Oral health promotion and prevention of Early Childhood Caries

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Abstract

Dental caries is a common childhood chronic disease which affects not only oral health of children but also their quality of life and their families. This paper reviewed the effectiveness of various preventive measures, categorized as primary, secondary and tertiary prevention. Primary prevention includes oral health education, tooth-brushing with fluoridated toothpaste, water fluoridation, fluoridated milk, and dietary control. Systematic reviews showed that effectiveness of simple health education for the prevention of ECC is limited. However, health education in conjunction with motivational intervention, active hands-on training, regular home visit, or with professional preventive programmes showed some promise results. Educational programmes that integrated with other health issues were also found more effective than simple oral health education alone. For fluoride strategies, water fluoridation is accepted as a high cost-effectiveness measure and most equitable method in dental health across social classes. Fluoridated milk, when provide before the age of 4 years, showed caries preventive effect on primary teeth. There is also evidence from systematic reviews and meta-analysis that tooth brushing with fluoridated toothpaste at least 1,000 ppm fluoride concentration, as home care intervention or school programs, is a cost effective way in reducing dental caries for young children. Sugar is a common risk to a number of other non-communicable diseases. The 'common risk approach', by multidisciplinary collaboration, as well as food policy development to reduce sugar consumption, is necessary. Fluoride varnish, as secondary prevention, can decrease caries incidence in early childhood. 10% providone iodine has been shown to provide some benefit to control of microbial colonization after treatment for severe ECC but for a limited period of time. Filling decayed teeth can be considered as tertiary prevention. The benefits of restoration not only help delay the new colonization of microorganism, but also enhance the healthy ecology of mouth and good nutrition of children.

Keywords

Early childhood caries, tooth decay in young children, dental caries in young children, prevention of Early Childhood Caries, Oral health promotion of early childhood caries

Introduction

Dental caries is a preventable disease and can be stopped or reversed during the early stages of caries development. Although dental caries in permanent teeth of school children and adults can be controlled to some extent, many reviews have shown that the prevalence of early childhood caries (ECC) in young children is generally high. Most young children do not have access to dental care, so that many decayed teeth are left untreated. This problem of ECC can impact on both oral health and the general health of children, such as their nutrition, their growth and development, their quality of life and adversely affect the cost of general health system.

This literature review is aimed to gather and update knowledge on the effectiveness of various measures to control and prevent tooth decay in young children. The review includes papers published during the years 1998 to 2015, and these are divided into three categories - primary, secondary and tertiary prevention - corresponding to different phases in the development and control of the disease.

Method

Literature to inform this review of aspects of Early Childhood Caries was obtained in several ways. First, an electronic internet search was made through PubMed and ScienceDirect databases. The primary search term was 'early childhood caries'. Other keywords included tooth decay in young children, dental caries in young children, nursing caries. Other associated terms used in the search included: diagnosis, criteria, epidemiology, prevalence, aetiology, risk factor, prevention, treatment and oral health related quality of life. Eligible studies were included when they met the following criteria: (1) articles in English providing relevant information within the time period 1990 to 2015; (2) presenting evidence relevant to ECC according to the defined themes: epidemiology, aetiology, prevention and treatment; (3) considers dental caries or sequelae in early childhood. Concerning the exclusion criteria, studies were excluded from the review if they focused on either: (1) concerned with other age-groups or other diseases, (2) studies published in languages other than English. A total of 417 articles were identified through database searching; duplicates and references irrelevant to ECC were removed, reducing this list by about one third. Two conference books relevant to the situation in Asian countries were also included.

Second, nine journals were searched by hand: International Journal of Paediatric Dentistry, European Journal of Paediatric Dentistry, Pediatric Dentistry, Journal of Dentistry for Children, Journal Clinical Pediatric Dentistry, Community Dentistry Oral Epidemiology, Community Dental Health, Caries Research, Journal of Public Health Dentistry. How far back the hand-searches were made, depended on the journal: for most journals it covered 2000 to 2015, while for International Journal of Paediatric Dentistry, the search extended back to 1990.

Third, some back-tracking from the reference lists attached to publications so far discovered was carried out to identify any remaining key articles. This resulted in a database of 380 references on all aspects of ECC, covering the years 1993 to 2016. Out of this database, 71 publications were relevant to this review of oral health promotion and the prevention of ECC.

Results and discussion

Primary prevention

The aim of primary prevention is to keep healthy children with healthy teeth. The incidence of ECC is controlled by targeting specific causes and risk factors. These measures include oral health education, tooth-brushing with fluoridated toothpaste, fluoridation as a community-based intervention, and dietary control. These will be considered in turn.

Oral health education

The oral health of young children depends on their parents' or caregivers' knowledge, attitudes, behavior, and the family lifestyle. For example, parents' beliefs influence the likelihood of their children brushing their teeth twice a day,[1] and parents' dental health habits also influence their children's oral health.[2]

The goal for health education is to increase the knowledge and healthy practices of parents or care givers about tooth-brushing, and also to improve dietary habits so as to improve their own oral health and their performance in looking after the health of their children. However, the effectiveness of health education for the prevention of ECC is limited,[3,4] according to this review of literature, and it can be concluded that education has a modest impact on improvement of dietary habits, and suggested that education should be provided in conjunction with early screening and professional preventive programmes. Castilho *et al.,*[2] in a systematic review, also confirmed the important of health education but suggested that oral health education programmes should pay attention, not only to the child's oral health, but also to their quality of life. The programmes should involve the entire family - their lifestyles and their oral health habits.

Many studies have tried to improve the effectiveness of programmes designed to educate parents and to change their attitudes and practices for the oral care of their young children. These have included either: the 'motivational intervention technique,[5,6] the 'autonomy-supportive psycho-educational technique,[7,8] tailored educational intervention,[9] a participatory dental health education programme,[10] or the free distribution of toothpaste and toothbrush together with an oral health education programme.[11] The varied nature of these interventions is shown in the studies listed in Table 1. From these several studies, some common results emerge:

(1) Health education with a neutral message (delivered for example by brochures) cannot make any positive change;

(2) Health education using the motivational intervention technique showed promising results in knowledge and behavioral change, but with an inconsistent effect for dental caries.

(3) Health education together with regular motivation or regular home visits can reduce dental caries and caries risk factors in children significantly.

(4) Multiple interventions, such as health education plus free distribution of toothpaste and toothbrushes, health education plus hands-on tooth-brushing practice, showed promising positive results in preventing Early Childhood Caries.

