УДК 616.314-002-053.2-084

Гусейнов Н.Р.

Научный руководитель: Ювакаева Гузелия Рахимжановна

Кафедра профилактической медицины и стоматологических дисциплин, Международный казахско-турецкий университет имени Ходжи Ахмеда Ясави, Туркестан, Республика Казахстан

СОВРЕМЕННЫЕ ДОКАЗАТЕЛЬНЫЕ ПОДХОДЫ К ПРОФИЛАКТИКЕ КАРИЕСА ЗУБОВ У ДЕТЕЙ И ПОДРОСТКОВ

Аннотация

Цель. *Обобщить современные доказательные подходы к профилактике кариеса зубов у детей и подростков, разграничить первичную профилактику, неинвазивное/минимально инвазивное ведение существующих поражений и перспективные вспомогательные технологии, а также сформировать возрастной и риск-ориентированный алгоритм.*

Материалы и методы. *Выполнен нарративный обзор с элементами структурированного поиска в PubMed/MEDLINE, Cochrane Library и на официальных ресурсах ВОЗ, Американской академии детской стоматологии и Американской стоматологической ассоциации. Рассматривались руководства, систематические обзоры, метаанализы и клинические исследования у лиц младше 18 лет. Из-за клинической и методологической неоднородности количественный синтез не проводился.*

Результаты. *Наиболее устойчивую доказательную основу имеют двукратная ежедневная чистка зубов фторсодержащей пастой, ограничение частоты воздействия свободных сахаров, регулярная оценка риска, профессиональное применение фторлака по показаниям и герметизация фиссур у детей с риском окклюзионного кариеса. Инфильтрация смолой предназначена для отобранных некавитированных поражений, а диаминфторид серебра — преимущественно для остановки активного кариеса; эти методы не следует приравнивать к первичной профилактике. Пробиотики, кальций-фосфатные продукты и цифровые приложения могут рассматриваться только как дополнение при ограниченной или неоднородной доказательной базе.*

Заключение. *Эффективная профилактика кариеса у детей и подростков требует непрерывного сочетания домашних, профессиональных, поведенческих и популяционных мер, выбранных с учетом возраста и индивидуального риска. Новые технологии не заменяют базовую фторидную профилактику, контроль сахаров и систематическое наблюдение.*

Ключевые слова: *кариес зубов; дети; подростки; профилактическая стоматология; фториды; герметизация фиссур; здоровье полости рта.*

Гусейнов Н.Р.

Ғылыми жетекші: Ювакаева Г.Р.

Профилактикалық медицина және стоматологиялық пәндер кафедрасы**,** Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті, Түркістан, Қазақстан Республикасы

БАЛАЛАР МЕН ЖАСӨСПІРІМДЕРДЕ ТІСЖЕГІНІҢ АЛДЫН АЛУДЫҢ ЗАМАНАУИ ДӘЛЕЛДІ ТӘСІЛДЕРІ

Аңдатпа

Мақсаты. *Балалар мен жасөспірімдерде тісжегінің алдын алудың заманауи дәлелді тәсілдерін жинақтау, бастапқы профилактиканы, бар зақымдарды инвазиясыз немесе аз инвазиялы емдеуді және перспективалы қосымша технологияларды ажырату, сондай-ақ жас пен қауіп деңгейіне негізделген алгоритм ұсыну.*

Материалдар мен әдістер. *PubMed/MEDLINE, Cochrane Library дерекқорларында және ДДҰ, Американдық балалар стоматологиясы академиясы мен Американдық стоматология қауымдастығының ресми ресурстарында құрылымдалған іздеу элементтері бар нарративті шолу жүргізілді. 18 жасқа дейінгі тұлғаларға қатысты нұсқаулықтар, жүйелі шолулар, метаталдаулар және клиникалық зерттеулер қарастырылды. Клиникалық және әдістемелік әртектілікке байланысты сандық синтез жүргізілген жоқ.*

