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PERSPECTIVES ON MOLAR INCISOR HYPOMINERALIZATION: INVESTIGATING PREVALENCE, IMPACT ON QUALITY OF LIFE AND PREVENTIVE APPROACHES: A SYSTEMATIC REVIEW

DR JAMKHANDI SHUBHANGI MALLAPPA[1*], PROF (DR) K. RESHMA PAI[2], DR EVETTE NATASHA DSOUZA[3], DR LAKSHMI PALLAVI K[4]

[1]SRINIVAS INSTITUTE OF DENTAL SCIENCES, SRINIVAS NAGAR, MUKKA SURATHKAL MANGALORE, COLLEGE NAME: SRINIVAS INSTITUTE OF DENTAL SCIENCES, DEPARTMENT OF PEDIATRIC AND PREVENTIVE DENTISTRY EMAIL ID: shubhangi13jamkhandi@gmail.com, ORCHID NUMBER : 0009-0004-3082-4809.
[2]SRINIVAS INSTITUTE OF DENTAL SCIENCES, SRINIVAS NAGAR, MUKKA SURATHKAL MANGALORE, COLLEGE NAME: SRINIVAS INSTITUTE OF DENTAL SCIENCES, DEPARTMENT OF PEDIATRIC AND PREVENTIVE DENTISTRY, EMAIL ID:docrpai@yahoo.co.in, ORCHID NUMBER :0000-0002-6235-5486,
[3]SRINIVAS INSTITUTE OF DENTAL SCIENCES, SRINIVAS NAGAR, MUKKA SURATHKAL MANGALORE, COLLEGE NAME: SRINIVAS INSTITUTE OF DENTAL SCIENCES, DEPARTMENT OF PEDIATRIC AND PREVENTIVE DENTISTRY, EMAIL ID: naatu86@gmail.com ORCHID NUMBER : 0000-0002-8441-2963,.
[4]SRINIVAS INSTITUTE OF DENTAL SCIENCES, SRINIVAS NAGAR, MUKKA SURATHKAL MANGALORE, COLLEGE NAME: SRINIVAS INSTITUTE OF DENTAL SCIENCES, DEPARTMENT OF PEDIATRIC AND PREVENTIVE DENTISTRY, EMAIL ID : pallavi.laksh@gmail.com, ORCID NUMBER 0000-0003-4205-7833,

Abstract

Background: Molar Incisor Hypomineralization (MIH), is a developmental enamel defect that affects first permanent molars and incisors. This condition makes diagnosis and treatment difficult and significantly challenges oral health and quality of life.

Aim: To conduct a comprehensive review of the literature to determine the prevalence of MIH on global, Asian, and Indian populations considering diverse populations and geographic contexts specifically on children.

Method: The website of PubMed, Science Direct, and Google Scholar were explored using a detailed electronic search for finding relevant studies from the year 2004 till the year 2024. The criteria of inclusion expanded to interventional as well as observational research studies about the prevalence of MIH, quality of life assessments, and prevention strategies among children up to 13 years. Standard tools and methods were adopted for data extraction as well as quality assessment. Prospero registration is completed with registration id CRD42024618619.

Results: The range of the prevalence of MIH worldwide varies between 2.4% and 40.2% and is significantly heterogeneous between regions. Quality of life was affected badly for children suffering from MIH due to pain upon mastication, hypersensitivity, psychological and social issues. The prevention of symptoms and further progression by the application of fluoride and casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) showed a moderate efficacy.

Conclusion: MIH is a very common condition and badly affects the quality of life. The review emphasizes on the importance of early diagnosis, multidisciplinary approaches and public awareness for the attenuation of burden of MIH.

Keywords: Molar Incisor Hypomineralization, prevalence, quality of life, enamel defect, pediatric dentistry

INTRODUCTION

Molar Incisor Hypomineralization (MIH) is a developmental disease characterized by hypo mineralisation of the first permanent molars and incisors. MIH could be associated with poor quality of life in the oral cavity owing to hypersensitivity as well as aesthetic issues [1]. Dental enamel changes that are qualitative, often result in a condition referred to as MIH. It causes tooth sensitivity; raises susceptibility to caries and may negatively affect an individual's appearance [2]. Although the exact genesis of the condition has not been known, environmental and genetic factors have been proposed to be involved [3] [4]. The clinical approach towards management of MIH is complex. Often prevention and repair courses are adopted to minimize the symptoms or improve the patients' quality of life [5]. These include recognizing the condition at an early stage and ensuring the patient receives immediate treatment to reduce the impact of any condition, especially to the children [3][4].

