Caries-risk factors for Hispanic children affected by early childhood caries

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Abstract

Purpose: The purpose of this study was to examine factors associated with early childhood caries (ECC) and to develop a profile of risk factors for Hispanic families affected by this condition.

Methods: Sixty Hispanic families with at least 1 child affected by ECC and 60 Hispanic families without any affected children were included in the study. Data was collected using a parent-completed questionnaire which gathered information about family demographics, dental care and hygiene practices, and feeding practices of the children.

Results: Parents in families without ECC were significantly more likely to have visited the dentist recently and the children were less likely to sleep while feeding compared to families with an ECC-affected child. Within families affected by ECC, siblings with ECC were significantly more likely to use the bottle and to sleep while feeding compared with their siblings without ECC. Fifty-five percent of the subject families had more than 1 child affected by ECC. However, odds ratios did not indicate an increased risk of ECC among younger siblings in the presence of affected older siblings.

Conclusions: The current study, while supporting the long-held belief that feeding practices influence the susceptibility and course of ECC, demonstrates the role of other nonfeeding practices. (*Pediatr Dent*. 2002;24:536-542)

KEYWORDS: EARLY CHILDHOOD CARIES, HISPANIC CHILDREN, CARIES-RISK FACTORS

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Early childhood caries (ECC) is a condition defined by its age of onset and specific pattern of decay in the primary dentition.[1] Other terms used to describe this condition include baby bottle tooth decay, nursing bottle syndrome, bottle-mouth caries, nursing caries, rampant caries, nursing bottle mouth, milk-bottle syndrome, breast milk tooth decay, and faciolingual pattern of decay.[2,3] ECC is a condition affecting infants and very young children, with teeth first showing signs of decay between 10 and 48 months.[1-3]

Factors attributed to the etiology of ECC include excessive bottle feeding with sugar-containing liquids, breastfeeding on demand and/or falling asleep while feeding, and nursing beyond the recommended age for weaning.[1-4] However, recent studies call into question the association between feeding patterns and ECC and warn against oversimplifying the cause of ECC. Other factors have been associated with ECC including genetic predisposition, nutritional, environmental, socioeconomic, parent education, awareness, and parenting style factors. In addition, ethnicity, education, marital status, and size of the family have been found to be related to feeding practices.[1-3] Though Febres et al failed to identify a unique family profile that predisposes to the condition, one common finding in families is parental overindulgence or lack of parental restraint.[5] Studies demonstrating the familial transmission of Mutans streptococci also suggest that ECC may be clustered in certain susceptible families.[14-16]

The incidence of ECC ranges from 1% to over 50% with an uneven distribution across population subgroups.[2-5,10,17-19] Hispanic children in particular have a higher than average prevalence, ranging from 13% to 29%, second only to that of Native Americans. [2,12,20-22] According to the recently released government report Healthy People 2010, nearly 1 in 4 Hispanic children between the ages of 2 and 4 years have untreated decay.[23]

One possible explanation for the higher than average rate of ECC among Hispanic children is the number of these children living in poverty, a condition previously linked with ECC.[22] According to 1999 figures from the Office of the

Table 1. Demographics

	Subjects (N=60) %	Controls (N=60) %	Test statistics χ^2	*P*
Number of children in family				
2	50	42		
3	37	42		
4	10	8		
5	3	8	2.02	.568
Marital status of parent(s)				
Married	82	76		
Single	17	15		
Widowed	0	2		
Separated	2	3		
Divorced	0	3	3.55	.471
Dental insurance				
Medicaid/mass health	78	75		
Private	0	14		
None	22	11	10.73	.005*
Mother's education				
Elementary	28	20		
High school	67	68		
College	5	12		
Graduate/professional	0	0	2.19	.335
Father's education				
Elementary	35	20		
High school	62	70		
College	4	9		
Graduate/professional	0	2	4.75	.191
Yearly family income				
<$6,999	8	10		
$7,000-$14,999	65	42		
$15,000-$34,999	23	44		
$35,000+	4	4	6.14	.105

*Significant at *P*=.05

Census, nearly 23% of Hispanic households had incomes at or below the poverty line, compared to approximately 8% of white, non-Hispanic households. However, even among low-income families, Hispanic children are less likely to have visited a dentist in the past year (16%) compared to white, non-Hispanic children (25%), suggesting that factors other than income serve as obstacles to dental care.[23]

The purpose of this study is to develop a profile of risk factors associated with Hispanic families affected by this condition. In addition, a possible increased susceptibility of younger siblings to this condition is explored when older siblings are diagnosed with ECC.

