ORIGINAL RESEARCH

Molar Incisor Hypomineralization: Prevalence and Treatment Needs in 7- to 9-year-old Children of Lucknow City

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Abstract

Background: Molar incisor hypomineralization (MIH) is one of the most common developmental disturbances that dental practitioners encounter, which may influence the child's quality of life and can impact their future dental health.

Aim: To determine prevalence and treatment needs of MIH in children of Lucknow.

Materials and methods: A total of 800 children aged 7 to 9 years were clinically screened for the presence of MIH. All demographic details were filled in by the examiner in communication with the parents, and examination was performed using the Würzburg MIH concept.

Results: The overall prevalence of MIH in the children examined was 5.12%. A higher prevalence was found in males (7%) than in females (3.25%). The distribution of MIH was higher in the mandibular arch than in the maxillary arch. Mandibular molars were the most affected teeth, followed by maxillary incisors, and the least affected teeth were maxillary molars. On the basis of severity, 55.14% of teeth with MIH had no breakdown or hypersensitivity followed by 30.14% of teeth with hypersensitivity but no breakdown, and 7.35% of teeth had both hypersensitivity and breakdown. Based on severity, in 39.70% of teeth, the intervention suggested was fluoridated toothpaste, casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) remineralizing agent, and varnish application. This was followed by the application of sealants and low-viscosity glass ionomer cement (GIC) in 38.97% of teeth, and in 7.35% of teeth, short- and long-term restorations, including stainless steel crown (SSC), were recommended.

Conclusion: Prevalence of 5.12% was observed in children of Lucknow city. The characteristics of MIH defects were predictive of the treatment of the affected first permanent molars and incisors and can guide their management.

Keywords: Molar incisor hypomineralization, prevalence, treatment, treatment need index.

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Introduction

Molar incisor hypomineralization (MIH) is a particular kind of enamel defect that affects the first molars and incisors in the permanent dentition. MIH is regarded as a global issue and typically affects children under 10 years old.[1] This developmental disease is brought on by the enamel's failure to mineralize throughout its maturity phase as a result of an ameloblast function disruption.[2] Numerous causes have been put forth, including heredity and pregnancy-related health issues, preterm delivery, cyanosis, illnesses in infancy like chickenpox and otitis media, urinary tract infections, and tonsillitis, but mainly childhood illnesses—particularly fever—seem to be linked.[3] One to four permanent molars and the associated incisors frequently exhibit discoloration as the first sign of MIH. The damaged teeth's enamel appears yellow, brown, cream, or white, leading to the nickname "cheese molars."[4] Children with MIH and their parents experience distress because of the perception that these teeth are less aesthetically acceptable. Compared to children without the lesion, children with MIH have a higher risk of developing dental decay. Furthermore, because the enamel is less mineralized, tooth decay develops very quickly. Opacities on the tooth, if it is affected, can be seen when the permanent molars begin to emerge and MIH becomes obvious. In order to avoid any additional issues impacting their dental health, it will be beneficial for children who are thought to have MIH to see their dentist more frequently when their first permanent molars (FPMs) erupt.

To describe hypomineralized molars, a variety of terminology was used, including nonfluoride enamel opacities, internal enamel hypoplasia, nonendemic mottling of enamel, opaque patches, idiopathic enamel opacities, enamel opacities, and cheese molars.[5] The term MIH was originally used in 2001 by Weerheijm et al.,[6] who defined MIH as the hypomineralization of one to four systemically derived permanent first molars that typically coexist with the affected incisors.

In 2003, MIH was further defined as a developmental, qualitative enamel defect that results in enamel discoloration and fractures of the affected teeth due to impaired mineralization and inorganic enamel components. The FPMs and incisors were initially identified as being affected by the condition; however, more recently, it has been observed that these defects can affect any primary or permanent tooth.[7]

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The prevalence of MIH varies greatly over the world, from 2.8% in Hong Kong[8] to 42% in Brazil.[9] The prevalence of MIH in India varies from one geographical location to another with 0.48% in Bengaluru,[10] 4.19% in Jaipur,[11] 9.46% in Udaipur,[12] and 21.4% in Muradnagar, Ghaziabad.[13]

The unexplained discrepancies in the stated prevalence rate are mostly a result of the absence of a consistent method for recording MIH data in epidemiological research. A global team of professionals in the field of MIH created a new index called molar incisor hypomineralization treatment need index (MIH-TNI),[14] which serves as an evaluation tool for determining the requirement of treatment for MIH and for routine monitoring of patients by dentists. The MIH-TNI evaluates the extent of damage to the teeth, along with any associated hypersensitivity, in individuals with MIH. It is recommended as a foundation for personal dental evaluations addressing all typical issues associated with MIH or for creating a treatment plan.

There are many different treatment options for MIH, but choosing the best one is a difficult and complicated decision. The severity of the illness, the patient's dental age, and the child's or parent's social background and expectations are only a few possible factors. There are therapy options available to manage children with MIH; however, the evidence for these options is still insufficient.