SIGNIFICANCE OF THE STUDY

The growing prevalence of Molar Incisor Hypomineralization (MIH) is the most crucial reason for writing the review. MIH condition has been reported more in developing regions, such as India and other parts of Asia, where dental health services are still limited. The early diagnosis will be necessary for preventing those interventions that can avoid severe dental complications, including increased caries susceptibility, tooth loss, and long-term oral health problems. This shall provide an idea of the environmental and genetic risk factors that could underpin the etiology of MIH and thus provide possible lines for better prevention and management strategies. By shedding light into the impact, the condition has on the quality of life, especially the perception of its impact as observed among the children. The review enlightens public dental health prevention policies that prefer early intervention. In doing so, this study aspires to reduce the worldwide burden of MIH by promoting more effective clinical and preventive strategies suited to the needs of the populations affected.

Research Objectives

- To conduct a comprehensive review of the literature to determine the prevalence of Molar Incisor Hypomineralization (MIH) on a global scale, considering diverse populations, and geographic contexts and focusing specifically on paediatric age groups up to 13 years.
- To analyze existing literature to identify regional disparities in MIH prevalence among global, Asian, and Indian populations, investigating factors contributing to these differences and examining the prevalence among male and female paediatric populations.
- To assess the impact of MIH on individuals' quality of life of paediatric patients up to 13 years, including its effects on pain, aesthetics, functional abilities, and psychosocial well-being, based on documented evidence.
- To review preventive and treatment strategies for MIH, examining their efficacy, practicality, and implications for public health strategies, with a specific focus on diverse geographic regions, particularly in India and considering gender-specific approaches.

Research Questions

- What is the prevalence of Molar Incisor Hypomineralization (MIH) on a global scale, considering diverse populations, geographic contexts and paediatric age groups up to 13 years?
- What are the regional disparities in Molar Incisor Hypomineralization prevalence among global, Asian, and Indian populations, what factors contribute to these differences, and what is its prevalence among male and female paediatric populations?
- What is the impact of MIH on individuals' quality of life of paediatric patients up to 13 years, including its effects on pain, aesthetics, functional abilities, and psychosocial well-being, based on documented evidence?
- What are preventive and treatment strategies for MIH, examining their efficacy, practicality, and implications for public health strategies, with a specific focus on diverse geographic regions, particularly in India and considering gender-specific approaches?
- What gaps exist in the current preventive strategies for MIH?

LITERATURE REVIEW

Molar incisor hypomineralization (MIH) is a developmental enamel defect of the first permanent molars and permanent incisors [6]. Ish Jim has revealed several risk factors that may lead to MIH which are prenatal, perinatal, and postnatal systemic conditions. Juárez-López et al, (2023) [7] argues that, pregnancy complications, such as urinary tract infections exhibited the highest risk of developing MIH. Air pollution may also enhance the vulnerability because children from industrial areas of Poland had a higher MIH prevalence [8].

The cause of MIH is complex and encompasses genetic and environmental risk factors that most likely interact in their effect on the development of MIH [9]. Other factors that have been postulated to have a role in MIH include perinatal conditions such as stress in the pregnancy period, respiratory diseases, and antibiotic use during childhood [10]. Furthermore, studies have also indicated that environmental pollutants, especially dioxins are causes of MIH [8].

From clinical perspective, MIH affected teeth are vulnerable for accelerated rate of caries because of the hypoplastic enamel that is softer and porous in nature, which results in pain, enhanced caries risk and esthetic concerns [5][3][4]. This, in turn, reduces the oral health-related quality of life (OHRQoL) of children who experience the problem. In their study, Bekes et al., 2021[11] pointed out that treatment measures including sealing agents were effective in enhancing OHRQoL of the children with MIH. It is important to retain the features of the treatment strategies of MIH which are glass hybrid restorations that enhance patients' quality of life by addressing pain and structure problems[12]. In Brazilian children, MIH has been associated with poor ability to practice proper oral hygiene which in turn may compromise the caries status even more [13]. However, this remains as an area of concern since, due to the multifactorial etiology of MIH, its prevention as well as treatment is still a challenge.

The following are some ways through which MIH can impair the quality of life of affected children: Dantas-Neta et al. (2016) [14] revealed that the children with MIH had poorer OHRQoL than the non-MIH children at the age of eight years. However, the differences were small and authors noted that MIH may not always have a significant

effect on OHRQoL. Similarly in a cross-sectional study involving German schoolchildren, Elhennawy et al. (2022) [15] established that there was minimal improvement in OHRQoL after the implementation of MIH. However, other research has reported a significant decrease in OHRQoL attributable to MIH [16] [17]. In the current literature, the quality-of-life outcomes seem most likely to be affected in more severe cases of MIH [18].

