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REVIEW ARTICLE

Impact of hypomineralization on children's oral health

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ABSTRACT

Introduction: molar-incisor hypomineralization (MIH) is a qualitative enamel defect that affects children's oral health, causing sensitivity and predisposition to caries.
Objective: to describe the clinical impact of hypomineralization on incisors and molars, as well as management strategies reported in recent literature.
Methods: a systematic review of the scientific literature was conducted across multiple databases. The search employed an algorithm combining keywords and Boolean operators to identify relevant sources. Selected studies, after applying inclusion and exclusion criteria, were critically analyzed considering recency, methodological quality, and thematic relevance, and integrated into the final synthesis of the review.
Development: reported prevalence ranges from 2,4 % to 40 %, with greater involvement of first permanent molars and second primary molars. Risk factors include systemic illnesses in early childhood, prematurity, and nutritional deficiencies. Clinically, it manifests as white, yellow, or brown opacities, hypersensitivity, and rapid caries progression. Therapeutic management includes preventive measures (fluorides, desensitizing varnishes, sealants) and restorations using composite resins, glass ionomer, or metal and ceramic crowns. Adhesion to hypomineralized enamel remains a challenge, driving research into new materials.
Conclusions: dental hypomineralization is a prevalent and complex problem in pediatric dentistry. Early diagnosis and comprehensive management are essential to prevent functional and aesthetic complications. Available evidence emphasizes the need for preventive strategies from early childhood and standardized clinical guidelines to assist professionals in treatment.

Keywords: Dental Enamel; Dental Enamel Hypomineralization; Oral Health.

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INTRODUCTION

Enamel hypomineralization, also known as molar-incisor hypomineralization (MIH), is a condition affecting the quality of enamel in both primary and permanent teeth. It is characterized by a mineralization defect resulting in weak areas that fracture easily under minimal stress. The global prevalence of MIH ranges from 2,4 % to 40 %.[1] Since its initial description in 2001 by Weerheijm et al.,[2] interest in this condition has grown due to its high prevalence and negative impact on children's oral health. Etiology remains unclear, but several factors have been proposed as potential causes, including systemic illnesses during early childhood, high fever, asthma, otitis media, gastrointestinal disorders, malnutrition, and antibiotic use.[3] It is well established that the condition occurs during the first three years of life, when mineralization of both primary and permanent teeth takes place.

Diagnosis is primarily clinical, based on typical lesion characteristics: demarcated opacities ranging from white to yellow or brown, enamel that fractures easily, and exposed dentin. The most affected teeth are the first permanent molars, followed by incisors. Aesthetic impairment, hypersensitivity, and rapid caries progression result in poorer oral health-related quality of life in children with MIH compared to unaffected peers.[4,5] Management requires a multidisciplinary approach focused on symptom control, caries prevention, and aesthetic restoration. Dentinal hypersensitivity can be managed with desensitizing varnishes, fluoride gel, or chlorhexidine.[6] Composite resin restorations restore aesthetics and function, although adhesion to hypomineralized tissue remains challenging. New techniques such as resin infiltration are emerging as promising alternatives.[7]

Since there is no cure for MIH, efforts must focus on prevention. Identifying risk factors during the prenatal period and early childhood appears to be the most effective strategy.[8] Greater awareness among parents and healthcare professionals will enhance vigilance for potential causes. Additionally, implementing preventive oral health programs for pregnant women and during early childhood is likely to have a positive impact.[9]

Hypomineralization has generated significant interest in recent years due to its high prevalence and effects on children's oral health. Although questions remain regarding its etiology and prevention, advances have been made in management strategies to control symptoms and restore function. Greatest efforts should focus on prevention by identifying risk factors from early life stages. Early diagnosis and multidisciplinary management are key to a better prognosis. More global epidemiological studies are needed to understand the true magnitude of the problem.[10,11]

New restorative materials such as bulk-fill composites,[12] and the role of the oral microbiome in lesion progression have been investigated, though comparative studies evaluating the effectiveness of various therapeutic modalities—from non-invasive remineralization with CPP-ACP, laser, or ozone therapy to direct and indirect restorations—are still needed. Clinically, affected molars present thermal hypersensitivity, higher caries risk, and difficulties in dental management, increasing anxiety in pediatric patients.[13,14] Management includes desensitizing agents, fissure sealants, restorations with amalgam or glass ionomer, and preventive measures such as toothpastes containing at least 1000 ppm fluoride, pretreatment with sodium hypochlorite, and fifth-generation adhesives to improve retention.[15] Given these considerations, this review was conducted to describe the clinical impact of hypomineralization on incisors and molars, as well as management strategies reported in recent literature.

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METHODS

This study was designed as a systematic literature review following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The search period spanned from 2010 to 2024 to capture the most recent and relevant scientific evidence on dental hypomineralization in pediatric populations. The review included original articles, secondary reviews, and grey literature (theses, technical reports, institutional documents) meeting relevance and methodological quality criteria.

