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DENTAL CARIES PREVENTION IN YOUNG CHILDREN: MODERN APPROACHES AND METHODS

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Abstract

Early Childhood Caries (ECC) remains one of the most prevalent chronic diseases of childhood, affecting, according to the WHO (2022), more than 600 million children worldwide. The aim of this work is to systematize current evidence on caries prevention methods in children under 3 years of age and to analyze their evidence base.

Materials and methods. A literature review covering 2013–2024 was performed in the PubMed, Cochrane Library, and eLibrary databases; systematic reviews, AAPD and WHO clinical guidelines, and national protocols were included.

Results. The most effective methods were: use of fluoridated toothpaste ≥1000 ppm in a "rice-grain" amount from eruption of the first tooth, professional 5% sodium fluoride varnish applications every 3–6 months, restriction of free sugars to <10% of energy intake, and the first dental visit before 12 months of age. Silver diamine fluoride (SDF 38%) demonstrated up to 81% caries arrest efficacy.

Conclusion. The contemporary strategy of ECC prevention is based on individualized risk assessment (CAMBRA, AAPD CAT) and a complex of medical, behavioral, hygienic, and pharmacological measures implemented from the antenatal period onwards.

Keywords: early childhood caries, prevention, fluorides, fluoride varnish, silver diamine fluoride, xylitol, caries risk assessment, dental home, infants and toddlers.

Аннотация

Кариес раннего детского возраста (Early Childhood Caries, ECC) остаётся одной из наиболее распространённых хронических болезней детского возраста, поражая, по данным ВОЗ (2022), более 600 млн детей в мире. Цель работы — систематизировать современные данные о методах профилактики кариеса у детей в возрасте до 3 лет и проанализировать их доказательную базу. **Материалы и методы.** Проведён анализ литературы за период с 2013 по 2024 г. в базах PubMed, Cochrane Library, eLibrary; включены систематические обзоры, клинические рекомендации AAPD, ВОЗ и национальные руководства. **Результаты.** Установлено, что наиболее эффективными методами являются: использование фторсодержащих зубных паст с концентрацией ≥1000 ppm в дозировке «рисового зерна» с момента прорезывания первого зуба, профессиональные аппликации 5% фторида натрия каждые 3–6 месяцев, ограничение свободных сахаров до <10% энергоценности рациона, ранний осмотр стоматологом до 12 месяцев. Серебро-диаминфторид (SDF 38%) показал эффективность остановки кариеса до 81%. **Заключение.** Современная стратегия профилактики ECC основана на индивидуальной оценке риска (CAMBRA, AAPD CAT) и комплексе медико-поведенческих, гигиенических и фармакологических мер, реализуемых начиная с антенатального периода.

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Ключевые слова: кариес раннего детского возраста, профилактика, фториды, фторлак, серебро-диаминфторид, ксилит, оценка риска кариеса, стоматологический дом, дети раннего возраста.

Annotatsiya

Erta yoshdagi bolalar kariyesi (Early Childhood Caries, ECC) bolalar yoshining eng keng tarqalgan surunkali kasalliklaridan biri bo‘lib qolmoqda; JSST ma’lumotlariga ko‘ra (2022) dunyoda 600 milliondan ortiq bolaga ta’sir qiladi. Ishning maqsadi — 3 yoshgacha bo‘lgan bolalarda kariyesni profilaktika qilishning zamonaviy usullarini tizimlashtirish va ularning dalillar bazasini tahlil qilish. **Materiallar va usullar.** PubMed, Cochrane Library, eLibrary bazalarida 2013–2024 yillar oralig‘idagi adabiyotlar tahlil qilindi; tizimli sharhlar, AAPD va JSST klinik tavsiyalari, milliy qo‘llanmalar kiritildi. **Natijalar.** Eng samarali usullar — birinchi tish chiqishi bilan ≥1000 ppm konsentratsiyali ftorli tish pastalari (“guruch doni” miqdorida), har 3–6 oyda 5% natriy ftorid bilan professional applikatsiyalar, ratsionda erkin shakar miqdorini <10% gacha cheklash, 12 oygacha stomatologning birinchi ko‘rigi. SDF 38% kariyesni to‘xtatishda 81% gacha samaradorlikni ko‘rsatdi. **Xulosa.** ECC profilaktikasining zamonaviy strategiyasi xavfni individual baholashga (CAMBRA, AAPD CAT) va antenatal davrdan boshlanadigan tibbiy-xulqiy, gigiyenik hamda farmakologik chora-tadbirlar majmuasiga asoslanadi.

