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

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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.umaniota.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 health⁶⁻⁹ and long-term health outcomes¹⁰⁻¹⁴ 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 fetoinfant 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

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

the articles in this supplement. These methods do not apply to the article prepared by the Manitoba Health Epidemiology Unit.

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*}

* 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

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.

TABLE I

Population Size by Sex and Age Classification in RHAs, 1998

	0-4		5-9		10-14		15-19		20+		Total Population
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
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 Population
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
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. Vital	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
Transcona	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 Carrier 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 1^{er} 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.