

Scientific Article

Risk Factors for Early Childhood Caries in Canadian Preschool Children Seeking Care

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Abstract: Purpose: The purpose of this study was to determine family characteristics, beliefs, and habits that contribute to early and severe caries in young children in Canada. **Methods:** A survey was administered to: (1) parents of 139 children diagnosed with early childhood caries (ECC) in 5 pediatric dentistry practices in Canada over a 33-month period (group 1); and (2) parents of all normal referrals (cariou and noncariou children) in one of the practices over a 3 month period (group 2). Group 2 prevented studying an exclusive or polarized population, and allowed direct comparison between children with decay and without decay. The survey responses were compared with caries rates in the children, determined by dental examination, to detect important correlations of family and child factors with the disease level. Chi-square and logistic regression analyses described the strength of the relationships. **Results:** Parent responses provided information on: (1) demographics; (2) economic status; (3) birth order; (4) parental education; (5) payment methods; (6) feeding and weaning history; (7) fluoride history; (8) food habits; (9) hygiene; (10) behavior; and (11) medication use. Caries presence and severe caries was linked to: (1) leaving the bottle with a child while sleeping; (2) having problems brushing a child's teeth; (3) prolonged holding of liquids in the mouth; and (4) being Caucasian. The authors did find that bottle use in general and having a difficult child were protective influences against decay. **Conclusions:** The factors providing the most caries risk are: (1) being left with a bottle while sleeping; (2) parents having problems brushing the child's teeth; (3) holding liquids in the mouth for prolonged times; and (4) ethnicity. (*Pediatr Dent* 2007;29:201-8)

KEYWORDS: EARLY CHILDHOOD CARIES, CARIES, PEDIATRIC DENTISTRY, ETIOLOGIC FACTORS, LOGISTIC REGRESSION

Early childhood caries (ECC) has become the inclusive term for baby bottle tooth decay (BBTD), nursing caries (NC), and other forms of dental decay in young children. However defined, tooth decay in children remains a widespread, serious health issue. Despite reports of an overall decrease in caries, severe decay is still a prevalent disease of early childhood.¹ It is estimated that 8% of 2-year-old children have at least 1 decayed or filled tooth and that, by age 5, 40% of the children are affected.² Kanellis, Milnes, and Ayhan³ independently demonstrated that ECC is costly to treat, often necessitating general anesthesia costs to manage the youngest of patients for whom normal outpatient dental care is impossible.

As pointed out by Milnes⁴ and the National Institute of Dental and Craniofacial Research (NIDCR), lack of a common working definition of ECC made it nearly impossible to evaluate

and compare evidence from different studies discussing frequency, etiology, clinical course, or impact of ECC. The NIDCR Workshop proposed case definitions of both ECC and severe ECC (S-ECC) to give a collective definition and recommended that additional research be conducted on the epidemiology, etiology, and prevention of dental caries in preschool children.

Most early studies of what is now called ECC reported on discrete, isolated populations and were little more than comprehensive case reports of prevalence as opposed to well-designed scientific investigations. These studies examined children between the ages of 5 and 10 because the subjects were in school, readily available, and old enough that long-term decay existed. As inquiry in the field progressed, research initiatives shifted to determining the disease's frequency and extent. These studies found ranges anywhere from 1% for urban children in Los Angeles⁵ to 68% in Navajo children.⁶

Recent studies have examined related etiologic factors linked to presence of early decay: (1) age; (2) race; (3) urban vs rural settings; and (4) parental roles and knowledge.⁷⁻⁹ The studies focused on children from discrete populations rather than diverse groups and often exhibited shortcomings such as: (1) nonprofessionals as examiners; (2) nonspecific, subjective diagnostic criteria; or (3) low interexaminer reli-

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ability. Some recent investigations have attempted to identify children who were at greatest risk of developing caries as a strategy to more efficiently target preventive procedures.¹⁰

Many have pointed out that caries prediction requires diligent efforts to optimize the predictive power of variables¹¹ and that no single factor will predict caries-prone individuals accurately.¹² In fact, the best predictor of caries risk was examiner recognition of caries experience and placement of that child in a high-risk group.¹³ Kanellis¹⁴ recommended that risk should be based on: (1) past caries experience; (2) presence of precavitated lesions; (3) visible plaque; and (4) perceived risk by examiners.

