calculated at any age (i.e., age 65).

Mammography

A procedure to determine if a woman has breast cancer or a breast tumor, it is commonly used for breast cancer screening. Mammograms can show most breast cancer two to three years before it can be detected through self-exams. Manitoba has a province-wide breast screening program operated by the **Manitoba Breast Screening Program**. See Table A3.1 for the codes used to identify this procedure.

Manitoba Breast Screening Program

Operated by CancerCare Manitoba (formerly known as Manitoba Cancer Treatment and Research Foundation), the breast screening program began in mid-1995 and involves the delivery of mammography screening through a province-wide program. The goal of the program is to screen 70% of Manitoba women age 50-69 every two years, approximately 33,000 women per year. It is recommended that all women between 50 and 69 years of age be screened every two years for breast cancer or breast tumors. Manitoba Breast Screening Program website: http://www.cancercare.mb.ca/home/patients_and_family/prevention_and_screening/manitoba_breast_screening_program/.

Manitoba Immunization Monitoring System

A population-based monitoring system that provides monitoring and reminders to help achieve high levels of immunization. Immunization status is monitored by comparing the system record and the recommended schedule.

Material Deprivation Index

A factor score derived from 2001 Census data that reflects the deprivation of goods and conveniences and includes the following indicators: average household income, unemployment rate, and high school education rate (Pampalon & Raymond, 2000).

Negative Binomial Distribution

A discrete probability distribution appropriate for analyzing count data when an event is relatively rare, but is highly variable over the entire population. The negative binomial distribution is often employed in regression analyses when the **Poisson distribution** results in an over-dispersed model.

Papaniculaou (Pap) Test

A test for cancer, especially of the female genital tract, in which a smear of exfoliated cells from a female's cervix is specially stained and examined under a microscope for pathological changes. See Table A3.1 for the codes used to identify this procedure.

Physician Claims

Claims that are submitted to the provincial government by individual physicians for services they provide. **Fee-for-service** physicians receive payment based on these claims, while those submitted by physicians on alternate payment plans are for administrative purposes only. The physician claims data file is part of the **Population Health Research Data Repository**.

Poisson Distribution

The pattern usually followed by a set of results in which the measurements are counts. It is a special case of the binomial distribution in which the number of individuals is very large and the chance of one of the two possible outcomes occurring is very small.

Population Health Research Data Repository (Repository)

A comprehensive collection of administrative, registry, survey, and other databases primarily comprising residents of Manitoba housed at the Manitoba Centre for Health Policy (MCHP). It was developed to describe and explain patterns of health care and profiles of health and illness, facilitating inter-sectoral research in areas such as health care, education, and social services. The administrative health database, for example, holds records for virtually all contacts with the provincial healthcare system, the Manitoba Health Services Insurance Plan (including physicians, hospitals, personal care homes, home care, and pharmaceutical prescriptions) of all registered individuals. MCHP acts as a steward of the information in the Repository for agencies such as Manitoba Health and Healthy Living.

Potential Years of Life Lost (PYLL)

An indicator of premature mortality (death before age 75), which gives greater weight to causes of death occurring at a younger age than to those at later ages. This measure is calculated by subtracting the actual age of death from 75, dividing the total potential years of life lost by the total population under age 75, and then presented as "years lost per thousand people." By emphasizing the loss of life at an early age, PYLL focuses attention on the need to deal with the major causes of such early deaths—cancer, accidents and cardiovascular disease—in order to improve health status. PYLL has also been found to vary with characteristics such as sex, **socioeconomic status** and place of residence.

Premature Mortality Rate (PMR)

The rate of deaths of residents aged 0-74 years, per 1,000 residents in this age range. The values are standardized to account for age/sex differences in populations. In order to provide an indicator that is comparable among different areas or regions the rate is usually expressed as a number per thousand. PMR is an important indicator of the general health of a population; high PMR indicates poor health status.

Prevalence

The proportion of the population that "has" a given disease at a given time. The measure of a condition in a population at a given point in time is referred to as point prevalence. A second type is called period prevalence. Over a period of time, such as five years, this measures the number of individuals with a particular condition in the population during that time period. We used period prevalence in this study. Prevalence data provide an indication of the extent of a condition and may have implications for the provision of services needed in a community. Both measures of prevalence are proportions—as such, they do not describe changes over time and should not be described as rates.

Principal Components Analysis

A method of **Factor Analysis** in which the total variance in a data set of many variables is analysed. That is, every variable contributes all of its variance (the sum of each score's squared difference from the mean) in an attempt to identify an underlying factor, or latent variable, that is responsible for the values on the observed variables. This can be contrasted with Principal Factor Analysis, in which only a subset of the total variance in a data set of many variables is analysed.

Regional Health Authorities (RHAs)

Regional governance structure set up by the province to be responsible for the delivery and administration of health services in specified areas. In Manitoba, as of July 1, 2002, there are 11 RHAs: Winnipeg, Brandon, South Eastman, Assiniboine, Central, Parkland, North Eastman, Interlake, Burntwood, Norman, and Churchill.

Salaried Physicians

Physicians who are paid on an annual or sessional salary (rather than **fee-for-service**). The claims they submit (shadow billing) are for administrative purposes only.

Social Deprivation Index

A factor score derived from 2001 Census data that reflects the deprivation of relationships among individuals in the family, the workplace, and the community and includes the following indicators: proportion of the population separated, divorced, or widowed; proportion of the population that lives alone; and proportion of the population that has moved in the past five years (Pampalon & Raymond, 2000).

Socioeconomic Factor Index (SEFI)

A factor score derived from Census data that reflects non-medical social determinants of health and includes the following variables: age dependency ratio, rate of single parent households, rate of female single parent households, female labour force participation rate, unemployment rate composite, and high school education rate composite. SEFI is calculated at the geographic level of the **dissemination area** and is then assigned to residents based on their postal codes. SEFI scores less than zero indicate more favourable socioeconomic conditions, while SEFI scores greater than zero indicate less ideal socioeconomic conditions.

Socioeconomic Factor Index–Version 2 (SEFI-2)

A factor score based on Census data that reflects non-medical social determinants of health and includes the following variables: average household income, percent of single parent households, unemployment rate, and high school education rate. SEFI-2 is calculated at the geographic level of the **dissemination area** and is then assigned to residents based on their postal codes. SEFI-2 scores less than zero indicate more favourable socioeconomic conditions, while scores greater than zero indicate less ideal socioeconomic conditions. SEFI-2 is a simplified version of the original SEFI, which utilizes prior factor scores of multiple education variables and multiple employment variables, an additional measure of single parent families, and an age-dependency ratio. Importantly, due to data restrictions of prior censuses, the SEFI does not include a measure of income in its calculation of socioeconomic risk. The SEFI-2 was developed to take advantage of this data.

Socioeconomic Status (SES)

Characteristics of the economic, social, and physical environments in which individuals live and work, as well as, their demographic and genetic characteristics.

Standard Error

In statistics, the standard error of a measurement, value or quantity is the standard deviation of the process by which it was generated, after adjusting for sample size. It is primarily used to determine the confidence interval of a parameter, such as a mean or rate, as it defines the range of expected values for the measurement.

Standardized Scores

Variable scores adjusted for the mean and standard deviation of the variable for which they are calculated. After the mean is subtracted from a score, it is divided by the standard deviation, resulting in a sample with a mean of zero and a standard deviation of one. They are typically applied when one wishes to compare variables that have considerably different means and variances as it puts them all on the same scale.

Stroke

A sudden death of brain cells due to a lack of oxygen when the blood flow to the brain is impaired by blockage or rupture of an artery to the brain.

Tonsillectomy and Adenoidectomy

The surgical removal of tonsils and/or adenoid glands. See Table A3.1 for the codes used to identify this procedure.

Transurethral Prostatectomy

The surgical removal of the prostate gland via the urethra (the tube through which urine is discharged from the bladder), that is, not requiring an incision into the abdomen. See Table A3.1 for the codes used to identify this procedure.

Type I Error

Being misled by the sample evidence into rejecting the null hypothesis (that there are no significant differences between variables or between population distributions) when it is in fact true.

Winnipeg Community Areas (CAs)

The 12 planning districts within the **Winnipeg Regional Health Authority**, which have similar populations to the rural and northern **Regional Health Authorities (RHAs)**. The 12 CAs include: East and West St. Paul, St. James-Assiniboia, Assiniboine South, Fort Garry, St. Vital, St. Boniface, Transcona, River East, Seven Oaks, Inkster, Point Douglas, Downtown, and River Heights.

Winnipeg Regional Health Authority (WRHA)

Formed in February 2000 through the amalgamation of the Winnipeg Community and Long Term Care Authority and the Winnipeg Hospital Authority. The WRHA is responsible for coordinating health services based on the needs of people in Winnipeg , including hospital, community health, home care, and long–term care services. Since it comprises about half the population of Manitoba, the WRHA has created 12 planning districts called the **Winnipeg Community Areas (CAs)**.

Appendix 1: References for General Indices Reviewed

Cat	Author	Reference	Comment
CCI	Rustagi, P	Significance of Gender-Related Development Indicators: An Analysis of Indian States. *Indian Journal of Gender Studies* 2004;11(3):291-343.	
CCI	Batista-Foguet, J	Socio-Economic Indexes in Surveys for Comparisons between Countries. *Social Indicators Research* 2004;67(3):315-332.	Weighting & detecting inequalities
CCI	Boadu, K	Social Class Differences and Malaria in Ghana. *Dissertation Abstracts International, A: The Humanities and Social Sciences* 2004;64(7):2655-A.	Dissertation?
CCI	Osborn, A	Assessing the Socio-Economic Status of Families. *Sociology* 1987;21(3):429-448.	Social index
HIS	Jinabhai, C	Socio-Medical Indicators of Health in South Africa. *International Journal of Health Services* 1986;16(1):163-176.	Socio-medical Indicators
CCI	Mazumdar, K	A New Approach to Human Development Index. *Review of Social Economy* 2003;61(4):535-549.	Human dev Index
CCI	Noorbakhsh, F	Human Development and Regional Disparities in Iran: A Policy Model. *Journal of International Development* 2002;14(7):927-949.	Human dev Index
CCI	Dogan, M	Strategies in Comparative Sociology. *Comparative Sociology* 2002;1(1):63-92.	Overall
CCI	Quadrado, L	Multidimensional Analysis of Regional Inequality: The Case of Hungary. *Social Indicators Research* 2001;56(1):21-42.	Regional inequality
CCI	Alston, P	Towards a Human Rights Accountability Index. *Journal of Human Development* 2000;1(2):249-269.	Overall
CCI	Warren, J	Choosing a Measure of Occupational Standing: How Useful Are Composite Measures in Analysis of Gender Inequality in Occupational Attainment? *Sociological Methods and Research* 1998;27(1):3-76.	Overall
CCI	Glass, T	Beyond Single Indicators of Social Networks: A LISREL Analysis of Social Ties among the Elderly. *Social Science and Medicine* 1997;44(10):1503-1517.	Social networks
CCI	Mazumdar, K	An Analysis of Causal Flow between Social Development and Economic Growth: The Social Development Index. *American Journal of Economics and Sociology* 1996;55(3):361-384.	Overall
CCI	Parker, R	Constructing an Index of Officially Recorded Crime: The Use of Confirmatory Factor Analysis. *Journal of Quantitative Criminology* 1986;2(3):237-250.	Crime bases
CCI	Wilson, R	General Indicators of Alcohol-Related Mortality for United States Counties. *Advances in Alcohol and Substance Abuse* 1982;2(2)41-52.	Alcohol-based
CCI	Suarez, P	Attitude Consistency and Validity-Reliability Assumptions: An Exercise in Methodological Self-Criticism. *International Sociological Association (ISA)* 1978.	Methods: May be hard to find
CCI	Gostowski, Z	Some Problems of Data Standardization. *Quality and Quantity* 1973;7(1):189-196.	Baseline publication?
CCI	McNamee, P	A comparison of the grade of membership measure with alternative health indicators in explaining costs for older people. *Health Economics* 2004;13(4):379-395.	Construction
CCI	Haley, J	Measuring the causes of economic insecurity: Construction of a composite index. *Journal of Financial Service* 2001;55(3):103-111.	
CCI	Nissan, E	Quality of Life Indicators for Selected South American Nations. *Atlantic Economic Journal* 1985;13(3):93.	
HSI	Margellos, H	Comparison of Health Status Indicators in Chicago: Are Black-White Disparities Worsening? *American Journal of Public Health* 2004;94(1):116-21.	14 HSIs race-based
HSI	Smith, S	Despite overall gains, disparities in health remain. *Public Health Reports* 2001;116(4):380-1.	17 HSIs

