

# The Burden of Seizures in Manitoba Children: A Population-Based Study

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**ABSTRACT: Background:** Population-based studies are necessary to better understand the risk factors for developing seizure disorders and the impact of these conditions on children. We undertook an assessment of the prevalence of seizure disorders in a population of children on the basis of health care utilization records. **Methods:** Using Manitoba's population-based prescription and health care data for 1998/99, the prevalence of children with seizure disorders, on the basis of at least one physician visit or hospitalization for epilepsy or a prescription for an antiepileptic drug, was determined by age, urban/rural region and socioeconomic status. The latter was measured as neighbourhoods stratified by income quintiles according to Census data. **Results:** Age-specific prevalence rates for seizure disorders in Manitoba children, determined from health care administrative records, were similar to published data on the prevalence of epilepsy, with one exception. Prevalence rates in adolescents were higher than those reported in the literature. No statistically significant differences in prevalence rates were observed between urban and rural populations. However, a higher prevalence was found among children of all ages living in lower socioeconomic neighbourhoods in urban areas, which presented as a gradient of increased prevalence with decreased levels of income. **Conclusions:** Population-based health care administrative data can be used to describe the geographical distribution of seizure disorders. Our data suggest that the burden of seizure disorders is not evenly distributed among children.

**RÉSUMÉ: Le fardeau des crises épileptiques chez les enfants du Manitoba: une étude de population.**

**Introduction:** Des études de population sont nécessaires pour mieux comprendre les facteurs de risque de l'apparition de troubles épileptiques et l'impact de ces troubles sur les enfants. Nous avons évalué la prévalence des troubles épileptiques dans une population d'enfants à partir des dossiers d'utilisation de soins de santé. **Méthodes:** La prévalence des troubles épileptiques chez l'enfant a été évaluée, selon l'âge, le lieu de résidence urbain ou rural et le statut socioéconomique, à partir des données de populations sur les prescriptions et les soins de santé au Manitoba. Les enfants étaient recensés si le diagnostic d'épilepsie avait été posé lors d'au moins une visite médicale ou d'une hospitalisation. Le statut socioéconomique était déterminé selon le lieu de résidence stratifié par quintiles de revenu selon les données du recensement. **Résultats:** Les taux de prévalence selon l'âge pour les troubles épileptiques chez les enfants du Manitoba, déterminés à partir des données administratives de soins de santé, étaient similaires aux données publiées sur la prévalence de l'épilepsie, à une exception près. Les taux de prévalence chez les adolescents étaient plus élevés que ceux rapportés dans la littérature. Il n'y avait pas de différences significatives dans les taux de prévalence entre les régions urbaines et rurales. Cependant, nous avons observé une prévalence plus élevée chez les enfants de tous âges dans les quartiers urbains de niveaux socioéconomiques plus bas, le taux de prévalence augmentant à mesure que le niveau de revenu décroît. **Conclusions:** Les données administratives sur les soins de santé dans une population peuvent être utilisées pour décrire la distribution géographique des troubles épileptiques. Nos données suggèrent que le fardeau des troubles épileptiques n'est pas réparti également chez les enfants.

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Seizures and epilepsy in children represent a chronic disability that impacts negatively on quality of life.<sup>1</sup> These disorders have implications for the child and family over and beyond the problem of seizures and their management. Behavioural problems, low self-esteem and poor academic performance are not uncommon.<sup>1</sup> Population-based studies are necessary to better understand the risk factors for developing seizure disorders and the impact of these conditions on children. Population-based data are also important for the planning of

health care services to provide optimal care to children with seizure disorders.

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There are few population-based studies on the prevalence of seizure disorders in children.<sup>1-3</sup> Prevalence studies that have been published are based on the case ascertainment of epilepsy from hospital visits, clinic databases, EEG records, and emergency room records.<sup>4</sup> These studies are time consuming and expensive to perform and, to-date, have been focused on the epidemiological aspects of epilepsy with respect to prevalence rates for age, sex, and specific epilepsy syndromes. Further, studies that are based on patients attending specialized clinics in urban areas do not provide a population view of the burden of seizure disorders in children. There is little information on the patterns of referral and treatment for these conditions in children or on the utilization of antiepileptic drugs. Still less is known about the distribution of seizure disorders and patterns of treatment in urban versus rural populations or in populations of different socioeconomic status. With the availability of many new antiepileptics in recent years, the impact of choice of an antiepileptic drug on the cost and outcomes of treatment is also in need of evaluation.<sup>5,6</sup>

Health care administrative datasets provide a useful means of studying chronic childhood illnesses.<sup>7</sup> Diagnosis information from physician billing claims and hospitalization records and data on antiepileptic prescriptions dispensed can be linked to identify children with seizure disorders and their subsequent treatment patterns. However, a potential limitation of using this type of data source, which is a product of how persons use health care services, is the under- or overestimation of disease prevalence. We wished to explore the usefulness of this data source in providing information on the population prevalence of seizures in children aged 0-19 years in the province of Manitoba. In this pilot study, we present data on the geographic distribution of seizure disorders by age.