ECC investigations have generated data on the etiology, prevalence and, to an extent, the influence of purported risk factors. Many of these studies, however, did not take into account the influence of extraneous risk factors. Regrettably, no studies exist in Canada that combine prevalence data with influence of risk factors for children under age 5. Although Schroth¹⁵ recently reviewed published prevalence rates for Canadian preschool children, these studies did not address a complete risk factor analysis.

This study was undertaken to determine the relative influence of purported risk factors, alone and in combination, on the severity of ECC as reported in surveys of parents seeking dental care for children in 5 Canadian dental practices. It compared children between 1 to 5 years old from a high caries population with a low caries population.

This study's purpose was to evaluate children's demographics, habits, fluoride exposure, child behavior, parent's beliefs and practices of nutrition, weaning, and hygiene when related to decay. Descriptive statistics were formulated for individual variables, and independent analyses were performed to determine relationships among risk factors.

Methods

This study was a collaborative effort involving data gathered by Canadian pediatric dentists as well as data organizational and analyses resources from the University of Michigan, Ann Arbor, Mich. Institutional Review Board (IRB) approval was granted by the University of Michigan, Ann Arbor, Mich. Dr. Alan Milnes designed a survey for pediatric dental practitioners to gather information related to ECC. The survey was administered by 5 certified pediatric dentists in private practice in Canada and distributed to guardians of children diagnosed with ECC by the practitioner treating the child.

The survey consisted of 36 questions, with open-ended responses and objective multiple choices, for the parent or guardian. The survey's second component gathered information by the practitioner. This included: (1) dmfs; (2) province; (3) provider; (4) date of the survey; and (5) the child's weight. Statistical validation of the survey was performed at

the University of Washington, Seattle, Wash., and examiners were calibrated for dmfs before the study began. All participants agreed on a common definition of ECC. Test photos of ECC at various stages were viewed independently and then as a group to ensure similar diagnosis before the survey was administered. Test photos and actual patient photos were again viewed during data collection to ensure there was no change in the working definition and agreed diagnostic criteria. Group 1 consisted of 1- to 5-year-old children, each diagnosed with ECC by a participating pediatric dentist and with guardians willing and able to fill out the survey and consent to treatment, if indicated. These surveys were administered from June 1998 until March 2000. The study group survey was administered in British Columbia (BC), Ontario (ONT), and Prince Edward Island (PEI), Canada, on the day the patient presented for initial exam and diagnosis.

Group 2 consisted of children presenting to Dr. Milnes' office, Kelowna, BC, as new patients between November 2000 and January 2001. The children were not designated as caries-free or carious. The patients merely represented typical appointments seen in a pediatric dental clinic for 1- to 5-year-old children during those weeks of control group intake. This group was used to prevent polarizing this study's sample with only children affected by severe decay and having typical issues such as pain, swelling, or behavior problems.

SPSS Statistical Services 10.1 for Windows (SPSS, Inc, Chicago, Ill) was used for all statistical operations. Frequency data were generated for each category. Chi-square tests were performed to assess the significance of the amount of decay to the following individual categories, with each chi-square analysis defining only one factor at a time without controlling for cofactors:

1. Demographics: (a) age at time of survey; (b) gender; (c) province or location; (d) birth order; (e) race or origin; (f) parental level of education; (g) payment of dental costs; (h) living arrangements; (i) marital status of parents;
2. feeding frequency;
3. weaning from the breast;
4. weaning from the bottle;
5. habits;
6. hygiene;
7. behavior;
8. medications; and
9. fluoride exposure.

These factors compared 2 categories: (1) decay presence vs absence; and (2) decay severity vs absence. This gave the authors a basis for determining ECC compared to no decay and S-ECC compared to no decay for all children in both groups, allowing the authors to determine that decay was a dependent variable for logistic regression analysis.

Logistic regression was performed for each risk model category when 2 or more questions comprised that category. The variable with the strongest predictive value was then selected for the limited model regression. One variable from each risk factor category was added to predictive values used in the limited model regression to comprise the full model

regression. In both cases, the dependent variable was decay. The presence of decay in any form was evaluated as “one or more surfaces of decay.” S-ECC was defined as “20 or more surfaces of decay.”