Many studies have indicated that to make oral preventive practices, such as tooth-brushing, sustainable for young children, families and communities, follow-ups are necessary and messages should be reinforced regularly. Home visits by dental personnel showed very good results in terms of monitoring, counseling, providing guidance, and even can provide some preventive dental services such as fluoride varnish application. In addition, dental personnel can learn and understand the social context of children and families.[12,13] Analysis of results of a preventive programme in Thailand, where health education was provided with active training by a 'hands-on' technique and regular home visits every 4 months, showed a significant reduction in dental caries when compared with the control group within one year ($P<0.001$).[14]

However, a programme of home visits is a heavy load for dental personnel in terms of cost and time, and telephone contact may be another choice with compatible effectiveness.[15]

Table 1 Summary of health education intervention

Authors, with year	Methods / content of the intervention	Main findings
Harrison *et al*.[5] Model Motivational Interviewing	240 children 6 to 18 months old were randomly assigned to either the study (MI + pamphlet +video +2 counseling sessions + 4 follow up telephone call) or control group (traditional health education; pamphlet+ video). Children had a dental exam, and their mothers completed questionnaires at baseline and 1, 2 years post intervention.	The MI group had about a 46% lower rate of dmfs at 2 years than did control children. Similar treatment effects were obtained from models that included white spot carious lesions.
Ismail *et al*.[9] Model Motivational Interviewing with tailored educational intervention	This randomized longitudinal study included 1,021 children (0–5 years) and their caregivers. The families were examined at baseline in 2002–2004, 2004–2005 and 2007. The families were randomized into two educational groups, intervention (MI + DVD + dialogue + booster telephone call within 6 months), and control group (DVD-only). Both caregivers and the children were interviewed and examined after 2 years of intervention (Wave III: 2007).	After 6-month of follow-up, caregivers receiving MI + DVD were more likely to report checking the child for 'pre-cavities' and making sure the child brushes at bedtime. Evaluation of the 2 years final outcomes found that MI intervention may change some reported oral health behaviours, but failed to reduce the number of new untreated carious lesions.
Borrelli *et al*. Model Motivational Interviewing	This paper presents a meta-analysis of parent-involved MI to improve paediatric health behaviour and health outcomes. Twenty-five studies (with 5,130 participants) were included. Three studies included oral health.	MI was associated with significant improvements in health behaviours (oral health, diet, physical activity, reduced screen time, smoking cessation, second hand smoke) and reduction in body mass index. Results suggest that MI may also outperform comparison groups in terms of dental caries, but more studies are needed.
Naidu R *et al*. Model Motivational Interviewing	This study included a cluster randomized controlled trial and semi-structured focus groups. Parents and caregivers in the test-group (n = 25) received a talk on dental health using MI approach + two telephone call follow-ups, and the control-group (n = 54) received a talk using traditional DHE. Both groups received written dental health information. Participants in the test group were also invited to take part in a focus group to share their views on the dental health talk.	At four month follow-up, knowledge items increased in both the test (DHE + MI) and control (DHE) groups (($p < 0.05$). In the test groups there were increases in mean child tooth-brushing frequency and a reduction in oral health fatalism ($p < 0.05$). Findings from focus groups suggested that MI talk and telephone follow-up were well accepted and helpful in supporting parent and caregiver efforts to improve oral health practices for their children.

Table 1 Summary of health education intervention (Continued)

Authors, with year	Methods / content of the intervention	Main findings
Weber-Gasparoni K *et al.* (Part 1)[7] Model Self-determination theory : Psycho-educational intervention	415, 12- to 49-month-old children and their mothers were included in the study. 283 in the intervention group received videotaped message, and were motivated for their autonomy feeling, their internalization of video, and their own expected outcome. 132 in control group received same content of message via brochure. Mothers completed questionnaires at baseline and after 6 months follow up regarding their child's dietary/oral hygiene habits.	Relative to their baseline scores, the intervention group showed a greater increase in knowledge and behavioural intentions than the control group, both at one-month (P=.002) and six-month follow-ups (P<.001). However, knowledge and behavioural intention levels at six-month follow-up did not differ significantly from those at one-month follow-up.
Weber-Gasparoni K *et al.* (Part 2)[8]		Significantly more positive changes were observed for dietary/oral knowledge and hygiene behaviours among the intervention group at one- and six-month follow-ups than for the controls.
Plutzer and Spencer Model Anticipatory guidance during pregnancy	A randomized controlled trial provided anticipatory guidance to expectant mothers during their pregnancy period, and later when the child reached 6 and 12 months of age.	Oral examination of the children at 20±2.5 months found that the incidence of severe-ECC in the test group was 1.7%, significantly lower (P < 0.001) compared with the control group of 9.6%.
Plutzer *et al*. Model Home visit	The evaluation of the above study was repeated when the children were 6-7 years old.	Caries prevalence was still significantly different - 33% in the study group and 42% in the control group. They concluded that providing new mothers with guidance on caries prevention can help to reduce ECC and the effect can be sustained up to school age.
Kowash *et al.*[12] Model Home visit	A randomly selected cohort of 228 children were divided into 5 groups: the 4 study groups (A to D) received different topics of dental health education through regular home visits every 3 months for the first 2 years and twice a year in the third year of the study. The control group (E) received no DHE and were never visited but examined. All children and mothers were examined for caries and oral hygiene at 3 years.	It was found that the differences in caries levels and caries risk factors between study and control groups were statistically significant (P < 0.001). Mothers in the study group also showed an improvement in their own levels of gingivitis, debris and calculus scores by the second and third examinations (P < 0.001).

Table 1 Summary of health education intervention (Continued)

Authors, with year	Methods / content of the intervention	Main findings
Feldens *et al*.[13] Model Home visit	A randomized field trial: intervention group received home visits for advising mothers about breast-feeding and weaning 10 days after the child's birth, monthly up to 6 months, at 8, 10 and 12 months, based on the 'Ten Steps for Healthy Feeding'. Feeding behaviours and dental caries of the children in both groups were collected at 6 and 12 months.	The results showed that 10.2% of the children in the intervention group had caries compared with 18.3% in the control. The intervention group had significantly longer duration of exclusive breast-feeding, and later introduction of sugary food and drink. It was concluded that home visits for dietary advice appear to help in reducing dental caries in infants.
Thanakanjanaphakdee and Trairatvorakul[14] Model 'Hands on' training with home visit	Health education was provided to care givers of 9-18 months old children, together with active training by a 'hands on' technique, and regular home visits every 4 months by local health volunteers	One year follow-up showed that this programme reduced the incidence of dental caries 2.5 times compared with the control group within the one year. The parents in the experimental group improved their brushing behaviour for children (P<0.05), while other behaviours, such as feeding habits, were not changed. The percent caries-free young children in the control group was 6.5% compared with 64.3% in the experiment group (P<0.001)
Plonka *et al*.[15] Model Home visit and Telephone contact	A longitudinal study of 325 children, mean age of 42 days, were randomly assigned to receive either home visit or telephone call, 3 contacts at 6 monthly, compared to control group.. At 24 months, all groups were orally examined for ECC and colonization of mutans streptococci and lactobacilli.	The caries prevalence in the HV, TC and control groups were 1.5%, 6.8% and 22.5%, respectively. (P= 0.5 to < 0.001). The colonization of mutans streptococcus was also different between the three groups (P = 0.02). The authors concluded that home visits and telephone contacts conducted 6 monthly from birth are effective in reducing ECC prevalence at the age of 24 months.
Vachirarojpisan *et al*.[10] Model Participatory dental health education	A one-year intervention programme among 520 mothers/ caregivers of 6-19 month-old children. Intervention included small group discussion with active involvement in the intervention group, and the national teaching dental health education programme in the control group.	Percent of subjects using a toothbrush and brushing with fluoride toothpaste was 93% and 87% respectively, in the intervention group, significantly higher (p<0.01) than the control group (73% and 58%). Eating behaviours appeared the same in both groups. The net cavity increment was 3.5 (±3.4) teeth in the intervention and 3.2 (±3.5) in the control group (NS).

