Primary incisor decay before age 4 as a risk factor for future dental caries

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Abstract

The purpose of this investigation was to determine whether early childhood caries (ECC) is a risk factor for future dental caries. One hundred fifteen dental charts of children younger than 4 years of age when initially treated were reviewed and abstracted for primary incisor caries and age at the initial examination, gender, recall dental visits, sealants, and age at the last dental examination. In addition, the number of carious, extracted, and restored teeth (cert/CERT:primary/secondary) at the last examination was determined. Children with ECC at their initial examination (N = 58) had a 93.0% cert rate, a 67.2% CERT rate, and a 60.3 % CERT in first molars rate by their last dental examination. Non-ECC children at their initial examination (N = 57) had less than half the rate of each cert/CERT parameter (43.9%, 22.8%, and 26.3%, respectively) at their last dental visit. The odds ratios for each cert/CERT parameter posed by ECC status were 17.3 for cert, 7.0 for CERT, and 4.3 for CERT in first molars. When these odds were adjusted for other study parameters by a forward step-wise logistic regression analysis, ECC status continued to be a risk factor for each cert/CERT parameter. We conclude that 1) early childhood caries is a risk factor for future caries, 2) increased age is a risk factor for CERT, and 3) recalls and sealants are protective factors. (Pediatr Dent 19:37–41, 1997)

Numerous reports have documented the decline in the level of dental caries in preschool- and school-age children.[1] However, some children still experience a significant amount of caries.

Early childhood caries (ECC) has been proposed by the Centers for Disease Control and Prevention to describe the forms of dental caries that initiate in the Primary incisors prior to 36 months of age. Baby bottle tooth decay (BBTD) and nursing caries (NC) are manifestations of ECC, the former being associated with bottle use, the later being associated with breastfeeding.

An estimate of the prevalence of ECC in different countries is difficult. Until epidemiological indices become standardized, the prevalence and severity data for these forms of caries will be crude at best. Ripa[2] reviewed several studies on BBTD in different countries and found the prevalence to be between 1 and 53%. He concluded that the overall prevalence of ECC in the United States and other Western-type countries is no higher than 5%. Therefore, with overall dental caries rates in children decreasing and ECC prevalence remaining stable, ECC has become a proportionally larger contributor to dental caries in the pediatric population.[3]

To achieve a further decrease in dental caries, it is important to identify the individuals most at risk. Many variables, including socioeconomic status, have been proposed and tested as predictors of caries risk. These studies have failed to identify a unique family profile that would predispose children to ECC.[4,5]

Different studies also have investigated the relationship between dental caries in the primary dentition and subsequent dental caries in the permanent dentition.[3,6–12] Poulsen and Holm[13] concluded that screening based on dental caries experience in the primary dentition at age 3 seems to have little practical value in identifying children who later would develop caries in the permanent teeth. They attributed their conclusion to the general decline of caries in the Scandinavian countries. The same conclusion was reached by Hill et al.[9] who found that the caries rate at age 6 years was a good indicator of future caries. Honkala et al.[11] concluded that developing a criterion to predict a caries-susceptible group of children seems difficult, but found that the DMF index appeared to be the most reliable. Gray et al.,[3] examined 565 children and concluded that caries in three or more primary molars at age 5 was the best predictor of caries experience in the first permanent molars at age 7. Ideally, earlier detection would be preferable to help identify at-risk individuals and institute special programs for them.

The purpose of this study was to 1) determine if incisor caries before age 4 is a risk factor for future caries in the primary and permanent dentition, and 2) to determine the effects of periodic recall evaluations on the development of future carious lesions in the permanent teeth of children previously treated for ECC.

Methods and materials

Subjects

Data for this study were collected from a retrospective dental chart review of all patients who received their initial dental care between 1985 and 1988 at the

Pediatric Dental Clinic, School of Dentistry, University of Minnesota. The charts were included in this study based upon the following criteria:

1. The patient was medically healthy (ASA = 1)
2. A complete dental record of the patient was available
3. The patient had no detectable developmental dental defects
4. Initial dental appointment was performed at this clinic before the patient was 4 years old
5. The patient was seen for at least one recall after age 6 years.

