MODERN METHODS OF DENTAL CARIES PREVENTION IN CHILDREN AND ADULTS

Fayziyeva Aziza Shuxrat Qizi

Alfraganus universiteti talaba

Annotation. This article analyzes modern methods of dental caries prevention in children and adults based on scientific literature, systematic reviews, clinical guidelines, and recommendations from international health organizations. Dental caries remains one of the most prevalent chronic diseases worldwide, affecting 30% to 90% of children and adults across different populations. Despite its preventable nature, caries continues to pose a significant public health challenge, contributing to pain, infection, tooth loss, and reduced quality of life. The article examines the multifactorial etiology of dental caries, the principles of modern caries prevention, the spectrum of preventive strategies ranging from individual (fluoride therapy, fissure sealants, dietary modification, oral hygiene) to professional (topical fluoride applications, silver diamine fluoride, atraumatic restorative treatment) and public health interventions (community water fluoridation, school-based programs, integrated care pathways). Special attention is given to emerging preventive modalities including nanosilver fluoride, probiotics and postbiotics, arginine-containing dentifrices, and fluoride-free hydroxyapatite toothpastes. The article also analyzes the clinical effectiveness, indications, and limitations of each approach, as well as the importance of risk-based, individualized prevention strategies across different age groups.

Keywords: dental caries prevention, fluoride therapy, fissure sealants, silver diamine fluoride, probiotics, caries risk assessment, children, adults, public health.

Dental caries is a multifactorial, biofilm-mediated, diet-modulated disease characterized by the demineralization of tooth hard tissues, resulting from the metabolic activity of cariogenic bacteria (primarily *Streptococcus mutans* and *Lactobacillus* species) that ferment fermentable carbohydrates

(especially sugars) to organic acids. These acids lower the pH of the plaque biofilm below the critical threshold (approximately 5.5), leading to the dissolution of hydroxyapatite crystals and the formation of subsurface enamel lesions. The dynamic balance between demineralization and remineralization determines whether the caries process progresses or is arrested. This balance is influenced by several factors: the presence and virulence of cariogenic bacteria, the frequency and quantity of fermentable carbohydrate intake, the flow rate and buffering capacity of saliva, fluoride exposure, and the individual's oral hygiene practices. Modern caries prevention is based on a comprehensive, evidence-based approach that targets all these etiological factors through a combination of individual, professional, and community-level interventions.

Fluoride therapy remains the cornerstone of modern caries prevention across all age groups. Fluoride exerts its cariostatic effect through multiple mechanisms: inhibiting demineralization by adsorbing to the surface of hydroxyapatite crystals and making them less soluble; enhancing remineralization by accelerating the precipitation of calcium and phosphate ions; and inhibiting bacterial metabolism by interfering with enolase and ATPase activity. Topical fluoride is delivered through various vehicles. Fluoride toothpaste is the most widely used and cost-effective method of fluoride delivery. The WHO and national guidelines recommend brushing twice daily with fluoride toothpaste containing 1000-1500 ppm fluoride for children aged 6 years and older, and lower concentrations (around 500 ppm) for younger children. Professional topical fluoride applications in the form of fluoride varnishes (5% NaF) and gels are recommended for individuals at moderate to high caries risk. Fluoride varnishes are particularly effective in preventing occlusal caries in permanent and primary dentition, and their protective efficacy has been shown to be comparable to resin-based sealants in some studies. A meta-analysis of sealants versus fluoride varnishes has been conducted to evaluate their relative effectiveness on occlusal surfaces in children's first permanent molars. For adults, mouthwashes with sodium fluoride are recommended for additional protection, especially for those

at high risk. Community water fluoridation remains one of the most effective and equitable public health measures, providing a slight reduction in caries across populations. The combination of fluoride with other active agents, such as arginine, represents a promising advance. Toothpastes containing 1.5% arginine and 1450 ppm fluoride have demonstrated significant efficacy in reducing the DMFT index by 21% and DMFS by 19.6% compared to fluoride-only toothpastes, and were shown to inactivate 14% of carious lesions after 12 weeks of treatment.[1]

Fissure sealants provide a physical barrier that protects the occlusal surfaces of posterior teeth from acid attack. They are indicated for the prevention of occlusal caries in children and adolescents, particularly soon after the eruption of first and second permanent molars. Systematic reviews have demonstrated that fissure sealants and fluoride varnishes have comparable efficacy in preventing occlusal caries. A randomized pragmatic split-mouth trial compared the clinical effectiveness of resin-based fissure sealants and fluoride varnish in children at high caries risk. Another randomized controlled trial evaluated the effectiveness of glass-ionomer sealant versus quarterly-applied fluoride varnish in preventing occlusal caries among preschool children, finding similar clinical efficacies.[2] Sealants are particularly valuable for children with deep pits and fissures, those with a history of caries, and those with limited access to regular dental care.

Silver diamine fluoride (SDF) has emerged as a revolutionary, minimally invasive, and cost-effective agent for both preventing and arresting dental caries. The Cochrane review on topical SDF for preventing and managing dental caries in children and adults included 29 randomized controlled trials with over 13,000

1 Efficacy of arginine- and fluoride-containing dentifrice in reducing dental caries progression // Clinical, Cosmetic and Investigational Dentistry. – 2025. – Vol. 17.