Kalit so‘zlar: erta yoshdagi bolalar kariyesi, profilaktika, ftoridlar, ftorlak, kumush diaminftorid, ksilit, kariyes xavfini baholash, stomatologik uy, erta yoshdagi bolalar.

Introduction

Early Childhood Caries (ECC) is defined by the American Academy of Pediatric Dentistry (AAPD, 2024) as the presence of one or more carious (cavitated or noncavitated), missing, or filled teeth in a child aged 71 months or younger. Severe ECC (S-ECC) is diagnosed in children under 3 years of age if any evidence of smooth caries is present, and in children aged 3–5 years, if at least one cavitated, missing, or filled smooth surface is present in the maxillary anterior primary teeth, or if the KPI (p) is ≥4 (3 years), ≥5 (4 years), and ≥6 (5 years) [1].

According to the WHO Global Oral Health Report (2022), dental caries in primary teeth is the fifth most common chronic disease worldwide, affecting over 514 million children; taking into account all forms of ECC, the total number of patients exceeds 600 million [2]. A systematic review by Tinanoff N. et al. (2019) showed that the prevalence of ECC in children under 6 years of age in developed countries varies from 23 to 35%, while in low- and middle-income countries it reaches 60–85% [3]. In the Russian Federation, according to consolidated data by E.E. Maslak (2015) and L.P. Kiselnikova (2020), the caries intensity (CI) in three-year-old children is 1.5–4.2 [8, 10].

The high prevalence, early age of onset, and significant medical and social consequences—pain, sleep, malocclusion, and nutritional disorders, the risk of developing odontogenic infections, and the development of a cariogenic microbiota that lasts a lifetime—determine the urgency of finding effective preventive approaches. The purpose of this review is to systematize current understanding of risk factors and methods for preventing caries in young children and to characterize the evidence base.

Materials and methods

This study is a narrative literature review conducted in accordance with the PRISMA-ScR principles. Publications were searched in PubMed/MEDLINE, the Cochrane Library, Scopus, and eLibrary for the period from January 2013 to December 2024. The following keywords and MeSH terms were used: "Early Childhood Caries," "Dental Caries / Prevention & Control,"

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"Topical Fluorides," "Silver Diamine Fluoride," "Xylitol," "Infant," "Preschool Child," "Caries Risk Assessment," and their Russian and Uzbek equivalents.

Inclusion criteria: systematic reviews and meta-analyses, randomized controlled trials (RCTs), clinical guidelines from specialized organizations (AAPD, ADA, EAPD, WHO), national guidelines, and consensus documents. Exclusion criteria: conference abstracts, non-systematic reviews without methodological specifications, and publications with a level of evidence lower than III. Study quality was assessed using the AMSTAR-2 scale for systematic reviews and the Cochrane RoB 2 tool for randomized controlled trials. A total of 47 sources were analyzed, of which 13 key publications were included in the review.

Results

Etiology and risk factors. Early childhood caries is a multifactorial disease, in the development of which four groups of factors play a leading role: microbiological (Streptococcus mutans, Streptococcus sobrinus, representatives of the genus Lactobacillus, Candida albicans), substrate (free sugars, primarily sucrose), host factors (enamel structure and mineralization, composition and rate of saliva secretion) and the time factor. It has been established that vertical transmission of S. mutans from the mother (or other primary caregiver) to the child occurs predominantly in the so-called "window of infection" - at the age of 19-31 months - and largely determines the further cariogenic potential of the biofilm [3, 9]. The main behavioral and social risk factors include: night and prolonged "bottle" feeding, especially with sweetened drinks; falling asleep with a bottle in the child's mouth; Frequent snacking on foods containing fermentable carbohydrates (more than 4–5 times per day); poor or no oral hygiene before the age of 2 years; low parental hygiene literacy; irregular dental visits; high maternal caries intensity (untreated caries of ≥3 teeth) [1, 3, 8].