Table 1 Summary of health education intervention (Continued)

Authors, with year	Methods / content of the intervention	Main findings
Azevedo *et al*. Model Pamphlet and verbal explanation	To evaluate the impact of an early educational intervention on ECC prevention, the study group (SG) comprised 271 children aged 0-12 months and their mothers, received oral health instructions from a pamphlet and by verbal explanation, while the control (CG; n = 251) received oral health instructions from a pamphlet only. The children were examined for caries status (cavity and/or white spot lesion) of maxillary anterior teeth, labial surface, after a one-year intervention.	The prevalence of caries was 12.9% in the SG and 17.9% in the CG. The odds of caries was 80% higher in the CG than in the SG (p = 0.037).
Azevedo *et al*. Model Pamphlet and verbal explanation	To evaluate the impact of an early educational intervention on ECC prevention, the study group (SG) comprised 271 children aged 0-12 months and their mothers, received oral health instructions from a pamphlet and by verbal explanation, while the control (CG; n = 251) received oral health instructions from a pamphlet only. The children were examined for caries status (cavity and/or white spot lesion) of maxillary anterior teeth, labial surface, after a one-year intervention.	The prevalence of caries was 12.9% in the SG and 17.9% in the CG. The odds of caries was 80% higher in the CG than in the SG (p = 0.037).

Tooth-brushing with fluoridated toothpaste

The most important way that family members can help to control plaque in infants and young children is tooth-brushing with fluoridated toothpaste twice daily at home. The lack of tooth-brushing, or brushing inefficiently, has been shown to be related to rampant caries development in the primary teeth,[16] while regularly brushing the teeth from birth to 5 years of age, reduced the occurrence of dental caries.[17] It is recommended that using of fluoride toothpaste should begin with the eruption of the first tooth.[18] A systematic review in 2014,[19] which included 17 studies, found that for children younger than 6 years, brushing under supervision with 1,000 to 1,500 ppm fluoride concentration toothpaste is effective in caries control when measured by dmfs and dmft. For the studies in which participants used toothpastes with less than 1,000 ppm fluoride, the findings were less consistent compared with those in control groups not using fluoride toothpastes. A systematic review to determine the efficacy of manual tooth-brushing in permanent teeth found that brushing led to a 42% reduction in plaque score, on average.[20] Sub-analysis of brushing duration revealed that 1 and 2 minutes brushing resulted in a mean reduction of 27% and 41%, respectively.

Tooth-brushing programmes may be organized effectively in a community formal setting, such as day - care centres or kindergarten schools. Schwarz *et al*.[21] demonstrated the long-term effects of daily tooth-brushing with fluoride toothpaste in 3-6 years old Chinese children attending kindergartens (test group) (control group). In the test group, teacher-supervised

compared with children of the same age who had no organized preventive programme tooth-brushing with 1,000 ppm MFP toothpaste in addition to oral health education activities. At baseline, the mean dmfs was 4.8 in the test group and 6.5 in the control group (NS). After three years, the caries increment was 6.2 and 8.4 in the test and control groups, respectively (P<0.05). It was concluded that a daily tooth-brushing with limited involvement of professional staff was feasible in a Chinese kinder-garten and that caries development was significantly slowed in the test children. Curnow *et al* [22] compared the rate of dental caries in 5 year-old children, where the study group brushed their teeth with fluoridated toothpaste every day at school under the supervision of volunteer mothers. The control group received only dental check - ups every six months. After two years of implementation, it was found that the study group had significantly lower dmft (0.81) compared with 1.19 dmft in the control group.

Brushing twice daily with fluoridated toothpaste is the most important primary prevention for ECC as part of self-care. A systematic review in 2003 [23] reported results of investigations into the caries preventive effect of fluoride toothpastes in primary dentition and young permanent dentition, with 2.25 to 7 years follow-up studies. The results revealed strong evidence (level 1) (i) for the caries preventive effect of daily use of fluoride toothpaste compared with a placebo in the young permanent dentition (Preventive Fraction 25%), (ii) that toothpastes with 1,500 ppm of fluoride had a superior preventive effect compared with standard dentifrices with 1,000 ppm F in the young permanent dentition (PF 10%), and (iii) that higher caries reductions were recorded in studies with supervised tooth-brushing compared with non-supervised tooth brushing (PF 23%). However, incomplete evidence (level 4) was found regarding the effect of fluoride toothpaste in the primary dentition. A review of 75 studies of interventions for caries prevention in children and adolescents with age 16 years or less found that, when compared with placebo, toothpaste with fluoride concentrations of 1,000 to 1,500 ppmF can provided 22% caries reduction compared with 36% for toothpastes containing 2,400 to 2,800 ppmF. The effectiveness of toothpastes containing 250 to 550 ppmF was not statistically significantly different from toothpastes without fluoride.[24]

According to AAPD recommendations, all children should have twice-daily brushing with fluoridated toothpaste from the time of eruption of the first teeth. To prevent any undesirable effects from swallowing dentifrice containing a high concentration of fluoride by young children, AAPD has recommended that: "A 'smear' or 'rice-size' amount of fluoridated toothpaste (approximately 0.1 mg fluoride) should be used for children less than three years of age. A 'pea-size' amount of fluoridated toothpaste (approximately 0.25 mg fluoride) is appropriate for children aged three to six".[25,26]

Water fluoridation

The first water fluoridation programme was instituted in United States of America in 1945 and this public health measure is now implemented widely in many countries. Evaluations have shown that caries levels were 21 percent lower in the primary dentition and 25 percent lower in the permanent dentition in fluoridated communities than in nonfluoridated communities[27] A Cochrane review in 2015[28] found that using water fluoridation resulted in children having 35% fewer dmft (primary teeth) and 26% fewer DMFT in the permanent dentition. The review also showed a 15% increase in children

[A] The Workshop on 'Effective use of Fluoride in Asia' was held in Thailand during March 22-24, 2011, under the co-organized by The Dental Association of Thailand and Faculty of Dentistry, Thammasat University. The co-sponsored were WHO, FDI, and IADR.

children with a caries-free permanent dentition. Petersen *et al*.[29] summarized a key conclusion from the 'Workshop on effective use of fluoride in Asia'[A] that water fluoridation is a most effective and equitable strategy for prevention of dental caries. However, currently there is a wide variety of other fluoride delivery methods, which may be useful if some groups of the population are more concerned about possible undesirable health impacts from fluoride. Thus, before implementing a water fluoridation programme, countries need to prepare a systematic management programme which would include a feasibility study, an epidemiological surveillance system, and community education, strengthen the health system research and arrange for technical support.

