

Prevalence of Early Childhood Caries in 4 Manitoba Communities

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ABSTRACT

Objectives: Early childhood caries (ECC) is a particularly destructive form of tooth decay that afflicts young children. Although few prevalence data have been published for Manitoba, long waiting lists for treatment of ECC in hospital indicate that many children in the province suffer from this condition. The purpose of this investigation was to determine the prevalence of ECC and the oral health status of children under 6 years of age in 4 communities in Manitoba and to identify risk factors associated with ECC.

Methods: The 4 Manitoba communities were selected according to the best available data regarding the number of young children scheduled for dental treatment under general anesthesia. Two of the communities were located in the southern region of the province, and the other 2 were northern communities. In each region, one community represented a disadvantaged population in a large urban centre, whereas the other was a First Nations (on-reserve) community. The parent or guardian (primary caregiver) of each child under 6 years of age was invited to participate. After informed consent had been obtained from the caregiver, each child underwent a dental examination of the deciduous dentition, and the caregiver completed a retrospective questionnaire by interview.

Results: A total of 408 children and their caregivers participated in the study. The overall prevalence of ECC was 53.7%, and the prevalence was similar in all 4 communities, with no statistically significant difference in caries between the high-risk urban communities and the First Nations (on-reserve) communities. The mean number of decayed, extracted or filled teeth \pm standard deviation was 4.2 ± 5.0 . Older children were more likely to have ECC ($p < 0.001$), but the caregiver's level of education was not associated with ECC prevalence ($p > 0.05$). Children with ECC also exhibited more plaque ($p < 0.001$).

Conclusions: The results of this study indicate that ECC is a serious problem in Manitoba. In addition, this investigation establishes a baseline to help evaluate the effectiveness of current and future prevention initiatives in these 4 communities.

MeSH Key Words: child, preschool; dental caries/epidemiology; Manitoba

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Early childhood caries (ECC), also known as early childhood tooth decay, is a particularly destructive form of tooth decay that afflicts young children. It usually involves a distinctive pattern of caries starting in the primary maxillary incisors of infants and very young children¹ and often progresses to include the deciduous molars. ECC is one of the most common diseases in this age group and although it is not life-threatening, it may contribute to suboptimal health and failure

to thrive.² The crowns of involved teeth may be completely destroyed, and treatment is both difficult and expensive,³ often necessitating general anesthesia. The most tragic fact about ECC may be that measures that could render the condition entirely preventable have not been implemented.

The older terms "nursing caries" and "baby bottle tooth decay" have largely been replaced with the broader term ECC. This change in terminology has helped to focus attention on

risk factors other than prolonged breast-feeding and bottle-feeding. Some research has shown that factors other than inappropriate feeding methods may be important;⁴⁻⁷ for example, attempts by health care professionals to change behaviours with respect to infant feeding methods have had little success in reducing the occurrence of ECC.⁸⁻¹⁰

Although the change in terminology has had benefits, an exact definition of ECC has remained elusive. Case definitions of ECC vary in the published literature, which makes comparisons among studies difficult.¹¹⁻¹³ For example, definitions have included one or more maxillary incisors with decay,¹⁴ 2 or more incisors with decay,¹⁵ and even 3 of 4 maxillary incisors with decay.^{16,17} A 1999 workshop recommended that ECC be defined as one or more teeth affected by caries in children 5 years and under.¹⁸ The American Academy of Pediatric Dentistry (AAPD) now defines ECC as the occurrence of at least one primary tooth affected by decay in a child under 6 years of age.¹ This consensus definition should help in advancing ECC research.

The typical causative triad for caries consists of cariogenic microorganisms, fermentable carbohydrates and a susceptible host, but a multitude of risk factors are involved in ECC development. ECC has been associated with socioeconomic status (SES), parental education, maternal nutrition, psychosocial issues and parenting practices.^{12,19-22} Even ethnicity has been identified as a factor, as the prevalence of childhood tooth decay remains high among ethnic minorities and various North American aboriginal populations.^{19,23-26}

The prevalence of ECC is estimated to range from 1% to 12% in infants from developed countries.²⁷ Canadian studies have reported a prevalence of less than 5% in the general population^{28,29} and from 50% to 80% in high-risk groups,^{19,20,23,30} including immigrants and aboriginal Canadians. Although few prevalence data have been published for the province of Manitoba,³¹ long waiting lists for operative treatment in hospital provide some evidence that ECC afflicts a disproportionate number of vulnerable Manitoba children, including those of aboriginal ancestry. Recent research from one First Nations community in northern Manitoba found that the prevalence of ECC among 3- to 5-year-old children was above 90%.³¹ This high prevalence may be a result of location (isolated northern communities) and low SES, factors shown to be associated with higher rates of caries.^{3,23,24,32,33}

