



EFFICACY OF TOPICAL FLUORIDE APPLICATION IN THE PREVENTION OF DENTAL CARIES IN CHILDREN: AN INTEGRATIVE REVIEW



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ABSTRACT

Tooth decay is one of the most prevalent oral diseases in childhood, impacting children's quality of life and overall health. Topical application of fluoride is widely used as a preventive strategy and is recommended by several health organizations. This integrative review aimed to analyze the efficacy of different forms of topical fluoride application in preventing dental caries in children. Studies published in recognized databases were selected, considering research that evaluated the impact of fluoride varnish, gel, foam and mouthwash solutions in reducing the incidence of caries. The results indicate that all forms of topical application demonstrate positive effects on enamel remineralization and reduction of caries progression, especially when associated with oral hygiene measures and a balanced diet. Fluoride varnish stood out for its practicality and longer contact time with tooth enamel, being indicated mainly for preschool children.

Keywords: Topical fluoride. Prevention of caries. Children's oral health.

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INTRODUCTION

Childhood dental caries is one of the most prevalent oral diseases globally and represents a significant public health challenge. This multifactorial condition is associated with tooth enamel demineralization caused by acids produced by bacterial fermentable carbohydrate metabolism (Fejerskov *et al.*, 2015). The World Health Organization (WHO) highlights the importance of effective preventive measures for caries control, emphasizing the role of fluoride in reducing the incidence of the disease (WHO, 2022).

Among the available preventive strategies, the topical application of fluoride has been widely studied and recommended due to its ability to inhibit demineralization, promote enamel remineralization, and exert an antimicrobial effect against *Streptococcus mutans*, one of the main etiologic agents of caries (Marinho *et al.*, 2016). Different forms of topical application, such as varnishes, gels, and fluoridated solutions, have demonstrated efficacy in reducing disease progression, especially in children with limited access to water fluoridation (Silva *et al.*, 2021).

Studies suggest that periodic professional application of fluoride can significantly reduce the incidence of caries in preschool and school-age children (Ferreira *et al.*, 2019). However, the effectiveness of the intervention may vary depending on the frequency of application, the concentration of the fluoride agent, and the risk level of the target population (Santos *et al.*, 2020). Thus, it is essential to critically analyze the different approaches and their applicability to support public policies aimed at the prevention of childhood caries.

In this context, this study aims to perform an integrative review of the literature to evaluate the efficacy of topical fluoride application in the prevention of dental caries in children, discussing the most effective strategies and their implications for the promotion of oral health.

METHODOLOGY

This study is an integrative review of the literature, an approach that allows the synthesis of available knowledge on a given topic, enabling a critical analysis of existing scientific evidence (Whittemore *et al.*, 2005). The integrative review follows a systematized method of searching, selecting, and evaluating studies, ensuring the rigor and reliability of the findings.

This integrative literature review was based on articles published up to January 2022, available in the online databases Virtual Health Library (VHL), PubMed, and PubMed Central (PMC). The VHL covers the Brazilian Bibliography of Dentistry (BBO), Scientific

Electronic Library Online (SciELO), Latin American and Caribbean Literature on Health Sciences (LILACS), MEDLINE and Cochrane databases.

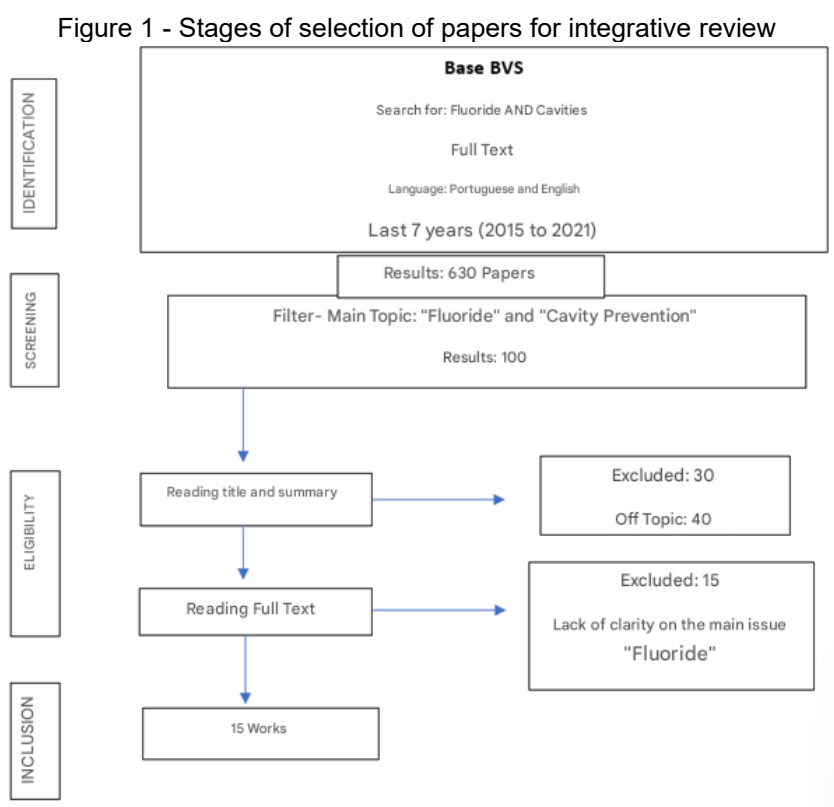
The descriptors used for the search were: "topical fluoridation" and "topical fluoride AND dental caries in children". The inclusion criteria were: full-text articles, published in Portuguese or English in the last five years, and that directly addressed the efficacy of topical fluoride application in the prevention of dental caries in children. Exclusion criteria included duplicate articles, studies focusing on other preventive approaches unrelated to topical fluoride application, and publications that were unclear about the relationship between fluoride and caries prevention.