Milk fluoridation

The fluoridation of milk is another kind of public health measure for caries prevention. Currently milk fluoridation programmes exist in several countries including Thailand, Chile, the Russian Federation, and the UK. This method is appropriate in the schools, kindergartens or day-care centres that already have a system of providing milk regularly to the children. Bánóczy *et al*.[30] reviewed the effectiveness of milk fluoridation: from the 20 reports of 15 studies carried out in 10 countries, eight studies showed a caries preventive effect in primary teeth and ten studies in permanent teeth. Two studies in United Kingdom showed no effect in either dentition. There is also evidence that beginning to drink fluoridated milk at an early age (before the age of 4 years) was essential to obtain a caries preventive effect in primary teeth .[31,32] A Cochrane review in 2015[33] confirmed that fluoridated milk may be beneficial to 3-year-old school children, substantially reducing the formation of caries cavities in primary teeth. Petersen *et al.*[34] evaluated the clinical effectiveness of a 5 year community milk fluoridation programme in Bulgaria. The result showed that, for primary teeth, caries increments were 46% ($p<0.001$) and 30% ($p<0.01$) lower in the fluoridated milk group compared with two non-fluoridated milk reference groups, respectively. For permanent teeth those reductions were 61% and 53% ($p<0.001$).

Dietary control

Many research reports have shown clear evidence that sugar consumption is one of the main aetiological factors for dental caries, both in terms of the amount and the frequency of sugars consumed. For young children, the use of a baby bottle filled with sweetened milk or beverages has been found to be associated with high dental caries experience.[16,17] In a review of literature, Rugg-Gunn and Woodward[35] concluded that milk and milk products, if unsweetened by added sugars, are safe and possibly beneficial for teeth. For young children, the risk of dental caries from sugar consumption increases with certain feeding habits, such as a feeding bottle with added sugars used for night-feeding, or feeding at will.

WHO and most national organizations recommend exclusive breast-feeding (EBF) for at least 6 months. To assess the impact of EBF on early childhood caries, a cluster randomized trial was done to compare dental caries of an EBF group and a control group at 5 years of age. The study showed no impact of EBF on early childhood caries when compared with the control group.[36] A systematic review and meta-analysis also confirmed that breast-fed children were significantly less affected by dental caries than bottle-fed children. The researchers concluded that breast-feeding can protect against early childhood caries.[37]

Health education alone seems unlikely to lead to behavioral change in mothers and children regarding dietary habits. In addition, more and more research shows the association between high sugar consumption and non-communicable diseases (NCDs), particularly overweight/obesity and diabetes. Thus, high sugars consumption is clearly with caries-free primary teeth and 14% increase in identified as a 'common risk factor', and the 'common risk approach',

by multidisciplinary collaboration is recommended. Sugar consumption is strongly linked to 'lifestyle' that is influenced by an unhealthy environment, which includes strong marketing of foods/drinks, easy access for all to food/drink with high sugar content, food marketing for children in schools, etc. This environment strongly influences people's behaviour. Thus, health education alone may not be enough to strengthen self-esteem and change people's behaviour - food policy development to reduce sugar consumption, particularly relevant for infants and young children, is also necessary.[38] However, more evidence-based research is required to evaluate the effectiveness of those approaches in terms of oral health outcomes.

To control the increasing trend of NCDs and dental caries, WHO recommends that free (added) sugars should remain below 10% of energy intake, and consumption of foods/drinks containing free sugars should be limited to a maximum of four times per day.[39] In 2015, this recommendation has been emphasized as a "STRONG" recommendation, while the new conditional recommendation suggests a further reduction to less than 5% of total daily energy intake.[40]

In some countries/communities, there are proposals for the introduction of healthy policies to the government and public. For example, in Thailand, the Ministerial Regulation (MR) number 286, since 2004 inhibits the addition of sugar to 'follow-on' formula milk for young children, and the MR number 305 which concerns labeling of the sugar, fat, sodium and energy content in certain kinds of Ready-to-Eat Foods, since 2007. Many countries have proposed school policies to control the sale and consumption of high sugar soft drinks and high calorie foods/snacks sold in school.

Secondary prevention

Secondary prevention aims to reduce or stop the disease at early stage through early diagnosis and preventive measure application. This level of prevention includes early detection, fluoride varnish and chemical control of microbial colonization by 10% providone iodine.

Early detection

The purpose of early detection is to screen for oral hygiene status as well as to detect white spot carious lesions in young children in order to provide early preventive intervention. Dental caries in infants often starts with the accumulation of plaque on the teeth and white lesions in the labial cervical areas of the maxillary anterior primary teeth. This is a strong predictor of future caries development. Therefore, the technique of "Lift the lip" to examine for visible plaque accumulation, any white lesions or frank dental caries on the four upper front teeth is recommended for dental caries screening.

To make the early detection activities appropriate to the health system, it is recommended that this oral screening process should be integrated with the 'well-child care clinic'. The AAPD Guideline on Infant Oral Health Care[26] stated that: 'Every infant should receive an oral health risk assessment from his/her primary health care provider or qualified health care professional by six months of age', and 'Parents should establish a dental home [B] for infants by 12 months of age' for oral examination, tooth-brushing demonstration, and prophylaxis and fluoride varnish treatment if indicated.

[B] Establishing a Dental Home means that a child's oral health care is managed in a comprehensive, continuously accessible, coordinated and family-centered way by a licensed dentist. *(http://www.aapd.org/assets/1/7/DentalHomeNeverTooEarly.pdf)*

Fluoride varnish

Fluoride varnish is a product containing a high concentration of fluoride (5% sodium fluoride) that is applied professionally to the surfaces of teeth, including primary teeth. The purpose of applying fluoride varnish is to arrest and reverse the process of demineralization. Currently, the use of fluoride varnishes to prevent tooth decay in young children is worldwide. Zimmer *et al*.[41] conducted a two-year longitudinal randomized clinical study to evaluate the efficacy of 0.1% fluoride varnishes four times per year, in addition to tooth-brushing and oral hygiene instruction, in the high risk school children. The results showed that the experimental group had 4.0 ± 4.97 increased rates of initial caries while control group had 6.5 ± 5.71 (P<0.001). However, no difference was found when the 'cavitated caries index' was used for evaluation.