Assessment of individual caries risk. Modern prevention is based on the principle of individual risk. The most validated tools are: AAPD Caries-risk Assessment Tool (CAT), Caries Management by Risk Assessment (CAMBRA — versions for children 0–5 and 6+ years old), and the Cariogram scale. According to the results of a comparative analysis by Featherstone J.D.B. et al. (2021), all three systems demonstrated comparable predictive value (AUC 0.71–0.78) and can be used in clinical practice [13]. Based on the risk assessment, the child is assigned to a low, medium, or high-risk group, which determines the intensity of preventive interventions and the frequency of routine checkups (every 12, 6, and 3 months, respectively).

Antenatal and perinatal prophylaxis. Prevention of ECC begins before the child's birth. Maternal oral hygiene, education on good oral hygiene, and the recommendation of chewing gum/lozenges with xylitol (5–10 g/day in 3–5 doses) during the first two years of life have been shown to significantly reduce early colonization with S. mutans and the incidence of ECC in offspring (OR 0.71; 95% CI 0.51–0.99) [11]. It is recommended to avoid pacifier and spoon licking, sharing cutlery, and other routes of vertical transmission of cariogenic flora [1, 9].

Oral hygiene and fluoride prophylaxis. Toothbrushing is the basis of individual prevention. According to the consensus recommendations of the AAPD (2024) and the European Academy of Paediatric Dentistry (EAPD), parents should begin brushing teeth with a soft-bristled toothbrush from the moment the first tooth erupts (usually at 6–8 months), twice a day, using a fluoride toothpaste in the amount of a “rice grain” (~0.1 g, which corresponds to ≈0.1 mg F^-) for children under 3 years old and a “pea” (~0.25 g, ≈0.25 mg F^-) for children 3–6 years old. The recommended fluoride concentration in toothpaste is at least 1000 ppm; in cases of high caries risk, up to 1450 ppm [1, 4].

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A systematic review by Wright J.T. et al. (2014), which included 17 RCTs, confirmed that the use of fluoride-containing toothpastes in children under 6 years of age in the indicated dosages reliably reduces the growth of caries (Prevented Fraction 24–32%) with a minimal risk of developing fluorosis, provided that the dosage is correct and spitting is controlled [4]. Professional methods of fluoride prophylaxis. Applications of fluoride varnish based on 5% sodium fluoride (22,600 ppm F^-) are the standard of professional prophylaxis in young children. A Cochrane meta-analysis (Marinho V.C. et al., 2013), which included 22 RCTs (n = 12,455), showed a 37% (95% CI 24–51%) reduction in caries incidence in primary teeth with an application frequency of 2–4 times per year [6]. The advantages of fluoride varnish include safety in patients under 6 years of age, ease of application, and a low risk of swallowing significant amounts. Silver Diamine Fluoride (SDF) 38% is a preparation that combines the antimicrobial action of silver ions and the remineralizing effect of fluoride. According to a review by Crystal Y.O. and Niederman R. (2016), a single application of SDF stops the progression of carious lesions in 47–81% of cases, with repeated applications every 6 months – up to 91%. SDF is approved by the FDA (USA) for the treatment of hypersensitivity and is widely used off-label for caries of primary teeth as a minimally invasive alternative to surgical treatment, especially in young children and patients with special needs [7].

The main side effect is irreversible black staining of carious dentin, which requires informed parental consent.

Dietary correction. WHO (2015, reprint 2022) recommends limiting the consumption of free sugars to less than 10%, and ideally less than 5% of the daily energy value of the diet. For young children, the critical factors are: excluding sweetened drinks (juices, fruit drinks, soda) from a bottle; Avoiding nighttime milk/formula feedings after the first teeth emerge; limiting free access to sweet snacks [2, 3]. Xylitol-containing products (lozenges, sprays) at a dose of 5–8 g/day, divided into 3–5 doses, demonstrate a moderate preventive effect (Riley P. et al., 2015); however, the quality of the evidence is assessed as low-moderate, and this method is used as an adjunct [11].