MIH management focuses on the following tasks: hypersensitivity management, aesthetics and function rehabilitation, caries and tooth wear prevention, and quality of life enhancement [19]. Oral health promotion and education, dietary counseling and assessment, fluoride therapy and application of pit and fissure sealants are some of the preventive and non-surgical procedures that are recommended [3][4]. In cases where the molar is severely damaged, restorations may be necessary. Treatment alternatives begin with direct composite restorations, then moving to indirect restorations, and finally, extraction of the tooth and using a space maintainer in the worst-case scenario [20]. The study of Bekes et al. (2021)[11], Fütterer et al. (2020)[21] & Tugcu et al. (2022) [12]establish that restorative treatment can enhance the children's OHRQoL with MIH. Further studies are still required to provide more evidence on what approach to take in order to effectively manage MIH and enhance the patient's quality of life.

METHODOLOGY

a. Selection Criteria

Inclusion Criteria: Studies focusing on pediatric patients diagnosed with Molar Incisor Hypomineralization (MIH). Epidemiological studies, observational studies, clinical trials, cross-sectional studies, cohort studies, case-control studies, and systematic reviews. Studies published in English. Studies published from 2004 to the present.

Exclusion Criteria: Studies focusing on adults or non-paediatric populations. Studies not primarily focused on Molar Incisor Hypo mineralization (MIH). Case reports, editorials, letters to the editor, conference abstracts, and commentaries. Studies published in languages other than English.

b. Data Collection

The data collected on Molar Incisor Hypomineralization through a search on Google Scholar, ScienceDirect, and PubMed. The articles identified were derived from the following words in the search string: prevalence, epidemiology, quality of life, prevention, and treatment of MIH among children and adolescents. Only English language articles were included, while all duplicates were excluded. Further screening of relevant references was performed. Data were extracted from 56 selected studies and synthesized to assess the global and regional patterns, impact, and prevention strategies regarding MIH.

A systematic review was carried out regarding Molar Incisor Hypomineralization, using databases such as Google Scholar, Science Direct, and PubMed. The search keywords were 'Molar Incisor Hypomineralisation' or 'MIH' in combination with one of the following words: 'prevalence', 'incidence', 'epidemiology', 'quality of life', 'pain', 'prevention', or 'treatment'. Children, pediatric, or adolescents were searched for and geographical filters included global, Asia, or India, with gender differences. Of these, the search yielded a total of 2483 references: 506 from PubMed, 99 from Science Direct, and 1800 from Google Scholar. At the stage of screening, 132 references fell outside the time frame of the study. Of the rest, 1726 were excluded based on language and other criteria. Finally, 757 articles were screened for inclusion, but 701 were removed due to not meeting study aims.

The systematic literature review completes with 55 references chosen relating to MIH. This is the best approach to correctly examine the information that is to this date available on prevalence, effects, and prevention regarding MIH. Prospero registration is completed with registration id CRD42024618619.