There is no epidemiological survey carried out using the Würzburg MIH concept: MIH-TNI[15] to find out the prevalence of MIH in Lucknow city, India. The purpose of this study is to assess the prevalence and treatment needs in 7- to 9-year-old school children with MIH in Lucknow city.

Materials and Methods

Study Design

The target population was 800 children between the age-group 7 and 9 years old attending various private and public schools in the city of Lucknow. The participants were selected using the stratified sampling method.

Study Place

The present cross-sectional study was conducted in the Department of Pediatric and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences (BBDCODS). After obtaining clearance from the institutional ethical committee of BBDCODS, Lucknow, participants who fulfilled the inclusion and exclusion criteria were enrolled in the study. Written informed consent was obtained from the school authorities and parents of children between 7 and 9 years old before the study was initiated.

Sample Size Calculation

According to a similar study conducted in Ghaziabad, expecting a 9% prevalence of MIH in children between 7 and 9 years old in Lucknow city and considering a 95% confidence level, the sample size was decided according to the formula: $N = Z^2p\,(1 - p)/d^2$. Using this formula, the sample size for the study was estimated to be 787.

Eligibility Criteria

Inclusion Criteria

- Both genders between the ages 7 and 9 years were present in the selected schools on the day of survey.
- Children with all permanent first molars, permanent incisors, and second primary molars present in the oral cavity.
- Subjects for whom consent was obtained from parents.

Exclusion Criteria

- Children undergoing orthodontic treatment.
- Those who were not unwilling to participate in the study.

Instruments and Equipment

- Examination gloves
- Mouth mask
- Head cap
- Mouth mirror
- Blunt probe
- Kidney tray
- Green cloth
- Sanitizer

Methodology

Eight hundred participants who fulfilled the inclusion criteria were enrolled in the study. Two calibrated examiners assessed the participants and recorded all the details in the case sheet. Initially, all the demographic details were recorded, and a rapport was established with the children by the means of communication, which helped in behavior modification and a positive response from the children. The evaluation was done according to the Würzburg MIH concept: MIH-TNI. All the index teeth, FPMs, and permanent incisors were examined provided that they were fully erupted.

Evaluation Criteria

The following evaluation criteria were applied to both primary and permanent teeth. The criteria set by the European Academy of Paediatric Dentistry (EAPD) served as the basis for the examiner to determine the presence or absence of MIH. Once a decision was made regarding the presence or absence of MIH, patients with other enamel developmental defects were ruled out. The presence of MIH was detected if any of the following characteristics were observed: defined opacity on occlusal and buccal surfaces of the teeth; varying shapes, sizes, and patterns of defects; deviations in color (white, cream-colored, or yellow-brown); varying sizes of defects (defects with a diameter/expansion <1 mm are not recorded); presence of hypersensitive teeth, atypical restoration, missing permanent teeth for suspected MIH reasons, or a combination of these characteristics. After determining the presence of MIH, further classification was made from levels 1 to 4.

Grading/Classification of the MIH-TNI

The grading was determined by the two primary clinical indicators: sensitivity and disintegration. Levels 1 to 4 are displayed in the Würzburg MIH concept: MIH-TNI. The assessment was conducted using visual inspection with a mirror, tactile examination with a probe, and under adequate lighting.

Measurements were taken in a clockwise direction starting with the maxillary right as the first quadrant. Values were noted viewing the patient from the front. All these values were taken by two calibrated examiners. Interexaminer reliability between the two examiners was determined by kappa coefficient.

Molar incisor hypomineralization treatment need index therapy plan based on the grading of MIH-TNI was assessed using the Würzburg MIH concept: part 2. The treatment plan[15] (Fig. 1). The MIH-TNI index was used to create a customized treatment plan for each instance of MIH. The range of options includes preventive measures, such as cleaning and sealing, as well as restorative treatments, such as temporary or permanent fillings, or tooth

extraction. The most suitable treatment for each individual case of MIH was determined based on the specific symptoms present.

Statistical Analysis

The data for the present study were entered into Microsoft Excel 2007 and analyzed using the SPSS statistical software version 23.0. The descriptive statistics included frequency and percentage. The level of significance for the present study was fixed at 5%. The intergroup comparison for the difference of frequency between independent groups was done using Chi-square test.

Results

Table 1 depicts that out of 800 individuals examined, 41 (5.12%) were found to have MIH. It was found that males had a higher prevalence of MIH at 7.0% compared to females, who had a prevalence of 3.25%. The statistical analysis revealed that there was no significant difference between the different age-groups in the studied population.

Table 2 depicts the distribution of MIH was higher in mandibular arch compared to maxillary arch. The highest scoring (score 4) as well as the least scoring (score 1) was seen more in the mandibular arch than in the maxillary arch. Therefore, severity of MIH was more in the mandibular arch, and the difference was found to be significant. The overall prevalence of incisors (42.60%) was more than molars (40.15%). However, the prevalence of MIH, on the basis of sextants, was higher in mandibular molars (28.65%), followed by maxillary incisors (23.10%) and least in maxillary molars (11.50%). Mandibular and maxillary molars had a higher level of severity (scores 3 and 4), with lower levels of severity found in maxillary and mandibular incisors (scores 1 and 2).

