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Improving Children's Health

How Population-based Research Can Inform Policy

~ The Manitoba Experience ~

REVUE CANADIENNE DE
SANTÉ PUBLIQUE
VOLUME 93, SUPPLÉMENT 2 ■ NOVEMBRE/DÉCEMBRE 2002

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Manitoba Centre for
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Foreword

Honourable Dave Chomiak
Minister of Health,
Province of Manitoba

For over ten years, the Manitoba Centre for Health Policy (MCHP) has been providing accurate and timely information to health care decision-makers, analysts and providers, so that policies, programs and services intended to improve the health of Manitobans can be efficaciously designed and implemented. MCHP delivers leading-edge research in the areas of health service utilization, health and illness patterns in the population, and the factors that affect health, all of which are critical to informing the health policy process.

Over the past several years, there has been a growing interest in child health and well-being as health policy-makers and researchers have turned their attention to the impact child health has on future health. It makes sense that those who experience health problems in childhood may be more likely to experience poor health as adults. Following from this, if we can put programs in place that enhance the health of young children, then perhaps we can not only improve their quality of life but also prevent future health problems for the next generation.

With these goals in mind, the Manitoba Ministry of Health asked MCHP to provide a report on child health in the province of Manitoba. Armed with objective data on the health status of children in our province, we felt we would be better able to design effective programs and policies aimed at enhancing the development and well-being of Manitoba children, and monitoring existing programs. MCHP was uniquely suited to perform this task given their ability to produce high caliber scientific research relevant to the policy process. Together with an advisory group made up of clinicians, researchers, policy-makers and government representatives, MCHP produced an encyclopedic report on child health in Manitoba, on which the papers in this supplement are based. Within weeks of releasing this report, research was translated into policy action when our government announced a new public health initiative focusing on preventing childhood injuries in the home. The MCHP report was key in identifying this real need within the province and underscored the importance of having province-wide information when designing and developing programs.

On behalf of the Manitoba Ministry of Health, I congratulate MCHP in producing this supplement focusing on child health and hope it can serve as a model for other jurisdictions attempting to identify areas where new programs and policies are necessary and for monitoring and evaluating existing programs and policies aimed at improving the health of children.

Foreword

Tim Sale
Chair of the Healthy Child Committee of Cabinet, Minister of Energy, Science and Technology, and former Minister of Family Services and Housing, Government of Manitoba

Rob Santos
Healthy Child Manitoba, Government of Manitoba, and Department of Psychology, University of Manitoba

The Manitoba Centre for Health Policy (MCHP) at the University of Manitoba is an international centre of research excellence, with an exemplary record of health services and health policy research over the last decade. In March 2001, MCHP released a report entitled, *Assessing the Health of Children in Manitoba – A Population-Based Study*.[1] The purpose of the report was to "provide planners and those involved in improving child health and well-being with a rich source of descriptive, population-based information on the health of children in Manitoba" (p. 7). Commissioned by Manitoba's Department of Health at the recommendation of our province's Healthy Child Manitoba office, the MCHP report came to be known as a "child health encyclopedia" and forms the basis for the studies published in this special issue of the *Canadian Journal of Public Health (CJPH).*

The Government of Manitoba viewed the MCHP report as a follow-up to a report commissioned by Manitoba Health, entitled *The Health of Manitoba's Children,*[2] submitted to government by Dr. Brian Postl in March 1995. The Postl report was the first population health study on children in Canada, and has been pivotal in developing *child-centred public policy* in Manitoba. The MCHP report builds on this important work. Comparing changes in children's health outcomes over the 5-year period between the two reports provides additional information for policy and program planning and development across government departments in Manitoba. Longitudinal trends highlight areas of improvement in children's well-being, as well as areas of enduring concern.

The MCHP report is consistent with a *determinants of population health* framework. It confirmed in Manitoba a number of findings from the international research literature, notably the socioeconomic gradient in children's health and development,[3,4] wherein increasing levels of socioeconomic status (e.g., income, education, employment) are related to increasing levels of developmental health across the life span. These data reaffirm the same fundamental premise in the Postl[2] report.

Related to the socioeconomic gradients evident in the MCHP findings are the continued and urgent needs of children and youth growing up in northern Manitoba and inner city Winnipeg. These issues were central policy imperatives in the Postl report and in Manitoba's recent implementation of recommendations from this report, through our province's commitment to both *economic justice*, through income and employment supports, and *social justice*, through community-based family supports from health, education, justice, and social services during the early years, into adolescence and the transition to adulthood, with special attention to Manitoba's Aboriginal children and youth.

Key MCHP findings are also consistent with an ecological model of child development, outlining how both risk and protective factors operate in the environments wherein children live, learn, and grow: family, preschool, school, neighbourhood, and community. The MCHP report found that each of these environments is related to the health and well-being of children and families, which in turn is related to the overall health of their communities. These social determinants of health are of central importance for child-centred public policy development. The MCHP report indicates that family resources (e.g., income, education, employment, dual parents), early learning and stability (e.g., Grade 3 math performance, school transfers), household environment (e.g., crowding, parental depression), and community resources (e.g., availability of child care, sports programs) are all related to children's health and the overall health of their communities. A major implication of the MCHP report is that improving the health of children in Manitoba requires continued intersectoral collaboration across departments and sectors, with special attention to children and youth growing up in Northern Manitoba and inner city Winnipeg, consistent with earlier recommendations from the Postl report.

Further comprehensive profiles of child health in Manitoba are essential for building healthy child development in the province. Our Healthy Child Manitoba initiatives began implementation in the years following the time period covered in the MCHP report (i.e., 1994-1998). The data in the MCHP report may therefore provide baselines for comparing changes in children's outcomes following the implementation of new programs and services for children and youth in Manitoba from 1998 to the present. A major area of interest will be the short- and long-term outcomes of new investments in Manitoba through the province's Healthy Child Committee of Cabinet and its Healthy Child Manitoba office, including funds from the Federal-Provincial-Territorial Early Childhood Development agreement arising from the First Ministers' Meeting in September 2000. Our Healthy Child Manitoba office and MCHP will continue their productive research partnership, building on the success of the child health encyclopedia.

In light of recent academic and policy attention to the determinants of population health, particularly healthy child development, the child health encyclopedia represents a natural growth in MCHP research, which has increasingly encompassed the broader determinants of health, in addition to health services. The Government of Manitoba is keenly interested in the long-term potential of research linking administrative data from provincial departments to inform intersectoral policy development. From our perspective, MCHP is second to none in its capacity and expertise in this area. Embedded in Healthy Child Manitoba's intersectoral, multilevel, and longitudinal research and evaluation framework, MCHP research is a key component of a developing provincial knowledge system for child-centred public policy.

We would suggest that the combination of intersectoral government structures, such as our Healthy Child Committee of Cabinet and its Healthy Child Manitoba office, and world-class research institutions, such as MCHP, is a powerful model for policy development. For example, the Healthy Child Committee of Cabinet comprises seven Ministers (Aboriginal and Northern Affairs; Culture, Heritage and Tourism; Education, Training and Youth; Family Services and Housing; Health; Justice; and Status of Women) and leads the Healthy Child Manitoba office, a single window through which the academic community can collaborate with the government community around a major cross-sectoral area of concern, namely the healthy development of children and youth. Manitoba is only beginning to tap the potential of this model for improving developmental health outcomes.

Our colleagues from other jurisdictions in Canada have also begun to explore the possibilities of this kind of academic-policy partnership, using MCHP as their model. We believe that this signals an ever-growing realization that, when it comes to investing in the growth and development of our youngest citizens, indeed of all citizens, no single sector of society can succeed on its own. A shared challenge of all government departments is to shift from independence to *interdependence*, a new way of working together. Historically, we have learned that the "silos" in government have been more likely to hinder, rather than help, development over the life course.

To inform decision-making, governments need reliable, valid, and policy-relevant research. To conduct high-quality policy research, academia needs effective, efficient, and cross-sectoral government structures that are committed to evidence-based decision-making. The MCHP studies in this special issue of *CJPH* are excellent examples of successful collaboration between policy researchers and policy-makers. If we are to improve outcomes for all children in Manitoba and Canada, we must continue to work together to develop effective mechanisms for developing and transforming leading-edge knowledge into community action.

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Foreword

Barbara Starfield, MD, MPH
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Several years ago, the Manitoba Centre for Health Policy (MCHP) developed a landmark population-based information system that is capable of collecting and linking data useful for making and evaluating health policies, with full attention to considerations of privacy and confidentiality. In this supplement, MCHP demonstrates its creativity in conceptualizing analyses that have immediate relevance to intelligent policy-making.

As a result of requests from the Manitoba government, MCHP mounted a series of investigations covering the entire developmental spectrum of health concerns in the child and adolescent population – the most neglected segment of the population as far as health services research is concerned. (Most health services research excludes children explicitly – a fact not usually reflected in the titles of the published articles). Thus, the first congratulations go to the Canadian province that recognized the importance of child health to population health. The second goes to MCHP for undertaking the task in a novel way.

True to its reputation, MCHP took an unconventional approach to its challenge. Almost any other qualified research group, armed with a source of survey data obtained from individuals, would have proceeded merely to analyze the data with the individual as the unit of analysis, dutifully describing the state of health of children, focusing on particular manifestations of ill health one by one, ably analyzing the findings by race, ethnicity, gender, age group, and probably also some measure of social class or socioeconomic position. Not so MCHP. Taking advantage of the radical change in conceptualization of the web of causation of ill health, and particularly the recognition of the importance of area-level characteristics *not* derivable from data obtained from individuals, the researchers developed a new approach to documenting and exploring the reasons for differences in health. They characterized their social groups by the area-level characteristic of income quintile, reasoning (consonant with current thinking) that the area in which people live has as much if not more explanatory power regarding health levels of the population therein as do individual characteristics. They did something equally novel; they characterized each area in the province according to its premature mortality rate – a validated measure of overall health needs in the area – ranked the areas according to this measure, and then compared these rankings with the areas rankings on each measure of child health. Doing so provided a graphic demonstration of where policies were most likely to have been successful or unsuccessful. Rankings of areas on health measures that differed from rankings on overall PMR suggested that the area had implemented (or failed to implement) policies that had not been implemented (or, conversely had been implemented) in other areas.

Thus, the reports in this Supplement are path-breaking – a model for other jurisdictions. Placing the findings in the context of an overall summary measure of health in specific areas and by income quintiles (instead of the more common poverty-non poverty measures based on individual data) is in tune with the current focus on gradients in health (rather than merely poor-non poor) and on the identification of correlates of disparities in health that are related to characteristics remediable by appropriate health policy.

The contributions also contribute to thinking about health services research techniques by focusing on both types of disparities in health and health services: vertical inequity as well as horizontal inequity. The latter considers the extent to which people with equal needs received equal services, and is a highly appropriate consideration in countries such as the United States and the developing world where access to care is limited as a direct result of the failure of social and health policy. In countries with universal financial access, vertical equity assumes a more central role; as different groups of the population almost never have equal burdens of ill-health, the policy-relevant question is the extent to which different population groups receive *more* than the average share of resources to deal with their greater needs. Ways in which the data are analyzed in the articles in this supplement are testimony to the awareness of MCHP to these new challenges to health policy.

Creativity is in evidence in specific contributions in this collection. The separation of neonatal from postneonatal mortality is testimony to the researchers' recognition that the two are differently sensitive to different aspects of health policy – a fact not recognized by those who continue to rely on infant mortality as the appropriate measure of ill-health among infants. Moreover, their characterization of areas by not only PMR but also a socioeconomic index (SEFI) made up of unemployment and educational statistics permits the generation of informed hypotheses about the kinds of policy that are related to poorer or worse performance of the area on particular ill-health measures. There was greater consistency (across health indicators) of the relationship across income quintiles than was the case for the comparisons with the PMR and SEFI rankings, suggesting that inequities across areas can, at least in part, be influenced by differences in specific policies or community actions. Sorting this out is a challenge for future studies. Other studies have shown, for example, that Canada, in general, has achieved horizontal equity in access and use, at least with regard to primary care services (although not, apparently, to specialty services).[1] The extent to which vertical equity has been achieved overall and differentially between areas, is not clear.

This Supplement provides the basis for heightened awareness of the need for new approaches to data collection and analysis in both Canada and the United States. Intelligent policy-making for populations will require a reorientation of data collection and analysis strategies to populations rather than individuals.[2] This is the major lesson from this remarkable effort to understand and improve the state of health of the population and reduce systematic disparities across population subgroups.

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Foreword

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It is well established that socioeconomic factors such as income and education influence health. Research from around the world has consistently found that on average, people who are the poorest and least educated are sicker than people who are less poor and more educated, who in turn are likely to be sicker than the wealthiest and best educated. In a public health care system such as Canada's, with no direct financial barriers to access, individuals from the poorest and least educated neighbourhoods visit a physician more often, are prescribed more pharmaceuticals, receive more procedures, and spend more time in hospital. Yet, despite investments in medical care targeted to those in need – these inequalities in health remain. Clearly, the medical care system alone cannot be expected to eradicate these inequalities in health.

For the past several years, the Manitoba Centre for Health Policy (MCHP) has been conducting population-based research on patterns of illness and the use of health care services in Manitoba. This research attempts to understand the relative contributions that health care, income level, education, and unemployment make to the health of Manitobans. In this Supplement, we share our experience of using population-based research methods to study child health. Viewing child health from a population rather than an individual perspective allows us to see that most childhood illnesses are not random events – that clear patterning of health and illness exists by region and by income level. Throughout this Supplement we have ordered regions and neighbourhood of residence by the health status of the population (from most healthy and least in need of health care to least healthy and most in need of health care). We demonstrate that the areas with the healthiest children are those with the most favourable socioeconomic conditions (lower unemployment rates, higher education, etc.) and the areas with the least healthy children are those with the least favourable socioeconomic conditions. Child health indicators are also displayed by the child's family or neighbourhood income level, making it easy to see which indicators are related to income and which are not.

The articles in this Supplement examine a wide range of important child health status indicators (e.g., low birthweight, infant mortality, child mortality, injury, and chronic conditions), and several measures of health care utilization (e.g., hospital utilization, rates of physician visits, and rates of pharmaceutical prescriptions). Together, this information puts into perspective the contribution of health care to child health status relative to the contributions made by other determinants of health.

Identifying conditions which lie outside the health care system which influence health moves our research focus beyond sick individuals, specific diseases and individual treatments. As a low-income single parent wrote in response to a front-page article about the Child Health Report from which this Supplement evolved, "to have children in [doctors'] offices more often will not help low-income families…will not put nourishing food on the table. Regular visits…will not improve sub-standard housing." We endorse this opinion. To improve child health, the health policy community must expand its research focus beyond the frequency and quality of children's doctors visits. That is one important message of this Supplement.

Using a Population-based Health Information System to Study Child Health

Marni Brownell, PhD[1]
Teresa Mayer[2]
Patricia J. Martens, PhD[1]
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ABSTRACT

Objective: This paper describes the population-based analyses of measures of child health status used throughout this supplement.

Methods: The articles in this supplement examine health-related data for children 0 to 19 years. Most analyses cover the period from April 1, 1994 to March 31, 1999. Administrative and survey data were used to assess child health and well-being. For regional comparisons, data were broken down by subregions of Manitoba, called Regional Health Authorities (RHAs), and neighbourhoods of Winnipeg, called Winnipeg Community Areas (Winnipeg CAs).

The premature mortality rate (PMR) was used as a proxy of the overall health of the population. All graphs comparing rates among RHAs and Winnipeg CAs rank these subregions in the same order, from lowest to highest PMR. Income was operationalized by dividing the province's population into urban and rural quintiles based upon household income. Other aspects of methodology are discussed.

Results: Results are presented in the articles that follow this one.

Conclusion: The relationships between key child health indicators and geographic and socioeconomic factors for Manitoba children are discussed in the articles following this one.

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

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The full report "Assessing the Health of Children in Manitoba: A Population-Based Study" on which this article is based is available from the Manitoba Centre for Health Policy at the above address or online at: http://www.umanitoba.ca/ centres/mchp/reports.htm

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Research in the area of child health has revealed a powerful relationship between child health and health in adulthood,[1,2] and compelling arguments have been made regarding the importance of early childhood experiences and development on later health and well-being.[3-5] Child health[6-9] and long-term health outcomes[10-14] have been shown to have a particularly strong relationship with socioeconomic status, which includes factors such as family income level, and parental education and employment. Lower socioeconomic status is associated with poorer health outcomes, and it is not just that those from the lowest income neighbourhoods have the poorest outcomes, but those from middle-income neighbourhoods do less well than those from the higher income neighbourhoods.[15] In other words, with each increase in level of socioeconomic status, there is an increase in health status; this relationship is referred to as the socioeconomic gradient in health status.

Children living in poverty are most at risk for poor health outcomes. The child poverty rate in Canada increased over the past several years, from 14.9% in 1981 to 18.9% in 1998.[16,17] A number of provincial and federal initiatives (see for example, http://unionsociale.gc.ca/nca/June21-2000/english/sharedvision_e.html) have called for child health strategies to attempt to minimize the effects of child poverty as well as to optimize the current well-being and future health of all children. Essential to the design and evaluation of policies and programs aimed at enhancing child health and well-being are accurate measurements of both child health status and the social conditions in which children live. Accurate measurements of child health status can be used to:

- identify vulnerable populations of children
- set targets for programs designed to enhance child health and well-being
- evaluate the effectiveness of programs designed to enhance child health and well-being.[18]

Manitoba's Child Health Report

As a first step toward optimizing the health of children in Manitoba, the ministry of health for the province of Manitoba (Manitoba Health) asked the Manitoba Centre for Health Policy (MCHP) to

develop a report on child health in Manitoba. MCHP was established in 1991 as a research unit within the Department of Community Health Sciences, Faculty of Medicine, University of Manitoba, with the goal of providing accurate and timely information to health care decision-makers, analysts, and providers to aid them in their role of providing effective and efficient services for improving the health of Manitobans. To achieve this goal, MCHP developed a population-based health data system 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.[19] The database is designed around information routinely produced as part of administering the health insurance system in Manitoba, and documents every contact that the population has with hospitals, physicians, nursing homes, as well as prescriptions dispensed in the province. It also includes vital statistics data documenting date and cause of death and public-use census information. This database has been used to study various aspects of population health and health care use.[20]

Together with an advisory committee composed of clinicians, researchers and policy-makers with expertise in child health, MCHP identified numerous key child health status indicators, and set out to compile detailed, population-based information on these indicators. The articles in this supplement describe the process and results of using this population-based information to study the health of children, focusing on how child health indicators are influenced by geographic and socioeconomic factors. The information produced has been used to assist regional health planners from every region in Manitoba to strategize child health improvement in their communities.[21] This work can serve as a model for jurisdictions across the country developing similar information systems to assist in the development of programs and policies aimed at improving child health in Canada. The full report is available at: http://www.umanitoba.ca/centres/mchp/reports/child_pdfs.htm

What we focused on

As one flips through the articles in this supplement, it becomes apparent that most graphs compare child health outcomes across geographic regions within Manitoba, and that these graphs maintain a consistent ordering of regions throughout. This ordering is based on a five-year average (1994/95-1998/99) of the premature mortality rate (PMR) which is the age- and sex-standardized death rate of persons under 75 years of age. This ordering is based on the belief that PMR is the best single measure to reflect the healthiness of a group of people and their need for health care services.[22-24] Regions at the top of the graphs (lower PMR) tend to have more educated, affluent residents who also tend to be healthier, whereas those at the bottom of the graphs (higher PMR) tend to have the opposite characteristics. Although it is legitimate to question whether a health measure based on the population up to 74 years should be used when studying children, there is no single child health indicator available that reflects overall child health. The ordering by PMR provides insight into which child health status measures are associated with the overall health of the populations within the regions. PMR correlates highly with a measure of socioeconomic well-being developed at MCHP called the Socioeconomic Factor Index (SEFI), and as such can be considered a surrogate for both the physical health and socioeconomic well-being of the population in which a child lives. The concepts of the healthiness of populations within regions and how these relate to measures of socioeconomic risk are described in the paper entitled "Embedding Child Health within a Framework of Regional Health: Population Health Status and Sociodemographic Indicators."

Demographic information is essential to health care planners, including infant and childhood mortality rates, which are well-established indicators of child health. This information is discussed in "A Matter of Life and Death for Manitoba's Children: An Overview of Birth Rates and Mortality Rates."

Perinatal surveillance systems have tended to lack conceptual frameworks to enable the translation of data into useful information. The Epidemiology Unit of Manitoba Health has successfully applied a conceptual framework for categorizing feto-infant mortality data in Manitoba, and this information has been used to aid in policy and program planning. We invited those working with the Epidemiology Unit to describe the application of this framework and their results in "Preventable Feto-Infant Mortality: Application of a Conceptual Framework for Perinatal Health Surveillance to Manitoba Perinatal Outcomes."

Many factors influence the health and well-being of children throughout youth and later into adult life, and many of those factors appear during pregnancy, birth, and in the first year of life. "Being Born in Manitoba: A Look At Perinatal Health Issues" presents some of the indicators for the health and well-being of our youngest members of society – infants.

Because teen pregnancy is associated with adverse outcomes of infant health and well-being, as well as having socioeconomic impact upon the adolescent parents, we have included a paper "Factors Affecting Adolescent Reproductive Health in Manitoba" that addresses the problem of "kids having kids." The Manitoba teen pregnancy rate is substantially higher than the Canadian rate, thus this paper includes information on risk factors and risk behaviours that may help planners develop or monitor programs designed to decrease teen pregnancy rates.

The assessment of health status plays an important role in the planning, delivery and evaluation of the effectiveness of health care systems. Included in this supplement are two papers on child health status. The first, "Assessing Health Status in Manitoba Children: Acute and Chronic Conditions," focuses on three sets of conditions that impose limitations in function and cause dependency on medications and technology: 1) lower respiratory tract infections, 2) chronic conditions, and 3) physical disabilities. The second health status paper, "Childhood Injury Rates in Manitoba: Socioeconomic Influences," is devoted entirely to an examination of injuries in Manitoba children. Injuries are the number one reason for deaths of children, and account for about one in every six hospitalizations.

Knowledge of patterns of health services utilization in children can provide useful information for the planning of health service delivery. We have included two papers on utilization of health services. The first, "Health Service Utilization by Manitoba

Children," examines hospitalization and physician visit rates, questioning whether large variations in rates across geographic regions indicate under- and over-servicing or variations in legitimate health care needs. In the second utilization paper, "Prescription Medications in Manitoba Children: Are There Regional Differences?", data on prescription drug utilization provide an indication of trends in physician prescribing as well as the distribution of disease. Among others, antibiotics, psychostimulants and antidepressants were examined because of concerns over their increased use in children in the past decade.

Medical care is only one of myriad factors that have an impact on child health. The social conditions in which children live also have an impact on child health and well-being. "Community Resources and Determinants of the Future Health of Manitobans" describes regional variation in school achievement and school mobility, as measures of future health, and places these measures in the context of available community resources which affect the health and education of children.

Our epilogue, "The Virtual Classroom: A Summary of Child Health Indicators" attempts to synthesize the information on child health status provided in the supplement articles by asking the question: how does all this information apply to typical classrooms of Manitoba children?

METHODS

Context

1.1 million people reside in Manitoba, with over half of these (approximately 650,000) residing in Winnipeg. Manitoba is divided into 12 health jurisdictions called Regional Health Authorities (RHAs). Figure 1 shows the location of the RHAs within the province. The regions in the northern part of the province (Burntwood, Nor-Man and Churchill) are referred to as the "north", all other regions except Winnipeg and Brandon (population about 47,000) are referred to as the "rural south." Winnipeg, which is itself an RHA, can be further divided into 12 distinct areas called Winnipeg Community Areas (Winnipeg CAs) (Figure 1).

The methods described in this article detail the general methods used for most of the articles in this supplement. These methods do not apply to the article prepared by the Manitoba Health Epidemiology Unit.

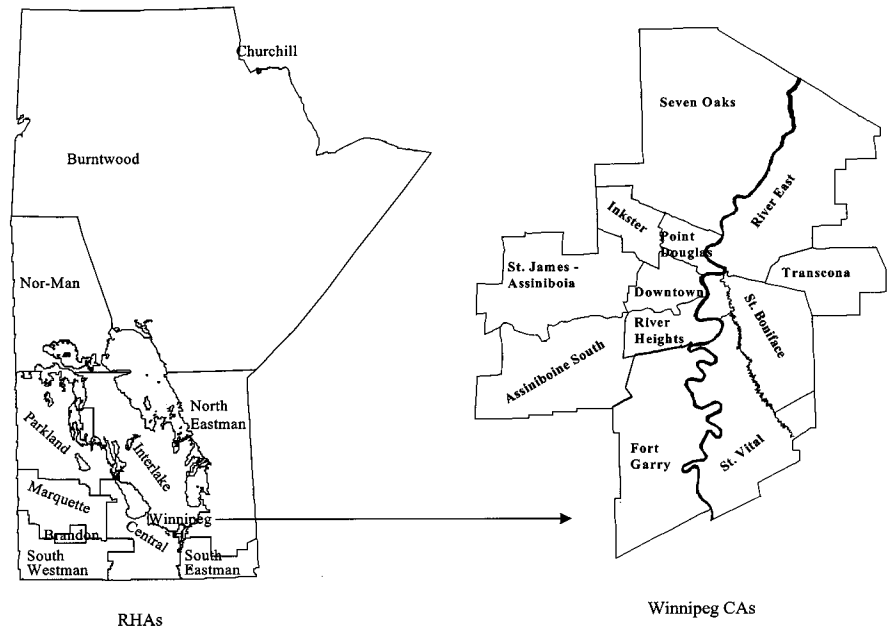

Figure 1. Manitoba's 12 Regional Health Authorities and Winnipeg's 12 Community Areas

Study design and population

The articles in this supplement use a descriptive, cross-sectional design. The study population consisted of all children who were 0 to 19 years old during the years reported, residing in the province of Manitoba at time of analysis. Most analyses in this supplement cover the period from April 1, 1994 to March 31, 1999. However, in some cases, data from the calendar years (January through December) 1994 to 1998 were used. All graphs and tables indicate the years used. For most analyses, comparisons of rates of child health indicators were made across the regional child populations – the RHAs and Winnipeg CAs.

First Nations children are not readily identifiable using the administrative data in the Manitoba Repository, and so were not analyzed separately in this supplement. According to a recent report on the health status of First Nations people in Manitoba, 7.5% of the entire population of Manitoba, and 12.9% of the population 0 to 19 years, have registered First Nations status.[25] *

Prior to undertaking the research described in the supplement articles, the MCHP studies were reviewed and approved by the Human Research Ethics Board, University of Manitoba, and the Manitoba Health Access and Confidentiality Committee.

Sources of data

We used three types of data sources for analyses: health care administrative, vital statistics, and survey data.

Health Care Administrative Data

The health care administrative data were obtained from the Population Health Research Data Repository. These data originate from Manitoba Health, the provincial agency that administers Manitoba's universal health insurance program. These data consist of anonymized, encounter-based records of Manitobans' interactions with the health care system, and are housed at the University of Manitoba. These administrative databases have been established to be both reliable and valid for examining health and health care use.[26-29] The provincial health program provides universal first dollar coverage (no deductibles, no co-payments) for hospital care and most physician services.

* Registered First Nations included only those First Nations people with Manitoba Band affiliation. Thus the following First Nations people were not counted: those with non-Manitoba Band affiliation living in Manitoba; those "First Nations" not registered; Metis and self-reported First Nations who are not Registered; those who could not be linked to administrative data due to missing information

TABLE I

Population Size by Sex and Age Classification in RHAs, 1998

	0-4		5-9		10-14		15-19		20+		Total
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Population
South Eastman	2010	1940	2295	2240	2331	2170	2387	2094	17849	17555	52,871
Central	3865	3549	4183	3940	4214	4006	4149	3846	32430	33302	97,484
Brandon	1490	1540	1723	1664	1788	1725	1655	1636	15799	18110	47,130
South Westman	1056	976	1242	1171	1341	1293	1349	1249	12326	12865	34,868
Winnipeg	21,041	19,998	22,572	21,466	21,540	20,612	20,804	20,085	230,210	252,537	650,865
Marquette	1115	1079	1277	1245	1403	1349	1495	1344	13580	13955	37,842
North Eastman	1379	1337	1622	1545	1593	1529	1557	1474	13758	13113	38,907
Interlake	2392	2293	2886	2677	3042	2709	2813	2607	26785	26613	74,817
Parkland	1411	1307	1620	1487	1697	1563	1692	1579	15477	15840	43,673
Burntwood	2812	2695	2744	2759	2430	2250	2085	1988	13097	12293	45,153
Nor-Man	1170	1152	1243	1161	1104	1092	1134	1002	8376	8132	25,566
Churchill	55	51	48	48	44	33	35	36	381	330	1,061
Manitoba	39,796	37,917	43,445	41,403	42,527	40,331	41,155	38,940	400,068	424,645	1,150,237

Prescription drugs are covered subject to an income-based deductible. All community-based pharmacies in the province of Manitoba are required to submit computerized records of pharmaceuticals dispensed, at time of dispensation. For some Manitoba children, especially those in sparsely populated rural areas, nurses assigned to nursing stations are more accessible than physicians and hospitals. These nurses are trained to provide services ordinarily provided by physicians in more populated areas. The absence of nursing station data from the Repository results in greater under-reporting of health care utilization for residents of northern Manitoba. Details about the key characteristics of Manitoba's health care system and the routinely collected administrative data that are the foundation of our population-based information system can be found elsewhere.[20,30]

(i) Hospital separations per 1000. Hospitalizations per 1000 measures the number of hospital separations for residents age 0 to 19 years for any given region of Manitoba, regardless of where the hospitalization took place. Rates of hospitalization were developed using the number of separations for children in a given region (numerator) divided by the child population in that region (denominator).

(ii) Physician visits per 1000. Rates of physician visits per 1000 provide a measure of the total ambulatory utilization of physician services by residents age 0 to 19 of a given region, regardless of where the service took place. Physician visit rates were defined by the number of visits by children in a given region (numerator) divided by the child population of that region (denominator).

(iii) Prescriptions per 1000. Rates of prescription medications per 1000 provide a measure of the intensity of pharmaceutical use by Manitoba residents age 0 to 19. These rates were defined as the number of different classifications of drugs used by children in a given region (numerator) divided by the child population in that region (denominator). Prescriptions dispensed in hospitals and in nursing stations were excluded.

Vital Statistics Measures

We used vital statistics measures to obtain mortality information, such as date of death and reasons for the death. For cause-specific mortality, only deaths until December 1997 were available from the Office of Vital Statistics in Manitoba.

Survey Data

The 1994 and 1996 National Population Health Survey (NPHS) and the 1994 and 1996 National Longitudinal Survey of Children and Youth (NLSCY) were used: 1) to provide information that was not available from health administrative data, and 2) to provide validity checks on some administrative data. No linkages were made between survey and administrative data. These surveys are administered by Statistics Canada, and use a multi-stage, cluster design to choose respondents. Information was provided by the children themselves or by the "Person Most Knowledgeable" about the child. Analyses were done on the master files, which contained anonymous information for individual respondents. Weighting variables were available for weighted estimates approximating population rates. Specialized analyses were required for statistical testing to adjust for design effects. We implemented the bootstrapping program provided by Statistics Canada to do statistical analyses for the NPHS survey. The bootstrapping program was not available for the NLSCY, thus statistical testing could be flawed and confidence intervals would be underestimated, resulting in possible elevations of Type I errors. Results from the NLSCY should, therefore, be interpreted with caution. As well, First Nations persons living "on reserve" were excluded from these surveys.

(i) NPHS. The NPHS comprises two sections: 1) a general (household) survey asked of all household members; and 2) a health section in which only one family member aged 13 years or more was selected. The 1996 NPHS for Manitoba also included children 0-12 years old. Most of these children had another family member (age 13 or older) who also responded to the health portion of the survey. Therefore, we included respondents aged 0 to 19 from the NPHS. Data used in this report come from those individuals answering the health portion of the survey.

(ii) NLSCY. The NLSCY was administered in 1994 and 1996. Most data reported in the papers in this supplement come from the 1996 cycle, unless the information was not available in the 1996 survey. In 1994, children ages 0-11 years were questioned on several components, including health, education and activities. Parental information, such as work, income and health, as well as data from teachers and principals on the social and academic aspects of school were also obtained. The 1996 survey included most of the same questions for children 0-13 years old.

TABLE II

Population Size by Sex and Age Classification in Winnipeg CAs, 1998

	0-4		5-9		10-14		15-19		20+		Total
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Population
Fort Garry	1967	1852	2190	2149	2144	2076	2124	2012	21,396	23,352	61,262
Assiniboine South	958	947	1299	1289	1421	1388	1405	1262	12,369	14,118	36,456
St. VBital	2043	1930	2308	2063	2135	2049	1930	1908	20,799	23,739	60,904
St. Boniface	1374	1414	1518	1483	1422	1324	1494	1413	16,606	18,149	46,197
River Heights	1514	1495	1486	1408	1374	1347	1342	1327	20,700	24,968	56,961
Seven Oaks	1731	1687	1911	1825	1948	1874	1913	1979	20,036	22,567	57,471
St. James-Assiniboia	1727	1659	1820	1717	1690	1588	1725	1641	21,826	24,998	60,391
River East	2861	2751	3142	3032	3119	2960	3197	3001	31,756	35,285	91,104
Transcoona	1185	1080	1349	1216	1293	1223	1182	1122	11,859	12,307	33,816
Inkster	1318	1113	1353	1237	1303	1259	1213	1168	10,370	10,873	31,207
Downtown	2707	2506	2536	2485	2262	2152	2061	2037	28,167	27,647	74,560
Point Douglas	1656	1563	1660	1561	1428	1371	1216	1214	14,323	14,529	40,521
Winnipeg	21,041	19,997	22,572	21,465	21,539	20,611	20,802	20,084	230,207	252,532	650,850*

* Winnipeg CAs are based on postal definitions. RHAs are based on geographic boundaries. Therefore, there are slight discrepancies between the Winnipeg RHA total and the sum total of the Winnipeg CAs.

(iii) Census. We used the aggregate, publicly available 1996 Canadian Census data for Manitoba to obtain average neighbourhood income, employment status, and lone-parent status. In 1996, Manitoba contained 2,050 populated census regions known as enumeration areas (EAs). EAs have a maximum of 440 dwellings in urban areas and a minimum of 125 dwellings in rural areas.[31] Only aggregate data, at the EA level, were used.

Twenty percent of the population was given a "long form" of the Census, which was a more detailed questionnaire. This information is also available only in aggregate form. Whereas all enumerated persons were asked information on parental status, only those responding to the long form were asked about their income and employment.[32] Income information is reported for the population 15 years of age and over, excluding institutional residents.[33] Income distributions are suppressed if the total non-institutional population in the area is less than 250, or if less than 250 people in an EA reported an income.[31]

Two First Nations communities were incompletely enumerated in 1996. Because many First Nations communities also have less than 250 people, income was not reportable. Thus, some areas of the province have missing income information.

Construction of income quintiles

The publicly available 1996 Canadian Census data were used to derive information on neighbourhood income level. The census data contain average household income for each EA. Each EA contains within it several postal codes, which comprise an average of 15 households. We derived the average household income for each postal code by assigning the average household income for the EA to each postal code within that EA. The postal codes were then sorted into urban and rural. Urban postal codes were those within the city limits of Winnipeg and Brandon, and rural comprised all other postal codes. For both urban and rural postal codes, we sorted each postal code into one of five categories, ranging from one category containing the poorest 20% of postal codes to a category containing the wealthiest 20% of postal codes. Thus, each class of postal codes formed an income quintile, with the lowest income quintile representing postal code areas with the lowest average income, and the highest income quintile representing areas with the highest average income. The urban average household income quintile brackets were as follows: 1) $10,577 to $31,207, 2) $31,207.01 to $39,848, 3) $39,848.01 to $49,817, 4) $49,817.01 to $62,231, and 5) $62,231.01 to $170,386. The rural income quintile brackets were: 1) $14,858.00 to $32,159.14, 2) $32,184.95 to $36,428.00, 3) $36,428.00 to $40,628.71, 4) $40,650.32 to $47,882.73, 5) $47,889.01 to $90,712.00. Each postal code income grouping, and hence the quintile grouping, reflects an average income for the population within that group, not an individual income by household. This area-level income measure provides a good approximation of household income.[34]

As mentioned previously, the 1996 census does not include some First Nations communities, so the average income in those postal code areas may be inaccurate.

Analyses

Most figures and tables in the articles in this supplement compare rates of child health indicators across the geographic regions known as RHAs and Winnipeg CAs, described above. All health care utilization rates used for comparisons across regions or income quintiles were adjusted for age and sex, using the direct method of standardization. This procedure mathematically removes the effects of different population structures that influence overall rates of use of health care. Statistical comparison tests of age- and sex-standardized rates were done using t-test methodology developed by Carriere and Roos.[35] Rates were suppressed where cell counts were less than 5. We implemented a Bonferroni correction factor using 99% confidence intervals when testing for statistical significance between rates. The Bonferroni is a statistical method that adjusts the significance level when multiple comparisons are made. Correlations and trend tests were performed for some measures. Rates of health measures were tested for correlations with PMR and SEFI, using the non-parametric Spearman rank correlation method, due to non-normal distributions. Trend tests were calculated using the Cochran-Armitage test for trend. All data management, programming and analyses used SAS® software.

All graphs comparing rates across geographic regions are ordered by PMR from lowest to highest (see Martens et al., this issue for a discussion of PMR as a framework).[36] For simplicity of presentation,

only certain significance symbols are depicted in the graphs. For RHA analyses, all RHAs were compared to the Manitoba average. The northern RHAs (those above the 53rd parallel – Burntwood, Nor-Man and Churchill) were compared to the northern average; the south rural RHAs (rural regions below the 53rd parallel – South Eastman, Central, South Westman, Marquette, North Eastman, Interlake and Parkland) were compared to the south rural average. The overall Winnipeg RHA rate was compared to the Manitoba total; Winnipeg CA rates were compared to the Manitoba and the Winnipeg overall rates.

RESULTS

In 1998, Manitoba was home to 325,524 children between the ages of 0 and 19 with almost half of these children residing in Winnipeg (168,111). Tables I and II give the population numbers by sex and age groups for each of the RHAs and Winnipeg CAs.

The relationships between key child health indicators and geographic and socioeconomic factors for these Manitoba children are discussed in the articles following this one.

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RÉSUMÉ

Objectif : Présenter les études représentatives sur l'état de santé des enfants dont il est question dans ce supplément.

Méthode : Les articles du supplément portent sur la santé des enfants de 0 à 19 ans. La plupart des études ont été menées entre le 1er avril 1994 et le 31 mars 1999. La santé et le bien-être d'enfants ont été évalués à l'aide de données administratives et d'enquêtes. Pour effectuer des comparaisons régionales, on a ventilé ces données selon les sous-régions du Manitoba, appelées offices régionaux de la santé (ORS), et les quartiers de Winnipeg, appelés communautés de la région de Winnipeg (CR de Winnipeg).

Le taux de mortalité prématurée (TMP) a servi au calcul approximatif de l'état de santé global de la population. Tous les graphiques qui comparent les taux respectifs des ORS et des CR de Winnipeg classent ces sous-régions dans le même ordre, c'est-à-dire du TMP le plus faible au plus élevé. On a opérationnalisé le revenu en divisant la population de la province en quintiles urbains et ruraux, déterminés selon le revenu des ménages. D'autres aspects de la méthode sont également expliqués.

Résultats : Les résultats sont présentés dans les articles qui suivent.

Conclusion : Les liens entre les indicateurs clés de la santé des enfants et les facteurs géographiques et socio-économiques propres aux enfants manitobains sont expliqués dans les articles suivants.

Embedding Child Health Within a Framework of Regional Health

Population Health Status and Sociodemographic Indicators

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ABSTRACT

Objective: The description of regional variation in children's health requires regional population-based context. But what is the best way to measure the health of a region's population?

Methods: The use of two indicators is described – one a health status measure and the other a measure of socioeconomic wellbeing. It is well known that the population's premature mortality rate (PMR), the age/sex-adjusted rate of death before age 75 years, is highly related to overall health status of an area's residents. Socioeconomic characteristics of an area's residents are also indicative (and likely causative) of health status differences.

Results: The Socioeconomic Factor Index (SEFI) was developed at the Manitoba Centre for Health Policy, using a Principal Components Analysis of census data. PMR and SEFI are highly correlated (Spearman's correlation coefficient r=0.85, p<0.0001).

Conclusion: PMR can be used as a surrogate measure for both the health status and socioeconomic well-being of regional populations in Manitoba.

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

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The full report "Assessing the Health of Children in Manitoba: A Population-Based Study" on which this article is based is available from the Manitoba Centre for Health Policy at the above address or online at: http://www.umanitoba.ca/ centres/mchp/reports.htm

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Children live in families, families live in communities, and communities are found within regions. Examining the health of children in isolation from the population groups within which they grow may ignore some of the macro-determinants of child health. Ill health in children is regrettable, but if ill health is looked upon solely as an individual characteristic of the child, then social policy and programming can do little to alleviate the burden of child illness. The question thus becomes – are there determinants of children's health to be found in the socioeconomic well-being and the health of a region's population? If the answer is "yes", then those programs and policies which can influence a population's socioeconomic well-being and health might also influence the health of the region's children.

In order to "embed" child health indicators within a framework of population health, one must first derive measures of a population's health status and socioeconomic well-being. What is the best way to measure this overall health of a region's population? The discussion focuses on the derivation of two population-based regional indicators and the relationship between them – one representing socioeconomic risk, and the other health status. This framework was used throughout this supplement whenever child health data were presented by geographical regions of the province of Manitoba, Canada.

Population-based socioeconomic indicators

A large body of research evidence supports what has been observed for centuries: at the population level, there is an association between socioeconomic status and health. Lower socioeconomic status is associated with poorer health outcomes, and there is a gradient effect such that with each increase in level of socioeconomic status there is an increase in health status.[1] This relationship is referred to as the 'socioeconomic gradient in health status.' Socioeconomic status in childhood is related not only to child health[2-5] but to long-term health outcomes.[6-10] So global measures of the health and socioeconomic well-being of the regional population wherein a child resides may help in the understanding of child health and well-being.

How, then, should one measure the effects of socioeconomic status on health? There is an extensive history of efforts to identify measures of socioeconomic status to serve as indicators of underlying factors that affect health. Some measures of socioeconomic well-being have relied on single indicators such as income levels, levels of education, and occupational status of the populations in regions.[11-13] For international comparisons, gross national product (GNP) has been used.[14] Carstairs and Morris[15,16] were interested in a relative deprivation score, based upon four census variables: overcrowding, unemployment among men, low social class, and not having a vehicle. Their deprivation score provided a much more powerful explanation for health differences in Scotland, England and Wales than social class analysis. The deprivation score was highly correlated with all-cause and cause-specific mortality, and a wide range of morbidity data including cancer, mental health, and rates of acute and chronic illness. Although the literature has identified a variety of factors related to health status and health care utilization, no consensus has emerged on either what constitute the best indicators or the exact nature of the causal relationships between various indicators and health status.

In attempting to address health policy issues in Manitoba, the Manitoba Centre for Health Policy (hereafter MCHP) sponsored the development of an indigenous index of socioeconomic status to use in its reports. This was called the Socioeconomic Risk Indicator, or SERI.[17,18] The index was found to correlate very highly with a variety of health differences and differences in utilization of health care resources across provincial regions.