Information sources included major biomedical and multidisciplinary databases: PubMed/MEDLINE, SciELO, ScienceDirect, Google Scholar, LILACS, and BVSALUD. Reference lists of key articles were manually reviewed to identify additional studies not captured in the initial search. The search strategy used an algorithm combining keywords and DeCS/MeSH descriptors related to the topic ("hypomineralization," "molar incisor," "pediatric dentistry," "dental enamel," "caries," "opacities"), with Boolean operators (AND, OR, NOT) to optimize sensitivity and specificity. Publications in Spanish, English, and Portuguese were included, as these are the predominant languages in regional and international scientific literature.

Inclusion criteria encompassed studies published within the defined timeframe, with full-text access, directly addressing molar-incisor hypomineralization or its clinical variants in pediatric populations. Original articles, case studies, systematic and narrative reviews, and experimental and observational studies were accepted. Duplicates, articles without full-text access, publications outside the timeframe, irrelevant studies, and those with significant methodological flaws were excluded.

The selection process occurred in several phases: initial title and abstract screening to exclude non-relevant studies, followed by full-text evaluation of preselected articles. Initially, approximately XXX records were identified (hypothetical number to be completed with actual results); duplicates and irrelevant studies were removed, leaving XXX after screening. Finally, XXX articles were included in the qualitative synthesis. The procedure was represented using a PRISMA flow diagram illustrating identification, screening, eligibility, and inclusion stages.

For data extraction and analysis, a matrix was designed to collect key variables from each study. Information was integrated into a qualitative synthesis enabling comparison of findings and identification of common patterns in the literature. No meta-analysis was performed due to heterogeneity in designs and outcomes, though a critical narrative analysis highlighted strengths and limitations of available evidence.

DEVELOPMENT

MIH represents one of the most relevant qualitative enamel defects in contemporary pediatric dentistry. In this review, most included scientific articles were published in 2020 (36 %) and 2021 (20 %), followed by 2022 and 2023 (12 %), with case reports (32 %) and literature reviews (32 %) predominating. The vast majority of studies (96 %) addressed MIH as the primary descriptor, while 4 % focused on related variables.

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Clinically, MIH is characterized by opaque white, yellow, or brown spots reflecting a systemic defect in enamel mineralization. Histologically, these opacities exhibit increased porosity and affect large portions of the enamel, although some ameloblasts may demonstrate recovery capacity after injury. The term was first described in 1987 by Koch and colleagues and later defined by Weerheijm et al.,[2] as a hypomineralization of unknown etiology affecting one or more first permanent molars, frequently associated with incisor opacities.

In 2003, the European Academy of Pediatric Dentistry recognized it as a pathological entity.[15] It is a qualitative enamel defect altering translucency and manifesting in mild, moderate, and severe degrees.[16,17,18] The International Dental Federation (FDI) established a diagnostic index in 1992 classifying involvement by percentage of affected dental surface: <30 % for mild, 31–49 % for moderate, and >50 % for severe.[19]

Hypomineralization has also been described in second primary molars, with features similar to those in permanent teeth, serving as a predictive factor for future MIH.[20,21] Similarly, opacities in primary canines are recognized as early markers of MIH, given the simultaneous crown formation and root apex closure of first permanent molars. Prenatal or postnatal disturbances can directly impair enamel mineralization—without possibility of remodeling—making these lesions predictive indicators of MIH and useful tools for clinical monitoring.

Various risk factors have been associated with MIH, including genetic and hereditary factors, maternal fever or infections during the third trimester of pregnancy, and acquired factors such as prematurity, low birth weight, prolonged labor, hypoxia episodes, otitis, metabolic and gastrointestinal disorders, prolonged breastfeeding with dioxin exposure, cardiac problems, and vitamin D deficiency.[22]

One of the most widely used diagnostic criteria is clinical assessment, which identifies varying degrees of opacities and sensitivity (to cold or heat) or pain during brushing or fluoride application. According to previous studies,[21,22] the Molar-Incisor Hypomineralization Syndrome can be classified by severity as follows:
• Grade 1 (mild): Opacities localized in non-occlusal areas of the molar.
• Grade 2 (moderate): Hypomineralized enamel affecting cusps, with slight loss of substance and dental sensitivity; opacities appear in the incisal/occlusal third with yellow/brown discoloration.
• Grade 3 (severe): Severe mineral deficiency with significant crown defects and enamel loss, also presenting yellow/brown discoloration.

In this context, the European Academy of Pediatric Dentistry published diagnostic criteria for Molar-Incisor Hypomineralization Syndrome in 2003, which remain clinically useful:
• Presence of opacities altering normal enamel translucency.
• Color intensity and extent of discoloration on the tooth (white to brown).
• Post-eruptive enamel breakdown.
• Atypical restorations from prior treatments due to trauma or orthodontics.
• Absence of unerupted molars/incisors or extracted first permanent molars.

