The Egyptian Journal of Hospital Medicine (January 2018) Vol. 70 (8), Page 1259-1265

Prevalence of Early Childhood Caries

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ABSTRACT

Background: Early childhood caries (ECC) is a severe form of dental decay with multi-factorial origin. ECC can significantly affect the child's quality of life, as it may lead to infection, swelling, pain, and other symptoms. The ECC affects children after eruption of primary teeth until age of around 5 years.

Aim of the study: Investigating the etiology and risk factors predisposing ECC among children and the optimal interventions for prevention.

Methods: We searched the medical literature to retrieve studies for the review to 30 November 2017. We searched Medline, Embase, the Cochrane Library websites for English Publications that were obtained from both reprint requests and by searching the database. Data extracted included authors, country, year of publication, characteristics of patients, pathophysiology, risk factors, clinical manifestations, different diagnostic approaches and prevention modalities.

Conclusion: The increase in the prevalence over time is mainly behind increased exposure to risk factors and increased number of teeth at risk. Predisposing and risk factors include living in a non-fluoridated county, low socioeconomic status and poor dietary behaviors. Preventive measures involve community, homecare and professional interventions to avoid risk factors which require to be followed with discipline in order to avoid potential incidence of ECC in the first place. We further recommended preventive strategies by increasing public awareness such as promotion of community-based interventions conducted by dental hygienists and the Inclusion of oral health screening in new child health immunization schedules and insurance legislation for children.

Keywords: Children, Early childhood caries, Fluoride, Nursing caries, Pediatric dentistry.

INTRODUCTION

Dental caries is a complex multifactorial disease that begins with microbiological shifts within the complex biofilm- biofilm-mediated-which is greatly influenced by the composition and flow of Saliva , exposure to fluoride, dietary factors especially Sugar consumption, and by preventive behaviors. The disease is initially reversible and can be halted at any stage, even when some cavitation occurs, provided enough biofilm can be removed[1].

Early childhood caries (ECC) is a form of dental caries that starts early in life as the name implies. It is a complex disease that involves the maxillary primary incisors within a month after eruption and spreads quickly to include other primary teeth[2]. It is a serious socio-behavioral and dental problem that afflicts infants and toddlers worldwide.The definitions of ECC in the published literature vary, making comparisons among studies difficult[2]. Yet they all have incisor involvements with decay as a common ground[3].

The American Academy of Pediatric Dentistry (AAPD) came with a definition for ECC in 2003 as the existance of one or more decayed (noncavitated or cavitatedlesions) or filled tooth surfaces in any primary tooth in a child up to 71 months of age or younger. The term "Severe Early Childhood Caries (S-ECC)" refers to "atypical" or "progressive" or "acute" or "rampant" patterns of dental caries. Moreover, from ages 3 to 5, it is defined as having 1 or more cavitated, missing or filled smooth surfaces in primary maxillary anterior teeth or decayed, missing, or filled score of $\geqslant 4$ (age 3), or $\geqslant 5$ (age 4), or $\geqslant 6$ (age 5) surfaces constitutes S-ECC [3].

Figure 1: Initial stages of ECC- the lesion can be arrested by the application of fluoride and improved OH habits[4].

Received: 16/12/2017
Accepted: 26/12/2017
DOI: 10.12816/0044633

Figure 2: Advanced stage of ECC - requiring restorative treatment or extraction [5].

ECC is a serious public health concern especially for social disadvantaged groups, in both developed and developing worlds. Yet, it remains relatively unexplored and poorly defined in many developing countries[6].

ECC can quickly deteriorate the primary dentition of toddlers, infants and young children if left untreated. It is painful and can cause acute infection, nutritional insufficiencies, learning and speech difficulties. The study of dental caries in primary dentition is imperative for the sake of improving the quality of life of young children that can be significantly worsened by ECC, alsosince dental caries in primary dentition is one of the best predictors of caries in the permanent dentition[7].

Good prevalence data are lacking because of inconsistent definitions of ECC, the frequent use of specialized, unrepresentative samples such as dental clinic attenders, and the absence of very young children from most study samples. The available figures, however, clearly demonstrate disparities in prevalence of ECC: poor African-American, Latino, and Native American children have higher ECC prevalence than Caucasian children. A total of 80 percent of all ECC is experienced by 24 percent of children, primarily from low-income families [8].