The SERI was based on data available in Manitoba from census and administrative data files. A set of health status indicators known to be sensitive to socioeconomic status were chosen as a base against which to measure the explanatory power of candidate socioeconomic indicators. These included hospital admissions for injury to females and to males, hospital admissions for children ages 0 through 4 years and for adults more than 65 years old for respiratory infection, and a measure of fertility. An index was constructed by summing these variables after normalisation. Out of 23 candidate socioeconomic indicators derived from public-use census data (1986, and then 1986/1991), six measures were retained in a stepwise multiple regression model against the index described above. The variables that were retained included average dwelling value, educational attainment in one age stratum (25-34), unemployment rates in two age strata (15-24 and 45-54), female single parenthood rates, and rates of female participation in the labour force. A composite socioeconomic index was formed from the weighted sum of standardized forms of the six selected measures, using the regression coefficients as the weights.*

While the SERI was quite robust and intuitively acceptable, it had a substantial disadvantage due to the data-intensive nature of its derivation. It was not easily transportable to other geographical areas, since most other jurisdictions lacked the data to derive the SERI for their own areas. In addition, the use of the SERI as a proxy for determining need for health care use was potentially subject to criticism inasmuch as it had been derived, in part, from utilization data.

In an attempt to correct these deficiencies, three of the authors (NF, KCC, and SD) were commissioned by MCHP to develop an alternative measure of socioeconomic status which would not be subject to the same limitations. This was called the "SEFI", or "Socioeconomic Factor Index", and its derivation is described in this paper.

Population-based health status indicators

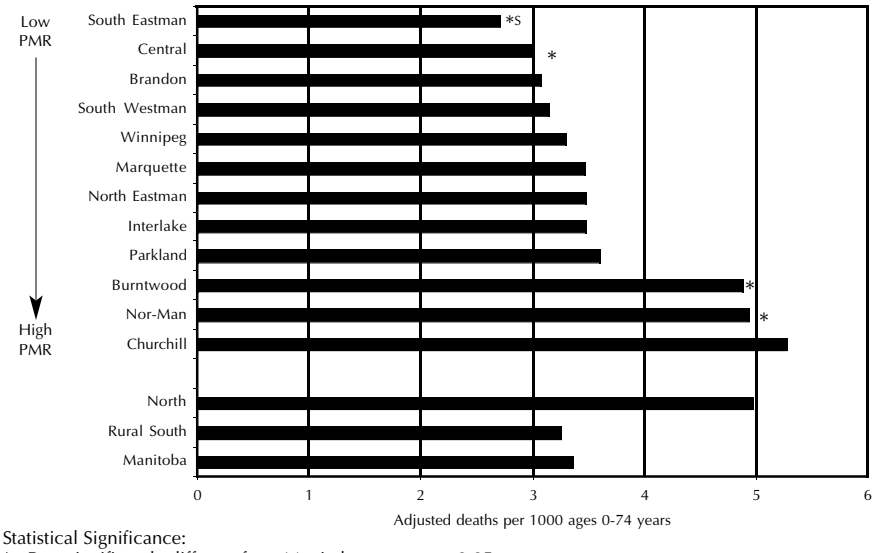
There have been many attempts over several decades to obtain global indicators for the health of the population living within a geographical region. Life expectancy at birth, infant mortality, child mortality, mortality rate for ages 15 to 65 ('50Q15'), all cause mortality, self-reported health, disease-specific mortality rates, and low birthweight rates have all been used as surrogates for a global measure of a population's health status.[11-14,19,20]

In Canada, there has been much discussion of needs-based regional funding for health care. With that in mind, there has been a call for measures of need based on a health status indicator. Eyles and Birch[21] voice a number of concerns regarding the attempt to derive a global measure of a population's health status. First, a population's current pattern of health services use may not necessarily reflect their need for health care. Within the province of Manitoba, for example, there are differential use patterns between rural and urban areas, with urban areas accessing physicians more frequently, but rural areas using hospitals more frequently per capita.[22] So current measures of service utilization risk the perpetuation of existing availability and accessibility as well as usage patterns. Second, self-reports of population health rely on high-cost surveys, and could be "gameable" – that is, could be influenced by the actions of those who stand to gain by manipulating the data. Thus, self-reported health may best be used as a measure to validate another more easily obtained global measure. Finally, demographic measures such as age, gender and ethnic background are not in and of themselves measures of healthiness, so these indirect proxies may or may not have justification.

Eyles and Birch have argued that measures of premature mortality, such as the PMR (premature mortality rate based on death before the age of 75 years), are more likely candidates for a global measure of a population's health status.[21,23] First, mortality is a very direct measure of a health outcome, albeit the worst case scenario. Second, mortality data are readily available from administrative data and are collected on a continual basis in a valid and reliable manner. Third, mortality is not affected by patterns of health care use that may not be related to need. Moreover, mortality is not a "gameable" indicator – increasing mortality rates to increase funding for a region is not a likely strategy, besides being completely unethical. PMR, adjusted for the age and gender mix of a population, has been found to correlate with types of morbidity associated with considerable and continual needs for health care. Such conditions include chronic and permanent illness, conditions with high case fatality rates, low birthweight rates, and self-reports of chronic illness.

On the other hand, PMR suffers from a few deficiencies of its own. Early death is a

* In the final form of the index, the sum was divided by the square root of the sum of squares of the regression coefficients to reproduce the scale in standard deviation units, and referred to as the SERI. See MCHP's Concept Dictionary at http://www.umanitoba.ca/centres/mchp for full details.



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
S - Rate significantly different from mean for Rural South Manitoba at p<0.05

Figure 1. Premature mortality rates by RHA, 1994/95-1998/99

TABLE I

Socioeconomic Characteristics from Census Data (1986, 1991, 1996) Selected for SEFI Derivation

Classification	Variable Definition	Exclusion Reason
Dwelling Characteristics	1. Dwelling Value	Not Defined for On-Reserve (First Nations Community) Households
Education	2. Percent of Population aged 25-34 with High School Diploma or Equivalent	
	3. Percent of Population aged 35-44 with High School Diploma or Equivalent	
	4. Percent of Population aged 45-54 with High School Diploma or Equivalent	
Employment	5. Percent Labour Force, Farming	Proxy for Urban/Rural Differences
	6. Percent Labour Force, Managerial/Sciences	Proxy for Urban/Rural Differences
	7. Percent Labour Force, Manufacturing/ Construction/Transportation	Proxy for Urban/Rural Differences
	8. Labour Force Participation Percent, Women aged 15+	
	9. Unemployment Rate, Aged 15-24	
	10. Unemployment Rate, Aged 25-34	
	11. Unemployment Rate, Aged 35-44	
	12. Unemployment Rate, Aged 45-54	
Income	13. Average Household Income	
	14. Percent of All Households in Owner-Occupied Dwellings	Not Defined for On-Reserve (First Nations Community) Households
	15. Percent Owner-Occupied Household with Costs ≥ 30% of Income	Not Defined for On-Reserve (First Nations Community) Households
	16. Percent of all Tenant-Occupied Household with Costs ≥ 30% of Income	Not Defined for On-Reserve (First Nations Community) Households
Mobility	17. Percent In-migrants, within Canada	Not Applicable to Health Status
Social Characteristics	18. Age Dependency Ratio	
	19. Percent Single Parent Household with Children	
	20. Percent Female Single Parent Household with Children	
	21. Percent Female Parent, aged 15-24	Not Present on 1991/1996 Census
	22. Percent French Mother Tongue	Not significant in regression models and not significantly associated with the first two principal components
	23. Percent Native Mother Tongue	Proxy for Native/Non-Native (First Nations/non-First Nations) Differences

The number of socioeconomic characteristics were further reduced to 7 variables by combining the 4 age-specific unemployment rate variables (variables 9 through 12) and the 3 age-specific education rate variables (variables 2, 3 and 4) into a single unemployment principal component factor and a single education principal component factor.

relatively infrequent event, and in smaller population aggregates, the PMR is subject to considerable variation from year to year. Hence it either requires a sufficiently high level of aggregation so that the variance from year to year makes it reliable, or several years of data to produce a more stable measure. Each of these deficiencies can prove problematic in certain analytic situations. In addition, PMR is an outcome measure and, although it may be an indicator of health status, it cannot, by any stretch of the imagination, be deemed to be in any way causative.

METHODS

Derivations, methodology, and comparison of PMR and SEFI

Premature Mortality Rate (PMR)

The PMR is an age- and sex-adjusted rate of premature death, that is, death before the age of 75 years, calculated as the number of deaths to residents ages 0 through 74 years old, divided by the total number of residents 0 through 74 years residing in that region. This rate was standardized to reflect the age and sex structure of the overall Manitoba population on December 31, 1996. PMR was calculated for each of the geographical divisions of the province and was based upon a five-year average from 1994/95 to 1998/99, to ensure stability of the measure. The mortality data were derived from Vital Statistics files. Figure 1 shows the PMR by Regional Health Authority (RHA).* The graphs are ordered from the region with the lowest PMR on top and in ascending order of health risk going down the Y-axis. South Eastman RHA had the lowest PMR, and Churchill the highest.

Socioeconomic Factor Index (SEFI)

SEFI was designed on the basis of sociodemographic indicators in publicly available census data. Since comparability with the earlier versions of the SERI was considered desirable, and since changes in SEFI over time would enable the tracking of changes in health status, data were collected from the 1986, 1991, and 1996 censii. The 23 variables used in deriving

* For corresponding Winnipeg Community Area (Winnipeg CA) graphs, refer to the complete child health report at the MCHP website.

the SERI served as the initial base of sociodemographic variables for possible inclusion in the index. Table I classifies the variables, and the reasons for exclusion of 11 of those variables. From the 12 eligible variables, the number was further reduced to 7 through the use of Principal Components Analysis. The 4 age-specific unemployment rate variables, and the 3 age-specific education rate variables, were each aggregated into a single unemployment principal component factor and a single education principal component factor. This produced 7 socioeconomic "characteristics" – labour force participation of women, average household income, age dependency ratio, percent single parent households, percent female single parent households, and the two aggregated factors of "unemployment" and "education." In the derivation of the previous index (SERI), it had been found that the average household income variable did not contribute significant additional explanatory power when combined with the other components. For comparison purposes, therefore, a 6-component index excluding the income variable was also constructed.

The derivation of the SEFI was based upon municipal code level data. Within the province of Manitoba for the 1996 census, there were 289 municipalities. A municipal code value for each of the socioeconomic characteristics was required, but the census data were based upon smaller enumeration area values. For any given characteristic, the municipal code level value was calculated using a population-weighted mean of all of the smaller enumeration area values within the municipal code. Missing census information at the enumeration area or municipal code level was imputed an appropriate community average value. Thus each municipal code had assigned to it values for all 7 (or 6) census socioeconomic characteristics. Each of these values was standardized, that is, stated as a comparison to the overall Manitoba average of that characteristic rather than as an actual "real" value. For example, if the labour force participation for women was 20% in municipal code A, and 70% in municipal code B, and the overall mean for Manitoba was 40%, then municipal code A's value would be -20, and B's value would be +30.

TABLE II

List of Candidate Socioeconomic Indicators for a Principal Components Analysis

Indicator	Method of Estimation	Component Characteristics	Municipality Level	Comparison Across Years		
				1986	1991	1996
SPASFLUE	First principal component factor of 6 variable model	A (Age Dep. Ratio), S (Single Parent), F (Female Single Parent), L (Labour Force Part. Female), U (Unemployment Factor), E (Education Factor)	Prop. Cum. Var.*	0.37	0.45	0.41
			Corr. W. Dir PMR†	0.51	0.56	0.63
			Corr. W. 86/91 SERI‡	0.86	0.81	0.75
SOCPC07	First principal component factor of 7 variable model	A (Age Dep. Ratio), S (Single Parent), F (Female Single Parent), L (Labour Force Part. Female), I (Average HH Income), U (Unemployment Factor), E (Education Factor)	Prop. Cum. Var.*	0.40	0.43	0.41
			Corr. W. Dir PMR†	0.50	0.59	0.62
			Corr. W. 86/91 SERI‡	0.86	0.86	0.73

* Proportion of total variance is reported for principal component factors.
† Pearson correlation with direct adjusted PMR
- 1986:N=277. Correlation analysis excludes 3 municipalities with extreme values of direct adjusted PMR
- 1991:N=280
- 1996:N=281

‡ Pearson correlation with 1986/91 composite SERI. All years N=265.
After careful consideration, the first principal component factor of six socioeconomic characteristics (SPASFLUE) was chosen as the index which best met the theoretical requirements.

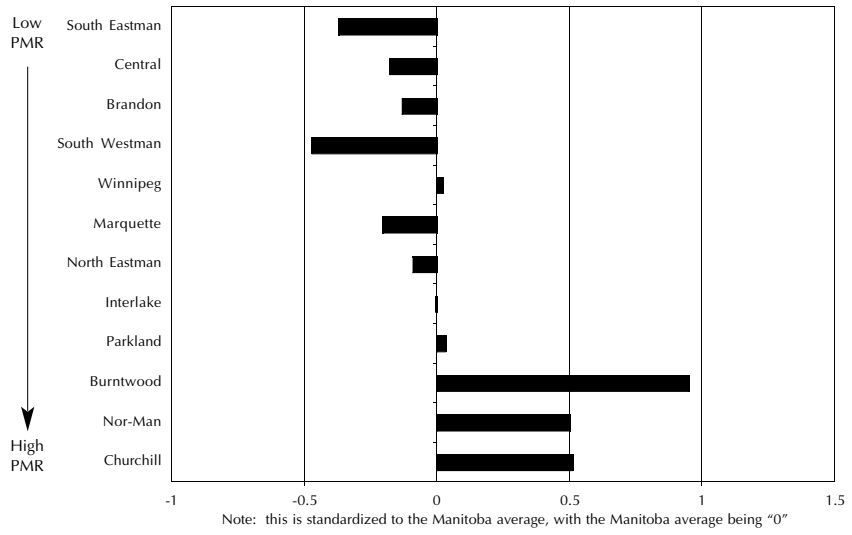
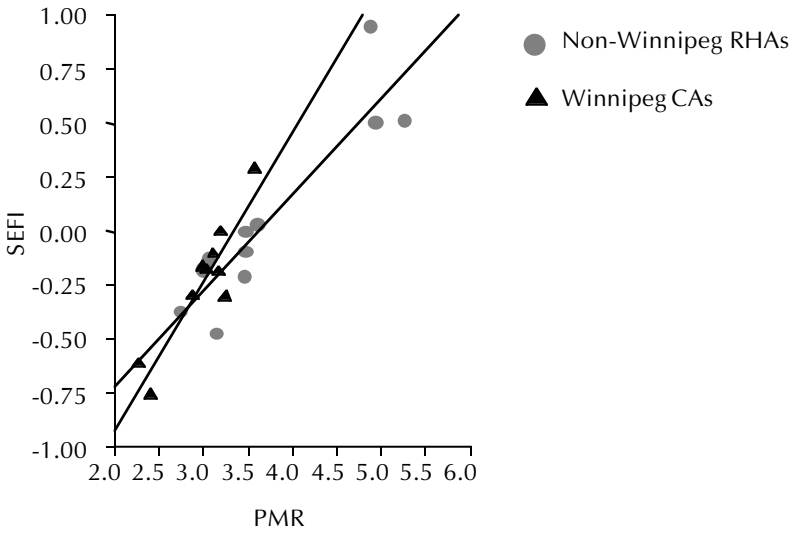


Figure 2. SEFI scores (Socioeconomic factor index) by RHA, 1996

The first principal component factors of the 7 (or 6) indices were tested for the proportion of total variance explained, and the correlations of the indices at the municipal code level with both PMR and SERI. These are reported in Table II. The average household income component in the 7-factor model did not contribute very much additional variance in the principal component analysis (+0.03, -0.02 and 0, in the 1986, 1991 and 1996 versions) compared with the 6-factor model. Nor did it consistently increase correlations with the corresponding SERI (0.0, +0.05 and -0.02, in 1986, 1991 and 1996). Hence the 6-factor model was selected as the SEFI.

The SEFI score was calculated at the municipal code level, by using the principal component factor values for each of the six census characteristic values for that municipality. When combining



* The Spearman correlation coefficients are: 0.87 (p<0.0001) for non-Winnipeg RHAs; 0.80 (p<0.01) for Winnipeg Community Areas (Winnipeg CAs); 0.85 overall (p<0.0001)

Figure 3. Socioeconomic factor index (SEFI) versus premature mortality rate (PMR)*

municipal areas into larger aggregates (such as RHAs, Winnipeg and its Winnipeg CAs), the SEFI for each municipal code level within the larger area was weighted by the population of the municipality to derive an overall SEFI for the larger area. For example, the Winnipeg SEFI was calculated as the population weighted sum of the SEFIs of the 14 municipalities which constitute the city. Figure 2 shows the SEFI scores for the RHAs (SEFI scores for Winnipeg CAs are available in the child health report on MCHP's website). The overall Manitoba score is set to "0". So a negative SEFI score indicates *less* risk (more favourable socio-economic conditions), and a positive score indicates *higher* risk compared to the Manitoba average.

The relationship between SEFI and PMR

Over the years for which data were available, the correlations between the SEFI and PMR have been relatively high. In an MCHP report focussing on Winnipeg,[24] the Pearson (Spearman) correlation between the SEFI and PMR was: at the Winnipeg CA level 0.98 (0.90); and at a level of further subdivision of Winnipeg neighbourhoods 0.96 (0.80). Figure 3 shows a scatter-plot graph of the relationship of SEFI with PMR values for the RHAs and Winnipeg CAs, with corresponding Spearman correlation coefficients.

DISCUSSION

Embedding child health within population health: Ordering regions by PMR

Since socioeconomic factors are essential to an understanding of the healthiness of regions, the SEFI is one way to indicate the non-medical determinants of health and to estimate where needs for health care are likely to be higher (where there are less favourable socioeconomic conditions). However, there is a high degree of correlation between SEFI and PMR, at all levels of population aggregation. Given the strength of the relationship between PMR and SEFI, it should be clear that the use of PMR not only gives insight into health status and the need for health care, but also, indirectly, into the socioeconomic well-being of the regional population.

As a result of this strong relationship, ordering the graphs by increasing PMR acts as a surrogate for ranking regional populations in terms of decreasing health status, increasing need for health care, and increasing socioeconomic risk. This ordering of regions is followed in figures within this supplement, derived from the child health report,[25] and has been used in most other MCHP reports. Hence the reader looking at graphs ordered in this way can use the ordering to ask questions about patterns of health and health care resource use. Which indicators of child health and resource use follow an "expected" pattern of increase or decrease with the healthiness measure of the region; which do not?

Throughout this supplement, the reader will note that many of the childhood morbidity and mortality indicators, as well as health care use patterns, are strongly related to the regional indicators of health and socioeconomic well-being. There are positive associations of such indicators as infant/child mortality, teen pregnancy, and injury rates with PMR and SEFI. Negative associations, demonstrating decreasing preventive care with increasing risk, are also evident in indicators such as immunization and breastfeeding rates. And then there are the "surprises" or anomalies – those child health indicators that do not show an association with PMR or SEFI, such as low birthweight and preterm rates in non-Winnipeg regions. All of these associations, whether they be positive, negative, or not significant, beg for more research into the causal nature of the associations in order to implement healthy child policy.

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RÉSUMÉ

Objectif : Les écarts régionaux dans la santé des enfants doivent être étudiés dans un contexte régional représentatif. Mais quelle est la meilleure mesure de l'état de santé d'une population?

Méthode : On décrit l'utilisation de deux indicateurs; l'un mesure l'état de santé, et l'autre, le bien-être socio-économique. Comme on le sait, le TMP d'une population donnée – son taux de décès avant 75 ans ajusté selon l'âge et le sexe – est fortement lié à l'état de santé global de cette population. Les caractéristiques socio-économiques des habitants d'une région sont également des indicateurs (et sans doute des facteurs causals) des écarts dans l'état de santé.

Résultats : À l'aide d'une analyse en composantes principales des données du recensement, le Centre d'élaboration et d'évaluation de la politique des soins de santé du Manitoba a mis au point un « indice des facteurs socio-économiques » (SEFI). Le TMP et le SEFI sont fortement corrélés ($r=0,85$, $p<0,0001$ selon le coefficient de corrélation de Spearman).

Conclusion : Le TMP peut servir de mesure auxiliaire, tant pour déterminer l'état de santé que le bien-être socio-économique des populations régionales du Manitoba.

A Matter of Life and Death for Manitoba's Children

An Overview of Birth Rates and Mortality Rates

Patricia J. Martens, PhD
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ABSTRACT

Objective: To determine the fertility and child mortality rates for Manitoba.

Methods: Fertility and mortality rates were derived from the Population Health Research Data Repository and Vital Statistics, for 1994 through 1998. Data are presented by 12 Regional Health Authorities (RHAs), 12 Winnipeg Community Areas (CAs) and by income quintile. Each indicator is correlated with PMR (the age- and sex-adjusted premature mortality rate, i.e., death before age 75) and SEFI (Socioeconomic Factor Index, a standardized composite index), both considered proxies for overall health and socioeconomic well-being of populations.

Results: Manitoba's total fertility rate was 1.77 children per woman, ranging from 1.62 to 3.15 by RHA, and 1.21 to 2.30 by Winnipeg CA. Manitoba's infant mortality rate was 6.6/1000 (or 5.5/1000 excluding <500 g or <20 weeks gestation), ranging from 4.5 to 10.2 by RHA (4.2 to 9.8 exclusive), and 3.7 to 8.4 by Winnipeg CA (2.7 to 6.7). There was a gradient of infant mortality by income quintile ($p<0.001$), with double the rate comparing lowest to highest. Child mortality rates varied geographically and by gender, with northern children at greatest risk. Injury was the leading cause of death (52% for ages 1 through 9, 75% for ages 15 to 19).

Conclusion: Fertility rates, as well as infant and child mortality rates, were positively associated with PMR and SEFI, with substantial geographical variation.

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

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The full report "Assessing the Health of Children in Manitoba: A Population-Based Study" on which this article is based is available from the Manitoba Centre for Health Policy at the above address or online at: http://www.umanitoba.ca/ centres/mchp/reports.htm
Sources of support: This work was supported as part of a project on child health in Manitoba, one of several projects undertaken each year by the Manitoba Centre for Health Policy under contract to Manitoba Health. The results and conclusions are those of the authors and no official endorsement by Manitoba Health was intended or should be inferred. Dr. Martens was also supported by a Community Alliances for Health Research Program grant from the Canadian Institutes of Health Research.

Responding in part to a growing body of evidence indicating that child health is a strong predictor of adult health, Manitoba Health, the provincial health department, asked the Manitoba Centre for Health Policy (MCHP) to develop a report on child health in Manitoba. The most basic indicators of child health revolve around issues of birth and death – fertility and mortality rates. This includes mortality rates for children ages 0 to 19 years, as well as causes of death. It was hypothesized that variations in fertility and mortality rates within Manitoba would be highly variable by geographical area. As well, these would be related to variations in income, and in the health and socioeconomic well-being of the community as measured by the premature mortality rate (PMR) and the socioeconomic factor index (SEFI) of a region.

The Canadian total fertility rate was 1.5 children per woman in 1997.[1] This is lower than the 1998 rate for USA at 1.97 children per woman, calculated from a general fertility rate of 65.6/1000.[2] Canada experienced a 5% drop in the annual number of births reported from 1996 to 1997. In the USA, births dropped successively from 1990 to 1997, with 1998 showing a modest increase of 1.6%. Who is giving birth? Canadian and USA statistics are quite similar. The percentages of Canadian 1997 births by maternal age were: 11% to women less than 20 years old; 58% to women ages 20-29 years old; and 31% to women age 30 and older. In the USA during 1998, 12.5% of the births were to women less than 20 years old, 52% to women 20 to 29 years old, and 35.5% to women 30 years or older.

Infant mortality rate (number of deaths among children less than one year old, per 1000 live births, per year) is considered an indicator of the level of health within a community.[3] Distinction is made between infant mortality rates calculated as either a) a percentage of all live births, or b) a percentage of all live births excluding infants born weighing less than 500 grams and those born before 20 weeks of gestation. The usefulness of distinguishing between these two rates has been noted by Joseph and Kramer,[4] due to the lower survival rate in babies less than 500 grams or born before 20 weeks gestation. The Canadian Perinatal Surveillance System Committee also recommends adjustment

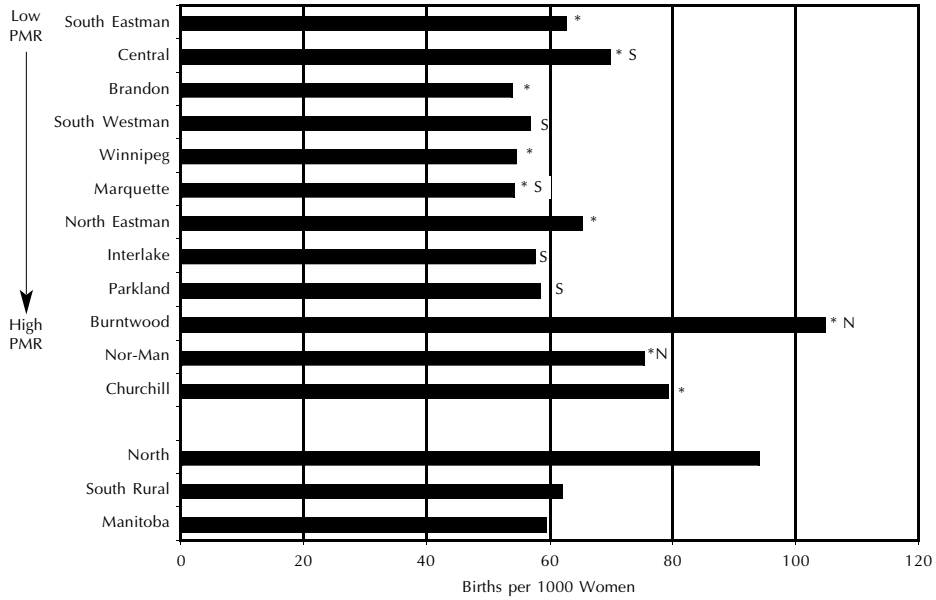
for birthweight, although it is sometimes difficult to obtain the necessary data.[5] Different regions, provinces, as well as countries may have very different proportions of infants weighing less than 500 g. Of Canada's 10 provinces, Manitoba had the fourth highest infant mortality rate in 1994, with Newfoundland, Saskatchewan and Alberta having higher rates. Using the exclusive infant mortality rate, Manitoba drops to the fourth lowest with Saskatchewan, Newfoundland, Prince Edward Island, Alberta, British Columbia, and Ontario all being higher.

In the analysis of causes of death, this paper separates infant mortality rates into neonatal (28 days and under) and post-neonatal (29 days to less than 1 year) mortality rates. Neonatal mortality is more sensitive to advances in medical care, whereas post-neonatal mortality is more related to both medical care and socioeconomic conditions of the infant.[6]

METHODS

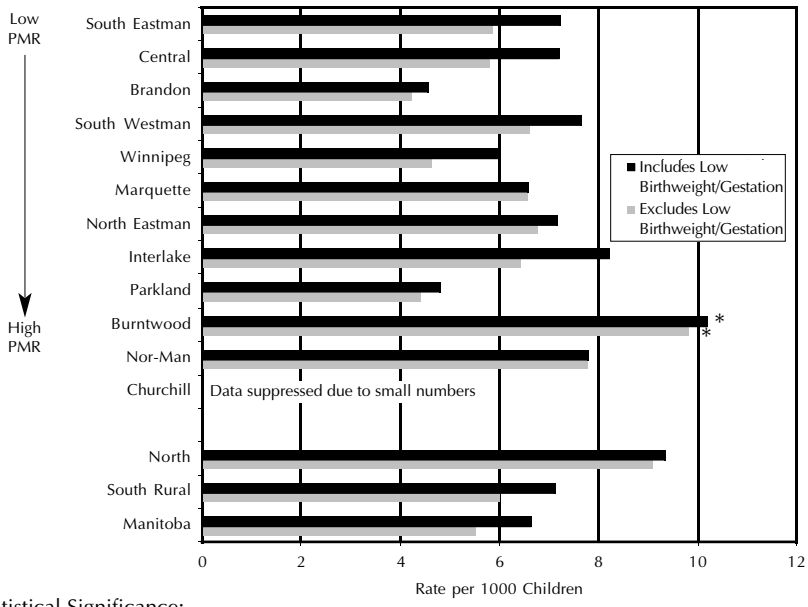
This is a cross-sectional study of children ages 0 to 19 years residing in the province of Manitoba from 1994 to 1998 inclusive. The "general fertility rate" calculates the number of births per 1000 women age 15 to 44 years old. A commonly used measure of fertility is the "total fertility rate",[7] interpreted as "the number of children who would be born to an average woman who experiences each of the age-specific fertility rates of a population in a given year as she progresses through her reproductive lifetime."

Infant mortality rates are reported in two ways: a) as a percentage of all live births, and b) as a percentage of all live births minus infants born weighing less than 500 grams and those born before 20 weeks of gestation. For the sake of brevity, this paper will refer to the former rate as the "inclusive infant mortality rate" and the latter rate as the "exclusive rate." For infant and child mortality, the calendar years (January 1 through to December 31) were used. Mortality data were available for the years 1994 to 1998 inclusive, but cause of death was only available for the 1994 to 1997 data. Birth, mortality, and cause-of-death data were derived from the Population Health Research Data Repository and Vital Statistics (see Brownell et al.[8] for more details on the methods and the databases).



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
N - Rate significantly different from mean for Northern Manitoba at p<0.05
S - Rate significantly different from mean for Rural South Manitoba at p<0.05

Figure 1. General fertility rate for women aged 15-44 years by RHA, 1994-98



Statistical Significance:
* Rate significantly different from Manitoba mean at p<0.05

Figure 2. Infant mortality rates for children aged <1 year at December 31, by RHA, 1994-98

Geographical data are presented by 12 geographical regions of Manitoba called "Regional Health Authorities" (RHAs), and also by 12 sub-regions of Winnipeg, Manitoba's largest city, called "Winnipeg Community Areas" (Winnipeg CAs). Comparisons of each RHA and Winnipeg CA were made to the overall provincial rate as well as to the North (a combined rate of Burntwood, Nor-Man, and Churchill RHAs) and to the South Rural (seven southern RHAs excluding Winnipeg and Brandon). Residents of Manitoba were placed into either urban or rural income quintiles based on their postal codes. "Urban" referred to location within

TABLE I

Causes of Mortality by Age, 1994 through 1997 *

Cause of Death	Infant Mortality Ages 0 through 1 Year		Child Mortality Ages 1 through 19 Years			
	Neonate (< 28 days)	Post-Neonate (29 days to 364 days)	1 to 4 Years	5 to 9 Years	10 to 14 Years	15 to 19 Years
SIDS	2%	29%	–	–	–	–
Congenital anomalies	26%	14%	13%	5%	1%	2%
Injury	1%	9%	52%	52%	69%	75%
Respiratory system	10%	11%	7%	6%	3%	2%
Digestive system	2%	1%	3%	5%	3%	1%
Circulatory system	4%	6%	5%	6%	3%	3%
Nervous system	–	9%	5%	5%	4%	10%
Endocrine/metabolic	2%	2%	–	–	–	–
Neoplasm	1%	1%	6%	12%	14%	9%
Infectious/parasitic	2%	8%	4%	3%	<0.5%	3%
Ill-defined/unknown	10%	9%	–	–	–	–
Fetal haemorrhage	2%	–	–	–	–	–
Short gestational age/low birthweight	18%	–	–	–	–	–
Complications of labour	10%	–	–	–	–	–
Maternal conditions or complications	7%	–	–	–	–	–
Other	12%	1%	5%	6%	3%	4%

* Note: a dash in the cell indicates that this cause of death was not separated out for that specific age category

the two major urban cities of Manitoba – Brandon and Winnipeg – each of which constitutes an RHA. "Rural" referred to all other RHAs. Each postal code income grouping, and hence the quintile grouping, is reflecting an average income for the population within that group, not an individual income by household.

To determine the relationship between fertility/mortality rates and the health and socioeconomic well-being of the community, two regional measures were used: the premature mortality rate (PMR) and the socioeconomic factor index (SEFI). The PMR is an age- and sex-standardized death rate of persons less than 75 years old. It is considered the best single measure to reflect the healthiness of a group of people and their need for health care services.[9-11] Socioeconomic status is another indicator of overall population health and well-being.[12,13] MCHP uses the SEFI as a composite measure of socioeconomic status. SEFI is based upon census measures of environmental, household and individual conditions associated with poor health, and hence a greater need for health care. PMR is highly correlated with SEFI and could be considered a surrogate for both physical health and socioeconomic health of the population within which the child resides (see Martens et al.[14] for a detailed explanation of PMR and SEFI).

All indicator graphs are ordered by a five-year average 1994/95 to 1998/99 PMR, from the region with the lowest PMR – the region with the healthiest population – on the top of the y-axis to the region with the highest PMR – the region with the least healthy population – on the bottom. For example, graphs displaying RHA data place South Eastman RHA at the top of the y-axis because South Eastman has the lowest PMR. This construction embeds the child health indicator in a framework of the healthiness of the region's population, thereby giving a pictorial sense of whether one is associated with the other.

RESULTS

Fertility rates

Figure 1 shows the general fertility rate by RHA, calculated as the number of births per 1000 women ages 15 to 44 years old. Rates for the Winnipeg CAs are available in the child health report on our website at www.umanitoba.ca/centres/mchp. The two main urban areas of Manitoba – Winnipeg and Brandon – have lower fertility rates (54/1000) compared to the Manitoba average (59/1000), but the North has a much higher rate (94/1000), 1.6 times the provincial average. Within Winnipeg, the range of the Winnipeg CA rates is from 41/1000 (Assiniboine South) to 76/1000 (Point Douglas).

To translate these general fertility rates into the average number of children born to each woman during her lifetime, one can use the "total fertility rate." Manitoba's total fertility rate was 1.77 children per woman for 1994 to 1998, higher than the Canadian rate (1.5) but lower than the USA rate (1.97). The Manitoba rate varies tremendously by region, ranging from 1.62 (Marquette) to 3.15 (Burntwood) at the RHA level, and 1.21 (Assiniboine South) to 2.30 (Point Douglas) at the Winnipeg CA level.

There was a significant decline in the general fertility rate in Manitoba from 1994 to 1998 ($p<0.001$), but this mainly reflects declines in urban and South Rural Manitoba ($p<0.001$). The North's fertility rates stayed relatively stable ($p=0.09$, NS). The annual number of live births in Manitoba dropped by 13% from 1994 to 1998. Actual numbers of live births within Manitoba for the years 1994 to 1998 were: 16,164; 15,833; 15,161; 14,361; and 14,143 respectively. The decline from the previous year was 2.1% (1994 to 1995), 4.2% (1995 to 1996), 5.3% (1996 to 1997) and 1.5% (1997 to 1998). In Manitoba for the year 1997, 18% of births were to women less than 20 years old; 55% to women 20 to 29 years old; and 27% to women 30 years old or more.

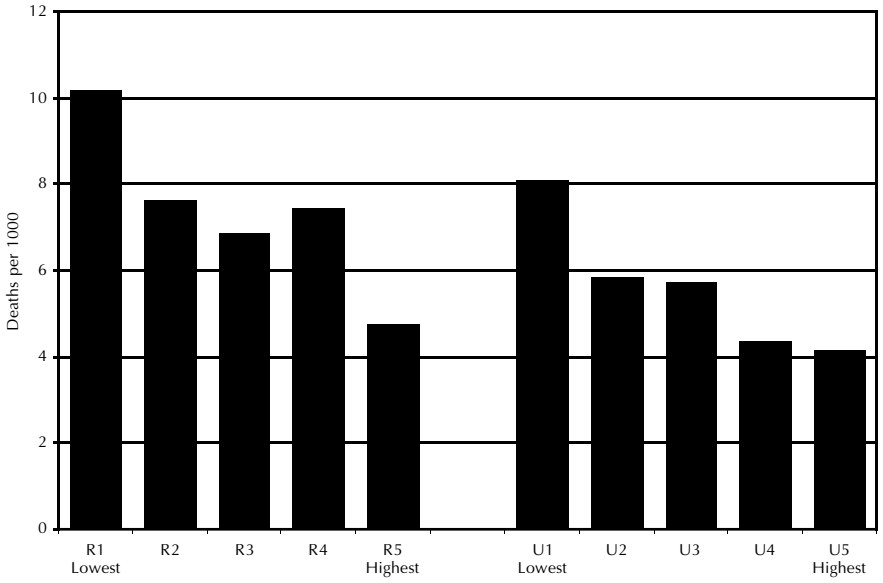
Infant mortality

Figure 2 presents the inclusive and exclusive infant mortality rate (the latter excluding babies weighing less than 500 g, or of less than 20 weeks gestational age). Rates for the Winnipeg CAs are available in the child health report on our website at www.umanitoba.ca/centres/mchp. For the years 1994-1998, the Manitoba inclusive infant mortality rate was 6.6/1000 (or 5.5/1000 exclusive), but rates varied by region from a low of 4.5/1000 (4.2/1000 exclusive) in Brandon RHA to a high of 10.2/1000 (9.8/1000 exclusive) in Burntwood RHA. Since infant mortality is a relatively rare event, thus fluctuating widely from year to year, the only region with a rate statistically different from the Manitoba rate was Burntwood. Infant mortality rates in Winnipeg CAs were lower, with the lowest inclusive rates being 3.7 (2.7 exclusive) for Transcona and St. Boniface, and the highest in Downtown at 8.4/1000 (6.7/1000 exclusive).

Causes of death for neonates and post-neonates are given in Table I. The leading causes of death for neonates in Manitoba

from 1994 to 1997 were congenital anomalies (26%), followed by short gestational age/low birthweight (18%). For post-neonates, SIDS (Sudden Infant Death Syndrome) was the leading cause of death at 29%, followed by congenital anomalies at 14%. Respiratory, infectious, and parasitic diseases made up a total of 19% of the causes of death for post-neonates.

There was a strong gradient ($p<0.001$) in infant mortality by both rural and urban income quintiles within Manitoba (Figure 3). Comparing the lowest income quintile to the highest, there was twice the infant mortality rate both in urban (8.12/1000 vs. 4.15/1000, inclusive; or 6.24 vs. 2.72 exclusive) and rural settings (10.18 vs. 4.75 inclusive; or 8.83 vs. 4.05 exclusive).



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban ($p<0.0001$), using two-tailed Cochran-Armitage trend test.

Figure 3. Infant mortality (inclusive rate) by rural and urban income quintiles, 1994-98

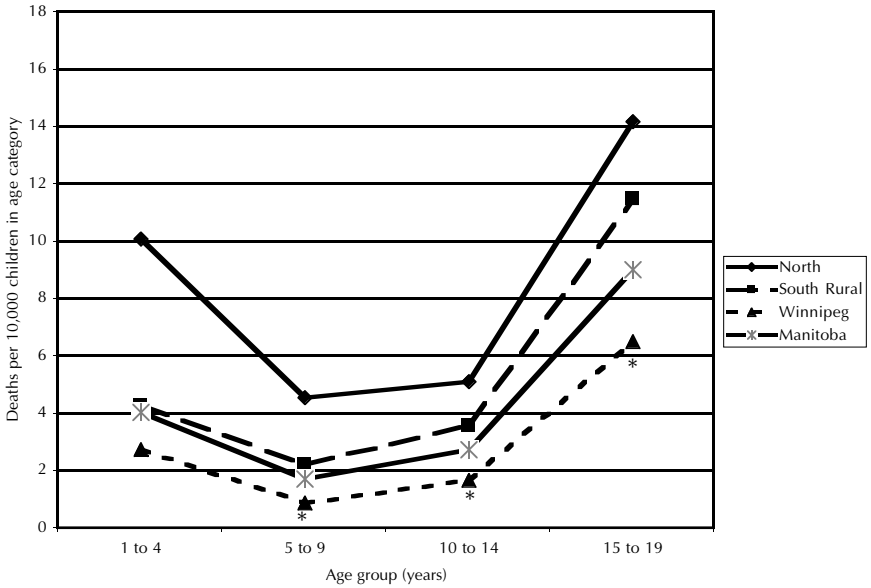
Child mortality

Age-specific mortality rates for 1-19 year olds are presented in Figures 4 and 5 by gender, age category and geographical location. Because child death is a rare event, child mortality rates are presented by larger geographical regions – North, South Rural, Winnipeg and Manitoba.

Winnipeg generally has lower child mortality rates than the Manitoba average, especially for male children ages 5 to 19 years. For males ages 5 to 19 years living in south rural areas, the rates are 26% to 47% higher than the average Manitoba male. In contrast, northern Manitoba shows an elevated pattern of mortality for both genders and nearly all age categories, especially for children ages 1 to 9 years. Females living in northern Manitoba have double the Manitoba female mortality rate at ages 5 to 9 years, almost triple the rate at ages 1 to 4 and 15 to 19 years, but about the same rate in the middle years of 10 to 14 years. Northern Manitoba males have almost triple the Manitoba male mortality rate at ages 1 to 9, double the rate at ages 10 to 14, and 1.6 times the rate at ages 15 to 19 years.

There was no statistically significant change in Manitoba's overall child mortality over the period 1994 to 1997, and no change by gender or by age category. Using three-year running average rates, the overall child mortality rates per 10,000 for ages 1 to 19 years were: 3.87 for 1994 to 1996; 3.86 for 1995 to 1997; and 3.82 for 1996 to 1998.

The causes of child mortality vary by age grouping (Table I). Death due to injury



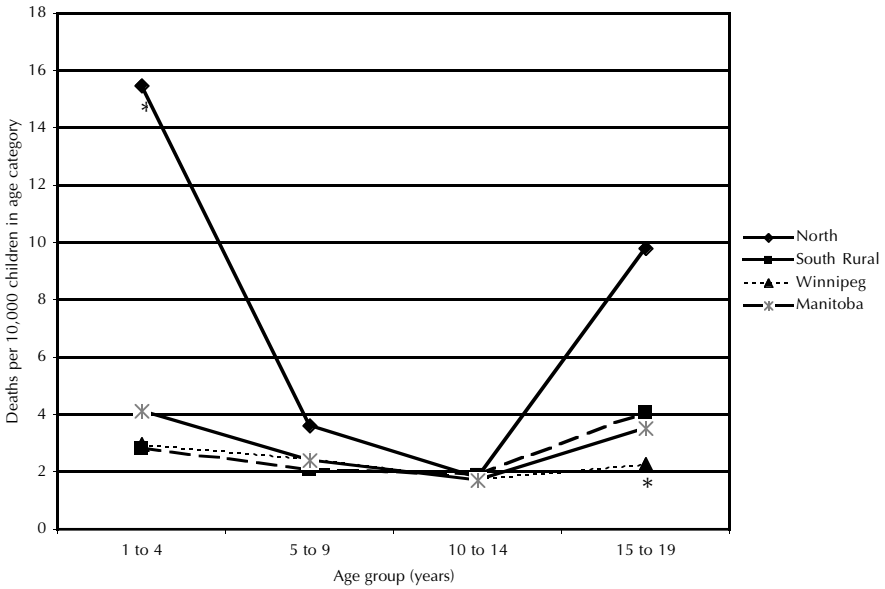
* Statistically different from Manitoba males in age group

Figure 4. Child mortality: males, 1994-98

was the leading cause for ages 1 through 19, ranging from 52% for ages 1 to 9 years, 69% for ages 10 to 14, and 75% for ages 15 to 19 (for detailed information on injury, see Brownell et al., this issue).[15] Other leading causes include congenital anomalies and respiratory diseases for the youngest, and neoplasms for ages 5 to 19 years.