Нәтижелер. *Күніне екі рет фторлы тіс пастасымен тазалау, бос қанттардың әсер ету жиілігін шектеу, тісжегі қаупін жүйелі бағалау, көрсетілім бойынша кәсіби фторлақ жағу және окклюзиялық тісжегі қаупі бар балаларда фиссураларды герметизациялау ең тұрақты дәлелдерге ие. Шайырмен инфильтрация таңдалған қуыстанбаған зақымдарға, ал күміс диаминфториді негізінен белсенді тісжегіні тоқтатуға арналған. Пробиотиктер, кальций-фосфатты өнімдер және цифрлық қолданбалар дәлелдері шектеулі қосымша құралдар ретінде ғана қарастырылады.*

Қорытынды. *Балалар мен жасөспірімдердегі тісжегінің тиімді профилактикасы жас пен жеке қауіпке сәйкес таңдалған үй жағдайындағы, кәсіби, мінез-құлықтық және популяциялық шаралардың үздіксіз үйлесімін талап етеді. Жаңа технологиялар негізгі фторидтік профилактиканы, қанттарды бақылауды және жүйелі бақылауды алмастырмайды.*

Түйін сөздер: *тісжегі; балалар; жасөспірімдер; профилактикалық стоматология; фторидтер; фиссураларды герметизациялау; ауыз қуысының денсаулығы.*

Nazim R.G.

Scientific Supervisor: Guzeliya R.Y.

Department of Preventive Medicine and Dental Disciplines**,** Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkistan, Republic of Kazakhstan

CONTEMPORARY EVIDENCE-BASED APPROACHES TO DENTAL CARIES PREVENTION IN CHILDREN AND ADOLESCENTS

Abstract

Objective. *To summarize contemporary evidence-based approaches to dental caries prevention in children and adolescents; distinguish primary prevention, non-invasive/minimally invasive management of existing lesions, and emerging adjunctive technologies; and propose an age- and risk-based practical algorithm.*

Materials and methods. *A narrative review with elements of a structured search was conducted in PubMed/MEDLINE, the Cochrane Library, and official resources of the World Health Organization, the American Academy of Pediatric Dentistry, and the American Dental Association. Guidelines, systematic reviews, meta-analyses, and clinical studies involving individuals younger than 18 years were considered. Quantitative synthesis was not undertaken because of clinical and methodological heterogeneity.*

Results. *The most consistent evidence supports twice-daily brushing with fluoride toothpaste, limiting the frequency of free-sugar exposure, repeated caries-risk assessment, professionally applied fluoride varnish when indicated, and pit-and-fissure sealants for children at risk of occlusal caries. Resin infiltration is intended for selected non-cavitated lesions, whereas silver diamine fluoride is used mainly to arrest active caries; neither should be presented as equivalent to primary prevention. Probiotics, calcium-phosphate products, and digital applications remain adjunctive options supported by limited or heterogeneous evidence.*

Conclusion. *Effective caries prevention in children and adolescents requires a continuous age-appropriate and risk-based combination of home, professional, behavioral, and population-level measures. Emerging technologies do not replace foundational fluoride use, sugar control, and systematic follow-up.*

Keywords: *Dental Caries; Child; Adolescent; Preventive Dentistry; Fluorides; Pit and Fissure Sealants; Oral Health.*

