Revisión Narrativa
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Marked expressions: The problem of dental fluorosis in children and adolescents. A systematic review

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Abstract: **Introduction:** Dental fluorosis is a condition that has captured the attention of public health professionals, especially with regard to children and adolescents. **Objective:** To evaluate the existing information on the incidence and prevalence of dental fluorosis in children and adolescents. **Methodology:** For this, a systematic review of scientific literature was carried out, using recognized electronic databases such as Scopus, WOS, EBSCO, Scielo, Latindex, Redalyc, Pubmed, Springer and Institutional Repositories, covering publications from 2018 to 2024. **Results:** The review of 34 studies that satisfied the selection criteria, highlights the following findings: Dental fluorosis is a prevalent condition in children and adolescents, mostly in its very mild form. Key risk factors include exposure to high concentrations of fluoride in drinking water (especially if they exceed 1.5 mg/L). Excess fluoride is a public health problem. **Conclusions:** Fluoride is essential for the prevention of caries, its excess is the main cause of dental fluorosis, which highlights the need for stricter monitoring and regulation of concentrations in water and oral hygiene products, as well as continuous education for the population.

Key words: Fluoridated water, fluoridated salt, fluorides, dental fluorosis.

Expresiones marcadas: El problema de la fluorosis dental en niños y adolescentes. Una revisión sistemática

Resumen: **Introducción:** La fluorosis dental es una condición que ha capturado la atención de los profesionales de la salud pública, especialmente en lo que respecta a los niños y adolescentes. **Objetivo:** Evaluar la información existente sobre la incidencia y prevalencia de la fluorosis dental en niños y adolescente. **Metodología:** Para ello, se llevó a cabo una revisión sistemática de literatura científica, utilizando bases de datos electrónicas reconocidas como Scopus, WOS, EBSCO, Scielo, Latindex, Redalyc, Pubmed, Springer y Repositorios Institucionales, abarcando publicaciones desde 2018 hasta 2024. **Resultados:** La revisión de 34 estudios que satisficieron los criterios de selección, se destacan los hallazgos siguientes: La fluorosis dental es una condición prevalente en niños y adolescentes, mayormente en su forma muy leve. Los factores de riesgo clave incluyen la exposición a altas concentraciones de flúor en el agua potable (especialmente si superan 1.5 mg/L). El exceso de flúor es un problema de salud pública. **Conclusiones:** El flúor es esencial para la prevención de caries, su exceso es la causa principal de la fluorosis dental, lo que subraya la necesidad de una vigilancia y regulación más estrictas de las concentraciones en el agua y productos de higiene oral, así como una educación continua para la población.

Palabras clave: Agua fluorada, fluoruros, fluorosis dental.

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Expressões marcadas: o problema da fluorose dentária em crianças e adolescentes. Uma revisão sistemática

Resumo: Introdução: a fluorose dentária é uma condição que tem captado a atenção dos profissionais de saúde pública, principalmente no que diz respeito às crianças e adolescentes. Objetivo: avaliar as informações existentes sobre a incidência e prevalência de fluorose dentária em crianças e adolescentes. Metodologia: para isso, foi realizada uma revisão sistemática da literatura científica, utilizando bases de dados eletrônicas reconhecidas como Scopus, WOS, EBSCO, Scielo, Latindex, Redalyc, Pubmed, Springer e repositórios institucionais, abrangendo publicações de 2018 a 2024. Resultados: a revisão de 34 estudos que atenderam aos critérios de seleção, destaca os seguintes achados: a fluorose dentária é uma condição prevalente em crianças e adolescentes, principalmente em sua forma muito leve. Os principais fatores de risco incluem a exposição a altas concentrações de flúor na água potável (especialmente se excederem 1,5 mg/L). O excesso de flúor é um problema de saúde pública. Conclusões: o flúor é essencial para a prevenção da cárie, seu excesso é a principal causa da fluorose dentária, o que evidencia a necessidade de um monitoramento e regulação mais rigorosos das concentrações na água e nos produtos de higiene bucal, além de educação continuada para a população.

Palavras-chave: Água fluoretada , fluoretos, fluorose dentária.

Introduction

Dental fluorosis is an alteration in the formation of tooth enamel attributable to excessive fluoride intake[1]. This condition is frequently endemic in areas where fluoride concentrations in water exceed 1.5 milligrams per liter[2]. Overexposure to fluoride during critical stages of dental development can result in staining and erosion of teeth, indicating the importance of monitoring and adjusting the presence of this element in the drinking water supply to prevent adverse effects on the dental health of the population[3] .

Dental fluorosis in children is a condition that has attracted considerable attention due to its prevalence and the aesthetic and health implications it entails[4] . It is characterized by alterations in tooth enamel as a result of excessive fluoride intake during the dental development stage, which occurs mainly in the first eight years of life. Fluorosis can vary from very mild forms, which present barely perceptible white spots, to severe forms with darker spots and a rough enamel texture[5] . Fluoride, being an essential mineral for the prevention of caries, is found in various sources such as fluoridated drinking water, processed foods, toothpastes and mouthwashes. However, excessive exposure to this mineral, especially during the tooth formation stage, is the main risk factor for the development of dental fluorosis[6] .

Preventing dental fluorosis in children involves proper supervision of the use of fluoride products. For children under 3 years of age, it is suggested to use a toothpaste containing 1,000 ppm of fluoride, applying an amount equivalent to the size of a grain of rice. For children 3 to 6 years of age, the recommended amount of fluoride in toothpaste is between 1,000 ppm and 1,450 ppm, using an amount similar to the size of a pea[7] . It is crucial to encourage the habit of spitting out the toothpaste rather than swallowing it, as well as limiting the consumption of sweets and starches, which, although less obvious, also contribute to tooth decay. Regular dental visits, starting in a child's first year of life, are essential for a proper diagnosis and early detection of dental fluorosis[8] .