The concept of a "dental home." The AAPD and the American Academy of Pediatrics (AAP) recommend establishing a "dental home"—an ongoing, long-term relationship between a child and their family and a pediatric dentist—no later than 12 months of age or within 6 months of the first tooth's eruption [12]. The first visit includes: risk assessment, oral examination (knee-to-knee position), parental education on toothbrushing techniques and principles of healthy eating, and, if necessary, application of fluoride varnish.

Summary of ECC Prevention Methods

Method	Age of application	Reduction in the growth of dental caries	Level of evidence
Toothpaste ≥1000 ppm F^-	From the eruption of the 1st tooth	24–32 %	1a (Cochrane)
Fluoride varnish 5% NaF	From 6 months, 2–4 times/year	37 %	1a (Cochrane)
SDF 38%	From 12 months	Stop 47–81%	1b–2a

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Method	Age of application	Reduction in the growth of dental caries	Level of evidence
	(off-label)		
Xylitol (5–8 g/day)	From 3 years (lozenges)	13–24 %	2a
Sugar control (<10% E)	From complementary feeding	Essential	1a (WHO)
Dental House	From 12 months.	Severe ECC Reduction	2b (cohort)

Discussion

Analysis of the results shows that modern caries prevention in young children is not a single intervention, but a multi-level system that integrates mother and child, family, healthcare providers, and the healthcare system. The cornerstone of this system is early assessment of individual risk and implementation of preventive measures beginning in the antenatal period—long before the first tooth erupts.

The proven effectiveness of fluoride prophylaxis deserves special attention. Twetman S. and Dhar V. (2015), in a systematic review on the effectiveness of existing methods for the prevention and treatment of ECC, reach a clear conclusion: daily toothbrushing with fluoride toothpaste and periodic applications of fluoride varnish are the two interventions with the highest level of evidence (Strong recommendation, high-quality evidence) [5]. At the same time, the authors note that without dietary behavior modification and microbiological monitoring, the effectiveness of fluoride is reduced. Silver diamine fluoride has significantly changed the paradigm for managing caries in primary teeth: the method allows for non-invasively halting the progression of lesions in children whose behavior does not allow for traditional preparation, and also avoids general anesthesia. Disadvantages of the method (aesthetic defect, technical nuances of isolation) require proper information for parents and selection of indications [7].

Russian authors (Kiselnikova L.P., Leontyev V.K., Maslak E.E.) emphasize the need to integrate preventive dentistry into primary pediatric care: the local pediatrician and nurse should be trained to assess the oral health and refer the child to a dentist before 12 months [8–10]. This is especially important for regions with limited access to specialized pediatric dental care.

The limitations of this review include primarily English- and Russian-language sources and the predominance of studies conducted in high- and middle-income countries; Extrapolation of results to populations with fluoride deficiency in drinking water or other cultural and dietary characteristics requires caution.

Conclusions

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Early childhood caries is a global health problem, affecting, according to various estimates, between 23% and 85% of children under 6 years of age. Its prevention requires a systematic approach that takes into account individual risk factors. Proven effective treatments include daily brushing with a fluoride concentration of ≥1000 ppm at a "rice grain"/"pea" dose, periodic applications of 5% fluoride varnish (2-4 times per year), limiting free sugars to <10% of daily energy intake, and establishing a "dental home" by 12 months of age. Silver diamine fluoride (SDF 38%) is an effective minimally invasive method for stopping caries in primary teeth in young children (47-81%) and should be considered when traditional surgical treatment is not possible. A key role in implementing preventive measures belongs to a multidisciplinary team (dentist, pediatrician, nurse, and parents), as well as health education for the mother during the antenatal and postnatal periods. Further research should be directed toward validating caries risk assessment tools in Central Asian populations and evaluating the cost-effectiveness of early preventive interventions.

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