Correlations of fertility and mortality rates with regional population health indicators

Table II details the correlation of fertility and mortality rates with the two indicators of the healthiness and socioeconomic well-being of regional populations – PMR and SEFI. The greater the PMR (that is, the poorer the overall population health sta-



* Statistically different from Manitoba females in age group

Figure 5. Child mortality: females, 1994-98

TABLE II

Association of Child Indicators with Population Health/Socioeconomic Indicators

Health indicator‡	Correlation of Indicator with Premature Mortality Rate (PMR)	Correlation of Indicator with the Socioeconomic Factor Index (SEFI)
General fertility rate (n=23)	0.74***	0.70***
RHAs (Non-Winnipeg)	0.55†	0.67*
Winnipeg CAs	0.80**	0.69*
Infant mortality rate (n=22)	0.42†	0.39†
RHAs (Non-Winnipeg)	0.39	0.31
Winnipeg CAs	0.38	0.51†
Infant mortality rate excluding <500g and <20 weeks gestation (n=22)	0.63**	0.52*
RHAs (Non-Winnipeg)	0.58†	0.33
Winnipeg CAs	0.61*	0.76*
Child mortality rate ages 1 to 4 years (n=21)	0.81***	0.69***
RHAs (Non-Winnipeg)	0.86***	0.92***
Winnipeg CAs	0.67*	0.40
Child mortality rate ages 5 to 9 years (n=23)	0.27	0.16
RHAs (Non-Winnipeg)	0.18	0.19
Winnipeg CAs	0.10	0.02
Child mortality rate ages 10 to 14 years (n=22)	0.60**	0.59*
RHAs (Non-Winnipeg)	0.56†	0.67*
Winnipeg CAs	0.57†	0.42
Child mortality rate ages 15 to 19 years (n=22)	0.47*	0.47*
RHAs (Non-Winnipeg)	0.33	0.25
Winnipeg CAs	0.19	0.54†

‡ Each of the 11 Non-Winnipeg regional health authority regions (RHAs) and the 12 Winnipeg community areas (Winnipeg CAs) was included in the Spearman's correlations with PMR and SEFI. In some regions, there was suppression of the rate due to small numbers. The level of significance of the correlation coefficient is indicated by the following: *p<0.05; **p<0.002; ***p<0.0001; †p<0.10, not statistically significant

tus), the greater a region's fertility rate, exclusive infant mortality rate, and child mortality rate in the age groups of 1 to 4, 10 to 14, and 15 to 19 years. In contrast, there was no relationship between child mortality rate of children ages 5 to 9 years and PMR (r=0.27, p=0.23) or SEFI (r=0.16, p=0.48), even when analyzing Winnipeg CAs and Non-Winnipeg RHAs separately.

When Winnipeg CA and Non-Winnipeg RHA rates were analyzed separately, the exclusive infant mortality was related to both PMR and SEFI within Winnipeg, but not outside of Winnipeg. In contrast, the inclusive infant mortality was not associated with PMR or SEFI. This may underscore the importance of using the exclusive definition of infant mortality, since the inclusive rate may obscure the association of this child health indicator with indicators of community health and well-being.

DISCUSSION

Fertility and infant/child mortality rates for Manitoba are highly correlated with the health and socioeconomic indicators of the region's population in which Manitoban children reside. This underscores the relationships of systemic community health and well-being with child health. Manitoba also has a high proportion of births (18%) to women less than 20 years old, compared to national statistics from Canada and the USA (11% and 12.5% respectively). Although the overall Manitoba birth rate is declining, children continue to be born at disproportionate rates in regions of poorer health and higher socioeconomic risk. Children also die at disproportionate rates in these regions, in any given age group from birth to late adolescence.

The Manitoba inclusive infant mortality rate of 6.6/1000 for 1994 to 1998 may be slightly higher than Canadian rates (6.3/1000 live births in 1994; 5.6/1000 in 1997),[1,5] yet much lower than the USA 1997 rate of 7.2/1000.[16] The leading causes of death for Manitoba were: congenital anomalies (26%) and being of short gestational age/low birthweight (18%) for neonates; and SIDS (29%) for post-neonates.[5]

Over the past few decades, the key reasons for decreased infant mortality rates in developed countries have been a) the improved rate of survival of low birthweight and preterm babies due to better resuscitation and care, and b) an increase in genetic counselling and congenital anomalies screening. But recent assisted reproductive technologies may actually

have the effect of increasing infant mortality rates in the future, since multiple births increase the risk of preterm or low birthweight infants.[17] Thus it would follow that Manitoba may actually see a rise in infant mortality as assisted reproductive technology becomes more common.

Manitoba infant mortality rates also vary by income, with double the rate in the lowest compared to the highest quintile. This gradient effect operates in both rural and urban income groupings, observable throughout all five quintiles for both rural and urban groupings. This means that income does not affect the poor only – gradients indicate an increasing infant mortality rate for decreasing income levels at each of the five quintile groupings. Absolute rates, however, are substantially higher in rural quintiles compared to the corresponding urban quintiles. Similar income gradient effects have also been observed for Canada-wide data,[5,18] where urban infant mortality rates were 1.7 times higher in the lowest compared to the highest quintile (7.5/1000 vs. 4.5/1000 for 1986-1991; and 6.5/1000 vs. 3.9/1000 for 1996).

The Manitoba overall child mortality rates were stable from 1994 to 1998. But there were differential rates by geographical region and by socioeconomic risk. Children living in the North had a disproportionately high child mortality rate, and males 5 to 19 years in South Rural areas had death rates 26% to 47% higher than the Manitoba averages. The leading cause of death for Manitoba children ages 1 to 19 years was injury: one half of the deaths for children ages 1 to 9, and three quarters of the deaths for children ages 10 to 19 years. The degree to which injury plays a role in child death underscores the importance of preventive injury programs, especially in the north and in south rural areas. It may also point to risky behaviour patterns in rural south and north areas, possibly related to access to snowmobiles, alternate terrain vehicles, and farm machinery, as well as to more risky infrastructures such as poorer road conditions in rural and northern areas. Manitoba causes of death are similar to Canadian statistics which indicate that 41% of deaths for children ages 5 to 9 years, and 52% of deaths for children ages 10 to 14 years, are due to accidents, motor vehicle deaths, homicides and suicides.[19]

Addressing the matters of life and death for the children of Manitoba is not easy. But the disparity in mortality rates among children, and, arguably, in fertility rates, between sub-regions of Manitoba indicates there is room for improvement on some of the basic levels of public health. The correlation reported here between infant mortality rates and fertility rates, and health and socioeconomic conditions, underscores the importance of macro-level policies when addressing issues of child health.

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RÉSUMÉ

Objectif : Déterminer les taux de fécondité et de mortalité juvénile au Manitoba.

Méthode : Les taux de fécondité et de mortalité ont été dérivés des chiffres de 1994 à 1998 de la base de données Population Health Research Data Repository and Vital Statistics. Les données sont présentées selon les 12 ORS, les 12 CR de Winnipeg et le quintile de revenu. Chaque indicateur est corrélé avec le taux de mortalité prématurée (c.-à-d. avant 75 ans, ajusté selon l'âge et le sexe) et avec le SEFI (un indice composite normalisé de facteurs socio-économiques), tous deux considérés comme pouvant remplacer les chiffres sur la santé globale et le bien-être socio-économique des populations.

Résultats : Le taux de fécondité dans l'ensemble du Manitoba était de 1,77 enfant par femme; il variait de 1,62 à 3,15 selon l'ORS et de 1,21 à 2,30 selon le CR de Winnipeg. Le taux de mortalité infantile au Manitoba était de 6,6 pour 1 000 (5,5 pour 1 000 si l'on exclut les bébés de moins de 500 g ou ceux nés avant 20 semaines de gestation); il variait de 4,5 à 10,2 selon l'ORS (de 4,2 à 9,8 avec les exceptions citées plus haut) et de 3,7 à 8,4 selon le CR (2,7 à 6,7). Le taux de mortalité infantile variait aussi du simple au double entre le premier et le dernier quintile de revenu ($p<0,001$). Les taux de mortalité juvénile affichaient des écarts géograhiques et selon le sexe, les enfants du Nord de la province étant les plus à risque. Les blessures étaient la principale cause de mortalité (étant responsables de 52 % des décès chez les 1 à 9 ans et de 75 % des décès chez les 15 à 19 ans).

Conclusion : Les taux de fécondité et de mortalité infantile et juvénile étaient positivement associés au TMP et au SEFI, avec des écarts géographiques considérables.

Preventable Feto-infant Mortality

Application of a Conceptual Framework for Perinatal Health Surveillance to Manitoba Perinatal Outcomes

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ABSTRACT

Background: Perinatal health surveillance systems have lacked conceptual frameworks to translate data into information for policy and program planning. This paper demonstrates the application of a conceptual framework in the analysis of feto-infant mortality data in the province of Manitoba.

Methods: Fetal and infant deaths were categorized according to a two-dimensional framework of birthweight and age-at-death, and grouped into four broad categories of contributors to perinatal health: Maternal Health, Maternal Care, Newborn Care, and Infant Care. Birth Weight Proportionate Mortality Rates (BWPMR) were calculated for each of the four categories, and preventable "excess" feto-infant mortality was estimated through comparisons to a benchmark sub-population.

Results: Between 1985 and 1998, feto-infant mortality declined from 12.3 to 9.8 deaths per 1000 births in Manitoba. Much of this decline occurred in the Newborn Care category; there were only slight declines in deaths attributed to Maternal Health and Infant Care factors. Comparison of the feto-infant mortality rate to the benchmark rate revealed an excess of 3.46 deaths per 1000 births, an "opportunity gap" of 33%. Substantial regional variations in feto-infant mortality rates were observed.

Summary: Application of this conceptual framework provided useful information to aid in policy and program planning. As the greatest excess feto-infant mortality was observed in the Maternal Health and Infant Care categories, attention to the broader determinants of health which influence these categories will be required.

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

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The full reports "Manitoba Perinatal Surveillance Report, 1985-1996" and "Manitoba Perinatal Health Surveillance Report, 1989-1998: Provincial and Winnipeg Geographic Breakdown" on which this article is based are available from the Manitoba Health Public Health Branch, 4th floor, 300 Carlton Street, Winnipeg, MB R3B 3M9, or online at: http://www.gov.mb.ca/health/publichealth/ epiunit/reports.htm

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Public health surveillance has been defined as the ongoing systematic collection, analysis, and interpretation of outcome-specific health data for use in the planning, implementation, and evaluation of public health practice.[1] Dr. Brian McCarthy of the Centers for Disease Control and Prevention (CDC), Atlanta, has defined perinatal health surveillance as a dynamic process which collects, analyzes, and responds to data on the occurrence and distribution of maternal and child health events in a defined population.[2] Common to both of these definitions of surveillance are analysis and interpretation to turn raw data into useful "information". This information can be used for a variety of purposes, including: estimating the burden of ill health and poor outcomes, generating hypotheses as to the contributors to poor outcomes, setting research priorities, planning and evaluating preventive and treatment services, and monitoring trends in outcomes and practices over time.

Perinatal databases and information systems have heretofore lacked conceptual frameworks on which to base such analyses and assist in the translation of data into information useful for health policy-making. This paper demonstrates the application of a conceptual framework to perinatal surveillance data in the Canadian province of Manitoba, thereby providing useful information on perinatal outcomes and the potential for improving these outcomes. The particular outcome of focus in this paper is the *feto-infant mortality rate*, which includes fetal mortality after 28 weeks of gestation and infant mortality during the first year of life. Feto-infant mortality has been previously used as an indicator of overall maternal/infant well-being in populations, and has been observed to decrease dramatically over the last century in most countries.[3-5]

The perinatal health surveillance conceptual framework used in this study was developed by Dr. Brian McCarthy and colleagues at the World Health Organization (WHO) Collaborating Center in Perinatal Care, Centers for Disease Control and Prevention, Atlanta, Georgia.[2,6-8] The conceptual framework analyzes feto-infant mortality by birthweight and age-at-death (Figure 1), and is used to determine the strategies having the greatest potential for reducing preventable

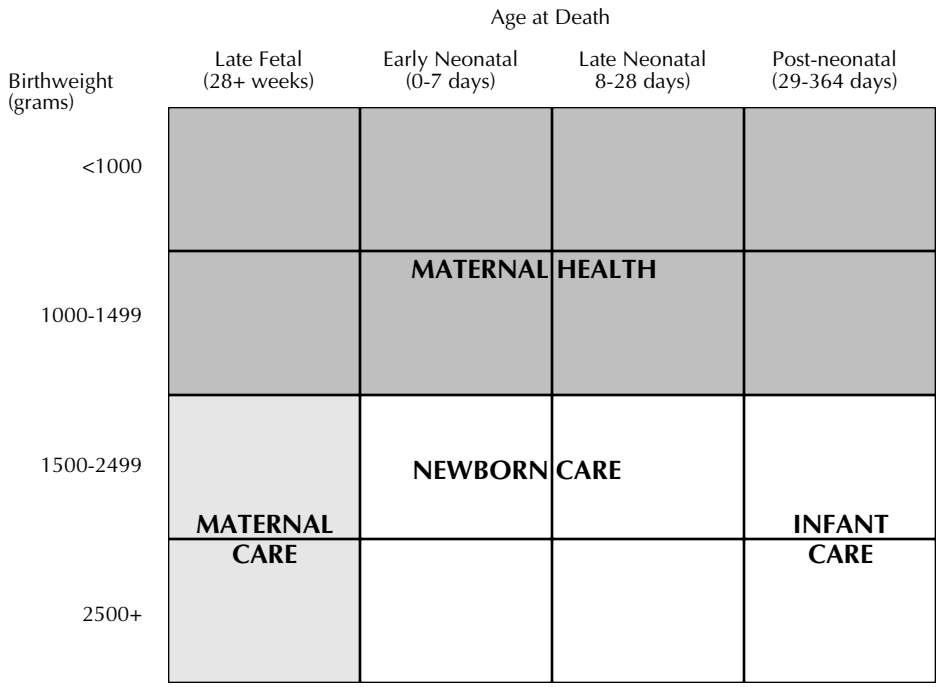

Figure 1. Framework for classifying feto-infant mortality by weight and age at death

feto-infant mortality through assessment of factors in four major categories: Maternal Health, Maternal Care, Newborn Care, and Infant Care.[2] Although these categories are not seen as mutually exclusive, this classification scheme attributes late fetal deaths (deaths occurring at 28 weeks gestation or greater) and infant deaths of very low birthweight (<1500 grams) to Maternal Health factors. Among intermediate (1500-2499 grams) and normal (2500+ grams) birthweight groupings, late fetal deaths are attributed to Maternal Care factors. Deaths of normal birthweight (>2499 grams) infants in the early neonatal period and intermediate weight infants (1500-2499 grams) in the early or late neonatal periods are attributed to Newborn Care factors. Finally, deaths after 1 week of life in normal birthweight infants and after 4 weeks of life in intermediate weight infants are attributed to Infant Care factors.

The Maternal Health category includes factors affecting adequate growth and development of the fetus, and is influenced by the broader determinants of health such as income and social status, education, physical environment, health services, and culture and ethnicity.[9-11] Maternal Health is also affected by factors such as maternal age and parity, pregnancy spacing, nutritional status, stress, smoking, drug and alcohol use, chronic health conditions, and access to primary health care. Very low birthweight (VLBW) deaths can best be prevented by addressing Maternal Health issues.[12] The Maternal Care category includes the availability of high quality care during pregnancy and in the labour and delivery period. Maternal Care is affected by access to prenatal care and screening; availability of high-risk pregnancy follow-up; an assessment, referral, and transfer system for maternal/fetal complications; intrapartum fetal health surveillance; and surgical services to perform emergency caesarean births. The Newborn Care category includes factors that exert a strong influence on infant health in the neonatal period, including a regional referral and neonatal transport system, timely and skilled resuscitation, attention to thermoregulation, and access to neonatal intensive care. In the category Infant Care are factors that influence the health of infants after the neonatal period, including immunizations, breast feeding promotion and support, community services, injury prevention and control, and high risk infant follow-up. Socioeconomic variables such as family income and maternal education, and maternal race or ethnicity, also influence infant health and infant mortality rates.[9,13-15] Analysis of feto-infant mortality according to these four categories in the framework provides an innovative method of monitoring and investigating preventable feto-infant mortality problems, targeting further investigations and informing policy and program activities.[12]

METHODS

Study setting

This study was conducted in the province of Manitoba. Manitoba has a population of 1.14 million (1997). Over 60% of the residents live in the only major urban centre, Winnipeg (population 647,000). The remainder of the population is distributed among small regional centres and farming communities in the rural southern half of the province and mining, forestry and Aboriginal communities in the northern half of the province. Each year in Manitoba there are approximately 21,000 pregnancies that result in a hospital-based outcome, about 75% of which result in a live birth; about 110 pregnancies result in stillbirth each year, and the remainder result in spontaneous or therapeutic abortions.[16,17]

Data sources

The main source of data for this study was the Manitoba Health Perinatal Database for the years 1985 through 1998. The provincial health department (Manitoba Health) maintains computerized health records based on health services utilization for all individuals enrolled in the universal health insurance system. For hospitalizations and/or hospital outpatient services, each hospital submits to Manitoba Health a hospital separation abstract that includes the patient's personal health identification number, dates of admissions and discharge, up to 16 ICD-9-CM diagnoses codes, and up to 12 ICD-9-CM procedure codes. The information gathered from the hospital separation abstracts is entered into a hospital abstract database. The utility, accuracy and completeness of these databases have been documented.[18] Using the hospital abstract database, records of women who have had a pregnancy that resulted in a hospital-based birth and their infants were identified and linked in a distinct Perinatal Database, maintained by the Manitoba Health Epidemiology Unit. This confiden-

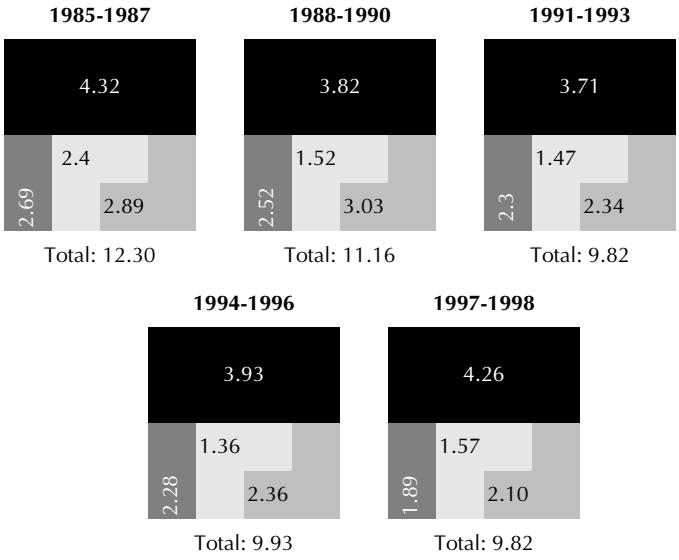

Figure 2. Time trends in Manitoba feto-infant mortality per 1000 births

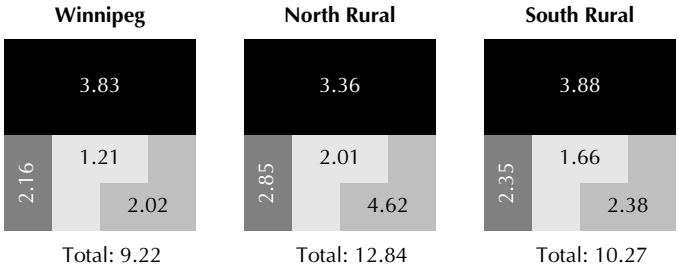

Figure 3. Manitoba regional feto-infant mortality per 1000 births, 1989-1998

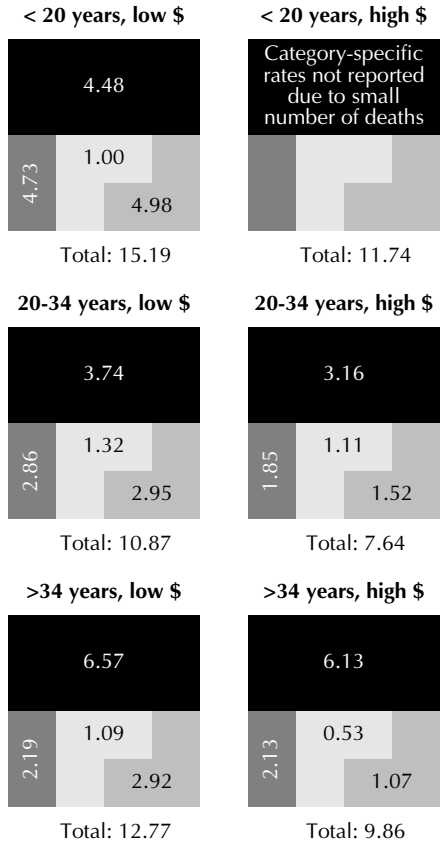

Figure 4. Feto-infant mortality by age and median household income, 1989-1998

tial, linked obstetrical-newborn database captures live births as well as stillbirths. It has a hospital discharge abstract record for each hospital-based delivery in Manitoba since 1984.

Application of conceptual framework and analysis

The perinatal health surveillance conceptual framework was applied to fetal death and linked birth and infant death files in Manitoba, as follows. The first step involved tabulating feto-infant mortality rates (per 1000 total births) in a two-dimensional matrix of birthweight and age-at-death, resulting in a 16 cell table (Figure 1). The 16-cells were then grouped into the 4 broad categories of contributors to perinatal health discussed above: Maternal Health, Maternal Care, Newborn Care, and Infant Care (Figure 1).

Birth Weight Proportionate Mortality Rates (BWPMR) were then calculated for each of the four categories. The BWPMR is the number of feto-infant deaths in a given weight group divided by the total number of fetal deaths and live births for all weight groups. The proportionate mortality for the four categories was then added together to derive the overall feto-infant mortality rate. The four categories were compared to determine where higher feto-infant mortality rates occur. The feto-infant mortality rates also were used to compare rates over time and across different population groups, defined by several variables (maternal age, area of residence, median household income of postal area of residence). Comparisons between within-province regional rates were made at two levels. The first involved subdividing the province into three large regions with common demographic characteristics: North Rural (consisting of the Burntwood, Churchill, Nor-Man and North Eastman Regional Health Authorities [RHAs]), South Rural (consisting of all the remaining rural RHAs) and Winnipeg (the only entirely urban RHA). The second level of regional comparisons was at the level of Manitoba's 12 RHAs (refer to Figure 1 in Brownell et al., this issue[19]).

The next analysis step involved calculation of excess (preventable) feto-infant mortality rates for the period 1989 to 1998. Excess feto-infant mortality is calculated by subtracting the mortality rates in a benchmark population from the rates in the comparison population. We chose as a benchmark population women aged 20-34 years of age who live in Winnipeg residential areas with a high median household income (greater than $43,457). The difference between a region's mortality rate and the benchmark rate may be viewed as an "opportunity gap" that reveals the potential for reduction in feto-infant mortality in that region.

RESULTS

Overall and category-specific feto-infant mortality rates for Manitoba are summarized in Figure 2. Between 1985-87 and 1997-98, there was a 20% reduction in overall feto-infant mortality in the province of Manitoba (from 12.3 to 9.8 deaths per 1000 births). There were reduc-

TABLE I

Feto-Infant Mortality Rates per 1,000 Births, 1989-1998

	Maternal Health		Maternal Care		Newborn Care		Infant Care		Total Feto-Infant Mortality	
Benchmark	2.76	Excess	1.88	Excess	1.16	Excess	1.16	Excess	6.96	Excess
Manitoba	4.02	1.26	2.29	0.41	1.59	0.43	2.52	1.36	10.42	3.46
Winnipeg	3.83	1.07	2.16	0.28	1.21	0.05	2.02	0.86	9.22	2.26
Brandon	3.46	0.70	1.57	-0.31	1.42	0.26	1.57	0.41	8.02	1.06
North Eastman	2.84	0.08	2.08	0.20	1.89	0.73	4.16	3.00	10.97	4.01
South Eastman	4.05	1.29	2.56	0.68	1.62	0.46	1.75	0.59	9.98	3.02
Interlake	3.93	1.17	2.51	0.63	1.42	0.26	2.95	1.79	10.81	3.85
Central	4.30	1.54	2.77	0.89	1.67	0.71	2.43	1.27	11.37	4.41
Marquette	4.34	1.58	1.69	-0.19	1.69	0.53	1.93	0.77	9.65	2.69
South Westman	3.69	0.93	1.97	0.09	1.47	0.31	2.46	1.30	9.59	2.63
Parkland	2.71	-0.05	2.32	0.44	1.93	0.77	3.48	2.32	10.44	3.48
Nor-Man	2.16	-0.60	1.73	-0.15	2.59	1.43	3.03	1.87	9.51	2.55
Burntwood	3.72	0.96	3.64	1.76	1.86	0.70	5.50	4.34	14.72	7.76
Churchill	unstable rates		unstable rates		unstable rates		unstable rates		unstable rates	

tions in the mortality rates in all four categorical areas during this 13-year period. However, much of the decline is attributable to improvement in the Newborn Care category, in which the mortality rate decreased by 35%. By contrast, mortality in the Maternal Health category improved by only 1.4% during this period. In terms of BWPMR, by 1997-98, approximately 43% of the feto-infant mortality (4.26 per 1000) occurred in the very low birthweight (Maternal Health) category, 21% in the Infant Care category (2.10 per 1000), 19% in the Maternal Care category (1.89 per 1000), and 16% in the Newborn Care category (1.57 per 1000).

There were substantial regional variations in feto-infant mortality rates in Manitoba. During the 1989-1998 time period, the highest rates were in the North Rural region of the province (Figure 3), followed by the South Rural region, and finally, Winnipeg. The greatest regional differences in category-specific feto-infant mortality rates were in the Infant Care category where the North Rural region had a 2.3-fold higher mortality rate than the city of Winnipeg (4.62 versus 2.02 per 1000, Figure 3). Feto-infant mortality rates by RHA are summarized in Table I. During the 1989-98 period, the Burntwood RHA (in the North Rural region) had the highest overall feto-infant mortality (14.72 per 1000), approximately 80% higher than the lowest, Brandon RHA (8.02 per 1000). Proportionately, the major contributions to this relatively high total mortality rate in Burntwood came from the Infant Care and Maternal Care categories.

Variations in feto-infant mortality by maternal age and median household income are illustrated in Figure 4 (analysis restricted to Winnipeg residents). In each age group, women living in areas of the city with a median annual household income greater than $43,457 (i.e., the upper one third) had lower feto-infant mortality rates than women living in areas with a median household income less than $35,772 (i.e., the lower one third). Furthermore, within both income strata, women aged 20-34 years had lower feto-infant mortality rates than women aged less than 20 years or greater than 34 years.

"Excess" feto-infant mortality in Manitoba and each of its RHAs in comparison to the "benchmark" rate is summarized in Table I. The overall feto-infant mortality rate in the benchmark population for 1989-1998 was 6.96 per 1000, compared to an overall Manitoba rate of 10.42 per 1000. This implies an "opportunity gap" in perinatal mortality of 3.46 per 1000. In other words, if all of Manitoba were able to achieve the feto-infant mortality rates achieved by the benchmark population, the feto-infant mortality rate would decline by 3.46 per 1000, or 33%. There was excess feto-infant mortality in Manitoba in all four categories, with the greatest excesses in the Infant Care (1.36 per 1000) and the Maternal Health (1.26 per 1000) categories. The opportunity gaps for the Newborn Care and Maternal Care categories were relatively small, at 0.43 and 0.41 per 1000, respectively.

Analysis of within-province regional differences in excess feto-infant mortality (Table I) again illustrated that the Burntwood RHA has the greatest "opportunity gap", followed by the Central, North Eastman and Interlake RHAs. There was some inter-regional variation in terms of which category contributed most to the excess mortality. In Burntwood, Infant Care (56% of total excess) and Maternal Care (23%) presented the main opportunity gaps, whereas in Central RHA, Maternal Health (35%) and Infant Care (29%) were the greatest categorical contributors. In North Eastman, Infant Care (75% of total excess) was by far the greatest contributor, followed by Newborn Care (18%), with minimal excess mortality in the Maternal Health or Maternal Care categories in this region. In contrast to most of the rural regions, in Winnipeg, the greatest opportunity gap existed in the Maternal Health area (47% of total excess). However, common to all regions except South Eastman was the importance of Infant Care as either the first or second most important contributor to overall excess feto-infant mortality.

DISCUSSION

Using a conceptual framework to guide the interpretation of perinatal health surveillance data helps to focus policy, program and research priorities on the areas of greatest need and potential for improvement. Application of the framework described in this paper involves analyzing feto-infant mortality rates and estimating excess mortality rates to identify areas of progress and areas where opportunities for further improvement exist. The strategies with the greatest potential for reducing feto-infant mortality can be determined through further analysis of factors related to Maternal Health, Maternal Care, Newborn Care, and Infant Care.[2] This approach was initially developed by the WHO Collaborating Center in Perinatal Care, and has been applied in both developing and developed countries. The Canadian Perinatal Surveillance System of Health Canada has used the framework to estimate preventable feto-infant mortality in Canada.[4,20] In the United States, the CityMatCH program, in collaboration with CDC and the March of Dimes, has used a modified version of this framework, which they refer to as the *Perinatal Periods of Risk Approach*, to study fetal and infant mortality in selected cities in order to help these urban areas shift their mortality prevention efforts from simple broad-based initiatives to more targeted effective strategies.[12,21]

In Manitoba, there are encouraging trends in the feto-infant mortality rates – notable, the reduction of 20% in the overall rate between 1985 and 1998, and declines in all four risk-factor categories. This decline in mortality rates is consistent with trends in Canada and other developed countries.[3,5,13]

There are also opportunities for improvement in Manitoba's feto-infant mortality rates. There are significant regional disparities, with higher mortality in some North Rural and South Rural regions in particular. These intra-provincial variations are consistent with the substantial variations in fetal, neonatal, and especially post-neonatal mortality rates found among the provinces and territories in Canada.[4] In comparison to a benchmark urban sub-population, there is excess feto-infant mortality in all four categories and in almost all regions of the province of Manitoba. The greatest excess feto-infant mortality, and therefore the largest opportunity gap, is in the Infant Care (1.36 per 1000) and the Maternal Health (1.26 per 1000) areas. The smallest opportunity gaps are in the areas of Maternal Care and Newborn Care, suggesting that the health care system is functioning fairly well in these areas. However, one of the North Rural RHAs has higher rates of late stillbirths, indicating that there may be room for improvement in the area of Maternal Care provided to pregnant women in that region.

Because the Maternal Health and Infant Care categories have the highest feto-infant mortality rates (4.02 and 2.52 deaths per 1000 live births, respectively), as well as the greatest excess feto-infant mortality rates for Manitoba as a whole, efforts to reduce the provincial feto-infant mortality rate should be concentrated in these areas. Understanding the known risk factors and causes of mortality within these categories is key to identifying methods of reducing excess mortality. Excess feto-infant mortality in the Maternal Health category suggests a need to better understand the determinants of preterm birth, since approximately 98% of very low birthweight infants are born preterm.[22] Preterm birth is associated with a number of modifiable risk factors, including smoking, substance abuse, low rate of weight gain during pregnancy, anaemia, urogenital infections, strenuous work, domestic violence, stress, and inadequate prenatal care.[11,23,24] In addition, preterm birth has been linked to socioeconomic factors, and is more frequent among the socially disadvantaged.[10,11] Further analysis needs to focus on the prevalence and population-attributable risk associated with these modifiable risk factors, to help direct program planning. Because preterm birth prevention efforts directed toward women at high risk have been ineffective,[25,26] a population health approach to reduce preterm birth has been proposed.[24]

Analysis of excess deaths in the Infant Care category includes examining the underlying causes of infant death and assessing the prevalence of known risk factors and interventions by specific causes of death.[21] The top three causes of post-neonatal mortality for Manitoba are sudden infant death syndrome (SIDS), congenital anomalies, and injuries. Deaths due to SIDS and injuries and some congenital anomalies have known modifiable risk factors, and more intensive promotion of known preventive practices is warranted. For example, preventive practices to reduce SIDS include decreasing use of the prone sleeping position for infants, eliminating exposure to second-hand smoke, and increasing breastfeeding rates,[27] while pre-conception use of folic acid supplements reduces the risk of neural tube defects[28] and safety measures can be implemented to reduce infant deaths due to injuries. In addition, underlying determinants of these outcomes, such as low socioeconomic status and environmental conditions, should be addressed.

This study provides evidence of socio-economic disparities in perinatal outcomes. We found that women living in the lowest income tertile areas have higher infant mortality rates than women in the highest income tertile areas. This is comparable to the overall Canadian situation, in which infant mortality rates in Canada's poorest neighbourhoods were found to be two thirds higher than those in the richest neighbourhoods.[5] Social approaches to lowering infant mortality are warranted.[29] In addition, the scope of information that is routinely collected through perinatal surveillance needs to be expanded to include maternal socioeconomic indicators, such as income and education.

There are limitations to the analyses of feto-infant mortality inherent in the data available and the scope of the conceptual framework. Pregnancies and deliveries not resulting in hospital outcomes are not captured in the Manitoba Perinatal Database and are therefore excluded; however, to date the number of home deliveries in Manitoba comprise less than 1% of the total. The 16-cell table places a gestational age restriction on fetal deaths, resulting in exclusion of early fetal deaths (less than 28 weeks gestation) from the analysis.[12] Future expansion of the framework to include analysis of early fetal deaths is warranted, since most countries include fetal deaths of 20 weeks gestation or greater in their fetal mortality rates. Two other major groups of adverse pregnancy outcomes excluded from this analysis include spontaneous abortions and therapeutic abortions, which account for approximately one quarter of hospital-based pregnancy outcomes in Manitoba.[17] In addition, classifying fetal and infant deaths using this conceptual approach may not be entirely appropriate for some deaths, such as those due to congenital anomalies.[20]

Other limitations relate to the fact that this conceptual framework is only a framework for surveillance. Any results related to excess feto-infant mortality need to be followed up with in-depth analysis of the reasons for excess deaths, including prevalence of known risk factors, availability of appropriate health care services, and causes of mortality, to provide sufficient direction for program planning and policy making. In addition, the link between assignment of birthweight and age at death within the 16-cell table, and the classification of determinants of perinatal outcomes into the four categories of Maternal Health, Maternal Care, Newborn Care, and Infant Care, requires further validation. Further testing is needed to determine whether the majority of deaths in each of these categories are largely attributable to factors in that category. For example, are excess deaths at birthweights of less than 1500 grams primarily attributable to a higher frequency of preterm births related to behavioural, social, health and economic disparities of the mothers, or to higher mortality rates once born at that birthweight related to quality of neonatal intensive care?[21] A preliminary validation of the conceptual

framework by CityMatCH concluded that the grouping of cells in the framework fairly closely aligned with the grouping created when cells were clustered by cause of death and maternal risk factors, although insufficient information was available from vital records to adequately cluster fetal deaths.[12] Finally, this framework focuses on one component of surveillance data, feto-infant mortality. Other types of frameworks should be developed and tested to improve the impact of perinatal health surveillance data.

SUMMARY

The results of the application of this conceptual framework to Manitoba data are currently being shared with a broad range of stakeholders in perinatal health, including governmental, non-governmental and community groups. Because the greatest excess feto-infant mortality and opportunities for improvement were observed in the Infant Care and Maternal Health categories, attention to the broader determinants of health which influence these categories will be required. The smaller opportunity gaps in the Maternal and Newborn Care categories, which refer to health care variables, suggest that the health care system, with the possible exception of the North, is functioning well in these areas.

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RÉSUMÉ

Contexte : Les systèmes de surveillance médicale périnatale n'ont pas encore les cadres conceptuels nécessaires pour que leurs données puissent étayer la planification des politiques et des programmes. On montre ici comment appliquer un cadre conceptuel à l'analyse des données sur la mortalité fœto-infantile au Manitoba.

Méthode : Les cas de mortalité fœtale et infantile ont été classés dans une matrice bidimensionnelle (poids à la naissance/âge au décès) et regroupés en quatre grandes catégories de facteurs contribuant à la santé périnatale : Santé maternelle, Soins aux mères, Soins aux nouveau-nés et Soins aux nourrissons. On a calculé les taux de mortalité en proportion du poids à la naissance pour chaque catégorie et estimé la surmortalité fœto-infantile évitable par comparaison avec une sous-population de référence.

Résultats : Entre 1985 et 1998, la mortalité fœto-infantile a baissé au Manitoba, passant de 12,3 à 9,8 décès pour 1 000 naissances. La majeure partie de cette baisse a été enregistrée dans la catégorie des soins aux nouveau-nés; les décès attribuables à la santé maternelle et aux soins aux nourrissons ont très peu diminué. La comparaison du taux de mortalité fœto-infantile au taux de référence a mis en lumière une surmortalité de 3,46 décès pour 1 000 naissances, soit une possibilité d'amélioration de 33 %. On observe d'importants écarts régionaux dans les taux de mortalité fœto-infantile.

Résumé : L'application de ce cadre conceptuel fournit des renseignements utiles à la planification des politiques et des programmes. Comme la surmortalité fœto-infantile la plus importante a été observée dans les catégories Santé maternelle et Soins aux nourrissons, il faudra s'intéresser de plus près aux déterminants généraux de la santé qui influent sur ces catégories.

Being Born in Manitoba

A Look at Perinatal Health Issues

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ABSTRACT

Objective: The Manitoba Centre for Health Policy was commissioned by Manitoba's provincial health department to examine the health of newborns born 1994 through 1998, using three indicators: preterm birth (<37 weeks gestation), birthweight, and type of infant feeding.

Methods: Data were derived from the Population Health Research Data Repository and the National Longitudinal Survey of Children and Youth 1996. Variation by 12 Regional Health Authorities (RHAs) and by 12 Winnipeg Community Areas (CAs) was examined, as well as associations with the population's health and socioeconomic well-being.

Results: Manitoba's preterm birth rate was 6.7% of live births, from 5.3% to 7.4% by RHA, and 5.7% to 8.0% by Winnipeg CA. Manitoba's low birthweight rate (<2500 g) was 5.3%, from 2.7% to 5.7% by RHA, and 4.4% to 7.2% by Winnipeg CA. The lower the income, the greater the likelihood of low birthweight ($p<0.05$). Manitoba's breastfeeding initiation rate was 78%, from 64% to 87% by RHA, and 66% to 90% by Winnipeg CA. The lower the income and the poorer the health status of the population, the lower the breastfeeding rate ($p<0.001$). Of those initiating breastfeeding, 42% breastfed for at least six months.

Conclusion: Factors affecting child health in Manitoba could be addressed through systematic programs both during pregnancy and during the postpartum period, including support for nutritional counselling, promotion of breastfeeding, smoking cessation programs, and social policy decisions designed to overcome disparities within low-income groups and populations with poorer health status.

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

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The full report "Assessing the Health of Children in Manitoba: A Population-Based Study" on which this article is based is available from the Manitoba Centre for Health Policy at the above address or online at: http://www.umanitoba.ca/centres/mchp/reports.htm
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The health of the youngest members of our society demands our attention as health planners and decision-makers. This paper was part of a provincially commissioned report on the health of children residing in the Canadian province of Manitoba, and focuses on three indicators associated with newborn health: gestational age, birthweight, and breastfeeding status. The relationship of each indicator with the health and socioeconomic well-being of the region's population in which the infant resides, is examined. It was hypothesized that these rates would be highly variable by geographical area, and would be associated with income and with the health and socioeconomic well-being of the community.

The World Health Organization considers the rate of low birthweight (less than 2500 grams) a key indicator when measuring progress towards attainment of overall population health.[1] Babies who are born preterm or at low birthweight are at greater risk of poor health outcomes and thus require more health care resources.[2] Lower than USA rates, Canadian rates for preterm and low birthweight were 7.1% and 5.9% respectively.[3-5]

High birthweight (greater than 4000 g) may also be a concern due to increased probability of birth complications, and possible increases in adult health problems such as obesity and diabetes.[6] In 1997, the large-for-gestational-age rate (defined as the number of live births above the 90th percentile of birthweight for gestational age) in Canada was 10.7%.[7]

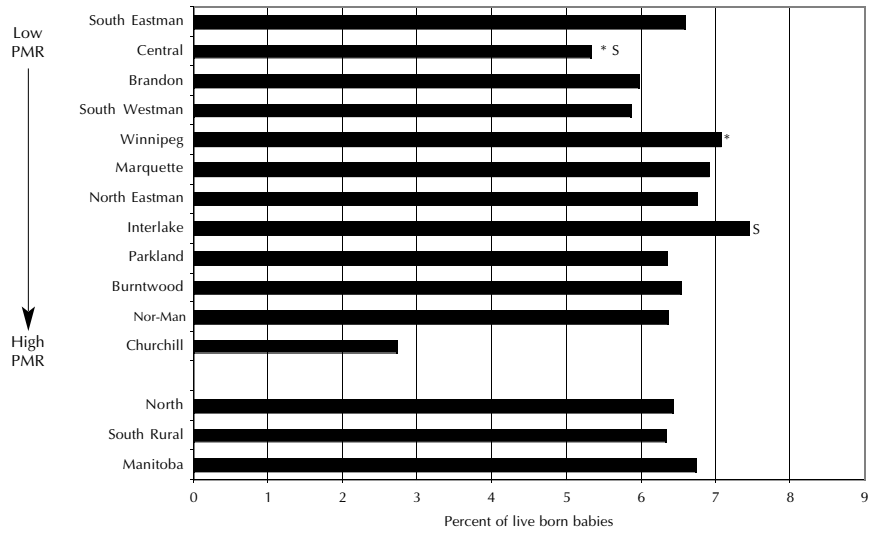
Breastfeeding is considered a key indicator of child health, due to the protection which breastfeeding affords in a dose-response relationship against such infant illnesses as gastrointestinal and respiratory infections[8-14] even in smoking households,[15] and the potential benefits of breastfeeding on cognitive development[16-21] and on cost savings within the health care system.[22]

The National Population Health Survey (NPHS) and the National Longitudinal Survey of Children and Youth (NLSCY) reported a Canadian breastfeeding initiation rate of 73% in 1996. The percentage of breastfed newborns who were breastfed longer than six months was 31% according to NPHS, and 23% according to NLSCY, slightly higher than reported USA six-month rates of 21.6%.[23-25] Reasons for the discrepancy between the two Canadian surveys are discussed further in the Methods section.