Of all dental charts, 115 were identified to fit these criteria; case ascertainment was considered complete. Although the two groups seem similar, no attempt was made to establish such similarity.

Patients with primary incisor caries at the initial dental examination are referred to as ECC subjects. Patients with no primary incisor caries at the initial dental examination are referred to as non-ECC subjects. The ECC status was determined for each subject by the presence or absence of caries in primary incisors at the initial dental examination. Non-ECC subject charts were reviewed to ensure that they did not subsequently develop ECC. None of these subjects developed ECC.

Chart review

On review of patient charts, we faced minimal problems. The most common problem was that several of the children did not attend regularly scheduled recall visits. Also, some dental charting dates were not clear. Where charting and/or recall status did not satisfy our selection criteria, the chart was excluded from the study. The total number of carious, extracted, and restored teeth (cert: primary) at the initial dental examination was obtained. In addition, the cert, CERT, and CERT of permanent first molars at the last dental examination were obtained. Each subject's age at the initial and last examination, the number of recall examinations over the study period, the number of recall visits per year, the presence of sealants on permanent first molars, and the number of years from initial examination to last examination also were obtained.

All the initial examinations were performed by graduate students. The recall examination procedure was performed by gradute or undergraduate students. All undergraduate and graduate students are supervised directly by pediatric dentistry faculty. Furthermore, all faculty and students applied standard criteria as established by the Division of Pediatric Dentistry.

Statistical analysis

All data were keyed twice into a computer, verified for accuracy, and analyzed by SPSS™ for Windows (6.0).[13]

Descriptive statistics were calculated for the entire cohort and separately by ECC status. The prevalence and prevalence rate of each cert/CERT parameter at the last dental visit similarly determined.

The odds ratios and 95% confidence intervals for each of any future cert/CERT parameter posed by ECC status were calculated. Also calculated were the odds ratios of each cert/CERT parameter posed by other study factors (male gender, more than 5 years of follow-up, 10 or more years old at the last dental exam, any sealants at the last exam, and more than five recall dental visits over the time period of the study).[14,15] Remarkable odds ratios (odds ratios that did not include one) posed by ECC were selected for further investigation of bias from other study variables (age at the last dental examination, the number of sealants at the last dental examination, and the number of years of follow-

TABLE 1. DESCRIPTION OF STUDY PARAMETERS BY EARLY CHILDHOOD CARIES (ECC)

	Subjects		
Study Parameters	*ECC* N = 58	*Non-ECC* N = 57	*Total* N = 115
Males (N)	33	29	62
Females (N)	25	28	53
Age (years) At initial exam*	2.9 ± 0.7 (1.5–4.0)	2.8 ± 0.4 (1.5–4.0)	2.9 ± 0.6 (1.5–4.0)
Age (years) at last exam*	8.3 ± 1.6 (6.0–14.0)	9.8 ± 1.6 (7.0–14.0)	9.0 ± 1.8 (6.0–14.0)
Years of follow-up*	5.3 ± 1.7 (3–12)	6.9 ± 1.5 (4–12)	6.1 ± 1.8 (3–12)
Sealants*	1.7 ± 1.8 (0–4)	3.2 ± 1.5 (0–4)	2.5 ± 1.8 (0–4)
Recalls*	4.0 ± 3.2 (1–15)	9.1 ± 3.3 (2–15)	6.5 ± 4.1 (1–15)
cert† at initial exam*	7.8 ± 3.8 (1–17)	0.2 ± 0.7 (0–4)	4.1 ± 4.7 (0–17)
cert at last exam*	8.4 ± 3.3 (0–14)	1.8 ± 2.9 (0–12)	5.2 ± 4.5 (0–14)
CERT at last exam*	2.3 ± 2.3 (0–12)	0.6 ± 1.2 (0–5)	1.4 ± 2.1 (0–12)
CERT of first molars at last exam*	1.6 ± 1.6 (0–5)	0.6 ± 1.1 (0–5)	1.1 ± 1.5 (0–5)

* Mean ± standard deviation (minimum-maximum) of subject values.