Introduction

Dental caries remains a widespread chronic disease in childhood, associated with pain, infectious complications, and impairments to nutrition, sleep, learning, and quality of life. The disease burden is unevenly distributed; factors such as access to preventive care, family income, parental education, the dietary environment, and fluoride availability influence both disease risk and the feasibility of timely prevention [1–3]. Caries is a dynamic, biofilm-mediated, and sugar-dependent process. Modern prevention strategies focus not only on tooth brushing but also on maintaining the balance between demineralization and remineralization, reducing the frequency of free sugar intake, controlling biofilm, using fluoride, and early management of initial lesions. It is essential to distinguish primary prevention from the arrest or treatment of existing carious lesions. An updated review is necessary because, alongside well-established measures, digital applications, probiotics, and calcium-phosphate or "biomimetic" products are being actively promoted. The evidence base for these methods varies; presenting all approaches as equivalent risks replacing effective core interventions with products of uncertain clinical efficacy. The scientific contribution of this review lies in the clinical classification of interventions and the development of a practical, age- and risk-based algorithm.Objective: To summarize and critically evaluate evidence-based methods for preventing dental caries in children and adolescents; to distinguish between core primary prevention, professional interventions, minimally invasive management of existing lesions, and promising adjunctive technologies; and to propose a practical algorithm based on age and caries risk.

Materials and methods: This work was conducted as a narrative review incorporating elements of a structured search. Sources were identified via PubMed/MEDLINE and the Cochrane Library, as well as through the official websites of the WHO, the American Academy of Pediatric Dentistry (AAPD), and the American Dental Association (ADA), and by reviewing the reference lists of selected guidelines. The primary search period spanned January 2015 through December

2025; earlier seminal guidelines and systematic reviews were included via manual searching. The final search was completed in December 2025. An example search strategy for PubMed/MEDLINE is as follows: ("Dental Caries"[MeSH] OR "dental caries"[tiab] OR caries[tiab]) AND ("Child"[MeSH] OR "Adolescent"[MeSH] OR child*[tiab] OR adolescen*[tiab]) AND (prevent*[tiab] OR "Fluorides"[MeSH] OR "Toothpastes"[MeSH] OR "Pit and Fissure Sealants"[MeSH] OR "fluoride varnish"[tiab] OR "silver diamine fluoride"[tiab] OR "resin infiltration"[tiab] OR "free sugars"[tiab] OR "school-based"[tiab]). Restrictions applied included human subjects, an age range of 0–18 years, and the use of Russian or English languages. Targeted searches were conducted for specific interventions. Included materials comprised clinical guidelines, consensus recommendations, systematic reviews, meta-analyses, and clinical studies evaluating the prevention of new lesions, increments in dmft/DMFT or dmfs/DMFS scores, remineralization, and lesion progression or arrest in individuals under 18 years of age. Excluded items were in vitro and animal studies, publications lacking clinical outcomes, promotional materials, non-peer-reviewed texts with unverifiable bibliographic data, and works not pertaining to the pediatric population. Guidelines were used for practical recommendations, systematic reviews for assessing the body of evidence, and primary studies for clarifying specific new areas. Data extracted from each publication included study design, participant age and risk profile, intervention, comparator, follow-up duration, clinical outcomes, and benefits. A formal assessment of the risk of bias was not conducted for the included publications; this aligns with the review's narrative nature but also represents a limitation. Interpretation prioritized current clinical guidelines, systematic reviews, and meta-analyses; individual studies were not used to formulate strong, universal recommendations. Quantitative meta-analysis was not performed due to heterogeneity in populations, interventions, and outcomes. This review is not systematic and does not include a quantitative synthesis. A limited number of databases and sources were used; language, selection, and publication biases are possible. A formal risk-of-bias assessment was not performed for all included studies. Clinical heterogeneity regarding age, baseline risk, diagnostic criteria, and follow-up duration limits direct comparisons between methods.

Limitations: Literature selection and data extraction were performed by a single reviewer without independent duplicate screening, which introduces a risk of selection and reviewer bias. Searching was restricted to PubMed/MEDLINE, the Cochrane Library, and selected professional organization websites, so relevant studies indexed elsewhere may have been missed. Only Russian- and English-language publications were considered, which may introduce language bias. No standardized data extraction form or formal risk-of-bias assessment was applied, and no quantitative synthesis was performed because of clinical and methodological heterogeneity across the included evidence. As a narrative review, this work is also subject to potential publication bias in the underlying literature. These limitations should be considered when interpreting the strength of the recommendations presented.