## STUDY DESIGN

This was a cross-sectional study of the treatment prevalence of seizure disorders in Manitoba children in 1998/99, reported by geographic area and neighborhood income. The geographic areas used were the Rural South, the North and two urban areas: Winnipeg and Brandon.

### Study population and data sources

The study protocol was approved by the Human Research Ethics Board, University of Manitoba, and the Manitoba Health Access and Confidentiality Committee. Data were obtained on children aged 0 to 19 from the Population Health Research Data Repository 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 and (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 patient diagnosis at the three-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. 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 the Population Health Research Data Repository databases have been found to be high for describing population drug use and health care utilization for specific conditions.<sup>8,9</sup> However, physician fee-for-service reimbursement claims and prescriptions dispensed in northern Manitoba nursing stations are not consistently captured in the health care databases. Further, care must be taken when making inferences about disease prevalence from health care utilization data. Children living in rural areas are less likely to contact the health care system than children living in urban areas.<sup>10</sup> The face validity for determining the prevalence of seizure disorders from health care data was determined by comparing treatment prevalence rates to the prevalence of children with epilepsy reported for the 1996 Manitoba sample (n=4,144 children) of the National Population Health Survey (NPHS).<sup>11</sup> The NPHS is a longitudinal survey of the health status and health care use of a representative sample of children and adults in Canada. The presence of epilepsy was determined from the response to the question: "Does your child have epilepsy?"

### Study measures and analyses

Treatment for a seizure disorder was identified on the basis of a diagnosis for epilepsy (all ICD-9-CM codes for 345) documented in at least one physician claim or hospitalization record, or the receipt of at least one prescription for an antiepileptic drug (barbiturates, phenytoin, clobazam, clonazepam, succinimide derivatives, valproic acid, carbamazepine, GABA derivatives, lamotrigine, topiramate). The denominator was the population of children residing in Manitoba as of December 31, 1998. Age-specific treatment prevalence rates were determined for Manitoba, Winnipeg, Brandon, the Rural South (children residing in rural regions below the 53rd parallel), the North (children residing in regions above the 53rd parallel) and neighbourhood income quintiles. Children were located in these regions according to the postal code of their place of residence. Treatment rates were reported per 1000 children and compared across ages, regions and years at the 99% confidence level.

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 lowest income neighbourhoods to 20% of the population residing in the highest income neighbourhoods.<sup>12-14</sup> The association between the treatment prevalence rate and neighbourhood income level was assessed with the Cochran-Armitage test for trend, separately for urban and rural areas.

## RESULTS

The treatment prevalence for seizure disorders among Manitoba children in 1998/99 was 4.7 per 1000 children and

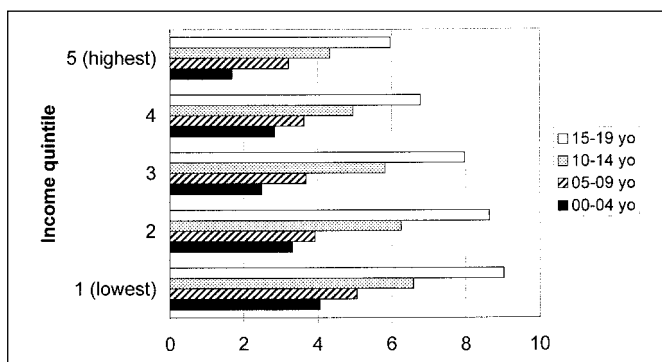


Figure 1: Treatment prevalence/1000 children of seizure disorders by age and urban income quintile, 1998/99

