Update on Early Childhood Caries Since the Surgeon General's Report

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The 2000 Surgeon General's Report on Oral Health included a limited discussion of the condition known as early childhood caries. Because of its high prevalence, its impact on young children's quality of life and potential for increasing their risk of caries in the permanent dentition, early childhood caries is arguably one of the most serious and costly health conditions among young children.

A necessary first step in preventing dental caries in preschool children is understanding and evaluating the child's caries risk factors. Previous caries experience and white spot lesions should automatically classify a preschool child as high risk for caries. Microbial factors, such as presence of visible plaque and tests that identify a child as having high levels of mutans streptococci, also predict caries in young children. Frequency of sugar consumption, enamel developmental defects, social factors such as socioeconomic status, psychosocial factors, and being an ethnic minority also have shown to be relevant in determining caries risk.

On the basis of this knowledge of specific risk factors for an individual, different preventive strategies and different intensities of preventive therapies can be implemented. Caries preventive strategies in preschool children include fluoride therapy, such as supervised tooth brushing with a fluoridated dentifrice, systemic fluoride supplement to children who live in a nonfluoridated area and who are at risk for caries, and professional topical fluoride with fluoride varnish. There is emerging evidence that intensive patient counseling or motivational interviews with parents to change specific behaviors may reduce caries prevalence in their children. Findings regarding antimicrobial interventions, efforts to modify diets, and traditional dental health education are less consistent.

KEY WORD: early childhood caries

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The purpose of this manuscript is to provide an update of early childhood caries (ECC) to health care providers in the areas of epidemiology, societal impact, risk factors, and interventions to reduce the disease. Of importance to clinicians are 2 summary tables, one that will help identify and categorize caries risk factors for preschool children, and a second that identifies caries management approaches to reduce ECC by risk categories.

EPIDEMIOLOGY

Although ECC was known to be a significant problem in preschool populations at the time of the Surgeon General's Report on Oral Health (SGROH) in 2000, comprehensive understanding of its epidemiology has been limited as a result of lack of a case definition, complexity in accessing this age group for data collection, and difficulty in examining these young children. The first reports of caries prevalence in preschool populations in the United States were derived from convenience samples of Head Start and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) populations that may be at higher caries risk than the general population.[1]

A better understanding of the epidemiology of caries in preschool children and prevalence trends can be derived from reports of the National Health and Nutrition Examination Survey (NHANES III) conducted between 1988 and 1994,[2] and 1999–2004 data collected by the ongoing National Health and Nutrition Examination Survey.[3] National studies are more reliable than other surveys because they include large representative samples with careful standardization of examiners. Furthermore, because the surveys include data on socioeconomic factors, insights can be derived regarding the prevalence of dental caries and its treatment in US preschool children at various income levels. Two measures of caries are useful. Prevalence refers to the presence of any carious lesions severe enough to cause cavities or be restored with fillings. The extent or intensity of caries attack in a person is measured by the number of decayed or filled primary teeth (dft) or surfaces (dfs).

The 1988–1994 NHANES data showed a high number of dft in US preschool children. Poor and near-poor 2-year-olds had an average of half a dft per child, and the number of lesions was greater in older age groups, with poor and near-poor 5-year-old children having 2.7 dft. In contrast, the mean dft for nonpoor 5-year-olds was less than 1. Separate analysis of data from only those children with caries demonstrates the severity of disease among these children. For instance, irrespective of economic status, 2-year-old children with caries had more than 3 lesions per child. Differences in dft between economic

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levels also was less evident in 3- and 5-year-olds with caries. Thus, although fewer nonpoor children had decayed teeth, those with decay, on average, experienced disease severity similar to that of poor and near-poor children.[4]

Analysis of 1988–1994 NHANES data indicated that more than half of the poor and near-poor 5-year-olds had caries, and that the disease was essentially untreated among these children, as shown by the percentage of untreated decay.[4] Data from the more recent study indicate that the prevalence of dental caries of children 2 to 5 years old increased from 24% in 1988–1994 to 28% in 1999–2004.[3] Overall, considering all 2- to 5-year-olds, the 1999–2004 survey indicates that 72% of decayed or filled tooth surfaces remain untreated.[3]

Therefore, the data clearly indicate that: 1) caries is highly prevalent in poor and near poor US preschool children; 2) in contrast to declining prevalence of dental caries among children in older age groups, the prevalence of dental caries in US children under the age of five has increased; 3) those children with caries experience, regardless of income status, have high numbers of teeth affected; and 4) dental caries in US preschool children is largely untreated.