Results:

Basic home-based prevention

The cornerstone of prevention is brushing twice daily with fluoride toothpaste under age-appropriate adult supervision [4]. Toothpaste concentration and quantity should be selected based on current national or professional guidelines, taking into account the child's age and risk of fluorosis. The AAPD recommends a rice-grain-sized amount of toothpaste for children under three years of age and a pea-sized amount for children aged three to six; an adult should apply the

toothpaste or supervise the process [4]. After brushing, it is preferable to spit out the residue without vigorous rinsing to avoid reducing the contact time between fluoride and enamel.Dietary prevention focuses primarily on reducing the frequency of exposure to free sugars, particularly between meals and before bedtime. The WHO recommends reducing free sugar intake throughout the lifespan; Practical counseling should take into account the family's actual dietary habits, the use of water as the primary beverage between meals, and the avoidance of sugary drinks in bedtime bottles [2].

Professional preventive interventions

Fluoride varnish is applied based on clinical indications—primarily in cases of high caries risk, active initial lesions, compromised oral hygiene, or the presence of orthodontic appliances. The frequency of application depends on reassessment of risk and the applicable protocol; a single application does not replace regular home-based preventive care [4,5]. Fluoride mouthrinses are appropriate only for children capable of reliably spitting out the solution. Systemic supplements require an assessment of water fluoride content, total fluoride intake, age, and fluorosis risk; they should not be prescribed automatically.Fissure sealing is recommended for primary and permanent molars at high risk of occlusal caries and may be used for specific non-cavitated occlusal lesions [6,7]. Resin-based sealants are preferred when reliable isolation can be achieved; glass-ionomer materials may be useful when moisture control is difficult but require monitoring. The integrity of the sealant must be checked, and it should be reapplied if lost.

Non-invasive and minimally invasive management of existing lesions

Low-viscosity resin infiltration is indicated for the management of selected non-cavitated enamel lesions or early-stage proximal lesions, rather than as a universal primary prevention measure. Indications are determined following an assessment of the lesion's depth, activity, and potential for control [8].

Silver diamine fluoride (SDF) is primarily used to arrest active caries, particularly when conventional treatment is temporarily unfeasible or a child's cooperation is limited [8,9]. A significant limitation is the permanent black staining of the affected tissue; this must be discussed in advance with parents or legal guardians, and informed consent must be documented. SDF is not a substitute for comprehensive diagnosis, management of the underlying cause of the disease, or restorative treatment when indicated.

Behavioral, digital, and adjunctive approaches

Motivational interviewing can improve certain behavioral indicators; however, its effect on clinical caries increment is inconsistent. It should be viewed as a method to personalize counseling rather than as a standalone anti-caries intervention. Digital reminders and mobile applications may improve adherence to toothbrushing regimens, but behavioral improvements cannot automatically be equated to a proven reduction in disease incidence without evidence of clinical outcomes.

Probiotics can temporarily alter microbiological parameters; however, variations in strains, dosages, delivery vehicles, and follow-up periods limit the ability to draw practical conclusions [10]. Calcium-phosphate products should be identified by their specific active ingredient; while they may serve as an adjunct in certain situations, they should not be promoted as a substitute for fluoride-based prevention. Independent, long-term studies assessing clinical outcomes are needed for most "biomimetic" products.

School-based and primary care programs

Population-based programs are particularly important for children with limited access to dental care. Their components may include supervised brushing with fluoride toothpaste, school-based fissure sealing, education, referral to a dentist, and the involvement of primary health care services [3, 11]. A recent meta-analysis demonstrated a moderate effect of supervised school-based brushing at the tooth-surface level, albeit with heterogeneity in the results; therefore, program sustainability, regularity, and clinical monitoring are crucial [11].