METHODS

This is a cross-sectional study of infants less than one year old, residing in the province of Manitoba and born during the calendar years from January 1, 1994 through to December 31, 1998. Two data sources were used – a hospital discharge file available through the Manitoba Population Health Research Data Repository of the Manitoba Centre for Health Policy, and the 1996 National Longitudinal Survey of Children and Youth (NLSCY) to determine breastfeeding duration rates. Preterm babies were defined as having a gestational age less than 37 weeks, low birthweight was defined as a birthweight less than 2500 g, and high birthweight greater than 4000 g. Breastfeeding initiation rates were approximated using the hospital discharge abstracts, where feeding type of newborns is recorded upon discharge as either "breast," "both breast or artificial," or "artificial." Grouping together "breast" and "both breast or artificial" to produce a summation percent of "any breastfeeding" is the most valid, since it has been noted anecdotally that different institutions use different amounts of supplement as the cut-off for coding "both" versus "only breastfed." The percentage of missing feeding type data was 1.95% provincially, but much higher in a few rural RHAs with the largest at 15% for Interlake RHA. All indicators were analyzed by 12 geographical areas of Manitoba called "Regional Health Authorities" (RHAs), by 12 subregions of Winnipeg called "Winnipeg Community Areas" (Winnipeg CAs), and by income quintile (urban and rural). Refer to Brownell et al. for more information about the methodology.[26]

The health status of a region's population is measured by the premature mortality rate (PMR) of the region, which is also correlated with a measure of socioeconomic well-being of the region, called the Socioeconomic Factor Index or SEFI. Each health indicator graph by region is ordered by PMR, from the regions with the lowest PMR at the top (that is, regions having populations with the best overall health status and socioeconomic well-being) to the regions with the highest PMR at the bottom (that is, regions having the poorest health status and socioeconomic well-being). Regional newborn health indicator rates were correlated with the regional PMR and SEFI, using Spearman rank correlations due to non-normal data (see Martens et al. for further explanation of PMR and SEFI[27]).



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
S - Rate significantly different from mean for Rural South Manitoba at p<0.05

Figure 1. Preterm birth rates (less than 37 weeks) by RHA, 1994-98

For the breastfeeding duration data, information was derived from the 1996 NLSCY. The NLSCY was administered by Statistics Canada, using a multi-stage, cluster design to choose respondents. Analyses were done on master files containing anonymous information for individual respondents. Weighting variables were available to yield weighted estimates approximating the population rates, but since specialized bootstrapping programs were not available for NLSCY, valid statistical testing which adjusts for design effect was not possible. Therefore, confidence intervals may be somewhat underestimated in our analyses. NLSCY also excluded "on reserve" First Nations women from the survey, so breastfeeding rates for many of the northern RHAs may not reflect the entire region's population.

The NLSCY survey asked women whose infants were less than 2 years of age about the type of feedings and duration of any breastfeeding. In the published analyses of the survey, any infant who was still breastfeeding at the time of the survey was excluded from the calculation of breastfeeding duration.[23] This could create a bias to underestimating breastfeeding duration rates. This study calculated breastfeeding duration rates using statistical techniques to allow incorporation of data for babies still breastfeeding at the time of the survey, called "censored data" (that is, data where one knows information up to a certain point but not beyond). Kaplan Meier Survival curves, and Cox's Proportional Hazards regression modelling, incorporate censored data.

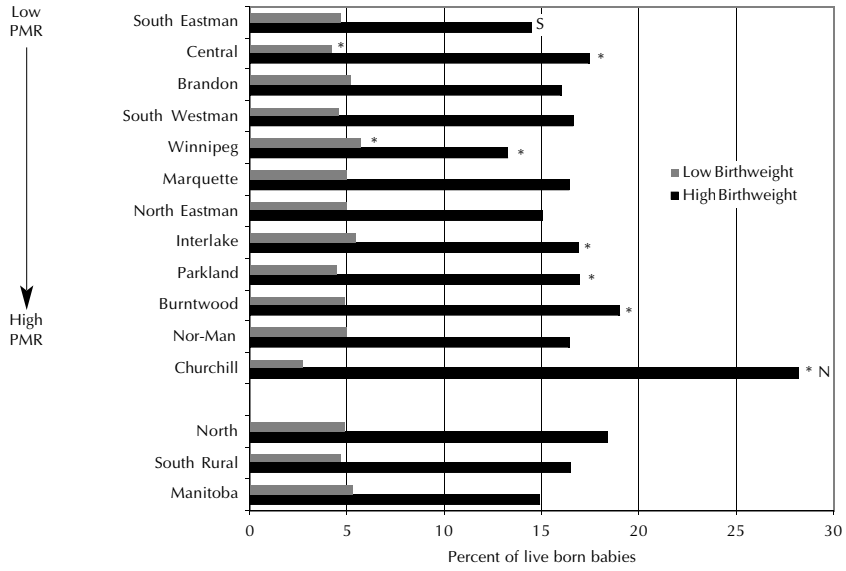
RESULTS

Preterm birth

For the years 1994-1998 in Manitoba, the overall preterm birth rate (less than 37 weeks gestation) was 6.72%, or 67.2/1000 live births. Figure 1 shows preterm birth rates by RHAs. For preterm rates within the Winnipeg CAs, refer to the complete report available at www.umanitoba.ca/centres/mchp. Babies born to Winnipeg residents were more likely to be preterm, at 7.06% of all live births. The Downtown area of Winnipeg, the area of poorest population health status and highest socioeconomic risk, had the highest preterm birth rate in the province at 7.96%.

"At risk" birth rates: Low and high birthweight babies

The 1994-1998 Manitoba rate of "at risk" birthweights was 20.2%, with 5.3% low birthweight and 14.9% high birthweight. Figure 2 compares the percent of "at risk" births by RHA (the complete report available at www.umanitoba.ca/centres/mchp gives Winnipeg CA rates). For low birthweight in 1994-1998, both North (4.9%) and South Rural (4.8%) areas had lower rates than Manitoba at 5.3%, with Winnipeg RHA having a significantly high-



Statistical Significance:
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N - Rate significantly different from mean for Northern Manitoba at p<0.05
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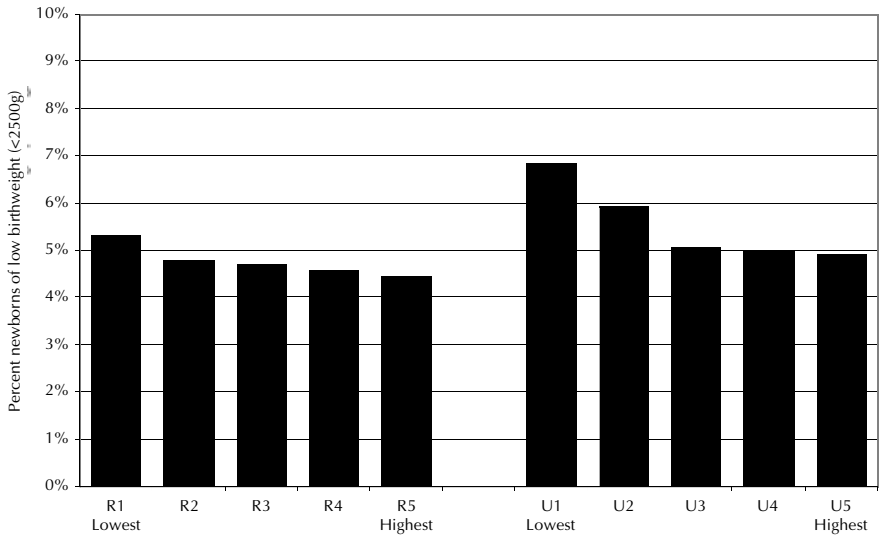
Figure 2. "At Risk" (high/low) birthweight by RHA, 1994-98



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban (p<0.05), using two-tailed Cochran-Armitage trend test.

Figure 3. Low birthweight by rural and urban income quintile, 1994-98

er rate at 5.7%. Within Winnipeg, the area with the poorest population health status overall (Downtown) had the highest low birthweight rate in the province at 7.2%.

Low birthweight rates decreased as neighbourhood income increased (p<0.05), both in the rural and urban regions of Manitoba (see Figure 3). Women in the lowest income group were 19% more likely (5.3% versus 4.4%) to have a low birthweight baby in rural Manitoba, and 39% more likely (6.9% versus 4.9%) in urban Manitoba. The relative risk, as well as the absolute risk, was not as great in the rural areas of Manitoba, where women even in the lowest income group had low birthweight rates equivalent to the provincial average (5.3%).

High birthweight (greater than 4000 g) also shows geographical variation. Figure 2 illustrates the fact that both the North (18.4%) and South Rural (16.4%) regions had greater high birthweight rates than Manitoba (14.9%), and that Winnipeg had the lowest rate at 13.3%. All Winnipeg CAs had rates similar to or lower than the provincial average.

In rural Manitoba, the trend of high birthweight by income quintile was significant (p<0.001) and consistent with those of low birth rates, with the women in the lowest income group 19% more likely (18.9% versus 15.9%) to have a high birthweight baby compared to the highest income quintile (see Figure 4). However, the trend was opposite in the urban areas (p<0.001), with the greatest high birthweight rates in the highest income group (14.8% versus 12.1%).

Breastfeeding initiation rates

For the years 1994 through 1998, the Manitoba breastfeeding initiation rate was 78.4%, with the North substantially lower at 64.5%, South Rural slightly higher at 79.4%, and Winnipeg higher at 80.6% (see Figure 5). Outside of Winnipeg, South Eastman's initiation rate of 87.2% was the highest, followed by Churchill RHA at 87.0%. Data from a longitudinal study on breastfeeding in South Eastman verifies this. A 1997 prospective survey found a 91% initiation rate for the South Eastman RHA (Roberts J. South Eastman Breastfeeding Survey, 1997. Unpublished). For all the birth records in the five-year period (n=75,662), 1.9% were missing feeding information on the hospital discharge record. Breastfeeding rates are based upon only those records with complete feeding information (n=74,191). Four regions were missing information on a substantial number of newborn records: Interlake (15.0% missing); North Eastman (6.5% missing); Marquette (12.5% missing); and South Westman (7.7% missing).

Within Winnipeg, there were marked differences in breastfeeding initiation rates, with lower rates in areas of poor health status and high socioeconomic risk (the complete report available at www.umanitoba.ca/centres/mchp gives Winnipeg CA rates). The Winnipeg CA of Fort Garry had the highest initiation rate in the province, at 90%.

There was a significant trend (p<0.001) in breastfeeding initiation by income quintile (see Figure 6). In both urban and rural areas, women in the highest income quintile were 30% more likely to breastfeed than women in the lowest income quintile – 90% versus 69% urban; 83% versus 61% rural.

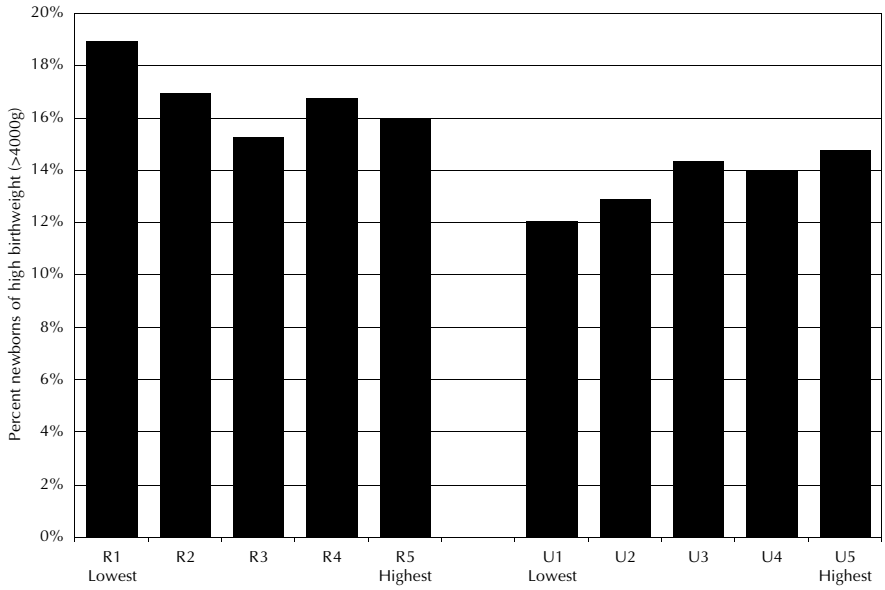
Breastfeeding duration rates

Figure 7 shows the percent of Manitoba infants being breastfed at various postpartum time points (n=199). The bottom (x) axis indicates the age of the infant, and the side (y) axis shows the percentage of children breastfeeding at that age: 85% (±5%) of all Manitoba infants initiated breastfeeding, 57% (±7%) of all Manitoba infants were being breastfed at 3 months postpartum in 1996, 36% (±7%) at 6 months and 15% (±6%) at 12 months postpartum. Comparison data from South Eastman RHA's prospective study in 1997 (Roberts J. South Eastman Breastfeeding Survey, 1997. Unpublished) indicate concurrence, with a reported 31% breastfeeding rate at 6 months.

Of those infants who initiated breastfeeding, about 67% (±4%) were still breastfeeding at 3 months, 42% (±4%) at 6 months, and 18% (±4%) at 12 months. These figures are higher than those reported for 1994/95 by NPHS (Prairie region: 34% at 6 months) and NLSCY (Prairie region: 29% at 6 months), most likely due to bias from the exclusion by these surveys of children still breastfeeding at the time of the survey. When the NLSCY data were run for the province of Manitoba excluding children who were still breastfeeding at the time of the survey, the calculated rates were similar to those previously reported, with only 55% breastfeeding at 3 months, 26% at 6 months, and 4% at 12 months. This demonstrates the possible underestimation bias of the reported NLSCY data, where duration rates of infants up to one year old could be potentially underestimated by 12 to 16%. It could also explain the lower degree of bias in the NPHS data, since NPHS included children up to five years old and hence there would be a lesser degree of exclusion bias when children still breastfeeding were not used in the calculation of duration rates.

Correlations of perinatal indicators with the healthiness and socioeconomic well-being of populations within a region

The three indicators of newborn health were correlated with PMR and SEFI. The results are shown in Table I. Provincially, those RHAs having less healthy populations and greater socioeconomic risk tended to have lower breastfeeding initiation rates. However, there were no consistent trends with preterm/low birthweight rates and PMR or SEFI in non-Winnipeg RHAs. Within Winnipeg, community areas having the highest PMR and SEFI also had the highest rates of preterm births, low birthweights, and the lowest breastfeeding initiation rates.



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban (p<0.001), using two-tailed Cochran-Armitage trend test.

Figure 4. High birthweight by rural and urban income quintile, 1994-98

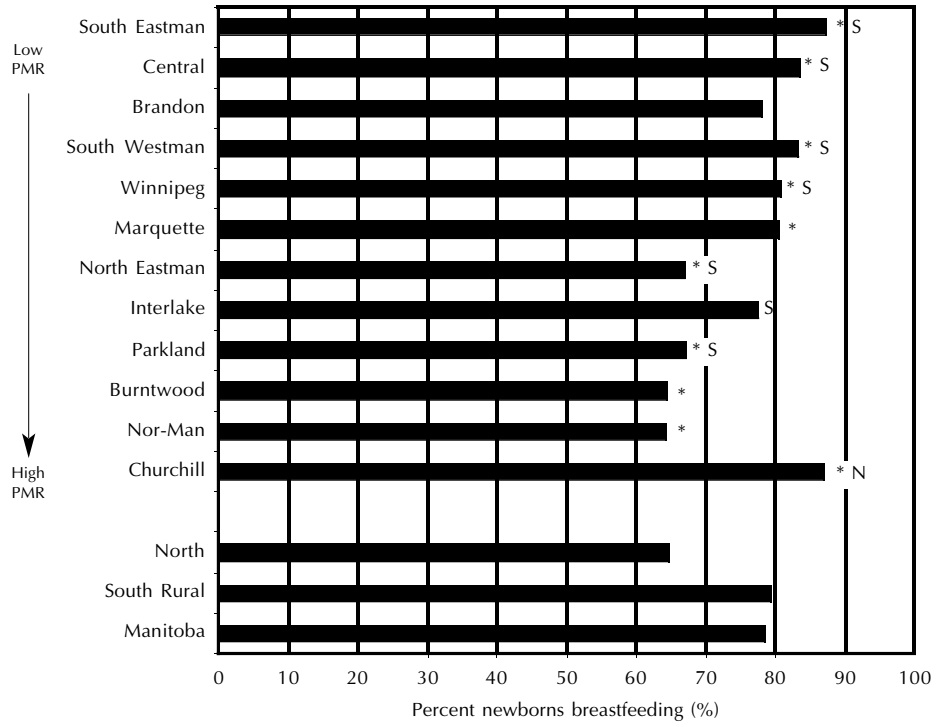


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Figure 5. Breastfeeding initiation rates by RHA, 1994-98

DISCUSSION

About 20% of Manitoba births are at risk for low and high birthweight, with 5.3% low

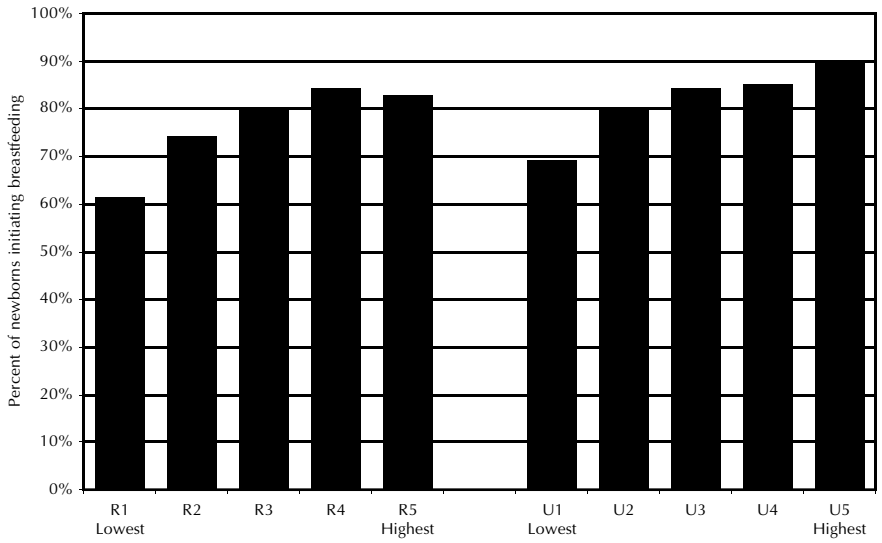

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Figure 6. Breastfeeding initiation rates by rural and urban income quintile, 1994-98

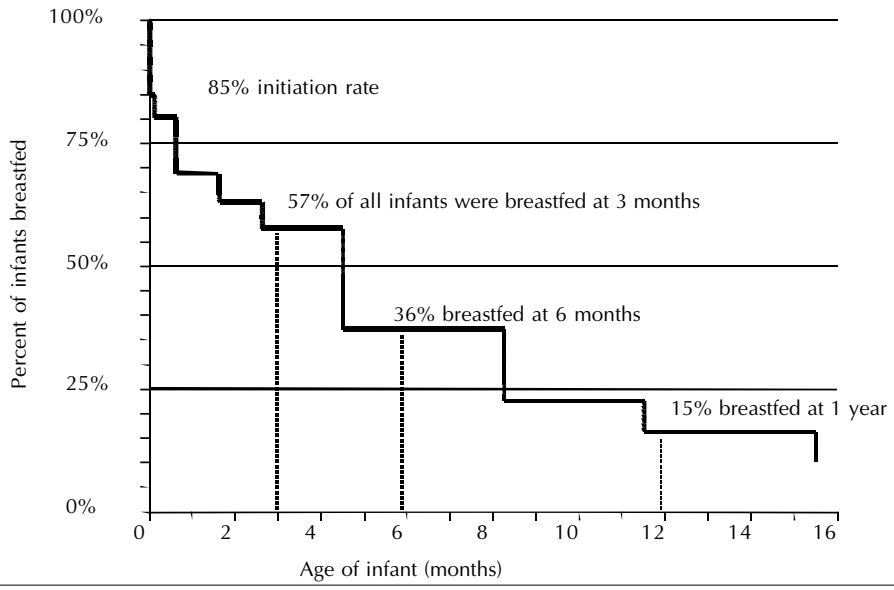

Figure 7. Percent of all Manitoba infants being breastfed at various time points postpartum NLSCY 1996†

† Of those infants who began to breastfeed, 67% were still breastfeeding at 3 months, 42% at 6 months, and 18% at 1 year

birthweight and 14.9% high birthweight. The Downtown area of Winnipeg, a community area with very poor overall health status, had one of the highest rates of low birthweight (7.2%) and of preterm birth (8.0%) in the province. Looking at income gradients, women in the lowest income quintile were at the greatest risk of giving birth to a low birthweight infant (20% more likely in rural, and 40% in urban areas), compared with women in the highest income quintile.

Preterm births and low birthweights may be associated with maternal stress due to socioeconomic risk, and lifestyle issues such as smoking during pregnancy. The literature suggests that prevention programs could include treatment for maternal hypertension, promotion of smoking cessation, surveillance for infection, and promotion of adequate nutrition.[6] Downtown Winnipeg has elevated rates of low-income families as well as lone parent families (see the child health report, Chapter 10, at www.umanitoba.ca/ centres/mchp), and one third of the women of this area reported smoking during pregnancy. According to the Manitoba Perinatal Health Surveillance Report,[28] the preterm birth rate for the province was 7.6%, but among women who smoked, it was 9.5% during 1997 to 1998. Similarly, the low birthweight rate was 5.2% provincially, but 6.9% for women who smoked during pregnancy. RHA decision-makers may need to look upon lifestyle programs (such as smoking cessation and nutrition counselling) as critical to the health and health care costs of newborns as well as adults.

Manitoba high birthweight rates are high at almost 15% of births, with rates especially high in rural and northern areas. As well, women in the lowest rural income quintile were at the highest risk of having a high birthweight baby. By area, Winnipeg had the lowest rate (13.3%) of high birthweight babies in the province, whereas the North region (18.4%) and the South Rural (16.4%) areas have elevated rates. This could partially be due to the widespread problem of Type II diabetes and gestational diabetes in the First Nations women of the province, who make up a substantial proportion of the population giving birth in the North, and who may also be over-represented in the low-income grouping. High birthweight underscores the need for prevention, including maternal nutritional programs and diabetes care during pregnancy.[6]

Breastfeeding initiation rates varied widely by geography, and are strongly associated with the health and socioeconomic well-being of the population. Women in regions having the least healthy population with the greatest socioeconomic risk, as well as women in the lowest income groups, are the least likely to initiate breastfeeding both in urban and rural areas. Given that child illness rates, especially respiratory infection, are elevated in low income groups,[29] and that breastfeeding is protective against respiratory infection, provincial health care providers and decision-makers need to support regional programs to promote breastfeeding, especially to high-risk groups. According to the World Health Organization, recommendations for breastfeeding include exclusive breastfeeding for the first six months of life, followed by breastfeeding up to two years old and beyond.[30] In this report, only 42% (± 4%) of babies who initiated breastfeeding were

breastfed for at least 6 months, and the rates of exclusive breastfeeding would most likely be much less than this. The necessity for providing individual breastfeeding support to women, and societal support through government policies, is underscored by the duration rates falling short of international recommendations.

Significant factors affecting the health of children born in Manitoba could be addressed through systematic programs both during pregnancy and during the postpartum period, including support for nutritional counselling, promotion of breastfeeding, smoking cessation programs, and social policy decisions designed to overcome the health disparities within low-income groups, and within populations with poorer overall health status.

TABLE I

Association of Child Indicators with Population Health Indicators

Health Indicator*	Correlation Coefficient of Indicator with Premature Mortality Rate (PMR)	Correlation Coefficient of Indicator with the Socioeconomic Factor Index (SEFI)
Preterm birth rate (n=23)	0.09	0.25
RHAs (non-Winnipeg)	-0.05	-0.06
Winnipeg CAs	0.41	0.67†
Low birthweight (n=22)	-0.07	0.10
RHAs (non-Winnipeg)	-0.07	-0.05
Winnipeg CAs	0.67†	0.75†
High birthweight (n=22)	-0.27	-0.18
RHAs (non-Winnipeg)	0.56‖	0.59‖
Winnipeg CAs	-0.49	-0.58†
Breastfeeding initiation rate (n=23)	-0.79§	-0.69‡
RHAs (non-Winnipeg)	-0.49	-0.44
Winnipeg CAs	-0.94§	-0.87‡

* Each of the 11 non-Winnipeg Regional Health Authority regions (RHAs) and the 12 Winnipeg Community Areas (Winnipeg CAs) was included in the Spearman's correlations with PMR and SEFI. In some regions the rate was suppressed due to small numbers. The level of significance of the correlation coefficient is indicated by the following: † $p<0.05$; ‡ $p<0.002$; § $p<0.0001$; ‖ $p<0.10$, not statistically significant at the $p<0.05$ cirterion but possibly showing a trend.

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RÉSUMÉ

Objectif : Le Centre d'élaboration et d'évaluation de la politique des soins de santé du Manitoba a été mandaté par le ministère manitobain de la Santé pour étudier l'état de santé des nouveau-nés nés entre 1994 et 1998 selon trois indicateurs : les naissances avant terme (<37 semaines de gestation), le poids à la naissance et l'alimentation du nourrisson.

Méthode : Les données ont été dérivées du Population Health Research Data Repository et de l'Enquête longitudinale nationale sur les enfants et les jeunes (1996). On a examiné les écarts entre 12 ORS et 12 CR de Winnipeg, ainsi que leurs liens avec l'état de santé et le bien-être socio-économique de la population.

Résultats : Le taux de naissance avant terme au Manitoba était de 6,7 % des naissances vivantes et variait de 5,3 % à 7,4 % selon l'ORS et de 5,7 % à 8,0 % selon le CR de Winnipeg. Le taux manitobain d'insuffisance de poids à la naissance (<2 500 g) était de 5,3 % et variait de 2,7 % à 5,7 % selon l'ORS et de 4,4 % à 7,2 % selon le CR. Plus le revenu était faible, plus la probabilité d'une insuffisance de poids à la naissance était forte ($p<0,05$). Le taux d'allaitement maternel au Manitoba était de 78 % et variait de 64 % à 87 % selon l'ORS et de 66 % à 90 % selon le CR. Plus le revenu et l'état de santé de la population étaient faibles, plus le taux d'allaitement l'était aussi ($p<0,001$). Parmi les femmes ayant allaité, 42 % l'avaient fait pendant au moins six mois.

Conclusion : On pourrait agir sur les facteurs qui influent sur la santé des enfants manitobains par le biais de programmes systématiques durant la grossesse et la période post-partum, notamment en appuyant le counselling nutritionnel, la promotion de l'allaitement, le renoncement au tabac et les politiques sociales visant à combler les écarts au sein des groupes à faible revenu et des populations dont l'état de santé est relativement mauvais.

Factors Affecting Adolescent Reproductive Health in Manitoba

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ABSTRACT

Objectives: To report teen pregnancy and sexually transmitted infections (STI) rates among Manitoba adolescents, and associated factors including rates of sexual intercourse and contraceptive use.

Methods: Teen pregnancy rates in females aged 15 to 19 for the fiscal years 1994/95 through 1998/99 were derived from the Population Health Research Data Repository and reported by geographical areas and income quintiles. Premature mortality rate (PMR) and the Socioeconomic Factor Index (SEFI) measured the overall health and socioeconomic well-being of regional populations. Data on sexual activity and contraceptive use were derived from the 1996 National Population Health Survey for males and females ages 15 through 19 years.

Results: The teen pregnancy rate for Manitoba was 63.2/1000, varying by geography and inversely correlated with income, PMR, and SEFI. 39% (95% CI 33-45) of teens reported sexual intercourse, with higher rates in urban areas (46%, 95 % CI 35-57) and the North (48%, 95% CI 36-60) compared to South Rural (30%, 95% CI 25-34), and in low-income families (68%, 95% CI 53-83) compared with middle/high (33%, 95% CI 26-40). For sexually active females, 42% (95% CI 28-57) used the birth control pill, with higher rates in low-income families (70%, 95% CI 50-90) compared to middle/high income (31%, 95% CI 14-48). Condom use (at last sexual intercourse) was reported by 82% (95% CI 72-92) of adolescents, with trends (though not statistically significant) to lower use in low-income families and the North.

Conclusion: Reliance on the pill for contraception, combined with low rates of condom use, are public health concerns for adolescents where STI and unintended pregnancy rates are high.

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

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Canada has a universal health insurance program in each of its provinces and territories, with the administration of health programs under the jurisdiction of the provincial or territorial health ministry. The Manitoba Centre for Health Policy (MCHP), University of Manitoba, was contracted by the provincial health ministry, Manitoba Health, to produce a report on the health of Manitoba children aged 0 to 19 years.

The objective of this paper is to examine adolescent reproductive health risk factors for unintended pregnancy and sexually transmitted infection (STI) by geographic area, household income, and the health and socioeconomic well-being of the population wherein the teen resides. The specific indicators included: teen pregnancy rates, age at first intercourse, and contraceptive use by adolescents. Adolescent STI rates are derived from reports of the provincial Public Health Branch.

The Canadian teen pregnancy rate for females aged 15-19 years was 40.2/1000 in 1994,[1] whereas the USA rate was substantially higher at 98.7 per 1000 in 1996.[2,3] Most teen pregnancies are "unintended" and pose physical, social and psychological risks to mother and baby.[4] Adolescents who give birth face many challenges, including maintaining their social life, continuing their education, and securing employment. Teen mothers are at increased risk of raising children in single-parent households, which can in turn increase the risk of those children living in poorer socioeconomic conditions.[5] Teen pregnancy at age 17 years or less has been associated with increased risk of preterm, low birthweight, and large-for-gestational age infants, even after controlling for major confounding factors.[6,7]

The prevalence of use and the contraception method chosen have effects on both the unintended pregnancy rate and the STI rate.[8-10] Manitoba chlamydia rates are available from the Public Health Branch's Communicable Disease Control Unit, with 1996 rates shown in Figure 1.[11] For females ages 15-19 years, rates varied from a low of 7.0 per 1000 to a high of 99.3 per 1000, for a provincial rate of 23.2 per 1000. Similar patterns – albeit substantially lower – are evident for males aged 15-19 years, with an overall rate of 4.75 per 1000. The Manitoba chlamydia rate in 1997 for females aged 15-24, at

20.0/1000, was the highest in any province in Canada, and over double the comparable Canadian rate of 9.4/1000.[12]

METHODS

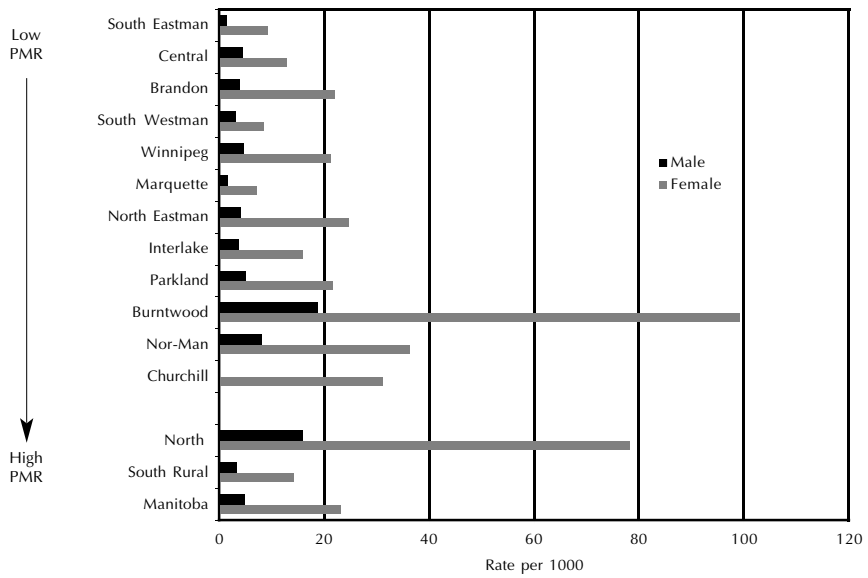
Data for this research were obtained from two sources: provincial health care administrative data, and the 1996 National Population Health Survey (NPHS). See Brownell et al., this issue for more information on data sources.[13]

Teen pregnancy rate was defined as the number of pregnancies in females aged 15-19 years inclusive during the fiscal years 1994/95 through 1998/99, including live births, stillbirths, abortions, and ectopic pregnancies, divided by the total female population aged 15-19 years at the mid-period (December 31, 1997), and expressed per thousand. For geographical rates, Manitoba is divided into 12 health jurisdictions called "Regional Health Authorities" (RHAs). Within Winnipeg, Manitoba's capital and its largest RHA, data are also presented by 12 sub-regions called "Winnipeg Community Areas" (Winnipeg CAs). Comparisons of each RHA and Winnipeg CA were made to the following rates: provincial, Winnipeg, North (defined as the RHAs of Burntwood, Nor-Man, and Churchill) and South Rural (7 southern RHAs excluding Winnipeg and Brandon). For the teen pregnancy rates, income quintile groupings divided the urban (Winnipeg and Brandon RHAs) or rural (all other RHAs) population into five groupings, assigning each person the value of the average neighbourhood income based on 1996 census information.

The teen pregnancy rate was correlated with the premature mortality rate (PMR) and the Socioeconomic Factor Index (SEFI) by region. These measures reflect the population's overall global health and the need for health care (see Martens et al., this issue, for a further discussion of these measures).[14] PMR, an age/sex-adjusted rate of death before the age of 75 years, is considered a global indicator of health status of a regional population. SEFI is derived from census-based information on regional demographics, employment and educational attainment, and as such is an indicator of socioeconomic well-being.

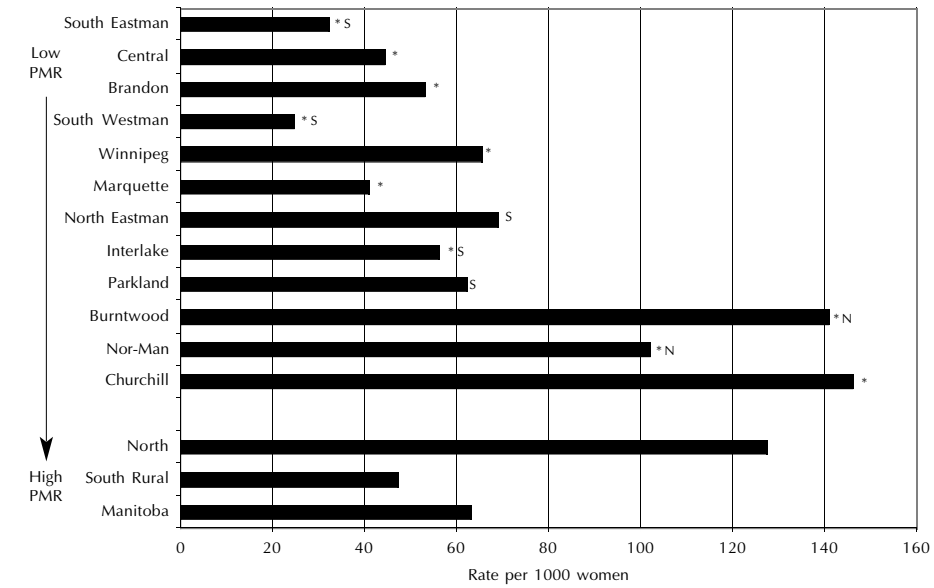
All figures showing RHAs and Winnipeg CAs are ordered by 5-year PMR for the years 1994/95 to 1998/99. The region with the lowest PMR (the region with the healthiest population) is on top of the y-axis, and the region with the highest (the least healthy population) is on the bottom. This construction embeds each indicator within a framework of the healthiness of the region's population, thereby giving a pictorial sense of whether one is associated with the other.

NPHS is administered by Statistics Canada, using a multi-stage, cluster design. One limitation that may affect results, especially in northern Manitoba, is the exclusion of people living in First Nations' communities. For NPHS data, household income was dichotomized to "low income" (less than $20,000 annual income per household), and "middle/high income" (at least $20,000).



(Source: Notifiable Diseases Manitoba: CDC Unit Annual review calendar year 1996, Manitoba Health Public Health Branch)

Figure 1. Chlamydia crude rates for males and females aged 15-19 years by RHA, 1996



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
N - Rate significantly different from mean for Northern Manitoba at p<0.05
S - Rate significantly different from mean for Rural South Manitoba at p<0.05

Figure 2. Teen pregnancy rates (females aged 15-19 years) by RHA, 1994/95-1998/99

TABLE I

Association of Teen Pregnancy Rates with Population Health/Socioeconomic Indicators

Health Indicator‡	Correlation of Indicator with Overall Population Health (Premature Mortality Rate, or PMR)	Correlation of Indicator with Regional Socioeconomic Well-being (Socioeconomic Factor Index, or SEFI)
Regional teen pregnancy rates (all non-Winnipeg RHAs and Winnipeg CAs n=23)	0.85***	0.92***
RHAs (non-Winnipeg n =11)	0.86**	0.96***
Winnipeg CAs (n=12)	0.94***	0.87**

‡ Each of the 11 non-Winnipeg Regional Health Authority regions (RHAs) and the 12 Winnipeg Community Areas (Winnipeg CAs) was included in the Spearman's correlations with PMR and SEFI. In some regions, there was suppression of the rate due to small numbers. The level of significance of the correlation coefficient is indicated by the following: *p<0.05; **p<0.001; ***p<0.0001; † p<0.10 (not statistically significant but showing a trend)

In Manitoba, it is very difficult to obtain accurate information on contraceptive use, since many clinics and health centres distribute condoms and birth control pills free to adolescents. Consequently, there is no record of a pharmaceutical purchase in the administrative databases. The NPHS 1996 survey does request this information from respondents aged 15-19 years, although the condom use question was only asked of those who had one or more sexual partners within the past 12 months, with at least one relationship lasting less than 12 months. The condom use question was, "For these relationships that lasted less than a year, did you use a condom the last time?" The birth control pill use question was, "In the past month, that is, from 1 month ago to yesterday, did you take birth control pills?" We analyzed this two ways – first, as a prevalence of all females aged 15-19 years old, and then as a prevalence of females 15-19 years old who *also* reported having sexual intercourse within the past 12 months.

RESULTS

Teen pregnancy rates and adolescent sexual activity

Teen pregnancy rates by RHA for 1994/95-1998/99 are shown in Figure 2 (see the child health report on the MCHP website, at www.umanitoba.ca/centres/mchp/ for Winnipeg CA rates). The Manitoba rate for 1994/95-1998/99 was 63.2/1000 females aged 15-19 years. RHA teen pregnancy rates varied from a low of 25/1000 (South Westman) to a high of over 140/1000 in two northern RHAs of Churchill and Burntwood. Provincial rates over the five years were relatively stable and showed slight decline, at 64.3, 64.2, 64.7, 60.1, and 62.7 per thousand for the years 1994/95 to 1998/99 respectively.

Teen pregnancy rates were highly and inversely correlated with the healthiness and socioeconomic well-being of a region's population (see Table I), as well as with income (see Figure 3). Comparing the lowest to the highest quintile (Q1 to Q5), rates were 2.8 times higher in rural areas, and 5.7 times higher in urban areas. But the actual pregnancy rate in the lowest *rural* income group (111/1000) was less than the corresponding lowest income group in *urban* areas (145/1000).

Table II shows data derived from NPHS in the year 1996, for adolescents 15-19 years old (n=1049). The proportion reporting "ever having sexual intercourse" was 39% (95% CI 32.9-45.4). Although not shown, those reporting sexual intercourse within the past year was similar, at 36% (95% CI 29.7-42.1). Groups *more* likely to report having sexual intercourse within the past year include: females; adolescents living in a low income family; and adolescents living in the North or Urban Manitoba (in contrast to the South Rural area).

Of Manitoba teens aged 17-19 years, almost one quarter (22.5%, 95% CI 10.4-34.7) who had experienced sexual intercourse were 14 years old or less at the time of their first experience, and an additional half reported the age at first intercourse as 15 to 16 years old (47.8%, 95% CI 35.8-59.8). There was a trend to urban adolescents reporting a three-fold rate of sexual intercourse at age 14 years or less, but this was not statistically significant: Urban 30% (95% CI 11-49); South Rural 10% (95% CI 4-16); North 12% (95% CI 1-24).

Contraceptive use by Manitoba adolescents

Table II includes data on contraceptive use reported by adolescents aged 15-19 years who were surveyed in the 1996 NPHS. Overall, 82% (95% CI 72-92) of Manitoba's sexually active adolescents aged 15-19 years used a condom at last sexual intercourse. Because of the very small sample size for the condom use question (n=187), none of the comparisons are statistically significant. However, there does appear to be a trend to low condom use in the North, and in low-income groups.

Of Manitoba females aged 15-19 years, 20.6% (95% CI 13.5-27.7) reported taking birth control pills. The vast majority of birth control pill use was related to contraception. Of those females who were not sexually active (n=252), only 1.8% reported using birth control pills, compared to 42.4% (95% CI 27.7 to 57.1) of those who reported having sexual intercourse within the past 12 months (n=205). Females in low-income groups were more likely to use birth control pills than those in middle/high-income groups.

DISCUSSION

Manitoba public health policy and programs must address two concerns of adolescent sexual behaviour – unintended adolescent pregnancy and STI transmission – in conjunction, not as separate issues. The Manitoba teen pregnancy rate 1994/95-1998/99 was 63.2 per 1000 females aged 15-19 years, with at least double these rates in the lowest urban income quintile group. The Manitoba rate was 50% higher than the Canadian rate (40.2/1000) and higher than comparable prairie provinces of western Canada, albeit much less than the USA rate (98.7/1000). Moreover, Manitoba chlamydia rates for adolescents are the highest provincial rates in Canada. But the context of both high pregnancy and STI rates for teens includes co-related factors such as adolescent sexual activity, contraceptive use, and choice of contraceptive method.

In the context of adolescent sexual activity, 39% (95% CI 33-45) of Manitoba adolescents aged 15-19 years reported having experienced sexual intercourse – 46% of the females (95% CI 37-55) and 33% of the males (95% CI 25-42). This is at the

TABLE II

Sexual Activity and Contraceptive Use for Manitoba Adolescents Aged 15-19 Years (NPHS 1996)

	Gender		Family Structure		Geographical Area			Family Income		Manitoba
	Male	Female	Dual Parent	Single Parent	Urban	South Rural	North	Low (<$20,000)	Middle/High ($20,000+)	Average
Have had sexual intercourse ever? % yes (n=1049)	33.4* (24.9-41.9)	46.2 (37.1-55.3)	34.6 (26.9-42.2)	45.7 (31.1-60.3)	45.6 (34.8-56.5)	29.7* (25.3-34.0)	48.0 (36.4-59.7)	67.7* (52.7-82.6)	32.9 (25.7-40.0)	39.2 (32.9-45.4)
Condom used last time person had sexual intercourse† (n=187)	79.2 (64.9-93.6)	84.7 (74.8-94.6)	76.9 (53.1-100)	86.2 (76.3-96.1)	85.9 (73.8-98.0)	72.6 (60.0-85.2)	63.3 (32.7-93.9)	58.9 (29.5-88.4)	81.5 (70.4-92.6)	82 (72-92)
Birth control pill use: All females aged 15-19 years (n=457)			16.3 (8.1-24.5)	22.7 (8.9-36.5)	21.6 (8.9-34.2)	18.7 (13.4-24.1)	36.2 (18.9-53.5)	39.7* (19.3-60.0)	14.7 (7.6-21.8)	20.6 (13.5-27.7)
Birth control pill use: Only females ages 15-19 years reporting sexual intercourse in past 12 months (n=205)			36.3 (16.7-55.9)	45.4 (17.8-73.0)	35.7 (15.0-56.5)	56.4 (43.7-69.2)	61.1 (39.0-83.1)	70.1* (50.0-90.2)	31.3 (14.4-48.1)	42.4 (27.7-57.1)

* Significantly different at the p<0.05 level within the corresponding category of gender, family structure, geography, or income

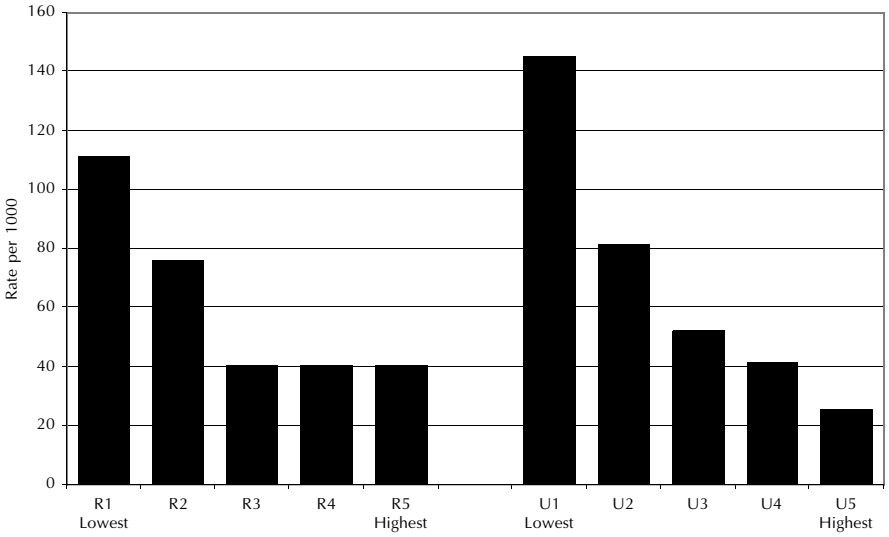
† Note: condom use question (use of condom during the last sexual intercourse) was restricted to those who had one or more partners, at least one relationship lasting less than 12 months. A smaller sample was available for the income question (n=147), resulting in values not necessarily reflecting the overall average.

middle to high end of the range compared to a nine-nation World Health Organization (WHO) survey, at 10% to 38% of girls, and 23% to 42% of boys.[15] Manitoba rates were higher for adolescents living in the North or urban areas, or in low-income families. Urban and North adolescents also reported younger ages at first sexual intercourse with a correspondingly high teen pregnancy rate, when compared to South Rural adolescents. This information underscores the necessity for public health planners to look at sexual education as an important part of the health curriculum in the pre-teen stage.