Child, Family, and Societal Impact of ECC

The SGROH devoted a chapter, "Effects on Well-Being and Quality of Life," to individual, family, and societal impacts of oral health and oral diseases. Oral health–related quality of life was defined as a multidimensional concept that included physiological function, symptoms, social functional, psychological well-being, and economic costs. Children 5 to 7 years of age in the United States have been estimated to lose more than 7 million school hours annually because of dental problems and/or visits, many of which are consequences of caries that began when they were preschoolers.[5] Describing the most extreme consequences, Cassamassimo and colleagues[6] recently summarized the human and economic costs of ECC, finding reports of several deaths associated with sepsis, and noting that the number of deaths associated with anesthesia for dental treatments is unknown.

Significant strides have been made in recent years in developing and applying oral health related quality of life measures for young children. Most studies rely on caregiver reports of the impact of severe caries on their children or on the family, although some studies also include self-reports from children. A study of 4-year olds with severe caries and those with no caries was conducted in Brazil.[7] Caregivers were interviewed and asked to assess the impact of caries on their children. The children also rated how they felt about their teeth using a happy face and sad face. Caregivers of children with severe caries (n = 77) stated that their children were more likely to be absent from school (26%), were ashamed to smile (31%), and had problems eating (49%). Children with severe caries were also more likely to select the sad face (34%) compared with caries-free children (22%).

A pilot study of children (n = 77) ages 35 to 66 months referred for treatment under general anesthesia was conducted in Montreal, Canada.[8] Caregivers interviewed before and after treatment reported that before treatment, 48% of the children complained of pain, 43% had problems eating, 35% had problems sleeping, and 5% had negative reports from school. After treatment, most of the problems resolved, and the authors concluded that severe caries had a serious impact on the children's quality of life and that treatment eliminated many of these problems. A study in the United Kingdom[9] found that 22% of parents of children aged 5 and under reported at least one impact of oral conditions among their children, the most common being pain (16%) and limitations in oral function (6%).

In the United States, Filstrup and colleagues[10] included self-reports from children on the impact of caries on quality of life. Forty-three percent of children aged 36 to 47 months (16 of 37 children) were able to respond to questions such as, "Do your teeth hurt you now?" and "Does a hurting tooth wake you up at night?" The authors suggest that young children can reliably assess how oral health problems affect their quality of life.

A group at the University of North Carolina developed a measure for assessing quality of life impacts associated with ECC on the basis of the domains of symptoms, function, and emotional and social/family well-being.[11] The most frequent impacts were pain (14.9%) and irritability (9.2%) for children and missing work for the family (20%). A group in Canada assessed the responsiveness of this scale among 101 parents of children aged 0 to 5 years attending a hospital dental clinic.[12] The greatest impacts were on child's function and parental stress. However, the results demonstrated relatively infrequent impacts on quality of life in the sample of children and their families, although the oral health problems of the children in the sample may have been relatively minor.

A common and immediate consequence of untreated dental caries on quality of life is dental pain. Yet, there are few studies of the epidemiology of children's dental pain. A study of Head Start children reported that among children with caries, 16.6% complained of a toothache and 8.9% cried because of a toothache.[13] Children's dental pain affects regular activities, such as eating, sleeping, and playing.[14]

The direct costs of ECC are difficult to document because no information is collected on medical and dental services specifically associated with ECC, but some estimates of the cost of care are possible. The Medical Expenditures Panel Survey found that in 2006, 19.4% of children under age 5 had a dental expenditure, for a total expense of $729 million in that year. Specific procedures or causes of expenses are not reported in this survey but even if only half of these expenditures were related to ECC, the costs were substantial.[15] Several studies of hospital emergency department visits have reported on nontraumatic dental treatment or preventable dental conditions among young children. The Texas Children's Hospital in Houston had 636 emergency room dental visits for children younger than 5 years of age between 1997 and 2001, of which 73% were for nontraumatic dental problems.[16] A California study of emergency department visits showed

Figure. *Carious lesions in a 12-month-old child that suggests that at least in some children mutans streptococcus colonization and the carious process begins before a child first birthday.*

that the rate of visits for those 0 to 5 years of age for preventable dental conditions ranged from 189 to 222 per 100 000 from 2005 to 2007.[17]