Table 1. Clinical role and level of evidentiary certainty of preventive approaches

Method	Category	Target group	Evidence	Key limitation
Fluoride toothpaste	Primary prevention	All age groups	Robust	Age-based amount; adult supervision
Limiting free sugars	Primary prevention	All children and families	Robust	Frequency of sugar exposure matters
Fluoride varnish	Professional prevention	Elevated risk	Robust	Repeat according to risk reassessment
Pit-and-fissure	Professional	Risk of occlusal	Robust	Retention must be

sealants	prevention	caries		monitored
Resin infiltration	Early-lesion management	Selected non-cavitated lesions	Moderate	Not a universal preventive method
SDF	Caries arrest	Active lesions; limited cooperation	Moderate–robust	Black staining; informed consent
Motivational interviewing	Behavioral adjunct	Families with modifiable habits	Heterogeneous	Does not replace clinical measures
Probiotics/digital applications	Emerging adjunct	Selected situations	Limited	No basis for replacing foundational measures

Practical Age- and Risk-Based Algorithm

Risk assessment should take into account current and recent lesions, white-spot lesions, plaque, sugar exposure, fluoride exposure, deep fissures, salivary flow, orthodontic appliances, special health care needs, the child's cooperation, and social factors [5]. The risk category should be reassessed at every preventive visit.

Table 2. Minimal practical algorithm

Age group	Risk/condition	Priority actions
Preschoolers	Any	Brushing with fluoride toothpaste under adult supervision; sugar control; early dental home
School-age children	Low	Basic home-based prevention; scheduled risk reassessment
School-age children	Moderate/high	Basic measures + fluoride varnish as indicated + pit-and-fissure sealants + shortened recall interval
Adolescents	Low	Independent brushing with quality checks; diet; scheduled follow-up
Adolescents	Moderate/high	Intensified fluoride prevention; sealants; attention to orthodontic appliances, sugary drinks, and tobacco/nicotine products
Any age	Active lesion	Determine activity and depth; select remineralization, sealing, infiltration, SDF, or restoration as indicated

Discussion

The review's main conclusion is that proven methods form a hierarchy rather than a list of equivalent options. Basic fluoride-based hygiene and free sugar control are essential for all children. Fluoride varnish and sealants enhance prevention when risk levels warrant them. Infiltration and SDF address the management of existing lesions. Probiotics, digital technologies, and certain remineralizing products remain adjunctive measures, as robust evidence regarding long-term clinical outcomes is currently lacking. Age influences program implementation. For preschoolers, outcomes depend on parental actions, the use of safe toothpaste quantities, and early dental contact. For school-aged children, the eruption of first and second permanent molars, fissure characteristics, and school-based programs become significant factors. Adolescents present additional considerations, such as behavioral autonomy, orthodontic appliances, frequent consumption of sugary drinks, and reduced parental supervision. Socioeconomic conditions can alter both baseline risk and the feasibility of recommendations; consequently, advice requiring frequent private visits or expensive products may exacerbate inequalities. Integrating prevention into primary healthcare and school-based programs expands coverage but requires the provision of fluoride toothpaste, staff training, established referral pathways, and quality monitoring.

Conclusion

Caries prevention in children and adolescents must be continuous, age-appropriate, and based on ongoing risk assessment. The most robust approach comprises twice-daily brushing with fluoride toothpaste, limiting the frequency of free sugar intake, regular monitoring, the use of fluoride varnish where indicated, and fissure sealing for children at risk. Resin infiltration and SDF are used for specific existing lesions and do not replace primary prevention. Prospective tools and digital technologies should be used only as a complement, without equating their evidence to established methods.

Authors' contributions:

Contribution to the concept and scientific design – Guzeliya Rakhimzhanovna Yuvakayeva, **Nazim Ramizovich Guseinov**

Conducting the presented scientific research, writing and editing the article – Guzeliya Rakhimzhanovna Yuvakayeva; **Nazim Ramizovich Guseinov**

Interpretation of the presented scientific research – Guzeliya Rakhimzhanovna Yuvakayeva

Ethical approval: As a narrative review of previously published literature involving no individual patient data, this work did not require ethical committee approval or informed consent.

