Determinants of Early Childhood Caries (ECC) in a Rural Manitoba Community: A Pilot Study

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Abstract

Purpose: Preschool oral health is often overlooked as an important aspect of childhood health and well-being. The purposes of this study were to: (1) determine the dental status of 3-year-old children in the community of Carman, Manitoba, Canada; and (2) identify the principal determinants of Early Childhood Caries (ECC) in 2 consecutive years.
Methods: All children and mothers attending a preschool health screening fair were invited to participate. Study procedures included a retrospective interview with parents and dental examination of the child. Statistical analyses included ANOVA, chi-square, and multiple regression. A *P* value of <.05 denoted significance.
Results: A total of 61 children participated (mean age=45.7±3.4 months). The prevalence of ECC was 44%, while the mean deft was 2±3.3. Increased caries activity and ECC were associated with lower maternal level of education (*P*<.01). Family size was associated with deft scores (*P*=.03) while the presence of debris was also associated with ECC (*P*<.05).
Conclusions: ECC prevalence among these 3-year-olds is less than exhibited among other Canadian preschool children. Factors associated with ECC included debris on the primary teeth and low maternal education. Factors most associated with increased caries activity included low maternal education and increased family size. In addition, parents were able to reliably assess their child's dental health status. Larger epidemiological studies of ECC are needed to better assess prevalence and risk factors. Such data may, therefore, assist in identifying those children at greatest risk for ECC. It may also help in the redirection of scarce resources to effective preventive oral health interventions, as these children have an increased caries burden along the continuum of childhood. (Pediatr Dent 2005;27:114-120)

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Preschool oral health is an overlooked aspect of childhood health and well-being, especially Early Childhood Caries (ECC). This specific form of dental decay in those less than 72 months of age has been defined as 1 or more primary teeth affected by caries.[1,2] ECC has even been subgrouped according to 3 prominent primary decay patterns of:

1. isolated decay of incisors or molars;
2. labiolingual decay of incisors with or without the molars;
3. generalized rampant primary dentition decay.[3]

ECC is not a new phenomenon. Its antecedent terms, nursing caries and baby-bottle tooth decay, are still used by some. The adoption of new terminology helped recognize the multiple etiologies involved,[4,5] as the evidence on the relationships between inappropriate feeding methods and ECC is inconsistent. In fact, the relationship between ECC and socioeconomic status (SES) is far stronger.[6-9]

Multiple risk factors have been associated with ECC. These include poor oral hygiene, frequent intakes of fermentable sugars, and low SES,[6,8,10-12] although limited access to professional dental care, inappropriate infant feeding practices, and psychosocial issues may also be involved.[3,11] Ethnic factors,[8] enamel hypoplasia,[1,13] and cariogenic bacteria, such as Streptococcus mutans,[14-16] have also been implicated—although their differential weighting remains unclear.

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ECC is a particularly problematic health issue, as severe forms of ECC often require treatment by pediatric dentists in the hospital while under general anesthesia, which can place young children at risk. It also leaves families and dental insurers with significant costs for rehabilitative treatment, travel, and facility charges.[17] While total elimination of ECC is a laudable goal, efforts must first strive to reduce ECC severity for children so that their treatment may be amenable to ambulatory settings, rather than reliance on general anesthesia. Instead, the use of alternative therapies such as alternative restorative treatment (ART) using glass ionomer, fluoride varnishes, and other chemotherapeutic agents should be considered.

The oral health of preschool children living in Canadian rural agricultural communities is currently undocumented, although that of some groups, including First Nations children and those in Canada's urban regions, has been described (Table 1).[18-25] More comprehensive epidemiological data on ECC is imperative, however, to focus preventive strategies and allocate scarce resources more appropriately.

The purposes of this pilot study were to document the prevalence of ECC among a group of primarily Caucasian 3-year-old children in a primarily agricultural, rural Manitoba community, and to assess risk factors for ECC.

Methods

In both 2003 and 2004, children between 36 and 48 months of age, residing in Carman, Manitoba, and neighboring areas in southwestern Manitoba, and their mothers who attended a multidisciplinary preschool health fair were invited to participate in a childhood oral health investigation. All child-parent pairs registered for the health fair event were given opportunity to take part. This was a convenience sample of children and their parent(s) residing in this community of 2,831 persons.[26] The water supply of the city of Carman is fluoridated. Families residing outside of Carman rely on well water. The objectives were to delineate their oral health status and the principal etiologies of ECC.