Treatment of ECC is expensive, often requiring extensive restorative treatment and extraction of teeth at an early age. In 1996, estimates of cost to treat a child with 2 to 5 lesions are $408 and $1725 for those with 16 to 20 lesions.[18] In addition to the expenses of dental restorations, general anesthesia or deep sedation may be required because such young children lack the ability to cope with the procedures. General anesthesia to facilitate dental treatment may add anywhere between $1500 to $6000 to the cost of dental care.[18–21] ECC also may contribute to other health problems, such as weight loss[22]; however, this evidence is inconsistent.[23]

RISK FACTORS FOR ECC

Previous Caries Experience

One of the best predictors of future caries is previous caries experience.[24,25] Children under the age of 5 with a history of dental caries should automatically be classified as being at high risk for future decay. However, the absence of caries is not a useful caries risk predictor for infants and toddlers because even if these children are at high risk, there may not have been enough time for carious lesion development. Because white spot lesions are precursors to cavitated lesions, they will be apparent before cavitations. These white spot lesions are most often found on enamel smooth surfaces close to the gingiva. Although only a few studies have examined staining of pits and fissures[26] or white spot lesions[27] as a caries risk variable, such lesions should be considered equivalent to caries when determining caries risk in young children.

Microbiologic Factors

Mutans streptococci (MS) are the microorganisms most associated with the dental caries process and are key to the understanding of caries in preschool children. MS contribute to caries formation with their increased ability to adhere to tooth surfaces, produce copious amounts of acid, and survive and maintain metabolism at low pH conditions.[28] Colonization of a child's oral cavity with MS is generally the result of transmission of these organisms from the child's primary caregiver.[29] Factors influencing colonization include frequent sugar exposure in the infants and habits that allowed salivary transfer from mother to infants. Maternal factors such as high levels of MS, poor oral hygiene, low socioeconomic status, and frequent snacking contribute as well.[25]

Preschool children with high colonization levels of MS have greater caries prevalence and a much greater risk for new lesions than those children with low levels of MS.[30] Additionally, colonization with MS at an early age is an important factor for early caries initiation.[31,32] Reports show that predentate children can be colonized with MS as early as 6 months of age.[33] A further understanding of the time of MS colonization may be appreciated from epidemiologic findings,[1] and clinical observations show detection of carious lesions in populations at or before the first birthday (Figure). Because colonization of MS must precede cavity formation, it seems likely that MS colonization, at least in high-risk populations, can occur before 12 months of age.

Visible Plaque

Studies demonstrate a correlation between visible plaque on primary teeth and caries risk.[34] One study found that that 91% of the children are correctly classified as to caries risk solely on the basis of the presence or absence of visible plaque.[35] Most interesting is a recent study of 39 children aged 12 to 36 months that found a positive correlation between baseline MS and plaque regrowth, suggesting that the presence of plaque on the anterior teeth of young children is related to MS colonization.[36] The potential for visible plaque to be an accurate predictor of caries risk and MS colonization in young children is encouraging because this screening method is relatively easy.

Dietary Factors

There is abundant epidemiological evidence that dietary sugars, especially sucrose, are a factor affecting dental caries prevalence and progression.[37] The acid production from sucrose metabolism disrupts the balance of the microbial community, favoring the growth of MS and lactobacilli.[38] Sucrose is a unique cariogenic carbohydrate because it also serves as a substrate for extracellular glucan synthesis.[39] Glucan polymers are believed to enable MS to adhere firmly to teeth and inhibit the diffusion properties of plaque,[40] or increase plaque porosity resulting in greater acid production adjacent to the tooth surface.[41] Yet a systematic literature review of caries risk due to sugar consumption has concluded that the relationship between sugar consumption and caries is weaker in an era of fluoride exposure.[42]

The intensity of caries in preschool children, however, may be due to frequent sugar consumption. High frequency of sugar consumption enables repetitive acid production by cariogenic bacteria that are adherent to teeth. Four cohort studies of preschool children from the age of 1 to 5 years found that daily consumption of sugar-containing drinks, especially during night, and daily sugar intake were independent risk factors in the development of ECC.[43–46]

Enamel Developmental Defects

Lack of enamel maturation or the presence of developmental structural defects in enamel may increase the caries risk in preschool children. Such defects enhance plaque retention and increase MS colonization; in severe cases, the loss of enamel enables greater susceptibility to tooth demineralization. A strong correlation is found between presence of enamel hypoplasia and high counts of MS.[47] Enamel defects in the primary dentition are most associated with pre-, peri-, or postnatal conditions such as low birth weight, and child's or mother's malnutrition or illness.[48] In the primary dentition, the prevalence of enamel defects is common, ranging from 13% to 39% in normal full-term infants[49–51] to over 62% in those born preterm with very low birth weight.[50] Enamel hypoplasia of primary incisors in poor urban populations in the United States has been reported to be over 50%,[52] leaving children vulnerable to the caries process.