Methods

In this study, 60 Hispanic families with at least 1 child diagnosed with ECC were used as the study group. This group consisted of 160 children (100 with ECC and 60 without). The control group consisted of 60 Hispanic families with children of the same age range and living in the same geographical region. This group consisted of 170 children, none of whom were affected with ECC. Families in both groups were excluded from the study if they consisted of only 1 child or if any children had a history of significant medical conditions. All the families came from fluoridated communities.

The study was conducted in Massachusetts from March 1999 to March 2000 at various clinics associated with the Department of Pediatric Dentistry at Boston University. All families meeting the criteria and attending the clinics during this timeframe were approached for possible participation in the study. The study was explained to the parent(s), and informed consent for participation was obtained. All families were interviewed in either English or Spanish using a close-ended questionnaire. The questionnaires were all administered by the same researcher (IJK) with the aid of a bilingual resident or staff member when required. The children's dental charts were used as additional reference for diagnostic history. The questionnaire attempted to establish demographic features of the families, parents, and children as well as information about feeding practices of the children and their dental care and hygiene practices.

There is currently no universally accepted operational definition of ECC. In this study, the definition of ECC was stated as labial or lingual caries of at least 1 primary maxillary incisor. Children had to be 5 years of age or younger at the time of diagnosis or treatment of ECC to be placed in the study group, but no current age restrictions were placed on study participation. Parents were asked to report on the presence of ECC and the age of diagnosis. This information was then confirmed using the children's dental charts.

Statistical analyses consisted of comparisons between control and subject families as well as within the subject families (siblings with and without ECC) using chi-square analysis of the appropriate contingency table or a *t* test of independent group means. In addition, logistic regressions were run to further quantify the differences between families and between siblings. All analyses were performed using SPSS 10.1 for Windows (SPSS, Inc, Chicago, Ill) and STATA 7.0 (StataCorp, College Station, Tex).

Results

Demographic characteristics of study population

Demographic data for families are shown in Table 1. No significant differences were found between subject and control families for number of children in the family, marital status of the parents, level of education of the mother and

Table 2. Dental Health Behaviors

	Subjects (N=60) %	Controls (N=60) %	Test statistics χ^2	*P*
Mother's last dental visit				
Less than 6 mo ago	14	47		
6 mo to 2 y ago	60	47		
2-5 y ago	21	2		
More than 5 y ago	5	5	20.65	<.001*
Father's last dental visit				
Less than 6 mo ago	9	33		
6 mo to 2 y ago	52	46		
2-5 y ago	24	9		
More than 5 y	15	11	11.36	.010*
Supervision of children's brushing				
Adult supervision	80	93		
Supervision by siblings	7	5		
No supervision	13	2	6.05	.048*
Frequency of children's brushing				
Once a day	38	12		
2-3 times a day	60	87		
Never/none	2	2	11.44	.003*

*Significant at *P*=.05

Table 3. Feeding Habits

	Subjects (N=60) %	Controls (N=60) %	Test statistics χ^2	*P*
Pacifier				
Yes	17	23		
No	83	77	0.83	.361
Bottle				
Yes	85	75		
No	15	25	1.88	.171
Breast-fed				
Yes	63	70		
No	37	30	0.60	.439
Slept while feeding				
Yes	78	27		
No	22	73	32.11	<.001*

*Significant at *P*=.05

Table 4. Odds Ratios and Their 95% Confidence Intervals (CI) for ECC^+ vs ECC^- Families

	Odds ratio	95% CI
History of sleeping while feeding		
No	1.00	
Yes	9.94	4.29–23.02
Frequency of brushing		
2-3 times per day	1.00	
Once per day	4.75	1.84–12.23
Father's last dental visit		
Within the past 2 y	1.00	
More than 2 y ago	2.49	1.05–5.87
Father's education		
High school grad or more	1.00	
Less than high school	2.16	0.91–5.11

father, or yearly family income. However, while approximately 75% of the families in both groups were insured through Medicaid, families affected by ECC were less likely to have private dental insurance and were more likely to be uninsured (χ^2=10.73; *P*=.005).