The following study, although conducted in older children, illustrates the effect of frequency of application of fluoride varnish. In 2005, Skold *et al*.[42] reported a 3-year randomized controlled trial in school students aged 13-16 years, to evaluate different regimes of applying 5% fluoride varnish to control dental caries in proximal surfaces of teeth. Fluoride varnish applied monthly prevented 76% of caries development, whilst the 6-monthly application of varnish prevented 57% of carious surfaces across all of the populations. In areas with a high risk of dental caries, fluoride varnish of any form showed significantly greater percentage caries reductions compared with a no-varnish group.

Marinho *et al*.[43], in a systematic review of fluoride varnishes together with a meta analysis, found a mean of 33% fewer surfaces with caries in the primary dentition and 46% fewer carious surfaces in the permanent dentition in the children treated with fluoride varnishes compared with those who had received no treatment. They concluded that regular fluoride varnish application 2 to 4 times per year in the primary and permanent dentitions prevents caries development in children. Weintraub *et al*.[44] studied the 2-year effectiveness of fluoride varnishes (5% NaF) two times per year, in addition to counseling, to prevent dental caries in 6 and 44 months-old high-risk children. The study started when the 376 children were cavity-free. They found that fluoride varnishes prevented the incidence of new dental caries 3.8 times (95% CI 1.88-7.58) in the study group compared with the control. This study was undertaken in San Francisco where drinking water is fluoridated. Other studies [45-47] also found positive results after fluoride varnish application in their studies. Fluoride varnish also has been accepted well by parents, compared with other measures.

A cohort study in Thailand [48] compared the application of fluoride varnish four times every six months (when the children were aged 9-12, 18, 24 and 30 months) together with oral hygiene instruction, with a control group who received oral hygiene instruction alone. The 2-year evaluation found that 34% of the study group had dental caries, compared with 48% in control group children (P=0.002). The protective effect of fluoride varnish in caries incidence was 30%. Another two studies, in 2013 and 2015, found that the number of non-cavitated carious lesions was significantly lower in the fluoride varnish group,[49] and a decrease in mean dmft in the fluoride varnish group compared with the non - fluoride varnish group.[50] However, some clinical evaluations of fluoride varnishes found no positive effect or found that the effect of fluoride varnish was no different from brushing with fluoride toothpaste alone.[51-53]

Chemical control of microbial colonization with 10% Povidone Iodine

Early childhood caries (ECC) is closely related to the high number of mutans streptococci, lactobacilli and Candida albicans. The reduction of oral colonization is one of the goals for preventing ECC.

10% Povidone Iodine (PI) consist of 90% aqueous (water), 8.5% polyvinyl pyrrolidone and 1% Iodine. Polyvinyl pyrrolidone acts as a carrier of iodine to cell membranes of bacteria, and also helps to reduce the irritation and staining from iodine. Iodine reacts with the cytoplasm and cytoplasmic membrane of bacteria, providing a bacteriocidal effect within seconds. Through this property, PI is used as a post-operative treatment for severe-ECC after dental surgery to prevent recurrence of new caries.There has been some research to explore the effect of 10% povidone iodine as a chemical control of microbial colonization after treatment of ECC. Simratvir *et al*.[54] compared the effects of application of 10% PI in the reduction of mutans streptococci (MS) and reduction of new carious lesions. PI was applied every three months, for a period of 12 months, to 4 year-old children with severe early childhood caries, after their dental treatment. The results showed that application of 10% PI caused a significant reduction in the rise of MS levels from the baseline after 12 months of treatment and also decreased the relapse of caries in these children compared with the control group. Berkowitz *et al*.[55] *assessed the effect of a single application of 10%* PI *on the number of salivary MS after dental surgery treatment. The samples were 2-5 year-old children with severe early childhood caries. It was found that* the percentages of subjects with at least a 50% reduction in MS level were 85%, 83% and 84% at 30, 60 and 90 days post dental surgery, when compared with baseline *(P < 0.0001).* No new cavitated caries lesion occurred during the first 90 days post dental surgery. *However, at the 12 months follow up examination,* 39% of children had new cavitated caries lesion(s) that required restoration.[56]

In a clinical trial among 2-7 year-old children with severe ECC and treated under general anesthesia, children received topical PI three times every two months during the first 4 months of the study, while the control group did not receive PI. At 6 months post dental surgery, both group had significantly decreased MS counts (P=0.003). At 1 year, 5 out of 8 children in the control group had new caries compared with 2 out of 11 children in the experimental group (P=0.06).[57]

There were two reports regarding the use of 10% povidone iodine in high risk children. Lopez *et al*.[58] reported a study in 12-19 month-old children with high risk of ECC. The experimental group had 10% povidone iodine every 2 months, while the control group had placebo applied to their dentition. The evaluation at 155 days found that 5 of the 16 control subjects and 0 of the 15 experimental subjects had white spot lesion on their four maxillary anterior teeth (P=0.04). Lopez *et al*.[59] also reported a 12-month follow-up trial in 12 to 19 month-old infants; 37 infants in the study group and 44 in the control group. The experimental group had 10% povidone iodine applied every 2 months. They found that 91% of experimental group and 54% of control group were disease-free (no white spot lesion). They concluded that 10% PI every 2 months as a topical antimicrobial therapy, reduced risk for the development of ECC in 12-19 month-old high-risk children.

However, studies have found that povidone iodine may not result in long-term effectiveness. Zhang *et al*.[60] *assessed the effects of a single application of 10%* povidone iodine together with 1.23% acidulated phosphate fluoride *gel application as an adjunct to clinical treatment of children with* severe *early childhood caries. It was found that MS and lactobacilli levels in the* povidone iodine *group were significantly reduced relative to baseline at one hour, three weeks and three months but, after one year, at least 60% of subjects had new caries lesions in each group, and there was no significant difference in caries increment between the two groups.*

In conclusion, use of *10%* povidone iodine has been demonstrated to be effective in reducing bacteria in the mouth. However, most studies are limited in short term of approximately one year.

Tertiary prevention

Filling carious cavities in teeth can be considered tertiary preventive care. The benefits of restoration are not only preventing the progress of disease, but also to enhance healthy ecology of mouth and ensure the good nutrition of the children.