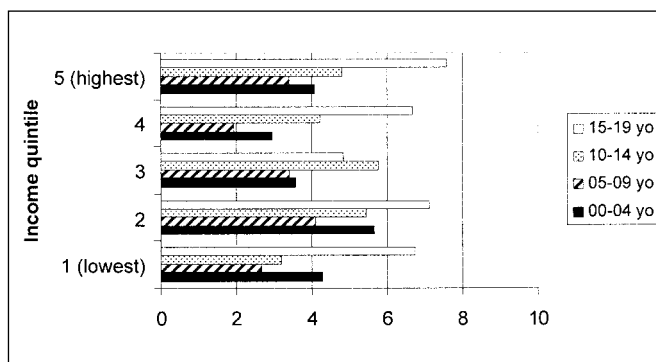


Figure 2: Treatment prevalence/1000 children of seizure disorders by age and rural income quintile, 1998/99

Table 1: Prevalence of Seizure Disorders by Age, Year and Data Source

Age group	Rate per 1000 Children				
	Survey Data			Health Care Data	
	1996	1996/97	99% CI	1998/99	99% CI
00-04 years	0.4	3.79	3.27-4.38	3.46	2.96-4.05
05-09 years	1.4	3.60	3.11-4.17	3.63	3.13-4.20
10-14 years	8.9	4.42	3.87-5.06	4.61	4.04-5.26
15-19 years	22.9	6.23	5.55-6.99	7.19	6.46-8.00
Total	8.4	4.49	4.20-4.80	4.72	4.40-5.00

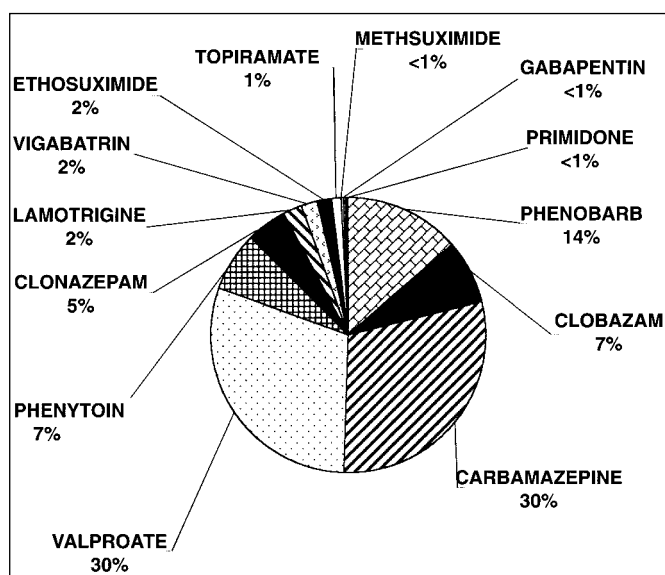
increased with age from 3.5 per 1000 in children less than five years old to 7.2 per 1000 children aged 15-19 years (Table 1). The prevalence rate in the oldest age group was significantly higher than the rate in children nine years of age and younger. The 1998/99-treatment prevalence and its distribution by age was very similar to the data for 1996/97. Survey estimates of the prevalence of age-specific seizure disorders among Manitoba children in 1996 (confidence intervals could not be estimated due to the small number of children in the survey) were not similar to the rates based on health care data.

Age-specific regional prevalence rates hovered around the provincial average and were not significantly different from each other (Table 2). The treatment prevalence of seizure disorders increased successively with decreasing level of neighbourhood income among children living in urban areas (Figure 1). The correlation with income was strongest in the youngest and oldest children. In rural areas (Figure 2), no variation by income quintile was observed, with the exception of children five years of age and younger where there was a suggestion of a trend (Cochran-Armitage test for trend,  $p=0.10$ ).

As shown in Figure 3, valproate (30%), carbamazepine (30%), phenobarbital (14%), clobazam (7%) and phenytoin (7%) were the most commonly dispensed antiepileptics; the newer anticonvulsants (GABA derivatives, lamotrigine, topiramate) individually accounted for 5% or less of prescriptions.