Fluorosis is diagnosed by clinical observation of the affected teeth. Although dental function is not affected in most cases, the aesthetic implications can be significant, especially in moderate to severe cases[9] . Treatment for fluorosis varies depending on the severity and may include everything from microabrasion techniques to veneers or crowns in more severe cases. It is also important to consider that fluorosis is an irreversible condition once it has developed, so education and prevention are key aspects in its management[10] .

Regarding current research, alternatives are being explored to reduce the prevalence of fluorosis without compromising the benefits of fluoride in caries prevention[11]. This includes studies on the optimization of fluoride concentrations in drinking water and dental products, as well as ongoing education of parents and caregivers on the appropriate use of fluoride in children's oral hygiene. Dental fluorosis in children is not only a public health issue but also a social equity issue, since populations with less access to education and health resources tend to be more vulnerable to this condition[4].

Based on the aforementioned aspects, it can be noted that dental fluorosis in children is a multifaceted problem that requires a comprehensive approach to its prevention and management. Collaboration between dentists, pediatricians, public health authorities, and educators is essential to effectively address this condition and reduce its impact on the quality of life of affected children. Education on the proper use of fluoride and supervision of oral hygiene in the first years of life are the cornerstones for preventing the onset of dental fluorosis and ensuring a healthy smile for all children[5] .

In this research, a systematic review was carried out under the PRISMA methodology in order to evaluate the existing information on the incidence and prevalence of dental fluorosis in children and adolescents. Likewise, it is hoped to improve the understanding and approach of this problem taking as a starting point the marked expressions and the problem of dental fluorosis in children and adolescents. For this purpose, undergraduate and postgraduate theses available in institutional repositories and current scientific articles, both qualitative and quantitative, indexed in reliable databases, will be used as information sources.

Material and method

To collect the information, a systematic review was formalized using the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) methodology[12], the preferred information tool for systematic observations and meta-analyses with the purpose of optimizing the inquiry and structuring of scientific articles in accordance with the selection guidelines used.

For the search of the articles and theses, inclusion criteria such as the year of publication (between 2018 and 2024) were used. Specific strategies were applied in each database. In Scopus, WOS and Springer, combinations of English keywords such as “dental fluorosis” and

"fluoride concentration in water for human consumption" were used, filtering by years (2018-2024) and type of document (scientific articles and reviews). In EBSCO, descriptors in Spanish such as "dental fluorosis" and "treatment of dental fluorosis" were used, applying filters by full text and academic publications. In SciELO, Latindex and Redalyc, the advanced search by title, abstract or keywords was used, incorporating terms such as "dental fluorosis in the child population". In PubMed and the National Library of Medicine, MeSH terms such as "Dental Fluorosis" and "Fluoride, Water Supply" were applied, limiting the search to human studies and recent dates. Finally, in institutional repositories, the keywords in titles and abstracts were explored, prioritizing theses that included variables related to public health, dentistry and treatment of fluorosis. These strategies ensured a systematic and relevant review of the literature.

For the selection of documents, a screening was carried out using the GRADE System: classification of the quality of evidence and graduation of the strength of the recommendation, which institutes 4 classes: high, moderate, low and very low, suppressing for this research those of low and very low category [13]. Likewise, a filtering procedure was carried out on the documents, in order to locate and dispense with duplicates. To structure the review, the following question was posed: ¿What is the current incidence of dental fluorosis in children and adolescents, do the different concentrations of fluoride in water for human consumption influence its prevalence and what are the treatment strategies evaluated in original and review studies? The objective is to evaluate the existing information on the incidence and prevalence of dental fluorosis in the child and adolescent population, as well as the treatments addressed in the academic literature, considering the influence of fluoride concentrations in drinking water.

To structure the review, the following structure was posed for the PICO question:

- P (Patient/Population): Children and adolescents.
- I (Intervention): Evaluation of dental fluorosis and its treatment (Original and review studies).
- C (Comparison): Different concentrations of fluoride in water for human consumption.
- O (Outcome): Prevalence and treatment of dental fluorosis.

A selection of 150 documents was immediately made, excluding 50 that were insufficiently related to the topic under study. 90 were considered viable candidates, and 20 were excluded because they addressed other topics or were not well-methodically selected. Therefore, 34 documents were included (high evidence: 26 and moderate evidence: 8) of the 70 suitable for analysis and execution of the thesis. This information is presented in Table 1.

Criteria of inclusion and exclusion

Inclusion criteria

- Scientific articles published in indexed journals and theses from institutional repositories in English or Spanish, from 2018 to 2024, that address the topic.