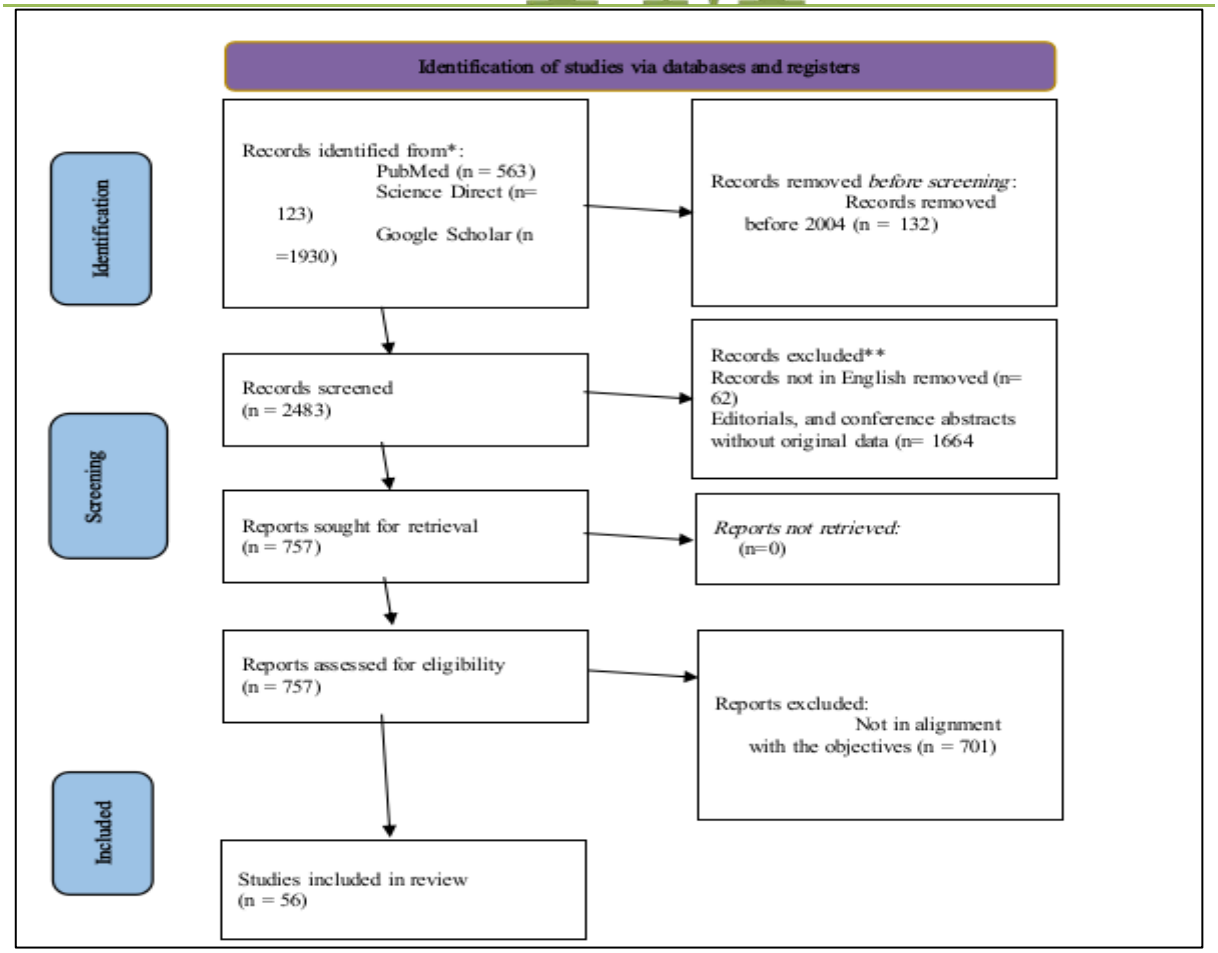

Figure 1 : PRISMA flow diagram

c. Analysis and Synthesis

This systematic review focused on published studies investigating the prevalence and the causes of MIH. A keyword search was conducted. Papers describing the epidemiology of MIH or evaluating potential risk determinants were considered. Information was gathered and analyzed to estimate the general prevalence of MIH and the quality of evidence supporting the suggested risk factors. A lot of variation was observed in terms of reported prevalence of MIH. Some of these were found to be supported by strong or moderate evidence such as genetic factors, childhood diseases, and drugs or toxins.

Prevalence

Studies have shown that the occurrence of Molar Incisor Hypomineralisation (MIH) in composite populations of the world differs. In Saudi Arabia prevalence is about 8 %; maxillary incisors and mandibular first molars are primarily involved [22]. The incidence rate of MIH differs worldwide with some research indicating the rate to be as high as 19%. The percentage of people with MIH differs from country to country; therefore, it is 2. 4% in Germany, according to Elhennawy et al. (2022)[15] and 40. 2% in Brazil, according to Lopes et al. (2021) [23]. 9% in Iran (Afshari et al., 2022)[24] and other studies executed in other countries like Switzerland revealed a significant proportion that MIH was identified in 14.1% of school-aged children, demonstrating its extensive prevalence within European demographics [2]. Comparable research conducted in Iran (Afshari et al., 2022)[24] and Sarajevo [25] supports this finding, revealing prevalence rates ranging from 6% to 20%, with children frequently exhibiting mild to severe enamel defects. Arslanagic-Muratbegovic et al. (2020) [25] also reported that children with MIH in Sarajevo had increased susceptibility to caries due to weakened enamel, and the same trends are observed.

Asia and India

A review done by Afshari et al. (2022)[24] had appraised the prevalence of MIH among Iranian children, reporting a prevalence rate of between 2.8% to 21.5% with variation tied up with regional factors, diagnostic criteria, and age ranges. Overall trends in other Asian regions are generally similar: such children suffer from an early onset of the condition that affects their oral health-related quality of life. In Asian populations teeth affected by MIH exhibit increased propensity towards caries progression and dental treatment complexities.

Some examples of such studies conducted in India include one by Subramaniam et al. [26] in 2016, which reported a prevalence rate of 6.31% among children aged 7–9 years in Bengaluru, thus showing that MIH is a significant problem in Indian pediatric populations. Rai et al [46]conducted a study in Virajpet, Karnataka on 9–12 year old children and found an 8.6 % prevalence, thus further inculcating the fact that MIH is getting increasingly prevalent

in India. In addition, these results are also consistent with the overall Asian data suggesting that MIH is not only a commonly prevalent condition but also poses critical challenges to pediatric dental care in the region.