In the context of contraceptive choices, 1 out of 5 females aged 15-19 years reported being on the birth control pill (21%, 95% CI 14-28), with greatest use in low-income groups. Of those females reporting sexual intercourse, almost half (42%, 95% CI 28-57) used the birth control pill, with rates highest once again in low-income groups. Condom use was reported much more frequently by females (85%, 95% CI 75-95) and males (79%, 95% CI 65-94) at the last episode of sexual intercourse. There was also a trend to higher condom use in urban areas and middle/high-income groups. Manitoba rates of condom use for adolescents appear to be at the higher end of the range in the nine-nation WHO study, at 63% to 87% for boys, and 55% to 86% for girls.[15]

The prevalence and type of contraceptive use affects both unintended pregnancy and STI rates.[8-10] According to the other research findings, of females relying on condoms, 2% became pregnant if condoms were used consistently, and 12% if inconsistently. Percentages of women with cervical gonorrhoea were 0% for consistent use, and 55% for inconsistent use. For females relying on combined oral hormonal contraception, 0.1% became pregnant with consistent use, and 3% with inconsistent use. However, 90% of the women were infected with cervical gonorrhoea, in both the consistent and inconsistent pill use groups. The Canadian General Social Survey[16] in 1995 found those *least* likely to use contraception were the young (less than 25 years olds), the least educated, and the unemployed. High school students' reasons for not using contraceptives are often related to unanticipated situations and to perceptions of low risk – "didn't expect to have sex"; and "just didn't think pregnancy would occur." Other reasons relate to lack of knowledge, fear of contraceptives and fear of parental disapproval.[17] The use of oral contraceptives to avoid unintended pregnancy may also be problematic due to the potential for improper adherence to instructions, as well as lack of simultaneous use of condoms to prevent STI transmission.[18-22]

In Manitoba, a high regional rate of sexual intercourse combined with a high



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban (p<0.0001), using two-tailed Cochran-Armitage trend test.

Figure 3. Teen pregnancy rates (females aged 15-19 years) by rural and urban income quintile, 1994/95-1998/99

regional rate of birth control pill use and low rate of condom use is associated with the dual problem of high regional rates of unintended pregnancies and STIs. This is particularly apparent in the North, and in low-income groups – adolescents show trends towards the highest prevalence of adolescent sexual intercourse, the lowest condom use rate, and the highest birth control pill prevalence. This relationship is underscored by the high correlation between teen pregnancy rates and regions having populations with poor health status and high socioeconomic risk (see Table I).

It is essential that STI and unplanned pregnancy prevention be intertwined, since modification of unsafe sexual practices reduces the risks of both. Public health decisions must be made with the knowledge that there is a potential for power imbalance between genders – in some cultures, many females have very little control over conditions of intercourse resulting in either STIs or in unplanned pregnancy, yet the burden of adverse outcomes falls differentially upon females. Our finding that high birth control pill use and low condom use are associated with high teen pregnancy rates and high chlamydia rates indicates that consistent contraception counselling will need to be a component of any successful campaign to reduce the rate of STIs and unplanned pregnancies. Qualitative research into the barriers to condom use, beliefs about birth control pill use, and systemic barriers to accessing sexual health information for adolescents is a priority in order to understand potential strategies for social marketing approaches and systemic public health approaches. Only by looking at the culture of adolescent sexuality will we be able to establish appropriate and effective programs to address the dual problems of STIs and unintended adolescent pregnancies.

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RÉSUMÉ

Objectifs : Déterminer les taux de grossesse et d'infections transmises sexuellement (ITS) chez les adolescents manitobains, ainsi que les facteurs associés, comme les taux de rapports sexuels et d'utilisation des contraceptifs.

Méthode : Les taux de grossesse chez les adolescentes de 15 à 19 ans de 1994-1995 à 1998-1999, dérivés du Population Health Research Data Repository, sont présentés selon la zone géographique et le quintile de revenu. Le TMP et l'indice SEFI ont servi à mesurer l'état de santé global et le bien-être socio-économique des populations régionales. Les données sur l'activité sexuelle et l'utilisation des contraceptifs sont dérivées des chiffres sur les adolescents de 15 à 19 ans dans l'Enquête nationale sur la santé de la population (1996).

Résultats : Le taux de grossesse chez les adolescentes, au Manitoba, était de 63,2 %, avec quelques écarts géographiques, et était réciproquement corrélé avec le revenu, le TMP et le SEFI. Trente-neuf p. cent (IC de 95 % = 33-45) des adolescents déclaraient avoir eu des rapports sexuels; ce taux était plus élevé dans les agglomérations urbaines (46 %, IC de 95 % = 35-57) et dans le Nord (48 %, IC de 95 % = 36-60) que dans le Sud rural (30 %, IC de 95 % = 25-34), et plus élevé dans les familles à faible revenu (68 %, IC de 95 % = 53-83) que dans celles à revenu moyen ou élevé (33 %, IC de 95 % = 26-40). Chez les adolescentes sexuellement actives, 42 % (IC de 95 % = 28-57) prenaient la pilule anticonceptionnelle; ce taux était plus élevé dans les familles à faible revenu (70 %, IC de 95 % = 50-90) que dans celles à revenu moyen ou élevé (31 %, IC de 95 % = 14-48). L'utilisation du condom (lors du dernier rapport sexuel) était déclaré par 82 % des adolescents (IC de 95 % = 72-92); on a observé des taux inférieurs (sans être statistiquement significatifs) dans les familles à faible revenu et dans le Nord.

Conclusion : La confiance en la pilule pour la contraception, combinée aux faibles taux d'utilisation du condom, posent des problèmes de santé publique chez les populations adolescentes où les ITS et les taux de grossesse non désirée sont élevés.

Assessing Health Status in Manitoba Children

Acute and Chronic Conditions

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ABSTRACT

Background: Numerous child health status measures have been developed, ranging from assessments of physical and mental health to activity continuums. Our objective was to report the regional distribution of physical morbidity among children in Manitoba.

Methods: Using Manitoba's population-based prescription and health care data for 1998/99, the prevalence of children with lower respiratory tract infections, four chronic conditions (asthma, cardiovascular disease, Type 1 diabetes mellitus and seizure disorders) and physical disabilities, including spina bifida and cerebral palsy, was determined for 12 Regional Health Authorities and 12 Winnipeg Community Areas, ranked by a measure of population healthiness, the premature mortality rate (PMR). Prescription rates were also reported by neighbourhood income quintile, derived from census data.

Results: Hospitalization for lower respiratory tract infection was highest in infants (6%) and increased with successive decreases in neighbourhood income or in the population healthiness of a region. On the basis of a physician diagnosis or prescription drug for asthma, 10% of school-age children had asthma. Asthma treatment rates in northern Manitoba were substantially lower than in Winnipeg. Treatment rates for cardiovascular conditions, Type I diabetes and seizure disorders approached 1% in adolescents and there were no regional differences in the distribution of these conditions. The prevalence of physical disability was highest in northern Manitoba.

Conclusion: A minority of Manitoba children suffer from chronic and serious acute health problems in childhood, but the burden of illness is not evenly distributed among children.

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

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The 1989 Convention on the Rights of the Child proposes a broad definition of health which describes a child's right to adequate circumstances for physical, mental, spiritual, moral and social development.[1] Numerous child health status measures have been developed over the years, ranging from simple scales assessing physical and mental health to activity continuums which assess the impact of illness on normal social role performance. What measures of child health should be used? The premature mortality rate has been accepted as a population health measure, but childhood mortality is an uncommon event, limiting its usefulness as a measure of health status.[2] Morbidity is more common in childhood, and includes physical, developmental, psychological, emotional and behaviour problems.

Physical conditions such as chronic illness and disability impose a considerable morbidity burden for children, in terms of interference with sleep, play and school, and dependency on medications or technology.[3,4] Almost 30% of children with asthma, cardiovascular conditions or diabetes are limited in their usual activities; the prevalence of activity limitation doubles in children with seizure disorders.[3,5] Over 80% of children with asthma, diabetes or seizure disorders take medications, and miss on average one week of school per year. Up to 90% of children with physical disabilities are limited in their usual activities. Recurrence of acute conditions such as lower respiratory tract infections also interferes with quality of life. This paper describes the regional distribution of the following physical conditions among Manitoba's children: 1) lower respiratory tract infections, 2) four chronic conditions (asthma, cardiovascular disease, Type 1 diabetes mellitus and seizure disorders), and 3) physical disabilities, including spina bifida, cerebral palsy and other paralytic conditions.

METHODS

Study design

This was a cross-sectional study of treatment prevalence of acute and chronic conditions in Manitoba children in 1998/99, reported by geographic area and neighbourhood income. The geographic areas used are 12 regions of Manitoba, called Regional Health Authorities (RHAs), and 12 sub-

TABLE I

Comparison of Treatment Prevalence Rates from Health Care Data (1996/97) and Disease Prevalence Rates from NPHS (1996) Survey

Condition	Age (yr)	Drug/Diagnosis Definition*	95% CI	NPHS 1996	95% CI
Asthma	5-9	11.00	10.70-11.30	12.40	7.90-16.99 M
	10-14	9.00	8.80-9.30	10.40	6.14-14.58 M
	15-19	7.70	7.50-8.00	12.70	8.13-17.25 M
Cardiovascular†	5-9	0.45	0.40-0.52	0.84	0.34-1.35 M
	10-14	0.58	0.52-0.66	0.64	-0.04-1.32 U
	15-19	1.11	1.02-1.21	0.54	0.13-0.95 U
Cardiovascular	5-9	0.27	0.23-0.32	0.84	0.34-1.35 M
Excluding Stroke†	10-14	0.42	0.37-0.49	0.64	-0.04-1.32 U
	15-19	0.89	0.81-0.98	0.54	0.13-0.95 U
Diabetes (Type I)	5-9	0.11	0.08-0.14		
	10-14	0.22	0.18-0.27		
	15-19	0.37	0.31-0.43		
Seizures	5-9	0.36	0.31-0.42	0.14	-0.07-0.35 U
	10-14	0.44	0.39-0.51	0.89	-0.16-1.93 U
	15-19	0.62	0.56-0.70	2.29	-0.38-4.96 U

* diagnosis data from physician claims/hospital separations and drug data from prescription database
† change in drug/diagnosis definition, but survey question remains the same
M = marginal estimates due to high sampling variability, U = unacceptable estimates due to high sampling variability

regions of Winnipeg, Manitoba's largest city, called Winnipeg Community Areas (Winnipeg CAs). RHAs and Winnipeg CAs were ranked by the premature mortality rate (PMR), the best single measure to represent the healthiness of a population, and its need for health care services.[6,7]

Study population and data sources

Administrative data were obtained on children aged 0 to 19 from the Population Health Research Data Repository (PHRDR) at the University of Manitoba. These data are anonymized, encounter-based records of Manitobans' interactions with the health care system. Four databases were used: 1) registration files, 2) records of physician reimbursement, 3) records of hospitalizations, and 4) records of prescriptions dispensed in retail pharmacies.

The registration file contains a record for every individual eligible to receive insured health services, and includes the individual's birth date, gender and geographic location. Records of physician reimbursement for medical care provided are submitted under a fee-for-service arrangement, and contain information on one patient diagnosis at the 3-digit level of the ICD-9-CM classification system and physician specialty. Discharge abstracts for hospital services include information on up to 16 ICD-9-CM diagnostic codes, of which the first diagnosis is the primary diagnosis responsible for the hospital stay. Prescription records are submitted by retail pharmacies for reimbursement by provincial drug insurance plans and for drug utilization review purposes. These records contain the drug's name, identification number, dosage form, and quantity dispensed, as well as the date the drug was dispensed.

The reliability and validity of the PHRDR databases have been found to be high for describing population drug use and health care utilization for specific conditions.[8,9] However, physician contact and prescription use in northern Manitoba nursing stations is incompletely recorded in the health care databases. Further, care must be taken when making inferences about disease prevalence from health care utilization data. Health care contact is less frequent among children living in rural versus urban areas.[10] Further, children are more likely to use prescription medications for chronic conditions than to visit a physician on an annual basis.[11] Our measure of chronic conditions also included prescription drug use to minimize bias subsequent to less frequent physician contact.

The face validity of defining chronic conditions according to diagnosis or prescription data was determined by comparing the rate of children defined on this basis, with the prevalence of children with the condition in the 1996 Manitoba sample of the National Population Health Survey (NPHS), recognizing the limitations of survey estimates of disease due to small sample size and wording of questions (i.e., ever had asthma versus current asthma). As parents may not view vascular diseases as "heart conditions," two categories of cardiovascular conditions were compared with survey data: all conditions and cardiovascular conditions excluding cerebrovascular (e.g., stroke) and vascular disorders. No comparisons with the survey data were made for the Type I diabetes case definition which had been validated previously by comparison to the Diabetes Education Resource Database.[12] To assess whether regional differences in chronic conditions could be real, we compared regional variation in overall health care contact and receipt of prescription drugs with regional variation in condition-specific treatment prevalence rates.

Study measures and analyses

The 1998/99 prevalence rate of children receiving health care was determined for: 1) lower respiratory tract infections, 2) four chronic conditions (asthma, cardiovascular disease, Type 1 diabetes mellitus and seizure disorders), and 3) physical disabilities, including spina bifida, cerebral palsy and other paralytic conditions. Hospitalization for lower respiratory tract infection included a hospitalization for pneumonia, bronchiolitis and bronchitis, and in children less than 5 years old, it also included hospitalization for asthma.[13] The treatment prevalence of asthma, cardiovascular conditions and seizure disorders was defined on the basis of at least one physician visit or hospitalization for these conditions or the receipt of at least one prescription drug to treat the condition. Children with a physical disability were identified on the basis of a physician visit or hospitalization for spina bifida, cerebral palsy or paralytic conditions from birth to 1998/99.[14]

The denominator was the population of children residing in Manitoba as of December 31, 1998. Age-specific and age-adjusted treatment prevalence rates were determined for each RHA and Winnipeg CA, and urban and rural neighbourhood income quintiles. Rates were suppressed where cell counts were less than 5. Children were placed into neighbourhood income quintiles, RHAs, and Winnipeg CAs, according to the postal code of their place of residence. Rural and urban neighbourhood income quintiles were created from Statistics Canada Census 1996 by aggregating household income data to the census enumeration area and ranking neighbourhood income quintiles from 20% of the population residing in the low-

est income neighbourhoods to 20% of the population residing in the highest income neighbourhoods.[15-17]

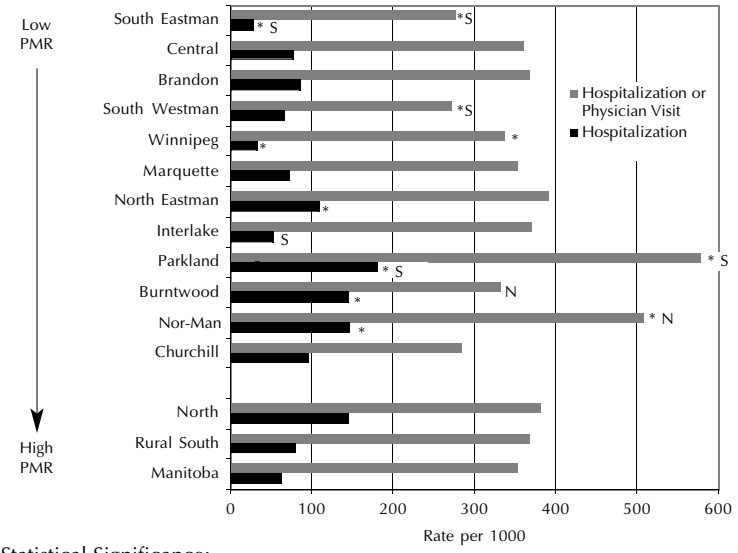
Using t-test methodology developed by Carriere and Roos,[18] treatment prevalence rates for individual RHAs and Winnipeg CAs were compared, at the 99% level of confidence, to the total Manitoba child population, Winnipeg, Non-Winnipeg (all children residing outside of Winnipeg), rural south (children residing in rural regions below the 53rd parallel) and north (children residing in regions above the 53rd parallel). Visual inspections of the regional rates, ranked according to PMR (lowest to highest), were performed to provide insight into the relationship with the healthiness of the population within a region (PMR). To further assess the association with PMR, treatment prevalence rates for regions were correlated with region PMR, using Spearman's rank correlation. Trends in prevalence rates across income quintiles were assessed with the Cochran-Armitage test for trend at the 95% level of confidence.

RESULTS

Validation of chronic conditions

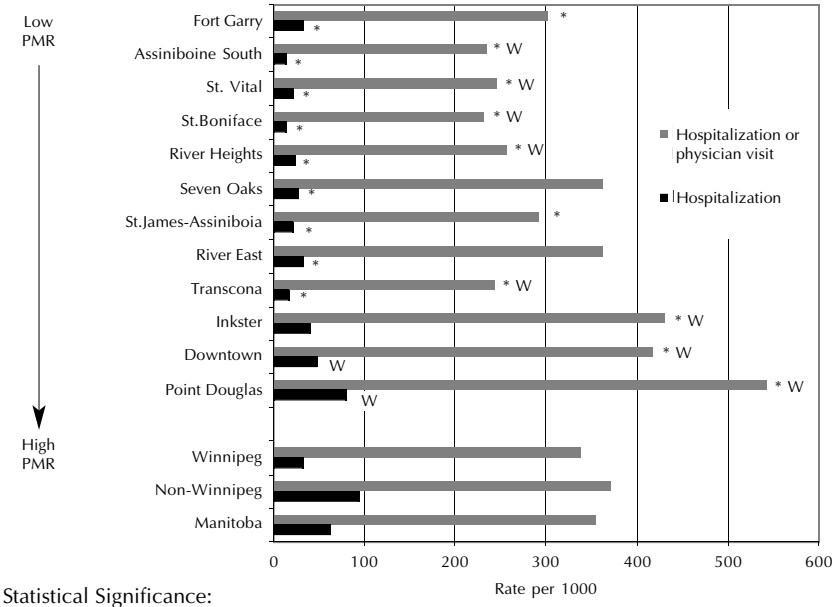
Age-specific asthma treatment rates fell within the 95% confidence intervals for asthma prevalence reported in the NPHS for children less than 15 years of age, indicating similarity in prevalence (Table I). The NPHS documented a higher prevalence of adolescents with asthma than that derived from health care administrative data, suggesting under-representation by health care administrative data or survey over-reporting of asthma which was no longer current.[19] The treatment rates of the other conditions were similar to survey rates, but because of their low prevalence, survey rates were unreliable.

Fewer children in Northern Manitoba had health care use or received prescription drugs than children living in Winnipeg. The ratio of the prevalence of any health care for Winnipeg children (86.3%) versus northern Manitoba children (67.6%) was 1.1. The ratio of the treatment prevalence for cardiovascular conditions between these regions was similar (Winnipeg/North ratio=1.3). However, the Winnipeg-to-North treatment prevalence ratio for asthma was 2.7.



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
N - Rate significantly different from mean for Northern Manitoba at p<0.05
S - Rate significantly different from mean for Rural South Manitoba at p<0.05

Figure 1. Rate of children aged < 1 year with at least one health care contact for lower respiratory tract infection by RHA, 1998/99



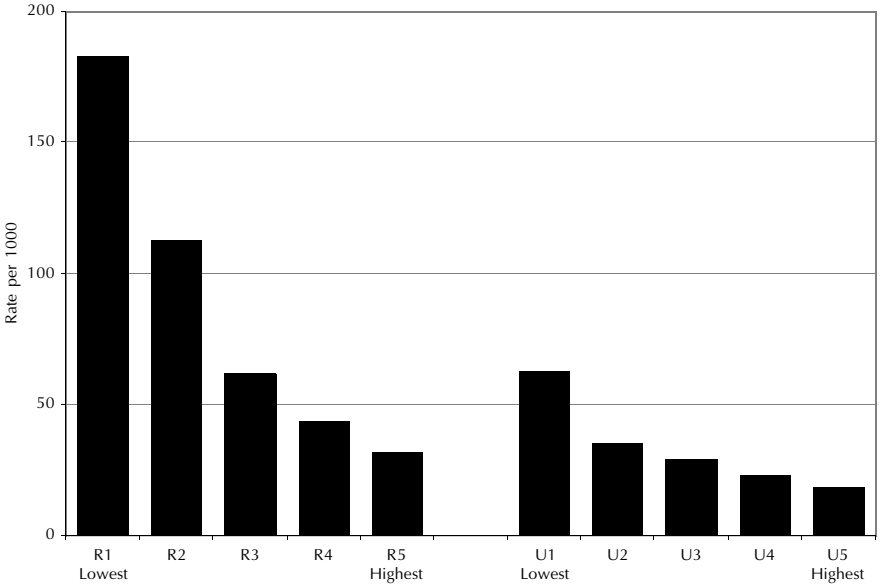
Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
W - Rate significantly different from Winnipeg mean at p<0.05

Figure 2. Rate of children aged < 1 year with at least one health care contact for lower respiratory tract infection by Winnipeg CA, 1998/99

Treatment prevalence rates

Eighty percent of Manitoba children saw a physician or were hospitalized in 1998/99 and 59% received at least one prescription drug. Defining health care contact on the basis of use of physician services, hospitalization or the receipt of a prescription drug, 83% of children received health care treatment.

1) Lower respiratory tract infection. In 1998/99, less than 1% of all children were hospitalized for a lower respiratory tract infection (LRI). The prevalence rate of hospitalization for LRI was highest in children less than one year of age (6% of infants), but declined dramatically by the age of five. The prevalence rate of LRI hospitalization in infants was highly correlated with the PMR (the healthiness) of the RHA populations (Spearman rank correlation =0.66, p<0.02). The rate in the Nor-



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban (p<0.0001), using two-tailed Cochran-Armitage trend test.

Figure 3. Rate of children aged < 1 year with at least one hospitalization for lower respiratory tract infection by rural and urban income quintile

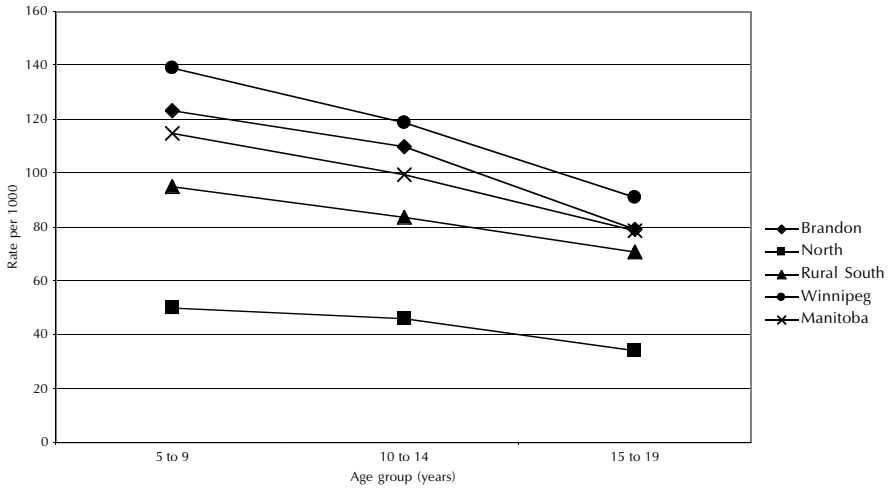


Figure 4. Rate of children with at least one health care contact or prescription drug for asthma by age and Manitoba region, 1998/99

Man, Burntwood and Parkland RHAs was significantly higher than the southern rural and the provincial average (Figure 1). Hospitalization for LRI was also highly correlated with the healthiness of populations in the Winnipeg CAs (Spearman rank correlation=0.61, p<0.04) (Figure 2). Infants living in the Point Douglas area were significantly more likely to be hospitalized for LRI than all Winnipeg infants combined (Figure 2). Of note, the prevalence rate of LRI hospitalization in the northern RHAs (150 per 1,000 infants) was 10-fold greater than the rate for infants living in the Winnipeg communities with the healthiest populations.

Hospitalization for LRI represents only the "tip of the iceberg" for all LRI morbidity as shown when physician contacts for LRI are combined with hospitalization rates (Figure 1). However, under-reporting of physician contacts in nursing stations makes this a less useful measure for comparisons across RHAs. Furthermore, there may be variation in LRI hospitalization by income neighbourhoods within RHAs and Winnipeg CAs. We observed increases in LRI hospitalization with decreasing neighbourhood income (Figure 3); this gradient effect was substantially steeper in rural areas (Cochran-Armitage trend test, p<0.0001).

2) Asthma. Ten percent of Manitoba's school-age children (5-19 years old) had either a physician diagnosis of asthma or a prescription for an asthma drug in 1998/99. The asthma treatment prevalence declined with age, from 11.5% in children 5-9 years to 8% in adolescents.

Asthma treatment rates were highest in Winnipeg (and Brandon in younger children), followed by southern rural areas, and then by the North (Figure 4). Among southern rural RHAs, the asthma treatment prevalence rate was significantly higher in the Interlake region than the southern rural average. Within Winnipeg, most asthma treatment rates did not differ by Winnipeg CA from the Winnipeg average, but a significantly higher rate was observed in the St. James-Assiniboine area for children 10 years of age and older.

3) Other chronic conditions. As documented for 1996/97 (Table I), the treatment prevalence for other chronic conditions in 1998/99 increased with age and was low in children less than 15 years old. On the basis of a physician visit, hospitalization or prescription drug, 1.2% of children, aged 15-19 years, had a cardiovascular condition, 0.7% had a seizure disorder, and 0.3% had Type I diabetes mellitus. In this age group, no statistically significant differences for the treatment prevalence of cardiovascular conditions, seizure disorders and type I diabetes were observed among RHAs or Winnipeg CAs. Age comparisons of the treatment prevalence for cardiovascular conditions (most frequent diagnosis was hypertension) by neighbourhood income documented the beginnings of a graded association with income (Figure 5). Higher cardiovascular condition rates were observed with decreases in neighbourhood income in urban areas among older children [Cochran-Armitage trend test for 5-9 year olds (NS), for 10-14 year olds (p<0.05), for 15-19 year olds (p<0.10)].

4) Physical disability (spina bifida, cerebral palsy and other paralytic conditions). In 1998/99, less than 1% of children were found to have spina bifida, cerebral palsy or paralytic conditions, determined on the

basis of their health care utilization records from birth. Figure 6 shows age-standardized disability rates by Winnipeg, Brandon, and northern and southern Manitoba. Winnipeg and northern regions were more likely to have children with these disabilities, but the only statistically significant difference was between northern versus southern rural rates of cerebral palsy/paralytic conditions.

DISCUSSION

Over 80% of Manitoba children received health care in 1998/99. However, health care for the acute and chronic conditions selected for study was not common. Hospitalization of children for respiratory conditions has declined over the past two decades;[20] less than 1% of all Manitoba children were hospitalized for LRI. However, LRI hospitalization rates were highest in infants and are a significant cause of mortality in this age group.[21] Infants living in low-income regions or the least healthy regions in Manitoba, as indicated by the PMR, were much more likely to be hospitalized for LRI. Similarly, higher LRI hospitalization rates among young children have been reported in US geographic areas characterized by higher rates of poverty.[13] A variety of risk factors for LRI, such as household crowding, smoking and lower breastfeeding rates, have been associated with living in a low-income household.[22] Manitoba regions with the highest LRI hospitalization rates also had the highest rates of these risk factors.[23]

Asthma was the most common chronic condition in childhood. On the basis of physician diagnosis or prescription use for asthma, 10% of school-age children had asthma in 1998/99, similar to the prevalence reported by the recent Canadian Student Lung Health Survey.[11] Not all children with asthma symptoms continue to have asthma as they grow older.[19] In our study, the treatment prevalence for asthma declined with age, compatible with this "growing out of asthma" phenomenon. Much lower asthma treatment rates were observed in northern Manitoba. While this finding may be a function of missing data on physician visits and prescriptions dispensed in nursing stations, relative differences in asthma treatment prevalence between Winnipeg and northern Manitoba were in excess of differences for health care contact between the two regions. Further, an asthma treatment definition which included prescription drug use potentially diminished bias from urban-rural differences in physician contact.[10,11] Our observations of lower asthma treatment rates in northern and southern rural regions do have some biological plausibility. First, a lower prevalence of asthma has been reported in Aboriginal children living in rural Manitoba and Australia.[24,25] Second is the cleanliness hypothesis which has been proposed to explain geographical differences in asthma prevalence.[26] The hypothesis states that children exposed to "germs" at an earlier age are much less likely to get asthma. We observed that northern and southern regions were also more likely than Winnipeg to have infants with lower respiratory tract infections.

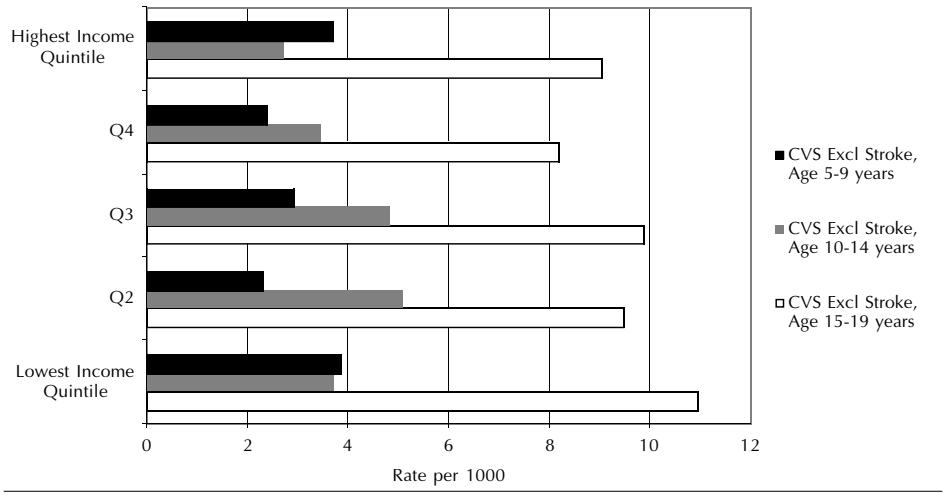


Figure 5. Rate of children with at least one health care contact or prescription drug for cardiovascular (CVS) conditions by age and urban income quintile, 1998/99

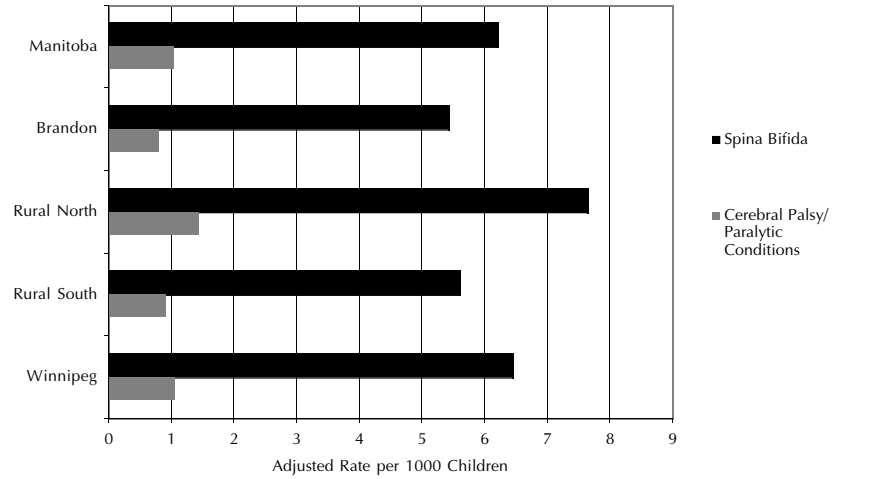


Figure 6. Rate of children aged 0-19 years with a major physical disability by Manitoba Region, 1998/99

Other chronic conditions in childhood were much less common than asthma, and their prevalence increased with age.[27] In our research, treatment rates for cardiovascular conditions, Type I diabetes and seizure disorders approached 1% in adolescents and there were no regional differences in the distribution of these conditions. We reported only on the prevalence of Type I diabetes in children, but there are regional differences in the prevalence of Type II diabetes, a disease which is reaching epidemic proportions in young Aboriginals.[28] Higher cardiovascular condition rates were observed with decreases in neighbourhood income in urban areas. This phenomenon has been documented by others, and has been attributed to the differential acquisition in children of risk factors, such as seden-

tary lifestyle and smoking, by household income.[29]

Physical disability can be the outcome of the prenatal period or of events later in childhood secondary to injury. The prevalence of physical disability was higher in the North, which we postulate is the outcome of higher rates of injury.[30] These disabilities cause a major interference with the activities of these children, significant consumption of health care services, and a high level of dependence on families for personal care.[31]

In summary, a minority of Manitoba children suffer from chronic and serious acute health problems in childhood, but the burden of illness is not evenly distributed among children. Acute conditions such as respiratory tract infections, and physical disability are more common in Northern Manitoba children, but asthma is more common in urban children. Our validity assessments suggest that these regional differences are real. However, we have presented data on physical health in Manitoba children, recognizing that physical health represents only one dimension of child health. Other dimensions, such as mental and emotional health, are equally as important and may be more pervasive in children.

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RÉSUMÉ

Contexte : Il existe de nombreuses mesures de l'état de santé des enfants; elles vont des évaluations de la santé physique et mentale aux continuums de l'activité physique. On présente ici la répartition régionale des troubles physiques chez les enfants manitobains.

Méthode : À l'aide des données représentatives du Manitoba sur la prescription de médicaments et les soins de santé (1998-1999), nous avons déterminé la prévalence des enfants présentant des infections des voies respiratoires inférieures, quatre états chroniques (asthme, maladie cardiovasculaire, diabète de type 1, troubles épileptiques) ou des déficiences physiques comme le spina-bifida et l'infirmité motrice cérébrale dans 12 ORS et 12 CR de Winnipeg, classés selon une mesure de l'état de santé de la population (le TMP). Les taux de prescription de médicaments sur ordonnance sont également présentés par quintile de revenu des quartiers (selon les données du recensement).

Résultats : Le plus haut taux d'hospitalisation pour infection des voies respiratoires inférieures a été mesuré chez les nourrissons (6 %) et augmentait avec les diminutions successives du revenu du quartier ou de l'état de santé de la population de la sous-région. D'après les diagnostics des médecins et les médicaments prescrits contre l'asthme, 10 % des enfants d'âge scolaire étaient asthmatiques. Les taux de traitement de l'asthme dans le Nord du Manitoba étaient sensiblement plus faibles qu'à Winnipeg. Les taux de traitement des maladies cardiovasculaires, du diabète de type 1 et des troubles épileptiques atteignaient près de 1 % chez les adolescents; on n'observe aucun écart régional dans la répartition de ces troubles. C'est dans le Nord du Manitoba que la prévalence des déficiences physiques était la plus élevée.

Conclusion : Une minorité d'enfants manitobains souffre de problèmes de santé chroniques et graves durant l'enfance, mais le fardeau de la maladie n'est pas équitablement réparti entre les enfants.

Childhood Injury Rates in Manitoba

Socioeconomic Influences

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David Friesen, BSc[2]
Teresa Mayer[3]

ABSTRACT

Background: Injury is the leading cause of death among Canadian children between 1 and 19 years, and accounts for one sixth of all hospitalizations of children between 0 and 19 years. We examined the causes of injury in Manitoba children, and the relationship between injury rates and region of residence, premature mortality rate (PMR), and income.

Methods: Regional differences in injury death and hospitalization rates, and causes of injury were derived from the Population Health Research Data Repository. The relationship between injury rates and area income levels was assessed and correlations between regional premature mortality rates (PMR) and injury rates were calculated.

Results: Motor vehicle crashes were the leading cause of injury mortality. Falls were the leading cause of injury hospitalization. Regional differences were substantial. Rural-urban differences in injury rates were pronounced; northern Manitoba's rates were very high compared to the rest of the province. Regional PMR values correlated significantly with injury mortality and hospitalization rates. Both types of injury rates correlated significantly with income; higher injury rates were associated with lower income levels.

Conclusion: Injuries are not random events, but are related to social factors.

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

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Injuries are the leading cause of death among Canadian children between the ages of 1 and 19. In 1995, over 30% of the deaths to Canadian children under 20 years were the result of injuries, compared to 5% for cancer and 1.8% for infectious diseases.[1] Injuries are also the leading cause of death in all developed nations, accounting for close to 40% of deaths among children between 1 and 14 years.[2] In Manitoba, injuries account for over half of all deaths to children between 1 and 9 years of age, and about three quarters of all deaths between 10 and 19 years of age (see Martens, this issue).[3] Most of these injury-related deaths are preventable: 59 of the 60 child and adolescent injury deaths in Manitoba in 1997 were deemed preventable by the standards committee of the College of Physicians and Surgeons charged with reviewing all child deaths in the province.[4]

Mortality represents only part of the story of injuries. Recent estimates suggest that for every injury-related death, there are 40 hospitalizations and an estimated 670 emergency room visits for treatment of injuries for Canadian children.[5] Injuries are responsible for about one sixth of all hospitalizations for Canadian children between 0 and 19 years.[1] Injuries exact a heavy price in health: every day Canadians are killed and disabled by injuries. Beyond the health burden, the economic burden of injuries is staggering; preventable injuries cost Canadians $8.7 billion in 1995, or $300 for every citizen in this country.[1]

Referring to injuries as "accidents" implies that these incidents are random and beyond our control. An examination of the geographic and socioeconomic patterns of childhood injuries demonstrates that they are not indiscriminate, but strongly influenced by such factors as age, sex, urban or rural residence, socioeconomic status, and the interaction between these factors. For instance, both injury mortality and hospitalization rates differ across income levels. One study reported that Canadian children living in the poorest urban neighbourhoods had a 39% higher death rate and a 25% higher hospitalization rate due to injuries compared to those from the wealthiest urban neighbourhoods.[6]

In this paper, we explore injury rates for Manitoba children. Injury rates are broken down by region of residence and income,

TABLE I

Injury Rates by Age and Sex, Manitoba Children 0-19 Years

Mortality per 100,000 (1994-1997)

	age <1	1-4	5-9	10-14	15-19	0-19
Males	21.65	20.23	10.84	22.78	69.25	30.36
Females	29.20	21.90	8.95	9.92	19.75	15.41
Overall	25.33	21.05	9.92	16.54	45.10	23.41

Hospitalization per 10,000 (1994/95-1998/99)

	age <1	1-4	5-9	10-14	15-19	0-19
Males	51.19	74.23	59.82	81.60	138.10	86.79
Females	50.68	52.30	35.85	59.45	103.47	62.16
Overall	50.94	63.51	48.11	70.85	121.22	72.88

in an attempt to explore the patterns of childhood injury. In addition, we look at the relationship between premature mortality rates (PMR) and injury rates, as well as the relationship between injury rates and the socioeconomic factor index (SEFI). PMR is considered an indicator of the healthiness of a population, with higher PMR generally associated with both poorer health and lower socioeconomic status. SEFI is an indicator of the socioeconomic conditions within regions, with higher SEFIs associated with socioeconomic conditions that are less favourable for population health (see Martens et al., this issue, for a more detailed discussion of PMR and SEFI).[7]

METHODS

Administrative data from the Population Health Research Data Repository were used to derive injury mortality and hospitalization rates for Manitoba children, aged 0 to 19 years. These data are anonymized, encounter-based records of Manitobans' interactions with the health care system. Injuries resulting from misadventures during surgical or medical care, and adverse drug reactions were excluded from analyses. Mortality rates were derived from Manitoba Vital Statistics data for calendar years 1994 to 1997, and hospitalization rates were derived from hospital separation abstract files for fiscal years 1994/95 to 1998/99 (see Brownell et al., this issue, for a more complete description of data sets).[8] Hospitalization rates were based on total separations rather than individuals. All rates were age- and sex-adjusted using the direct method of standardisation. For both mortality and hospitalization, injuries were broken down into 14 categories, based on the external cause of the injury. The ICD-9-CM codes and labels that fall into each of the 14 categories can be found in Table G.5 at http://www.umanitoba.ca/centres/mchp/reports/pdfs/childpdfs/child_glossary.pdf. Regional differences in the rates at which these 14 types of injury occur were examined. Regions were defined using Manitoba's 12 Regional Health Authorities (RHAs). Manitoba's largest city, Winnipeg (population approximately 650,000), which is itself an RHA, was divided into 12 subregions called Winnipeg Community Areas (Winnipeg CAs). Summary rates are given for: 1) the total Manitoba child population; 2) Winnipeg; 3) Non-Winnipeg (all children residing outside of Winnipeg); 4) Rural South (children residing in rural regions below the 53rd parallel); and 5) North (children residing in regions above the 53rd parallel). Comparisons of rates across regions used t-test methodology.[9] To adjust for multiple comparisons between each RHA or Winnipeg CA and an overall provincial or Winnipeg rate, 99% confidence intervals were used. Rates were suppressed where cell counts were less than 5. Because regions are ordered according to PMR (from lowest to highest) in each graph, visual inspection of the regional graphs provides insight into the relationship between the healthiness of the population within a region (PMR) and the injury variables. To further assess the association between injuries and PMR as well as the socioeconomic conditions in the region, injury mortality and hospitalization rates for the regions were correlated with the regions' PMRs and SEFIs, using Spearman's rank correlation.

To determine differences in income levels, rural and urban neighbourhoods were each divided into five different income levels referred to as quintiles, based on 1996 Census information available through Statistics Canada (see Brownell et al., this issue, for a complete description of the construction of income quintiles).[8] Cochran-Armitage trend tests were used to assess the significance of the relationships between injury variables and area income level.