Even though the prevalence data of several regions are available, long waiting lists for treatment of ECC in hospitals indicate that many children still suffer from this condition.

In the present study, we aimed at investigating the etiology and risk factors predisposing ECC and the optimal interventions for prevention.

MATERIALS AND METHODS

Electronic search in the scientific database from 1960 to 2017.

Data Sources: Literature searches of MEDLINE, EMBASE, SCOPUS, Current Contents, Cochrane Library, and Clinicaltrials.gov between 1960 and 2017 were performed.

The search terms included "Early childhood caries"," Nursing caries ""ECC," "prevalence," "etiology," "risk," and "Flouride". For the sections on diagnosis, treatment, and key challenges, articles were selected for inclusion from the extensive literature based on the clinical judgment of the author, using the conventional criteria of relevance, importance, and robustness of data.

Data extracted included authors, country, year of publication, characteristics of patients, pathophysiology, risk factors, clinical manifestations, different diagnostic approaches and prevention modalities.

The study was done after approval of ethical board of King Abdulaziz university.

PREVELENCE OF ECC

The study of the prevalence of ECC is important because it provides a snapshot and allows comparisons between different study samples and potential risk groups. There seems to be wide variation in the prevalence of ECC, in part due to different definitions and criteria used. Although the prevalence of ECC has decreased since the middle of the last century in the developed countries, a high percentage of children throughout the world and in the U.S. still suffer from ECC and its consequences. For example, two series of studies (discussed in detail previously in this section) were conducted in the United Kingdom to show the general trends in the prevalence of ECC among different samples with the same characteristics[9].The first series of studies showed a decreased prevalence of ECC among 12- to 60-month-old children from 1971 through 1988 **[10]. While, the** second part of the studies showed a decrease in prevalence of ECC among 3-year-old children from 1973 through 1989 [9].

Studies conducted in difference regions reported a highest prevalence of caries found in Africa and South East Asia while in European countries (England, Sweden and Finland) the prevalence is estimated from 1% to 32%and in Eastern Europe it is reported up to 56% [11]. The prevalence of ECC in Canadian general population is less than 5% and in high risk group 50 % to 80% [12].The reports from developed countries showed that prevalence of caries was found higher among preschooler and severity of the disease was reported more in certain ethnic and immigrant groups, which is a serious concern [13]. In developing world the prevalence of ECC was very high. In Far East Asian region, ECC prevalence was reported ranging from from 36% to 85% [14].

Furthermore, the prevalence of ECC was higher among specific risk groups, such as children from low SES families, and those who were from specific racial and ethnic backgrounds, such as Hispanics, Native Americans, and African Americans. Recent data from NHANES, 1999-2002 showed that the prevalence of ECC among children aged 2, 3, 4, and 5 years was 10.9%, 20.9%, 34.4%, and 44.3%, respectively[15].

Two large studies from the Middle East were included in Milnes review[16] of nursing caries articles. In Kuwait, 5,473 4- to 5-year-old children were recruited from public kindergartens in Kuwait City, Kuwait, and examined for the prevalence of nursing caries, which was defined according to nursing caries pattern[17].The study was conducted by Soparkar at al. [17] and published in 1986. Soparkar at al. [17] stated that the prevalence of nursing caries was 11.5%. In Iraq, Yagot *et al.* [18] screened 2,389 children who were 12-53 months of age from a nursery school in Baghdad. The results of this study which were published in 1990 showed that the prevalence of nursing caries, which was defined as the presence of caries on the gingival third of the labial surface of any of the maxillary incisors, was 15.6%.

In Saudi arabia, a study carried out by Al-Meedani *et al.* reported that about 69% of children had dental caries with dmft score of 3.4 (± 3.6) and dmfs of 6.9 (± 9.9). There was no statistically significant difference between boys and girls. Less caries was observed among children whose parents worked and it was statistically significant as well as whose mothers had high or low educational level. Increased number of family members appeared to have a high incidence of dental caries which was also statistically significant. There was no significant difference in dental caries prevalence with birth order[19].