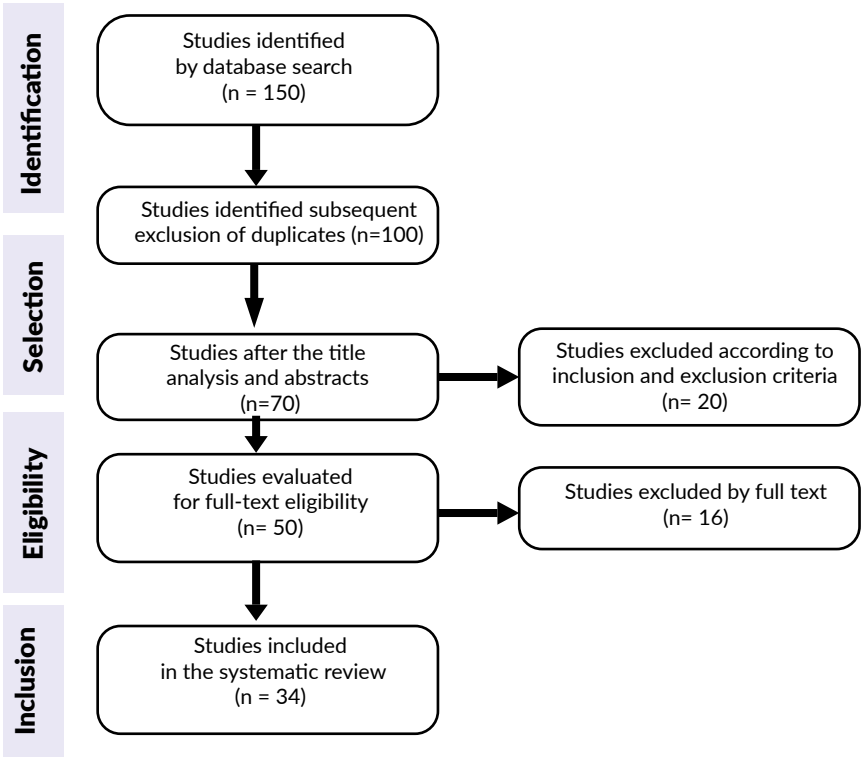

Figure 1. *Process for searching and selecting scientific documents*

- Studies that address the topic of dental health, fluorosis and water.
- Studies in English and Spanish

Criteria of exclusion

- Dental health studies that do not address fluorosis.

After applying the methodological elements, 150 publications were identified that address the research topic. Figure 1 shows the process followed. out for the search and selection of scientific documents, applying the inclusion and exclusion criteria described above.

To represent the framework of scientific advances related to the topic, content analysis was used. Thus, it is evident that the evaluation of this theoretical material was carried out through a detailed review of the sources consulted during the course of the research, according to Garcés-Cano and Duque-Oliva[14] . The process began with the compilation of articles from scientific journals, which formed the final sample for the study.

Results

A word database was created with the indexing, titles, year, author(s), country, and conclusions of each selected document. This information is presented below in Table 1:

Of the 34 articles that met the inclusion criteria, a significant 62% corresponded to research conducted between 201 8and 2024. The accumulated evidence in these studies strongly suggests incorporating fluoride use in children, highlighting the wide range of benefits it offers for dental health. Therefore, 34 documents were included (high evidence: 26 and moderate evidence: 8). This information is presented in Table 2.

Text analysis derived from the review of studies related to dental fluorosis

Table 1. *Selected documents*

Não.	Indexing/ Repository	Title-Author-Year-Country	Results	Conclusions
1	Scielo	The use of fluorides in children under 5 years of age. Evidence. Literature review. Acosta de Camargo *et al.* (2020)[11]. Venezuela	EThe use of fluorides should be incorporated in children due to the numerous benefits it offers.	Using toothpastes high in fluoride can be implemented as a preventative measure to reduce the prevalence of this disease in children under 5 years of age.
2	Scielo	Prevalence of fluorosis in children aged 4 to 15 years, according to Dean's index and its association with the level of fluoride present in drinking water (2021). Masabanda-Olivares *et al.* (2021)[18] . Ecuador	The data, tabulated and processed using SPSS, Chi square and Spearman correlation, show that there is no statistically significant relationship between the variables analyzed.	The study reveals that the incidence of dental fluorosis, which ranges from mild to moderate, is not correlated with the concentration of fluoride in the drinking water consumed by the population examined.
3	Latindex	Suitability of fluorides in drinking water: Contrasting perspectives. Perozo-Vázquez (2018)[27]. Venezuela	Scientific evidence indicates that excessive consumption of fluoridated water can have negative health effects, and even be fatal, both in the short and long term.	It is imperative to reevaluate public health regulations regarding fluoridation of water and salt for human consumption. This review is necessary given the lack of publicity regarding its potential adverse health effects. According to the Pan American Health Organization, it is recommended that countries opt for a single source of fluoride, either salt or water, but not both simultaneously.
4	Latindex	Fluoride: permissible limits in drinking water and recommended adequate intake. (2021)[28]. Venezuela	Although fluoride is not considered an essential nutrient, an adequate intake (AI) has been established for different age groups due to its unique dietary benefit: the prevention and reduction of caries severity. A recommended AI for fluoride from all sources for both children and adults is 0.05 mg/kg of body weight per day.	The use of fluoridated salt, fluoride rinses, gels, and varnishes, as well as fluoride tablets, is recommended only in areas without intentional fluoridation of drinking water. In contrast,
5	Scielo	Dental fluorosis in early childhood: state of the art Puello (2023)[5]. Barranquilla Colombia	The prevalence of dental fluorosis reported in the studies ranged from 6.2% to 96.6%, depending mainly on the fluoride concentration in the drinking water.	The diagnosis of dental fluorosis in primary teeth involves a thorough clinical examination, considering the location, size, color, and appearance of the lesions. Treatment will vary depending on the clinical signs, the severity of the lesions, and the patient's particular circumstances.
6	Scielo	Factors associated with dental fluorosis in children aged 10 to 12 years in the Pimampiro canton, Imbabura province, Ecuador 2016-2017. Rivera Martínez (2019)[29] . Ecuador	The prevalence of dental fluorosis was 81.4%, with grade 2 being the most common at 32.6%. When analyzing the variables established in the survey and the presence of fluorosis, a significant relationship was found between the condition and the consumption of packaged beverages, the amount of toothpaste used, and accidental ingestion (p = 0.000).	It can be stated that the most common levels of dental fluorosis ranged from 1 to 3, according to the Thylstrup and Fejerskov index, with these cases representing 75% of the total observed. Furthermore, analysis of the responses suggests a significant correlation between the incidence of fluorosis and the accidental ingestion of fluoride toothpastes.