2 Effectiveness of glass-ionomer sealant versus fluoride varnish application to prevent occlusal caries among preschool children — a randomised controlled trial // ScienceDirect. – 2024.

participants.[3] The evidence suggests that SDF likely prevents new root caries and may help arrest caries in the primary and permanent dentition. A systematic review and meta-analysis evaluated the effectiveness of SDF with atraumatic restorative treatment (ART) in arresting the progression of dental caries in cavitated primary or permanent teeth. The SDF-ART technique combines the antibacterial and remineralizing properties of SDF with the minimally invasive removal of carious tissue, offering a patient-friendly and cost-effective approach, particularly in underserved populations. SDF is especially valuable for young children, individuals with special needs, and those with limited access to traditional restorative care. Its main limitation is the permanent black staining of arrested lesions, which may be unacceptable in esthetically sensitive areas.

Nanosilver fluoride (NSF) has been developed as a modification of SDF to overcome its esthetic limitations. NSF combines the antibacterial action of silver nanoparticles with the remineralizing properties of fluoride, showing promising potential as a cariostatic agent with good antibacterial action and a lower tendency to cause dentin staining compared to SDF. Studies have demonstrated that NSF presents less dentin staining than 35% silver fluoride, 30% SDF, and 38% SDF. A clinical trial in children aged 4 to 9 years found that 68% of carious teeth showed hard dentin at 7 days after NSF application; after 5 months, 72.91% of teeth in the NSF group showed arrested caries compared to only 34% in the control group; and at 12 months, 65.21% showed arrested caries compared to 28.88% in the control group. NSF is concluded to be a noninvasive cariostatic substance for the arrest and treatment of caries when applied directly on caries lesions in dentin. Studies have also shown that nanosilver toothpaste exhibits high antibacterial efficacy against *Streptococcus mutans*.

3 Topical silver diamine fluoride (SDF) for preventing and managing dental caries in children and adults // Cochrane Database of Systematic Reviews. – 2024. – № 11. – CD012718.

Probiotics and postbiotics represent an emerging adjunctive strategy for caries prevention by modulating the oral microbiome. A systematic review of clinical evidence on the role of probiotics in preventing dental caries identified 21 studies that met the inclusion criteria.[4] Most clinical trials reported a significant reduction in *Streptococcus mutans* levels following administration of probiotic strains, particularly *Lactobacillus paracasei*, *Lactobacillus rhamnosus*, and *Bifidobacterium lactis*. Several studies also demonstrated a decreased incidence of new carious lesions and an improvement in salivary immune markers. The current evidence supports the potential of specific probiotic strains to reduce cariogenic bacterial loads and contribute to caries prevention. However, variability due to strain type, dosage, delivery method, and population characteristics highlights the need for further standardized, long-term trials. Probiotic lozenges, gums, and dairy products have been shown to reduce *Streptococcus mutans* counts and caries incidence in both children and adults. Emerging evidence of low certainty suggests that lozenges or tablets containing synbiotics or postbiotics could reduce caries incidence in preschool and schoolchildren compared with standard preventive care.

Fluoride-free alternatives are being investigated for individuals seeking to avoid fluoride or for those in areas with high natural fluoride levels. Hydroxyapatite toothpastes have been evaluated in clinical trials across children, adolescents, and adults, showing potential for caries prevention. However, current evidence indicates that caries prevention still relies primarily on reducing sugar intake and thorough daily oral care, with toothpaste containing evolving combinations of active ingredients.

Dietary modification remains a fundamental component of caries prevention. The frequency of sugar consumption is more critical than the total amount, as each sugar challenge initiates an acid attack lasting 20-40 minutes. The WHO recommends that

4 Inchingolo A.D. et al. The role of probiotics in preventing dental caries: a systematic review of clinical evidence // Frontiers in Oral Health. – 2025. – Vol. 6. – Art. 1720036.

free sugars should constitute less than 10% of total energy intake, with a further reduction to below 5% for additional health benefits. Anticipatory guidance, which provides oral health education to parents and young children during childcare visits, has been shown to effectively prevent dental caries in young children.

Integrated oral health care pathways have been developed to enhance patients' oral health by integrating prevention with treatment across both pediatric and adult populations. These pathways focus on primary prevention as the foundation of care, with the aim of improving oral health outcomes and quality of life. Regular dental check-ups are recommended: every six months for healthy children and adults, and more frequently for those at increased risk. School-based oral health programs combining education with preventive care have emerged as both cost-effective and impactful interventions. A systematic review of early detection and prevention interventions in children found that strategies such as fluoride varnish, fissure sealants, SDF, and school-based programs significantly reduced caries incidence, arrested lesion progression, and improved oral health behaviors.

In conclusion, modern dental caries prevention in children and adults is based on a comprehensive, evidence-based, and risk-stratified approach that integrates individual, professional, and public health strategies. Fluoride therapy in its various forms remains the cornerstone of prevention, with SDF and NSF emerging as transformative minimally invasive options for arresting existing lesions. Fissure sealants provide effective protection for occlusal surfaces, while probiotics and postbiotics offer promising adjunctive strategies for modulating the oral microbiome. Dietary modification, particularly reducing the frequency of sugar consumption, and regular dental check-ups are fundamental to long-term caries prevention. The development of integrated oral health care pathways and school-based programs ensures that prevention is accessible and equitable across different populations. As the evidence base continues to expand, the future of caries prevention lies in personalized, risk-based approaches that target the specific

etiological factors of each individual, ultimately reducing the global burden of this preventable disease.

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