A recent cross-sectional study conducted in Saudi Arabia from December 2014 to April 2015 to measure Prevalence of Dental Caries among Children in Jeddah - Saudi Arabia, a total of 2113 children aged 12 - 14 were randomly selected from 16 schools located in different geographic areas. Three calibrated examiners using World Health Organization (WHO) criteria to diagnose dental caries performed the clinical examinations. The proportion of Boys and Girls affected by dental caries were similar with no statistical significant difference. They suggested that an early intervention program is urgently needed to help control dental defects in Saudi Arabia[20].

The study was done after approval of ethical board of King Abdulaziz university.

ETIOLOGY

ECC is a multi-factorial disease. An early infection with Streptococcus-mutans group organisms is reported to be a major risk factor for the development of dental caries. The determinants of ECC are identified as biological, social, and behavioural[21].

The disease is a prime example of the consequences arising from complex, dynamic interactions between microorganisms, host, and diet, leading to the establishment of highly pathogenic (cariogenic) biofilms.

The risk factors including; age of the child, educational and occupational status of mothers, number of siblings, time of cessation of breastfeeding, high intake of carbohydrate snacks and biscuits are found to be associated with child's oral health [22].ECC was always correlated to improper and prolonged bottle use or breast feeding. Particularly at bedtime, the use of the bottle is thought to be associated with increased risk for caries, however this is not the only factor in caries development in early childhood. Carious lesions are produced from the interaction of cariogenic microorganisms, fermentable carbohydrate such as sugars , and susceptible tooth surface. Given the proper time, these factors induce incipient carious lesions. The associated risk factors have also been found to vary from population to population[23].

PREDISPOSING AND RISK FACTORS OF ECC

1. Oral hygiene and Dietary Behaviors

Oral hygiene is generally accepted that the presence of dental plaque is a high risk factor for developing caries in young children. Some studies [24]have reported that a child's brushing habit, frequency of brushing, and/or use of fluoride toothpaste are associated with the occurrence and development of dental caries. It was found that children who did not have their teeth cleaned at bedtime had a higher risk of developing ECC. As young children lack the ability to clean their own teeth effectively, parents are recommended to clean their children's teeth at least until they reach school age[24].

Tanaka *et al.* [25] recruited 2,056 Japanese children aged three years and collected oral hygiene practices information from their parents cross-sectionally to assess risk factors associated with ECC (discussed earlier in this chapter). Furthermore, the descriptive analyses showed that approximately 85% of the children reportedly used toothpaste and 44% of the children received regular dental check-ups. In our study and when the children were 3 years old, 100% of the children used toothpaste and 51% had a regular dentist.

2. Microbiological risk factors

S. mutans and *Streptococcus sobrinus* are the main cariogenic micro-organisms. These acid-producing pathogens inhabiting the mouth cause damage by dissolving tooth structures in the presence of fermentable carbohydrates such as sucrose, fructose, and glucose. Most of the investigations[26]have shown that in children with ECC, *S. mutans* has regularly exceeded 30% of the cultivable plaque flora. These bacterial masses are often associated with carious lesions, white spot lesions, and sound tooth surfaces near the lesions. Conversely, *S. mutans* typically constitutes less than 0.1% of the plaque flora in children with negligible to no caries activity, it is already well known that initial acquisition of mutans streptococci (MS) by infants occurs during a well-delineated age range that is being designated as the window of infectivity[27].Most of the long-term studies also demonstrated that the individuals with low infection levels in this period are less likely to be infected with MS, and subsequently have the lowest level of risk of developing caries which can be explained by the competition between the oral bacteria, resulting in the invasion of the niches, where MS can easily colonize, by less pathogenic species[28].

3. Feeding practices

Prolonged and night-time bottle-feeding practices in infants and toddlers generally are thought to provide the carbohydrate source that promotes high acid production by mutans streptococci. Yet evidence suggested that blaming sleeping with a bottle of milk may over simplify the cause of rampant caries. Several studies have reported that the majority of U.S. preschool populations take, or have taken, a bottle to bed2s, **[29]** In one study of U.S. Head Start children, 86% of children with caries of the maxillary anterior incisors were reported to have taken a bottle to bed, but surprisingly, 69% of those who did not have maxillary anterior caries also reportedly took a bottle to bed.2° In another study, 90% of children in a population with and without caries were bottle-fed between 12 and 18 months of age, yet the prevalence of nursing caries was only 20% **[30]** Since this feeding pattern is pervasive, it follows that parents of children with ECC often answer "yes" to the question, "Do you put your child to bed with a bottle?". 2° Thus, it is logical that the bottle-to-bed habit is inferred as the cause of early childhood caries.