RESULTS

Age and sex differences in injury rates

Injury mortality rates by age for Manitoba children form a j-shaped curve, with rates decreasing after the first year of life and then increasing again after age 14 years (Table I). The highest rate of injury deaths is found in the oldest (15-19 years) age category, with the second highest death rates in the youngest (less than 1 year) age category, and the lowest mortality rate for those in the 5-9 year old category.

The injury mortality rate for Manitoba males 0 to 19 years is almost twice as high as that for females. Due to the small number of deaths, and because it is contrary to national trends, the higher mortality rate for females in the first year of life shown in Table I is most likely due to random fluctuations that could differ should different years of data be examined. Sex differences are minimal between 1 and 9 years of age, and begin to reappear at 10 to 14 years of age, with males having higher injury mortality rates than females. The greatest sex differences occur at 15 to 19 years of age, with males having an injury mortality rate over three and a half times higher than females.

Hospitalization rates for Manitoba children increase slightly after the first year of life, then drop after the 1-4 year old category and increase after the 5-9 year old category, with the most dramatic increase in the 15-19 year old category (Table I). As was found with mortality rates, males have a higher rate of injury hospitalization than females, with the differences starting younger (at 1 to 4 years) than was seen with mortality rates, but being much less dramatic.

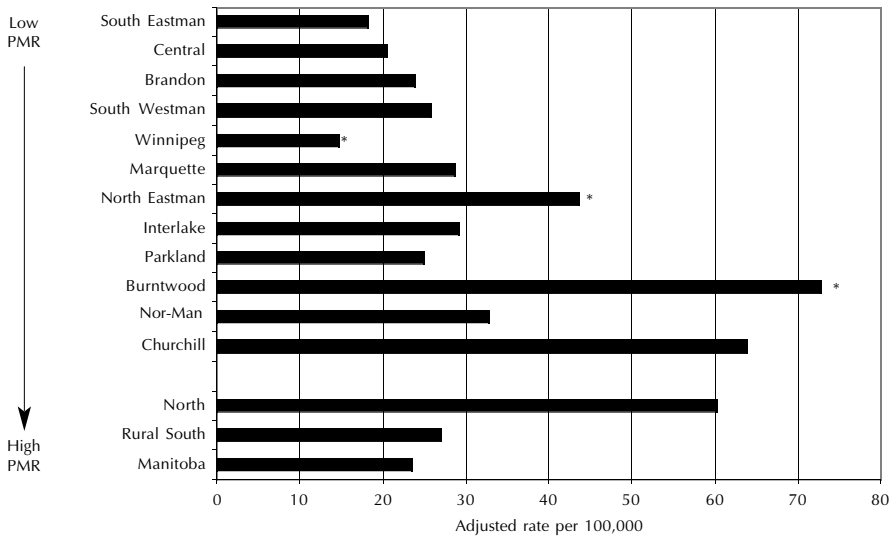
Regional differences in injury rates

Figure 1 shows the four-year injury *mortality* rates across RHAs, and Figure 2 shows these rates across Winnipeg CAs. There was a tendency for higher overall injury mortality rates in regions with higher PMRs (i.e., where the populations are

found to be generally less healthy), with a moderately high correlation between the two variables (r=0.68, p=0.0005). The correlation with SEFI was less pronounced but still significant (r=0.59, p=0.0039), suggesting that areas with less favourable socioeconomic conditions had higher injury mortality rates.

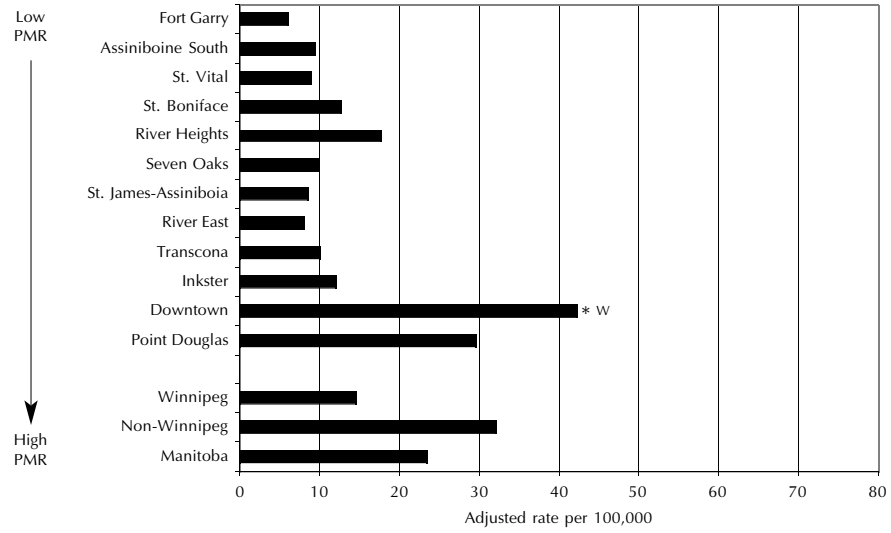
Children residing in the north, where the highest PMR values are found, had a significantly higher injury *mortality* rate than those residing in the rural south, who in turn had a significantly higher rate than those children residing in Winnipeg. There was an almost five-fold variation in injury mortality rates across the province, ranging from a low of 14.6/100,000 (Winnipeg) to a high of 72.7/100,000 (Burntwood) (Figure 1). Within Winnipeg the variation was seven-fold, ranging from 6.0/100,000 (Fort Garry) to 42.2/100,000 (Downtown) (Figure 2).

Figure 3 shows the five-year injury *hospitalization* rates by RHA, and Figure 4 shows these rates for the Winnipeg CAs. Regional variation is evident in both figures. As with mortality, there was a significant correlation between injury hospitalization rates and PMR, with higher injury rates in areas with less healthy populations (r=0.71, p=0.0001). Injury hospitalization rates also correlated with SEFI, with higher injury rates in areas with less favourable socioeconomic conditions (r=0.58, p=0.004). Both the north and rural south injury hospitalization rate totals were significantly higher than the Manitoba rate, which is driven largely by the substantially lower injury hospitalization rate for Winnipeg children.



Statistical Significance:
* Rate significantly different from Manitoba mean at p<0.05

Figure 1. Injury mortality rates for children aged 0-19 years by RHA, 1994-97



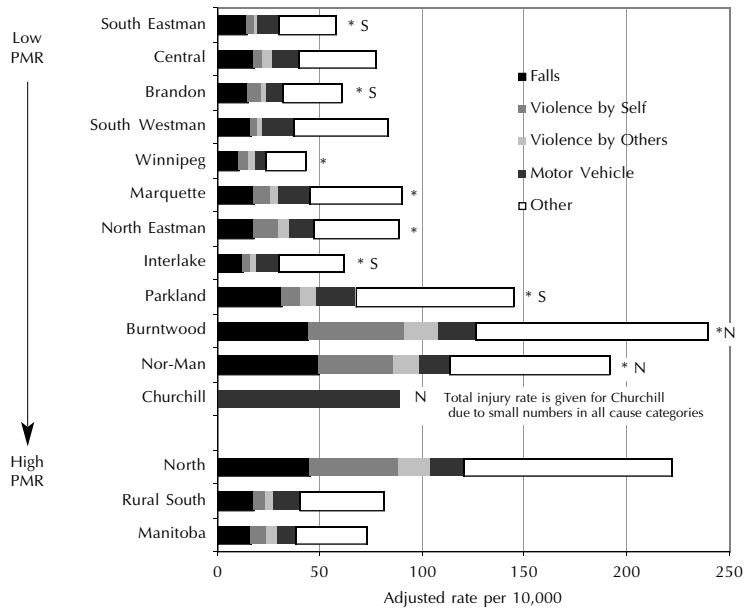
Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
W - Rate significantly different from Winnipeg mean at p<0.05

Figure 2. Injury mortality rates for children aged 0-19 years by Winnipeg CA, 1994-97

Causes of injuries

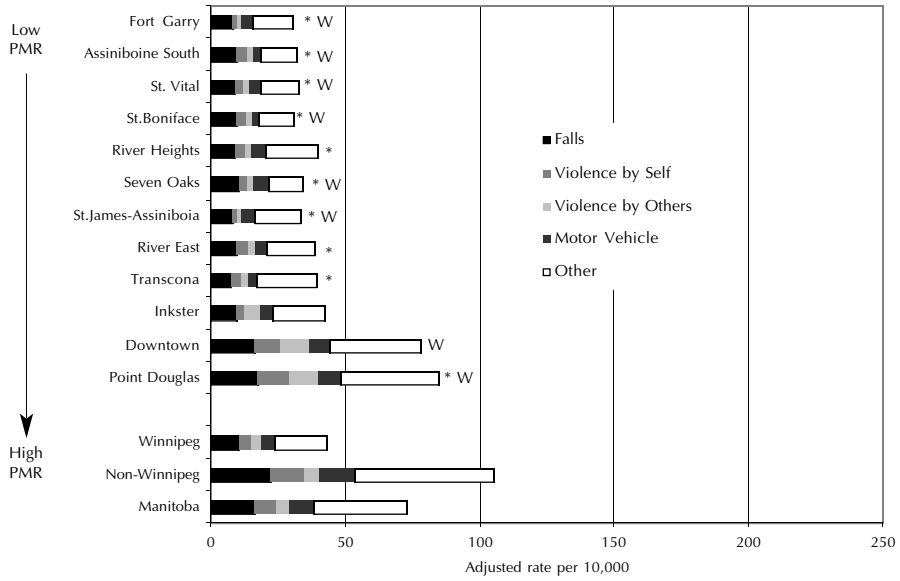
Motor vehicle crashes (MVCs) were the leading cause of injury death in Manitoba children, accounting for about 34% of all injury deaths over a four-year period (7.7/100,000). Other major causes of childhood injury deaths included violence to self (4.2/100,000), drowning (2.6/100,000), suffocation and choking (2.4/100,000), and violence by others (1.6/100,000).

The mortality rates by cause of death were too low for detailed comparisons across RHAs and Winnipeg community areas, although Winnipeg/non-Winnipeg comparisons were made for some categories. For MVCs, violence to self, and drowning, the rates for non-Winnipeg children were significantly higher than those for Winnipeg children: over 2 times higher for MVCs, 2 times higher for violence to self, and over 4 times higher for drowning. For both violence to self and drowning, the rates for children from regions with the highest PMRs (north) were significantly higher than the provincial average: over 2.5 times higher for violence to self, and 4 times higher for drowning. Figures 3 and 4 show injury hospitalization rates by causes of injury, with many of the 14 categories of injury combined in the "other" category due to small numbers. Accounting for approximately 22% of all injury hospitalizations (16.1/10,000), falls were the leading overall cause of injury hospitalization for Manitoba children. Other leading causes of injury hospitalization included MVCs (12%) and violence to self (11%). For all 14 categories of injury cause, the hospitalization rates for those children residing in the regions with the highest PMRs (northern Manitoba) were significantly higher



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
N - Rate significantly different from mean for Northern Manitoba at p<0.05
S - Rate significantly different from mean for Rural South Manitoba at p<0.05

Figure 3. Injury hospitalization rates for children aged 0-19 years by cause of injury, RHAs, 1994/95-1998/99



Statistical Significance (For Totals Only):
* - Rate significantly different from Manitoba mean at p<0.05
W - Rate significantly different from Winnipeg mean at p<0.05

Figure 4. Injury hospitalization rates for children aged 0-19 years by cause of injury, Winnipeg CAs, 1994/95-1998/99

than both the provincial average and the rural south average. The injury hospitalization rate due to violence to self for children from the north (43.3/10,000) was over 7 times as high as that for children from the rural south (5.9/10,000). Injury hospitalization rates due to violence from others were over 4 times higher, hospitalizations due to drowning were over 5 times higher, hospitalizations due to poisoning were almost 4 times higher, and hospitalizations due to falls were over 2 times higher for children from the north compared to the rural south.

Children living in Winnipeg had significantly lower injury hospitalization rates for all 14 causes of injury than were found in the rest of the province. Within Winnipeg, children living in the two community areas with the highest PMRs (Downtown and Point Douglas) had significantly higher overall rates of injury hospitalizations. For MVCs, violence to self and by others, falls, poisoning, and "other" causes of injury hospitalizations, the rates for children from these two areas were significantly higher than those found for other Winnipeg children.

For a more detailed breakdown of injury rates by cause, please see http://www.umanitoba.ca/centres/mchp/reports/pdfs/child-pdfs/child06_injury.pdf.

Injury and income

Injury *mortality* rates for children from the lowest income neighbourhoods in rural areas were almost 2.5 times higher than those from the highest income neighbourhoods (Figure 5). For urban areas, children from the lowest income neighbourhoods had injury mortality rates 4.5 times higher than those from the highest income areas (Figure 5). Trend tests confirmed highly significant differences (p<0.0001) across income quintiles for both rural and urban areas.

For injury *hospitalizations* among children from rural areas, those from the lowest income areas had rates almost 3 times higher than those from the highest income areas (Figure 6). For children from urban areas, those from the lowest income areas had injury hospitalization rates 2.5 times higher than those from the highest income areas (Figure 6). Once again, trend tests confirmed highly significant trends (p<0.0001) of increasing injury hospitalization rates with decreasing income quintile.

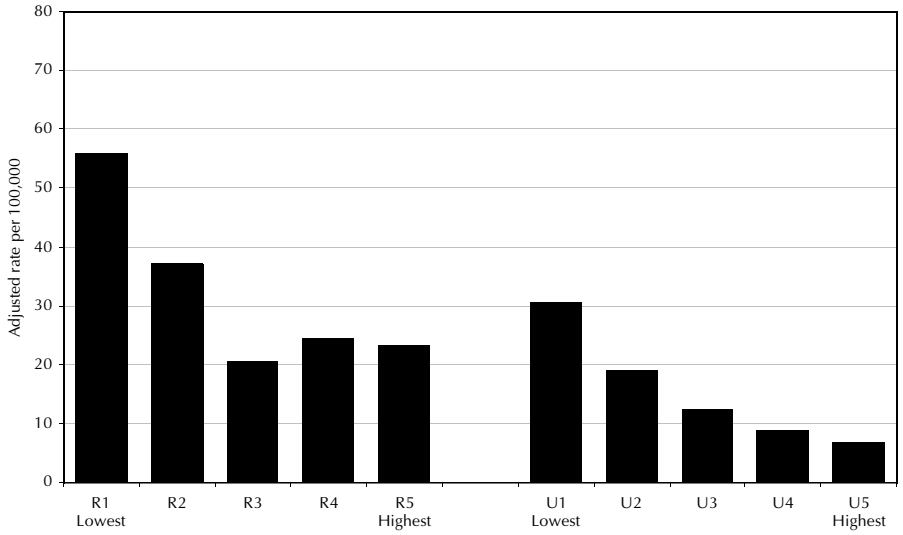
DISCUSSION

This paper examined rates of death and hospitalization from injury in Manitoba children, as well as the causes of injuries. We found correlations between injury rates (both mortality and hospitalization) and PMR value, SEFI, region, and income.

National data indicate that the leading causes of death in Canadian children are also the leading causes of death in Manitoban children. Manitoba's principal

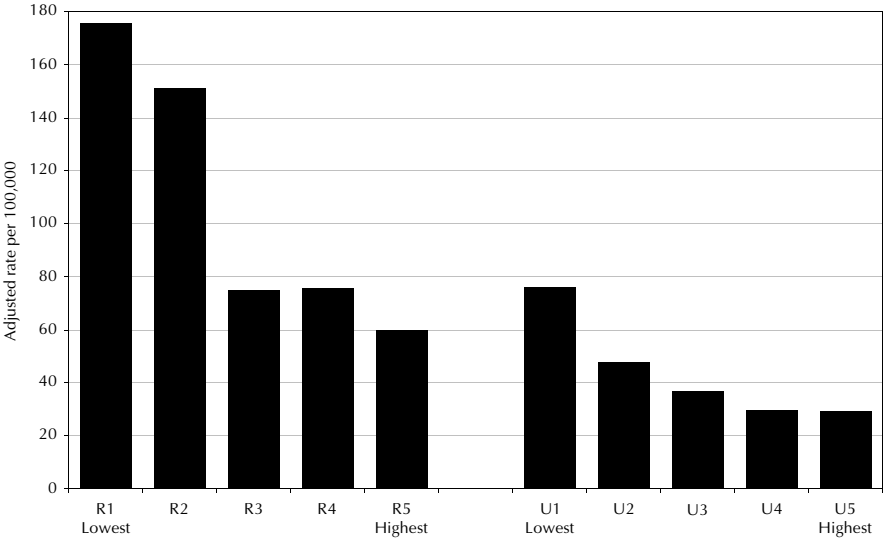
difference with Canada is its very high injury mortality rate. At 23.4 deaths per 100,000 children 0 to 19 years, Manitoba's injury mortality rate for 1994-1997 was almost 50% higher than the national rate in 1996 of 16 deaths per 100,000.[5] The injury mortality rate for Manitoba males is 41% higher and for females 51% higher than their national counterparts. The data presented in this paper do not permit us to state with any confidence why Manitoba's rate is so high, but they do suggest several possible explanations.

Regional differences within Manitoba are substantial, and appear to be related to the overall healthiness of the populations within the regions and the socioeconomic conditions within the regions. We found significant, positive correlations between both injury mortality and hospitalization rates and PMR, which suggest that as PMR increases (indicating a less healthy population), injuries also increase. We also found significant positive correlations between both types of injury rates and SEFI, suggesting that as the socioeconomic factors that are associated with poor health increase, so too do injury rates. The extremely high injury rates in the northern part of Manitoba are of particular concern. This part of the province is sparsely populated, accounting for only about 6% of the total population. It is home to over one third of Manitoba's First Nations communities and over 40% of the province's First Nations population 0 to 19 years.[10] Data from Health Canada and Statistics Canada indicate that injury mortality rates are much higher among First Nations children with Treaty Status, compared to the total population of Canadian children.[6] During infancy (under 1 year), the rate of death from injuries for First Nations children is almost 4 times greater than the general population; for preschoolers, the rate is over 6 times greater; for children 5-9 years the rate is 3 times greater; and for 10-14 year olds, the rate is over 1.5 times greater.[6] First Nations teenagers aged 15-19 years are 3.5 times more likely to die due to injuries than the total population of 15-19 year olds in Canada.[6] The Manitoba Paediatric Death Review Committee[4] reported that the injury mortality rate for First Nations children aged 29 days to 14 years was over 9 times higher than that for non-First Nations children in Manitoba.



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban ($p<0.0001$), using two-tailed Cochran-Armitage trend test.

Figure 5. Injury mortality rates for children aged 0-19 years by rural and urban income quintile, 1994-97



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban ($p<0.0001$), using two-tailed Cochran-Armitage trend test.

Figure 6. Injury hospitalization rates for children aged 0-19 years by rural and urban income quintile, 1994/95 - 1998/99

Also substantial is the difference in injury rates between rural and urban areas, notably Winnipeg. Non-Winnipeg children die from injuries more than 2 times as frequently as Winnipeg children and are hospitalized almost 2.5 times as frequently. While it could be argued that the substantially higher injury *hospitalization* rates in rural regions may in part reflect admission practices (see Brownell, et al., this issue),[11] judging from the higher injury *mortality* rates in rural areas, injuries are a more significant problem in rural than in urban areas, particularly more serious injuries. Studies in the U.S. have also found higher injury rates in rural compared to urban areas.[12-15] The rural-urban differences in injury could be due to exposure to haz-

ardous environments and products,[14] differences in response rate and transportation-time to trauma centres,[14,15] and differences in the use of prevention strategies.[13,16] An observational study of Winnipeg and nearby rural communities reported significantly higher helmet use for urban children compared to rural children. The overall urban/rural difference (including adults) was highly significant with the prevalence of helmet use for urban cyclists at 22.9% compared to 8.9% for rural cyclists.[16]

The causes of injuries are also influenced by many of the factors discussed above. Motor vehicle crashes (MVCs) are the leading cause of injury death in all Manitoba children, findings that are replicated both nationally and internationally.[5,17] Nationally, MVC injuries and deaths for children 0 to 14 are lower than any other age group (including adults), whereas rates for those 15 to 19 years are about double the population as a whole, suggesting that the factor underlying the sudden and dramatic increase in MVCs at this age is strongly related to the acquisition of a driver's licence,[5] as well as exposure to motor vehicles. Preliminary evidence from Ontario's Graduated Licencing System suggests graduated licencing may be an effective means of reducing MVCs for new drivers. This system requires new drivers to go through several stages of increasing responsibility and decreasing restrictions over a specified period of time before they qualify for a full driver's licence. The collision rate for novice drivers was 31% lower in 1995, after the introduction of graduated licencing than in 1993, prior to its implementation, whereas the general driving population experienced only a 4% drop during the same time period.[18]

Suicide is the second leading cause of injury mortality for Manitoba children, a finding that mirrors national statistics.[5] Whereas unintentional injury has decreased nationally over the past several years, suicide rates have increased slightly.[5] The rate of suicide deaths in the northern part of Manitoba is almost three times higher than the provincial average, whereas the rate of hospitalization for suicide attempts is over seven times higher in the north than in the rest of the province.

Accounting for close to a quarter of all injury hospitalizations, falls were the leading overall cause of injury *hospitalization* for Manitoba children, a finding that is also consistent at the national level.[19] Injuries from childhood falls cost $630 million each year in Canada.[1]

In addition to PMR, SEFI and region, injury mortality and injury hospitalization rates for Manitoba children correlate with neighbourhood income level, meaning that the lower the income level, the higher the injury rate. Other studies have found not only this association between decreasing SES and increasing injury rates,[20] but also that children from lower SES families tend to experience more severe and more often fatal injuries.[21] Why do we find higher injury rates for children from lower income families? Morrongiello[19] suggests that these children are more likely to live and play in more hazardous environments and their parents may have limited knowledge about parenting and child development and abilities, leading to poor parental judgement. All these factors are associated with greater risk for injury.[19] An observational study of Manitoba cyclists found that helmet use was strongly related to income level: 30.5% of the cyclists in the highest income neighbourhoods were observed wearing helmets compared to only 7.8% in the lowest income neighbourhoods.[16] Manitoba data from the NLSCY showed that 40.6% of children from low-income families (less than $20,000 per year) seldom or never wore seatbelts while driving in a motor vehicle, compared to 14.5% of children from families with higher incomes.

National data from Statistics Canada confirm that both injury mortality and injury hospitalization rates differ across urban income quintiles, and also show that the income gap narrows as children get older, and income differences are greater for some types of injury than others.[6] Whereas income was not significantly associated with deaths due to MVCs, poisonings or suicide, children in the lowest income group were 1.5 times more likely to die from drowning, twice as likely to die from falls, over 4 times more likely to die from homicide, and over 18 times more likely to die from fires.[6] For injury hospitalizations, there was no clear effect of income on motor vehicle collisions or falls. Hospitalization rates for children from the poorest neighbourhoods were almost 1.5 times higher for choking and suffocation, over 1.5 times higher for suicide attempts, 2 times higher for poisonings, over 2 times higher for fires and burns, and almost 3 times higher for violence by others.[6]

Clearly, injuries are not random events but are related to social factors, including income level, and the overall healthiness and socioeconomic well-being of the population. Given the significance of injuries to child health, it is imperative to use existing information on the impact of social and demographic factors when designing and implementing programs and policies for injury prevention. Perhaps the most effective means of reducing the burden of childhood injury would be to reduce the social inequalities that contribute to inequalities in both child and adult health.

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RÉSUMÉ

Contexte : Les blessures sont la principale cause de mortalité chez les enfants canadiens de 1 à 19 ans et entraînent le sixième de toutes les hospitalisations de la naissance à 19 ans. On examine ici les causes de blessures chez les enfants manitobains et le lien entre les taux d'accident avec blessures et la région de résidence, le TMP et le revenu.

Méthode : Les écarts régionaux dans les taux de décès et d'hospitalisation résultant de blessures et dans les causes de blessures ont été dérivés du Population Health Research Data Repository. On a examiné le lien entre les taux d'accident avec blessures et les niveaux de revenu par sous-région et calculé les corrélations entre les TMP et les taux d'accident avec blessures des sous-régions.

Résultats : Les accidents de la route étaient la principale cause de décès résultant de blessures, et les chutes, la principale cause d'hospitalisation résultant de blessures. Les écarts régionaux étaient considérables. Les écarts entre les zones urbaines et rurales dans les taux d'accident avec blessures étaient marqués; les taux dans le Nord du Manitoba étaient très élevés par rapport au reste de la province. Les valeurs régionales du TMP présentaient des corrélations significatives avec les taux de décès et d'hospitalisation résultant de blessures. Ces deux types de taux d'accident avec blessures présentaient des liens significatifs avec le revenu (les taux étant plus élevés au bas de l'échelle des revenus).

Conclusion : Les blessures ne sont pas le fait du hasard, mais sont liées à des facteurs sociaux.

Health Service Utilization by Manitoba Children

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ABSTRACT

Objective: To compare physician and hospital utilization rates by children across subregions of Manitoba.

Methods: 1998/99 data for physician visits and hospitalizations for children aged 0 to 19 were extracted from the Population Health Research Data Repository. Rates of utilization were compared across 12 regions (RHAs) within Manitoba, and 12 community areas within Winnipeg. Rates were also compared across premature mortality rates (PMR) and area income levels.

Results: Substantial regional variation was found for utilization rates. The hospitalization rate for children from the three northern RHAs (highest PMRs) (114/1000) was almost four times the Winnipeg rate (30/1000) and almost double the rate for the rural south RHAs (lowest PMRs) (59/1000). The variation among regions in physician visits ranged from under 2 visits in 2 of the northern RHAs to almost 4 visits in urban areas. However, the low visit rates in rural RHAs are offset somewhat by greater use of nurses. Hospitalizations and physician visits were also related to area income level.

Conclusion: Findings are discussed in terms of health care need.

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

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In 1973, John Wennberg and Alan Gittelsohn published a paper examining the rate at which surgery was performed in various New England communities. They found, for example, that the rate of tonsillectomy in Vermont ranged from 3 to 15 per 1000 residents.[1] Since then, numerous "small area" analyses have been done. These studies are of interest to health policy analysts and policy-makers because large variations in utilization of health services suggest overuse in areas with above-average rates and underuse in areas with below-average rates. "Small area" studies cannot resolve the question of what utilization rate is appropriate, but they can suggest hypotheses that deserve further research.

In this paper, we examine regional differences in utilization rates of physician and hospital services by children ages 0 to 19 years living in Manitoba, Canada. In addition to describing overall rates of health care use, we also examine regional differences in the location of health services provided, and the use of specialist physicians. We also look at the relationship between income levels and health care use as well as the relationship between the premature mortality rate (PMR) and the Socioeconomic Factor Index (SEFI) and health care use. PMR is considered an indicator of the healthiness of a population, with higher PMR generally associated with both poorer health and lower socioeconomic status. SEFI is an indicator of the socioeconomic conditions within a region, with high SEFI associated with conditions considered to be less favourable to overall health (see Martens, et al. this issue, for a description of PMR and SEFI and the use of PMR as a conceptual framework).[2]

METHODS

Data were derived from the population-based Population Health Research Data Repository. Details about these anonymized data sets can be found elsewhere (see Brownell, et al. this issue).[3] Specifically we examined physician claims and hospital separation abstracts for the period April 1, 1998 through March 31, 1999. Hospitalization rates included all inpatient separations for 0-19 year old children residing in Manitoba, excluding births, in the numerator and all children residing in the province of Manitoba dur-

ing the study year in the denominator. Physician visits included all ambulatory encounters with Manitoba physicians by 0-19 year old Manitoba residents in the numerator, and all children residing in Manitoba during the study year in the denominator. Physician visits were further broken down by specialty of physician in the following categories: general practitioners, paediatricians, and all other specialists. Regional rates indicate where children who received the health care services resided, rather than where the services were delivered. All rates using children 0 to 19 years were age- and sex-adjusted using the direct method of standardization.

These utilization data were broken down by regions. At the provincial level, we used 12 subregions called Regional Health Authorities (RHAs). We further sub-divided Manitoba's largest city, Winnipeg, which is itself an RHA, into 12 subregions called Winnipeg Community Areas (Winnipeg CAs). Summary rates are given for 1) the total Manitoba child population, 2) Winnipeg, 3) Non-Winnipeg (all children residing outside of Winnipeg), 4) Rural South (children residing in rural regions below the 53rd parallel) and 5) North (children residing in regions above the 53rd parallel). Comparisons of utilization rates across regions used t-test methodology developed by Carriere and Roos.[4] To adjust for multiple comparisons between each RHA or Winnipeg CA and an overall provincial or Winnipeg rate, 99% confidence intervals were used. Rates were suppressed where cell counts were less than 5. Because regions are ordered according to PMR (from lowest to highest) in each graph, visual inspection of the regional graphs provides insight into the relationship between the healthiness of the population within a region (PMR) and the utilization variables. To further assess the association between utilization and PMR as well as the socioeconomic conditions in the region, hospital separation and physician visit rates for the regions were correlated with the regions' PMRs and SEFIs, using Spearman's rank correlation.

An index of morbidity burden was created, using the Adjusted Clinical Group (formerly Ambulatory Care Group) classification system.[5] All children with a health care contact were sorted into those receiving well child care (a group with no morbidity) and those seeking all other types of care. The latter category was in turn sorted into lower morbidity burden and higher morbidity burden. Lower and higher morbidity burden were determined based upon the number of acute, recurrent and chronic conditions diagnosed in the child.[6]

Survey data from the 1996 National Population Health Survey (NPHS) were used to estimate nursing station visits as these are not captured in the administrative data. For some Manitoba children, especially those in sparsely populated rural areas, nurses assigned to nursing stations are more accessible than physicians and hospitals. These nurses are trained to provide services ordinarily provided by physicians in more populated areas. The NPHS survey did not include children living in First Nations communities, and because many of these communities are situated in sparsely populated rural areas, nursing station visit data from the NPHS underestimate the use of these nurses in these areas.

To obtain income level information, rural and urban neighbourhoods were each divided into five different income levels referred to as quintiles, based on 1996 Census information available through Statistics Canada.[3] Cochran-Armitage trend tests were used to assess the significance of the relationships between health care utilization variables and neighbourhood income level.

TABLE I

Health Care Utilization Rates by Age, Children 0-19 Years in Manitoba

Hospitalization per 1000	Age <1	1-4	5-9	10-14	15-19	Total
	217.44	52.89	26.90	29.24	70.38	48.12
Physician Visits per Child per Year	**Age <1**	**1-4**	**5-9**	**10-14**	**15-19**	**Total**
Total	7.47	5.10	3.08	2.58	3.17	3.59
General Practitioners	4.12	3.08	1.97	1.81	2.58	2.40
Paediatricians	2.86	1.65	0.87	0.51	0.19	0.86
Other Specialists	0.50	0.37	0.24	0.27	0.40	0.33

RESULTS

Health care utilization

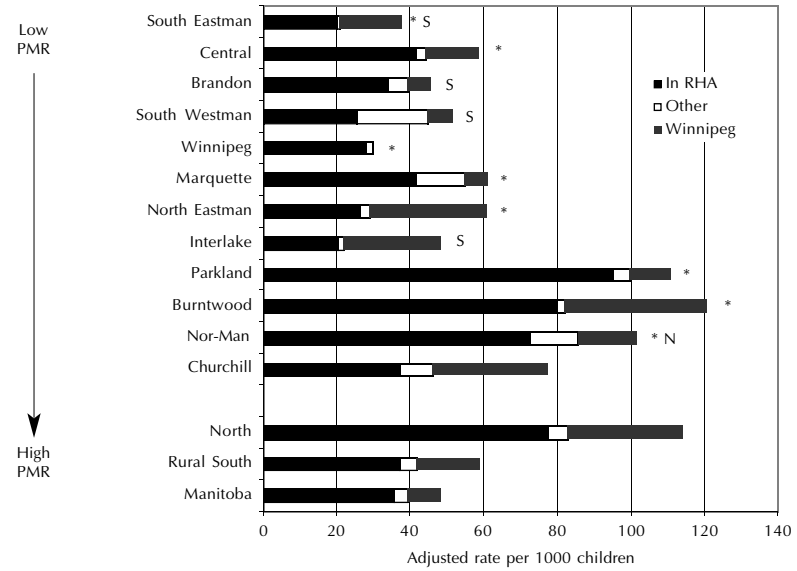
In 1998/99, 80% of Manitoba children had at least one health care contact. Almost 5% of all Manitoba children were hospitalized (48/1000) and the average rate of physician visits was 3.6 per child. The most common diagnosis for hospitalization was bronchitis/ bronchiolitis and, for physician consultation, upper respiratory tract infection. Approximately 10% of children with health care contacts were classified as higher morbidity burden (e.g., acute, recurrent and chronic conditions). These children used a disproportionate number of services, especially acute care services (30% of hospitalizations and 20% of physician services). However, the majority of health care services were for children with lower morbidity burden.

Hospital utilization

Hospital Utilization by Region

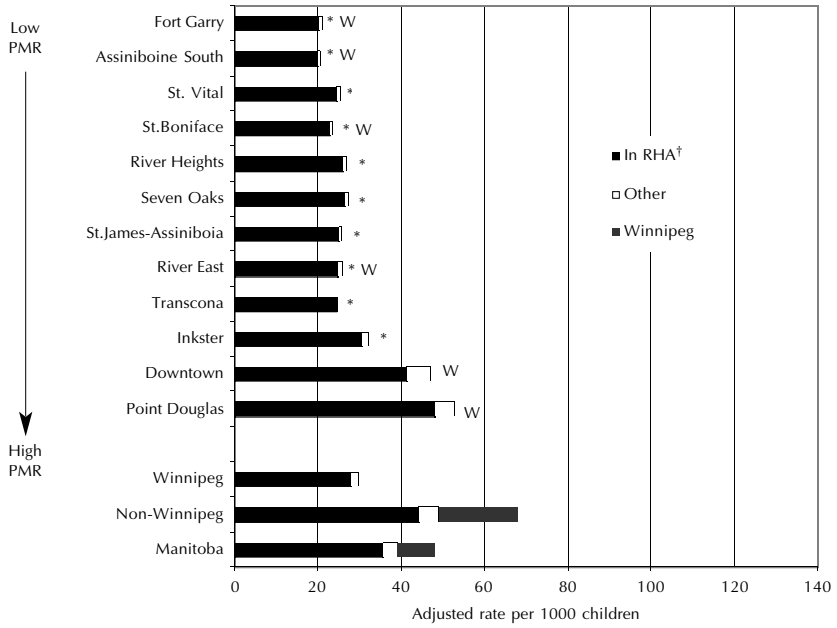
Figures 1 and 2 show the hospitalization rates in 1998/99 by RHAs and Winnipeg CAs respectively, with significant regional variation evident. The hospitalization rate for Non-Winnipeg children (68/1000) was over twice as high as that for Winnipeg children (30/1000). The hospitalization rate for children from the north, areas with the highest PMRs, was almost 4 times higher (114/1000) than that for Winnipeg children, whereas the rate for children from the rural south, areas with the lowest PMR, was almost twice as high (59/1000) as the Winnipeg rate. For children from all Winnipeg CAs except the two with the highest PMRs (Downtown and Point Douglas), the hospitalization rates were lower than the provincial average. For children from these high PMR areas, the hospitalization rates were higher than the Winnipeg average, but still lower than the Non-Winnipeg average. Hospitalization rates correlated significantly with PMR ($r=0.71$, $p<0.0001$), with regions with less healthy populations having higher hospitalization rates. The hospitalization rates also correlated significantly with SEFI ($r=0.62$, $p<0.01$), with regions with less favourable socioeconomic conditions having higher hospitalization rates.

Figure 1 also indicates where residents of the various regions were hospitalized. About 28% of northern residents and 29% of chil-



Statistical Significance (For Totals Only):
* - Rate significantly different from Manitoba mean at p<0.05
S - Rate significantly different from mean for Rural South at p<0.05
N - Rate significantly different from mean for North at p<0.05

Figure 1. Hospitalization rates for children aged 0-19 years by location of hospital and RHA, 1998/99



† - The RHA for all of the Winnipeg CAs is Winnipeg
* - Rate significantly different from Manitoba mean at p<0.05
W - Rate significantly different from Winnipeg mean at p<0.05

Figure 2. Hospitalization rates for children aged 0-19 years by location of hospital and Winnipeg CA, 1998/99

dren from the rural south were hospitalized in Winnipeg; however these percentages varied across regions, ranging from 10% to 55%. Almost 65% of children residing outside of Winnipeg (including the North, Rural South and Brandon) were hospitalized in their own RHA, but this value also varied, ranging from 42% to 86%.

Hospital Utilization by Age

Hospital utilization varies with age, with the highest utilization rates for children under one year of age decreasing substantially after the first year, and then increasing somewhat in the 15 to 19 year age group (Table I).

Hospital Utilization by Income

Significant trends were found for hospitalization rates for both rural and urban neighbourhood income levels, with higher hospitalization rates associated with lower income (Cochran-Armitage trend, p<0.0001, Figure 3). Children living in the lowest neighbourhood income quintile in urban and rural areas were 3 times more likely to be hospitalized than children in the highest income quintile.

Physician visits

Physician Visits by Region

Figure 4 shows the physician visit rates per 1000 children 0 to 19 years of age by RHA. Physician visit rates varied significantly across regions, with children from Winnipeg and Brandon (the two areas with the highest supply of physicians) having almost 4 visits per child annually, whereas children from the northern regions of Churchill and Burntwood had fewer than 2 visits per child. The significantly lower visit rates shown for children residing in the north were at least partly attributable to the higher use of nursing stations for health care services in these regions; these visits are not captured in the administrative data. According to the 1996 NPHS, 18% of residents of northern Manitoba (excluding those First Nations persons living "on reserve", who were excluded from the survey sample) had at least one contact with a nurse or nurse practitioner for health consultation, compared to 12% for the Rural South and 6% for urban (Winnipeg and Brandon) Manitoba. Those residing in the Rural South also had significantly lower physician visit rates than the Manitoba average, which is strongly influenced by the higher Winnipeg rates. As Figure 5 indicates, the visit rates for Winnipeg children were significantly higher (4 visits per child) than those for Non-Winnipeg children (3.2 visits per child). Physician visits in the Winnipeg CAs ranged across areas from 3.7 to 4.5 (Figure 5).

Due to missing data in the North, correlations between PMR and physician visits were run separately for RHAs and Winnipeg CAs. A significant association was found between PMR and physician visit rates only for the Winnipeg CAs, with those areas with less healthy populations

having higher physician visits (r=0.62, p<0.03). Likewise, correlations with SEFI were significant only for the Winnipeg CAs (r=0.74, p<0.01), with community areas with less favourable socioeconomic conditions having higher physician visit rates.

Physician Visits by Specialty

Figures 4 and 5 also show the types of physicians accessed by children living in different areas. Children residing in Winnipeg were far more likely to access specialists (paediatricians* and other specialists) than non-Winnipeg children. Winnipeg children made over 3.5 times more visits to specialists (1.82/1000) than their Non-Winnipeg counterparts (0.51). Although the use of specialists varied across areas, correlation analyses showed that the use of specialists was not correlated with PMR or SEFI in either the RHAs or the Winnipeg CAs.

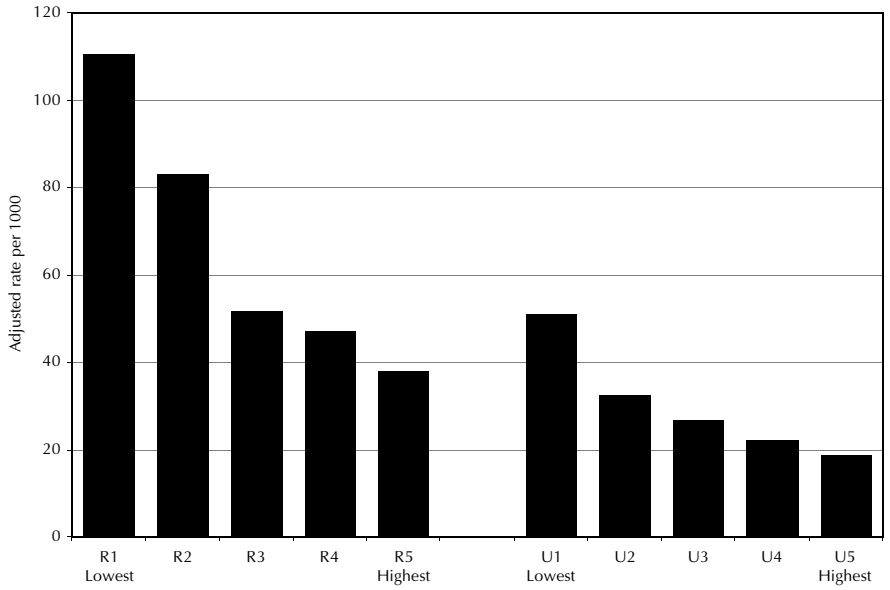
Almost 80% of the physician visits for children in the north and over 75% of the visits for those in the south were provided within the child's own RHA (not shown). The percent of visits provided within the Non-Winnipeg RHAs varied by region, ranging from less than 60% to about 90%. For all RHAs except Winnipeg and Brandon, the majority of visits to paediatricians and other specialists took place outside the child's own RHA, most often in Winnipeg.

Physician Visits by Age

Physician visits also vary by age, with substantially more visits in the first year of life, and declining after one year of age (Table I). Visits to paediatricians dropped steadily with each age group after the first year of life, whereas visits to other specialists decreased after the first year of life, but then increased again in the 15 to 19 year group (Table I).

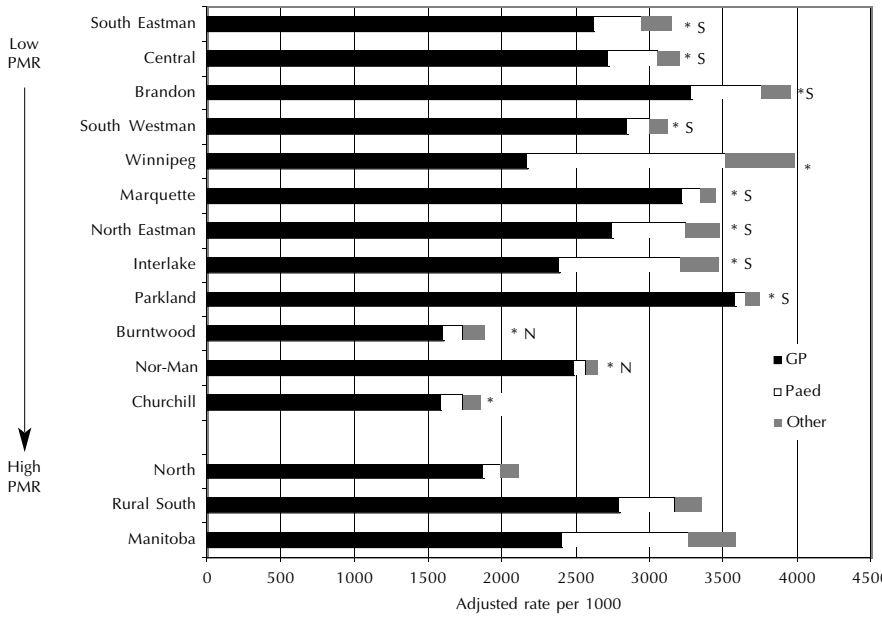
Physician Visits by Income

Significant trends were found for physician visit rates across income quintiles; however the trends went in opposite directions for rural and urban income. For children living in rural areas, lower income levels were associated with decreasing physician visits, potentially an outcome of missing data from northern regions (Cochran-Armitage p<0.0001). For children living in urban areas, physician visits increased as neighbourhood income level decreased (Cochran-Armitage trend p<0.001). Children living in the lowest income neighbourhoods in urban areas made 20% more visits to physicians (4.1 per child) than those living in the highest urban income neighbourhoods (3.5 per child).