Cat	Author	Reference	Comment
CCI	Hyder, A	Applying burden of disease methods in developing countries: a case study from Pakistan. *American Journal of Public Health* 2000;90(8):1235-40.	DALYs HeaLYs
CCI	Kawachi, I	Women's status and the health of women and men: a view from the states. *Social Science and Medicine* 1999;48(1):21-32.	4 indices women
CCI	Hyder, A	Measuring the burden of disease: healthy life-years. *American Journal of Public Health* 1998;88(2):196-202.	DALYs HeaLYs
CCI	Galal, O	Dispersion Index: measuring trend assessment of geographical inequality in health- the example of under-five mortality in the Middle East/North African region, 1980-1994. *Social Science and Medicine* 1997;44(12):1893-902.	Based on space & time
HSI	Sutocky, J	Year 2000 health status indicators: A profile of California. *Public Health Reports* 1996;111:521-6.	18 HSIs
CCI	Frohlich, N	A regional comparison of socioeconomic and health indices in a Canadian province. *Social Science and Medicine* 1996;42(9):1273-81.	SEFI/MCHP
HSI	Speake, D	Integrating indicators into a public health quality improvement system. *American Journal of Public Health* 1995;85:1448-9.	HSIs Healthy People 2000
HSI	Zucconi, S	CDC's consensus set of health status indicators: monitoring and prioritization by state health departments. *American Journal of Public Health* 1994;84(Oct):1644-6.	Air quality Childhood poverty
CCI	Kang, S	The trends of composite environmental indices in Korea. *Journal of Environmental Management* 2002;64(2):199-206.	Environmental
CCI	Galster, G	The disparate racial neighborhood impacts of metropolitan economic restructuring. *Urban Affairs Review* 1997;32(July):797-824.	Economic restructuring
CCI	Thomas, V	Distortions, interventions, and productivity growth: is East Asia different? *Economic Development and Cultural Change* 1996;44(Jan):265-88.	Two CIs constructed
CCI	Gaiha, R	Poverty, development, and participation in India: a progress report. *Asian Survey* 1995;35:867-78.	Anti-poverty interventions
CCI	Turner, S	A composite measure to determine improvement following treatment for social phobia: the Index of Social Phobia Improvement. *Behaviour Research and Therapy* 1994;32:471-6.	Construction Treatment improvement
CCI	Gupta, D	Creating a composite index for assessing country performance in the field of human rights: proposal for a new methodology. *Human Rights Quarterly* 1994;16:131-62.	Attributing weights
CCI	Koenig, E	Why the composite index of leading indicators does not lead. *Contemporary Economic Policy* 1994;12:52-66.	A critique of a CI
CCI	Nandy, S	Poverty, child undernutrition and morbidity: New evidence from India. *Bulletin of the World Health Organization* 2005;83(3): 210-216.	Anthropo-metric
CCI	Lee, W	Bone densitometry: which skeletal sites are best predicted by bone mass determinants? *Journal of Bone and Mineral Metabolism* 2004;22(5):447-455.	
CCI	Borrell, L	Neighbourhood characteristics and mortality in the atherosclerosis risk in communities study. *International Journal of Epidemiology* 2004;33(2):398-407.	Neighborhoods & CVD
CCI	Bozkurt, A.I.	Association between household conditions and diarrheal diseases among children in Turkey: A cohort study. *Pediatrics International* 2003;45(4):443-451.	Indices based on survey Qs
CCI	McAuliffe, W	Identifying substance abuse treatment gaps in substate areas. *Journal of Substance Abuse Treatment* 2002;23(3):199-208.	Substance abuse
CCI	Piaggio, G	Methodological considerations on the design and analysis of an equivalence stratified cluster randomization trial. *Statistics in Medicine* 2001;20(3):401-416.	Methods Equivalence approach
CCI	Wei, J	Development and validation of the Expanded Prostate Cancer Index Composite (EPIC) for comprehensive assessment of health-related quality of life in men with prostate cancer. *Urology* 2000;56(6):899-905.	Validity HRQOL based
CCI	Leibowitz, S	Use of scale invariance in evaluating judgment indicators	Ecological

Cat	Author	Reference	Comment
		Environmental Monitoring and Assessment 1999;58(3):283-303.	endpoints
CCI	Meng, L	Lifestyle factors and chronic diseases: Application of a composite risk index. *Preventive Medicine* 1999;29(4):296-304.	Chronic disease index
CCI	McAuliffe, W	Measuring interstate variations in drug problems. *Drug and Alcohol Dependence* 1999;53(2):125-145.	Drug abuse
CCI	Cadman, D	Construction of social value or utility-based health indices the usefulness of factorial experimental design plans. *Journal of Chronic Diseases* 1986;39(8):643-652.	Canadian discussion: summary indices

Appendix 2: Published Health Indices

Index: **Human Development Index (HDI)**	
Citation: http://hdr.undp.org/en/statistics (United Nations Development Programme)	
Scope of Index	
	The **Human Development Index** (**HDI**) is the normalized measure of a long and healthy life (life expectancy at birth), knowledge (adult literacy rate & gross school enrolment ratio), and a decent standard of living (GDP per capita in PPP US$)
Description of variables	
	Life expectancy (LE): in years at birth Adult literacy rate: in proportion and given two-thirds weight in index Education: combined primary, secondary and tertiary gross school enrolment ration and given one-third weight in index NOTE that adult literacy rate and gross school enrolment ratio are combined to make an education index Gross domestic product (GDP): per capita in PPP US$ (purchasing power parity in US dollars)
Preliminary variable treatment (normalization, factor analyzed)	
	Before the HDI is calculated, the base components are scaled between [0,1] using the minimum and maximum values for each indicator (goalposts). For example, the life expectancy (LE) index measures the relative achievement of a country in LE at birth. The goalpost for LE is 25 years (min) and 85 years (max). So, if country A's LE is 71.4 years in 2005, then LE index is 0.773: 71.4-25 / 85-25 = 0.773
Aggregation method	
	The HDI is a linear aggregate of rescaled life expectancy (see above), income per capita and literacy where the weights are one-third for each (12). The HDI is calculated as the arithmetic average of the three scaled indicators (life expectancy, education and GDP) or: HDI = 1/3 [life expectancy index] + 1/3 [education index] + 1/3 [GDP index]
Presentation method	
	The HDI is given in table format, along with the values of the indicators (variables): HDI, life expectancy at birth (years), adult literacy rate (% aged 15 and above), combined gross enrolment ratio for primary, secondary and tertiary education (%), GDP per capita (PPP US$), LE index, Education index, GDP index. The UNDP ranks countries by High, Medium and Low Human Development
Comments (on interpretation)	
	The HDI is calculated and published yearly. In the 2007/2008 Human Development Report, Canada is ranked 4th in the world after Iceland, Norway and Australia. The US is ranked 12th and the UK is ranked 16th.

Comments (on use of Index)	
	The variables used to calculate the HDI by country have been used within countries in a disaggregated form (LE, education, GDP) along gender, ethnic, age, race, geographic lines enabling deeper analysis of country-specific causes of inequality and poverty. These have sometimes revealed systematic discrimination and serious deprivations.[1] In addition, two Canadians (Ogwang and Abdou, 2003) have applied principal components analysis (PCA) to the HDI and have concluded that there is statistical justification for selecting on one of the components of the index (i.e., life expectancy index or LEI) without a loss of too much information (e.g., the product moment correlation and rank correlation coefficients between HDI and LEI are 0.934 and 0.944.)[2]
Related Indices [explanations found at: http://hdr.undp.org/en/statistics (United Nations Development Programme)]	
	Human poverty index for selected OECD countries (HPI-2): measures deprivations in four basic dimensions of human development: - A long and healthy life: vulnerability to death at a relatively early age, as measured by the probability at birth of not surviving to age 60. - Knowledge: exclusion from the world of reading and communications, as measured by the percentage of adults (ages 16-65) lacking functional literacy skills - A decent standard of living: as measured by the percentage of people living below the income poverty line (50% of the median adjusted household disposable income) - Social exclusion: as measured by the rate of long-term unemployment (12 months or more) Gender related development index (GDI): adjusts the average achievement to reflect the inequalities between men and women using the following dimensions: - A long and health life: as measured by life expectancy at birth - Knowledge: as measured by the adult literacy rate and the combined primary, secondary and tertiary gross enrolment in education ratio - A decent standard of living, as measured by estimated earned income (PPP US$) Female and male indices in each dimension are calculated in a way that penalizes differences in achievement between men and women. This index is called an equally distributed index (ELEI, EEAI-equally distributed educational attainment index, EGDPI). The GDI is the unweighted average of the three component indices.

[1] Noorbakhsh F. Human development and regional disparities in Iran: a policy model. J Int Develop 2002;14:927-949.
[2] Ogwang T, Abdou A. The choice of principal variables for computing some measures of human well-being. Soc Indic Res 2003;64:139-152.

	Gender empowerment measure (GEM): focuses on women's opportunities rather than their capabilities and captures gender inequality in three key areas: - Political participation and decision-making power as measured by women's and men's percentage shares of parliamentary seats - Economic participation and decision-making power, as measured by two indicators: women's and men's percentage shares of positions as legislators, senior officials and managers and women's and men's percentage shares of professional and technical positions - Power over economic resources, as measured by women's and men's estimated earned income (PPP US$) For each dimension, an equally distributed equivalent percentage (EDEP) is calculated, as a population-weighted average. The GEM is also calculated as a simple average of the three indexed EDEPs.

Index: **Overall Health System Attainment Index (OHSAI): WHO**	
Citation: http://www.who.int/healthinfo/paper28.pdf (World Health Organization)	
Scope of Index	
	The **Overall Health System Attainment Index** (**OHSAI**) was developed by the World Health Organization to summarize the performance of health systems using measures of overall good health, distribution of good health, overall responsiveness of the system, distribution of responsiveness and fairness in financial contributions.
Description of variables	
	(H) Good health: disability-adjusted life expectancy (HI) Distribution of good health: equality of child survival index as a measure of health inequality (R & RI) Overall responsiveness & distribution of responsiveness inequality in the system: measured on the basis of survey responses relating to respect for patients and client orientation (FF) Fairness in financial contributions: estimated using the ration of households' total spending on health to their permanent income above subsistence.
Preliminary variable treatment (e.g., normalization, factor analyzed)	
	The variables are scaled in a range between [0, 100] To make the definition of the composite easier to understand, the survey results for the weights were rounded to the nearest one-eighth so that the final weights to be used are 0.25 for health, 0.25 for health inequality, 0.125 for level of responsiveness, 0.125 for distribution of responsiveness and 0.25 for fairness of financial contribution. Before applying these weights to calculate the composite, each component measure was rescaled on a 0 to 100 scale: for healthy life expectancy, $H_{\text{rescaled}} = ((H - 20)/(80 - 20)) \times 100$, for health inequality, $HI_{\text{rescaled}} = (1 - HI) \times 100$, for responsiveness level, $R_{\text{rescaled}} = (R - 10) \times 100$, for responsiveness inequality, $RI_{\text{rescaled}} = (1 - RI) \times 100$, for fairness in financing, $FF_{\text{rescaled}} = FF \times 100$.

	The overall composite was, therefore, a number on the interval 0 to 100, with 100 being the highest possible level of attainment.
Aggregation method	
	The choice of the weights has been based on a survey of preferences of informed individuals for the five components and, where H is the level of health, HI is health inequality, R is responsiveness, RI is responsiveness inequality and FF is fairness of financial contribution the simplest approach defines the composite as a linear aggregate of the five components such that: $Composite = a_1 H + a_2 HI + a_3 R + a_4 RI + a_5 FF$
Presentation method	
	The overall health system achievement index is reported with 80% uncertainty intervals due to data and weight uncertainty. This communicates to the user of the index the plausible range of estimates for each country on each measure.
Comments (on interpretation)	
	Some critics of the development of a composite measure of overall health system attainment may argue that global comparisons should not be undertaken because every society will have dramatically different weights on the five components. The survey work to date does not support such wide variation in population average weights. Overall health system attainment varies widely across countries. This variation is highly correlated with general levels of human development as captured in the Human Development Index. Perhaps, not surprisingly, richer more educated countries have better levels of health, responsiveness and fairness of financial contribution. This composite measure can best be considered as the health-system-specific analogue of the Human Development Index (HDI) or GDP per capita.
Index: **National Health Care Systems Performance using a Composite Performance Indicator**	
Citation: http://www.kingsfund.org.uk/media/news_in_context/healthcare_commission_state_of_healthcare_2007/ Choose file (How_Well1.pdf) : How well is the NHS performing ? A composite performance indicator based on public consultation	
Scope of Index	
	The composite index aims to measure the performance of 120 Health Authorities in England, Scotland and Wales and to see if there is any variation in six health care standards (see below), a gap between the health of town versus city dwellers and an impact of poverty on the National Health Service (NHS).