Tabela 1. *Documentos seleccionados. (cont.)*

Não.	Indexing/ Repository	Title-Author-Year-Country	Results	Conclusions
7	Scielo	Dental fluorosis in a sample of adolescents from the state of Coahuila, Mexico. (Cristian Mayela Estrada-Valenzuela (2019)[30]. Mexico	The estimated prevalence of fluorosis was 53%. The most common severity level was very mild. The community fluorosis index was 0.602, indicating proximity to a public health problem.	A 53% prevalence of fluorosis was observed. The data showed a slightly higher incidence in 12-year-olds compared to 15-year-olds. The predominant severity was classified as very mild, and severe cases were notoriously rare. The community fluorosis index reached a value of 0.602, suggesting a potential risk of becoming a public health problem.
8	National Library of Medicine	Fluorides in drinking water in northern and western Mexico. Vázquez-Bojórquez et al. (2022)[31]. Mexico	The observed regions presented maximum ranges and sample means higher than those recommended by the World Health Organization and national regulatory agencies.	The reports analyzed in this systematic review indicate that concentrations frequently exceed the threshold of 1.5 mg/L. This is alarming as it exceeds the limits recommended by health authorities, suggesting a potential risk to the affected population and underscoring the need for stricter water quality monitoring and regulation.
9	Scielo	Fluoride concentration in groundwater and its relationship with serum calcium levels in children living in the district of Loreto, Concepción, Paraguay. Diez-Pérez (2019)[32]. Paraguay	Two wells were identified with fluoride concentrations above the maximum allowable limit, and 61% of the children had serum calcium levels below the reference value. A weak correlation was found between the variables (r = 0.212).	The research provides crucial information about areas with high fluoride levels, which pose a health threat. Despite consuming sufficient amounts of calcium, children were observed to develop hypocalcemia.
10	Latindex	Analysis of fluoride concentration in public water supplies in the canton of Cuenca as a possible contributing factor to the development of dental fluorosis. León-Vélez (2019)[33] . Ecuador	Fluoride content in drinking water between 0.01ppm and 0.11ppm.	The amounts of fluoride found are not significant; they are within the established parameters, without being a factor directly associated with dental fluorosis.
11	Latindex	Impact of dental fluorosis on the quality of life of adolescents Ecuadorians between 11 and 14 years old. Constante-Cruz (2020)[34] . Ecuador	The prevalence of dental fluorosis was 70.3% in TF grades 1, 2, and 3. Chemical analysis of the water revealed a mean fluoride concentration of 1.06 mg/L. Statistical tests showed a significant relationship between CV and dental fluorosis (p = 0.000), as well as with socioeconomic status (p = 0.001).	This demonstrates a direct correlation, with the highest levels of CV observed in higher socioeconomic strata. Conversely, the lowest levels of CV are found in the middle and lower socioeconomic strata. Additionally, there is an inverse relationship between CV and disease frequency (DF); the greater the presence of DF, the lower the CV.
12	Latindex	Dental fluorosis and its causes. Mena-Silva (2022)[35] . Colombia	The severity of fluorosis depends on the concentration of fluoride ingested, and the countries most affected by this disease are Ecuador, Colombia, and Chile.	There are multiple risk factors that predispose to dental fluorosis. These include sociodemographic characteristics, consumption of water with high levels of fluoride, certain foods that increase fluoride levels in the body, and the use of age-appropriate toothpaste during daily brushing.
13	Scopus	Fluoride and heavy metal concentrations in bottled water; Weighed in: Measures, Barriers to dental caries, and fluorosis. Gallego Reyes (2019)[36]. Spain	The minimum fluoride content detected was 0.05 ppm, while the maximum reached 0.95 ppm. Eighty percent of the brands tested had fluoride levels below 0.6 ppm. Only one brand exceeded 0.8 ppm. The heavy metals chromium and arsenic were present in all brands tested, although they did not exceed the permissible limits.	The chemical composition of bottled water in Spain shows remarkable diversity. It has been observed that the fluoride concentration in most of these waters is lower than that suggested for the prevention of dental caries, which would imply the need for additional fluoride supplementation. Although traces of heavy metals have been detected in the samples analyzed, the concentrations do not exceed the maximum limits permitted by current regulations.

