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Pediatric dentistry and the controversy over fluoride use: integrative review

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ABSTRACT

Introduction: Dental caries remains one of the most prevalent chronic diseases in childhood, representing a significant public health concern. Fluoride is widely recognized as the gold standard for its prevention, due to its effectiveness in promoting enamel remineralization and reducing cariogenic activity. However, excessive fluoride exposure has been associated with dental fluorosis and potential systemic effects, although the evidence remains limited. At the same time, alternative agents such as nano-hydroxyapatite have emerged as promising remineralizing agents, although further high-quality clinical studies are required to establish their long-term effectiveness.
Objectives: This study aims to examine the ongoing debate surrounding the use of fluoride in pediatric dental practice, considering both its preventive benefits on oral health and potential systemic adverse effects.
Methodology: An integrative review was conducted using two complementary search strategies to evaluate both the preventive efficacy and potential adverse effects of fluoride use in pediatric dentistry. Literature searches were performed in PubMed, B-on, ScienceDirect, Cochrane Library, RCAAP, and SciELO databases, covering publications from 1984 to 2025. The search strategy included combinations of the keywords “fluoride”, “pediatric dentistry”, “dental caries”, “fluorosis”, “fluoride toxicity”, and “nano-hydroxyapatite” using Boolean operators (AND/OR). The extended timeframe was selected to capture both the historical development of fluoride-based preventive approaches and contemporary evidence regarding fluoride safety and emerging alternatives. Studies published in English, Portuguese, or Spanish that addressed fluoride efficacy, adverse effects, fluorosis, systemic toxicity, or alternative remineralizing agents in pediatric populations were included. Duplicate records, studies unrelated to pediatric dentistry, articles lacking relevance to the review objectives, and publications with insufficient methodological information were excluded. Following duplicate removal, title and abstract screening, and full-text eligibility assessment, 41 studies were included in the final synthesis, comprising 21 studies focused on fluoride-related adverse effects and 20 studies evaluating preventive efficacy. Data extraction and synthesis were performed considering study design,

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investigated outcomes, principal findings, and relevance to the objectives of the review. The review specifically distinguished between optimal therapeutic fluoride exposure, chronic excessive exposure, endemic fluorosis contexts, and acute fluoride toxicity, while also examining the potential role of emerging alternatives such as nano-hydroxyapatite compounds.

Results: While fluoride remains a cornerstone in the prevention of dental cavities, there is growing body of evidence indicating potential risks associated with excessive fluoride exposure, particularly in children. Reported adverse effects include dental fluorosis and potential cognitive, thyroid, and systemic alterations associated with excessive fluoride exposure, although much of the available evidence derives from experimental and observational studies. Nonetheless, emerging alternatives such as nanostructured hydroxyapatite and the combination of fluoride with bioactive compounds hold promise as potentially safer alternatives.

Conclusion: The decision to use fluoride in pediatric dental care should be personalized based on a thorough evaluation of risks versus benefits, considering factors such as age, method of administration, frequency of use, and cumulative exposure. It is essential that parents are properly educated, dental professionals provide appropriate supervision, and children use age-appropriate fluoride toothpastes in accordance with current clinical recommendations. This critical review offers a comprehensive perspective on the topic and underscores the necessity for updated clinical guidelines grounded in robust scientific research.