Description of variables	
	Six indicators from the High Level Performance Indicator set were chosen to reflect various aspects of NHS performance in the areas of process, output and outcome: Number of deaths from cancer (per 100,000) Number of deaths from heart disease (per 100,000) Number of people on hospital waiting lists (per 1,000) Percentage of people on waiting lists for more than 12 months Number of hip operations (per 100,000) Number of deaths from 'avoidable' diseases (tuberculosis, asthma, etc.) (per 100,000)
Preliminary variable treatment (normalization, factor analyzed)	
	Several of the variables have a skewed distribution when the original raw data are examined. Four of the variables showed skewed data: deaths from cancer, deaths from heart disease, people on waiting lists more than 12 months, and avoidable deaths. These were transformed using the 'square root'. Two of the variables: waiting list length and hip operation rate were relatively unskewed and not transformed. In addition, there is considerable variation between the size of the values of the individual rates. The effect of adding (weighted) big numbers to (weighted) small numbers on the composite indicator is to give more weight to differences in cancer deaths than waiting lists. The transformed data were standardized by taking the difference between the transformed values for each performance indicator (variable) for each health authority and the average value for the UK and expressing this as a proportion of the standard deviation for each indicator (resulting in a Z-score).
Aggregation method	
	The composite is a weighted sum of a health authority's actual performance in the six variables. The actual value of each indicator (by health authority) is multiplied by the relevant weight obtained for the indicator from 1,000 persons randomly selected from throughout the UK. A 'budget pie' technique was used. This involves the respondent choosing how to allocate a fixed total budget of 60 chips to some or all of the performance indicators (e.g., reducing the number of deaths from cancer). Based on these findings, the weight for "deaths from cancer" was set at 1.0 and the remaining indicators were rescaled according to their relative values. As an example, consider the composite indicator for Enfield/Haringey health authority: ***CI****= [1.0 (cancer) x 124] + [0.75 (heart disease) x 139] + [0.63 (people on waiting lists) x 31) + [0.56 (waiting lists over 12 months) x 9) + [0.5 (deaths from avoidable diseases) x 76] + [-0.31 (increase number of hip operations) x 295] =* ***199.37***
Presentation method	
	Health authorities or boards are ranked based on the composite indicator. The lower the CI and the rank, the better.

Comments	
	The 'budget pie' allocation method was used as it allowed respondents the chance to say how much more they value one measure (reducing the number of deaths from cancer) over another (reducing the number of people on hospital waiting lists). By using this allocation method, little difference was found in the distribution of the chips depending on respondents' sex, social class, age or the area of the UK where they lived.

Appendix 3: Definitions and Codes used to Develop Indicators

Table A3.1: Indicator Definitions & Codes

Indices & Indicators	Definitions	Codes
A. Prevention & Screening Composite Index		
1. Influenza vaccination for seniors	Percentage of older adults aged 65 years or older who received an influenza vaccine in a fiscal year; presented as an annualized average rate (over 3 years).*	Tariffs 8791, 8792, 8793, 8799
2. Childhood immunization	Percentage of children (born April 1, 1998 to March 31, 2004) who received their primary course of immunization (i.e., DPT-HiB x4, polio x3, and MMR x1) by age 24 months; presented as an annualized average rate (over 3 years).*	Tariffs: DPT [x4] 8601, 8602, 8603, 8609, 8641, 8642, 8643, 8649, 8921, 8922, 8923, 8929, 8781, 8782, 8783, 8789, 8802, 8804, 8806, 8807, 8798, 8805, 8824; HiB (x4) 8781, 8782, 8783, 8789, 8901, 8902, 8903, 8909, 8802, 8804, 8806, 8807; Polio (x3) 8611, 8612, 8613, 8619, 8931, 8932, 8933, 8939, 8802, 8804, 8806, 8807, 8798, 8805, 8824; MMR (x1) 8670, 8621
3. Breast cancer screening (mammograms)	Percentage of females aged 50-69 years who had at least one mammogram in a two-year period.*	Tariffs 7098, 7099, 7104, 7110, 7111
4. Cervical cancer screening (Papanicolaou (Pap) test)	Percentage of females aged 18–69 years who had not undergone a complete hysterectomy and who had at least one Pap test in a three-year period.*	Tariffs 8470, 8495, 8496, 8498, 9470, 9795
B. Healthy Living Composite Indices		
1. Health-Promoting Behaviours Index		
a. Changes to improve health	Percentage of respondents (weighted) who said 'yes' to CCHS question: "In the past month, did you do anything to improve your health (e.g., lost weight, quit smoking, increased exercise)?"	N/A

Table A3.1: Indicator Definitions & Codes

Indices & Indicators	Definitions	Codes
b. Positive food choices	Percentage of respondents (weighted) who made positive food choices. Derived from 'yes' responses to at least one of a series of CCHS questions regarding whether they choose or avoid certain foods because of concerns about such things as body weight, heart disease, cancer, osteoporosis, lower fat, fibre, calcium, salt content, or calorie content.	N/A
c. Leisure time physical activity	Average #hours per week per respondent (weighted) spent in leisure time physical activity in the previous three months. Derived from CCHS question: "In the past three months, how many times did you [participate in identified activity]? About how much time did you spend on each occasion?"	N/A
2. Health-Risk Behaviours Index		
a. Current smoking	Percentage of respondents (weighted) who identified themselves as currently being a daily smoker, an occasional (former daily) smoker or always an occasional smoker. Derived from series of CCHS questions regarding smoking habits, such as, "Have you ever smoked cigarettes daily?"	N/A
b. Binge alcohol use	Percentage of respondents (weighted) who engaged in heavy drinking at least once in the previous 12 months. Derived from CCHS question: "How often in the past 12 months have you had 5 or more drinks on one occasion?" NB: 'Drink' refers to one bottle or can of beer or a glass of draft, one glass of wine or a wine cooler, one drink or cocktail with 1½ ounces of liquor.	N/A
C. Surgical Waiting Times Composite Index		
1. Carotid endarterectomy	Median time (per patient) in days, between date of pre-surgical visit and date of surgery to remove plaque from the carotid artery.**	ICD-9-CM Proc: 38.12 Tariffs: see De Coster et al. (2007)
2. Carpal tunnel release	Median time (per patient) in days, between date of pre-	ICD-9-CM Proc: 04.43

Table A3.1: Indicator Definitions & Codes

Indices & Indicators	Definitions	Codes
3. Cataract surgery	Median time (per patient) in days, between date of pre-surgical visit and date of surgery to replace the lens of the eye with an artificial lens, due to cataract formation.**	ICD-9-CM Proc: 13.11, 13.19, 13.2, 13.3, 13.41, 13.43, 13.51, 13.59 Tariffs: see De Coster et al. (2007)
4. Cholecystectomy	Median time (per patient) in days, between date of pre-surgical visit and date of surgery to remove the gallbladder.**	ICD-9-CM Proc: 51.22, 51.23 Diag: 574.0, 574.1, 574.3, 574.2, 574.4, 574.5, 575.0, 575.1, 576.1, 789.0 Tariffs: see De Coster et al. (2007)
5. Excision of breast lesions	Median time (per patient) in days, between date of pre-surgical visit and date of surgery to remove benign and malignant breast lesions. Exclusion: breast biopsies.**	ICD-9-CM Proc: 85.21-85.23, 85.33-85.36, 85.41-85.48 Diag: 706.2, 174.x, 233.0, 233.3, V71.1, 610.x, 214, 217, 216.5 Tariffs: see De Coster et al. (2007)
6. Hernia repair	Median time (per patient) in days, between date of pre-surgical visit and date of surgery to repair the hernia.**	ICD-9-CM Proc: 53.00-53.03, 53.10-53.17, 53.21, 53.29, 53.31, 53.39 Diag: 550.1, 550.9, 553.0, 552.0 Tariffs: see De Coster et al. (2007)
7. Stripping/Ligation of varicose veins	Median time (per patient) in days, between date of pre-surgical visit and date of surgery to remove varicose veins in the legs only (not esophageal or gastric).**	ICD-9-CM Proc: 38.5 Diag: 454.0, 454.1, 454.2, 454.9 Tariffs: see De Coster et al. (2007)
8. Tonsillectomy & adenoidectomy	Median time (per patient) in days, between date of pre-surgical visit and date of surgery to remove tonsils and/or adenoids due to tonsillitis or hypertropy (not for middle ear).**	ICD-9-CM Proc:28.2-28.4, 28.6 Diag: 474.0, 474.1, 474.8, 474.9, 463 Tariffs: see De Coster et al. (2007)
9. Transurethral prostatectomy	Median time (per patient) in days, between date of pre-surgical visit and date of surgery to remove the prostate gland via the urethra.**	ICD-9-CM Proc: 60.2 Diag: 600 Tariffs: see De Coster et al. (2007)

Table A3.1: Indicator Definitions & Codes

Indices & Indicators	Definitions	Codes
D. Quality of Primary Care Composite Index		
1. Antidepressant prescription follow-up	The percentage of residents with a new prescription for an antidepressant associated with a depression diagnosis (within two weeks of each other) who had three subsequent ambulatory visits within four months of the prescription being filled.*	**Depression:** ICD-9-CM 296, 311 **Antidepressants:** ATC codes N06AA, N06AB, N06AF, N06AG, N06AX
2. Asthma care (long-acting anti-inflammatory prescribing)	The percentage of residents (age 12+ yrs) with an asthma diagnosis (defined as those who had one repeat prescription of a beta 2-agonist in the past year) who filled a prescription for medications recommended for long-term control of asthma (i.e., inhaled corticosteroids).*	**ATC codes:** **Beta 2-agonist:** R03AA, R03AB, R03AC **Inhaled corticosteroids:** R03BA **Leukotriene modifiers:** R03DC
3. Diabetes care (eye exam)	The percentage of residents (age 19+ yrs) with diabetes (defined as those who had at least one drug used to treat diabetes) who saw either an optometrist or ophthalmologist in the same fiscal year as the prescription.*	**Diabetes:** ATC codes A10A, A10B **Optometrist/Ophthalmologist:** MD Bloc: 051, 053
4. Post-Acute myocardial infarction (AMI) care (beta-blocker prescribing)	The percentage of residents discharged alive from hospital in the preceding three years with a discharge diagnosis of MI (excluding those with a prior diagnosis of asthma, MI, COPD, or peripheral vascular disease) who filled at least one prescription for a beta-blocker within four months of the first infarction.*	**MI:** ICD-9-CM 410; ICD-10 CA I21 ***Excluding:*** **Asthma:** ICD-9-CM 493; ICD-10 CA J45 **COPD:** ICD-9-CM 491, 492; ICD-10 CA J41-J44 **Peripheral vascular disease:** ICD-9-CM 443, 459; ICD-10 CA I73, I79.2, I87 **Prior MI:** ICD-9-CM 410; ICD-10 CA I21, I22 **Beta-blocker:** ATC codes C07AA C07AB