In response to concerns about the number of children presenting for treatment of ECC in Manitoba, a multi-agency collaborative group was formed to address the issue using community development methods. A baseline survey was conducted to establish the oral health status of young children in selected pilot communities, as well as to determine the knowledge, attitudes and behaviours of caregivers related to dental health. The ultimate goal of the

project was to produce an ECC prevention program that might be used across the province of Manitoba. This paper describes the baseline prevalence of ECC and the risk factors associated with the presence of this condition. This information should help with community development initiatives and policy development to combat ECC in specific communities in Manitoba.

Materials and Methods

Pilot Sites

Four Manitoba communities were selected on the basis of the best available data regarding the number of young children scheduled for dental treatment under general anesthesia. Two of the communities were located in the southern region of the province, and the other 2 were northern communities. In each region, one community represented a disadvantaged population in a large urban centre, whereas the other was a First Nation (on-reserve) community. The urban pilot sites were in the cities of Winnipeg and Thompson. The southern on-reserve pilot site was the Roseau River First Nation; at the request of the northern First Nation community, its name is not reported here. How well these communities represent the prevalence of ECC in other First Nations and disadvantaged urban populations in Manitoba is not known.

Sampling Methods

The sampling methods differed among the 4 communities, but the samples were essentially convenience samples. Comprehensive sampling frames were available for the 2 on-reserve First Nations communities, and all children were eligible to participate. No comprehensive sampling frames were available for the 2 urban communities, so public agencies providing support to families with young children were asked to recruit from among their clients, including clients of programs such as Head Start, family centres and other local services. Initial sample size calculations were performed to ensure sufficient statistical power for future comparisons of baseline prevalence rates with those following planned community interventions.

In each community, the parent or guardian of each child under 6 years of age was invited to participate. Participation involved a dental examination of the child followed by a comprehensive interview with the parent or guardian. Informed consent was obtained from the parent or guardian before each child was enrolled.

Ethical Approval

This study was approved by the Health Research Ethics Board, University of Manitoba, and was supported by a collaborative partnership and the community leadership in the 2 First Nations (on-reserve communities).

Data Collection

All examinations were performed by one experienced dentist, who underwent a training session at the University

of Manitoba. No formal calibration was undertaken, and examiner reliability was not assessed. In addition, a comprehensive manual, developed specifically for the survey on the basis of World Health Organization methodology, was available during all dental examinations.³⁴

Portable dental chairs, lights and gauze for drying the teeth were used in the examinations. Compressed air was not available to dry the teeth, and no radiographs were obtained. At the discretion of the dentist, a knee-to-knee approach was used to examine very young children. The dentist recorded data related to the presence of decayed, extracted and filled teeth (defect), gingival health, presence of debris or calculus, oral habits and malocclusion traits.^{18,34}

All interviews were conducted with the child's primary caregiver, defined for the purpose of the survey as the adult who was most often responsible for the care of the

child. The project coordinator (PM) served as the interviewer in each of the communities. In situations where translation was required, a community resident was recruited to help with the interview. The interview was based on a previous tool developed to investigate ECC-related risk factors in Sioux Lookout, Ontario.³⁵

Data Analysis

The data were entered into a database over a 3-month period using Epi Info (version 5.0) (Centers for Disease Control and Prevention, Atlanta, Ga.) and were analyzed by a consultant statistician and the authors using SAS (SAS Institute Inc., Cary, N.C.) and SPSS (version 10.0.7) (SPSS Inc., Chicago, Ill.). Summary variables for the caregiver's awareness of the child's dental health, the impact of the child's health and activities, and the caregiver's knowledge of ECC were created by combining responses to individual interview items. The presence of caries on one or more

primary teeth (defect ≥ 1) was used as the case definition for the presence of ECC, consistent with the AAPD consensus statement.^{1,18} The data are reported as valid percentages (i.e., excluding missing responses).

Results

Participant Information

A total of 408 children were examined and their primary caregivers interviewed between November 2001 and March 2002. The mean age \pm standard deviation (SD) of the children was 2.9 ± 1.7 years, and the overall sample consisted of 220 (53.9%) girls and 188 (46.1%) boys. Most children (317 or 77.8%) had resided in their respective communities since birth. The distribution of children by community of residence appears in **Table 1**.