4. Socioeconomic factors

Association between ECC and the socioeconomic status (SES) has been well documented. Studies suggested that ECC is more commonly found in children who live in poverty or in poor economic conditions[31],who belong to ethnic and racial minorities[32], who are born to single mothers,[81] whose parents have low educational level, especially those of illiterate mothers. In such populations, due to the prenatal and perinatal malnutrition or undernourishment, these children have an *increased risk* for enamel hypoplasia and exposure to fluorine is probably insufficient, and there is a greater preference for sugary foods [32].

The possible influence of SES on dental health may also be a consequence of differences in dietary habits and the role of sugar in the diet. Sheiham and Watt [33] concluded in their review on inequalities in oral health, that the main causes of inequalities in oral health are differences in patterns of consumption of non-milk sugars and fluoride toothpaste. Another study[34]emphasized the discrepancy in ECC prevalence rate: 1–12% in developed countries, whereas it as high as 70% in developing countries or within select immigrant or ethnic minority populations. Moreover, children with parents in the lowest income group had mean Decayed, Missing, and Filled Teeth (dmft) scores four times as high as children with parents in the highest income group.

PREVENTION OF ECC

The ultimate goal of oral health education is to prevent disease, its motivation is to encourage basic leadership for oral health reviews and to motivate proper decisions for such behaviors. The main factor contributing to caries formation is the substrate component of sugar. Consequently, most dentists shifted their concern to concentrate on child diet modification and feeding habits by educating parents and caregivers**[35]**.

The preventive interventions for mothers should be designed to reduce the translocation of bacteria from the mother to children and for better oral health of children.

The AAPD **[36]**recognized early childhood caries as a significant chronic disease resulting from an imbalance of multiple risk and protective factors over time. To decrease the risk of developing ECC, the AAPD encourages professional and at-home preventive measures that include:

1. Avoiding frequent consumption of liquids and/or solid foods containing sugar, in particular: • Sugar-sweetened beverages (e.g., juices, soft drinks, sports drinks, sweetened tea) in a baby bottle or no-spill training cup. • Ad-libitum breast-feeding after the first primary tooth begins to erupt and other dietary carbohydrates are introduced. • Baby bottle use after 12-18 months.

2. Implementing oral hygiene measures no later than the time of eruption of the first primary tooth. Tooth brushing should be performed for children by a parent twice daily, using a soft toothbrush of age-appropriate size. In children under the age of three, a smear or rice-sized amount of fluoridated toothpaste should be used. In children ages three to six, a pea-sized amount of fluoridated toothpaste should be used.

3. Providing professionally-applied fluoride varnish treatments for children at risk for ECC.

4. Establishing a dental home within six months of eruption of the first tooth and no later than 12 months of age to conduct a caries risk assessment and provide parental education including anticipatory guidance for prevention of oral diseases.

5. Working with medical providers to ensure all infants and toddlers have access to dental screenings, counseling, and preventive procedures.

6. Educating legislators, policy makers, and third party payors regarding theconsequences of and preventive strategies for ECC.

Ismail *et al.* [37] suggested in the strategies for ECC prevention in the below chart.