Tabela 1. *Documentos seleccionados. (cont.)*

N°	Indexing/ Repository	Title-Author-Year-Country	Results	Conclusions
14	ReUnc.edu.py	Presence of dental fluorosis in public schoolchildren in the City of Loreto, Concepción Py period 2021. Acevedo-Giménez (2022)[15]. Ecuador	The prevalence of dental fluorosis was recorded at 44.8% (n=113), being more common in males, with 27.39% (n=69), and in adolescents aged 13 years, with 15.1%. Regarding fluorosis levels, the "very mild" type was the most common, reaching 34.9%. A significant correlation was also observed between the presence and degree of fluorosis and the number of fluoride applications (p<0.05). Additionally, the Dean community fluorosis index was reported to be 0.43.	Fluorosis was observed most frequently in the very mild range, followed by borderline, mild, and moderate levels. When classified by dental quadrant, all quadrants showed fluorosis almost uniformly at the very mild, mild, and borderline levels. The most affected age group was the 13- to 16-year-old group, followed by the 10- to 12-year-old group.
15	Latindex	Prevalence of dental fluorosis in children aged 6 to 12 years in the city of Cuenca. Literature review. Yansaguano-Toral & Andrade Molina (2023) [37] . Ecuador	The results indicate that the percentages of FD in the studies investigated is 12.67% prevalence.	It is determined that the scientific literature on dental fluorosis in children aged 6 to 12 years is limited.
16	Scielo	Fluoride concentration in domestic salt sold in Montevideo, Uruguay. Dall'Onder. (2021) [38] . Uruguay	Most packages showed levels below 250 mgF/kg. Coarse salt samples showed higher concentrations compared to fine salt samples (p < 0.05). Furthermore, those containing sodium fluoride showed higher fluoride concentrations compared to those containing potassium fluoride (p < 0.05).	Significant variability in fluoride concentrations has been detected among different brands of fluoridated table salt sold in Montevideo, Uruguay.
17	Scopus	Fluoride concentration in drinking water and dental fluorosis in children. Mercado-Mamani (2022) [39] . Peru	Excessive fluoride accumulation on teeth can lead to dental fluorosis, a condition that can cause psychological problems in children, primarily related to aesthetics.	The growing number of oral conditions has sparked research interest to identify their causes and possible treatments. Systematic review seeks to contribute to the understanding of the epidemiology of fluorosis and evaluate the effectiveness of current preventive and therapeutic strategies.
18	Redalyc	First studies on dental fluorosis in archaeological populations of the province of Córdoba (Argentina) (2022) [40] . Argentina	The findings indicate that 21 individuals (55.3%) exhibit signs of dental fluorosis, of which 13 are men (34.2%) and 8 are women (21.0%).	It can be stated that dental fluorosis is an endemic disease that affects a considerable proportion of the current population of Córdoba, as well as inhabitants of the region.
19	Repository. Ucc.Edu.Co	Adverse effects of excessive fluoride consumption on human health. Lara-García & Carrillo-Gaona (2021)[41] . Colombia	The reviewed studies indicate an association between high fluoride exposure and various pathologies, including osteoskeletal, cardiometabolic, ocular, hematological, endocrine, renal, and neurological diseases. Furthermore, an inverse correlation has been observed between high fluoride levels and IQ.	Long-term exposure to high concentrations of fluoride has been associated with negative health impacts, especially in children and adolescents. These effects can range from dental problems to more serious complications in bone development and cognitive function. Therefore, it is crucial to monitor and regulate fluoride intake to protect health, particularly in the early stages of life.
20	Scielo	The concentration of fluoride in the water consumed in the Region of Murcia is not sufficient to prevent dental caries Pérez-Silva *et al* (2021)[42] . Spain	In the water supply, fluoride concentrations were detected between 0.09 and 0.18 mgF/L (ppm); in bottled water, the fluoride concentration ranged from 0.04 to 0.50 ppm.	Drinking water, both supplied and bottled, in the Region of Murcia contains insufficient fluoride levels to prevent cavities.

Tabela 1. *Documentos seleccionados. (cont.)*

N°	Indexing/ Repository	Title-Author-Year-Country	Results	Conclusions
21	Scielo	Dental fluorosis in adolescents attending educational institutions in Lima, Peru. Chumpitaz-Cerrate (2023)[4] . Peru	The prevalence of dental fluorosis was recorded at 44.8% (n=113), being more common in males, at 27.39% (n=69), and in adolescents aged 13 years and over, at 15.1%. Regarding the degrees of fluorosis, the "very mild" type was the most frequent, reaching 34.9%. Furthermore, a significant correlation was observed between the presence and degree of fluorosis and the number of fluoride applications ($p<0.05$). Additionally, the Dean community fluorosis index was reported to be 0.43.	A fluorosis frequency of 44.8% was observed, with the predominant level being very mild. The community index was 0.43, indicating a borderline level of public health importance.
22	Scielo	Minimally invasive clinical approach to dental fluorosis in stages TF1 to TF5. Systematic review. Covaleda Rodríguez (2021)[21]. Spain	The most effective therapeutic approach for lesions classified as stages TF1 and TF2 consisted of dental bleaching using 15% carbamide peroxide or 35% hydrogen peroxide, administered in three 15-minute sessions, supplemented with 10% carbamide peroxide. For lesions in stages TF3 and TF4, microabrasion using 6% hydrochloric acid and silicon carbide was chosen, in addition to the option of dental bleaching. For lesions classified as TF5, a combined macro- and microabrasion technique with 37% phosphoric acid or hydrochloric acid at concentrations of 6%, 15%, and 18% was used, along with bleaching and the application of infiltrating resin.	Lack of knowledge about minimally invasive treatments can lead to restorative procedures with veneers or crowns, which cause greater wear of tooth enamel and accelerate tooth destruction at early ages. Infiltrating resin is an innovative technique mentioned in the literature that offers aesthetic results for fluorotic lesions.
23	Scielo	Epidemiology of Dental Fluorosis in 12-Year-Olds: A Systematic Review. Ivanna Gugliucci (2024)[16] . Maontevideo	Nineteen cross-sectional articles were included, of which 16 correspond to communities using fluoridated water, one that uses fluoridated salt, and two that compare outcomes between communities using fluoridated water or salt.	Variability in reporting the prevalence of dental fluorosis (DF). Mild fluoride is the most common, regardless of the community fluoridation method and rate used. Since this mild form of fluoride is generally not perceived as a cosmetic problem, it does not affect people's quality of life. It is crucial that the scientific community work together to analyze and measure the impact of this public health measure in order to maximize its benefits and ensure its safety.
24	Scielo	Educational strategy for the prevention of dental fluorosis aimed at pregnant women in Huachi Grande, Ambato. (González Cardona (2021)[43] . Ecuador	The findings indicated a lack of knowledge about aspects related to dental fluorosis and its prevention from pregnancy onwards. It was observed that only about one-fifth of pregnant women possess the basic level of knowledge required to prevent this condition.	A low level of knowledge was identified among participants about the relationship between fluoride consumption during pregnancy and dental fluorosis in their future children.