Table A3.1: Indicator Definitions & Codes

Indices & Indicators	Definitions	Codes
5. Potentially Inappropriate prescribing of benzodiazepines for seniors*	Percentage of community-dwelling residents (not residing in a PCH) aged 75 years or older with two or more benzodiazepine prescriptions for greater than 30 days.*	**ATC codes:** N05BA01, N05BA02, N05BA04, N05BA05, N05BA06, N05BA08, N05BA10, N05BA12, N05CD01, N05CD02, N05CD06, N05CD07, N05CF01
E. Quality of Pharmaceutical Use Composite Index		
1. Beers' Criteria	The proportion of older adults aged 65 years or older who filled 2+ prescriptions (with a 30+ day supply) for higher risk medications that should not be dispensed to older adults, due to their limited efficacy and/or significant contraindications of the drug. **Inclusion:** only those medications that are considered to be higher risk independent of the prescription dose of the drug or of people's disease (i.e., some Beers Criteria medications are only considered to be high risk if they are prescribed in certain doses or if they are given to people who have certain diseases). **Exclusions:** over-the-counter medications; benzodiazepines (to reduce confounding with the benzodiazepine prescribing indicator).	**ATC codes: Anti-inflammatory** M01AB01, **Analgesics** N02AB02; **Barbiturates** N05CA02, N05BC01; **Antiarrythymic** C01BA03; **Anticholinergics and antihistamines** R06AB02; N05BB01; **Anticlotting** B01AC07, B01AC06; **Antidepressant** N06AA09, N06AA12; **Antihypertensive** C02AB; **Muscle relaxants** M03BA03; M03BX08; **Gastrointestinal/antispasmodic** A03BA03, A03AB05
2. Polypharmacy	Percentage of older adults aged 65 years or older who filled prescriptions for 6+ different drugs within 121 days. **Exclusions:** individuals with 60+ days in hospital in a fiscal year, over-the-counter medications.	
3. Potentially inappropriate prescribing of benzodiazepines for older adults*	as above	
4. Post-Acute myocardial infarction (AMI) care (beta-blocker prescribing)	as above	
F. Prevalence of Chronic Illness Composite Index		
1. Arthritis prevalence	% of residents (aged 19+) with: • 1+ hospitalizations with arthritis diagnosis in 2 years, **OR** • 2+ physician visits with arthritis diagnosis in 2 years, **OR** • 1 physician visit with arthritis diagnosis **AND** 2+ prescriptions for arthritis drugs in 2 years	**Arthritis:** ICD-9-CM 274, 446, 710-721, 725-729, 738; ICD-10 CA M00-M03, M05-M07, M10-M25, M30-M36, M65-M79 **Arthritis Drugs:** ATC codes A07EC01, J01AA08, L01AA01, L01BA01, L04AA01, L04AA13, L04AX01, L04AX03, M01CB01, M01CB03, M01CB04, M01CC01, P01BA02

Table A3.1: Indicator Definitions & Codes

Indices & Indicators	Definitions	Codes
2. Asthma prevalence	% of residents (aged 12+) with: • 1+ hospitalizations with asthma diagnosis in 2 years, **OR** • 1+ physician visits with asthma diagnosis in 2 years, **OR** • 1+ prescriptions for asthma drugs in 2 years	**Asthma:** ICD-9-CM 493; ICD-10 CA J45 **Asthma Drugs:** ATC codes R03A, R03B, R03C, R03D
3. Diabetes prevalence	% of residents (aged 19+) with: • 1+ hospitalizations with diabetes diagnosis in 2 years, **OR** • 2+ physician visits with diabetes diagnosis in 2 years, **OR** • 2+ prescriptions for diabetes drugs in 2 years	**Diabetes:** ICD-9-CM 250; ICD-10 CA E10-E14 **Diabetes Drug:** ATC code A10
4. Hypertension prevalence	% of residents (aged 19+) with: • 1+ physician visits with hypertension diagnosis in 2 years	**Hypertension:** ICD-9-CM 401, 402, 403, 404, 405
5. Ischemic heart disease (IHD) prevalence	% of residents (aged 19+) with: • 1+ hospitalizations with IHD diagnosis in 2 years, **OR** • 2+ physician visits IHD diagnosis in 2 years, **OR** • 1 physician visit IHD diagnosis **AND** 2+ prescriptions for IHD drugs in 2 years	**IHD:** ICD-9-CM 410- 414; ICD-10 CA I20-I22, I24, I25 **IHD Drugs:** ATC codes C01, C07, C08, C09
G. Health Status Composite Index		
1. Life expectancy	The expected length of life (years) from birth based on the current mortality of the population	
2. Material Deprivation Index	A factor score derived from 2001 Census data that reflects the deprivation of goods and conveniences and includes the following indicators: average household income, unemployment rate, and high school education rate	
3. Potential years of life lost	The years of life lost due to early mortality, calculated by subtracting the actual age of death from 75, dividing the total potential years of life lost by the total population under age 75, and then presented as "years lost per thousand people."	
4. Premature mortality rate	The rate of deaths (per 1,000 residents) that occurred before age 75 years.	
5. Self-Rated health	Percentage of CCHS respondents (weighted) who rated their health as 'very good' or 'excellent'.	

Table A3.1: Indicator Definitions & Codes

Indices & Indicators	Definitions	Codes
6. Social Deprivation Index	A factor score derived from 2001 Census data that reflects the deprivation of relationships among individuals in the family, the workplace and the community and includes the following indicators: proportion of the population separated, divorced or widowed, proportion of the population that lives alone and proportion of the population that has moved in the past five years.	
7. Socioeconomic Risk Factor Index (SERI)	A factor score based on 2001 Census data that reflects non-medical social determinants of health and includes the following variables: age dependency ratio, rate of single parent households, rate of female single parent households, female labour force participation rate, unemployment rate composite, and high school education rate composite.	
8. Socioeconomic Risk Factor Index – Version 2 (SERI-2)	A factor score based on 2001 Census data that reflects non-medical social determinants of health and includes the following indicators: average household income, rate of single parent households, unemployment rate, and high school education rate.	

* Katz et al. (2004)

** De Coster et al. (2007)

Source: Manitoba Centre for Health Policy, 2009

Table A3.2: Manitoba's Routine Childhood Immunization Schedule (as of January 2001)

AGE	DaPTP*	Hib*	MMR
2 months	X	X	--
4 months	X	X	--
6 months	X	X	--
12 months	--	--	X
18 months	X	X	--

*DaPTP and Hib are given as "one needle"

D or d	-	diphtheria	M	-	measles (red measles)
aP	-	accelular pertussis (whooping cough)	M	-	mumps
			R	-	rubella (German measles)
T	-	tetanus			
P	-	polio			
Hib	-	haemophilus influenza type B			

Source: Routine Childhood Immunization Schedule (as of January 2001)**.** Communicable Disease Control Unit, Manitoba Health and Healthy Living, May 2001

Source: Manitoba Centre for Health Policy, 2009

Appendix 4: Crude Rate Tables

Table A4.1: Number and Percentage (Unadjusted) of Older Adults Aged 65+ Years Who Received an Influenza Vaccine, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	9,042 (50.7)	11,170 (59.9)
Central	20,275 (51.6)	24,335 (61.7)
Assiniboine	22,152 (53.7)	25,380 (63.5)
Brandon	12,214 (60.7)	14,554 (71.1)
Interlake	16,963 (53.5)	21,176 (64.6)
North Eastman	6,940 (47.3)	9,472 (60.8)
Parkland	12,504 (50.9)	14,542 (60.8)
Churchill	76 (47.8)	86 (48.6)
Nor-Man	3,074 (52.0)	3,793 (63.3)
Burntwood	1,264 (27.4)	2,323 (46.7)
Aggregate Areas		
Rural South	87,876 (51.9)	106,075 (62.3)
North	4,414 (41.3)	6,202 (55.6)
Winnipeg	149,214 (55.7)	183,269 (67.8)
Manitoba	253,718 (54.2)	310,100 (65.6)
Winnipeg Community Areas		
Fort Garry	12,843 (58.6)	16,909 (70.7)
Assiniboine South	9,669 (65.1)	11,717 (72.2)
St. Boniface	10,198 (51.8)	13,569 (67.2)
St. Vital	13,675 (57.3)	17,457 (70.6)
Transcona	5,598 (54.2)	7,181 (67.9)
River Heights	15,937 (55.2)	18,433 (67.0)
River East	23,312 (58.3)	28,345 (68.7)
Seven Oaks	14,171 (56.3)	17,233 (67.3)
St. James - Assiniboia	19,451 (60.9)	23,801 (73.6)
Inkster	3,853 (45.0)	4,838 (57.7)
Downtown	12,518 (47.8)	14,638 (59.6)
Point Douglas	7,989 (48.4)	9,148 (60.2)
Winnipeg Aggregate Areas		
Wpg Most Healthy	83,366 (58.0)	105,842 (69.6)
Wpg Average Healthy	25,199 (52.7)	30,585 (66.0)
Wpg Least Healthy	40,649 (53.1)	46,842 (65.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.2: Number and Percentage (Unadjusted) of Two-Year-Olds with Complete Immunizations, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	1,592 (77.1)	1,645 (76.6)
Central	2,737 (69.0)	2,548 (65.7)
Assiniboine	1,702 (77.3)	1,459 (73.9)
Brandon	1,174 (75.1)	1,204 (73.3)
Interlake	1,746 (71.9)	1,580 (68.0)
North Eastman	933 (62.4)	810 (61.7)
Parkland	1,139 (73.8)	1,041 (74.6)
Churchill	46 (92.0)	40 (83.3)
Nor-Man	830 (62.6)	793 (64.5)
Burntwood	1,583 (49.9)	1,568 (50.7)
Aggregate Areas		
Rural South	9,849 (71.9)	9,083 (69.7)
North	2,459 (54.0)	2,401 (55.0)
Winnipeg	15,753 (73.8)	15,127 (73.5)
Manitoba	29,235 (71.0)	27,815 (70.2)
Winnipeg Community Areas		
Fort Garry	1,457 (74.1)	1,425 (75.9)
Assiniboine South	671 (79.1)	689 (77.4)
St. Boniface	1,160 (79.0)	1,160 (77.3)
St. Vital	1,534 (79.4)	1,452 (79.3)
Transcona	923 (80.3)	799 (75.8)
River Heights	1,261 (75.6)	1,213 (75.1)
River East	2,298 (76.8)	2,127 (76.6)
Seven Oaks	1,294 (75.9)	1,284 (77.5)
St. James - Assiniboia	1,261 (75.6)	1,203 (76.4)
Inkster	910 (72.7)	785 (68.4)
Downtown	1,862 (64.7)	1,907 (66.6)
Point Douglas	1,122 (61.5)	1,083 (60.5)
Winnipeg Aggregate Areas		
Wpg Most Healthy	8,953 (78.4)	8,503 (77.6)
Wpg Average Healthy	2,526 (73.2)	2,482 (74.2)
Wpg Least Healthy	4,274 (66.0)	4,142 (66.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.3: Number and Percentage (Unadjusted) of Women Aged 50-69 Who had a Mammogram, by Region

	Time 1 (2001/02-2002/03)	Time 2 (2004/05-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	2,878 (59.9)	3,494 (63.7)
Central	5,075 (59.5)	5,639 (59.4)
Assiniboine	5,132 (68.3)	5,252 (65.9)
Brandon	3,199 (69.0)	3,407 (67.5)
Interlake	5,143 (62.3)	5,900 (64.7)
North Eastman	2,613 (61.8)	3,066 (64.5)
Parkland	2,934 (64.8)	3,136 (65.3)
Churchill	34 (47.2)	50 (64.1)
Nor-Man	1,136 (57.4)	1,303 (60.3)
Burntwood	1,134 (46.0)	1,293 (48.2)
Aggregate Areas		
Rural South	23,775 (62.8)	26,487 (63.7)
North	2,304 (51.0)	2,646 (53.8)
Winnipeg	39,023 (58.1)	44,078 (60.2)
Manitoba	68,301 (59.8)	76,618 (61.4)
Winnipeg Community Areas		
Fort Garry	4,081 (62.6)	4,762 (65.3)
Assiniboine South	2,911 (65.8)	3,334 (67.8)
St. Boniface	3,321 (64.1)	3,647 (64.4)
St. Vital	3,930 (61.6)	4,580 (63.8)
Transcona	1,976 (61.3)	2,126 (60.9)
River Heights	3,695 (61.3)	4,120 (63.1)
River East	5,629 (57.9)	6,419 (60.4)
Seven Oaks	3,607 (55.3)	4,273 (59.5)
St. James - Assiniboia	4,534 (63.3)	4,763 (65.3)
Inkster	1,316 (47.9)	1,622 (51.5)
Downtown	2,593 (43.8)	2,875 (45.5)
Point Douglas	1,430 (42.7)	1,557 (43.2)
Winnipeg Aggregate Areas		
Wpg Most Healthy	25,747 (61.7)	29,478 (64.1)
Wpg Average Healthy	5,728 (54.9)	6,348 (56.3)
Wpg Least Healthy	7,548 (50.2)	8,252 (51.7)