The full regression model was comprised of: (1) government assistance; (2) first born; (3) using a bottle; (4) left bottle at night; (5) parental level of education; (6) problems brushing; (7) Caucasian; (8) regular time for snacks; (9) holds liquids in mouth; (10) difficult child; (11) fluoridated water; and (12) daily medications.

Significance was determined with $\alpha=0.05$, and trends were evaluated for those significant findings. Risks were interpreted as:

1. positively influencing (a protecting factor—less likely to have decay); or
2. negatively influencing (a predicting factor—more likely to have decay.)

Results

Overview. Details of demographic responses are presented to enhance understanding of the population studied. When appropriate, chi-square statistics are given to show the effect of each factor when related by itself to presence or severity of caries in the child. The most powerful analyses of factor relationships to caries are reported in the logistic regression section. A total of 139 surveys were administered, but 2 were excluded because survey pages were missing, leaving 137 considered to be “completed.”

A total of 102 children were diagnosed with decay, 90 of whom were considered “severe,” while 35 children had no decay. Values for weight were not answered by every practitioner, and, thus, were omitted. Mean age ($N=128$) of the children surveyed was 3.05 years old. Four percent were age 1, 23% were age 2, 44% were age 3, 24% were age 4, and 5% were 5 years old. There was an even distribution of gender: 52% males and 48% females. Sixty-nine percent of children were from BC, 28% from Ontario, and 3% were from PEI. No relationship was found via chi-square analyses between the amount or presence of decay and factors of age, gender, or location.

Birth order data showed that 69 (51%) were first-born children and 45 (33%) were second-born children. Chi-square results found that being second-born was significantly related to having one or more surfaces of decay ($P=.026$.)

Race or origin also produced a significant relationship to decay: (a) 105 children (77%) were Caucasian; (b) 7% ($N=9$) were First Nation; (c) 2% ($N=3$) were Asian; (d) Filipinos comprised 4% ($N=6$); and (e) 2% ($N=2$) were East Indians. Ethnicity was then dichotomized into “Caucasian” and “other.” Significant chi-square relationships were found between being Caucasian and having decay ($P=.04$) and severity of decay ($P=.02$).

Parental levels of education ($N=136$) varied greatly: (a) 1 parent (1%) had only finished elementary school; (b) 15 (11%) had some high school; (c) 28 (21%) completed high school; (d) 39 (29%) had some college training; and (e) 53 (39%) had graduated from college. Like race, education was dichotomized to “more than high school” and “high school or less.” Chi-square analysis showed significant inverse relationships between the level of mother’s education and presence of decay ($P=.02$) and severity of decay ($P=.01$)

Payment of dental costs had 136 responses:

- a. 73 people (54%) had insurance from work;
- b. 34 (25%) had government assistance;
- c. 24 (18%) would pay the costs themselves with no reimbursement; and
- d. 5 people (4%) stated they had another form of payment.

These groups were then divided into 2 categories for chi-square analysis: (1) insurance vs decay; and (2) insurance vs parental level of education. For those who had dental insurance, children were less likely to have decay ($P=.001$) and less likely to have severe decay ($P=.002$), while children with government assistance were more likely to have decay ($P=.004$) and more likely to have more severe decay ($P=.004$.) The second category examined the relationship between form of payment and level of education. Education was divided into: (1) post-high school graduation; and (2) high school graduation or less. Type of payment was significantly related to level of education ($P<.001$.) Those highly educated had insurance from work ($P=.001$), and those without had government assistance ($P<.001$).

Living arrangements of parents and children ($N=136$) found that parents lived together with the child ($N=107$), while those who lived in a single-parent house usually lived with the mother ($N=20$). One child lived with grandparents, and 6 children had parents who lived in separate homes but who split custody. Living arrangements were not significantly related to decay.

Marital status ($N=136$) showed that most parents were married and living together ($N=90$) or were common law spouses and living together ($N=18$.) Four were married but separated, and 21 were common law married and living in separate homes. Three parents were divorced. Marital status was not related to decay.