Preventive restorative procedures

Many studies have indicated that most of dental caries in young children is left untreated. Restoration of a cavity can help to reduce accumulation of microorganisms, resulting in good oral health, and enhancing the quality of life of the children. Peretz *et al.*[61] evaluated the microbial flora immediately after treatment for ECC in 44 children. It was found that dental treatment resulted in significantly lower MS counts. Palmer *et al.*[62] reported that the amount of microorganisms was reduced significantly after restorative treatment: the evaluation of mutans streptococci strains before, and six months after this treatment, showed that MS strains fell from 3-7 to 1-2 strains. Another prospective clinical study[63] monitored the oral health of 50 children after comprehensive treatment under general anesthesia. The 12 months follow-up found that plaque and the numbers of mutans streptococci, lactobacilli and yeasts were significantly reduced as a result of treatment (P<0.0001). Never-theless, this effect was not permanent - the number of bacteria and yeasts increased linearly over time (P<0.01) with an odds ratio of 2.2 per year. One third (34%) of the children developed new dentinal lesions within 1 year post-operatively.

The restoration of carious teeth may also improve the nutrition and growth of children. Acs *et al.*[64] compared the percentile weight and percentile growth velocity of children with severe early childhood caries after dental treatment (test subjects) with the caries free children. Prior to dental rehabilitation, test subjects' percentile weight categories were significantly less than the caries free group (P<.001). After comprehensive dental treatment, it was found that the ECC children exhibited significantly increased growth velocities through the follow-up period (P<.001). At the end of the follow-up period (1.58 years for ECC group and 1.36 years for caries free group) there were no statistically significant differences noted in the percentile weight categories of the test and comparison groups.

Currently, the use of glass ionomer restorative material by the 'atraumatic restorative treatment' technique (ART/SMART) may be another choice for restoring primary teeth. This material is a fluoride-releasing material and this may provide an additional benefit in preventing dental caries. A systematic investigation, plus meta-analysis, into survival of ART sealants and restorations, using high-viscosity glass ionomer, reported 2-year survival rates of 93% for single-surface and 62 % for multiple-surface restorations in primary teeth[65]. A randomized control trial was reported which compared atraumatic restorative treatment procedures (ART: Test) against the standard care approach (Control) to treat early childhood caries in 273 children of mean age 3.8 years, in a primary care setting. At the 11.4 month follow-up, it was found that more teeth were filled in the ART group (2.9 ± 2.48) than in the control group (1.5 ± 2.20) (P < 0.0001). The control group also showed a higher risk of referral for specialist care than the ART group (OR 33, 95% CI 10.8–98.4, P < 0.0001). The researchers concluded that the ART approach reduced significantly the likelihood of referral for specialist care, and more children and teeth were provided with treatment[66].

Conclusions

This literature to review the effectiveness of various preventive measures was searched through PubMed, ScienceDirect databases, and searched by hand for the years 1998 to 2015. This review has examined the 71 publications concerned with the prevention of ECC. From these several studies, we found that:

1. The effectiveness of simple health education for the prevention of ECC is limited. However, health education in conjunction with motivational intervention, active hands-on training, regular home visit, educational programmes that integrated with other health issues, or with professional preventive programmes, showed some promise results.

2. Water fluoridation is accepted as a high cost-effectiveness measure and most equitable method in dental health across social classes. Fluoridated milk, when provide before the age of 4 years, showed caries preventive effect on primary teeth. Tooth brushing with fluoridated toothpaste at least 1,000 ppm fluoride concentration, is a cost effective way in reducing dental caries for young children

3. To reduce sugar consumption, the 'common risk approach', by multidisciplinary collaboration, as well as food policy development is necessary.

4 . Fluoride varnish can decrease caries incidence in early childhood particularly in high risk children. 10% providone iodine has been shown to provide some benefit to control of microbial colonization but for a limited period of time.

Filling decayed teeth, considered as tertiary prevention, may help delay the new colonization of microorganism and also enhance the healthy ecology of mouth and good nutrition of children.

References

1. Pine CM, McGoldrick PM, Burnside G, Curnow MM, Chesters RK, Nicholson J, Huntington E. An intervention programme to establish regular toothbrushing: understanding parents' beliefs and motivating children. Int Dent J. 2000;Suppl Creating A Successful:312-23.

2. Castilho AR, Mialhe FL, Barbosa Tde S, Puppin-Rontani RM. Influence of family environment on children's oral health: a systematic review. J Pediatr (Rio J). 2013 Mar-Apr;89(2):116-23. (abstract)

3. Ammari JB, Baqain ZH, Ashley PF. Effects of programs for prevention of early childhood caries. A systematic review. Med Princ Pract. 2007;16(6):437-42.

4. Ismail AI. Prevention of early childhood caries. Community Dent Oral Epidemiol. 1998;26(1 Suppl):49-61

5. Harrison R, Benton T et al. Effect of motivational interviewing on rates of early childhood caries: a randomized trial. Pediatr Dent 2007; 29: 16-2

6. Cascaes AM, Bielemann RM, Clark VL, Barros AJ. Effectiveness of motivational interviewing at improving oral health: a systematic review. Rev Saude Publica. 2014 Feb;48(1):142-53.

7. Weber-Gasparoni K, Reeve J et al. An effective psychoeducational intervention for early childhood caries prevention: part 1. Ped Dent 2013; 35: 241-246.

8. Weber-Gasparoni K, Warren JJ, Reeve J, Drake DR, Kramer KW, Marshall TA, Dawson DV. An effective psychoeducational intervention for early childhood caries prevention: part II. Pediatr Dent. 2013 May-Jun; 3 5 (3):247-51

9. Ismail AI, Ondersma S et al. Evaluation of a brief tailored motivational intervention to prevent early childhood caries. Community Dent Oral Epidemiol. 2011 Oct;39(5):433 – 438

10. Vachirarojpisan T, Shinada K, Kawaguchi Y. The process and outcome of a programme for preventing early childhood caries in Thailand. Community Dent Health. 2005; 22(4): 253 – 259.

11. Sgan-Cohen HD, Mansbach IK, Haver D, Gofin R. Community-oriented oral health promotion for infants in Jerusalem: evaluation of a program trial. J Public Health Dent. 2001 Spring;61(2):107-13.

12. Kowash MB, Pinfield A, Smith J, Curzon ME. Effectiveness on oral health of a long-term health education programme for mothers with young children. Br Dent J. 2000 Feb 26;188(4):201-5.

13. Feldens CA, Vitolo MR, Drachler ML. A randomized trial of the effectiveness of home visits in preventing early childhood caries. Community Dent Oral Epidemiol 2007; 35: 215-223.