Socioeconomic Status

Consistent evidence supports a strong association between family income and caries prevalence. Preschool children from low-income families are more likely to have caries.[53,54] However, children from higher income levels may have lower prevalence of caries experience, but when they do develop caries, the severity of the disease is similar to that of low-income children.[4]

Psychosocial Risk Factors

Despite the consistent evidence demonstrating the importance of socioeconomic status on ECC risk, the understanding of the underlying mechanisms that account for these disparities is limited. Similarly, psychosocial and environmental factors implicated in the development of dental disease are not well understood, including parenting stress, social support, caregiver perceived self-efficacy, and neighborhood issues.

The association between stress and chronic illness is well established in the medical literature. However, the relationship between stress and dental caries is equivocal. Studies of caregiver stress and caries risk among young children have shown varying results.[55–57] In contrast, Finlayson and colleagues[55] found that lower parental stress is associated with greater risk of ECC when adjusting for other factors. Longitudinal and causal modeling approaches are needed to further investigate the role that parental stress plays in ECC risk.

Social support also has received considerable attention in the general health literature, whereby social support and social integration reduce the adverse effects of many health conditions and contribute to positive well-being, improved quality of life, and greater longevity.[58] Social support has received less attention in the oral health literature and relatively little in studies of ECC. Reports from the Detroit Dental Health Project, a longitudinal study of low-income African American children and their caregivers, consistently demonstrate the importance of individual- and neighborhood-level social support on reducing caries risk and in predicting caries progression among young children.[55] Findings from this study suggest that the development of more formal sources of support may be warranted.

Theories of self-efficacy postulate that a person's belief or confidence in their ability to perform certain actions influences the decision to perform these actions.[59] Self-efficacy has been found to be strongly associated with people's decision to engage in a broad range of health behaviors. A study of low-income African American caregivers in Detroit investigated the effects of perceived self-efficacy about toothbrushing and perceived fatalism about children developing tooth decay. Scores on the perceived self-efficacy were fairly high, indicating strong caregivers' beliefs in their ability to brush their children's teeth. However, about 80% of these caregivers also believed that most children will develop dental cavities.[55]

Sociocultural Factors

Ethnic minorities and new immigrants experience oral health disparities for many reasons beyond ability to pay for care. A recent review of health disparities in the Veterans Affairs Health System, consistent with the current literature, suggests that the underlying problems are, in part, cultural differences in how health care providers interact with ethnic minority patients, levels of patient trust, how patients think about the etiology, course. and outcomes of disease, and access to social resources.[60] A small focus group study of cultural beliefs and children's oral health care among African American, Chinese, Latino, and Filipino caregivers found that health beliefs concerning the cause of disease, community beliefs about fear of dental care, and knowledge about oral health care influenced the use of dental services.[61] These findings reinforce the views put forth by Garcia and colleagues[62] on the importance of cultural competence. More work is needed to understand the cultural competency of dental care providers, improve communication skills, and address the limitations in oral health literacy among people at the greatest risk of poor oral health.

Utilizing Risk Factors

Strategies for managing caries in preschool children have increasingly emphasized the concept of risk assessment for clinical decision making; these strategies have also sought to better understand the disease process in a specific individual. Table 1 incorporates available evidence into a nonvalidated tool that may assist health care providers in assessing levels of caries risk for preschool children. As new evidence emerges, tools such as this will certainly be further refined.