Comparison of families with and without early childhood caries

Characteristics related to dental hygiene and feeding practices were compared between affected and unaffected families. For child-centered variables such as brushing or feeding habits, a target child was selected from each family. For subject families, the oldest child with ECC was selected. Children from the control families were matched on birth order to the children selected from the subject families.

Dental hygiene and supervision information is shown in Table 2. Both the mother and father in families without ECC (ECC^-) were more likely to have visited the dentist recently (for mothers, χ^2=20.65; *P*<.001; for fathers, χ^2=11.36; *P*=.01). Children from families affected by ECC (ECC^+) were less likely to have adult supervision during routine oral hygiene (χ^2=6.05; *P*=.05), and less likely to brush more than once per day (χ^2=11.44; *P*=.003).

Despite the presence of ECC in one or more of their children, only 22% of parents in the subject group reported having knowledge of or information about ECC. In the control group, 19% of parents reported having knowledge or information. This difference was not significant.

The infant nursing patterns of children in both subject and control families are seen in Table 3. No significant differences were found between the control and subject families in the use of a pacifier, the use of a bottle containing liquids other than water, or breast-feeding. However, while 78% of ECC^+ families reported that their child slept while feeding, only 27% of ECC^- parents reported the same (χ^2=32.11; *P*<.001). No differences were found between the subject and control groups on the age that children were weaned from the pacifier, bottle, or breast-feeding.

To determine which of the factors examined were the most important for distinguishing families with ECC from families without ECC, a logistic regression analysis was performed using a forward stepwise entry method. All variables with a *P* value of .20 or less for the univariate analyses were

selected for possible inclusion in the model. These included insurance status, father's education, family income, dental visits by the mother and the father, supervision of brushing, child's frequency of brushing, and child's habit of sleeping while feeding.

The result included four variables in the final model: (1) child's habit of sleeping while feeding, (2) child's brushing frequency, (3) father's last dental visit, and (4) father's education (R^2=.653; *P*<.001). Odds ratios were calculated for each of these variables, three of which were significant (Table 4). Children with ECC were nearly 10 times more likely to have slept while feeding, nearly 5 times more likely to brush only once per day, and more than twice as likely to have a father who had not visited the dentist in more than 2 years.

Children within the ECC$^+$ families

Within the subject families, 45% had 1 child affected with ECC, 43% had 2 affected children, and 12% had 3. The number of affected children was independent of the total number of children in the family. As most subject families had both children with ECC and children without ECC, hygienic and nutritional factors were compared between affected children and their unaffected siblings to find additional possible risk factors for ECC. Because the focus of this analysis was on individual children, and not families, all children were included in the analyses. Across all the subject families, 100 children were affected with ECC and 60 were not.

Table 5. Feeding and Hygiene Habits for Children within the Families Affected by ECC

	Subjects with ECC (N=100) %	Subjects without ECC (N=60) %	Test statistics χ^2	*P*
Pacifier				
Yes	16	13		
No	84	87	0.21	.647
Bottle				
Yes	88	72		
No	12	28	6.74	.009*
Breast-fed				
Yes	62	77		
No	38	23	3.68	.055
Slept while feeding				
Yes	82	63		
No	18	37	6.70	.008*
Frequency of brushing				
Once a day	48	25		
2-3 times a day	47	70		
Never/none	6	5	8.65	.013*

*Significant at *P*=.05

The infant feeding patterns of children within the subject families are seen in Table 5. No significant differences were found in the use of a pacifier between the children with ECC and their siblings without ECC. However, children without ECC were less likely to use a bottle containing liquids other than water (χ^2=6.741; *P*=.009), were more likely to have been breast-fed (χ^2=3.677; *P*=.055), were less likely to have slept while feeding (χ^2=6.969; *P*=.008) and were more likely to brush more than once per day (χ^2=8.652; *P*=.013) when compared with their siblings affected with ECC.