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban (p<0.0001), using two-tailed Cochran-Armitage trend test.

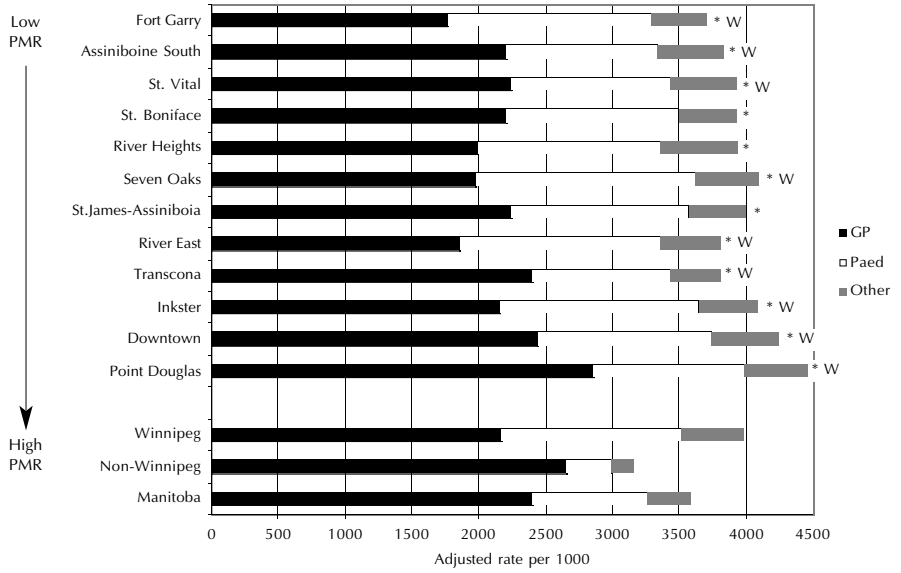
Figure 3. Hospitalization rates for children aged 0-19 years by urban and rural income quintiles, 1998/99



Statistical Significance:
*- Rate significantly different from Manitoba mean at p<0.05
N - Rate significantly different from mean for North at p<0.05
S - Rate significantly different from mean for Rural South at p<0.05

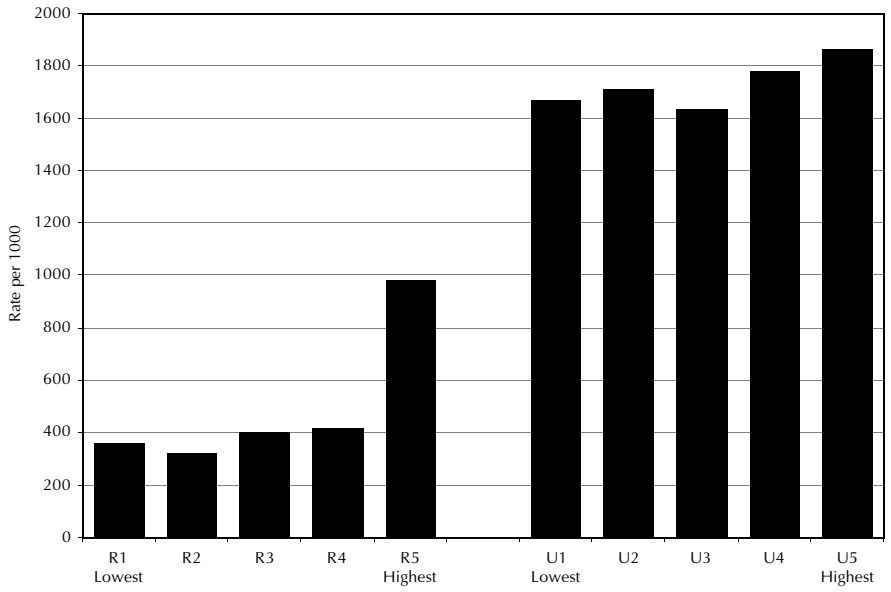
Figure 4. Physician visit rates for children aged 0-19 years by physician specialty and RHA, 1998/99

* Paediatricians are defined as specialists here based on training, rather than the level of care they deliver. Indeed, paediatricians in Winnipeg and Brandon provide not only specialist care but also primary care which, for rural residents, is delivered by general practitioners.



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
W - Rate significantly different from Winnipeg mean at p<0.05

Figure 5. Physician visit rates for children aged 0-19 years by physician specialty and Winnipeg CA, 1998/99



R represents rural income quintiles, with R1 being the lowest and R5 being the highest income quintile; U represents urban income quintiles, with U1 being the lowest and U5 being the highest income quintile. Statistically significant trends in both rural and urban (p<0.0001), using two-tailed Cochran-Armitage trend test.

Figure 6. Rate of visits to specialist physicians by urban and rural income quintiles

For both rural and urban children, the likelihood of visiting a specialist increased as neighbourhood income level increased (Cochran-Armitage p<0.0001 for both rural and urban quintiles, Figure 6). For urban areas, children living in the highest income neighbourhoods had 11% more visits to specialists (1.86 per child) than those living in the lowest income neighbourhoods (1.67 per child). For rural areas, the differences were more dramatic: those from the highest income neighbourhoods had 170% more visits to specialists (0.98 per child) than children from the lowest income neighbourhoods (0.36 per child).

DISCUSSION

This paper confirms the findings of a substantial body of "small area" research, namely, that medical utilization rates can vary substantially between communities in the same general area.[7-10] Our data indicate that physician and hospital utilization rates for children vary considerably by region within Manitoba. This is especially true of hospital utilization rates. It is often suggested that above-average use rates signify overuse of medical services. Does high use of hospitals or physician services in one area compared to another necessarily mean that the high-use areas are over-serviced? In the case of health services use by Manitoba children, we think the answer is "not necessarily." In order to state with confidence that a high-use region is overusing medical services, one would have to make at least two adjustments to raw use rates for all regions in the comparison, one on the demand side and one on the supply side. On the demand side, we must adjust for differences in population health. Where populations are of similar health status and rates vary greatly, then one may question whether usage patterns relate to the needs of the population. On the supply side, we must adjust for, or at least take note of, differences in availability of health care providers.

Data reported here and elsewhere in this volume (see Martens, et al., this issue)[2] indicate that the variations in hospitalization among regions within Manitoba reflect differences in need for hospital services rather than differences in physician propensity to hospitalize. The relationship reported in this paper between PMR (and SEFI) and hospitalization rates for both RHAs and Winnipeg CAs suggests that much of the variation observed across regions in hospitalization is due to the needs of the populations within the regions. In other words, the sicker populations with higher socioeconomic risk had higher hospitalization rates. High use of hospitals by children in northern regions is not surprising because these populations have high health risks. As Brownell et al. have shown elsewhere in this volume,[11] injuries to children serious enough to warrant hospitalization occur at a much higher rate in the north and the south – especially the north – than they do in Winnipeg.

Likewise, higher hospitalization rates for children from lower income neighbourhoods, a trend observed in this study and also reported elsewhere,[12] are not surprising given the higher health needs of children from lower income groups. Research suggests that these gradients in hospital use across socioeconomic status reflect real differences in the health of these groups, not differences driven by social causes of admissions. Patients admitted to Winnipeg hospitals from the lowest income neighbourhoods were just as likely to meet criteria suggesting that acute care was required as were patients admitted from middle income or even from the highest income neighbourhoods.[13] On the other hand, higher use of hospitals by children in relatively healthy areas in the rural south compared to Winnipeg children may signal the need to focus on whether over-servicing exists.

The other factor that must be taken into account in comparing regional use rates is the availability of physicians and hospitals. The low physician visit rate for the three northern RHAs shown in Figure 4 is almost certainly due to the lower availability of physicians in those RHAs.

Within Winnipeg CAs, the relationship between PMR (and SEFI) and physician visits suggests that those children living in areas of higher health need are also seeing physicians more frequently, which is exactly how an equitable health care system should work. However, when we looked at visits to specialists, we found that those children from the lower income neighbourhoods in urban areas were less likely to see specialists than children from higher income neighbourhoods, despite apparently equal availability of these specialists to the lower income urban children. Others[14] have also found a gradient for specialist visits in Canada, with those from higher income groups more likely to see a specialist. In the current study, children from high-income rural areas were almost 3 times as likely to visit specialists than their counterparts from lower income neighbourhoods. Although no direct financial barriers exist in accessing specialists in Manitoba, due to universal coverage, indirect barriers, such as having to travel to Winnipeg or Brandon to meet with specialists, may play a role in the lower specialist visit rates for rural low income children. As mentioned above, however, even for urban children the gradient exists, with children from higher income groups more likely to visit specialists. Over all income levels, Winnipeg children are more than 3.5 times more likely to access specialists than their rural counterparts. Because a good part of this care may be primary care by paediatricians, it may, at least in part, reflect parental preference for a paediatrician. Regardless, it is clear that use of specialists is not equitable across regions and income groups for Manitoba children.

In conclusion, when considering the over-servicing debate, we must distinguish over-servicing from legitimate high use driven by high health care needs. Where high health care needs coincide with high use, it appears to be one indication that the system is working well, and that those who need services most are receiving them. Where high use coincides with relatively healthy populations, we need to ask whether lower use areas are being underserviced or whether the high-use, healthy areas are instances of over-servicing. Similarly, in evaluating whether below-average use rates are appropriate and may, therefore, serve as a standard against which to compare higher-use regions, we must determine whether access barriers have depressed use rates.

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RÉSUMÉ

Objectif : Comparer les taux d'hospitalisation et de visites chez le médecin pour les enfants des sous-régions du Manitoba.

Méthode : Les données de 1998-1999 sur les visites chez le médecin et les hospitalisations des enfants (de 0 à 19 ans), proviennent du Population Health Research Data Repository. On a comparé les taux respectifs dans 12 ORS du Manitoba et 12 CR de Winnipeg, et comparés ces taux aux TMP et aux niveaux de revenu régionaux.

Résultats : D'importants écarts régionaux ont été observés. Le taux d'hospitalisation des enfants des trois ORS nordiques (dont les TMP étaient les plus élevés) (114/1 000) était près de quatre fois celui de Winnipeg (30/1 000) et près du double de celui des ORS du Sud rural (dont les TMP étaient les moins élevés) (59/1 000). Pour ce qui est des visites chez le médecin, elles étaient inférieures à deux dans deux des ORS nordiques, mais allaient jusqu'à quatre dans les agglomérations urbaines. Toutefois, le faible taux des visites chez le médecin dans les ORS ruraux était compensé dans une certaine mesure par le recours accru aux infirmières. Les hospitalisations et les visites chez le médecin présentaient aussi un lien avec le niveau de revenu.

Conclusion : Ces constatations sont examinées dans l'optique des besoins en soins de santé.

Prescription Medications in Manitoba Children

Are There Regional Differences?

Anita L. Kozyrskyj, BScPhm, PhD

ABSTRACT

Background: Population-based studies of pharmaceutical use in children provide information on disease prevalence, physician practice and adherence to treatment. We undertook an evaluation of regional differences in prescription drug use by Manitoba children.

Methods: Using Manitoba's population-based prescription data for 1998/99, the prevalence of children receiving prescriptions for antibiotics, analgesics, iron supplements, and four classes of psychotropic drugs was reported for Regional Health Authorities and Winnipeg Community Areas, ranked by a measure of population healthiness, the premature mortality rate (PMR). Prevalence rates were also reported by census-based neighbourhood income areas.

Results: 60% of children received at least one prescription in 1998/99. Antibiotics, antiasthmatics, analgesics, antidepressants, and psychostimulants were the most commonly dispensed drugs. Prescription use of antibiotics, iron supplements, analgesics, antidepressants, antipsychotics and anxiolytics was highest in low income, urban neighbourhoods. Few associations between a region's PMR and prescription utilization were observed, but children living in regions with the least healthy populations were more likely to use antibiotics, non-steroidal anti-inflammatory drugs and anxiolytics. Psychostimulant use was unrelated to neighbourhood income, but highest rates were documented in some of the healthiest Winnipeg neighbourhoods.

Conclusion: We documented regional variation in prescription use which may be related to differences in health, physician practice or child use.

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

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The full report "Assessing the Health of Children in Manitoba: A Population-Based Study" on which this article is based is available from the Manitoba Centre for Health Policy at the above address or online at: http://www.umanitoba.ca/centres/mchp/reports.htm
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Population-based studies of pharmaceutical use in children are valuable in filling gaps in knowledge about the effectiveness and safety of drugs in children,[1,2] and also provide information on the type of health care children receive. Despite the need for this information, few population-based studies of prescription drug use in children have been conducted.[3-5] Even more rare are studies that examine geographic area differences in prescription utilization among children.[6] Geographic area variations in prescription drug use provide evidence for regional differences in disease prevalence, physician practice style and adherence to prescribed treatment. We undertook an evaluation of regional differences in prescription drug use by children in Manitoba, showcasing drugs that are being used increasingly more often in this age group. The drugs selected for examination were: 1) antibiotics, 2) pain-relief drugs (narcotic analgesics and non-steroidal anti-inflammatory drugs (NSAIDs), 3) iron supplements, and 4) psychotropics (psychostimulants, antidepressants, antipsychotics, and anxiolytics).

METHODS

Study design

This was a cross-sectional study of prescription drug use in Manitoba children in 1998/99, reported by geographic area and neighbourhood income. The geographic areas included 12 Regional Health Authorities (RHAs), and 12 subregions of Winnipeg, Manitoba's largest city, called Winnipeg Community Areas (Winnipeg CAs).

Study population

Data were obtained on children aged 0 to 19 years from two population-based, electronic databases that are part of the Population Health Research Data Repository at the University of Manitoba: 1) registration files and 2) records of prescriptions dispensed in retail pharmacies. These data are anonymized, encounter-based records of Manitobans' interactions with the health care system. The registration file contains a record for every individual eligible to receive insured health services, and includes birth date, gender and geographic location. Prescriptions records are submitted by retail pharmacies for

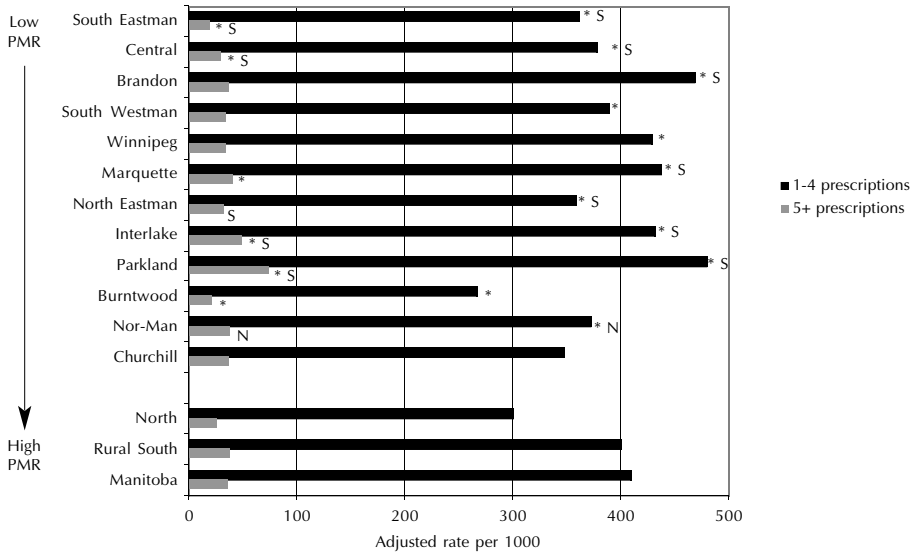
reimbursement by provincial drug insurance plans and for drug utilization review purposes. These records contain the drug's name, identification number, dosage form, and quantity dispensed, as well as the date the drug was dispensed. The reliability and validity of this prescription database has been found to be high for describing population use of prescription drugs.[7] While the prescription database is complete for prescriptions dispensed in community pharmacies, medications dispensed in northern nursing stations to First Nations children are not entirely captured.

Study measures and analyses

The prevalence rate of children receiving at least one prescription was determined for the following categories of drugs: oral antibiotics (excluding tuberculosis drugs), iron supplements, analgesics and psychotropic drugs. The prevalence of children receiving multiple courses of antibiotics was also reported.[8] The denominator was the population of children residing in Manitoba as of December 31, 1998. Age-standardized and age-specific prevalence rates of prescription use were reported by RHA and Winnipeg CA, ranked by the premature mortality rate, the best single measure to represent the healthiness of a population.[9,10] Comparisons were also made to the total Manitoba child population, Winnipeg, Non-Winnipeg (all children residing outside of Winnipeg), rural south (children residing in rural regions below the 53rd parallel) and north (children residing in regions above the 53rd parallel). Prevalence rates of children were also reported by the income quintile of their neighbourhood of residence.[11-13]

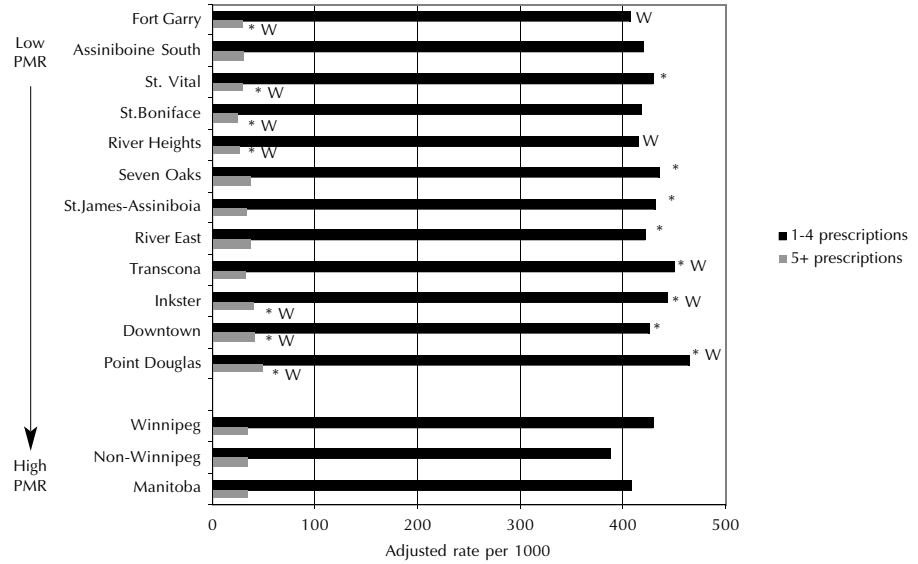
RESULTS

Almost 60% of Manitoba children received at least one prescription for a medication in 1998/99. Prescription use followed a U-shaped curve by age, with lowest rates in children 10-14 years old (52%). Children living in Winnipeg and Brandon were significantly more likely, and children living in the rural south and northern Manitoba were significantly less likely to receive a prescription medication than the average Manitoba child. The most frequently dispensed drugs were oral antibiotics (36% of all prescriptions). Other common prescription drugs were antiasthmatics, topical steroids, analgesics, ophthalmic products and anxiolytics.



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
N - Rate significantly different from mean for Northern Manitoba at p<0.05
S - Rate significantly different from mean for Rural South Manitoba at p<0.05

Figure 1. Rate of children aged 0-19 years with one or more antibiotic prescriptions by RHA, 1998/99



Statistical Significance (For Totals Only):
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W - Rate significantly different from Winnipeg mean at p<0.05

Figure 2. Rate of children aged 0-19 years with one or more antibiotic prescriptions by Winnipeg CA, 1998/99

Antibiotics

Forty-four percent of Manitoba children received one or more prescriptions for an oral antibiotic in 1998/99. The majority of children received 4 prescriptions or less; 3.5% of children received 5 or more antibiotic prescriptions. Close to 60% of children less than 5 years old had received one or more antibiotic prescriptions; this proportion declined to 40% in adolescence. Young children were three times more likely than adolescents to receive 5 or more antibiotic prescriptions.

Children living in northern RHAs were the least likely to receive antibiotic prescriptions (Figure 1), potentially the out-

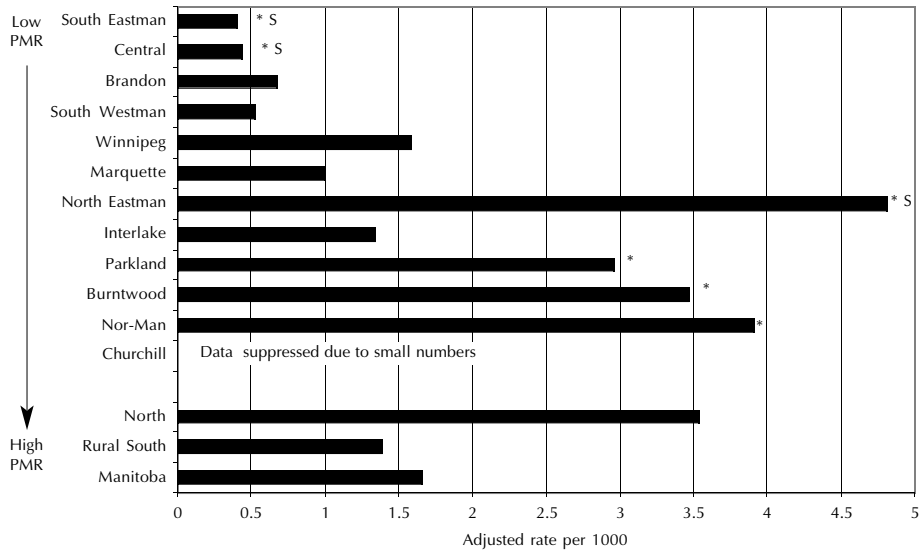

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Figure 3. Rate of children aged 0-19 years with one or more prescriptions for iron supplements by RHA, 1998/99

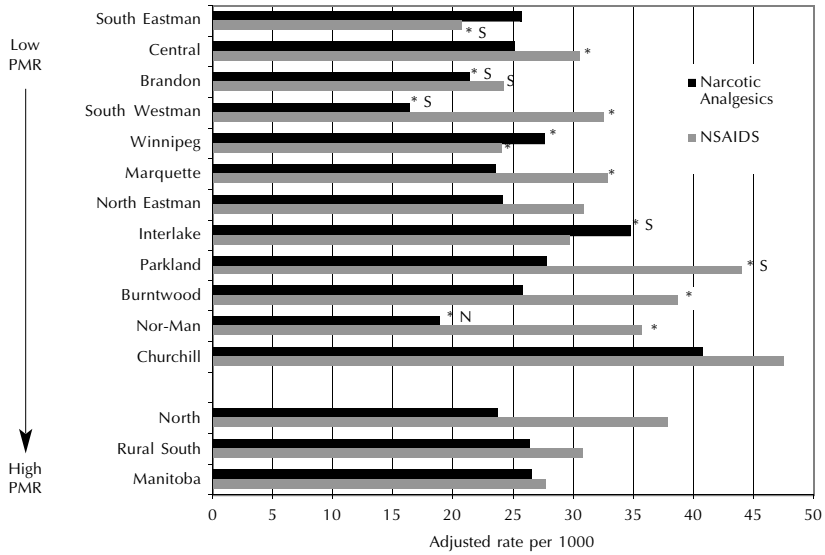

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Figure 4. Rate of children aged 0-19 years with one or more prescriptions for pain relief drugs by RHA, 1998/99

come of missing prescription data. In comparison to the average utilization of antibiotics in southern rural regions, the regions with less healthy populations (Parkland, Interlake) were the most likely and the regions with the healthiest populations (Central, South Eastman) were the least likely to have children with 5 or more antibiotic prescriptions. In addition, children living in the Winnipeg, Brandon and Marquette RHAs were more likely to receive 4 or less antibiotic prescriptions than the southern rural average. Within the city of Winnipeg (Figure 2), children living in the areas with the least healthy populations were more likely to receive 5 or more prescriptions for antibiotics, than children in areas where the populations are generally healthier (Spearman correlation=0.832, p<0.0008). A similar trend was observed for children receiving fewer antibiotics (Spearman correlation=0.734, p<0.007). Close to 5% of children living in the Point Douglas and Downtown areas received more than 5 or more prescriptions for an antibiotic in 1998/99, significantly higher than the overall rate for Winnipeg. In urban areas, antibiotic prescription utilization increased with decreasing neighbourhood income (Cochran-Armitage trend test, p<0.0001). In rural areas, antibiotic prescription use increased with decreasing income level only for children receiving 5 or more prescriptions (Cochran-Armitage, p<0.0003).

Iron supplements

Iron treatment was most frequent among 0-4 year olds and 15-19 year olds. In addition to children living in the northern RHAs, those living in Parkland and North Eastman were at greatest risk of being treated for iron deficiency anemia (Figure 3). Within Winnipeg, iron supplement use in children was highest in the Point Douglas, Downtown and Inkster CAs. As neighbourhood income decreased, the rate of treatment for iron deficiency anemia increased, with the highest treatment rates observed in the lowest income rural areas (Cochran-Armitage trend p<0.0001 for both).

Pain-relief drugs

Narcotic analgesics and NSAIDs, which are prescribed to manage acute and chronic pain, were most often dispensed to older children. Children living in the Brandon, South Westman and Nor-Man RHAs had lower prescription rates for narcotic analgesics than the southern rural average, while Interlake had significantly higher rates (Figure 4). Children from the Point Douglas CA had the highest rate of narcotic analgesic prescription in Winnipeg. The use of NSAIDs was positively associated with the general healthiness of the population within the RHAs (Spearman correlation=0.804, p<0.002). In Winnipeg, the CAs with the least healthy populations – Point Douglas and Downtown – had higher rates of NSAID use than the Winnipeg average, although Assiniboine South, an area with a generally healthier population, also had higher rates of use. Higher use of NSAIDs was found with decreasing income level in both rural and urban areas,

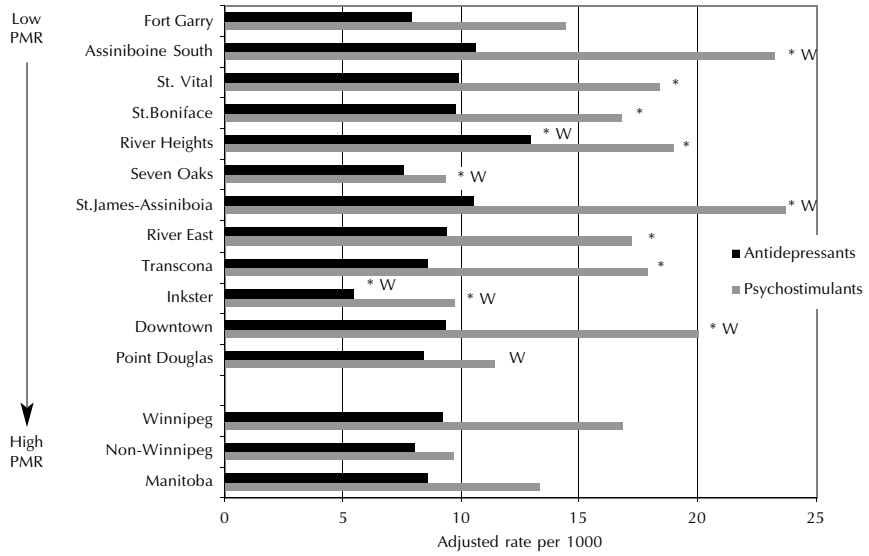
whereas the prescription of narcotic analgesics showed this same significant trend for urban areas only (Cochran-Armitage trend p<0.0001 for all).

Psychotropic drugs

In 1998/99, over 1% of children had received a prescription for a psychostimulant and close to 1% of children had received an antidepressant. Anxiolytics and antipsychotics were dispensed in 0.5% or less of children.

Psychostimulants. Psychostimulants were used most often in male children between the ages of 10 and 14, at a treatment prevalence of 2.7%. The dispensation of psychostimulants was significantly higher in Winnipeg and Brandon than the Manitoba average, and use in northern regions was significantly lower. In addition, children in Marquette and Interlake were also more likely to be exposed to these drugs than the southern rural average. Within Winnipeg, the highest rates of psychostimulant use were observed in the St. James-Assiniboine and Assiniboine South Winnipeg CAs. (Figure 5). Children living in higher income rural neighbourhoods were more likely to receive psychostimulants, but no trend in psychostimulant prescription use was observed across urban neighbourhood incomes.

Antidepressants. Three percent of adolescent females received prescriptions for antidepressants in 1998/99, almost double the prevalent use in adolescent males. However, antidepressant use was higher in 10-14 year old males than females. Aside from lower rates in northern areas, no other variations in the age-standardized use of antidepressants were observed between RHAs. Within the city of Winnipeg, children living in the River Heights CA were more likely than the Winnipeg average to receive antidepressants, while Inkster area children were less likely to be treated with them (Figure 5). There was a trend in increased utilization of antidepressants in lower income levels in urban areas (Cochran-Armitage trend test, p<0.05).



Statistical Significance (For Totals Only):
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W - Rate significantly different from Winnipeg mean at p<0.05

Figure 5. Rate of children aged 0-19 years with one or more prescriptions for psychostimulants and antidepressants by Winnipeg CA, 1998/99

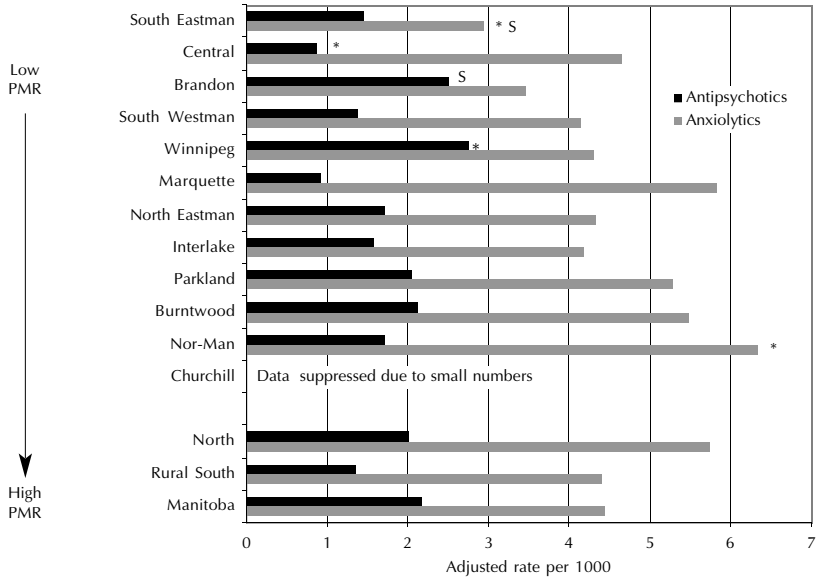

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Figure 6. Rate of children aged 0-19 years with one or more prescriptions for antipsychotics and anxiolytics by RHA, 1998/99

Antipsychotics. The receipt of prescriptions for antipsychotics was highest in adolescents, but children as young as 0 to 4 years old were treated with these agents. Males, aged 10 to 14 years, were more likely to receive prescriptions for antipsychotic drugs than females. The age-standardized prevalence of antipsychotic drug treatment was higher in the Winnipeg, Brandon and Burntwood RHAs than the southern rural average (Figure 6). Within Winnipeg, the utilization of antipsychotics in children living in the Downtown WCA was twice as high as the Winnipeg average. Whereas no significant trend was evident for antipsychotic prescriptions across income quintiles in rural areas, the rate of antipsychotic prescriptions increased with decreasing neighbourhood income level in urban areas (Cochran-Armitage trend test, p<0.0001).

Anxiolytics. Rates of anxiolytic prescription use were highest in adolescent females. RHAs with less healthy populations such as Nor-Man had significantly higher age-standardized prescription rates of anxio-

lytics, while healthier populations such as South Eastman had lower rates (Figure 6). The higher prescription utilization rates of anxiolytics in northern Manitoba was concentrated in children 5-9 years. Winnipeg CAs with generally less healthy populations tended to have a higher rate of prescription for anxiolytics (Spearman correlation=0.6215, p<0.03). Although no association was found in rural areas, anxiolytic prescription utilization increased with decreasing income level in urban areas (Cochran-Armitage trend test, p<0.0001).

DISCUSSION

Sixty percent of children received at least one prescription medication in 1998/99. Very young children and adolescents were the most likely to receive prescription drugs. Antibiotics, antiasthmatics, analgesics, antidepressants, psychostimulants and anxiolytics were among the most commonly dispensed drugs. Similar patterns of prescription utilization have been reported by others.[4,14] Numerous differences in the receipt of prescription drugs by children were found among Manitoba's regions. Because we did not link prescription use to a diagnosis, it was not possible to draw any conclusions about reasons for the regional variation in prescription rates, and comparisons involving the North were biased by the incompleteness of prescription data for this region. However, the associations we observed between prescription dispensing rates and socioeconomic status suggested that regional differences reflected differences in health. We reported several inverse relationships between prescription use rates and income quintile, especially in urban neighbourhoods, for antibiotics, iron supplements, NSAIDs and analgesics, antidepressants, antipsychotics and anxiolytics. The most likely indications for use of these drugs are known to have higher prevalence rates in low income areas. On the other hand, prescription rates for the psychostimulants were unrelated to neighbourhood income, suggesting differences in physician practice. We found fewer relationships between the PMR of region and prescription utilization, but for antibiotics, NSAIDs and anxiolytics, this association was positive and consistent with the neighbourhood income findings. For the remainder of the discussion, we draw on the literature to propose reasons for the geographic variation of individual drugs.

Antibiotics were, by far, the most frequently dispensed drug, accounting for 36% of all prescriptions and 44% of all children. Sixty percent of children under 5 years of age received at least one prescription for an antibiotic. Young children were much more likely to receive multiple courses of antibiotics, which is a risk factor for antibiotic resistance.[8,15] Close to 5% of children living among the least healthy populations of Winnipeg received five or more prescriptions for an antibiotic in 1998/99, significantly higher than the overall rate for Winnipeg. As reported by others, antibiotic prescription utilization increased with decreasing neighbourhood income in urban areas.[16] Antibiotics are frequently prescribed for respiratory tract and ear infections in preschool children.[17] In our study, antibiotic use was greater in Winnipeg CAs with higher rates of lower respiratory tract infections. Concern has been raised over the inappropriate prescribing of antibiotics in respiratory tract infections of viral etiology, and over long courses of antibiotics in ear infections.[7,17]

Iron treatment was most frequent among preschool children. Iron prescription rates in northern areas may underestimate the extent of iron deficiency anaemia in First Nations children, which has been estimated to be 50% in some Aboriginal populations.[18] Substantially higher iron supplementation rates were documented in Winnipeg neighbourhoods with a high First Nations and new immigrant Asian population in comparison to other neighbourhoods.[19] Iron deficiency anaemia is reported to be twice as common among children of new immigrant parents from Asia[20] and 4-fold as common in low compared with higher income children. Iron deficiency anaemia can be associated with developmental delay if left untreated in early childhood.[20,21] This outcome may not be fully reversible with treatment, but iron deficiency anaemia can be prevented through nutrition counselling of pregnant women and increased availability of affordable iron-rich foods in low-income areas.[20]

Physicians have realized over the past decade that children feel pain as keenly as adults do and that their pain should be treated.[22] Approximately 3% of children received prescriptions for NSAIDs and narcotic analgesics. Analgesics are frequently prescribed to children presenting to emergency with injury.[23] The pattern of analgesic use paralleled the neighbourhood income association with injury hospitalization reported in this supplement.[24] Unlike the male dominance of injury rates, we found that female children were more likely to receive NSAIDs than male children. Two possible explanations for this non-concurrence of findings are that male children with injury are less likely to receive analgesic prescriptions, or analgesics are being prescribed to female children for other reasons. Little is known about the epidemiology of pain in children, but chronic pain is not uncommon in childhood and adolescence. Chronic pain such as headache and abdominal pain is more common in female adolescents, and there are calls for further investigation into the psycho-social causes of this female predominance.[25]

The dramatic increase in prescribing of psychostimulants such as Ritalin has received public attention.[22] Rates of psychostimulant prescription use in Manitoba children have doubled over the past three years.[24] Psychostimulant prescriptions were received most often by male children aged 10-14 years. Similar age and gender patterns of psychostimulant use have been reported by others.[26,27] The receipt of psychostimulant prescriptions was significantly higher in urban RHAs such as Winnipeg and Brandon, and in two Winnipeg CAs. Geographical variations in psychostimulant use, on the order of 5- to 10-fold differences, have been documented by others.[26,27] This variation has not been explained by socioeconomic or ethnic composition. We also observed no trend in psychostimulant prescription use across urban neighbourhood incomes.

The prescription of antidepressants has increased in children subsequent to the availability of newer agents with fewer side effects.[28] While higher use in school-age males probably represented antidepressant treatment of nocturnal enuresis in our study,[29] adolescent females were the most likely to receive prescriptions for antidepressants. Geographic variation in the use of psychotropics has been related to the prevalence of mental disorders, drug insurance policies, school referral programs, physician specialty training, parental disclosure of problems and family cultural

values.[30,31] The latter may explain lower use in the Inkster Winnipeg CA, an area with a high concentration of Asian immigrant households. The trend towards increased utilization of antidepressants in lower income levels in urban areas parallels reports of increased depression/emotional-disorder anxiety among children from lower income households,[32] but there are concerns over the long-term safety of antidepressants in children.[33]

Antipsychotics have traditionally been used to treat acute psychoses such as schizophrenia, which usually develops after the age of 15.[22] In our data, adolescents most often received prescriptions for these agents. The utilization of antipsychotics was highest among children living in the Downtown Winnipeg CA, and increased with decreasing neighbourhood income level in urban areas, which may or not be related to the existence of residential treatment facilities in this area. Children as young as 0-4 years old were treated with antipsychotics, consistent with the trend of increased use of newer antipsychotics for the treatment of aggressive behaviour in preschoolers.[30,34] Although serious behavioural and emotional problems have been identified in preschoolers,[35] the use of antipsychotics in this age group raises concerns about the potential for adverse effects on the developing brain.[30]

Adolescent females were twice as likely to receive prescriptions for anxiolytics than males, a finding which is compatible with higher rates of anxiety in teenage females than in males.[36] However, the over-prescription of anxiolytics, such as benzodiazepines, in women has long been criticized.[37] RHAs with less healthy populations had highest rates of use; higher use was concentrated in children 5-9 years, which may be related to benzodiazepine treatment of febrile seizures.[38] Anxiolytic prescription utilization increased with decreasing income level in urban areas, as has been reported by others.[39] Schoolchildren living in low-income households may be at risk of receiving a benzodiazepine prescription because they are more likely to have emotional-disorder anxiety than children living in higher income households.[32] Benzodiazepines are considered safe and effective in short-term therapy, but long-term use is a clear risk factor for abuse and dependency.[39]

In conclusion, we documented regional variation in prescription use, which may be related to differences in need, physician practice or patient use. Analyses that link prescription and diagnosis data are necessary to make this determination. Further, as high rates of use for drugs such as antibiotics, are associated with negative outcomes, assessments to determine appropriateness of use are necessary.

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RÉSUMÉ

Contexte : Les études représentatives sur la consommation de produits pharmaceutiques par les enfants renseignent sur la prévalence des maladies, la pratique médicale et l'assiduité aux traitements. On examine ici les écarts régionaux dans la consommation de médicaments sur ordonnance par les enfants manitobains.

Méthode : À l'aide des données représentatives du Manitoba concernant les médicaments sur ordonnance (1998-1999), on a déterminé la prévalence des enfants s'étant fait prescrire des antibiotiques, des analgésiques, des suppléments de fer et quatre catégories de psychotropes dans les ORS et les CR de Winnipeg, classés selon une mesure de l'état de santé de la population (le TMP). On présente aussi les taux de prévalence en fonction du niveau de revenu des quartiers (selon le recensement).

Résultats : Soixante p. cent des enfants s'étaient fait prescrire au moins un médicament en 1998-1999. Les plus communément délivrés étaient les antibiotiques, les antiasthmatiques, les analgésiques, les antidépressifs et les psychostimulants. C'est dans les quartiers urbains à faible revenu que la consommation d'antibiotiques, de suppléments de fer, d'analgésiques, d'antidépressifs, d'antipsychotiques et d'anxiolytiques sur ordonnance était la plus élevée. On observe peu d'associations entre le TMP d'une région donnée et la consommation de médicaments sur ordonnance, mais les enfants vivant dans les régions où l'état de santé de la population était relativement mauvais étaient plus susceptibles de consommer des antibiotiques, des anti-inflammatoires non stéroïdiens et des anxiolytiques. La consommation de psychostimulants n'était pas liée au niveau de revenu des quartiers, mais les taux les plus élevés ont été documentés dans certains des quartiers les plus aisés de Winnipeg.

Conclusion : Les écarts régionaux observés dans la consommation de médicaments sur ordonnance pourraient être liés aux écarts dans l'état de santé, les pratiques des médecins ou la consommation par les enfants.

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Community Resources and Determinants of the Future Health of Manitobans

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ABSTRACT

Background: Life history studies in health show that some of the key determinants of health inequalities lie in biological and social experiences at the earliest times of life. The objectives of this research were to describe the regional distribution of childhood determinants of adult health, such as school achievement, and the environments which contribute to their development.

Methods: Using Manitoba data from the National Population Health Survey, the National Longitudinal Survey on Children and Youth, the Department of Education, Training and Youth, the Department of Family Services and Housing, the Library Association website and the Agriculture and Food website, the regional distribution of Grade 3 standards test scores and neighbourhood resources such as child care services, libraries, sports participation and food costs were determined for 12 Regional Health Authorities and 12 Winnipeg Community Areas, ranked by a measure of population healthiness, the premature mortality rate. Findings were also reported by income level and larger geographic regions.

Results: Children living in neighbourhoods with less healthy populations were more likely to have poorer school performance, as indicated by Grade 3 math standards test scores. They were also more likely to change schools, less likely to participate in sports, and had decreased access to affordable food and licenced day care. They had similar access to library books as children living in more healthy neighbourhoods, although book lending rates were not measured.

Conclusion: We documented regional variation in the availability of resources to support healthy childhood development.