Oral Health-Related Quality of Life

The quality of life of the affected child is highly affected by MIH, mainly on account of the hypersensitivity and aesthetic problem of the condition. A systematic review and meta-analysis were carried out by Amrollahi et al. in 2023 [1]; the study revealed how MIH has a destructive impact on oral health-related quality of life in the 8–10-year age group. The children with MIH main problems are mostly issues with keeping their teeth clean, which are naturally very sensitive, creating a potential gateway for the development of caries and other serious complications related to their dental health. This has been very worrying in Asia and India, where the availability of dental care is often not accessible, particularly in rural areas.

Alzahrani et al. (2023) [9] also laid out the contemporary perspective on the etiology and management of MIH, reiterating prevention as being crucial, especially in regions such as Asia whose environmental and nutritional circumstances might exacerbate the condition. Public health initiatives aimed at early diagnosis and preventive treatment could be good avenues to radically reduce the long-term oral health consequences of MIH in children.

The diagnosis and management of MIH among Asian populations, including India, raise a challenge because of the heterogeneity of dental care access, economic factors, and awareness of the disease. According to Al-Nerabieah et al. (2024) [3], the development of accurate diagnostic tools and reliance is essential for the early detection of MIH, which may include the use of fluorescence dental loupes. The study provided insight that early diagnosis is very important in preventing the progression of caries and other complications associated with MIH, especially in pediatric patients who may have advanced hypersensitivity or even pain.

Altner et al. (2022) [5] compared the treatment outcomes for children suffering from severe caries and MIH and found that the management of MIH-affected teeth is a multidisciplinary task. A major problem in the management of MIH in Asia and India remains inadequate dental services in most communities. Proper restorative materials, fluoride varnish preventive treatments, and qualified dental professionals are needed to enhance the treatment outcomes of patients diagnosed with MIH.

Khan et al., 2022 [27] published a research study regarding Moradabad, India, on the prevalence, pattern, and severity of MIH in 8–12-year-old schoolchildren. The research study emphasized the early diagnosis and preventive treatment to avoid the transition of MIH to a severe form of dental disease. This would suggest that school-based dental screening programs are a good avenue through which an identification and subsequent management of MIH can be affected, more so in rural areas where dental care is not readily available. The study by Mittal and Sharma (2015) [28] reports on the prevalence and characteristics of MIH in Indian schoolchildren. The cross-sectional survey conducted with 1,240 children between the age of 8-12 years in Gautam Budh Nagar revealed a prevalence of MIH to be 10.48% and post-eruptive breakdown or caries in 42.31% of the affected children that required restoration.

Impact of MIH on Quality of Life

MIH results in functional impairments, including tooth sensitivity and a heightened risk of caries, which subsequently detrimentally influence oral health-related quality of life [1]. A systematic review indicated that children diagnosed with Molar-Incisor Hypomineralization (MIH) often endure pain, challenges in consuming food, and heightened social anxiety stemming from their discolored teeth [18]. Pain and discomfort can significantly hinder daily functioning, encompassing academic performance and social engagement [5]. Recent developments in diagnostic instruments, including fluorescence dental loupes, have enhanced the accuracy of MIH detection, facilitating prompt intervention [3]. Preventive methods using silver diamine fluoride, in combination with CPP-ACP fluoride varnish, have been found to alleviate symptoms and prevent further enamel deterioration [3][4]. However, MIH treatment remains challenging, especially in regions where access to specialist dental services is limited. Thus, early diagnosis and tailored interventions may be critical strategies for ensuring an optimal oral health outlook and quality of life for the affected child in later years [11].

Children with MIH often experience tooth hypersensitivity, post-eruptive enamel breakdown, and aesthetic concerns, which can lead to embarrassment, anxiety, and lower self-esteem. This often results in a reluctance to participate in social activities, such as smiling or interacting with peers, which can exacerbate social isolation [29]. Additionally, children with MIH face challenges in academic settings due to the discomfort and pain associated with the condition, particularly during eating and speaking, affecting concentration and participation in school activities [30]. The psychological toll of MIH is further reflected in reports of bullying related to the appearance of discolored teeth, leading to emotional distress (Schneider et al., 2024).

Preventive Strategies

Molar Incisor Hypomineralization (MIH) is described as a developmental defect that impacts the enamel of first permanent molars and permanent incisors [23]. There are ways that can help prevent MIH from happening in the first place. Latest guidelines suggest the use of fluoride varnish application and the placement of sealants to prevent dental caries in teeth affected by MIH [3][4]. Adherence to better oral hygiene measures can help avoid the progression of hypomineralized defects (Dulla & Meyer-Lückel, 2021). Screening and early detection enables the implementation of prevention measures before complications arise [20]. Minimally invasive therapeutic methods such as resin infiltration prevent the further destruction of caries [19]. It has been reported that microabrasion

enhances the surface texture and optical properties of enamel [31]. To avoid further decay or wearing off of hypomineralized teeth, dentists should ensure that parents and patients improve on oral hygiene, diet regulation, and dental check-ups [20] Dulla & Meyer-Lückel, 2021). The deployment of preventive measures at the initial stages can have better results concerning the MIH prognosis and overall course of the illness.