Table 2. Treatment Prevalence of Seizure Disorders by Region and Age, 1998/99

	Number of Children	Prevalence Rate/1000	99% Confidence Level	
			Lower	Upper
<b>Age 0-4 years old</b>				
North	7935	4.28	2.76	6.66
Rural South	25709	4.08	3.18	5.25
Brandon	3030	2.64	1.06	6.56
Winnipeg	41039	2.97	2.36	3.75
Manitoba	77713	3.46	2.96	4.05
<b>Age 5-9 years old</b>				
North	8003	3.12	1.87	5.22
Rural South	29430	3.13	2.39	4.09
Brandon	3387	5.61	3.11	10.11
Winnipeg	44038	3.91	3.21	4.75
Manitoba	84858	3.63	3.13	4.20
<b>Age 10-14 years old</b>				
North	6953	4.75	3.03	7.42
Rural South	30240	4.63	3.73	5.75
Brandon	3513	8.26	5.13	13.29
Winnipeg	42152	4.27	3.53	5.17
Manitoba	82858	4.61	4.04	5.26
<b>Age 15-19 years old</b>				
North	6280	7.01	4.76	10.32
Rural South	29635	6.51	5.41	7.83
Brandon	3291	8.51	5.24	13.82
Winnipeg	40889	7.61	6.58	8.80
Manitoba	80095	7.19	6.46	8.00



**Figure 3:** Prescription patterns of antiepileptic drugs in Manitoba Children (1997-1998)

## DISCUSSION

Age-specific prevalence rates for seizure disorders in Manitoba children, determined from health care administrative records, were remarkably similar to published data on the prevalence of epilepsy in other populations of children,<sup>1,4</sup> with one exception. Treatment prevalence rates in adolescents were higher than those reported in the literature. The NPHS survey estimates of epilepsy did not aid in validating the health care-based prevalence rates and illustrate the problems of obtaining estimates from small numbers of children. No statistically significant differences in prevalence rates were observed between urban and rural populations. However, a higher prevalence was found among children living in lower socioeconomic neighbourhoods in urban areas, which presented as a gradient of increased prevalence with decreased levels of income. In their community-based study of epilepsy, Heaney and colleagues<sup>15</sup> observed urban-rural, as well as socioeconomic differences in epilepsy.

Our definition of cases included both single and multiple events where contact with a physician occurred or, in the absence of physician contact, at least one prescription for an antiepileptic. The inclusion of antiepileptic drugs in the definition diminished potential under-reporting of seizure disorders subsequent to the presence of only one diagnosis per physician claim. The prescription database does not record indication, but the use of antiepileptic medications for indications other than seizure related uses is limited in children. Eighty-five percent of antiepileptic prescription use in children is for epilepsy.<sup>16</sup> However, the selection of children on the basis of one antiepileptic prescription had the potential to overestimate the prevalence of seizure disorders by including cases with single seizures, provoked and unprovoked seizures, and seizures caused

by trauma, infection, and tumors, as well as increasing usage of antiepileptic medication for the treatment of psychiatric disorders. This may explain the rising prevalence rates with increasing age (particularly the 15-19 yr age group), which is contrary to the natural history of seizure disorders which decline with increasing child age.<sup>17,18</sup>

Despite the limitations to using health care utilization data, our data suggest an over-representation of seizure disorders in children born to parents of lower socioeconomic status. Preschool children in the lowest income quintile were twice as likely as their counterparts in the highest income quintile to have seizure disorders. The higher prevalence of seizure disorders among school-age children living in low-income neighbourhoods may be the consequence of environmental factors, such as higher exposure rates to antecedent illnesses (infections) or risk factors for seizures (head trauma from injury).<sup>19,20</sup> Children less than five years old were twice as likely to have a seizure disorder if they lived in a low rather than high-income area. Possible explanations of this are higher rates of seizures resulting from prenatal or perinatal risk factors such as congenital malformations, birth trauma and birth asphyxia, which are more common in low income mothers.<sup>19,20</sup> The genetic basis for epilepsy is increasingly being recognized, although the relation between genetic factors and social disadvantage is likely to be complex.<sup>21</sup> Another important finding of our pilot study is the presence of a socioeconomic gradient, which indicates that children living in middle-income households were at higher risk of seizure disorders than children in high-income households. In addition, the association between seizure prevalence and socioeconomic status was weak in rural areas.

Our understanding of the risk factors for childhood seizure disorders remains far from complete and the observed socioeconomic differences in treatment prevalence identify promising areas for further study. We plan to refine our case definition of epilepsy in future research using Manitoba's health care database. Using approaches developed in other clinical conditions such as asthma,<sup>22</sup> algorithms can be developed to identify patients who have a high certainty of having the diagnosis of active epilepsy. By assembling cohorts with active epilepsy, we can investigate risk factors leading to the development of this chronic condition. We can also evaluate patterns of health service and antiepileptic drug utilization and their impact on seizure remission rates, the use of other psychotropic medications and the presence of comorbidities.

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