14. Thanakanjanaphakdee W and Trairatvorakul C. Effectiveness of Parental Toothbrushing Instruction toward The 1-Year Incremental DMF Rate of 9-18 Month Old Children. J Dent Assoc Thai 2010; 60 (2):82-91

15. Plonka KA, Pukallus ML et al. A controlled, longitudinal study of home visits compared to telephone contacts to prevent early childhood caries. Int J Paediatr Dent. 2013 Jan;23(1):23-31.

16. Petti S, Cairella G. Rampant Early Childhood Dental Decay: an Example from Italy. Journal of Public Health Dentistry 2000;60:3,159-166.

17. Levy S.M., Warren J.J., Broffitt B., Hillis S.L., Kanellis M.J. Fluoride, Beverages and Dental Caries in the Primary Dentition. Caries Res 2003;37:157–165

18. Clark MB, Slayton RL. Fluoride Use in Caries Prevention in the Primary Care Setting. www.pediatrics.org/cgi/doi/10.1542/peds.2014-1699 doi:10.1542/peds.2014-1699 Accepted for publication Jun 9, 2014

19. Wright JT, Hanson N, Ristic H, Whall CW, Estrich CG, Zentz RR, Fluoride toothpaste efficacy and safety in children younger than 6 years. A systematic review. JADA 145(2) http://jada.ada.org February 2014

20. Slot DE, Wiggelinkhuizen L, Rosema NAM,Van der Weijden GA. The efficacy of manual toothbrushes following a brushing exercise: a systematic review. Int J Dent Hygiene 10, 2012; 187–197

21.Schwarz E, Lo ECM, Wong MCM. Prevention of Early Childhood Caries- Results of Fluoride Toothpaste Demonstration Trial on Chinese Preschool Children after Three years. Int J Paed Dent 1998; 58(1): 12-18

22. Curnow M.M.T., Pine C.M., Burnside G. A Randomised Controlled Trial of the Efficacy of Supervised Toothbrushing in High-Caries-Risk Children. Caries Res 2002;36:294-300

23. Twetman S, Axelsson S, Dahlgren H, Holm A-K, Kallestal C, Lagerlof F, Lingstrom P, Mejare I, Nordenram G, Norlund A, Petersson LG, Soder B. Caries-preventive effect of fluoride toothpaste: a systemic review. Acta Odontol Scand 2003;61:347-355.

24. Wong M.C.M, Clarkson J, Glenny AM, Lo E.C.M, Marinho V.C.C, Tsang B.W.K, Walsh T, and Worthington H.V. Cochrane Reviews on the benefits/ risks of fluoride toothpastes.J Dent Res 90(5)2011; 573-579

25. AAPD 2014, Classifications, Consequences, and Preventive Strategies. AMERICAN ACADEMY OF PEDIATRIC DENTISTRY. REFERENCE MANUAL V 37 / NO 615 / 16. Available from: http://www.aapd.org/media/policies_guidelines/p_eccclassifications.pdf

26.AAPD 2014, Guideline on Infant Oral Health Care REFERENCE MANUAL V 37 / NO 6 15 / 16. http://www.aapd.org/media/policies_guidelines/g_infantoralhealthcare.pdf

27. Gillcrist J.A., Brumley D.E. Blackford J.U. Community fluoridation status and caries experience in children. J Public Health Dent 2001;61(3):168-71

28. Iheozor-Ejiofor Z, Worthington HV, Walsh T, O'Malley L, Clarkson JE, Macey R, Alam R, Tugwell P, Welch V, Glenny A. Water fluoridation for the prevention of dental caries (Review) A reprint of Cochrane review, prepared and maintained by The Cochrane Collabolation and published in The Cochrane Library 2015, Issue 6.
http://www.thecochranelibrary.com

29. Petersen P.E., Baez R.J., and Lennon M.A. Community-oriented administration of fluoride for the prevention of dental caries: A summary of the current situation in Asia. Adv Dent Res 24(1):5-10, 2012.

30. Bánóczy J, Petersen JE, Rugg-Gunn AJ. Milk fluoridation for the prevention of dental caries. [Last accessed on 2015 November 10]. Available from: http://www.who.int/oral_health/publications/milk_fluoridation_2009_en.pdf

31. Mariño, R., Villa, A. and Guerrero, S. A community trial of fluoridated powdered milk in Chile. Community Dentistry and Oral Epidemiology, 2001, 29: 435–442.

32.Bian, J. Y., Wang, W. H., Wang, W. J., Rong, W. S. and Lo, E. C. M. (2003), Effect of fluoridated milk on caries in primary teeth: 21-month results. Community Dentistry Oral Epidemiology, 31: 241–245.
Health (2015) 32, 199–203

33. Yeung CA,Chong LY and Glenny AM. Fluoridated milk for preventing dental caries. . Fluoridated milk for preventing dental caries (Review) A reprint of Cochrane review, prepared and maintained by The Cochrane Collabolation and published in The Cochrane Library 2015, Issue 5.
http://www.thecochranelibrary.com
34. Petersen P.E., Kwan S. and Ogawa H. Long term evaluation of the clinical effectiveness of community milk fluoridation in Bulgaria Community Dental Health (2015) 32, 199–203
35. Rugg-Gunn A, and Woodward M. Milk and oral health. [Last accessed on 2015 November 10]. Available from: http://www.borrowfoundation.org/assets/uploads/milk-and-oral-health.pdf.
36. Birungi N, Fadnes LT, Okullo I, Kasangaki A, Nankabirwa V, Ndeezi G, Tumwine JK, Tylleskär T, Lie SA, Aström AN. Effect of breastfeeding promotion on early childhood caries and breastfeeding duration among 5 year old children in Eastern Uganda: a cluster randomized trial. PLoS ONE 2015; 10: e125352.
37. Avila WM, Pordeus IA, Paiva SM, Martins CC. Breast and bottle feeding as risk factors for dental caries: a systematic review and meta-analysis. PLoS ONE 2015; 10: e142922.
38. Sheiham A and Watt RG. The common risk factor approach: a rational basis for promoting oral health.Community Dent Oral Epidemiol. 2000 Dec;28 (6):399-406.
39. WHO-FAO, 2003. Diet, nutrition and the prevention of chronic diseases. http://apps.who.int/iris/bitstream/10665/42665/1/WHO_TRS_916.pdf
40. World Health Organization. Guideline: Sugars intake for adults and children. Geneva: World Health Organization; 2015. [Last accessed on 2015 November 10]. Available from: http://www.who.int/nutrition/publications/guidelines/sugars_intake/en/
41. Zimmer S Zimmer, M Bizhang, R Seemann, S Witzke... The effect of a preventive program, including the application of low-concentration fluoride varnish, on caries control in high-risk children. Clin Oral Invest (2001) 5:40-44
42. Skold UM, Petersson LG, Lith A, Birkhead D. 2005. Effect of School-Based Fluoride Varnish Programmes on Approximal Caries in Adolescents from Different Caries Risk Areas. Caries Research 39, pp. 273-279.
43. Marinho VCC, Higgins JPT, Logan S, Sheiham A. Fluoride varnishes for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews 2002, Issue 1.
44. Weintraub J.A., Ramos-Gomez F, Jue B, Shain S, Hoover C.I0, Featherstone J.D.B., and Gansky S.A. Fluoride Varnish Efficacy in Preventing Early Childhood Caries. J Dent Res. 2006 Feb; 85(2): 172–176
45. Lawrence HP, Binguis D et al. A 2-year community-randomized controlled trial of fluoride varnish to prevent early childhood caries in Aboriginal children. Community Dent Oral Epidemiol 2008; 36: 503-516.
46. Adams SH, Hyde S, Gansky SA. Caregiver acceptability and references for early childhood caries preventive treatments for Hispanic children. J Publ Health Dent 2009; 69: 217-224.
47. Milgrom P, Tut OK. Evaluation of Pacific Islands early childhood caries prevention project: Republic of the Marshall Islands. J Publ Health Dent 2009; 69: 201- 203.
48. Leelasithorn S, Ungchusak C, Promma S,Bunmee S. Effect of Fluoride Varnish on Caries Prevention in 0-3 Year-old Children. THAILAND JOURNAL OF HEALTH PROMOTION AND ENVIRONMENTAL HEALTH 2009;32(2):62-71
49. Pitchika V, Kokel C, Andreeva J, Crispin A, Hickel R, Kűhnisch J, Heinrich-Weltzien R. Effectiveness of a new fluoride varnish for caries prevention in pre-school children. J Clin Pediatr Dent 2013; 38: 7-12.
50.Mohammadi TM, Hajizamani A, Hajizamani HR, Abolghasemi B. Fluoride varnish effect on preventing dental caries in a sample of 3-6 years old children. J Int Oral Health 2015; 7: 30-35.