Al-Nerabieah et al. [4] conducted a randomized controlled trial to assess the preventive efficacy of 38% silver diamine fluoride and casein phosphopeptide-amorphous calcium phosphate fluoride varnish in the treatment of MIH-impacted molars. Both treatments were efficacious in preventing hypersensitivity and caries progression in impacted MIH molars. Such preventative treatments may prove useful in under-resource regions in Asia and India where sophisticated dental treatment is not readily available.

Quality assessment

All the studies included in this review were evaluated on methodological robustness, sample size, design of the study, and relevance. Any study with high bias, methodology that was not clear, or with a small sample size was excluded from this final review. The remainder of the studies were rated with their contribution to the understanding of MIH in its prevalence, impact on quality of life, and preventive strategies in line with the topic of study. This ensured that this systematic review would be based on high-quality evidence.

The selected articles were independently reviewed by two reviewers who assessed whether the included articles matched the criteria listed for their inclusion. Each of the selected articles was analyzed in detail for the quality of the work and the database from where they were collected. Based on this assessment a final list of articles for the study was obtained. The final articles obtained for the study were indexed in Pubmed. The Mixed methods assessment tool (MMAT) was used for the quality assessment of the papers identified for the systematic literature review. MMAT methods were proposed for qualitative and quantitative studies. However, this method is not applicable for the assessment of the review papers and theoretical papers [32]. The MMAT summarizing the various studies included is shown in Table 1 as follows.

Table 1: MMAT analysis of the studies included in the systematic review

Category of study designs	**Methodological quality criteria**	**Responses**			
		Yes	No	Can't tell	Comments
Screening questions	S1. Are there clear research questions?	✓			
(for all types)	S2. Does the collected data allow me to address the research questions?	✓			
	Further appraisal may not be feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.				
1. Qualitative	1.1. Is the qualitative approach appropriate to answer the research question?	✓			

	1.2. Are the qualitative data collection methods adequate to address the research question?	✓			Shields et al. (2024)[29] da Silva, et al. (2023)[13] Sezer & Çarıkçıoğlu, (2024) [33] Afshari, E., et al. (2022)[24] Alzahrani, A. Y., et al. (2023)[9] Amrollahi, N., et al. (2023) [1] Awwad, A., et al. (2023)[18] Bandeira Lopes, L., et al. (2021)[23] Bukhari, S. T., et al. (2022)[34] Elhennawy, K., & Schwendicke, F. (2016)[19] Fatturi, A. L., et al. (2019)[35] Gevert, M. V., et al. (2024) [36] Inchingolo, A. M., et al. (2023)[31] Jälevik, B., et al. (2022)[37] Jawdekar, A. M., et al. (2022) [38] Juárez-López, M. L. A., et al. (2023)[7] Lopes, L. B., et al. (2021)[23] Mazur, M., et al. (2023) [39] Romo Pérez, C., et al. (2023) [40] Somani, C., et al. (2022)[20]
	1.3. Are the findings adequately derived from the data?	✓			
	1.4. Is the interpretation of results sufficiently substantiated by data?	✓			
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?	✓			
2. Quantitative randomized controlled trials	2.1. Is randomization appropriately performed?	✓			Al-Nerabieah, et al. (2024) [3] Bekes, et al. (2021)[11]
	2.2. Are the groups comparable at baseline?	✓			

	2.3. Are there complete outcome data?	✓			
	2.4. Are outcome assessors blinded to the intervention provided?	✓			
	2.5 Did the participants adhere to the assigned intervention?	✓			
3. Quantitative non-randomized	3.1. Are the participants representative of the target population?	✓			
	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	✓			Altner, S., et al. (2022)[5] Fütterer, J., et al. (2020)[21] Joshi, T., et al. (2022)[16] Michaelis, L., et al. (2021) [41] Portella, P. D., et al. (2019) [17] Reissenberger, T., et al. (2022) [42]
	3.3. Are there complete outcome data?	✓			
	3.4. Are the confounders accounted for in the design and analysis?			✓	
	3.5. During the study period, is the intervention administered (or exposure occurred) as intended?	✓			
4. Quantitative descriptive	4.1. Is the sampling strategy relevant to address the research question?	✓			Abdelaziz, M., et al. (2022) [2] Arslanagic-Muratbegovic, A., et al. (2020)[25] Berenstein Ajzman, G., et al. (2023) [10] Brejawi, M. S., et al. (2023) [43] Głódkowska, N., & Emerich, K. (2020)[8] Hussein, A. S., et al. (2015) [44] Khan, A., et al. (2022)[27] Mishra, A., & Pandey, R. K. (2016) [45] Rai, A., et al. (2018) [46] Rai, P. M., et al. (2019) [47] Shah, V. U., et al. (2023) [48] Subramaniam, P., et al. (2016)[26]