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

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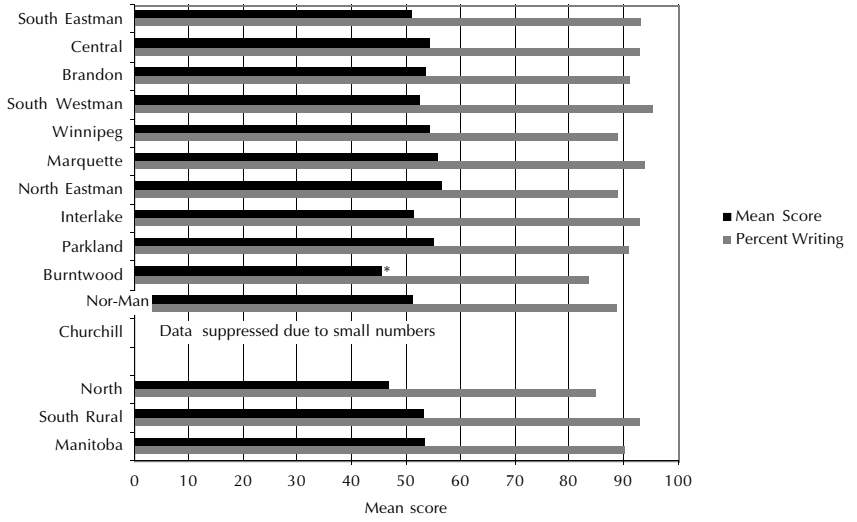
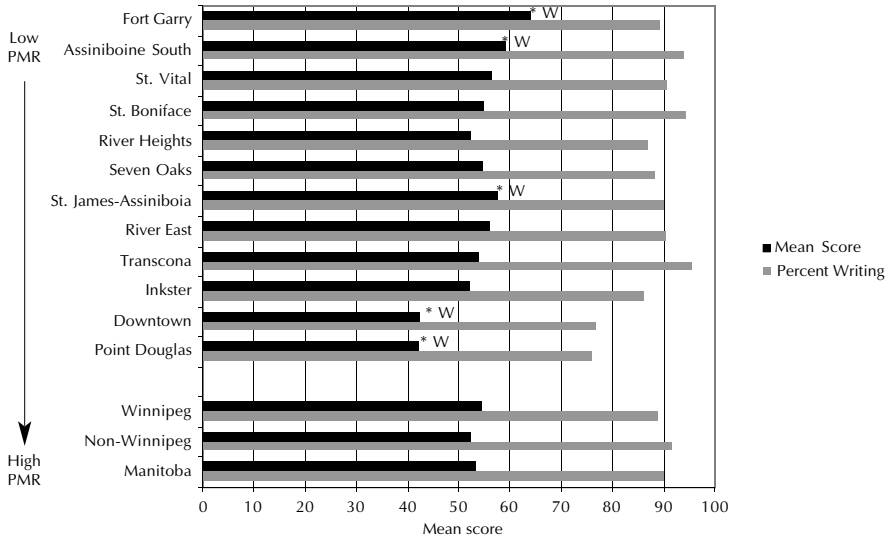
Life history studies provide preliminary evidence that some of the key determinants of health inequalities lie in biological and social experiences at the earliest times of life.[1-3] Good health in adulthood is predicated by good health in childhood. Chronic conditions in childhood, such as diabetes or seizure disorders, continue to affect quality of life throughout the lifespan. Events such as teen pregnancy also have a long-term impact; young lone parents are more likely to live in poverty.[4,5] Other childhood determinants of adult health include school achievement and the acquisition of risk factors for chronic disease. The latter has a direct effect on the development of cardiovascular disease in adulthood.[6,7] The former sets the child on a lifelong trajectory. Children who have poor school performance are less likely to complete high school.[8] Level of education influences health through its association with work conditions (e.g., being employed, fewer economic burdens, more satisfying occupations), social-psychological factors (e.g., sense of control and self-efficacy with regard to life generally and health), and healthy lifestyle factors (e.g., smoking, exercise).[9] It is well known that the chances of living in poverty increase as level of education decreases.[10]

The objectives of this research were to describe the regional distribution of childhood determinants of adult health and the environments which contribute to their development. Children encounter three major social environments from birth to adolescence: household, neighbourhood and school.[11] The household environment is important in early childhood to outcomes such as injury, but also influences school achievement.[12,13] As children grow older, the neighbourhood environment becomes more influential.[14] In this paper, we present information on neighbourhood resources that affect determinants of adult health: school achievement and health risk factors. Such an approach is consistent with the broader portrait of child health and additionally, identifies a developmental pathway that fosters healthy adulthood.[15] Further, the distribution of neighbourhood resources is related to the socioeconomic status of the neighbourhood, contributing to evidence on the uneven allocation of resources and their impact on the child, and eventual impact on adult health.[16-22]



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05

Figure 1. Grade 3 mean math scores by RHA, 1998 (Manitoba Education, Training and Youth)



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
W - Rate significantly different from Winnipeg mean at p<0.05

Figure 2. Grade 3 mean math scores by Winnipeg CA, 1998 (Manitoba Education, Training and Youth)

METHODS

Findings are presented in two sections: school achievement and availability of neighbourhood resources. The rationale for measures and data sources used are described under each section. The common framework described in Brownell et al.[23] was employed; findings are presented by Regional Health Authority (RHA) and Winnipeg Community Area (Winnipeg CA), and ranked by the premature mortality rate (PMR), a measure of the healthiness of a population.[24,25] Using t-test methodology developed by Carriere and Roos,[26] treatment prevalence rates for individual RHAs and Winnipeg CAs were compared, at the 99% level of confidence, to the total Manitoba child population, Winnipeg, Non-Winnipeg (all children residing outside of Winnipeg), rural south (children residing in rural regions below the 53rd parallel) and north (children residing in regions above the 53rd parallel). Visual inspections of the regional rates, ranked according to PMR (lowest to highest), were performed to provide insight into the relationship with the healthiness of the population within a region (PMR). To further assess the association with PMR, treatment prevalence rates for regions were correlated with region PMR, using Spearman's rank. In the absence of data at the level of the RHA and Winnipeg CA, findings were also reported by income level and rural/urban area.

RESULTS

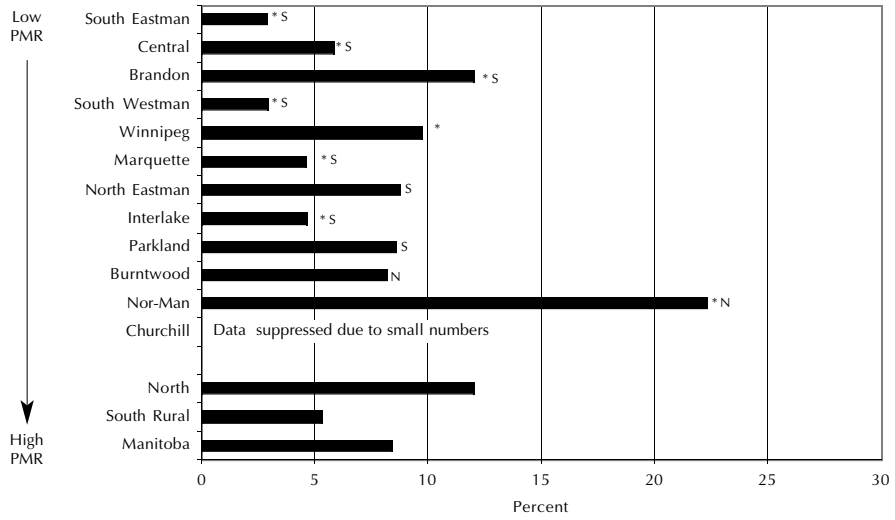
School achievement and household mobility

Documenting population-based indicators of educational achievement in children represents the first step towards determining the importance of education in moderating the socioeconomic gradient in health. We present area-based data on the educational achievements of Manitoba children available from the database of Manitoba Education, Training and Youth. These data include the publicly available results of the 1997-98 Grade 3 mathematics standards tests. Standards tests are developed to reflect learning outcomes in the school curriculum and are pilot tested in a sample of students prior to use at the provincial level. All schools in the province participated in writing these exams, with the exception of First Nations-operated schools and non-funded independent schools. Given that standard tests were administered on a province-wide basis and were centrally marked, comparisons across regions were possible. Test scores were school-based and aggregated to RHAs and Winnipeg CAs. Mean test scores were weighted by the number of students writing the exam. Data from funded independent schools were excluded because test scores could not always be attributed to specific geographical areas (i.e., students travelling out of their neighbourhood to attend a particular independent school). Overall, 8% of grade 3-aged Manitoba children who were enrolled in First Nations-operated schools did not write the standards tests. However, in the RHAs of Burntwood, North Eastman and Nor-Man, this statistic increased to over one third of grade 3-aged children enrolled in First Nations-operated schools.

Figures 1 and 2 show the mean score on a province-wide Grade 3 Mathematics test,

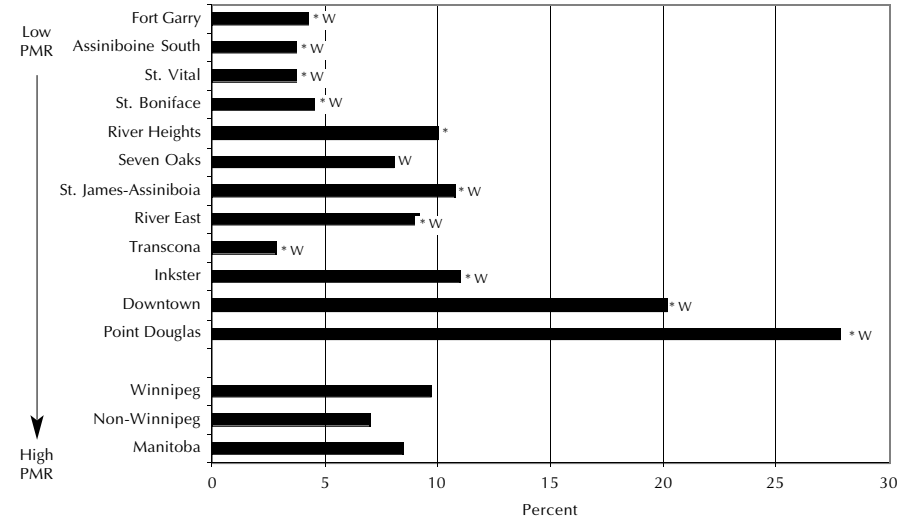
by RHA and Winnipeg CA, respectively. Presented also are the percentage of children registered in Grade 3 who wrote the exam, recognizing that this may vary by region and be a potential source of bias in the findings. Students who did not write the exam were those who were either absent on exam day, or exempt from writing (e.g., students with special needs or in modified programs). Little variation was observed across RHAs where mean scores varied from 45.2 in Burntwood to 56.3 in North Eastman. However, these findings may not represent the educational achievements of children in RHAs which had a very high percentage of children attending First Nations-operated schools. In Winnipeg areas, we documented greater variability in mean scores across areas, ranging from 42.1 and 42.0 in the Downtown and Point Douglas areas, respectively, to 63.9 in the Fort Garry area. Examination of Figure 2 also reveals some variation in the percent of students writing exams across Winnipeg areas. The highest percentage of students not writing was observed in areas where scores also tended to be lower. We might speculate that the addition of absent students would enhance the observed gradient across areas. The correlation between PMR rank and mean scores was relatively weak for RHAs (r=-0.11, ns). Across Winnipeg areas, however, we observed a clear pattern of lower test scores in areas where the populations have relatively poorer health and higher socioeconomic risk. (r=-0.84, p<0.001).

Household mobility is one of many factors that influence a child's ability to take advantage of the educational opportunities afforded. Children who move frequently are less likely to complete school.[27] Household mobility also affects neighbourhood stability. To better understand the regional distribution of household mobility, the percent of enrolled students in each RHA and Winnipeg CA who transferred from a school in each of the areas to some other school (all grades included) were obtained from Manitoba Education, Training and Youth. Figures 3 and 4 present these data by RHA and Winnipeg CA, respectively. While we observed regional variation across both RHAs and Winnipeg CAs, the results across Winnipeg areas appear to parallel the gradient observed for Grade 3 math scores; a higher percentage of transfers were found in areas in which populations are at higher health and socioeconomic risk. Correlations between rank PMR and percent transfers were much weaker for RHAs (r=0.43, ns) than for Winnipeg CAs (r=0.66, p<0.05).



Statistical Significance:
* - Rate significantly different from Manitoba mean at p<0.05
N - Rate significantly different from mean for Northern Manitoba at p<0.05
S - Rate significantly different from mean for Rural South Manitoba at p<0.05

Figure 3. Percent of school transfers by RHA, 1997-98 (Manitoba Education, Training and Youth)



Statistical Significance:
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W - Rate significantly different from Winnipeg mean at p<0.05

Figure 4. Percent of school transfers by Winnipeg CA, 1997-98 (Manitoba Education, Training and Youth)

Neighbourhood resources

Healthy communities, or neighbourhoods, provide opportunities for residents to maintain or improve their physical and mental health, and for children to learn.[18] The impact of communities, beyond the influence of the family, has been documented. For example, at age three years, children from more affluent neighbourhoods have higher IQ scores than children from less affluent neighbourhoods, even after controlling for differences in family resources.[28] At early school age, independent of family factors, higher neighbourhood socioeconomic status and less neighbourhood crowding remain significantly related to higher cognitive functioning.[29] Adjusting for family characteristics such as income

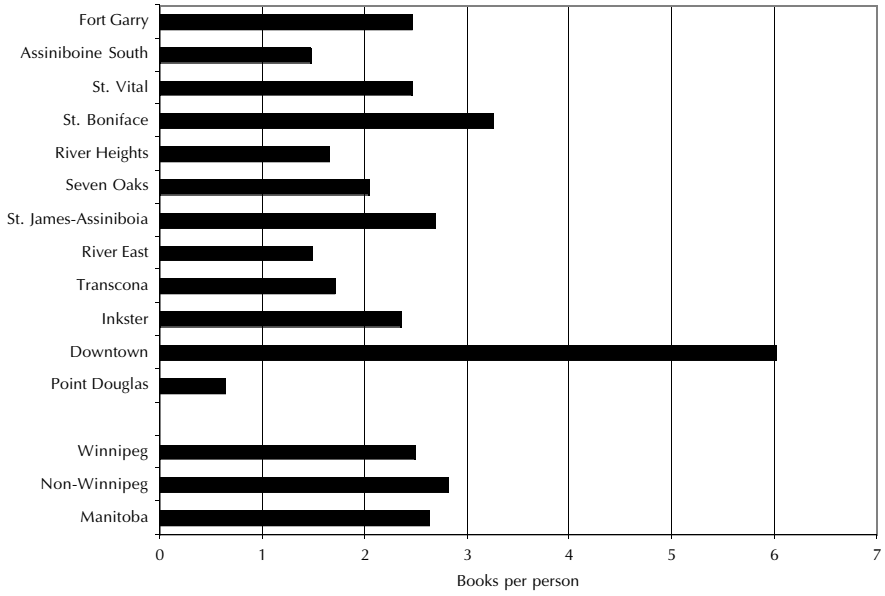

Figure 5. Public library books per person by Winnipeg CA

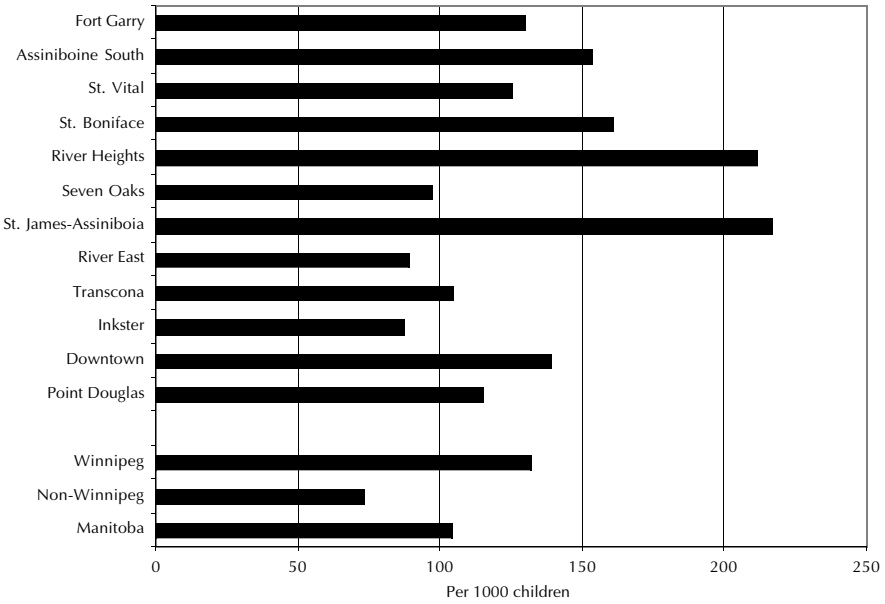

Figure 6. Child day care spaces for children aged 0-12 years by Winnipeg CA, 2000

level, children from more affluent communities continue to show better developmental outcomes through adolescence, as evidenced by lower teenage pregnancy and school dropout rates.[14] More affluent communities often have more resources such as libraries, community programs, museums, and sports facilities. The presence of neighbourhood resources has been known to influence children's behaviour and development.[30,31] In this section, we present information about the distribution of select community resources in Manitoba.

Libraries

Public libraries are places for children to improve their reading skills, to participate in story times or other reading programs, and for parents to find information on many topics such as healthy child development.[32] "Libraries cannot solve all of the problems kids have, but they can and do make a tremendous difference".[33]

In Manitoba, there are over one hundred public libraries. The number of books stocked by individual libraries was determined from the Manitoba Library Association web site (www.mla.mb.ca/) and totalled across libraries located within RHAs and Winnipeg CAs. Figure 5 shows the number of library books per person in each Winnipeg CA, excluding the number of books in school libraries. The large number of books per person in the Downtown Winnipeg area is due to the location of the main branch of the Winnipeg Public Library. Child access to books was also similar across RHAs. The number of library books in a region was not significantly correlated with PMR for either RHAs (Spearman r=0.22, ns) or Winnipeg CAs (Spearman r=-0.10, ns). Further, children may have access to many more books than indicated because the regional library systems share books and bookmobiles visit smaller communities that may not have their own libraries (L. Innerst, Dauphin Public Library, July 20, 2000).

Child Care

High quality child day care encourages children to develop social, language, and cognitive skills, and often compensates for poor family conditions.[34] Quality child care also benefits families, communities and society when access to high quality child care allows parents to find and keep jobs, a key step in improving the health of their children.[35,36] Although not the only criterion for quality, licensure of a child care facility has been associated with higher quality care. According to the Childcare Research and Resource Unit,[37] Manitoba has the fourth highest number of regulated child day care spaces available (105) per 1000 children age 0-12 years in Canada, after Prince Edward Island (154), Quebec (149), and British Columbia (108).

The number of licenced child day care spaces per RHA and Winnipeg CA was obtained from Manitoba Family Services and Housing. Figure 6 shows the number of licenced child day care spaces per 1000 children aged 0-12 years across Winnipeg CAs. Similar to RHA patterns, regions with healthier populations had more day care spaces per 1000 children, but these correlations were non-significant at both the RHA (Spearman r=-0.09, ns) and Winnipeg CA (Spearman r=-0.40, ns) levels. Information on unlicenced home day cares is available from the National Longitudinal Survey of Children and Youth (NLSCY), where results show an additional 131 children per 1000 were in unregulated care.

Sports Programs and Physical Activity

Sports programs, both supervised and unsupervised, are part of many children's community resources. According to Sport Manitoba (B. Moroz, Sport Manitoba Communications, January 4, 2000), 95% of all schools in Manitoba have a basketball court and almost every community has either indoor or outdoor ice rinks. These facilities may or may not get used by children, and aspects of the community itself may affect participation. In addition to preventing traffic injuries in children,[38] the presence of parks, playgrounds, and other play spaces, or having a supportive neighbourhood, tends to increase participation in sports.[39] When children participate in community sports programs – they benefit in many ways – for example, by developing preventive strategies to protect themselves against the potentially negative effects of stress and trauma.[40]

Physical activity also has positive effects on both physical health and emotional well-being. Children can gain a sense of mastery and competence from participating in both organized and unorganized sports. According to the 1996 NLSCY, almost 35% of Manitoba children under the age of 14 years watched one or less hours of television a day. On the other hand, close to 25% of Manitoba children spent three or more hours a day watching television. Seventy percent of Manitoba children frequently (more than once per week) participated in some form of organized or unorganized sport. In *urban* areas (Winnipeg and Brandon) children from low-income families were less likely to participate frequently in sports (54.1%) than children from high-income families (71.8%). (Caution must be exercised in interpreting group differences found with NLSCY data, as significance tests controlling for sampling variability were unavailable). In *rural* areas, participation in sports did not vary according to family income. In both urban and rural areas, children in families with mothers who had some post-secondary education were somewhat more likely to participate frequently in sports (77.4%) than those with mothers who did not have this level of education (66.4%).

One possible outcome of inactivity in children is obesity. Obesity in childhood can have serious consequences in adulthood,[41,42] including continued obesity.[43-46] There is ample evidence linking obesity with health problems including coronary heart disease[47] and diabetes.[48] Childhood obesity has increased over the past several years, with approximately one in four children experiencing problems of overweight.[49,50] Increased rates of obesity in children have been paralleled by dramatic increases in sedentary activities such as TV watching, and computer and video games.[51] The Body Mass Index (kilogram/metres^2) of Manitoba children was calculated from weight and height data in the 1996 National Population Health Survey (NPHS).[52] Values in excess of age-gender cutoffs for the 85th percentile of Body Mass Index, based on the NHANES I survey, were selected as indicators of obesity or risk for obesity.[53] Almost 29% of Manitoba children were obese or at risk for obesity, ranging from 23% to 36% across RHAs. Regional differences were not statistically significant, possibly due to the high sampling variability in the NPHS data.

Nutrition

Healthy diets are important for children's health, not only with respect to obesity and overweight, but also with respect to malnourishment. Child hunger affects school performance.[54] Further, longitudinal research has shown that adult health is influenced by nutrition in childhood.[55] The cost of food in a region is another neighbourhood resource that can affect child health when healthy food intake is more difficult for children in regions where food costs are high. A study by Alderson and Ogden[55] reported that the quality of food was an important motivator for mothers when choosing food for their children, but cost and availability were motivators when mothers chose food for themselves. Both cost and quality of food have been found to vary by geographic location; families living in lower income or inner-city urban areas have less access to healthy and affordable food.[56,57]

Yearly food costs in different regions of Manitoba were obtained from the Manitoba Agriculture and Food web site (http://www.gov.mb.ca/agriculture/homeec/cba24s01.html). Food basket costs were obtained from stores in each region in October 1998. A food basket contained 5-12 servings of grain products, 5-10 servings of vegetables and fruits, 2-4 servings of milk products, and 2-3 servings of meat and alternatives per day per person, based on a family of two adults and two children. The yearly cost of a food basket for a family of four in a small northern community was nearly $1,400 higher than for the same family in Winnipeg. The most expensive places to feed an infant were small communities in South Westman, where it was approximately $500 more expensive per year than in Winnipeg.

DISCUSSION

Thirty percent of Winnipeg children under the age of 15 and 30% of children aged 15 to 24 years lived in poverty in 1995.[10] Poor children are beset with numerous material, environment, and social burdens that impact on future health. We obtained information from a variety of data sources to describe future determinants of health in children and the neighbourhood resources which shape these determinants. There were several limitations to the measures created, namely resulting from the lack of available data. For example, we had no regional information on unlicenced day care or the availability of children's books in libraries. However, within the constraints of some of these measures, we were able to identify potential risks to health faced by children living in neighbourhoods with the least healthy populations. We know that neighbourhoods with the least healthy populations also had lower socioeconomic status.[58]

Our findings indicate that children living in neighbourhoods with less healthy populations were more likely to have poorer school performance, as indicated by Grade 3 math standards test scores. This places them at increased risk for not completing high school and following a pathway to poorer health in adulthood.[8] While these children had similar access to library books as children living in more healthy neighbourhoods, they were also more likely to change schools and to have decreased access to licenced day care, circumstances which can lead to poor school performance.[27,34] There was also some indication that low-income children in urban areas were less likely to participate in sports, and children residing in northern rural areas had decreased access to affordable healthy food.

Although not borne out by our data, these examples of decreased access to health-enhancing neighbourhood resources may predispose children to the development of obesity and future cardiovascular disease.

The provision of the basic necessities for healthy human growth and development, in addition to being a basic human right, lays the foundation for the reduction of inequalities in health. Some have likened the underinvestment in children in low-income neighbourhoods to a policy of 'compound disinterest,' which leads to a cumulative and accelerating societal deficit in health, well-being, and productivity.[59] While the availability and use of neighbourhood resources are closely tied, availability does not guarantee use. Resources may not be used because people choose not to use them or do not know about them, or because of barriers to use, such as language, transportation, and user fees.[31] Investigation into actual use of neighbourhood resources is required to fully understand the influence of neighbourhoods as a determinant of the current and future health of children.

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RÉSUMÉ

Contexte : Les études sur les cycles évolutifs de l'état de santé montrent que certains déterminants clés des inégalités en matière de santé découlent d'expériences biologiques et sociales vécues pendant l'enfance. On examine ici la répartition régionale des déterminants de la santé des adultes qui datent de l'enfance (comme la réussite scolaire) et les milieux qui contribuent au développement de ces déterminants.

Méthode : À l'aide des données manitobaines de l'Enquête nationale sur la santé de la population, de l'Enquête longitudinale nationale sur les enfants et les jeunes et des données du ministère de l'Éducation, de la Formation professionnelle et de la Jeunesse, du ministère des Services à la famille et du Logement et des sites Web de l'Association des bibliothécaires et du ministère de l'Agriculture et de l'Alimentation, on a déterminé la répartition régionale des notes aux examens standardisés de 3e année, des ressources de quartier (garderies, bibliothèques), de l'activité sportive et du coût des aliments dans 12 ORS et 12 CR de Winnipeg, classés selon une mesure de l'état de santé de la population (le TMP). Les constatations sont également présentées selon le niveau de revenu et la sous-région.

Résultats : Les enfants des quartiers dont l'état de santé de la population est relativement mauvais étaient plus susceptibles d'avoir de piètres résultats scolaires, comme en témoignent les résultats aux examens standardisés de 3e année. Ils étaient aussi relativement plus nombreux à changer d'école, relativement moins nombreux à pratiquer un sport et avaient moins accès à des aliments à bon prix et à des garderies agréées. Leur accès aux livres de bibliothèque était semblable à celui des enfants des quartiers en meilleure santé, mais les taux de prêt des livres n'ont pas été mesurés.

Conclusion : Il existe des écarts régionaux dans la disponibilité des ressources à l'appui du développement de l'enfant.

EPILOGUE

The Virtual Classroom

A Summary of Child Health Indicators

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ABSTRACT

Objective: To provide an overview of child health indicators and health care utilization patterns in Manitoba by comparing child health outcomes for different income groups: a) children from two different community areas of Winnipeg (Fort Garry and Point Douglas), and b) adolescents from two different parts of Manitoba (the North, and Winnipeg).

Methods: Various child health indicators derived from population-based administrative data and national surveys are reported in the articles within this supplement. Childhood morbidity and mortality, health care utilization patterns, pharmaceutical use, and regional demographic information discussed in the research articles in this supplement are summarized here using comparisons of outcomes in "virtual classrooms" of 100 children.

Results: Large gradients were observed in the comparison of the virtual classrooms of 100 high school students, including the following numbers of adolescents: females on birth control pills (Winnipeg 11, North 18); injury hospitalization annually (Winnipeg 1; North 4). Gradients are observed for some child outcomes of the virtual classroom of 100, but not for others. Examples include the following numbers of children: preterm at birth (FG 7, PD 7); breastfed at birth (FG 90, PD 66); hospitalized for lower respiratory tract infection in first year (FG 3, PD 8); parents having no high school (FG 11; PD 41).

Conclusion: Throughout Manitoba, child and adolescent health indicators and determinants of health show gradients by income as well as by geographical regions.

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

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Greenwood,[1] a health statistician, once made the comment that "health statistics represent people with the tears wiped off." Health statistics can, at times, distance a reader from the reality of the grassroots situation unless the data are translated into tangible word-pictures. This summary article attempts to translate the child health statistics from the various papers in the supplement into vivid word-pictures through the use of a "virtual classroom" image. One comparison focuses on differentials in adolescent health – a virtual high school of 100 students from northern Manitoba compared to the same age group in Winnipeg. The second virtual classroom comparison matches cohorts of children residing in two areas of Winnipeg – the community area with the most healthy population (Fort Garry) versus that with the least healthy population (Point Douglas). As well, our focus throughout this supplement has included two other concepts, or themes, that highlight child health differences – income level and the healthiness of the community in which the children reside. Not surprisingly, some recurring patterns emerge from many of the papers as to their effects.

The effect of income level on child health

For the majority of the indicators studied, we found that the higher the neighbourhood income level, the better the outcomes for the children. It was not just the case that those children living in poverty had poor health and the rest of the children were indistinguishable. With every increase in neighbourhood income level, there tends to be an increase in favourable outcomes. For example, at the perinatal stage, the lower the income level the greater is the likelihood that the infant will: be born at a low birthweight (which has multiple potential problems associated with it),[2] be readmitted to hospital,[2] be hospitalized for lower respiratory tract infections,[3] and die in the first year of life.[4] Even in terms of perinatal preventive health measures, the lower the income the less is the likelihood that the infant will be breastfed.[2]

As children grow and develop, the impact of income continues to be felt. The lower the income level, the greater the likelihood the child will be hospitalized for any reason,[5] or be hospitalized or die from injury.[6] In relationship to their health needs, the good news is that children from lower income groups are more likely to visit

a physician (urban children), but the downside is that they are less likely to have a usual provider for care and less likely to see a specialist.[5] Decreasing income is also associated with an increase in a number of prescription medications: antibiotics (urban children only), iron supplements, pain relief drugs, antidepressants (urban children only), antipsychotics (urban children only) and anxiolytics (urban children only).[7] During adolescence, decreasing income is associated with increasing teen pregnancies.[8]

Embedding child health within regional population health

Health outcomes and health care use also vary considerably across regions in Manitoba. And for many of the child health indicators examined, this regional variation is not random but related to characteristics within the regions themselves. How healthy the population is within a region is related to the socioeconomic conditions within that region, and both these in turn are related to many of the indicators of child health. The poorer the health of the population and the less favourable the socioeconomic conditions, the greater the likelihood of unfavourable child health outcomes. By ordering the graphs in this supplement by increasing premature mortality rate (PMR) down the *y*-axis, the regional graphs highlight the differences in child health associated with decreased regional population health and high socioeconomic risk (see Martens et al., this issue, explaining PMR and its relationship to the socioeconomic factor index SEFI).[9] As well, many of the papers in this supplement provide correlations of the various child health indicators with PMR and SEFI. As an example, Figure 1 shows increased health risk (infant mortality) with decreasing healthiness and socioeconomic well-being regionally.

There are significant positive associations between the PMR and numerous child health indicators, including such diverse indicators as child mortality,[4] not being breastfed,[2] teen pregnancy,[8] injury hospitalization and mortality,[6] overall hospitalization,[5] lower respiratory tract infection,[3] prescription rates for NSAIDs and antidepressants (at the RHA, but not at the Winnipeg area level),[7] Grade 3 math scores,[10] and percent of children transferred to different schools within a year.[10] On the other hand, some of the anomalies are just as interesting – e.g., those child health indicators not associated with the healthiness of the population, such as high birthweight rates,[2] some health conditions such as asthma, cardiovascular conditions, and seizure disorders,[3] some prescription rates such as ADHD drugs, narcotic analgesics and antipsychotics,[7] and availability of licenced day care spaces and library books.[10]

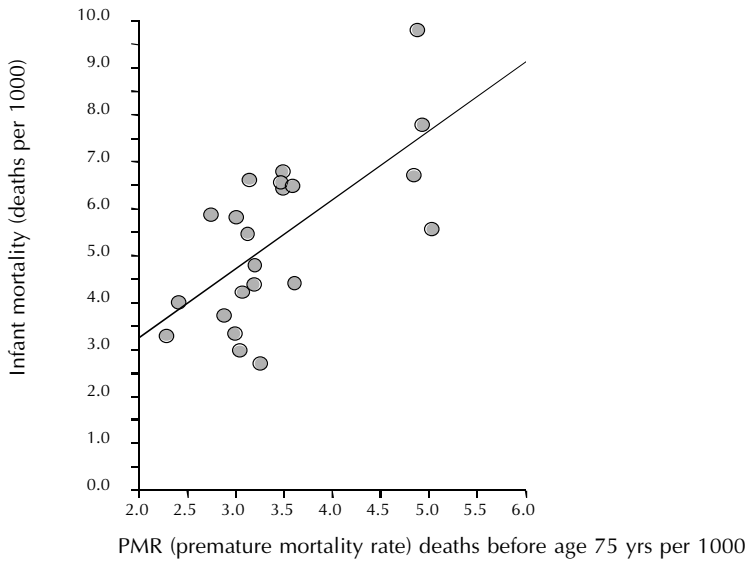

Figure 1. Regional proportion of infant mortality (excluding <500 g and <20 weeks gestation) versus regional premature mortality rate, RHAs and Winnipeg Community Areas

The virtual classrooms: Word-pictures of geographical disparities

How does all this information translate into the real world? Let's consider two different comparisons to illustrate the practical meaning of differences in child health indicators across regions. First, we compare two hypothetical high schools in two different regions of Manitoba, with 100 students in each (50 of each sex). Second, we compare two hypothetical cohorts of children in two different community areas within Winnipeg, looking at various measures over the childhood lifetime of 100 infants in each community area. The data for these comparisons are taken from various articles within this supplement.

High school comparison

For comparisons between a cohort of 100 adolescents in Winnipeg with 100 in the North, we used the averages of regional child health indicators applied to the cohort of 50 male and 50 female students in each. The North refers to the combined regional health authorities (RHA) of Burntwood, Churchill and Nor-Man. The RHAs in northern Manitoba tend to have the highest regional PMRs in the province, indicating that the regional populations are at high socioeconomic risk and in poorer health. See Table I for an overview of the adolescent virtual classroom comparison.

Compared to Winnipeg, the virtual classroom of high school students in the North will report a slightly higher number having sexual intercourse within the past year compared to Winnipeg (46 versus 42), but fewer will use condoms at last coitus (30 versus 36), possibly explaining the elevated rates of chlamydia in both males (1 versus 0) and females (4 versus 1) in the North. More females in the North will use oral contraceptives (18 versus 11) in comparison to Winnipeg females, yet over double the number of teen pregnancies will occur in the North (6 or 7 versus 3).

Over three times the number of North students will be hospitalized (18 versus 5) overall, with about one third of those hospitalizations requiring relocation to Winnipeg from the northern area. Hospitalization due to injury would affect 4 North teens compared to less than 1 teen in Winnipeg. Violence to self is over 10 times more likely to be the reason for injury hospitalization for teens from the North compared to their Winnipeg counterparts.

The Winnipeg teens will make more visits to physicians – 3.4 visits per student compared to 2.1 for the students in the North – despite the North being a region of poor

TABLE I

The Virtual Classroom: Comparisons of a High School in Winnipeg and in Northern Manitoba

In a High School of 100 Students (50 male, 50 female):

	Winnipeg	Northern RHAs
Sexual intercourse within the past year (d)	42	46
Used condoms the last time (d)	36 (86% of those sexually active)	29 (63% of those sexually active)
Females on birth control pill (d)	11	18
Teen pregnancy (d)	3 females	6 or 7 females
Chlamydia (d)	1 female, 0 male	4 females, 1 male
Injury hospitalization (f)*	1 (0.7)	4
Hospitalization for any reason (g) *	5 (almost all occurring in Winnipeg)	18 (about 1/3 of these are in Winnipeg)
Physician visits per person (g) *	4 per year (75% are with a GP)	2 per year (91% are with a GP)
Medications (h)	3 (2.5) on antidepressants, 1 on psychostimulants	1 (1.5) on antidepressants, 0 (0.25) on psychostimulants

Virtual classroom: comparisons of a high school in Winnipeg and in northern Manitoba
* this is age-specific data for ages 15 through 19 years, whereas the supplement article shows graphs for all ages.
a. Embedding child health within a framework of regional health: Population health status and sociodemographic indicators[9]
b. A matter of life and death for Manitoba's children: An overview of birth rates and mortality rates[4]
c. Being born in Manitoba: A look at perinatal health issues[2]
d. Factors affecting adolescent reproductive health in Manitoba[8]
e. Assessing health status in Manitoba children: Acute and chronic conditions[3]
f. Childhood injury rates in Manitoba: Socioeconomic influences[6]
g. Health service utilization by Manitoba children[5]
h. Prescription medications in Manitoba children: Are there regional differences?[7]
i. Community resources and determinants of the future health of Manitobans[10]

TABLE II

The Virtual Classroom: Comparisons of a Cohort of Young Children in Two Areas of Winnipeg Having the Poorest and Best Overall Healthiness

In a Cohort of 100 Children in Winnipeg:

	Fort Garry (Region with the Healthiest Population)	Point Douglas (Region with the Poorest Population Health)
Preterm (c)	7	7
Low birthweight (<2500 g) (c)	6	6
High birthweight (>4000 g) (c)	14	12
Breastfed at birth (c)	90	66
Infant mortality (b)	0	1
Admitted to hospital within 6 weeks of discharge (c)	2 to 3	4 to 5
At least one health care contact (MD or hospitalization) for lower respiratory tract infection in first year (e)	30	54
Hospitalized for lower respiratory tract infections in first year (e)	3	8
Hospitalizations (g)	2	5
Physician visits per child (g)	3.7 (48% with a GP)	4.5 (64% with a GP)
1-4 antibiotic prescriptions, 5+ (h)	41 get 1-4, 3 get ≥5	46 get 1-4, 5 get ≥5
Asthma (5-9 years old) (e)	14	14
Hospitalized for injury 0-19 years old (f)	0 (0.2)	1 (0.8)
Living in the lowest income quintile grouping (a)	10	56
Living in lone parent family (a)	12	28
Parents unemployed (a)	4	14
Parents having no high school (a)	11	41
Access to day care spaces (i)	13	11
Access to library books (i)	2.5 books per person	0.6 books per person
Average Grade 3 Math mark (i)	64%	42%
Transferred to another school during the year (i)	4	28

a. Embedding child health within a framework of regional health: Population health status and sociodemographic indicators[9]
b. A matter of life and death for Manitoba's children: An overview of birth rates and mortality rates[4]
c. Being born in Manitoba: A look at perinatal health issues[2]
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i. Community resources and determinants of the future health of Manitobans[10]

health. However, the northern teens may visit nursing stations for their health care needs and these visits are not captured in our database.[11] More of the Winnipeg teens will also be prescribed medications for mental health problems: 2 or 3 of our Winnipeg teens will be prescribed psychostimulants compared to 1 or 2 in the North, and 1 Winnipeg teen will be prescribed antidepressants compared to none in the North. Note, however, that dispensation of medications from nursing stations may lead to undercounting prescriptions for our northern students.

Winnipeg school comparison

Within Winnipeg, we have chosen two hypothetical virtual classrooms of younger children, one from the community area of Fort Garry which has the lowest PMR (and therefore the healthiest population and lowest socioeconomic risk), and the other from the community of Point Douglas with the highest PMR (the least healthy population and highest socioeconomic risk). The values shown in Table II for this comparison are for children of all ages.

Interestingly, about the same number in each classroom would be born with a low birthweight (6) or preterm (7), with only slight elevations in the Point Douglas area. The Fort Garry classroom would have 14 who had a high birthweight, compared to 12 in Point Douglas.

Once born, though, the differences for our two sets of children begin to emerge. Far fewer of the Point Douglas children were breastfed compared to the Fort Garry children (66 versus 90). And one of the children who would have gone to the Point Douglas school will die in the first year of life, whereas none of the Fort Garry children will die during this time period. Double the number of Point Douglas children will have been admitted to hospital as newborns within 6 weeks of discharge compared to Fort Garry (4 versus 2), and almost double will have a health care contact for a respiratory tract infection in their first year

of life (54 versus 30). More of the Point Douglas children will have been hospitalized for lower respiratory tract infection as an infant (8 versus 3). Clearly, in the first year of life, the disadvantages in terms of health and development for the Point Douglas children are already accruing.

Use of the health care system is somewhat related to overall population health disparity. In any given year, Point Douglas children will be hospitalized 2.5 times more than their Fort Garry counterparts (5 versus 2). Point Douglas children will also make more visits to physicians each year (4.5 visits each) compared to the Fort Garry children (3.7 visits each), however, a much higher percentage of Fort Garry children will see specialists. Considering the relative health disparity, it is surprising that the antibiotic prescription profiles are similar, with over 40 of the children in both classrooms having from 1 to 4 antibiotic prescriptions (46 Point Douglas, 41 Fort Garry), but more Point Douglas children will have had at least five prescriptions during the year (5 versus 3). One of the Point Douglas students will sustain an injury serious enough to be hospitalized, compared to none of the Fort Garry students. Interestingly, between 5 and 9 years of age, the number of students in each school with asthma will be the same (14).

Children in the Point Douglas school will experience socioeconomic conditions which put them at greater risk for poorer health, both in childhood and later in adulthood. Five times as many students in Point Douglas live in households where the income is in the lowest income quintile, compared with Fort Garry (56 versus 10). There are far more students in the Point Douglas classroom who live in lone parent families (28 versus 12), with unemployed parents (14 versus 4), and with parents who have not completed high school (41 versus 11). These factors may be related to the higher number of Point Douglas children who will transfer schools: 28 Point Douglas children will transfer schools at some point during the year, compared to only 4 Fort Garry children. It is no wonder that the performance of children from the two schools on Grade 3 Math tests also differs, with a mean score at the Point Douglas school of 42% compared to 65% at the Fort Garry school (scores are weighted for the number of students writing the exam).

Access to community resources also differs for the children at the two different schools. The children at the Fort Garry school have access to about 2.5 public library books per child, compared to less than 1 public library book for children at the Point Douglas school. There are also 13 day care spaces available to the 100 Fort Garry children, compared to 11 spaces for the Point Douglas children.

The last word

Health statistics do, indeed, implore the reader to look behind the numbers to the people. In this Epilogue, we have tried to bring to life the health statistics for the children of Manitoba by focussing on health indicators and health care use patterns of hypothetical groups of Manitoba children. By contrasting the extremes, we highlight the disparities by income, by neighbourhood, and by geographical region. The reader must also keep in mind, however, that child health within income groupings or geographical groupings is not always homogeneous. In every region and within every income level, there is room for improvement in child health. The child health indicators within this supplement enable us to call for action at the macro-level of policy and programs, addressing not only the individual health issues, but the socioeconomic well-being of the families, communities and regions in which our children reside.

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RÉSUMÉ

Objectif : Donner un aperçu des indicateurs de la santé des enfants et des modes d'utilisation des soins de santé au Manitoba en comparant les résultats de santé d'enfants pour différentes catégories de revenu : a) les enfants de deux communautés de la région de Winnipeg (Fort Garry et Point Douglas) et b) les adolescents de deux régions du Manitoba (le Nord et Winnipeg).

Méthode : Divers indicateurs de santé des enfants, dérivés de données administratives et d'enquêtes nationales représentatives, sont décrits dans les articles du présent supplément. La morbidité et la mortalité des enfants, les modes d'utilisation des soins de santé, la consommation de produits pharmaceutiques et les données démographiques régionales dont il est question dans le supplément sont résumés ici en comparant les résultats obtenus dans des « classes virtuelles » de 100 enfants.

Résultats : De hauts gradients ont été observés en comparant les classes virtuelles de 100 élèves du secondaire, notamment dans le nombre d'adolescentes prenant la pilule anticonceptionnelle (Winnipeg 11, Nord 18) et le nombre annuel d'élèves hospitalisés en raison de blessures (Winnipeg 1; Nord 4). Dans les classes virtuelles de 100 enfants, on a observé des gradients pour certains résultats, mais pas pour d'autres. Par exemple : nombre d'enfants nés avant terme (FG 7, PD 7); enfants allaités à la naissance (FG 90, PD 66); enfants hospitalisés pour des infections des voies respiratoires inférieures avant l'âge d'un an (FG 3, PD 8); et enfants dont les parents n'ont pas terminé leurs études secondaires (FG 11; PD 41).

Conclusion : Partout au Manitoba, les indicateurs et les déterminants de la santé des enfants et des adolescents montrent des gradients selon le revenu et la zone géographique.