Following ethical approval by the Health Research Ethics Board, University of Manitoba, informed consent was obtained from parents prior to examining children. This entailed a dental screening by a licensed dentist and a brief interviewed questionnaire of each mother regarding infant feeding methods, oral hygiene, frequency of snacking, child's dental history, and family characteristics and demographics. Both caries rates (deft) and the prevalence of ECC were calculated using the definition of ECC adopted by the American Academy of Pediatric Dentistry (AAPD).[1] Severe ECC (SECC) cases were determined using the established definition, which was a dmfs score of ≥4 or 1 or more smooth dmf surfaces in the primary maxillary anterior teeth.[2] An established oral debris index was used to assess the amount of debris on primary teeth.[27]

The interview and dental examination results were coded for anonymity, and mother and child components

Table 1. Recent Studies Reporting Prevalence and Severity of Dental Caries Among Preschool Children in Canada

Study	Region of Canada	Population	Age	Prevalence (%) of ECC*	Mean deft (±SD)
Schroth et al 2005[18]	Garden Hill First Nation, Manitoba	First Nation	3- to 5-year olds	98	13.7±3.2
Peressini et al 2004[19]	District of Manitoulin, Ontario	First Nation	3-year-olds 5-year-olds	67 78	3.5±4.0 4.8±4.1
Harrison and Wong 2003[20]	Vancouver, British Columbia (1996 follow-up)	Urban Vietnamese (Intervention Group) Control group	22.1±5.0 mos 22.7±5.8 mos	6 57	
Harrison et al 1997[21]	Vancouver, British Columbia	Urban Vietnamese	3-74 mos < 18 mos ≥ 18 mos	 0 80	 0.0 8.4±4.6
Weinstein et al 1996[22]	Edmonton, Alberta	Urban Caucasian and diverse ethnic	Mean age=19 mos	5	0.14
Young et al 1995[23]	Keewatin region, Northwest Territories	Aboriginal (Inuit)	0-2 ys 3-5 ys	50-100, depending on community	≈1.8 ≈8.0
Harrison and Davis 1993[24]	British Columbia (1988 survey)	First Nation	5-year-olds	88	7.5 ±4.9
Williams and Hargreaves 1990[25]	Edmonton, Alberta	Urban Asians	2-year-olds 3- to 4-year olds 5-year-olds	0 28 62	0.0 1.2±2.2 3.2±3.7

*Based on deft ≥1.[1,2]

were combined. Data were analyzed using Number Cruncher Statistical Software (NCSS; Number Cruncher Statistical Systems Kaysville, Utah). Bivariate statistical testing included analysis of variance (ANOVA) and chi-square analysis, while multivariate analyses included multiple regression and logistic regression. Main outcome variables included deft, ECC, and SECC. A *P* value of .05 was selected as the threshold for determining statistical significance.

Results

The total sample included 61 primarily Caucasian children in this specific community. Thirty-nine children were assessed in 2003, while another 22 were assessed in 2004. The prevalence of ECC did not differ between the 2 years, so the data were combined. The study included 36 boys and 25 girls, with a mean age of 3.3±0.5 years (45.7±3.4 months). The mean birth weight was 3,567.1±587.5 grams (g), with only 1 child having a low birth weight (<2,500 g), yielding a low birth weight prevalence of 2%.

Most children (88%) were breast-fed, and 81% were bottle-fed: 11 children were exclusively breast-fed, while 7 were exclusively bottle-fed. Some parents (31%) admitted to putting their child to sleep with a bottle during infancy, a habit frequently believed to contribute to ECC. Children were breast-fed for 8.3±5.3 months, with bottle-feeding being initiated, on average, at 4.6±3.9 months. Both the rate and duration of breast-feeding among this cohort was slightly higher than the mean for children in Manitoba.[28] The mean age of weaning from the bottle was 15.6±6.2 months, slightly longer than the recommended 12 to 14 months.[1]

Caregivers reported that children's teeth were brushed, on average, 1.5±0.7 times daily, while the mean age of oral hygiene initiation was 16.6±8.1 months. Ninety-five percent used toothpaste, with the majority brushing with parental assistance (76%). Twelve percent of parents reported that they only brushed, and 12% allowed their child to brush independently. Dental histories for these 3-year-olds appear in Table 2.

On average, caregivers reported that children had 2 to 4 snacks per day (mean=2.8±0.9), which commonly comprised cookies and crackers (48%) or fruits and vegetables (43%). The most common snack drinks were juice (58%), milk (28%), and water (12%).