	4.2. Is the sample representative of the target population?	✓			
	4.3. Are the measurements appropriate?	✓			
	4.4. Is the risk of nonresponse bias low?	✓			
	4.5. Is statistical analysis appropriate to answer the research question?	✓			
5. Mixed methods	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?	✓			Dias, F. M. C. S., et al. (2021) [49] Freitas Fernandes, L. H., et al. (2021)[30]
	5.2. Are the different components of the study effectively integrated to answer the research question?	✓			
	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	✓			
	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	✓			
	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	✓			

DISCUSSION

Molar Incisor Hypomineralization (MIH) is defined as a developmental defect involving the enamel of at least one first permanent molar, possibly extending to the incisors [23]. The hypothesized enamel is predisposed to breakdown following eruption because of the altered mechanical characteristics of the teeth making them sensitive to post-eruptive challenges. MIH is reported in 5. 6% to 40. 2% of the population worldwide [23]. MIH prevalence was 21. 8% in the Swiss population and based on a systematic review the rate was between 2. 4%-35. 5% in Iranian children [24] [2].

It is characterized by having a multifactorial etiology where systemic and genetic factors occur during the maturation stage of permanent molars[7]. Dioxins or air pollution could also be connected with MIH [8]. Infectious and perinatal factors such as preterm birth, respiratory infection, and otitis media could be potential antecedents of MIH [10].

MIH can have an influence on OHRQoL and children with this condition experience a significant difference as compared to a control group [16]. Pain is a common concomitant symptom which adds to impacts on OHRQoL [41]. The resin infiltration or sealing of MIH lesions were associated with improvements in OHRQoL[21].

In order to control MIH, the management protocols should include early diagnosis of the disease [6] as well as the application of remineralizing agents or sealants that can slow down the further development of the disease (Al-Nerabieah et al., 2024) [3][4]. Composites, crowns or Glass Hybrid Restorations can restore the morphology, function and aesthetics of the formed teeth in cases with severe involvement [12] [20]. In essence, follow-ups are mandatory due to the lifetime consequences posed by MIH.

Table 2: Characteristics of studies from year 2004 to 2024

Author(s) & Year	**Study Method/Design**	**Outcome**	**Region/Country**
Abdelaziz et al. (2022) [2]	Cross-sectional study	Prevalence of MIH in schoolchildren	Switzerland
Afshari et al. (2022)[24]	Systematic review and narrative synthesis	MIH prevalence in Iranian children	Iran
Al-Nerabieah et al. (2024)	Diagnostic accuracy study	Reliability of fluorescence dental loupes in detecting MIH	Not specified
Al-Nerabieah et al. (2024)	Randomized controlled trial	Preventive efficacy of SDF and CPP-ACP fluoride varnish on MIH-affected molars	Not specified
Altner et al. (2022)[5]	Comparative study	Influence of treating severe caries & MIH on oral health-related quality of life (OHRQoL)	Not specified
Alzahrani et al. (2023)[9]	Literature review	Contemporary understanding of MIH etiology and management	Not specified
Amrollahi et al. (2023) [1]	Systematic review and meta-analysis	MIH impact on OHRQoL in 8–10-year-old children	Not specified
Arslanagic-Muratbegovic et al. (2020)[25]	Cross-sectional study	MIH prevalence and severity in 6–9-year-olds	Bosnia & Herzegovina (Sarajevo)

Awwad et al. (2023)[18]	Systematic review and meta-analysis	Effect of MIH prevalence & severity on OHRQoL	Not specified
Bandeira Lopes et al. (2021)[23]	Umbrella review	Summarized evidence on MIH	Not specified
Bekes et al. (2021)[11]	Prospective cohort study	Changes in OHRQoL after sealing hypersensitive MIH molars	Not specified
Berenstein Ajzman et al. (2023) [10]	Cross-sectional study	Developmental enamel defects prevalence and perinatal conditions association	Israel
Brejawi et al. (2023)[43]	Cross-sectional study	MIH prevalence and severity in children	UAE (Fujairah)
Bukhari et al. (2022)[34]	Systematic review and meta-analysis	MIH prevalence & risk factors in Middle East	Middle East
Dantas-Neta et al. (2016)[14]	Cross-sectional study	MIH impact on OHRQoL in schoolchildren	Brazil
da Silva et al. (2023)[13]	Narrative review	MIH and OHRQoL evidence summary in Brazilian children	Brazil
Dias et al. (2021) [49]	Cross-sectional study	Parents' and children's perception of MIH impact on OHRQoL	Brazil
Elhennawy & Schwendicke (2016)[19]	Systematic review	Management strategies for MIH	Not specified
Elhennawy et al. (2022)[15]	Cross-sectional study	Association of MIH and OHRQoL	Germany
Fatturi et al. (2019)[35]	Systematic review and meta-analysis	Systemic exposure associated with MIH	Not specified
Fernandes et al. (2021)[30]	Population-based study	MIH and quality of life in Brazilian schoolchildren	Brazil