Source: Manitoba Centre for Health Policy, 2009

Table A4.4: Number and Percentage (Unadjusted) of Women Aged 18-69 Who had a Pap Test, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	10,810 (69.6)	11,374 (70.0)
Central	17,121 (63.3)	17,265 (62.7)
Assiniboine	12,255 (63.5)	11,810 (62.7)
Brandon	10,983 (75.0)	11,270 (75.6)
Interlake	15,212 (69.5)	14,849 (67.1)
North Eastman	7,571 (67.2)	7,158 (62.8)
Parkland	7,008 (60.1)	6,824 (59.8)
Churchill	160 (51.0)	72 (23.8)
Nor-Man	3,645 (52.3)	3,524 (51.4)
Burntwood	5,448 (45.7)	4,670 (39.8)
Aggregate Areas		
Rural South	69,977 (65.6)	69,280 (64.4)
North	9,253 (48.2)	8,266 (43.8)
Winnipeg	150,964 (73.4)	150,742 (72.7)
Manitoba	241,177 (69.6)	239,558 (68.7)
Winnipeg Community Areas		
Fort Garry	15,780 (76.9)	16,160 (76.6)
Assiniboine South	8,949 (75.7)	8,981 (76.1)
St. Boniface	11,841 (78.4)	12,194 (76.6)
St. Vital	15,265 (78.1)	15,293 (77.9)
Transcona	8,117 (77.9)	8,003 (77.2)
River Heights	14,606 (76.2)	14,408 (75.6)
River East	21,546 (74.1)	21,295 (72.9)
Seven Oaks	13,124 (71.4)	13,174 (70.7)
St. James - Assiniboia	14,406 (76.6)	13,923 (74.9)
Inkster	6,299 (65.6)	6,190 (64.9)
Downtown	13,768 (63.0)	13,847 (63.3)
Point Douglas	7,263 (63.5)	7,274 (61.8)
Winnipeg Aggregate Areas		
Wpg Most Healthy	93,270 (76.2)	93,641 (75.6)
Wpg Average Healthy	22,535 (70.3)	22,286 (69.7)
Wpg Least Healthy	35,159 (68.6)	34,815 (67.3)

Source: Manitoba Centre for Health Policy, 2009

Table A4.5: Number and Percentage (Unadjusted) of Respondents Who Reported Making Behavioural Changes to Improve Their Health, by Region*

Region	Number (%)
RHAs	
South Eastman	526 (57.1)
Central	638 (50.9)
Assiniboine	542 (48.8)
Brandon	567 (56.6)
Interlake	611 (55.5)
North Eastman	459 (59.7)
Parkland	368 (51.7)
Nor-Man	482 (58.3)
Burntwood/Churchill	463 (57.2)
Aggregate Areas	
Rural South	3,144 (53.4)
North	945 (57.8)
Winnipeg	1,899 (57.1)
Manitoba	6,555 (55.9)
Winnipeg Aggregate Areas	
Wpg Most Healthy	1,149 (58.3)
Wpg Average Healthy	263 (51.0)
Wpg Least Healthy	487 (57.9)

Source: Manitoba Centre for Health Policy, 2009

*Canadian Community Health Survey 2.1 (2003) and 3.1 (2005) cycles combined

Table A4.6: Number and Percentage (Unadjusted) of Respondents Who Reported Making Healthy Food Choices, by Region*

Region	Number (%)
RHAs	
South Eastman	509 (50.9)
Central	635 (47.6)
Assiniboine	643 (54.4)
Brandon	570 (53.8)
Interlake	646 (53.7)
North Eastman	487 (60.2)
Parkland	403 (52.3)
Nor-Man	503 (57.0)
Burntwood/Churchill	419 (55.6)
Aggregate Areas	
Rural South	3,323 (52.3)
North	922 (56.3)
Winnipeg	2,018 (58.9)
Manitoba	6,833 (56.4)
Winnipeg Aggregate Areas	
Wpg Most Healthy	1,243 (60.4)
Wpg Average Healthy	275 (54.8)
Wpg Least Healthy	500 (57.5)

Source: Manitoba Centre for Health Policy, 2009

*Canadian Community Health Survey 2.1 (2003) and 3.1 (2005) cycles combined

Table A4.7: Number of Respondents and Average Number of Hours per Week, per Person (Unadjusted) Spent in Leisure Time Physical Activity, by Region*

Region	Number of Respondents (hours)
RHAs	
South Eastman	825 (1.45)
Central	1,074 (1.35)
Assiniboine	972 (1.42)
Brandon	926 (1.60)
Interlake	989 (1.55)
North Eastman	713 (1.74)
Parkland	641 (1.48)
Nor-Man	756 (1.64)
Burntwood/Churchill	684 (1.70)
Aggregate Areas	
Rural South	5,214 (1.47)
North	1,440 (1.67)
Winnipeg	3,008 (1.60)
Manitoba	10,588 (1.56)
Winnipeg Aggregate Areas	
Wpg Most Healthy	1,857 (1.66)
Wpg Average Healthy	428 (1.53)
Wpg Least Healthy	723 (1.48)

Source: Manitoba Centre for Health Policy, 2009

*Canadian Community Health Survey 2.1 (2003) and 3.1 (2005) cycles combined

Table A4.8: Number and Percentage (Unadjusted) of Respondents Who Reported Being a Current Smoker[1], by Region*

Region	Number (%)
RHAs	
South Eastman	167 (17.2)
Central	205 (15.9)
Assiniboine	170 (14.5)
Brandon	202 (19.6)
Interlake	204 (19.0)
North Eastman	145 (18.0)
Parkland	138 (18.4)
Nor-Man	201 (23.5)
Burntwood/Churchill	263 (33.8)
Aggregate Areas	
South	1,029 (16.9)
North	464 (28.6)
Winnipeg	566 (16.7)
Manitoba	2,261 (17.3)
Winnipeg Aggregate Areas	
Wpg Most Healthy	272 (13.1)
Wpg Average Healthy	92 (18.4)
Wpg Least Healthy	202 (25.1)

Source: Manitoba Centre for Health Policy, 2009

[1]includes Daily Smoker, Occasional (Former Daily) Smoker and Always Occasional Smoker

*Canadian Community Health Survey 2.1 (2003) and 3.1 (2005) cycles combined

Table A4.9: Number and Percentage (Unadjusted) of Respondents Who Engaged in Binge Alcohol Use (5+ Drinks at One Time) at Least Once in the Previous 12 Months, by Region*

Region	Number (%)
RHAs	
South Eastman	303 (34.8)
Central	350 (31.8)
Assiniboine	380 (39.6)
Brandon	437 (44.6)
Interlake	390 (37.1)
North Eastman	287 (39.4)
Parkland	204 (31.2)
Nor-Man	355 (46.5)
Burntwood/Churchill	380 (51.4)
Aggregate Areas	
Rural South	1914 (35.5)
North	735 (48.9)
Winnipeg	1216 (39.0)
Manitoba	4302 (38.4)
Winnipeg Aggregate Areas	
Wpg Most Healthy	702 (37.7)
Wpg Average Healthy	163 (34.1)
Wpg Least Healthy	351 (45.3)

Source: Manitoba Centre for Health Policy, 2009

*Canadian Community Health Survey 2.1 (2003) and 3.1 (2005) cycles combined

Table A4.10: Number of Cholecystectomies and Median Wait Times (Unadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	357 (40.0)	325 (56.0)
Central	582 (24.0)	590 (26.5)
Assiniboine	409 (35.0)	317 (42.0)
Brandon	246 (48.5)	187 (53.0)
Interlake	500 (33.0)	488 (36.5)
North Eastman	266 (26.0)	289 (33.0)
Parkland	326 (33.0)	314 (40.0)
Nor-Man	140 (19.5)	178 (26.0)
Burntwood/Churchill	290 (43.0)	374 (41.0)
Winnipeg	3,359 (35.0)	3,181 (35.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.11: Number of Hernia Repairs and Median Wait Times (Unadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	322 (42.0)	312 (61.0)
Central	507 (28.0)	514 (31.0)
Assiniboine	374 (42.5)	352 (45.0)
Brandon	205 (49.0)	213 (46.0)
Interlake	356 (34.0)	360 (38.0)
North Eastman	190 (34.0)	202 (37.5)
Parkland	262 (29.0)	260 (37.0)
Nor-Man	74 (18.0)	67 (18.0)
Burntwood/Churchill	55 (43.0)	57 (33.0)
Winnipeg	3,219 (38.0)	3,071 (39.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.12: Number of Excision of Breast Lesions and Median Wait Times (Unadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	148 (18.0)	108 (20.5)
Central	223 (14.0)	198 (17.5)
Assiniboine	209 (21.0)	231 (21.0)
Brandon	155 (21.0)	163 (21.0)
Interlake	250 (18.5)	189 (23.0)
North Eastman	118 (17.0)	73 (19.0)
Parkland	163 (17.0)	121 (15.0)
Nor-Man	46 (15.0)	47 (20.0)
Burntwood/Churchill	40 (19.5)	30 (30.0)
Winnipeg	2,171 (20.0)	1,687 (20.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.13: Number of Strippings/Ligations of Varicose Veins and Median Wait Times (Unadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	67 (60.0)	65 (91.0)
Central	101 (42.0)	98 (49.5)
Assiniboine	60 (56.5)	50 (74.0)
Brandon	27 (72.0)	34 (91.5)
Interlake	51 (77.0)	47 (104.0)
North Eastman	22 (56.5)	21 (134.0)
Parkland	65 (49.0)	63 (61.0)
Nor-Man	14 (17.5)	11 (22.0)
Burntwood/Churchill	28 (68.0)	24 (76.0)
Winnipeg	547 (65.0)	408 (86.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.14: Number of Carpal Tunnel Releases and Median Wait Times (Uadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	140 (52.5)	168 (72.5)
Central	250 (28.0)	256 (32.0)
Assiniboine	236 (37.5)	295 (39.0)
Brandon	120 (47.5)	145 (54.0)
Interlake	230 (53.0)	199 (57.0)
North Eastman	109 (33.0)	117 (60.0)
Parkland	177 (39.0)	250 (35.0)
Nor-Man	44 (13.5)	42 (21.0)
Burntwood/Churchill	45 (78.0)	39 (69.0)
Winnipeg	1,294 (64.0)	1,061 (81.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.15: Number of Tonsillectomies and Median Wait Times (Unadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	357 (49.0)	287 (73.0)
Central	372 (45.5)	414 (65.0)
Assiniboine	382 (60.0)	365 (84.0)
Brandon	251 (69.0)	263 (97.0)
Interlake	320 (63.0)	274 (79.0)
North Eastman	186 (57.5)	190 (80.0)
Parkland	243 (49.0)	208 (54.0)
Nor-Man	174 (27.0)	89 (57.0)
Burntwood/Churchill	244 (54.0)	126 (75.5)
Winnipeg	2,466 (59.0)	2,294 (75.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.16: Number of Cataract Surgeries and Median Wait Times (Unadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	634 (135.0)	661 (139.0)
Central	1,258 (152.5)	1,200 (160.0)
Assiniboine	1,290 (135.0)	1,415 (118.0)
Brandon	797 (127.0)	890 (120.0)
Interlake	1,115 (160.0)	1,088 (169.0)
North Eastman	423 (179.0)	501 (160.0)
Parkland	482 (194.5)	499 (205.0)
Nor-Man	157 (146.0)	180 (122.5)
Burntwood/Churchill	186 (132.0)	174 (105.0)
Winnipeg	10,095 (163.0)	9,788 (148.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.17: Number of Carotid Endarterectomies and Median Wait Times (Unadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	34 (22.5)	17 (16.0)
Central	64 (25.5)	27 (12.0)
Assiniboine	45 (30.0)	39 (18.0)
Brandon	24 (22.0)	36 (16.0)
Interlake	76 (29.5)	62 (19.0)
North Eastman	23 (15.0)	17 (18.0)
Parkland	18 (38.0)	25 (18.0)
Nor-Man	7 (18.0)	8 (21.5)
Burntwood/Churchill	15 (19.0)	9 (42.0)
Winnipeg	409 (29.0)	289 (21.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.18: Number of Transurethral Prostatectomies and Median Wait Times (Unadjusted), by Regional Health Authority (RHA)