Tabela 1. *Documentos seleccionados. (cont.)*

N°	Indexing/ Repository	Title-Author-Year-Country	Results	Conclusions
25	Repository umsa.bo	Demographic factors associated with dental fluorosis in children and adolescents in the department of La Paz. Ugarte-Cabo & Mendoza-Huaylla (2022)[44] . Bolivia	The incidence of dental fluorosis was recorded at 13.6% (188), with adolescents being the most affected at 10.7% (149). Regarding gender, the prevalence in females was 7.4% (103). In rural areas, 8% (112) of dental fluorosis cases were detected. When classifying the severity, it was found that 8% (113) had debatable fluorosis, 4% (51) very mild, 1.3% (18) mild, 0.4% (5) moderate, and one severe case was identified in a student.	Dental fluorosis is primarily perceived as a cosmetic problem. Implementing preventative measures to control it is highly recommended and beneficial.
26	Latindex.	Prevalence of oral diseases in schoolchildren aged 6, 12, and 15 in Islay (Arequipa, Peru). (Villagra-Valdivia *et al.* (2020)[45] . Peru	Regarding fluorosis, 34.7% of the individuals presented no lesions; 15% had questionable fluorosis; 30.3% had very mild fluorosis; 11.7% had mild fluorosis; and 1.1% had moderate fluorosis. The overall prevalence of the condition was 58.1%.	The prevalence of oral diseases is high, with a significant risk of dental caries. Poor hygiene is observed in the permanent teeth, and the percentage of gingivitis is also high.
27	Scielo	Factors associated with dental fluorosis in children and adolescents in the city of Montería, Colombia. Espitia-Cabralez *et al* (2019)[46] . Colombia	It was observed that 81.6% of the schoolchildren exposed to fluoride belonged to the subsidized system, which is available to the most disadvantaged population. Furthermore, 89% of the cases were from the municipal capital. Forty-seven percent of the patients had cavities.	Dental fluorosis is strongly associated with several factors, such as the amount of toothpaste used during brushing, the habit of brushing three or more times a day, dietary salt intake, and accidental ingestion of toothpaste at an early age. Most schoolchildren have a moderate degree of dental fluorosis.
28	Scielo	Fluoride in drinking groundwater and prevalence of fluorosis in children and adolescents: a systematic review. Oliveira-Chagas (2023) [47] . Argentina	A total of 2,189 articles were identified; after reviewing the titles and abstracts, 63 references were selected for further analysis, from which data were extracted from 15 articles.	A relationship has been identified between the consumption of fluoridated well water and the prevalence of fluorosis in people up to the age of 18. This study is the first to systematically assess this connection worldwide.
29	Springer	Groundwater fluoride concentration and prevalence of dental fluorosis in the Ethiopian Rift Valley: A systematic review and meta-analysis. Demelash *et al.* (2019)[48] . Ethiopia	Toothpaste use was recorded at 28.7%, while topical fluoride application in the past year was 17.6%, and mouthwash use reached 6.6%. Breastfeeding was also considered a variable, which is presented in the report as a protective factor. This study revealed that 49.3% of patients who were breastfed, according to the American Dental Association (ADA), benefit from better oral health in childhood.	In the Rift Valley region, fluoride concentrations in groundwater frequently exceed the WHO recommended limit of 1.5 mg/l, which has led to a high incidence of dental fluorosis in Ethiopia.
30	Latindex	Dental fluorosis and its prevention in primary health care. Guerrero & Domínguez (2018)[49] . Cuba	It is essential to prevent high concentrations of fluoride from pregnancy until approximately eight years of age. This includes drinking water containing fluoride, whether natural or artificial, as well as foods made with such water and fluoridated toothpaste in children.	Excess fluoride on teeth, primarily due to consumption of water and products containing high concentrations of this element. Clinically, this manifests as stains ranging from whitish to dark brown and a corroded texture.

Tabela 1. *Documentos seleccionados. (cont.)*

N°	Indexing/ Repository	Title-Author-Year-Country	Results	Conclusions
31	Pubmed	Periodontal and dental conditions of a school population in a volcanic region of Tanzania with highly fluoridated community drinking water Miranda-Rius (2020)[50] . Tanzania	The majority of the population (511, 87.95%) showed bleeding during probing. Moderate to high levels of some dental disease (DMF score) were observed in 14.46%. The relationship between dental fluorosis, gingival bleeding, and caries revealed a higher prevalence of these conditions in the groups with more severe fluorosis (p<0.05).	In this large population study, a significant correlation was found between the presence of caries and gingivitis and cases of moderate to severe dental fluorosis.
32	Scopus	Fluorosis and oral health status in adolescents living in a high-fluoride groundwater area: a case study in the slums of Nairobi, Kenya. Demarchi *et al.* (2023)[51] . Kenya	The CPOD index recorded in the total sample was 0.87. Approximately 78.6% of individuals experienced varying degrees of fluorosis, ranging from mild to severe. Furthermore, a relationship was observed with tooth brushing frequency (OR = 2.8), toothbrush and toothpaste use (OR = 3.8), bleeding (OR = 10.2), and tartar buildup (OR = 12.1).	Fluorosis has gained significant clinical and social-health importance due to its high prevalence, caused primarily by the consumption of water with excessive fluoride. To prevent fluorosis, water treatment and the implementation of pipeline systems for a controlled supply of drinking water are proposed, complemented by geochemical studies for the optimal selection of drilling sites in appropriate hydrogeological zones.
33	Pubmed	The impact of reducing fluoride concentration in Malaysian water supply on the prevalence of fluorosis and dental caries Mohd Nor *et al* (2018)[52] . Malaysia.	A higher prevalence of fluorosis was observed in participants aged 6 to 11 years, with very mild and mild degrees being more common. A Spearman linear correlation was shown, with a p-value of 0.004 and a rho coefficient of 0.265, suggesting a positive correlation. When analyzing the relationship between the degree of fluorosis and gender, the absence of a significant relationship between these variables was evident (p=0.202).	The results indicate that changing the fluoride level from 0.7 to 0.5 ppm reduced fluorosis and maintained a caries-preventive effect. Although there was a reduction in the prevalence of fluorosis, the difference was not statistically significant.
34	Scopus.	Impact of fluoride reduction in water on dental caries and fluorosis James *et al* (2021)[53] Ireland	The findings indicated poor acceptance of the toothbrushing guidelines, a limited preventive effect of water fluoridation on primary teeth, and no decrease in fluorosis cases after the implementation of appropriate policies.	The incidence of fluorosis remained largely at the "very mild" level between 2002 and 2017, with no statistically significant changes. Community water fluoridation (CWF) between 0.6 and 0.8 ppm has been shown to be effective in preventing caries.