Fütterer et al. (2020)[21]	Prospective study	Customized therapy's influence on children's oral hygiene & quality of life	Germany
Garg et al. (2012)[6]	Literature review	Early diagnosis importance, clinical presentation, etiology, management of MIH	India
Gevert et al. (2024)[36]	Systematic review and meta-analysis	Clinical consequences of MIH in children and adolescents	Not specified
Głódkowska & Emerich (2020)[8]	Cross-sectional study	Environmental air pollution's impact on MIH prevalence	Poland
Hussein et al. (2015)[44]	Cross-sectional study	MIH distribution in Malaysian children	Malaysia
Inchingolo et al. (2023)[31]	Systematic review	Treatment approaches to MIH	Not specified
Jälevik et al. (2022)[37]	Systematic review	MIH influence on dental fear, anxiety, and OHRQoL	Not specified
Jawdekar et al. (2022)[38]	Systematic review and meta-analysis	OHRQoL in children with MIH	India
Joshi et al. (2022)[16]	Cross-sectional study	MIH impact on OHRQoL in 8–10-year-olds	Germany
Juárez-López et al. (2023)[7]	Systematic review and meta-analysis	Etiological factors of MIH	Not specified
Khan et al. (2022)[27]	Cross-sectional study	MIH prevalence, pattern, and severity	India (Moradabad City)
Kisacik et al. (2024) [50]	Cross-sectional study	MIH and OHRQoL in 8–12-year-old children	Turkey
Lopes et al. (2021)[23]	Systematic review and meta-analysis	MIH prevalence globally	Global
Mazur et al. (2023)[39]	Systematic review and meta-analysis	MIH association with dental caries	Not specified
Michaelis et al. (2021)[41]	Cross-sectional study	Caries & MIH impact on OHRQoL	Germany
Mishra & Pandey (2016) [45]	Cross-sectional study	MIH prevalence & etiological factors in Indian children	India

Portella et al. (2019) [17]	Cross-sectional study (hierarchical approach)	MIH impact on quality of life in children with mixed dentition	Brazil
Rai et al. (2018)[46]	Cross-sectional study	MIH prevalence and risk factors among 7–9-year-old children	India (Ghaziabad)
Rai et al. (2019)[47]	Cross-sectional study	MIH prevalence in 9–12-year-old children	India (Karnataka)
Reissenberger et al. (2022)[42]	Cross-sectional study	Hypomineralized teeth impact on OHRQoL	Germany
Rodd et al. (2021) [51]	Literature review	Current knowledge and practice on MIH	Not specified
Romo Pérez et al. (2023)[40]	Systematic review	MIH effect on OHRQoL in children and adolescents	Peru
Sezer & Çarıkçıoğlu (2024)[33]	Narrative review	Treatment strategies for incisors affected by MIH	Not specified
Shah et al. (2023)[48]	Cross-sectional study	MIH prevalence, severity, and risk indicators in 8–13-year-olds	India (Gujarat)
Shields et al. (2024)[29]	Narrative review	Impact of MIH on children and adolescents	Not specified
Somani et al. (2022)[20]	Systematic review	Updated treatment modalities for MIH	Not specified
Subramaniam et al. (2016)[26]	Cross-sectional study	MIH prevalence in 7–9-year-old children	India (Bengaluru)

CONCLUSION

Molar Incisor Hypomineralization (MIH) is a developmental defect of enamel that affects at least one first permanent molar but may also involve other molars or the incisors. MIH is globally estimated to affect between 2. 4% and 40. 2% of the population. It is a polygenic condition, and although it is not clear whether genetic and systemic factors that exist during molar maturation can cause the disease, they could be factors. Other possible antecedents might include infections, perinatal conditions, and environmental conditions. As a result of MIH, children are more likely to have higher pain and dental sensitivity than children of similar ages. The use of resin infiltration or sealing of the lesion may be beneficial. This is because early diagnosis allows for prompt intervention which includes remineralizing agents that check the progression of the disease. For very complex deformities, direct or indirect fillings such as composites, crowns, or glass hybrids reconstruct the shape, function, and appearance of affected teeth. In a nutshell, MIH carries lifelong implications which necessitate constant supervision. The data regarding prevalence confirms MIH as a significant dental public health concern on a global level. Subsequent studies should be conducted to identify more specific etiology and to define the most effective treatment strategies to minimize the effects of MIH on the quality of life.

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