† cert/CERT: the total number of carious, extracted, and restored teeth; primary/secondary.

TABLE 2. THE PREVALENCE RATE OF ANY FUTURE CARIOUS, EXTRACTED AND RESTORED TEETH AMONG STUDY SUBJECTS BY ECC CHILDHOOD CARIES STATUS

	Subjects, %					
	ECC		Non-ECC		Total	
*Any cert/CERT**	(N = 58)		(N = 57)		(N = 115)	
Any cert at last exam†	93.0	(54)	43.9	(25)	68.7	(79)
Any CERT at last exam†	67.2	(39)	22.8	(13)	45.2	(52)
Any CERT in first molars at last exam†	60.3	(35)	26.3	(15)	43.4	(50)

* cert/CERT: primary carious, extracted, and/or restored teeth; primary/secondary.

† Chi-square test of assocation between initial primary caires status and any cert/CERT ($P < 0.05$).

TABLE 3. THE UNADJUSTED ODDS RATIOS OF ANY FUTURE CARIOUS, EXTRACTED, AND RESTORED TEETH POSED BY EACH STUDY FACTOR

Study Factor	*Unadjusted Odds Ratios*	*Lower 95% Confidence Limits*	*Upper 95% Confidence Limits*
Any cert in Subjects at Last Visit*			
Early childhood caries†	17.28	5.51	54.16
Male	1.19	0.54	1.60
≥ 10 years of age‡	0.18	0.07	0.45
> 5 recall visits‡	0.02	0.00	0.14
Any CERT in Subjects at Last Visit			
Early childhood caries†	6.95	3.04	15.88
Male	1.22	0.58	2.55
≥ 10 years of age	0.73	0.30	1.73
> 5 years follow-up	0.45	0.18	1.15
Any sealants‡	0.30	0.13	0.69
> 5 recall visits‡	0.20	0.09	0.44
Any CERT in Subjects of Molars at Last Visit			
Early childhood caries†	4.26	1.93	9.39
Male	1.65	0.78	3.47
≥10 years of age	0.97	0.41	2.29
> 5 Years follow-up	0.52	0.21	1.30
> 5 recall visits‡	0.28	0.13	0.60
Any sealants‡	0.27	0.12	0.62

*cert/CERT: the total number of carious, extracted, and restored teeth; primary/secondary.

†Increased odds (risk) ($P < 0.05$). Confidence limits of the odds ratio do not include 1.

‡Decreased odds (protection) ($P < 0.05$). Confidence limits of the odds ratio do not include 1.

up). Variables associated with any cert/CERT parameters were entered into logistic regression equations[15,16] along with ECC status to compute the adjusted odds ratio and to ascertain the predictor(s) for each cert/CERT parameter. Relationships between these variables were reviewed for interaction when observed. Interaction terms were entered into the model if clinically feasible.

Results

Statistical summaries (Table 1)

Of the 115 subjects in the study, 58 (50.4%) had ECC as demonstrated by caries in maxillary primary incisors. The remaining 57 (49.6%) subjects had no initial primary incisors caries. The mean age at the initial dental visit was 2.9 years (SD ± 0.6) and was remarkably similar between ECC subjects (2.9 ± 0.7) and non-ECC subjects (2.8 ± 0.4).

Subjects were followed for an average of 6.1 years (± 1.8). The non-ECC subjects had longer average follow up period per subject (6.9 ± 1.5 years) than the ECC subjects (5.3 ± 1.7 years). At the last examination, the ECC subjects were on average younger (8.3 ± 1.6 versus 9.8 ± 1.6 years), had more recall dental visits per year (1.00.5 versus 0.70.4), and had fewer sealants (1.7± 1.8 versus 3.2 ± 1.5) than the non-ECC subjects.