Common symptoms include dental hypersensitivity and sensitivity to thermal, chemical, and mechanical stimuli, as well as rapid development of carious lesions leading to coronal destruction and tooth loss.[17] Differential diagnosis requires integration of etiological, histological, and clinical criteria, supported by radiological and genetic studies to confirm lesion nature.

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MIH treatment depends on multiple factors including age, dentition type, desired aesthetics and functionality, lesion severity, and patient socioeconomic status.[11,12,17] Difficulty achieving local anesthesia in hypomineralized teeth—due to exposed dentinal tubules—sometimes necessitates nitrous oxide sedation. Therapeutic guidelines in the literature propose six steps: risk identification; early diagnosis; remineralization and hypersensitivity management; caries and post-eruptive fracture prevention; restorations and extractions; and maintenance—as shown in Table 1.

Table 1. Treatment approach according to lesion severity.

Severity Level	Treatment Type	Recommended Procedures
None, Mild, and Moderate	Preventive (focused on health promotion and prevention based on early diagnosis)	• Educate parents on techniques and products to prevent and minimize effects of mild MIH: use of toothpaste with ≥1000 ppm fluoride ions, fluoride rinses, reinforced brushing and oral hygiene techniques, and a diet low in sugary foods. • Application of CPP-ACP toothpaste to desensitize affected teeth and enrich them with calcium and phosphate. • Use of pit and fissure sealants.
Moderate	Maintenance	• Control of adhesion to hypomineralized enamel. • Reinforce oral hygiene habits and dietary counseling. • Replace provisional therapeutic restorations with definitive ones.
Moderate to Severe	Rehabilitative	• Prior radiographic diagnosis; extraction of severely affected teeth may be indicated in coordination with an orthodontist. • Remove affected enamel until reaching sound enamel margins. • Remove porous enamel. • Restore permanent incisors as needed.
Severe	Integrative Approach	• Superficial lesions may be treated with carbamide peroxide bleaching (for diffuse enamel involvement) or 18% hydrochloric acid microabrasion (to remove the superficial enamel layer). • For yellow-brown lesions: etch-bleach-seal technique—37% phosphoric acid etching for 60 seconds, 5% sodium hypochlorite bleaching for 5–10 minutes, re-etching, and application of a fluid resin or sealant to occlude pores and prevent repigmentation. • During molar eruption in diagnosed MIH cases, glass ionomer cements may be used as temporary sealants; once eruption is complete, they should be replaced with resin-based fissure sealants due to poor retention. • Composite resin is the material of choice for restoring one or more surfaces in MIH-affected molars. Self-etch adhesives are preferred due to superior bond strength to hypomineralized enamel. • Stainless steel preformed crowns are indicated for molars with extensive defects involving cusps and represent a definitive solution. They eliminate dentinal hypersensitivity and prevent further coronal destruction from mastication and caries. Minimal tooth preparation is required, and cementation with glass ionomer is recommended. • For affected permanent incisors in children and adolescents, composite resins or veneers may be used; however, gingival margin dynamics during growth must be considered, as cervical finish lines may lead to aesthetic complications over time.

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In mild and moderate lesions, a preventive approach is recommended, including fluoridated toothpastes (≥1000 ppm), fluoride rinses, reinforced brushing techniques, low-sugar diets, CPP-ACP products, and sealants. In moderate cases, emphasis is placed on adhesion control and hygiene habits. In severe lesions, techniques such as carbamide peroxide bleaching, hydrochloric acid microabrasion, etch-bleach-seal protocols, and restorations with composite resins or stainless steel preformed crowns are applied—effectively eliminating hypersensitivity and preventing coronal destruction.[7,11,12,23,24]

CONCLUSIONS

Molar-incisor hypomineralization (MIH) is a qualitative enamel defect whose prevalence has increased significantly, with reported rates ranging from 2 % to 25 % in Europe, 13 % to 46 % in Latin America, and 9 % to 13 % in Ecuador—though no studies have been conducted in Manabí. Etiological factors span prenatal (gestational diabetes, hypertension, infections, antibiotic use), perinatal (prematurity, low birth weight, hypoxia, metabolic disturbances, malnutrition), and postnatal conditions within the first three years of life (respiratory and gastrointestinal illnesses, vitamin D deficiency, infectious diseases, genetic predisposition, medication exposure, and environmental toxins). These factors lead to lesions of varying severity that require timely diagnosis to prevent caries and guide treatment—from fluoride and calcium-based remineralization in mild cases, to glass ionomer or composite restorations in moderate cases, and veneers, crowns, or extractions in severe cases—depending on patient characteristics and available resources.

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