The characteristics of the primary caregivers were also assessed. The majority of primary caregivers interviewed were mothers (348 or 85.3%), and nearly half (181/399 or 45.4%) stated that their highest educational achievement was Grade 12 or higher. Employment outside the home was uncommon, with 68.3% (273/400) of the caregivers reporting no outside employment. Although the majority of parents were not currently employed, employment rates did vary by community and were significantly

Table 1. Distribution of children by community

Community	No. (%) of participants	Mean age \pm SD (years)	Boys	Girls
Urban				
Winnipeg (South Point Douglas community)	67 (16.4)	3.0 ± 1.7	34	33
Thompson	105 (25.7)	2.8 ± 1.7	48	57
On-reserve				
Northern First Nation	128 (31.4)	2.9 ± 1.8	55	73
Roseau River First Nation	108 (26.5)	2.9 ± 1.8	51	57

SD = standard deviation

Table 2. Prevalence of early childhood caries (ECC) and mean number of decayed, extracted and filled teeth (defect) by community

Community	No. of cases of ECC (prevalence, %) ^a	Mean defect \pm SD ^b
Urban		
Winnipeg (South Point Douglas community)	29/67 (43.3)	3.1 ± 4.4 (range 0–16)
Thompson	54/105 (51.4)	4.3 ± 5.2 (range 0–17)
On-reserve		
Northern First Nation	75/128 (58.6)	4.5 ± 4.9 (range 0–17)
Roseau River First Nation	61/108 (56.5)	4.4 ± 5.2 (range 0–16)
Total	219/408 (53.7)	4.2 ± 5.0 (range 0–17)

SD = standard deviation

^aNo significant difference among communities ($p > 0.05$ by χ^2 testing)

^bNo significant difference among communities ($p > 0.05$ by analysis of variance)

higher ($p < 0.001$) in the northern First Nation. The average number of people residing in the home was 5.0 (3.0 ± 1.7 children and 2.0 ± 1.1 adults, including the primary caregiver). In 25.6% of cases (101/395) the child was the sole child in the family. Most primary caregivers received help from others in raising the child.

In total, 93.4% (380/407) of caregivers reported that the child was in good or very good general health. Dental visitation was not common for the majority of children in this cohort; overall, only 36.2% (144/398) of the children had previously visited an oral health professional.

Health Outcomes

Gingivitis

Gingivitis was present in 65.8% (240/365) of children, and 34.2% (125 children) were free of gingivitis. The severity of gingivitis was generally low; 88.8% (324) of the children had a gingival index of less than 1.00. Among the children with gingivitis, the mean gingival index was 0.68 ± 0.43 .

Early Childhood Caries

According to the AAPD definition, 53.7% children (219/408) had ECC. The rates of decay and the prevalence of ECC did not differ significantly among the 4 communities ($p > 0.05$) (Table 2). Because the communities did not differ significantly in terms of either prevalence of ECC or mean deft rate, the children were considered as a single group for the remaining analysis and discussion.

Among children at least 2 years of age, the prevalence of ECC was 73.6% (187/254). This prevalence value may give a more accurate picture of the disease burden in these communities because it excludes very young children whose

teeth may not have been erupted long enough for caries initiation or progression. This analysis is further supported by the fact that children under 2 years of age had significantly lower deft scores than those at least 2 years of age (Tukey's multiple-comparison post hoc test, $p < 0.05$).

Older children were significantly more likely than younger children to have ECC ($p < 0.001$) (Table 3). No other variables related to family demographic characteristics were significantly associated with the presence of ECC ($p > 0.05$). Bivariate analysis indicated that other known risk factors were not associated with ECC in these communities, including income, employment status and caregiver education ($p > 0.05$). In addition, there was no significant association between the child's general health as reported by the caregiver (very good to good v. fair to very poor) and ECC ($\chi^2 = 3.2$, $df = 1$, $p = 0.052$). However, bottle-fed children were significantly more likely to suffer from ECC than non-bottle fed children (54.9% v. 36.6%, $\chi^2 = 4.95$, $df = 1$, $p = 0.026$), while those who were breast-fed were significantly more likely to be free from decay than children who were not breast-fed (50.8% v. 40.7%, $\chi^2 = 4.04$, $df = 1$, $p = 0.044$).

Decayed, Extracted and Filled Teeth

A total of 1,711 deft were found on examination (mean \pm SD 4.2 ± 5.0). Caries experience was not evenly distributed across the population, as 189 children (46.3%) had not experienced any dental caries. The vast burden of disease was born by a relatively small proportion of the children, with about 80% of caries occurring in only 31% of the total population. However, the mean deft was significantly associated with the age of the child (Table 3).