51. Oliveira BH, Salazar M, Carvalho DM, Falcão A, Campos K, Nadanovsky P. Biannual fluoride varnish applications and caries incidence in preschoolers: a 24-month follow-up randomized placebo-controlled clinical trial. Caries Res. 2014;48(3):228-36. Epub 2014 Jan 29.

52. Agouropoulos A, Twetman S, Pandis N, Kavvadia K, Papagiannoulis L. Caries-preventive effectiveness of fluoride varnish as adjunct to oral health promotion and supervised tooth brushing in preschool children: a double-blind randomized controlled trial. J Dent. 2014 Oct;42(10):1277-83.

53. Jiang EM, Lo ECM, Chu CH, Wong MCM. Prevention of early childhood caries (ECC) through parental toothbrushing training and fluoride varnish application: a 24-month randomized controlled trial. J Dent 2014; 42: 1543-1550.

54. Simratvir M, Singh N et al. Efficacy of 10% Povidone Iodine in Children Affected with Early Childhood Caries: An In vivo Study. J Clin Paediatr Dent 2010; 34(3): 233 – 238.

55. Berkowitz RJ, Koo H et al. Adjunctive chemotherapeutic suppression of mutans Streptococci in the setting of severe early childhood caries: an exploratory study. J Publ Health Dent 2009; 69: 163-167.

56. Berkowitz R.J., Amante A, Dorota T. Kopycka-Kedzierawski, Billings R.J., Feng C, Dental caries recurrence following clinical treatment for severe early childhood caries. Pediatr Dent. 2011 Nov-Dec;33 (7):510-4

57. Amin MS, Harrison RL, Benton TS, Roberts M, Weinstein P.Effect of Povidone-iodine on Streptococcus Mutans in Children With Extensive Dental Caries. Pediatr Dent. 2004;26:5-10

58. Lopez L, Berkowitz R, Zlotnik H, Moss M, Weinstein P. Topical antimicrobial therapy in the prevention of early childhood caries. Pediatr Dent. 1999 Jan-Feb;21(1):9-11

59. Lopez L, Berkowitz R , Spiekerman C, Weinstein P. Topical antimicrobial therapy in the prevention of early childhood caries: a follow-up report. Pediatr Dent 24:204-206, 2002.

60. Zhang L, Featherstone JDB et al. Antibacterial treatment needed for severe early childhood caries. J Publ Health Dent 2006; 66: 174-179.

61. Peretz B, Sarit F et al. Mutans Streptococcus counts following treatment for early childhood caries. J Dent Child 2003; 70: 111-114.

62. Palmer EA, Nielsen T et al. Children with severe early childhood caries: pilot study examining mutans streptococci genotypic strains after full-mouth caries restorative therapy. Pediatr Dent. 2012 Mar-Apr;34(2):e1 – 10.

63. Klinke T, Urban M et al. Changes in Candida spp., Mutans Streptococci and Lactobacilli following treatment of early childhood caries: A 1-Year follow-up. Caries Res 2014: 48: 24 – 31.

64. Acs G, Shulman R et al. The effect of dental rehabilitation on the body weight of children with early childhood caries. Pediatr Dent 1999; 21: 109-113.

65. de Amorim RG1, Leal SC, Frencken JE. Survival of atraumatic restorative treatment (ART) sealants and restorations: a meta-analysis.Clin Oral Investig. 2012 Apr;16(2):429-41. doi: 10.1007/s00784-011-0513-3. Epub 2011 Jan 28.

66. Arrow P, Klobas E. Minimum intervention dentistry approach to managing early childhood caries: a randomized control trial. Community Dent Oral Epidemiol 2015; 43: 511-520.

67. Borrelli, Belinda1; Tooley, Erin M.2; Scott-Sheldon, Lori A.J.Motivational Interviewing for Parent-child Health Interventions: A Systematic Review and Meta -Analysis Pediatric Dentistry, Volume 37, Number 3, May/June 2015, pp.254-265(12)

caries. Braz Oral Res 2015; 29: 1-8.

68. Naidu R, Nunn J, Irwin JD. The effect of motivational interviewing on oral healthcare knowledge, attitudes and behaviour of parents and caregivers of preschool children: an exploratory cluster randomised controlled study. BMC Oral Health 2015; 15: 101.

69. Plutzer K, Spencer AJ. Efficacy of an oral health promotion intervention in the prevention of early childhood caries. Community Dent Oral Epidemiol 2008; 36: 335-346.

70. Plutzer K, Spencer AJ, Keirse MJNC. Reassessment at 6 – 7 years of age years of randomized controlled trial initiated before birth to prevent early childhood caries. Community Dent Oral Epidemiol. 2012; 40 (2):116 – 124.

71. Azevedo MS, Romano AR, Correa MB, dos Santos IS, Cenci MS. Evaluation of a feasible educational intervention in preventing early childhood caries. Braz Oral Res 2015; 29: 1-8.