The ECC subjects definitely had more cert at the initial dental visit than did the non-ECC subjects. However, ECC subjects were selected by the presence of incisor caries in primary teeth. At the last examination of permanent teeth, ECC subjects had a higher average CERT (2.3 versus 0.6) and CERT in the first molars (1.6 versus 0.6) than did the non-ECC subjects.

The rate of any future cert, CERT, and CERT in the first molar exhibit equally remarkable differences between ECC subjects and the non-ECC subjects (Table 2). The percentages of any future cert, CERT, and CERT in the first molar in the ECC subjects is well over twice that of the non-ECC subjects. For each cert/CERT parameter, this comparison is statistically significant (chi-square test of association, P-value < 0.05).

Unadjusted odds ratios

The unadjusted odds ratios of any future cert, CERT, and CERT in the first molar posed by initial primary incisor caries status are 17.3, 7.0, and 4.3 respectively (Table 3). Each confidence interval is above — and does not include one, thereby implicating ECC as a risk factor for future cert/CERT.

In order to determine whether the relationship between ECC status and any future cert/CERT was affected by other study factors, the unadjusted odds ratios of any future cert, CERT, and CERT in first molars posed by each of the remaining study variables (gender, age at last examination, years of follow-up, sealants, and recall dental visits) were calculated. None of these other study variables indicated an increased risk for any future cert, CERT, or CERT in first molars. Gen-

TABLE 4. ADJUSTED ODDS RATIOS OF ANY CARIOUS, EXTRACTED, AND RESTORED TEETH IN SUBJECTS

Statistically Significant Study Parameters in Logistic Regression Model	*Adjusted Odds Ratio*	*β*
cert•		
Recall visits	0.72	-0.33
Early childhood caries	6.69	1.90
CERT•		
Age at last examination	2.08	0.73
Early childhood caries	5.69	1.74
Recall visits	0.74	-0.30
Sealants	0.72	-0.33
CERT in First Molars•		
Age at last examination	2.41	0.88
Early childhood caries	3.39	1.22
Recalls	0.74	-0.30
Sealants	0.59	-0.53

• cert/CERT: the total number of carious, extracted, and restored teeth; primary/secondary.

der and years of follow-up were not associated with any of the cert/CERT parameters. However, age 10 and older at last examination and more than five recall visits were each protective factors for cert. This might be due to the loss of primary teeth with age, resulting in fewer primary teeth counted at the last dental examination. The presence of sealants was protective against future CERT and future CERT in first molars, as was more than five recall dental visits (Table 3).

The number of recall visits per year was associated with ECC. Due to this association, an interaction term (ECC x recall per year) was added to the logistic regression for each of the cert parameters. This term never reached statistical significance and was not included in the final logistic model.

Adjusted odds ratios

Table 4 lists the adjusted odds ratios from logistic regression for each of the cert/CERT parameters. ECC continued to be a risk factor (adjusted odds ratio = 6.86) for future cert even after it was adjusted for the protective effects of increased recall visits (0.13) and age at last examination (0.6). Therefore, ECC, age, and a decreased number of recall dental visits per year together are predictive variables of any future cert.

ECC continued to be a risk factor for future CERT after adjustment for age and sealants (adjusted odds ratio: 6.4). Age also was a risk factor for future CERT (adjusted odds ratio: 1.8) and sealants were protective (adjusted odds ratio: 0.7). It is important to note that the confidence interval (CI) for sealants was very close to 1, however, it was statistically significant. Age was not a factor associated with future CERT when viewed alone, and recalls per year were protective (Table 2). However, when adjustments for ECC status and sealants were computed, age was a risk factor for future CERT. Age, ECC, recall visits per year, and sealants were predictive of future CERT.