Intraoral Risk Factors

Plaque on the deciduous teeth is considered one of the primary causative factors in the development of ECC. Plaque buildup was a common finding in this population, and only 15.9% (58/365) of children had no plaque on their teeth. The mean debris index \pm SD was 0.93 ± 0.60 . A significant association was found between ECC and the presence of plaque (analysis of variance, $p < 0.001$); the mean debris index was 0.55 ± 0.50 for children without ECC and 1.19 ± 0.52 for children with ECC.

An association was also found between debris and gingivitis; the debris index

Table 3. Prevalence of early childhood caries (ECC) and mean number of decayed, extracted and filled teeth (deft) by age

Age (years)	No. examined (valid %)	No. of cases of ECC (prevalence, %) ^a	Mean deft \pm SD ^b
< 1	70 (17.4)	5 (7.1)	0.3 ± 1.9 (range 0–15)
1	79 (19.6)	24 (30.4)	1.5 ± 2.6 (range 0–10)
2	64 (15.9)	35 (54.7)	3.5 ± 4.2 (range 0–12)
3	73 (18.1)	57 (78.1)	7.0 ± 5.2 (range 0–17)
4	60 (14.9)	47 (78.3)	6.6 ± 5.4 (range 0–17)
5	57 (14.1)	48 (84.2)	7.2 ± 4.9 (range 0–16)
Total	403^c	216 (53.6)	4.2 ± 5.0 (range 0–17)

SD = standard deviation
^a $p < 0.001$ by χ^2 testing

^b $p < 0.001$ by analysis of variance
^cAge was missing for 5 children

and the gingival index had a statistically significant 2-tailed Pearson correlation coefficient of 0.467 ($p < 0.001$). A similar relationship was found between debris and deft scores, with a significant 2-tailed Pearson correlation coefficient of 0.482 ($p < 0.001$).

Discussion

With a total of 408 children and their primary caregivers, this was the largest dental epidemiological study of ECC in Manitoba to date. Residents from the 2 on-reserve First Nations communities were of aboriginal heritage, whereas the ethnic background of participants from the 2 urban communities was more heterogeneous. The First Nation subjects were probably more representative of their communities than were the urban subjects because of the higher participation rates that were possible in these smaller communities.

The study revealed that ECC afflicts children in Manitoba, with a prevalence of 53.7% among study participants. Of interest was the finding that the prevalence of ECC was similar in the 4 communities. Assumptions have often been made that this dental phenomenon is more prevalent among children from on-reserve communities than among children in urban centres. However, these comparable findings indicate that children from high-risk urban areas are also affected. This may be attributed to the targeting of lower-income neighbourhoods in the urban settings for selection of participants. Given that ECC has been associated with low SES^{4,33} and given the economic disadvantages known to be present in these urban communities, the prevalence rates obtained here are not surprising. For instance, the South Point Douglas community has the highest premature mortality rate (a surrogate marker of overall health status) in Winnipeg, and it has the lowest SES in the city.³⁶ It could also be speculated that the high prevalence of ECC among participants was related to the possibility that caregivers would be more likely to participate if they knew their child had dental decay.

When children under 2 years of age were excluded from the analysis, the prevalence of ECC increased to 73.6%, which highlights the burden of disease and the need for treatment. The findings that caries experience and the number of confirmed cases of ECC increased with increasing age is logical, as the teeth of older children have been exposed for significantly longer periods of time to cariogenic microorganisms, fermentable carbohydrates and other risk factors. It should come as little surprise that 31% of the children accounted for 80% of the deft, consistent with previous research indicating that the majority of the caries burden is often borne by a minority of children.³⁷

ECC was not related to the education level of the child's caregiver. This finding contrasts with results from some other studies reporting a strong association with parental education,^{33,38} which is often an indicator of SES. However, the lack of an association in this study is

consistent with other recent research.^{13,39} One possible explanation is that each of the communities is fairly homogeneous with respect to completed levels of education, with many of the primary caregivers having similar educational experiences.