The age at which children within the subject group were weaned from their feeding habits is presented in Table 6. On the average, children without ECC were weaned from breast feeding at an earlier age than their siblings with ECC (t_{84}=2.19; *P*=.031). No significant differences were found between the children with and without ECC and those without for the time when they were weaned from the bottle.

When the siblings with ECC were divided in 2 groups based on age of diagnosis (1-3 years vs 4-5 years), a different pattern emerged. For the children who were breast-fed, the difference in age of weaning was even greater when siblings without ECC (9.5 months) were compared with siblings with an early diagnosis of ECC (16.3 months - t_{66}=2.93; *P*=.005). No differences were found in age of

Table 6. Duration of Feeding Habits for ECC Children and Their Non-ECC Siblings

	Average age in mo	SD	Test statistics (ECC vs non-ECC)
Siblings without ECC			
Stopped using bottle	22.9 N=42	11.70	
Stopped breast-feeding	9.5 N=36	6.51	
Siblings with ECC			
Stopped using bottle	26.3 N=87	11.60	t_{127}=1.52 *P*=.447
Stopped breast-feeding	14.1 N=50	11.06	t_{84}=2.19 *P*=.031*
Siblings with ECC diagnosed at 1-3 y			
Stopped using bottle	25.2 N=47	11.23	t_{87}=0.91 *P*=.366
Stopped breast-feeding	16.3 N=32	11.88	t_{66}=2.93 *P*=.005*
Siblings with ECC diagnosed at 4-5 y			
Stopped using bottle	27.6 N=40	12.04	t_{80}=1.77 *P*=.080
Stopped breast-feeding	10.2 N=18	8.36	t_{52}=0.30 *P*=.764

*Significant at *P*=.05

weaning for the breast-fed siblings without ECC and those with a later diagnosis of ECC.

For bottle-fed children, no differences were found for age of weaning between the non-ECC siblings and those with an early ECC diagnosis. However, the difference in age of weaning for the non-ECC children and their siblings with a later diagnosis of ECC approached significance, with the ECC siblings weaning nearly 5 months later than the non-ECC siblings (t_{80}=1.77; *P*=.08).

A logistic regression analysis with forward stepwise entry was performed using a robust estimate of variance to account for the correlation of sibling data. All variables with a *P* value of .20 or less for the univariate analyses were selected for possible inclusion in the model. The analysis found that breast-feeding, frequency of brushing, and sleeping while feeding best explained the presence or absence of ECC among siblings (R^2=0.086; *P*<.001). Odds ratios for these variables are presented in Table 7. Children with ECC, compared with their unaffected siblings, were twice as likely to not breast-feed and nearly 3 times as likely to only brush once per day and to sleep while feeding.

Finally, the occurrence of multiple affected children in 55% of these families suggested that a child with an older sibling with ECC may be at increased risk for developing ECC and a likely target for aggressive preventive efforts. Curiously, the risk of developing ECC in second siblings with an older sibling affected by ECC did not seem to be greater than in second siblings with unaffected first siblings (OR=1.17; 95%CI=0.39-3.47). Similarly, the chi-square test is non-significant (χ^2=0.077; *P*=.781) indicating that the presence or absence of ECC in one child is independent of the presence or absence in the other child. The data seems to indicate no increased risk among younger siblings with older siblings affected by ECC.

A potential explanation for this unexpected finding was the possibility that the parent of an ECC^+ first-born child became more sensitized to dental issues and changes in behavior resulted. To examine this possibility, the relationship between the age of the first dental visit of second-born children and the ECC status of their first-born siblings was considered. It was found that the average age that the second-born children first visited a dentist was related to the ECC status of their older sibling. When a first-born child does not have ECC, the second-born child, on the average, first visits the dentist at the age of 5.4 years. In contrast, when a first-born child does have ECC, the second-born child first visits the dentist at age 3.3 years (t_{54}=3.57; *P*<.001). This pattern existed regardless of the ECC status of the second-born child.