INTERVENTIONS TO REDUCE ECC

As we have seen, there has been an increase in our knowledge regarding the risk factors for ECC, but interventions to reduce the disease have been less successful. Clinical trials on infants and toddlers are challenging and difficult to accomplish for several reasons. Populations of young children at risk for dental caries are difficult to

Table 1. Caries Risk Assessment for Children Aged 0 to 6*

Assessment Characteristic	Low Risk	Moderate Risk	High Risk
Fluoride exposure (through drinking water, supplements, professional applications, toothpaste)	Yes	No	No
Sugary foods or drinks (including juice, carbonated or noncarbonated soft drinks, medicinal syrups)	Consumed primarily at mealtimes	Frequent or prolonged between meal exposures	Bottle or sippy cup with sweetened beverages as pacifying drink
Socioeconomic status	Non-poor	Nearly poor	Poor
Caries experience of mother, caregiver, and/or other siblings	No dental problems, has regular dentist	Receiving treatment for dental caries	Untreated dental caries, no source of dental care
Special health care needs	No	Yes, depends on condition	Yes, depends on condition
White spot lesions, enamel defects, restorations, or cavitated carious lesions	None		Yes
Plaque	No visible plaque		Visible plaque
Mutans *streptococcus*	Low	Moderate	High

Overall assessment of the child's dental caries risk High ☐ Moderate ☐ Low ☐

*Adapted from American Dental Association Caries Risk Assessment Forms. This table can be used as a checklist for the health care worker and parent. Circling those conditions that apply to a specific patient prompts a discussion of the factors that contribute to or protect from caries and interventions that are needed (Table 2). Risk assessment categorization of low, moderate, or high is based on preponderance of factors for the individual. However, clinical judgment may justify the use of one factor in determining overall risk—for instance, frequent exposure to sugar-containing snacks or beverages, or visible cavities.

recruit because they are not enrolled in large numbers in institutional settings. Parents of young children, especially those in low socioeconomic settings, have difficulty in complying with the interventions and often drop out of clinical trials. Furthermore, institutional review boards are cautious to approve studies in very young children and make demands on the study design, such as not allowing untreated control groups and requiring that treatment must be assured for children identified with disease. However, data from current peer-reviewed literature and expert panels suggest appropriate interventions to reduce ECC (Table 2).

Toothbrushing With Fluoridated Toothpaste

The role of toothbrushing in the prevention of tooth decay has long been considered self-evident. Yet there is little evidence to support the notion that tooth brushing *per se* reduces caries. The relationship between individual oral hygiene status and caries experience is weak, and instructional programs designed to reduce caries incidence by promoting oral hygiene have failed.[63–65] However, convincing evidence exists for the decay-preventing benefit of tooth brushing with fluoride-containing toothpaste.[66] Three clinical trials have shown that daily toothbrushing with fluoride toothpaste in 3- to 6-year-olds significantly reduces caries incidence.[67–69] To prevent dental fluorosis from excessive swallowing of toothpaste, children's brushing should be supervised with dispensing only a "smear" of fluoridated toothpaste for children younger than 2 years, and a "pea-size" amount of toothpaste for children aged 2 through 5 years.[70]

Systemic Fluoride Supplements

If the fluoride content of water is suboptimal or unknown, the drinking water can be analyzed for fluoride content, and systemic fluoride supplementation can be recommended on the basis of the fluoride content of the water, the child's age, and the child's caries risk. Data from over 20 clinical trials show caries reduction in primary teeth of 30% to 80% from fluoride supplements, provided that

Table 2. Caries Management Approaches to Reduced Early Childhood Caries by Risk Category

Approach	Low Risk	Moderate Risk	High Risk
Toothbrushing with fluoridated toothpaste*	Yes	Yes	Yes
Systemic fluoride supplements†	No	Consider	Consider
Fluoride varnish	No	At least every 6 mo	Every 3 mo
Counseling to reduce high frequency of sugar exposure	Yes	Yes	Yes
Dental referral	No later than age 3 y	Age 1 y	Age 1 y

*"Smear" of toothpaste for children under age 2; "pea-size" over age 2; twice daily.
†Patient's age, parent's compliance, and knowledge of fluoride levels in tap water.

therapy is started close to birth and continued for 5 or more years.[71] However, these studies were done in the 1950s and 1960s, when research designs may not have been as rigorous, and children living in nonfluoridated area were receiving less fluoride from toothpaste, beverages, and foods.[72] Because of the risk of fluorosis, Centers for Disease Control and Prevention recommendations suggest that fluoride supplements should be prescribed only to children residing in nonfluoridated communities who are identified as being at high caries risk.[73] Fluoride supplementation is not recommended as the first-line preventive approach because of compliance issues, lack of information about the fluoride status of the child's drinking water, and the child's caries risk status.[74]