Breast-feeding was protective against ECC, and breast-fed children were less likely to be affected ($p < 0.05$); in contrast, bottle-fed children were more likely to have ECC than those whose caregivers reported that they did not receive a bottle ($p < 0.05$). This baseline study collected additional information on breast-feeding and bottle-feeding, including the frequency and duration of breast-feeding and the frequency, duration and contents relating to bottle use, along with information about oral hygiene after feeding episodes. An in-depth analysis of infant feeding practices based on these data is beyond the scope of this article and will be explored in a future report. Nonetheless, mothers and other caregivers should be informed of how they can reduce the probability of ECC by avoiding inappropriate bottle use and contents, discouraging breast-feeding on demand, transitioning to use of a regular cup at 12 months of age, and cleaning the child's mouth regularly once the first primary tooth has erupted.¹

This initial survey may provide an accurate assessment of ECC in Manitoba, but the study's limitations should be recognized. For instance, the interviews with primary caregivers were retrospective. The use of retrospective interviews to recall children's past exposures and experiences continues to be a limitation of this form of research. Furthermore, caution must be exercised in generalizing from these data to the participating communities as a whole, given that the proportion of potential participants who actually participated differed among the communities. For instance, the information from the 67 child-caregiver pairs in the southern urban community cannot be generalized to the entire pediatric population of Winnipeg, as the convenience sample was small relative to the city's population. In some instances, initial participant targets were not met. Recruiting high-risk preschool children and their primary caregivers was a significant challenge, as the families face numerous other life stressors. However, these results are probably generalizable to other disadvantaged communities, in that the prevalence rates did not differ significantly with geographic locale.

Many children in Manitoba are at risk for ECC, including those in urban centres. The costs of treating this disease are enormous and continue to escalate in Manitoba.^{3,4} The estimated annual costs for treatment a decade ago in Manitoba approached \$2.5 million.⁴ Apart from the financial burden on both families and government, there are other difficulties associated with treating ECC. Many children with ECC are from isolated northern communities, and travel is often required to 1 of the

2 larger urban centres (Winnipeg or Thompson) for hospital treatment under general anesthesia. Other major issues, such as travel costs, the need for patients and caregivers to leave the home community for treatment, the potential danger of general anesthesia and the burden on pediatric health care facilities, highlight the need for effective prevention. While the elimination of ECC is a laudable goal, a more practical aim may be to first reduce the severity of cases to allow for ambulatory treatment.

Alternative approaches to preventing ECC are required. New initiatives must be community-based and should involve partnerships among vulnerable communities, the public health sector, academics and policy-makers. Such a multidisciplinary perspective is paramount and has been the guiding principle behind the Manitoba Collaborative Project for the Prevention of Early Childhood Tooth Decay. This nonprofit partnership has included representation from the University of Manitoba, Manitoba Health, the First Nations and Inuit Health Branch of Health Canada, the Winnipeg Regional Health Authority and the Burntwood Regional Health Authority.

Traditional strategies for preventing caries have improved the oral health of many children, but the failure of these measures in achieving similar gains among high-risk pediatric groups must be recognized. There is a need to consider multiple strategies targeting those who are most vulnerable. Ultimately, community-based solutions should be explored and can be strengthened if used in conjunction with existing and emerging strategies for promoting early childhood oral health and preventing dental decay, including promoting the first dental visit by 12 months,¹ providing anticipatory guidance,^{40,41} motivational interviewing,⁴² using chemotherapeutics⁴³ (e.g., fluoride varnish,⁴⁴ silver diamine fluoride,⁴⁵ povidone iodine [Betadine],⁴⁶ chlorhexidine⁴⁷) and using unconventional treatment and management approaches such as alternative restorative techniques with glass ionomer¹ or perhaps Nd:YAG (neodymium:yttrium–aluminum–garnet) lasers.⁴⁸

Overall, the findings of this survey will form part of a baseline oral health assessment for children under 6 years of age in these 4 Manitoba communities. In addition, these results should benefit the communities by helping residents to understand the factors that are significantly associated with ECC.

These data may also serve as a baseline for planning and evaluation of ongoing community development and oral health promotion programs in each of these communities. Although future community initiatives have the potential to increase community knowledge of ECC, the ultimate challenge will be sustaining long-term behavioural change among parents, caregivers and the community at large.⁴⁹ Perhaps community development initiatives with participation that extends beyond health care providers to actively engage the residents of each region will help to improve the oral health of these children.^{50–52}

Conclusions

This study indicates that ECC is a serious problem in Manitoba; the prevalence of ECC was 53.7% in this cohort. Neither prevalence of ECC nor rates of decay differed significantly between the southern and northern communities or between the urban and on-reserve locales. This investigation establishes a baseline to help evaluate the effectiveness of current and future prevention initiatives in these 4 communities. Community-based solutions should be explored and can be strengthened if they are used in conjunction with existing and emerging strategies for promoting early oral health and preventing dental decay. ♦

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