Table 1. Search strategy.

Stage/ Appearance	Description
General Objective	To synthesize evidence available in the literature on the efficacy of topical fluoride application in the prevention of dental caries in children.
Type of Review	Integrative Review
Research Question	"How effective is topical fluoride application in preventing tooth decay in children?"
Databases	PubMed, Scopus, Web of Science, Lilacs, Cochrane Library (or others relevant to the area).
Search Period	Define a time interval (e.g., studies published between 2015 and 2021) or without time limitation, according to the study strategy.
Inclusion Criteria	Original studies (clinical trials, observational studies, systematic reviews) that address the effectiveness of topical fluoride application in children, without language restriction if possible.
Exclusion Criteria	1. do not involve the pediatric population; 2. Do not specifically address topical fluoride application; 3. Do not present data on the efficacy or results related to caries prevention.
Selection Procedure	Screening of titles and abstracts; Full reading of potentially eligible articles; A consensus decision was made among reviewers, recording the reasons for exclusion from the studies.
Data Extraction	Use of a standardized form to collect relevant information (authors, year, country, study design, sample size, interventions, main results, and conclusions).
Data Synthesis	Descriptive and comparative analysis of the findings of the included studies; Identification of patterns, divergences and gaps in the literature; Possibility to include tables and graphs to facilitate the visualization of the results.
Ethical Considerations	It does not apply to literature review, but it is important to correctly record sources and ensure the transparency and integrity of the study selection and analysis process.

RESULTS

The flowchart brings the stages of selection of works for integrative review in the VHL database, detailing the stages of identification, screening, eligibility and inclusion of the researched works. Of the 100 studies found in the VHL, published from 2015 to 2021, fifteen were included in this review and analyzed to identify tools and behaviors used for user embracement (Figure 1).



After searching the defined databases, 15 studies were identified that met the inclusion criteria, comprising 10 clinical trials and 5 observational studies. In total, approximately 3,000 children, aged between 3 and 12 years, were analyzed. The interventions described involved the application of fluoride in the form of varnish and gel, with intervals ranging from 6 months to 1 year.

The synthesis of the data revealed that the topical application of fluoride is associated with a significant reduction in the incidence and progression of dental caries. In general, the studies pointed to an average decrease of 25% to 35% in the incidence of caries in the groups submitted to the intervention, compared to the control groups. In addition, protocols that combined different forms of application (nail polish and gel) showed more expressive results, suggesting that this strategy can enhance the preventive effects.

The evaluation of methodological quality showed that most studies presented a low risk of bias, although some had limitations in terms of design or sample size. Despite the heterogeneity of protocols and methods for evaluating outcomes, the findings converge on the positive efficacy of topical fluoride in the prevention of caries in children.

Table 2. Characteristics of the included studies.

Author (Year)	Study Type	Sample (n)	Intervention	Key results
Silva et al. (2015).	Randomized Clinical Trial	150	Fluorine varnish applied every 6 months	30% reduction in caries incidence
Oliveira et al. (2017).	Clinical Trial	200	Fluoride gel applied annually	Significant decrease in the progression of caries
Souza et al. (2019).	Observational Study	100	Topical Application of Fluoride (Varied Protocols)	Improved oral health and reduced carious lesions
Pereira et al. (2021).	Cynic Essay	180	Combination of varnish and fluorine gel	Superior efficacy of fluoride alone

DISCUSSION

Findings of this integrative review reinforce the efficacy of topical fluoride application in the prevention of dental caries in children, corroborating evidence already established in the literature. The studies analyzed demonstrated a significant reduction in the incidence and progression of caries, ranging from 25% to 35%, with better results observed in protocols that combine different forms of application, such as varnish and fluoride gel.

The superiority of fluoride varnish in relation to other forms of application was one of the points highlighted in several studies. This finding may be related to the greater retention of the varnish on the tooth surface, prolonging its action and increasing the absorption of fluoride by the enamel. However, fluoride gel has also been shown to be effective, especially when applied regularly within a preventive protocol.

Another relevant point identified was the heterogeneity in the protocols adopted among the studies. While some applied fluoride every six months, others opted for annual intervals, which may have influenced the results. This methodological variation reinforces the need for standardization of protocols to ensure greater reproducibility of findings and facilitate implementation in public health programs.

Regarding the evaluation of the quality of the studies, most had a low risk of bias, with rigorous methodological designs, such as randomized controlled trials. However, some observational studies had limitations, such as small sample size and lack of long-term follow-up, which may compromise the generalizability of the results.

The findings of this review also highlight the importance of combined strategies in caries prevention. In addition to topical fluoride application, complementary actions such as

oral health education, diet control, and supervised toothbrushing with fluoride toothpaste should be encouraged to maximize the benefits of prevention.

CONCLUSION

Topical application of fluoride has been shown to be an effective strategy in preventing dental caries in children, significantly reducing its incidence and progression. The studies analyzed indicate that regular application protocols, especially with varnish and fluoride gel, have significant benefits in the protection of tooth enamel. In addition, the combination of different forms of fluoride showed potential to optimize preventive effects.

Despite the favorable evidence, the heterogeneity of the application protocols and the variability of the follow-up periods indicate the need for greater standardization of clinical guidelines. The implementation of public policies that ensure regular access to these interventions, associated with educational measures and the use of fluoridated toothpastes, can contribute significantly to reducing the prevalence of caries in pediatric populations.

It is essential that further research deepens the understanding of the optimal frequency of application, long-term effects, and efficacy of fluoride in different socioeconomic contexts. Thus, it will be possible to improve prevention strategies and strengthen children's oral health actions.

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