Nearly 95% of parents reported that they had heard of ECC, where 59% believed this syndrome is related to putting children to bed with a bottle. Other causes cited included increased sugar consumption or milk, juice, or food sitting on the teeth, while others were unsure of the etiology.

Oral hygiene was assessed by the accumulated debris and plaque on the primary teeth. The majority of 3-year-olds had no soft debris or staining present on their primary teeth (54%), while 44% had debris or staining covering less than one third of the tooth surface. The mean cumulative debris index score was 2.6±3.4 (range=0-18).

Dental examination showed the prevalence of ECC to be 44%, while the mean deft was 2.0±3.3. Only 13 children had SECC (21%), defined as 1 or more maxillary anterior smooth surfaces affected by caries or a total dmfs score of 4 or higher.[2] ANOVA showed there was no significant association between caries experience and gender, although females demonstrated a slightly higher mean deft (2.3±3.4 vs 1.8±3.2, *P*>.05). Overall, 16 (44%) boys and 11 (44%) girls had ECC (chi-square=0.001, DF=1, *P*=0.9). Mean d, e, f, and deft, along with the prevalence of both ECC and SECC, appear in Table 3.

Further ANOVA found that caries experience (deft) was significantly associated with the parent's assessment of their child's overall dental health. For instance, as described dental health decreased, the deft rate increased (*P*<.001). Children with very good reported oral health had a mean deft of 1.3±2.9 (N=22), those with reported fair oral health had a deft score of 1.6±1.9 (N=5), while those rated to be in poor or very poor oral health had a mean deft of 9.0±1.2 (N=4) (Table 4).

Table 2. Dental History of Child as Reported by Parent

Never been to dentist	51%
Mean age of first visit	32.1±5.6 mos
Main reason for first visit	
Examination	76%
Caries/Toothache	17%
Other	7%
Parental oral health assessment of child	
Very good	37%
Good	48%
Fair	9%
Poor to very poor	7%
Treatment under general anesthesia	8%
Unable to afford dental care for child	14%

Table 3. Distribution of Caries

	Mean deft(±SD)	Mean d(±SD)	Mean e(±SD)	Mean f(±SD)	ECC(%)	SECC(%)
Male	1.8±3.2(range=0-12)	1.4±2.3(range=0-8)	0.25±1.0(range=0-5)	0.2±0.9(range=0-5)	16(44)	7(19)
Female	2.3±3.4(range=0-11)	1.7±2.9(range=0-10)	0.04±0.2(range=0-1)	0.6±1.6(range=0-6)	11(44)	6(24)
Total	2.0±3.3(range=0-12)	1.5±2.5(range=0-10)	0.2±0.8(range=0-5)	0.3±1.2(range=0-6)	27(44)	13(21)

In addition, the prevalence of ECC increased as reported oral health status declined (P=.02).

Putting a child to bed with a bottle was not significantly associated with increased caries activity or ECC (P=.8), as has often been purported. Children who were given a bottle at bedtime, however, demonstrated a slightly higher mean deft caries activity (2.1±3.5 deft vs 1.7±3.0 deft, P=.7). The age at which bottle-feeding ceased also did not significantly differ between children with and without ECC (P=0.8). Further statistical testing (ANOVA) revealed that ECC was not significantly associated with the duration of breast-feeding. Children with ECC breast-fed until 9.7±6.2 months of age, while those without ECC breast-fed until 7.3±4.3 months (P=.09).

Child caries rates declined as maternal education levels increased, and this relationship was statistically significant (P<.01; Table 5). In addition, children with ECC and SECC were more likely to have mothers who did not complete high school (ECC: chi-square=10.9, df=2, P<.01; SECC: chi-square=6.8, df=2, P<.05), compared with those who had completed high school and those who pursued post-secondary educational opportunities. As only 1 child had a birth weight <2,500g, the authors were unable to determine whether low birth weight was a risk factor for ECC. Birth weight itself, however, did not significantly differ between children who had ECC and those who were free from caries (P=.6).

As family size increased, so did the amount of decay experienced by children. Half of the children came from families with a total household count of 4 or fewer persons. Children from households with 5 or more persons had higher caries experiences (deft) than children from smaller households (2.8±3.8 vs 1.0±2.1, P=.03). ANOVA demonstrated, however, that family size was not significantly associated with ECC (5.1±1.4 persons vs 4.5±1.4 persons) or SECC (4.7±1.5 persons vs 5.1±1.0 persons)—P>.05 and P>.05, respectively.