ECC remained a risk factor for CERT in first permanent molars even though it was adjusted for sealants and age (adjusted odds ratio: 3.7) and recall per year (0.11). Older age presents a risk for future CERT in first molars (adjusted odds ratio: 2.1), and the use of sealants was protective (adjusted odds ratio: 0.6). Therefore, ECC status, age, sealants, and recall visits per year were predictive of future CERT in first molars.

In summary, initial primary incisor caries is a risk factor for developing future carious, extracted, and restored teeth. In addition, age at last examination was a risk factor for CERT and CERT in first molars, therefore, the older a child is, the more likely he/she will have CERT. More recalls per year offer protection from future cert and CERT in first molars, and sealants offer protection to future CERT and CERT in first molars. It is important to note that after initial primary incisor caries were adjusted for risk factors (age) and protective factors (recalls and sealants), initial primary incisor caries continued to be a significant risk factor for future caries in primary and permanent teeth, and in permanent first molars alone.

Discussion

DMFT and dmft are commonly used measures of dental caries. Unfortunately, these indices are not precise measures of the incremental carious process because they become saturated quickly. Using the DMFT index, once a tooth is carious or filled, future caries in that tooth will not be reflected in a count taken at a later date. The DMFS and dmfs indices were introduced to overcome this disadvantage. Unfortunately, these indices also have disadvantages. For example, when one tooth is missing, should it be counted as five surfaces even though it is unlikely that all five surfaces were carious?

In this study, we apply a new index for use in incremental studies. The sum of the number of teeth that are carious, extracted, and/or restored (cert/CERT) is determined. This index more accurately reflects the development of future caries by allowing a tooth to be counted as one if it is carious or has been filled. However, if a tooth is filled and subsequently displays recurrent caries or is extracted, it is counted more than once to more accurately express the progression of the carious process. These measures were used in this study to investigate the relationship between ECC and future caries in order to estimate the risk for subsequent dental decay.

Whereas previous studies were concerned with the total caries experience in both primary and permanent dentition, this controlled study evaluated the relationship between incisor caries and subsequent decay. This is of clinical relevance since primary incisor caries in young children is associated with a diagnosis of nursing caries or baby bottle tooth decay.

Previous studies have suggested that caries may be associated with a patient's racial and socioeconomic

status. University of Minnesota Pediatric Dentistry Clinic serves a diverse racial and socioeconomic population. Therefore, it is not possible to draw any conclusion from this retrospective study regarding the family characteristics and/or socioeconomic status.

Our study has shown that a significant relationship exists between primary incisor caries, as an indication of nursing caries or baby bottle tooth decay, and future caries in the same individual. This is consistent with previous studies[3,8,9,11,12] that found a direct relationship between caries in the primary teeth in general and the caries in the permanent teeth of the same child. A comparison with previous studies is difficult because this study looked at the relationship between early incisor caries and the future caries experience whereas previous studies looked at the total caries experience of the primary teeth. This is an important finding, suggesting that proper dental planning for patients with these forms of ECC also should include parental education regarding the risk for future caries and prevention counseling.

Because of the age of the patients at the last dental visit, caries of the permanent teeth is mainly in the pits and fissures of the permanent first molars. One may anticipate more carious lesions on the proximal surfaces of the ECC group as these patients are followed for a longer period of time.

This study also investigated the relationship between recall examinations and caries experience. The data we collected included the number of recall examinations. Other visits, such as emergency or operative visits were excluded from this number. A high correlation was found between the number of regular check-up appointments and a lower incidence of subsequent caries (cert/CERT). At the University of Minnesota Pediatric Dental Clinic every patient is sent a card reminding them of the need for recall appointments. No differentiations are made between patients with previous carious lesions and patients with no caries. Therefore, no bias should be present in the clinical procedures for encouraging periodic examinations.

Conclusions

Based upon the results of this study, we conclude:

1. Initial primary incisor caries is a risk factor for any future cert, CERT, and CERT in first molars even when adjusted for age, recall visits per year, and sealants.
2. Recalls and sealants are each protective of any future cert/CERT.

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