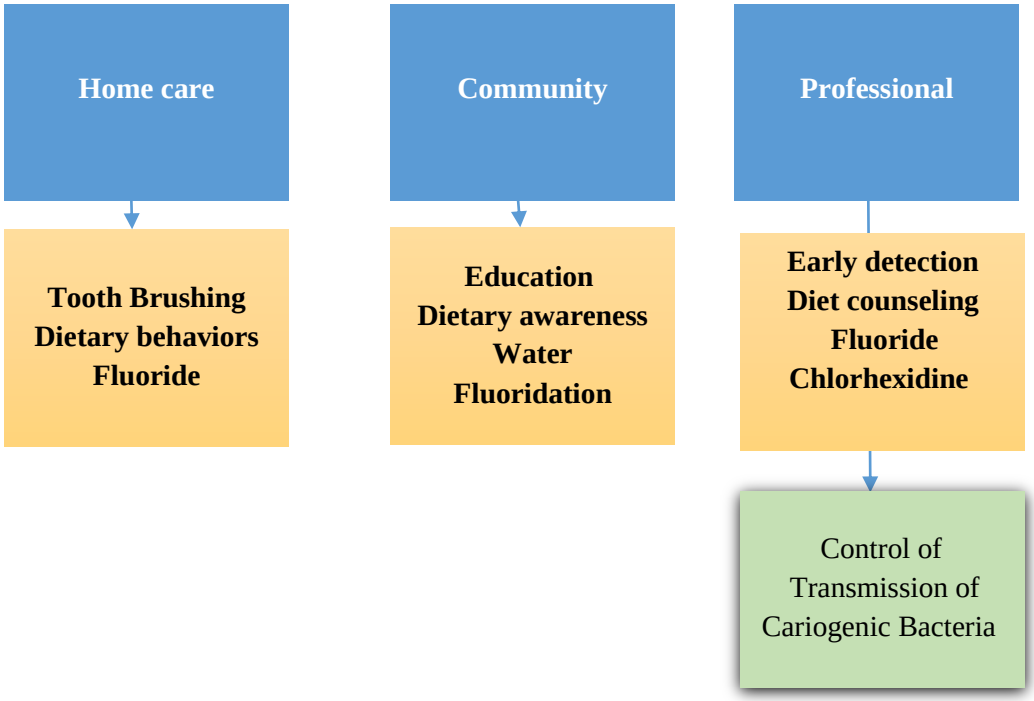

Figure 3: Strategies for the prevention of ECC.

It's noteworthy to indicate that the incidence of ECC can be modified by applying different preventive care programs. For instance, many studies stated that the application of fluoride varnish decreases the incidence of ECC when compared with a control group. Weintraub *et al.* [38] conducted a RCT study to assess the efficacy of professional application of fluoride varnish and the results showed that the incidence of ECC in the control group was statistically significantly higher in the control group (did not get fluoride varnish application) compared to the treatment group (get professional fluoride varnish application).

FLUORIDE SUPPLEMENTATION

Fluoride is found in water so that all people ingest some fluoride every day. Water fluoridation is considered as a general well-being measure, this will aid in people in the formation of chewable tablets, washes, capsules, toothpastes, droplets, and by the dental experts in the expert use of varnishes, froths, and gels. The fluoride varnish type contains high concentration of topical fluoride, the mode of action is by increasing the concentration of fluoride on the applied surface of the tooth; this increases fluoride uptake during early stages of tooth demineralization[39].

Furthermore, The AAPD has provided certain recommendations that should be followed while prescribing fluoride toothpaste or fluoride supplements to patients in order to decrease the chance of fluoride poisoning or fluorosis while maintaining its advantages[40]; Table 1.

Table 1: Recommended dosages for fluoride supplementation chart

	Fluoride level of drinking water in PPM		
Age	<0.3	0.3–0.6	>0.6
Birth–6 Months	No Supplements	No Supplements	No Supplements
6 Months–3 Years	0.25 mg per day	No Supplements	No Supplements
3–6 Years	0.50 mg per day	0.25 mg per day	No Supplements
6–16 Years	1.0 mg per day	0.50 mg per day	No Supplements

Preventive interventions taken up to the six months showed that the proportion of teeth with new decay reduced to 52% in primary teeth and 39% in permanent teeth of children. Moreover, the percentage of newly decayed or restored primary and permanent teeth in children is reduced to 25.4% and 53.2%, respectively [41].

CONCLUSION

The increases in the prevalence over time is mainly behind increased exposure to risk factors and increased number of teeth at risk. Predisposing and risk factors include living in a non-fluoridated county, low socioeconomic status and poor dietary behaviors. Preventive measures involve community, home care and professional interventions to avoid risk factors which require to be followed with discipline in order to avoid potential incidence of ECC in the first place.

RECOMMENDATION

We further recommend specific preventive strategies which improve and increase public awareness such as promotion of community-based interventions conducted by dental hygienists and the Inclusion of oral health screening in new child health immunization schedules and insurance legislation for children.

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