Source: Own elaboration

reveals several dimensions and categories related, first, to the prevalence and impact of fluorosis in certain regions, followed by the epidemiological category, which includes the overall prevalence of 53% and the differential incidence according to age, with a higher incidence in 12-year-olds compared to 15-year-olds. Likewise, the severity of fluorosis is classified in another dimension, where most cases are very mild and severe cases are rare, reflected in a community fluorosis index of 0.602.

The geographic and environmental dimension is evident in the presence of fluoride in drinking and bottled water, especially in areas where concentrations frequently exceed the threshold of 1.5 mg/L, exceeding the limits recommended by health authorities. This

Table 2. *GRADE Screening for the Identification of Articles and Theses on Dental Fluorosis*

Phases	Activities
1. Formulation of the PICO Question	To structure the review, the following PICO question was posed: P (Patient/Population): Children and adolescents. I (Intervention): Evaluation of dental fluorosis (Original and review) C (Comparison): Different concentrations of fluoride in drinking water. O (Outcome): Prevalence and treatment of dental fluorosis
2. Identification of Articles and Theses	For the identification of articles and theses, the following databases were used: Scopus 4 Web of Science (WOS): 0 Redalyc: 1 Scielo: 13 Institutional Repositories: 3 Latindex: 8 National Library of Medicine: 1 Springer: 1 Pubmed: 2
3. Keywords	From the literature review, the following keywords were concluded: In Spanish: “dental fluorosis” “dental fluorosis in children and adolescents” “fluoride concentration in drinking water” “treatment of dental fluorosis”
4. Evaluation of the quality of the evidence	• Risk of bias: Evaluates the possibility that the study results are biased. • Inconsistency: Analyzes the variability of results between studies. • Indirect evidence: Consider whether the studies are directly applicable to the clinical question. • Imprecision: Evaluates the precision of the results. • Publication bias: Consider the possibility that published studies do not represent all studies conducted.
5. Classification of the certainty of evidence of scientific documents into four levels:	High: 26 Moderate: 8 Low: 40 Very low: 10
Formulation of recommendations	Quality of evidence and other factors such as the balance between benefits and harms, patient preferences and resource use, formulate recommendations.

Source: Own elaboration

suggests a dimension of risk to public health that requires stricter monitoring and regulation of water quality.

The most widely used epidemiological index to examine the existence of dental fluorosis is the Dean index[15] , which was developed in 1942. This index establishes a correspondence between the amount of fluoride present in daily drinking water and the appearance of mottled enamel. The data reveal that the most common levels of dental fluorosis are in the mild range, with a predominance of cases classified between 1 and 3 according to the Dean index and the equivalent with the Thylstrup and Fejerskov index. This information highlights an epidemiological dimension that reflects the distribution and frequency of the disease in the study population.

Dental fluorosis is a pathological condition that affects the mineralization of dental tissue due to excessive exposure to fluoride during tooth development. From the analysis provided, several categories and dimensions can be established that emerge in the study of this condition.

The prevalence and severity of dental fluorosis varies between deciduous and permanent teeth, being less frequent and severe in the former. This suggests a dimension of analysis related to the stage of dental development at which fluoride exposure occurs.

Biological and postnatal factors, such as exposure to various sources of fluoride in the first months of life, as well as environmental factors, such as living in mountainous areas or near coal mines, constitute a relevant category that influences the development of fluorosis in deciduous teeth.

The clinical diagnosis of dental fluorosis requires a detailed evaluation of the physical characteristics of the lesions, which involves a diagnostic dimension that includes their location, size, color, and appearance.

The treatment of dental fluorosis is presented as a therapeutic dimension that must be personalized based on the severity and individual circumstances of the patient, which underscores the importance of a comprehensive clinical approach.

The correlation between the incidence of fluorosis and the accidental ingestion of fluoride toothpastes introduces a preventive dimension, emphasizing the need for education and control measures to reduce fluoride exposure.

Furthermore, the research identifies a nutritional and physiological dimension, where, despite adequate calcium intake, hypocalcemia was observed in children, indicating that high fluoride levels pose a health threat even with adequate nutrition. On the other hand, a clinically relevant dimension is mentioned, where the amounts of fluoride found in some studies are not significant and are within established parameters, without being a factor directly associated with dental fluorosis.

A sociodemographic and behavioral dimension is highlighted, which includes risk factors such as sociodemographic characteristics, consumption of water with high levels of fluoride, diet, and the use of age-inappropriate toothpaste. These interrelated dimensions underscore

the complexity of the problem of dental fluorosis and the need for multidisciplinary approaches to its prevention and management.

The analysis of dental fluorosis reveals multiple dimensions, including dental development, biological and environmental factors, clinical diagnosis, personalized treatment, epidemiology, prevention, and public health, all of which are crucial to understanding and effectively addressing this condition. In summary, the analysis of dental fluorosis reveals multiple dimensions, including dental development, biological and environmental factors, clinical diagnosis, personalized treatment, epidemiology, prevention, and public health, all of which are crucial to understanding and effectively addressing this condition.