	Time 1 (1998/99 – 2000/01)	Time 2 (2001/02 – 2003/04)
RHAs	Number (median days)	Number (median days)
South Eastman	78 (29.0)	67 (35.0)
Central	128 (26.5)	104 (31.5)
Assiniboine	98 (34.5)	74 (33.5)
Brandon	47 (32.0)	51 (43.0)
Interlake	108 (25.0)	104 (34.5)
North Eastman	55 (23.0)	44 (30.5)
Parkland	50 (31.0)	39 (36.0)
Nor-Man	12 (24.0)	11 (32.0)
Burntwood/Churchill	17 (25.0)	16 (39.0)
Winnipeg	921 (26.0)	706 (32.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.19: Number and Percentage (Unadjusted) of Patients Who were Newly Diagnosed with Depression and Who had Three Follow-Up Ambulatory Physician Visits, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	510 (58.7)	412 (57.5)
Central	751 (54.5)	650 (52.2)
Assiniboine	620 (55.1)	493 (53.1)
Brandon	558 (64.1)	557 (65.0)
Interlake	643 (56.4)	467 (54.9)
North Eastman	365 (60.9)	316 (62.2)
Parkland	369 (63.8)	269 (57.1)
Churchill	11 (68.8)	
Nor-Man	202 (55.2)	144 (56.7)
Burntwood	209 (44.9)	
Aggregate Areas		
Rural South	3,258 (57.3)	2,607 (55.2)
North	422 (49.8)	274 (46.1)
Winnipeg	6,217 (61.4)	4,768 (59.9)
Manitoba	10,455 (59.6)	8,206 (58.1)
Winnipeg Community Areas		
Fort Garry	504 (62.2)	402 (61.4)
Assiniboine South	356 (61.6)	294 (59.9)
St. Boniface	422 (62.0)	319 (57.8)
St. Vital	604 (60.8)	402 (58.0)
Transcona	347 (61.3)	253 (55.2)
River Heights	670 (64.1)	448 (59.8)
River East	853 (58.7)	636 (57.5)
Seven Oaks	528 (65.0)	394 (64.0)
St. James - Assiniboia	598 (58.9)	489 (59.8)
Inkster	223 (58.5)	171 (59.8)
Downtown	737 (64.6)	605 (62.1)
Point Douglas	375 (57.6)	355 (63.6)
Winnipeg Aggregate Areas		
Wpg Most Healthy	3,465 (61.3)	2,586 (58.5)
Wpg Average Healthy	1,019 (63.4)	774 (61.9)
Wpg Least Healthy	1,733 (60.5)	1,408 (61.5)

Source: Manitoba Centre for Health Policy, 2009

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Table A4.20: Number and Percentage (Unadjusted) of Asthmatics Receiving Appropriate Care, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	2,228 (69.8)	2,214 (68.1)
Central	3,971 (64.3)	4,233 (64.3)
Assiniboine	4,265 (70.7)	4,068 (71.4)
Brandon	2,953 (63.5)	2,826 (64.4)
Interlake	4,134 (64.8)	4,455 (65.5)
North Eastman	1,704 (66.0)	1,827 (67.8)
Parkland	2,673 (69.8)	2,722 (70.6)
Churchill	87 (75.7)	84 (71.2)
Nor-Man	1,203 (70.1)	1,266 (68.7)
Burntwood	1,767 (62.7)	2,119 (66.2)
Aggregate Areas		
Rural South	18,975 (67.3)	19,519 (67.6)
North	3,057 (65.8)	3,469 (67.2)
Winnipeg	36,579 (63.8)	38,550 (65.8)
Manitoba	61,564 (64.9)	64,364 (66.4)
Winnipeg Community Areas		
Fort Garry	2,954 (67.5)	2,950 (69.8)
Assiniboine South	1,755 (68.2)	1,764 (69.2)
St. Boniface	2,509 (63.4)	2,518 (61.6)
St. Vital	3,174 (64.4)	3,208 (65.4)
Transcona	1,598 (63.2)	1,608 (62.9)
River Heights	3,181 (63.3)	3,198 (65.7)
River East	4,820 (63.9)	5,197 (66.9)
Seven Oaks	2,976 (62.4)	3,176 (66.0)
St. James - Assiniboia	3,695 (68.1)	3,523 (67.7)
Inkster	1,747 (60.0)	1,978 (65.3)
Downtown	4,875 (62.0)	5,390 (64.3)
Point Douglas	3,295 (60.9)	4,040 (65.5)
Winnipeg Aggregate Areas		
Wpg Most Healthy	18,690 (65.3)	19,138 (67.0)
Wpg Average Healthy	5,794 (62.6)	5,974 (64.8)
Wpg Least Healthy	12,095 (62.2)	13,438 (64.6)

Source: Manitoba Centre for Health Policy, 2009

Table A4.21: Number and Percentage (Unadjusted) of Older Adults (65+ Years) Who Filled a Prescription for at Least One Beers Criteria Medication, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	1,097 (6.2)	1,025 (5.5)
Central	2,333 (5.9)	2,118 (5.4)
Assiniboine	2,409 (5.8)	2,130 (5.3)
Brandon	915 (4.5)	805 (3.9)
Interlake	1,600 (5.0)	1,516 (4.6)
North Eastman	691 (4.7)	655 (4.2)
Parkland	1,128 (4.6)	1,034 (4.3)
Churchill		
Nor-Man	315 (5.3)	259 (4.3)
Burntwood	167 (3.6)	
Aggregate Areas		
Rural South	9,258 (5.5)	8,478 (5.0)
North	486 (4.6)	414 (3.7)
Winnipeg	12,385 (4.6)	11,364 (4.2)
Manitoba	23,044 (4.9)	21,061 (4.5)
Winnipeg Community Areas		
Fort Garry	979 (4.5)	1,008 (4.2)
Assiniboine South	730 (4.9)	726 (4.5)
St. Boniface	956 (4.9)	841 (4.2)
St. Vital	1,224 (5.1)	1,146 (4.6)
Transcona	448 (4.3)	435 (4.1)
River Heights	1,392 (4.8)	1,171 (4.3)
River East	1,715 (4.3)	1,713 (4.2)
Seven Oaks	1,106 (4.4)	1,072 (4.2)
St. James - Assiniboia	1,547 (4.8)	1,386 (4.3)
Inkster	355 (4.2)	292 (3.5)
Downtown	1,161 (4.4)	925 (3.8)
Point Douglas	772 (4.7)	649 (4.3)
Winnipeg Aggregate Areas		
Wpg Most Healthy	6,408 (4.5)	6,264 (4.1)
Wpg Average Healthy	2,185 (4.6)	1,981 (4.3)
Wpg Least Healthy	3,792 (5.0)	3,119 (4.3)

Source: Manitoba Centre for Health Policy, 2009

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Table A4.22: Number and Percentage (Unadjusted) of Diabetic Patients Who had an Eye Exam, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	1,641 (37.7)	2,126 (38.6)
Central	3,488 (40.9)	4,334 (42.0)
Assiniboine	3,945 (46.7)	4,937 (49.1)
Brandon	2,445 (49.6)	3,222 (50.4)
Interlake	3,492 (36.9)	4,149 (36.6)
North Eastman	1,661 (36.7)	2,205 (37.2)
Parkland	2,465 (40.1)	2,758 (39.1)
Churchill	38 (28.1)	44 (26.0)
Nor-Man	1,405 (43.9)	1,697 (44.7)
Burntwood	1,669 (28.3)	2,452 (29.5)
Aggregate Areas		
Rural South	16,692 (40.3)	20,509 (40.8)
North	3,112 (33.7)	4,193 (34.1)
Winnipeg	24,372 (37.2)	29,965 (37.5)
Manitoba	46,621 (38.5)	57,889 (38.9)
Winnipeg Community Areas		
Fort Garry	1,844 (38.5)	2,474 (40.0)
Assiniboine South	1,088 (39.3)	1,381 (39.9)
St. Boniface	1,648 (39.1)	2,033 (39.4)
St. Vital	2,161 (40.8)	2,566 (39.6)
Transcona	1,509 (45.3)	1,676 (42.0)
River Heights	2,040 (40.1)	2,354 (39.6)
River East	3,736 (40.6)	4,683 (41.6)
Seven Oaks	2,592 (36.5)	3,172 (35.7)
St. James - Assiniboia	2,334 (38.5)	2,970 (39.7)
Inkster	1,187 (32.8)	1,474 (33.4)
Downtown	2,556 (29.9)	3,120 (30.8)
Point Douglas	1,677 (30.3)	2,062 (31.2)
Winnipeg Aggregate Areas		
Wpg Most Healthy	13,455 (39.8)	16,768 (39.9)
Wpg Average Healthy	4,319 (36.8)	5,022 (36.0)
Wpg Least Healthy	6,598 (33.0)	8,175 (34.0)

Source: Manitoba Centre for Health Policy, 2009

Table A4.23: Number and Percentage (Unadjusted) of Older Adults (65+ Years) Who Filled Presciptions for Six or More Drugs Within a 121-Day Period, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	1,067 (6.3)	1,672 (9.3)
Central	2,751 (7.4)	4,028 (10.7)
Assiniboine	3,189 (8.4)	4,679 (12.4)
Brandon	1,538 (8.0)	2,338 (12.0)
Interlake	1,866 (6.3)	2,852 (9.0)
North Eastman	671 (4.9)	1,127 (7.4)
Parkland	2,247 (9.7)	3,004 (13.2)
Churchill	18 (13.2)	33 (19.8)
Nor-Man	611 (11.1)	806 (13.9)
Burntwood	412 (9.4)	942 (19.1)
Aggregate Areas		
Rural South	11,791 (7.4)	17,362 (10.6)
North	1,041 (10.4)	1,781 (16.4)
Winnipeg	11,604 (4.5)	16,769 (6.4)
Manitoba	25,974 (5.8)	38,250 (8.4)
Winnipeg Community Areas		
Fort Garry	854 (3.9)	1,355 (5.7)
Assiniboine South	661 (4.4)	853 (5.5)
St. Boniface	968 (5.2)	1,431 (7.3)
St. Vital	1,043 (4.5)	1,582 (6.6)
Transcona	345 (3.6)	480 (4.7)
River Heights	1,229 (4.6)	1,780 (6.9)
River East	1,589 (4.0)	2,363 (5.9)
Seven Oaks	1,167 (4.7)	1,628 (6.6)
St. James - Assiniboia	1,274 (4.1)	1,858 (5.9)
Inkster	337 (4.3)	465 (5.8)
Downtown	1,330 (5.5)	1,765 (7.6)
Point Douglas	807 (5.3)	1,209 (8.5)
Winnipeg Aggregate Areas		
Wpg Most Healthy	5,587 (4.0)	8,431 (5.7)
Wpg Average Healthy	2,121 (4.8)	2,951 (6.6)
Wpg Least Healthy	3,896 (5.5)	5,387 (7.9)

Source: Manitoba Centre for Health Policy, 2009

Table A4.24: Number and Percentage (Unadjusted) of Acute Myocardial Infarction (AMI) Patients Who Filled a Prescription for a Beta-Blocker Four Months After Their First AMI, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	182 (77.8)	174 (79.1)
Central	361 (80.0)	358 (80.3)
Assiniboine	338 (76.6)	286 (81.9)
Brandon	222 (82.5)	214 (82.6)
Interlake	379 (78.5)	312 (81.3)
North Eastman	132 (75.9)	162 (84.8)
Parkland	202 (67.8)	230 (78.5)
Churchill		
Nor-Man	73 (76.8)	93 (81.6)
Burntwood	103 (62.8)	110 (72.4)
Aggregate Areas		
Rural South	1,594 (76.6)	1,522 (80.8)
North	179 (67.8)	205 (76.5)
Winnipeg	2,762 (80.1)	2,751 (81.7)
Manitoba	4,757 (78.5)	4,692 (81.2)
Winnipeg Community Areas		
Fort Garry	207 (79.0)	185 (80.8)
Assiniboine South	155 (82.4)	168 (85.3)
St. Boniface	204 (83.3)	192 (81.7)
St. Vital	242 (80.4)	239 (86.3)
Transcona	118 (80.8)	143 (88.3)
River Heights	245 (77.8)	216 (84.0)
River East	411 (79.3)	441 (78.6)
Seven Oaks	275 (82.3)	277 (80.5)
St. James - Assiniboia	342 (83.2)	310 (80.7)
Inkster	103 (79.2)	110 (83.3)
Downtown	266 (76.4)	272 (80.0)
Point Douglas	194 (77.3)	198 (79.5)
Winnipeg Aggregate Areas		
Wpg Most Healthy	1,486 (80.7)	1,513 (82.4)
Wpg Average Healthy	444 (79.3)	453 (81.8)
Wpg Least Healthy	832 (79.5)	785 (80.3)