Despite the fact that second-born children with affected older siblings tended to first visit the dentist earlier than second-born children with unaffected older siblings, half of these children still developed ECC. Family- and child-level differences were explored between the affected and unaffected second-born children with affected older siblings. No differences were found for feeding habits or the hygiene habits of the children or parents. However, while 43% of the families with affected second-born children were uninsured, only 10% of the families with unaffected second-born children were uninsured (χ^2=5.634; *P*=.018).

Table 7. Odds Ratios and Their 95% Confidence Intervals (CI) for Children with ECC as Compared to Their Unaffected Siblings

	Odds ratio	95% CI
Frequency of brushing		
2-3 times per day	1.00	
Once per day	2.87	1.45–5.64
History of sleeping while feeding		
No	1.00	
Yes	2.54	1.26–5.17
Breast-fed		
Yes	1.00	
No	2.12	1.01–4.46

Discussion

Given the high incidence of ECC in the Hispanic population, being aware of certain risk factors may help to identify and target preventive measures and to provide anticipatory guidance of families at increased risk of ECC. Targeting a high-risk subpopulation for further counseling, awareness, and preventive measures has been shown to help alleviate the psychosocial, economic, and health consequences of ECC.[17,22,24,25] The current study has identified several characteristic features of families with ECC including less private dental insurance coverage, less frequent parental dental visits, and less parental supervision during routine oral hygiene by children. In addition, children in these families were less likely to brush more than once per day and were more likely to have slept while nursing.

Previous investigators have examined a number of familial characteristics that may influence ECC. Del Valle et al,[20] in a study of rural Puerto Rican children affected by ECC, found that the number of adults and children in the family were associated with the caries process. They reported that limited resources within larger families make it difficult to appear at follow-up appointments for continued treatment. In contrast, Marino et al[4] found no correlation between ECC and family size. In this study, no correlation was discovered between family size and ECC. In fact, demographic factors were found to be remarkably similar between families with and without ECC. Interestingly, the differences that were found between families with and without ECC suggest that awareness of and interest in oral health, and not family size, may influence susceptibility to ECC in these families.

Dietary issues and feeding practices have long been assumed to play a primary role in the etiology of ECC. Numerous studies attribute certain feeding practices to the etiology of ECC, including excessive bottle feeding with sugar-containing liquids, breast-feeding on demand and/or

falling asleep while feeding, and nursing beyond the recommended age for weaning.[1,3-8,13,26,27] In the current study, though a majority of the children in both groups were bottle fed, children in families with ECC were more likely to have slept while feeding. In addition, within the subject families, the children who suffered from ECC were more likely to sleep with the bottle than their unaffected siblings. This finding is consistent with many previous studies of ECC.

Del Valle et al[20] found that bottle feeding and bottle propping questions were not associated with ECC risk. However, what the mother reported doing to stop her baby crying at night *was* related to the caries process. Alternative behaviors to nursing and bottle feeding such as holding, rocking, talking, and distracting were reported by mothers whose children were at lower risk, suggesting that the use of soothing techniques that do not include cariogenic substrates may be a helpful strategy for parents of children at risk for ECC. In the current study, the use of the pacifier, an alternative soothing technique, did not differ significantly between subject and control families or between children with ECC and their unaffected siblings. However, other soothing techniques were not explored.

The role played by breast-feeding in the development of ECC appears to be complex. On the one hand, breast-feeding seems to be a protective factor against ECC as children with ECC were twice as likely to have not been breast-fed as their non-ECC siblings. However, extended breast-feeding seems to put children at risk for ECC, specifically for developing ECC at an earlier age. Siblings who developed ECC in the first 3 years of life breast-fed for more than 6 months longer than either their non-ECC siblings or their siblings who developed ECC at a later age. This perhaps is consistent with recent studies showing that breast-feeding past the recommended age of weaning, particularly at night, can increase the child's risk of developing ECC.[28]

In this study, a majority of the families from both groups lacked knowledge and information about ECC. There is a strong (and surprising) indication for a need to inform parents of the nature and background of ECC. However, there is no guarantee that, even with appropriate health promotion interventions, prior knowledge of the harmful effects of bottle feeding might hinder its use. O'Sullivan and Tinnanoff revealed that the majority of parents of children affected by nursing caries knew of the potentially deleterious effects of prolonged bottle feeding.[11] Other studies[5,29] have also found that knowledge of parents about caries occurrence does not have an inhibitory effect on the caries experience of their children.