While children with ECC had more debris on their teeth than children without ECC (chi-square=7.2, df=2, P<.05), those exhibiting debris had higher deft scores than children who were free from debris. This association, however, was not found to be statistically significant (2.9±3.6 vs 1.3±2.8, P=.06). Furthermore, those afflicted by ECC had a higher mean debris index score than their caries-free counterparts (3.5±2.7 vs 1.8±3.7, P=.07), an association that nearly approached the threshold of significance. The frequency of reported daily brushing and the mean age of initiating early childhood brushing did not significantly differ between children with and without caries (P=.3 and P=.9, respectively).

More robust multiple regression analysis revealed that mother's level of education was significantly associated with mean deft (P<.05; Table 6), while logistic regression analysis did not reveal any significant associations with ECC.

Table 4. Mean deft and ECC by Parent Oral Health Assessment

Described oral health	N	Mean deft(±SD)	ECC*
Very good	22	1.3±2.9	7
Good	28	1.3±2.5	10
Fair	5	1.6±1.9	4
Poor to very poor	4	9.0±1.2**	4

*Significant; P<.05 (chi-square analysis).
**Significantly differs from other categories; P<.001 (ANOVA).

Table 5. Mean deft by Mother's Education Level

Mother's education level	Mean deft
Did not finish high school	5.1±4.7[a]
Completed high school	2.0±3.6[b]
Postsecondary education	1.1±2.2[c]

*a vs c; P<.01

Discussion

The absence of an acceptable working definition for ECC has constrained previous research into causation and prevention and limited comparisons between previous epidemiological studies. While the new clinical definition for ECC may be too broad, however, and may fail to differentiate between those children at higher and lower risk for caries,[29] the findings between different epidemiological studies can now be contrasted.

Considering that 44% of children in this sample were found to have ECC, the mean deft score for the cohort was low (2.0±3.3), with the majority having isolated areas of either molar or incisor decay. While many of the children in this sample demonstrated ECC, almost half of these cases were classified as the severe form of ECC that often afflicts children from lower SES and ethnic minority groups.[30,31]

The amount of ECC in this convenience sample of primarily Caucasian 3-year-olds approximates the prevalence of ECC experienced by 3-year-olds in Kentucky,[32] but is less than that exhibited in some Canadian aboriginal and First Nations communities.[18,19,23,24] The mean deft among this cohort of 3-year-olds is also lower than rates experienced among Canadian aboriginals, but is comparable to results of studies involving children residing in urban centres.[18,19,22-25]

Family size was significantly associated with the rate of decay experienced. Children belonging to larger families (more than 4 persons) had significantly higher deft scores. This finding is consistent with other findings[8,33] and may

Table 6. Multiple Regression Analysis for deft

Variable	Regression coefficient (±95% CI)
Mother's education level	-1.44 (±1.26)*
Family size (≥5 persons)	0.88 (±1.76)

*P<.05.

be due to the financial strain[33] or limited time that larger families encounter, which may curb their ability to adequately meet the oral health needs of their children.[34] Considering, however, that only 14% of parents indicated that family finances was a barrier to accessing oral health care for their child, it is likely that the demands of a large family may reduce the amount of time parents devote to practicing oral hygiene. Another possibility is that children from larger families may be at increased risk of colonization by S mutans, as suggested by some.[35]

The finding that ECC was significantly associated with parent's level of education is consistent with other recent reports[8,36,37] that have begun to investigate the social determinants of ECC. It is undeniable that ECC is influenced by such factors as parental education, family income, single-parent households, and family socioeconomic status.[8,29,36,37]

Chi-square analysis determined that the presence of debris on the primary teeth was significantly associated with the presence of ECC, but not with increased deft (ANOVA). A positive trend was evident, however, indicating that 3-year-olds with ECC had a higher mean debris index score. While this association does not identify causation and effect, it does allow one to speculate that those children with increased plaque at the time of examination likely had debris on their teeth at the time caries activity began. It also indicates that children with ECC continue to suffer from less-than-ideal oral hygiene.