Source: Manitoba Centre for Health Policy, 2009

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Table A4.25: Number and Percentage (Unadjusted) of Older Adults Aged 75+ Years Who filled 2+ Prescriptions or > 30-day Supply of Benzodiazapines, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	1,605 (21.7)	1,655 (21.3)
Central	3,596 (19.8)	3,783 (20.6)
Assiniboine	4,058 (20.7)	4,041 (21.1)
Brandon	1,891 (21.0)	2,028 (21.7)
Interlake	2,129 (16.9)	2,119 (16.3)
North Eastman	780 (14.2)	832 (14.5)
Parkland	2,584 (21.7)	2,752 (23.5)
Churchill		0 (0.0)
Nor-Man	336 (14.4)	316 (13.9)
Burntwood	76 (5.2)	109 (7.8)
Aggregate Areas		
Rural South	14,752 (19.6)	15,182 (20.1)
North	413 (10.8)	425 (11.4)
Winnipeg	21,904 (18.0)	22,536 (18.0)
Manitoba	38,960 (18.6)	40,171 (18.8)
Winnipeg Community Areas		
Fort Garry	1,582 (17.3)	1,718 (16.4)
Assiniboine South	1,145 (18.3)	1,352 (19.1)
St. Boniface	1,986 (23.0)	1,969 (22.2)
St. Vital	2,047 (19.2)	2,179 (19.2)
Transcona	669 (17.5)	691 (16.7)
River Heights	2,821 (18.6)	2,664 (18.6)
River East	3,229 (18.1)	3,480 (18.2)
Seven Oaks	2,230 (19.7)	2,296 (19.4)
St. James - Assiniboia	2,383 (17.3)	2,543 (17.8)
Inkster	439 (11.7)	458 (12.2)
Downtown	2,035 (15.6)	1,957 (16.0)
Point Douglas	1,338 (16.7)	1,229 (16.4)
Winnipeg Aggregate Areas		
Wpg Most Healthy	10,590 (17.7)	11,499 (17.5)
Wpg Average Healthy	4,242 (18.3)	4,221 (18.5)
Wpg Least Healthy	7,072 (18.4)	6,816 (18.7)

Source: Manitoba Centre for Health Policy, 2009

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Table A4.26: Number and Percentage (Unadjusted) of Residents (19+ Years) with Arthritis, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	7,608 (19.5)	7,504 (17.9)
Central	13,527 (19.7)	13,071 (18.4)
Assiniboine	12,000 (22.9)	10,734 (20.7)
Brandon	7,688 (21.7)	7,760 (21.0)
Interlake	11,403 (20.6)	10,827 (18.9)
North Eastman	6,299 (22.2)	6,096 (20.9)
Parkland	8,414 (26.3)	8,104 (25.8)
Churchill	151 (20.8)	59 (8.8)
Nor-Man	3,868 (23.1)	3,601 (22.0)
Burntwood	4,989 (19.1)	4,240 (15.8)
Aggregate Areas		
Rural South	59,251 (21.5)	56,336 (19.9)
North	9,008 (20.7)	7,900 (18.0)
Winnipeg	103,484 (20.8)	97,573 (19.2)
Manitoba	179,431 (21.1)	169,569 (19.4)
Winnipeg Community Areas		
Fort Garry	8,626 (18.2)	8,597 (17.1)
Assiniboine South	5,972 (21.3)	6,046 (21.2)
St. Boniface	7,291 (19.8)	6,940 (17.8)
St. Vital	9,206 (20.0)	8,982 (18.9)
Transcona	4,647 (19.0)	4,533 (18.3)
River Heights	9,579 (20.9)	8,738 (19.2)
River East	14,415 (20.4)	13,423 (18.5)
Seven Oaks	9,786 (22.0)	9,199 (19.8)
St. James - Assiniboia	10,464 (22.4)	9,689 (20.8)
Inkster	4,306 (19.4)	3,867 (17.1)
Downtown	11,950 (21.6)	10,758 (19.6)
Point Douglas	7,242 (24.7)	6,801 (22.6)
Winnipeg Aggregate Areas		
Wpg Most Healthy	57,125 (19.8)	55,119 (18.5)
Wpg Average Healthy	16,981 (21.6)	15,681 (19.7)
Wpg Least Healthy	29,378 (22.5)	26,773 (20.4)

Source: Manitoba Centre for Health Policy, 2009

Table A4.27: Number and Percentage (Unadjusted) of Residents (12+ Years) with Asthma, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	4,685 (10.3)	4,421 (9.0)
Central	8,095 (10.1)	6,872 (8.3)
Assiniboine	6,368 (10.6)	5,467 (9.3)
Brandon	5,039 (12.5)	4,284 (10.2)
Interlake	7,655 (12.1)	6,510 (9.9)
North Eastman	3,844 (11.7)	3,384 (10.0)
Parkland	4,362 (12.0)	3,588 (10.0)
Churchill	105 (12.7)	80 (10.4)
Nor-Man	1,845 (9.3)	1,514 (7.8)
Burntwood	2,836 (8.7)	2,271 (6.7)
Aggregate Areas		
Rural South	35,009 (11.0)	30,242 (9.3)
North	4,786 (9.0)	3,865 (7.2)
Winnipeg	66,137 (11.9)	59,387 (10.4)
Manitoba	110,971 (11.4)	97,778 (9.9)
Winnipeg Community Areas		
Fort Garry	5,773 (10.8)	5,335 (9.4)
Assiniboine South	3,573 (11.1)	3,273 (10.1)
St. Boniface	4,627 (11.3)	4,248 (9.7)
St. Vital	5,993 (11.6)	5,393 (10.1)
Transcona	3,075 (11.0)	2,822 (10.0)
River Heights	5,947 (12.0)	5,198 (10.5)
River East	8,898 (11.2)	8,033 (9.8)
Seven Oaks	6,056 (12.1)	5,468 (10.5)
St. James - Assiniboia	6,403 (12.4)	5,772 (11.2)
Inkster	3,107 (12.1)	2,953 (11.3)
Downtown	7,604 (12.3)	6,434 (10.5)
Point Douglas	5,081 (15.2)	4,458 (12.9)
Winnipeg Aggregate Areas		
Wpg Most Healthy	36,201 (11.1)	33,164 (9.9)
Wpg Average Healthy	10,582 (12.1)	9,309 (10.6)
Wpg Least Healthy	19,354 (13.4)	16,914 (11.6)

Source: Manitoba Centre for Health Policy, 2009

Table A4.28: Number and Percentage (Unadjusted) of Residents with Diabetes, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	1,988 (5.1)	2,474 (5.9)
Central	3,907 (5.7)	4,582 (6.5)
Assiniboine	3,965 (7.6)	4,453 (8.6)
Brandon	2,267 (6.4)	2,814 (7.6)
Interlake	4,249 (7.7)	4,894 (8.5)
North Eastman	2,159 (7.6)	2,651 (9.1)
Parkland	2,790 (8.7)	3,148 (10.0)
Churchill	73 (10.1)	68 (10.1)
Nor-Man	1,489 (8.9)	1,693 (10.3)
Burntwood	2,832 (10.8)	3,458 (12.9)
Aggregate Areas		
Rural South	19,058 (6.9)	22,202 (7.9)
North	4,394 (10.1)	5,219 (11.9)
Winnipeg	31,157 (6.3)	36,604 (7.2)
Manitoba	56,876 (6.7)	66,839 (7.7)
Winnipeg Community Areas		
Fort Garry	2,441 (5.1)	2,949 (5.9)
Assiniboine South	1,398 (5.0)	1,624 (5.7)
St. Boniface	2,064 (5.6)	2,520 (6.4)
St. Vital	2,575 (5.6)	3,085 (6.5)
Transcona	1,511 (6.2)	1,753 (7.1)
River Heights	2,522 (5.5)	2,760 (6.1)
River East	4,366 (6.2)	5,131 (7.1)
Seven Oaks	3,351 (7.5)	4,007 (8.6)
St. James - Assiniboia	2,960 (6.3)	3,501 (7.5)
Inkster	1,573 (7.1)	1,881 (8.3)
Downtown	3,871 (7.0)	4,510 (8.2)
Point Douglas	2,525 (8.6)	2,883 (9.6)
Winnipeg Aggregate Areas		
Wpg Most Healthy	16,315 (5.7)	19,531 (6.6)
Wpg Average Healthy	5,451 (6.9)	6,275 (7.9)
Wpg Least Healthy	9,391 (7.2)	10,798 (8.2)

Source: Manitoba Centre for Health Policy, 2009

Table A4.29: Number and Percentage (Unadjusted) of Residents with Hypertension, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	6,674 (17.1)	7,496 (17.9)
Central	11,973 (17.5)	13,385 (18.9)
Assiniboine	11,847 (22.6)	12,675 (24.5)
Brandon	6,847 (19.3)	7,285 (19.7)
Interlake	11,985 (21.6)	13,084 (22.8)
North Eastman	5,583 (19.7)	6,814 (23.3)
Parkland	6,736 (21.1)	7,518 (23.9)
Churchill	155 (21.3)	32 (4.8)
Nor-Man	2,494 (14.9)	2,477 (15.1)
Burntwood	3,823 (14.6)	4,046 (15.1)
Aggregate Areas		
Rural South	54,798 (19.9)	60,972 (21.6)
North	6,472 (14.8)	6,555 (15.0)
Winnipeg	93,325 (18.8)	102,766 (20.2)
Manitoba	161,442 (18.9)	177,578 (20.4)
Winnipeg Community Areas		
Fort Garry	8,209 (17.3)	9,669 (19.3)
Assiniboine South	5,148 (18.4)	5,915 (20.7)
St. Boniface	6,783 (18.4)	7,406 (19.0)
St. Vital	8,865 (19.2)	9,490 (20.0)
Transcona	4,440 (18.1)	4,814 (19.4)
River Heights	8,644 (18.9)	9,138 (20.1)
River East	13,353 (18.9)	15,135 (20.9)
Seven Oaks	9,208 (20.7)	10,252 (22.1)
St. James - Assiniboia	9,717 (20.8)	10,605 (22.8)
Inkster	4,202 (18.9)	4,646 (20.6)
Downtown	9,283 (16.8)	9,800 (17.8)
Point Douglas	5,473 (18.6)	5,896 (19.6)
Winnipeg Aggregate Areas		
Wpg Most Healthy	53,880 (18.7)	60,940 (20.4)
Wpg Average Healthy	15,801 (20.1)	16,613 (20.9)
Wpg Least Healthy	23,644 (18.1)	25,213 (19.2)

Source: Manitoba Centre for Health Policy, 2009

Table A4.30: Number and Percentage (Unadjusted) of Residents with Ischemic Heart Disease, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (%)	Number (%)
South Eastman	1,868 (4.8)	1,792 (4.3)
Central	3,441 (5.0)	3,190 (4.5)
Assiniboine	3,160 (6.0)	2,799 (5.4)
Brandon	1,815 (5.1)	1,717 (4.6)
Interlake	2,931 (5.3)	2,821 (4.9)
North Eastman	1,322 (4.7)	1,360 (4.7)
Parkland	2,689 (8.4)	2,668 (8.5)
Churchill	33 (4.5)	16 (2.4)
Nor-Man	650 (3.9)	607 (3.7)
Burntwood	788 (3.0)	800 (3.0)
Aggregate Areas		
Rural South	15,411 (5.6)	14,630 (5.2)
North	1,471 (3.4)	1,423 (3.2)
Winnipeg	27,123 (5.5)	26,217 (5.2)
Manitoba	45,820 (5.4)	43,987 (5.0)
Winnipeg Community Areas		
Fort Garry	2,139 (4.5)	2,271 (4.5)
Assiniboine South	1,637 (5.8)	1,543 (5.4)
St. Boniface	2,085 (5.7)	2,020 (5.2)
St. Vital	2,461 (5.3)	2,421 (5.1)
Transcona	1,137 (4.6)	1,074 (4.3)
River Heights	2,783 (6.1)	2,431 (5.3)
River East	3,769 (5.3)	3,987 (5.5)
Seven Oaks	2,750 (6.2)	2,740 (5.9)
St. James - Assiniboia	3,293 (7.0)	3,069 (6.6)
Inkster	861 (3.9)	836 (3.7)
Downtown	2,418 (4.4)	2,188 (4.0)
Point Douglas	1,790 (6.1)	1,637 (5.4)
Winnipeg Aggregate Areas		
Wpg Most Healthy	14,673 (5.1)	14,797 (5.0)
Wpg Average Healthy	4,683 (6.0)	4,423 (5.6)
Wpg Least Healthy	7,767 (5.9)	6,997 (5.3)

Source: Manitoba Centre for Health Policy, 2009

Table A4.31: Number and Rates (Unadjusted) of Residents (aged 0-74) Who Died Prematurely, by Region