Feeding frequency. The category of feeding frequency was divided into questions about snacks for the: (1) child; and (2) parent. Of 136 children, the average number of snacks per day was 2.54, with 54% not having a regular time for snacks. The parent chooses snacks for the child 81% of the time, with the child (12%), caretaker (4%), or another relative (3%) having some input. For the parent ($N=131$), snacking occurred an average of 2 times a day (40%), but was as frequent as 6 times

a day. No relationship was found between feeding frequency and decay with chi-square or logistic regression analysis.

Weaning from the breast. When asked if the child was breast-fed now: (a) 132 responded “no” (97%); and (b) 4 responded “yes” (3%). Of those who answered “no,” 52 children (38%) were never breast-fed. Weaning ages ranged from 1 to 33 months. When grouped (N=84): (a) 48% were weaned between 1 to 6 months; (b) 32% were weaned between 7 to 12 months; and (c) 20% were weaned between 13 to 33 months. For children who slept with their mothers and nursed at night (N=113): (a) 52 people (46%) said “yes”; (b) 53 (47%) said “no”; and (c) 8 (7%) said “no, my child slept with me, but did not nurse at night.”

No correlations were found between amount of decay and weaning with chi-square analysis.

Weaning from the bottle. Bottle use elicited 135 responses: (a) 21 (16%) said “yes, currently”; (b) 17 (13%) said “no, never”; and (c) 97 (72%) said “yes, in the past.” One third carried a bottle or sippy cup throughout the day (N=41.) Bottle weaning (N=100) ranged from 0 to 36 months. Excluding the 17 who stated that the child never used the bottle: (a) 23% were weaned from the bottle between 1 and 12 months; (b) 59% were weaned between 13 and 24 months; and (c) the last 18% were weaned by 36 months.

When asked if the child fell asleep with the bottle: (a) 66% said “yes”; and (b) 34% said “no.”

Chi-square analysis showed that there was a significant relationship ($P=.001$) between: (1) falling asleep with the bottle; and (2) both the presence and severity of decay. The number of times a child fell asleep with the bottle (N=131) was also significantly related to: (1) presence of decay ($P=.02$); and (2) severity of decay ($P=.009$.) Seventy-nine of 131 children fell asleep with the bottle more than once a day. When asked if the bottle was left with the child when sleeping (N=137): (a) 65 (47%) said “yes”; (b) 72 (53%) said “no.” This was significantly related to decay ($P<.001$).

Habits. Pacifier use (N=134) included: (a) 50 past users; (b) 6 current users; and (c) 78 who never used. Holding liquids in the mouth for a prolonged time (N=135) was observed in 2 children, while 21 children held liquids for several seconds before swallowing. There were no significant relationships found for either habit or decay level through chi-square analysis.

Hygiene. Current tooth-brushing (N=136) occurred for 126 children, but not for 10. Fifty-three out of 124 parents said they had problems cleaning their child’s teeth. Frequency of cleaning (N=128) showed that: (a) 60 brushing more than once a day; (b) 49 at least once a day; (c) 10 people brushed infrequently;

and (d) 2 did not know how frequently their child’s teeth were being brushed.

When asked if there were any problems, common responses from parents were that: (1) their child was stubborn; (2) their child was gaggy; or (3) they wanted to do it themselves. Only 1 response indicated pain. None of these groups had significant relationships with decay by chi-square analyses.

Behavior. Behavior evaluation was comprised of 3 questions that asked parents if their child:

1. required more attention than others (N=135): (a) 24 responded “yes”; and (b) 113 responded “no”;
2. was difficult (N=137): (a) 18 responded “yes”; and (b) 119 responded “no”;
3. had regular problems going to sleep: (a) 18 responded “yes, the child had problems in the past”; (b) 21 responded that they “still had problems falling asleep”; and (c) 96 said there were “no problems.”

Chi-square tests did not show any relation between behaviors and decay.

Medications. Only 6 out of 137 children took daily medications. The types of medications were not given. Sixty children never had ear, nose, or throat infections that required antibiotic treatment within the last year. Forty-seven had 1 infection, 21 had 2 or 3 infections, and 7 had 4 or more infections. No significant relations were found between either of the questions and presence or severity of decay.