Parents who ranked their child's oral health as "good" had a child with a lower prevalence of caries than children from parents who rated their child's dental health less favorably ($P<.05$). Considering that 49% of the children had not visited a dentist, parents reliably assessed their child's oral health condition. It is still essential, however, that parents be educated about the need for earlier and regular dental attendance, as the mean age for the first visit was 32.1±5.6 months and only 51% of children had been to the dentist. Experts recommend that the initial visit should occur by the child's first birthday.[1]

The duration of breast-feeding was not found to be significantly associated with whether children had ECC. Those children who had ECC breast-fed for a mean of 9.7±6.2 months, while those who did not have ECC only breast-fed for 7.3±4.3 months. While a recent recommendation for the prevention of ECC called for breast-feeding to cease at 6 months of age,[38] it is not without controversy. The AAPD does not have a recommended weaning age, but believes that breast-feeding is best for ensuring both physical and psychosocial development.[1,39] Recommending that mothers discontinue breast-feeding at this stage is misleading, detrimental to infant development,[40] and contrary to the policy adopted by the AAPD.[1,41] Mothers who choose to breast-feed their infants, however, must adhere to strict oral hygiene regimens, including cleaning the teeth following nursing before naptime or bedtime. An infant who is breast-fed still can be at risk for ECC[42] if oral hygiene is not initiated and maintained.[1]

While bottle-feeding, bedtime bottle use, and prolonged bottle use were not found to be significantly associated with an increase in deft or ECC, the age at which parents stated that their child stopped bottle-feeding was 15.6±6.2 months, slightly longer than the recommended age of 1 year supported by the AAPD.[1] Prolonged bottle use, late initiation of oral hygiene, and low dental attendance highlight the need for better parental education for childhood oral health. Furthermore, there is likely a need to inform parents about the establishment of "dental homes" for these young children to assess caries risk and obtain necessary prevention, education, and dental care at early stages of development.[1,43]

One limitation of this study is the retrospective design of the interview, as parents may not have been able to specifically recall the exact stage of infancy and childhood when specific events occurred. The reliability of caregiver responses—with respect to infant feeding practices and child's dental history—is an inherent weakness. Retrospective interviews, however, are the only way to glean such information in cross-sectional studies. Additionally, the questionnaire used for this investigation was brief and only focused on specific issues that might have influenced the caries status of children. Perhaps if more time had been available to conduct a larger comprehensive questionnaire with parents, the authors would have been able to uncover more epidemiological information on childhood caries.

A further limitation is the sample's small size and its convenient nature. While small convenience samples may pose statistical challenges and may hinder the external validity of study findings, they can add insight into the caries burden among preschool populations at low cost. Considering that this community is quite small, however, this cohort likely gives a small glimpse into the oral health of its preschoolers, which was a primary goal of this investigation. Larger scale investigations are planned that will utilize more representative sampling methods.

Currently, little oral health programming for children exists in regions of the province outside of Winnipeg, with the majority of the responsibility, if any, being offloaded to other health care providers. Future epidemiological information may assist these regions in identifying groups at greatest risk for caries and the need for increased and far-reaching prevention. This may help to best redirect scarce funding for oral health prevention. It is anticipated that this pilot data will add to the limited ECC epidemiological data in Manitoba and may foster further epidemiological and clinical interventional studies. With this may come the development of new prevention policies for ECC that may be deemed more effective than traditional methods of delivering health prevention.[44]

Ideal periods for prevention and health promotion interventions include pregnancy and early childhood. Many jurisdictions, however, continue to allocate their scarce oral health promotion resources for school-aged children. This policy must be revisited, as there is evidence that preschool children who exhibit primary tooth decay at young ages are more likely to have an increased caries burden along the continuum of childhood.[29,45-48]

Therefore, efforts to reduce caries among the very young may have a broader impact. Treatment alone is not the appropriate solution for this devastating pediatric dental syndrome, as the risk of recurrent caries following complex restorative care is considerable.[49,50] Instead, during key periods of early childhood development, more attention needs to be spent on effective preventive strategies, such as:

1. bolstering prenatal nutrition;
2. reducing maternal levels of S mutans;
3. reducing the vertical transmission of cariogenic microorganisms from mothers to infants;
4. early screening of infants and toddlers;
5. promoting regular infant oral hygiene;
6. applying fluoride varnish or other chemotherapeutic agents (ie, silver fluoride, chlorhexidine, Betadine).

Conclusions

The following conclusions are based on this study's results:

1. Parents were able to reliably assess their child's dental health status.
2. The majority of children were caries free, but children from this region of Manitoba are affected by ECC and SECC—with an overall prevalence of 44% and 21%, respectively.
3. Factors associated with ECC in this convenience sample included debris on the primary teeth and low maternal education.
4. Factors most associated with increased caries activity included low maternal education and increased family size.
5. Larger epidemiological studies of ECC are needed to better assess prevalence and risk factors for children from this region of the province.

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