	Time 1 (1998/99-2002/03)	Time 2 (2001/02-2005/06)
RHAs	Number (rate per 1,000)	Number (rate per 1,000)
South Eastman	612 (2.4)	618 (2.3)
Central	1,351 (3.0)	1,271 (2.8)
Assiniboine	1,249 (3.9)	1,113 (3.6)
Brandon	743 (3.4)	670 (3.0)
Interlake	1,257 (3.6)	1,267 (3.6)
North Eastman	702 (3.8)	663 (3.5)
Parkland	831 (4.2)	816 (4.2)
Churchill	13 (2.6)	17 (3.4)
Nor-Man	450 (3.7)	420 (3.5)
Burntwood	685 (3.1)	764 (3.4)
Aggregate Areas		
Rural South	6,002 (3.4)	5,748 (3.2)
North	1,148 (3.3)	1,201 (3.4)
Winnipeg	10,029 (3.3)	9,937 (3.3)
Manitoba	17,922 (3.3)	17,556 (3.2)
Winnipeg Community Areas		
Fort Garry	643 (2.2)	720 (2.4)
Assiniboine South	433 (2.5)	436 (2.5)
St. Boniface	673 (3.1)	666 (2.9)
St. Vital	831 (2.9)	779 (2.7)
Transcona	453 (2.8)	428 (2.7)
River Heights	837 (3.3)	811 (3.2)
River East	1,409 (3.3)	1,338 (3.1)
Seven Oaks	857 (3.2)	922 (3.4)
St. James - Assiniboia	1,068 (3.9)	1,017 (3.8)
Inkster	437 (2.9)	411 (2.7)
Downtown	1,494 (4.4)	1,464 (4.3)
Point Douglas	894 (4.8)	945 (4.9)
Winnipeg Aggregate Areas		
Wpg Most Healthy	4,700 (2.6)	4,701 (2.6)
Wpg Average Healthy	1,663 (3.6)	1,634 (3.5)
Wpg Least Healthy	3,666 (4.7)	3,602 (4.6)

Source: Manitoba Centre for Health Policy, 2009

Table A4.32: Number and Rate (Unadjusted) of Potential Years of Life Lost, by Region

	Time 1 (2000/01-2002/03)	Time 2 (2003/04-2005/06)
RHAs	Number (rate per 1,000)	Number (rate per 1,000)
South Eastman	10,021 (39.3)	10,486 (38.9)
Central	21,096 (47.5)	20,463 (45.0)
Assiniboine	17,373 (55.0)	17,025 (55.3)
Brandon	10,297 (47.6)	9,282 (42.2)
Interlake	19,337 (55.7)	19,788 (56.4)
North Eastman	12,618 (68.6)	12,035 (64.8)
Parkland	12,085 (62.0)	11,929 (62.8)
Churchill	257 (51.7)	330 (68.0)
Nor-Man	8,433 (70.6)	7,646 (64.9)
Burntwood	18,413 (84.7)	18,904 (86.4)
Aggregate Areas		
South	92,530 (53.1)	91,726 (52.2)
North	27,103 (79.3)	26,880 (78.7)
Winnipeg	152,651 (51.1)	154,047 (51.0)
Manitoba	282,581 (53.5)	281,935 (52.8)
Winnipeg Community Areas		
Fort Garry	9,668 (33.3)	10,836 (36.3)
Assiniboine South	5,734 (33.8)	5,944 (35.0)
St. Boniface	10,193 (47.0)	9,000 (39.8)
St. Vital	12,286 (43.8)	11,500 (40.9)
Transcona	7,207 (45.7)	6,621 (42.2)
River Heights	11,992 (47.8)	12,166 (48.6)
River East	19,576 (46.2)	19,245 (44.9)
Seven Oaks	12,173 (46.1)	13,047 (48.7)
St. James - Assiniboia	13,751 (51.0)	12,895 (48.5)
Inkster	7,138 (48.4)	6,481 (43.8)
Downtown	27,555 (83.3)	28,039 (83.6)
Point Douglas	15,378 (83.5)	18,273 (96.5)
Winnipeg Aggregate Areas		
Wpg Most Healthy	67,800 (38.5)	67,450 (37.8)
Wpg Average Healthy	25,111 (54.5)	24,901 (54.1)
Wpg Least Healthy	59,740 (78.1)	61,696 (79.5)

Source: Manitoba Centre for Health Policy, 2009

Table A4.33: Number and Percentage (Unadjusted) of Respondents Who Rated Their Health as 'Very Good' or 'Excellent', by Region*

Region	Number (%)
RHAs	
South Eastman	919 (61.2)
Central	1,083 (61.1)
Assiniboine	1,187 (60.5)
Brandon	902 (58.6)
Interlake	938 (58.7)
North Eastman	743 (57.6)
Parkland	631 (52.7)
Nor-Man	692 (58.0)
Burntwood/Churchill	644 (51.9)
Aggregate Areas	
Rural South	5,501 (59.3)
North	1,345 (55.0)
Winnipeg	2,967 (62.1)
Manitoba	10,715 (60.8)
Winnipeg Community Areas	
Fort Garry	366 (68.3)
Assiniboine South	158 (69.3)
St. Boniface	242 (61.6)
St. Vital	303 (62.8)
Transcona	142 (60.1)
River Heights	303 (67.8)
River East	360 (57.9)
Seven Oaks	223 (60.1)
St. James - Assiniboia	324 (60.3)
Inkster	132 (62.7)
Downtown	309 (60.0)
Point Douglas	105 (55.4)
Winnipeg Aggregate Areas	
Wpg Most Healthy	1,809 (63.9)
Wpg Average Healthy	470 (61.7)
Wpg Least Healthy	242 (61.6)

Source: Manitoba Centre for Health Policy, 2009

*Canadian Community Health Survey 2.1 (2003) and 3.1 (2005) cycles combined

Appendix 5. Statistical Methods Used to Create the Composite Indices

This appendix describes in further detail the process used to create and evaluate the composite indices described in this report, as well as the rationale for using these methods. Issues related to creating and comparing a composite over multiple time periods is also addressed. More about the general principles of factor analysis can be learned in Factor Analysis by Richard L. Gorsuch (1983).

A5.1 Creating a Composite Index

The basic process for creating a composite index is fairly straightforward. A factor analysis examines the common variance between indicators and creates a mathematical combination of the indicators. This is done by a means similar to a regression formula; a certain portion of each indicator contributes to the overall index. The degree to which each indicator contributes to the composite index depends on its degree of commonality with the entire set of indicators.

For the analyses presented in this report, several issues needed to be addressed (Velicer and Jackson, 1990). The first is how the common variance should be analysed. Two primary methods may be employed: 1) Principal components analysis – this method analyses all of the variance in the set of included variable and includes variance that is unique to only one of the indicators. 2) Principal factor or principal axis analysis – this method analyses only the common variance in the set of variables.

Choosing one method over another depends on the theory behind conducting the analysis in the first place. Principal components analysis tends to be used when one is simply trying to reduce the number of variables to a more manageable set (i.e., data reduction). There may be no theoretical reason for their inclusion in a single analysis, or no well reasoned argument for why the variables would actually vary together. Principal factor analysis assumes that there is an underlying force, or trait, that is causing the variables to behave in a similar manner. Variance that is unique to a single variable, therefore, would simply be 'error', and excluded from the analysis. We used this latter approach for the majority of our analyses.

In SAS, the program PROC CALIS was used to conduct the factor analyses. Specifying the principal factor analysis was a matter of including options for analyzing the covariance matrix ('cov') and the maximum likelihood method ('ml'). A sample of the code would appear as follows:

```
proc calis data = test cov ku method=ml;
factor n=1; *rotate=varimax;
var <variables to include in analysis>;
title2 'Title here';
run;
```

The factor statement includes options for specifying the number of resulting factors; initially, this was not restricted. Where a single factor was found, n=1 would be specified. If more than one factor was identified, then n=2 could be specified, and in this case, the 'rotate = varimax' option would be employed.

The second issue to be addressed concerns the decisions regarding the adequacy of the resulting factor structure, which can be either theoretical or statistical. If the resulting factor structure does not make sense to the researcher, then one can choose to reject it, as seen in Chapter 6. The variables included in a factor, and the direction of the factor loadings, should be interpretable.

Beyond theoretical considerations, there are three ways to assess the statistical adequacy of a factor analysis. The first is to measure goodness-of-fit. There are a number of such measures, all intended to assess the same basic idea: the ability of the resulting factor model to replicate the data. In our study, we considered several measures to determine the adequacy of the models, including the most commonly used goodness-of-fit index (GFI), McDonald's index (McDonald and Marsh, 1990; McDonald, 1989), indices by Bentler and Bonett (1980), and the root mean square residual. If all of these measures met the minimum criterion (e.g., minimum GFI > 0.90), the factor model was accepted as adequate.

In addition to goodness of fit, researchers should also consult two measures of the variance accounted for by the factor model. The first measure is the total variance in the variables accounted for by the factors that are retained while the second measure addresses the variance accounted for in a single variable. The first measure is essentially the sum of the squared correlations between a factor and all the variables in the analysis, and is known as an eigenvalue. The initial analysis will create as many factors as there are variables and accounts for 100% of the variance in the data set. Eigenvalues for factors are used to determine which factors, and how many factors, to keep in a model; generally, factors with eigenvalues greater than one are considered to meet a minimum criterion for being retained. The variance accounted for by a factor is: R^2 = eigenvalue / number of variables in analysis. Thus, if one wanted to see at least half the variance accounted for by a single factor, then the required eigenvalue for that factor would be equal to the number of variables divided by two.

The second measure addressed how well the individual variables are accounted for by the factor structure. The proportion of variance accounted for in a variable would be the sum of the squared correlations with all retained factors, and is known as the 'communality' for the variable. It is what the variable has in common with the factors, or other variables. Where only a single factor is extracted, it would simply be the squared factor loading (a factor loading is the correlation between a factor and a variable). A minimum of 16% of the variance was expected in these analyses (which would require a single factor loading of 0.40). Although a factor may emerge, a particularly low communality for a variable would suggest that that particular variable is not 'part' of the factor(s).

A5.2 Testing the Factor Structure Over Time

The third issue for constructing these composite indices concerns the evaluation of the indices over time. For the indices to be used comparatively over time it is essential that the same structure be imposed at both time periods. There are two ways to accomplish this. The first is to create a stable index at Time 1 (or Time 2) and then apply that structure to the indicators at Time 2 (or Time 1). This ensures the ideal fit at the reference time point, and tests its applicability at Time 2. The second method is to simultaneously analyze both time points using structural equation modeling, constraining the contribution of indicators from both time points to be identical. In this way, the best overall fit across both time points is obtained.

While the second method may seem preferable, there is a major drawback. One of the constraints under which these indices are being developed is that they can be replicated over time. If one wanted to see how an index changed in another three years, how to do so would be difficult. The simultaneous procedure where all time points are evaluated together would have to be replicated with the inclusion of three time points, rather than only two, complicating the analysis, and placing computational demands that may not result in a satisfactory solution. As well, a major drawback would be that including an additional time point would result in a different solution, making the comparison of results from the current analysis to a follow-up analysis impossible.

The alternative approach taken in this deliverable was to generate a composite index using the data from the first time period. The weights assigned to the variables from this analysis were then applied to the data from the second time period. Because we were applying a set of weights from an external model, the criteria for assessing goodness-of-fit were relaxed (0.80). Using this method, the best fitting, stable model from the start of the study period was assessed at the later time point. Further updates can be done by simply applying the same factor model to new raw data.

If the factor structure holds, then any changes in factor scores can be directly assessed. If it does not hold, that in itself reveals important changes in the individual indicators that can then be evaluated. Essentially, a poor fitting model would mean that the indicators are no longer correlated in the way that they were previously. Discovering the reason(s) the relationship between a set of indicators has changed over time can be a learning tool and illustrative, despite the fact that it makes comparisons of the factor scores over time suspect.

Slight changes to the SAS code enforce a particular factor structure in the analysis:

```
proc calis data = test cov ku method=ml ;
factor n=1;
 matrix _F_
[1,1] = 0.05,
[2,1] = 0.06,
[3,1] = 0.08,
[4,1] = 0.07;
var <variables to be included in analysis>;
run;
```

The 'matrix _F_' statement indicates that the following numbers are to be used in the analysis, and would come from the initial analysis (i.e., Time 1) for the particular composite index. The matrix is described using rows and columns, where the first number represents the number of variables and the second the number of factors. If, in the previous example, six variables were included, then two additional points would have been necessary ([5,1] and [6,1]). An additional factor would result in a second set of constraints being listed (i.e., [1,2], [2,2], [3,2], etc.).

The methods described above ensure that any composite index would adhere to the conditions described at the outset of this report. A composite index produced by these methods will reflect common variation in the majority of the constituent indicators, if not all of the indicators, that are retained in the factor model (i.e., those with high factor loadings). The resulting factor should be interpretable and have face validity. The commonality between indicators at one point in time will remain stable at a second point in time. Finally, because of these conditions, the scores should be directly interpretable, with higher scores for one geographic area meaning that that area will tend to have high scores on all of the indicators for the index. Although other methods for creating composite variables are possible, initial factor analysis combined with confirmatory factor analysis is the preferred method for accomplishing these specific goals.

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