Fluoride exposure. Fluoride exposure was measured by 3 questions:

1. Fluoridated toothpaste use (N=136) was regular for 108 children: (a) 10 said once in a while; (b) 7 said they did not use it; and (c) 11 said they did not know;
2. fluoridated water (N=136) was used by 27 children: (a) 53 said “no”; and (b) 56 said they “didn’t know”;
3. fluoride supplements (N=137) were: (a) used by 17 children; and (b) not used by 128.

There were no significant chi-square findings for fluoride.

Logistic regression, full model. Presence of decay (N=102, 74%; see Table 1) was influenced both negatively and positively in the full regression model. The following factors contributed to decay:

1. leaving the bottle with the child ($P=.002$), ($\beta=1.90$);
2. having problems brushing ($P=.05$), ($\beta=1.13$); and
3. holding liquids in the mouth for prolonged time ($P=.04$), ($\beta=1.95$).

Behaviors associated with diminishing presence of decay were: (1) using a bottle ($P=.01$), ($\beta=-2.19$); and (2) hav-

ing a difficult child ($P=.04$), ($\beta=-2.59$). Examining severity of decay ($N=90$; 65%) found the following behaviors related to increased decay: (1) leaving the bottle ($P=.002$), ($\beta=2.01$); and (2) being Caucasian ($P=.05$), ($\beta=1.98$).

Discussion

No other studies have used this combination of risk factors for evaluation of ECC. Since most other studies did not account for confounding factors, the authors had to be cautious when comparing this study's results to other findings. The results are informative concerning the added value of

using logistical regression to analyze for multiple cofactors in such a study, since in the single-factor analyses accomplished with chi-square analyses, several factors appeared to be statistically significant in relationship to caries. After logistical regression, which analyzes the effect of each factor when controlled across all other factors, many of these early significant relationships disappeared.

Most children were 3 years old, which may reflect the public's perception of the ideal age for a child to have a first dental visit. Of 33 children 1 and 2 years old, 24 had decay, 19 of which were defined as severe. This supports the need

to educate professionals to the need for and the importance of early dental care. It also shows the extent of restorative need in a sample of children referred by other professionals or self-referred to a pediatric dental specialist. This prevalence of caries is rarely seen in general dental practices because few of these practices see young patients and few have patients with severe decay referred to them.

Despite the fact that these children were not randomly selected, there was an equal distribution of boys and girls that showed no relationship between decay and gender. More children were seen in the BC practices than in the Ontario or PEI practices. This difference may stem from interest level or practice activity of various providers.

Birth order produced conflicting results in this sample. When only birth order is taken into account, there is a significant risk of being the second born and having decay. In the logistic regression, however, this influence is negated and being first-born became the more important risk factor. This supports Wyne's¹⁶ finding that first-born children were at higher risk for decay. It may be more accurate, however, to compare this study's preliminary data (chi-square only) that showed that second-born children were at greater risk for decay since Wyne only studied frequency tables.

A child's race or origin was found to be significantly related to decay. This is noteworthy because

Table 1. LOGISTIC REGRESSION ANALYSIS OF PURPORTED RISK FACTORS FOR EARLY CHILDHOOD CARIES ON PRESENCE AND SEVERITY OF DECAY*

VARIABLE	MEAN±(SD)			
	DECAY PRESENT		SEVERE DECAY	
	P-value	RISK RATIO	P-value	RISK RATIO
Government assistance	.34	2.17	.34	2.18
First born	.21	1.98	.22	2.06
Using the bottle	.01	.11	.05	.16
Left the bottle with the child while sleeping	.002	6.71	.002	7.43
Parental level of education	.34	1.84	.21	2.44
Problems brushing	.05	3.11	.17	2.36
Caucasian	.16	3.11	.05	7.22
Regular time for snacks	.37	1.65	.33	1.80
Holds liquids in the mouth for long period of time	.04	7.04	.07	5.60
Difficult child	.04	.08	.09	.12
Fluoridated water	.22	.63	.11	.53
Daily medications	.79	4,385.24	.80	3,307.67

* N=102 children with decay present (74% of all participants in the study); N=90 children with severe decay present (65% of all participants in the study); omnibus test of model significance <.001.

most of these children were Caucasian. Most ECC studies look at minority children. In this case, being Caucasian was related to caries presence and severity. This may be:

1. a reflection of the trends in Canada;
2. due to the fact that the study group was taken from private practice; or
3. specific to the study population.