Fluoride Varnish

Fluoride varnish is ideally suited for topical applications to the teeth of preschool children because of ease of use, acceptability to young children, and reduced risk of overingestion of fluoride. Commercially, these varnishes generally come in single-use dispensers that limit the quantity of fluoride application to either 5.6, 9.0, 13.6 mg F, corresponding to 0.25, 0.4, and 0.6 mL varnish in the dispenser. Their efficacy to reduce caries in primary teeth has been shown in several studies.[75–79] The American Dental Association's 2006 topical fluoride guidelines recommend that fluoride varnish be applied every 6 months for those preschool children at moderate caries risk, and every 3 to 6 months for children at high risk.[80]

The American Academy of Pediatrics has endorsed the use of fluoride varnishes by pediatricians, and such recommendations are reimbursed by Medicaid in more than 25 states. However, as of 2002, no studies assessed the appropriateness (familiarity with the procedures, patient selection, and adherence to clinical protocols) of primary care physicians' use of topical fluoride.[81]

Counseling to Reduce Harmful Behaviors

Good data show that children's oral cavity is colonized with MS generally as result of their transmission from the child's primary caregiver. As a result of these findings, there have been at least 11 reports of interventions of the mothers by using various combinations of treatments, including antimicrobial agents, fluoride, xylitol chewing gum, and restorative care in order to reduce MS and consequently caries in their offspring.[29] Most studies found a reduction of MS in their children, but only 2 showed significant caries reduction. The efficacy of caregivers' preventing MS transmission to their child by proper hygiene practices that reduces the transmission of MS still needs to be established.

Nutritional counseling for the purpose of reducing caries incidence in children is aimed primarily at teaching parents the importance of reducing frequent sugar exposures. Two Swedish studies have tested the effect of preventive education for new mothers on the subsequent caries experience of their children. One study provided diet and oral hygiene counseling to the test group at 6, 12, and 24 months of age, as well as fluoride supplements. This study observed a 65% lower caries experience in the 4-year-old children of mothers who received counseling compared with the control group.[82] Another study with a similar program found a 42% decrease in caries prevalence after 4 years.[83] Although the results of these studies are encouraging, it is not clear why there have not been more studies to explore the potential of dietary counseling in reducing dental caries in preschool children.

A Canadian study among Vietnamese preschool children in Vancouver assessed the effectiveness of lay community workers in one-on-one counseling during well-child visits to the health clinic. Mothers who had more than one counseling visit reported less use of daytime and sleep-time bottles, and their children had lower prevalence of dental caries.[61] In another study, children of parents exposed to motivational interviews had 63% fewer new carious lesions than those parents exposed to traditional health education.[84] Motivational interviewing to help parents change behaviors and adopt preventive dental recommendations merits further investigation.

Dental Referral

For children at risk for caries, MS colonization and the carious process often begin before the first birthday. Therefore, a dental referral consisting of examining the teeth, providing anticipatory guidance counseling, performing preventive procedures, and establishing a "dental home" is recommended for all infants at 12 months.[85,86] Yet the capacity of dental providers willing to see infants is fixed, and if such services were implemented among all 1-year-olds, those children identified with caries risk may be crowded out and not receive care.[87] Thus, from a public health perspective, it may be prudent not to recommend dental referral at age 1 for children at low caries risk.

Conclusions

Although ECC is a significant health problem, little emphasis was placed on this disease before the SGROH, perhaps because of the difficulty in conducting dental studies in young children. ECC remains a major health problem in the United States, with a prevalence of 50% in poor and near-poor 5-year-olds. This disease has increased in the past 10 years and is mostly untreated in preschool children.

Strategies for managing dental caries in young children have increasingly emphasized identification of children at risk and individual assessment of caries risk factors. Risk assessment tools are still being developed and tested. However, caries risk indicators that are currently accepted as important include a child's fluoride exposure from various sources, the way sugar-containing foods are consumed, the socioeconomic status of the family, the caries experience of others in the family, previous caries experience, visible plaque on teeth, and levels of MS.

Currently, interventions to reduce ECC have been only partially successful, and many barriers to conducting such studies persist. Several reports have shown that daily toothbrushing with fluoride toothpaste and application of fluoride varnish reduce caries incidence in preschool children. Such topical fluoride applications are becoming more popular to prevent ECC than systemic fluoride supplements. Recent reports also show that motivational interviews with parents of preschool children that include diet counseling may affect caries prevalence in their children.

Certainly, progress has been made in the past few years, but significant work is needed to better understand the biological and sociodemographic factors related to caries, as well as the preventive strategies that can be used to treat this disease.

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