Data availability: No new data were generated. All information analyzed in this review was derived from publicly available published sources cited in the reference list.

Funding: The authors declare that they received no funding for this research.

Research transparency: The authors bear full responsibility for the content of this article.

Conflict of interest: The authors declare no conflict of interest.

Using artificial intelligence. A generative tool of artificial intelligence was used for structural and language editing of the manuscript; the author verified the result, bears full responsibility for the

content and must clarify the name of the tool and the wording in accordance with the policy of the journal. Tool used: ChatGPT (GPT-5), developed by OpenAI.

List of literature

1. World Health Organization. Global oral health status report: towards universal health coverage for oral health by 2030. Geneva: WHO; 2022.

2. World Health Organization. Guideline: sugars intake for adults and children. Geneva: WHO; 2015.

3. World Health Organization Regional Office for Europe. Child and adolescent health in the WHO European Region: oral health fact sheet. Copenhagen: WHO Regional Office for Europe; 2025.

4. American Academy of Pediatric Dentistry. Fluoride therapy. The Reference Manual of Pediatric Dentistry. Chicago, IL: AAPD; 2025.

5. American Academy of Pediatric Dentistry. Caries-risk assessment and management for infants, children, and adolescents. The Reference Manual of Pediatric Dentistry. Chicago, IL: AAPD; 2025.

6. Wright JT, Crall JJ, Fontana M, et al. Evidence-based clinical practice guideline for the use of pit-and-fissure sealants. J Am Dent Assoc. 2016;147(8):672–682.e12. doi:10.1016/j.adaj.2016.06.001.

7. Amend S, Boutsiouki C, Winter J, Kloukos D, Frankenberger R, Krämer N. Clinical effectiveness of pit and fissure sealants in primary and permanent teeth of children and adolescents: an umbrella review. Eur Arch Paediatr Dent. 2024;25(3):289–315. doi:10.1007/s40368-024-00876-9.

8. Slayton RL, Urquhart O, Araujo MWB, et al. Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions. J Am Dent Assoc. 2018;149(10):837–849.e19. doi:10.1016/j.adaj.2018.07.002.

9. Gao SS, Zhao IS, Hiraishi N, et al. Clinical trials of silver diamine fluoride in arresting caries among children: a systematic review. JDR Clin Trans Res. 2016;1(3):201–210. doi:10.1177/2380084416661474.

10. Inchingolo AD, Inchingolo AM, Palumbo I, et al. The role of probiotics in preventing dental caries: a systematic review of clinical evidence. Front Oral Health. 2025;6:1720036. doi:10.3389/froh.2025.1720036.

11. Tavakoli S, Saadatfar N, Tiyuri A. The effectiveness of school-based supervised tooth brushing intervention for preventing dental caries: a systematic review and meta-analysis. BMC Oral Health. 2025;25(1):1967. doi:10.1186/s12903-025-07299-y.

12. Luo BW, Liang NL, Townsend JA, Lo ECM, Chu CH, Duangthip D. Sugar substitutes on caries prevention in permanent teeth among children and adolescents: a systematic review and meta-analysis. J Dent. 2024;146:105069. doi:10.1016/j.jdent.2024.105069.

13. Sabbagh S, Mohammadi-Nasrabadi F, Ravaghi V, et al. Food insecurity and dental caries prevalence in children and adolescents: a systematic review and meta-analysis. Int J Paediatr Dent. 2023;33(4):346–363. doi:10.1111/ipd.13041.

14. Schulze ZJ, Schubert F, Gernhardt CR, et al. Area-level factors of dental caries in children and adolescents in European neighborhoods: a systematic review. J Urban Health. 2025;102(1):125–138. doi:10.1007/s11524-024-00916-1.

15. American Academy of Pediatric Dentistry. Policy on oral health care programs for infants, children, adolescents, and individuals with special health care needs. The Reference Manual of Pediatric Dentistry. Chicago, IL: AAPD; 2025:90–92.