Parental level of education was significant in 2 aspects: (1) relation to type of insurance; and (2) relation to decay. In this study, type of payment for dental costs was this study's only available surrogate for income. Although this may not be the most accurate method of rating SES, it provided useful information. Parents with a higher level of education tended to have insurance from work. This is logical, given that insurance from work is usually associated with a full-time position—a more lucrative, competitive or desirable job that a college or university graduate would maintain. In contrast, parents with lower levels of education predominantly had government assistance. The same trends were seen with levels of decay. Parents with a higher education tended to have children with less decay and less severe decay compared to parents with low levels of education. Therefore, the authors were able to support most of the previously existing data relating SES and decay.

Living arrangements and marital status of the child's parents did not play a role in influencing decay. Most children lived in a 2-parent household. This study's sample was similar to the trends for living arrangements produced by the 1994 Census.¹⁷ Children who lived in single-parent households did not have significantly more decay than their counterparts in 2-parent households. The authors can hypothesize that delegating child care to a surrogate is not a factor in the caries status of this study's sample in contrast to other findings.¹⁸

This study's demographic breakdown was unique. Most studies do not include this spectrum of SES, making comparisons between and among different SES levels difficult, while this study attempted to include and compare possible differences. If one assumes that parental level of education and insurance type makes a commentary on SES, it is interesting to see that a large number of well-educated, ethnically similar (Caucasian), affluent parents were in the same study as uneducated, poor parents with different ethnicities. This variety of family demographics makes this study unique because most studies examine racial isolates or minority children of poor backgrounds.

Dietary influences on decay rates are notoriously difficult to accurately define due to sampling issues and survey answer uncertainties. This study shows similar problems in determining effects of diet on the decay of these children. Favorite snacking foods were often complex and ferment-

able carbohydrates. Juice, apples, and crackers were most often given as snacks by the parent on average more than twice a day sporadically. These foods can be cariogenic¹⁹ even though the perception that giving fruit, juice, or crackers are a healthy alternative to "junk foods."

The authors found that the children's snacking habits were close to parents' habits regarding frequency. The authors did not, however, find a statistically significant relationship between snacking frequency of child or parent and decay. Since the authors did not find a statistical relationship between food or beverage and decay, they could not comment on the direct impact or influence of fermentable carbohydrates on this group of children. Bottle use and sleeping with a bottle, however, can be considered a snacking, frequency habit, and this factor was significantly related to decay.

Juice was the most common liquid in the cup or bottle, and one third carried that bottle or cup throughout the day. This affords for constant insult of acid attack on the teeth, and although juice consumption was not shown to be significantly related to causing cavities, it still may play a role in the decay process by increasing the frequency of oral contact with fermentable carbohydrates overall.

While a majority of this study's children were breast-fed and the range of duration was quite large (0 to 33 months), the authors found no significant relationship to decay. It is important to note that 17 children over the age of 1 continued breast-feeding. This may be due to: (1) personal choice; (2) convenience; or (3) education.

A surprisingly high number of children (64) were not weaned from the bottle until well after the age recommended by the American Academy of Pediatric Dentistry (AAPD) and American Academy of Pediatrics (AAP). Leaving the bottle with the child and the number of times this occurred were both significantly related to presence and severity of decay. Interestingly, the modified question of leaving the bottle with the child when he or she slept showed a stronger relationship. It is possible that the conscious act of leaving the bottle with the child is more detrimental than noticing the bottle is with the child while sleeping.

When the authors compared answers for when the child was weaned from the bottle to when parents think they should be weaned, 39 parents weaned their child later than when they thought they should have. For breast-feeding, parents actually weaned the child before they thought it was appropriate. These data indicate that, for this study's sample, it is more acceptable to use a bottle for prolonged periods of time than it is to prolong breast-feeding. This may reinforce the findings that consciously leaving the bottle with the child at night, whether a matter of convenience or education, is acceptable to most parents.

Habits, hygiene, and behavior as related to decay rates.