Discussion

The presented study highlights an overall prevalence of fluorosis of 53%, with a higher incidence in 12-year-olds. This prevalence is comparable to that reported by Gugliucci *et al*.[16] in their study, which included a systematic review, which observed that mild fluorosis lesions were the most prevalent, regardless of the community fluoridation method used. On the other hand, Olivares-Keller *et al*.[17] , in a study conducted in Chile, reported a prevalence of dental fluorosis of 53.31% in 7-year-old children, with the severity mostly ranging from questionable to mild. Meanwhile, research on the prevalence of fluorosis in children has revealed that exposure to fluoride, especially through drinking water, is a determining factor.

The epidemiology of dental fluorosis in children and adolescents has been the subject of analysis, with studies seeking to understand the relationship between the prevalence and severity of fluorosis and the community fluoridation methods used[18] . These studies are essential for evaluating the effectiveness of public policies on dental health and for adjusting prevention strategies according to the needs of the population. Masabanda-Olivares *et al*.[18] advanced a study in which they examined the prevalence of fluorosis in children aged 4 to 15 years and its association with the level of fluoride in the water, concluding that there is no statistically significant relationship between the presence of mild to moderate fluorosis and the percentage of fluoride in drinking water. This finding is revealing because it challenges the common notion that dental fluorosis is directly related to fluoride levels in drinking water, suggesting that other factors may be contributing to the incidence of this condition.

These findings are consistent with the severity classification of the study under discussion, where severe cases are rare. Furthermore, it is important to consider the study by Velasco-Ramírez[19] which highlights the cumulative impact of fluoride on different areas of the ecosystem, including human health. The variability in the reports of prevalence and severity of dental fluorosis suggests the need for a more in-depth and comparative analysis between different regions and methods of fluoridation, to better understand the implications of this condition on public health .

Dental fluorosis in children is a condition

that has captured the attention of the scientific community due to its prevalence and public health implications. Scientific studies have addressed this issue from various perspectives, evaluating both incidence and treatment and prevention strategies. A systematic review published by Vinueza-Jarrín *et al*.[20] highlights the importance of a minimally invasive clinical approach to the treatment of dental fluorosis, noting that less aggressive procedures can be effective for lesions in stages TF1 to TF5. This study highlights the importance of tailoring interventions to the degree of fluorosis severity, which is crucial for optimizing aesthetic and functional outcomes.

Dental fluorosis, as described in the analysis provided, is a multifactorial condition that affects dental tissue mineralization. The study by Covaleda-Rodríguez *et al*.[21] addresses the clinical treatment of dental fluorosis, highlighting the need for a minimally invasive and aesthetic approach to dental lesions caused by this condition. On the other hand, Hidalgo-Gato Fuentes *et al*.[22] argue that dental fluorosis is not only an aesthetic problem but can also be an indicator of exposure to elevated levels of fluoride, pointing to a broader potential impact on human health. These studies highlight the importance of considering both biological and environmental factors in the onset and management of dental fluorosis. Furthermore, the epidemiological analysis of dental fluorosis in countries such as Colombia provides insight into the prevalence and characteristics of this condition in a specific context, which may be useful for contrastarfurther studies and understanding regional variations. Comparing these studies with the initial analysis allows for a richer and more informed discussion about the dimensions of dental fluorosis and its clinical and preventive management.

The diagnosis and treatment of dental fluorosis are highly relevant topics in contemporary dentistry. In the diagnostic field, Covaleda-Rodríguez *et al*.[21] highlight the importance of a minimally invasive clinical approach for stages TF1 to TF5, based on a systematic review of studies ranging from tooth whitening to microabrasion. On the other hand, González-Rodríguez and Cardentey-García[23] propose a specialized clinical history that allows for a comprehensive and personalized diagnosis, considering socioeconomic factors and endemic characteristics. Regarding treatment, personalization is key, and techniques ranging from whitening to the application of infiltrating resins have been proposed, depending on the severity of the fluorosis.

In terms of public health policy, it is essential that water fluoridation programs be carefully monitored and regulated to prevent dental fluorosis, while continuing to protect the population against dental caries[24] . Education on oral hygiene and the proper use of fluoridated dental products is equally important to minimize the risk of fluorosis in children. Prevention also plays a crucial role. Studies such as that of Pérez-Puello *et al*.[5] suggest that, although the risk of toxicity from accidental ingestion of fluoride toothpastes is low, supervision in children and education to avoid excessive intake are essential. Furthermore, research by Aguilera Galaviz *et al*.[25] indicates a significant association between salivary fluoride concentration

and caries experience, reinforcing the need for adequate control of fluoride use.

Analysis of the scientific literature on dental fluorosis in children reveals a complex interplay of factors contributing to its incidence, as indicated by Valdivia-Padilla [26] . Studies argue that, although water fluoridation is an important factor, it is not the only contributor to the condition. Treatment and prevention strategies must be individualized and evidence-based to effectively address this condition. Continued research is vital to better understand the epidemiology of dental fluorosis and to develop more effective and less invasive interventions. Finally, the literature suggests a multidimensional approach to the management of dental fluorosis, ranging from detailed clinical diagnosis to personalized treatments and preventive measures. Collaboration between clinicians, patients, and communities is essential to mitigate the effects of this condition and improve public dental health.

Conclusion

Dental fluorosis in children represents a significant public health challenge. Studies indicate wide variability in the prevalence of this condition worldwide, suggesting the need for more rigorous epidemiological monitoring and locally tailored prevention strategies.

A systematic review of the literature reveals that, regardless of the community fluoridation method used, mild fluorosis lesions are the most common among 12-year-old adolescents.

This underscores the importance of oral hygiene education and the appropriate use of fluoride to minimize the risk of dental fluorosis, while maximizing caries-preventive benefits.

The findings emphasize the need for health policies that balance fluoridation with fluorosis prevention, especially in vulnerable communities where fluoride exposure may be more difficult to control.

Conflicts of Interest:

The author declares that there are no conflicts of interest in conducting this study.

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