Numerous studies suggest that cultural and familial characteristics may influence caries experience. In addition, the familial transmission of cariogenic microorganisms suggests that ECC may be clustered in certain susceptible families. The occurrence of both unaffected and affected children in the subject families suggested that a child with an older sibling with ECC may be at increased risk for ECC and a likely target for aggressive preventive efforts. Curiously, the risk of developing ECC in second siblings with an older sibling affected by ECC did not seem to be greater than in second siblings with unaffected first siblings.

However, the average age that the second-born children first visited a dentist was influenced by the ECC status of the older sibling, suggesting that the parents of an ECC$^+$ first-born child became more sensitized to dental issues and changes in behavior resulted. The influence of ECC in an older child on parental feeding practices with subsequent children may be an interesting area for further investigation.

One caution in interpreting these data concerns the accuracy of parental reports. Parents were asked to provide information on all of their children about behaviors and habits that occurred primarily in the first 2 or 3 years of life. It is possible that parents were not able to remember accurately or confused the histories of their various children. One potential reassurance is the consistency between parental reports and clinical records on the presence of ECC and age of diagnosis for each affected child. Another reassurance is that a majority of parents provided different "profiles" of eating, sleeping, and brushing habits for each of their children, indicating that they at least were able to differentiate between each child. Whether they did so accurately remains unknown. However, the patterns presented by the data they provided are consistent with the findings of other ECC studies.

It is evident throughout the literature that ECC is a complex clinical entity influenced by a myriad of cultural, behavioral, biological, and microbiological factors. The current study, while supporting the long-held belief that feeding practices influence the susceptibility and course of ECC, demonstrates the role of other, nonfeeding practices such as parental dental habits, the child's oral hygiene habits, and dental insurance. In addition, the fact that the cluster of variables significantly related to ECC in the univariate analyses differed from those in the multivariate analyses suggests that complicated relationships exist between potential risk factors, including factors not measured in the current study. The varying relationships between age of weaning from bottle or breast-feeding and the age of diagnosis of ECC indicate also that different factors may play a role in early vs later development of ECC. Finally, the current study, in concurrence with many other studies, shows that many children who sleep with the bottle or who have poor oral health care habits remain unaffected by ECC. These observations suggest that other as yet unidentified factors must also play a critical role in ECC susceptibility.

Conclusions

1. Characteristic features of Hispanic families with ECC include less private dental insurance coverage, less frequent parental dental visits, less parental supervision of oral hygiene, and less frequent brushing by children. Children in the ECC$^+$ families are also more likely to feed while sleeping.
2. Logistic regression analysis suggests that a child's habit of sleeping while feeding, brushing frequency, and father's last dental visit best predict the occurrence of

ECC in Hispanic families. Children from families with ECC are 10 times more likely to have slept while feeding, 5 times more likely to brush only once per day and twice as likely to have a father who last visited the dentist more than 2 years ago.

3. Within families with ECC, children without ECC were less likely to have used a bottle containing liquids other than water, more likely to have breast-fed, less likely to sleep while feeding, and more likely to brush more than once a day than their siblings affected by ECC.
4. Logistic regression analysis suggests that breast-feeding, frequency of brushing, and sleeping while feeding best explain the presence or absence of ECC among siblings. Children with ECC, compared with their unaffected siblings, were twice as likely to not have breast-fed and nearly 3 times as likely to only brush their teeth once a day and to sleep while feeding.
5. The risk of developing ECC in second siblings with a first sibling affected by ECC did not seem to be greater than in second siblings with unaffected first siblings. Second siblings with affected older siblings, however, did first visit the dentist at a significantly earlier age than those with unaffected older siblings.
6. Knowledge of ECC was low among all families in the study.

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