Habits are often related to a child's temperament and behavior and, in turn, can be related to hygiene. When a child is "difficult" or "demanding," a parent may feel uncomfortable "forcing" tooth-brushing on the child. If the child becomes violent or obstructive, the parent may avoid the situation completely, thus negatively reinforcing the child's behavior and preventing even minimal oral hygiene or fluoride exposure. One may also think that an overindulgent parent prolongs habits like pacifier use and facilitates "difficult" or "demanding" behaviors in children. A parent may also be tempted to give the child a bottle at night when there are problems sleeping. In this study, almost 30% of the children had or currently have problems sleeping.

When studied individually, hygiene, habits, and behavior did not have a relationship to decay. In contrast, logistic regression found a significant relationship between decay levels and holding liquids for a prolonged time, having a difficult child, and having problems brushing teeth. Because only one parent's response to problems with brushing was "pain or discomfort," the authors have used this as a gauge of child's temperament, not a "quality of life" indicator.

Medications and fluoride exposure. Neither of these categories produced significant associations to decay. Unfortunately, there were not enough children taking medications to have an accurate sample, and this study was not designed to determine if the medications were acting in favor of or against production of decay. Fluoride exposure did not have an impact on caries in this study. The children seem to be getting fluoride from various sources (toothpaste, water, or supplements) and, as with evaluating the data from the section "Medications," the authors are not able to determine fluoride's direct impact (if one exists) on decay for this sample.

Logistic regression. The full regression model offers an accurate representation of how risk factors interplay. Leaving the bottle with the child while sleeping has been consistently shown to be related to causing decay in this study, but bottle use in general was protective against decay. This is an unusual finding that seems contradictory. As discussed earlier, the conscious act of leaving the bottle with the child may reflect indifference by the parent. This is because the authors did not find the same cause and effect of finding the bottle with the child when sleeping. Perhaps the parent who finds the bottle removes it, knowing that leaving the bottle with a sleeping child is not recommended. This study did not examine this aspect. The other explanation relates to statistical anomaly. Most children in this study used the bottle at some time, thus giving these children a common thread and possibly obscuring accurate statistical analysis.

A relationship between decay and difficulty brushing may reflect less effective mechanical cleaning or decreased topical fluoride exposure as opposed to a lack of parent involvement. Because having a "difficult child" was shown to be protective, having difficulty brushing may not be because a parent is too protective of the child's psyche. As with the controversial findings found with bottle use, few children were deemed difficult and thus, this finding may also be a statistical anomaly.

Holding liquids in the mouth may signify an increased time that fermentable carbohydrates are allowed to bathe the teeth, consequently increasing acid attack potential. If a child carries a bottle or sippy cup throughout the day and has to be reminded to swallow the liquids, then the time that the teeth are being insulted is assumed to be very high.

Conclusions

This study tried to improve on past inquiries by studying a population that is not exclusive or polarized. It preliminarily compared children with decay to children without decay, then used the presence and severity of decay in those children, combined with numerous potential risk factors, for analyses. The authors concluded from these data that, for the population studied, the factors providing the most caries risk are:

1. being left with a bottle while sleeping;
2. parents having problems brushing the child's teeth;
3. holding liquids in the mouth for prolonged times; and
4. ethnicity.

This study's data do not support the concept that bottle use alone is a risk factor for decay. In contrast, this study's data do support that having a difficult child may be protective from decay.

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Abstract of Science of Literature

Enamel Maturation of Permanent First Molars

This study investigated the enamel maturation process in the occlusal pits of sound permanent first molar teeth by measuring electrical resistance. Ninety-nine sound permanent first molars in 34 Japanese children (mean age 6.47 + 0.51 years in a Japanese primary school) were measured electrically once every 6 months and were monitored for up to 66 months. These children had used a daily fluoride mouth rinse (0.05% NaF) in nursery school and a weekly rinse (0.2% NaF) in primary school. Electrical resistance increased during the post-eruptive period and had not yet reached the level of electrical resistance present in adult molars. Post-eruptive enamel maturation was not completed by 66 months after tooth eruption.

Comments: *The highly porous enamel present on permanent molars at the time of eruption has been thought to mature 6-12 months after eruption. This study indicates that the maturation process for permanent first molars is in excess of five years post-eruption, which may impact treatment decisions. GEM*

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