Table 3 shows that out of 136 teeth examined, the largest number of teeth, 75 (55.14%), received a score of 1 meaning they had no breakdown or hypersensitivity. These were followed by

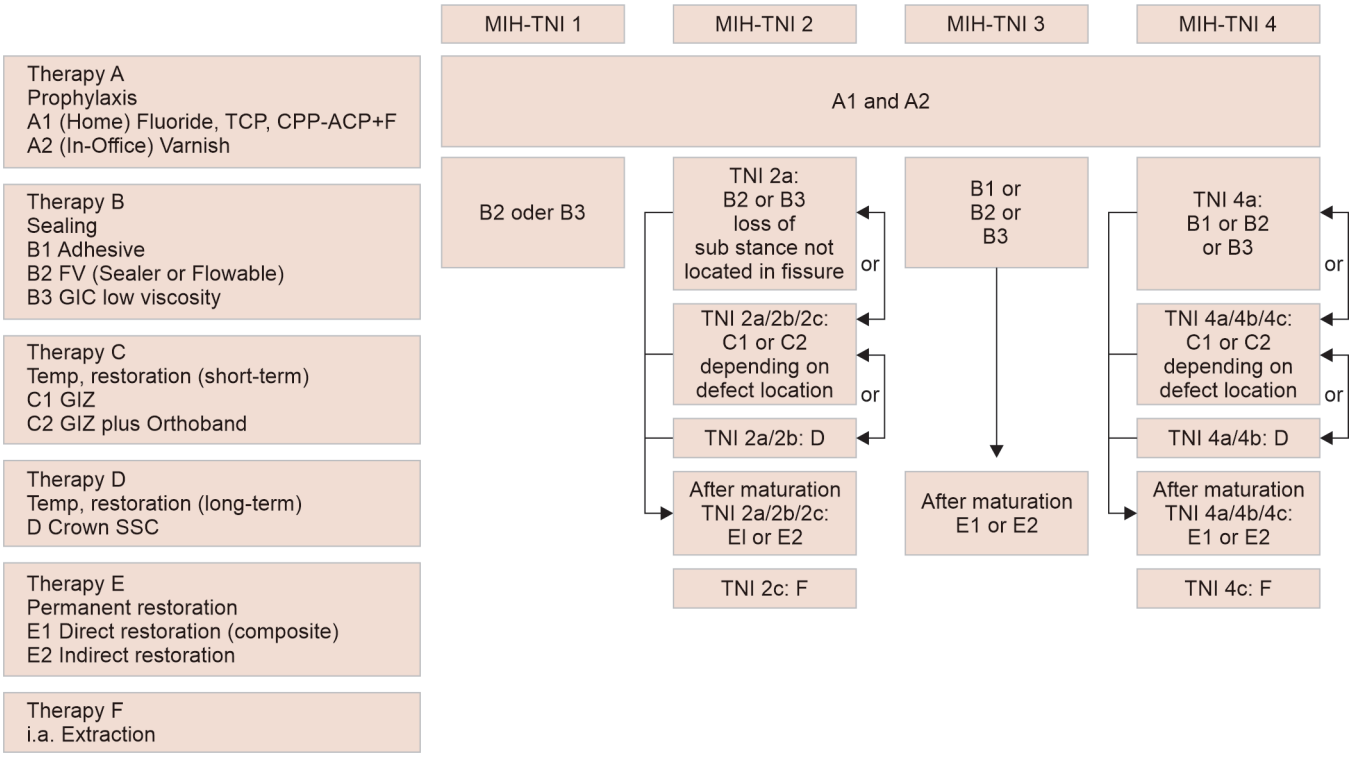

Fig. 1: Molar incisor hypomineralization treatment need index therapy plan based on the grading of MIH-TNI

Table 1: Age-wise and gender-wise distribution of molar incisor hypomineralization

	MIH present	*MIH absent*	*Chi-square value*	*p-value*
N				
800	41 (5.12%)	759 (94.88%)	101.718	0.001 (Sig.)
Gender				
Male	28 (7.0%)	372 (93%)	5.718	0.016 (Sig.)
Female	13 (3.25%)	387 (96.75%)		
Age of children				
7 years (*N* = 265)	10 (3.77%)	255 (96.23%)	2.564	0.277 (Non-sig.)
8 years (*N* = 265)	18 (6.79%)	247 (93.21%)		
9 years (*N* = 270)	13 (4.81%)	257 (95.19%)		

MIH, molar incisor hypomineralization

41 teeth (13.40%) which received a score of 3, indicating they had hypersensitivity but no breakdown. The smallest number of teeth, 10, receives scores of 2 and 4 with breakdown and both hypersensitivity as well as breakdown, respectively.

Table 4 illustrates that out of the 136 teeth assessed, the most frequently required treatment were therapy A and therapy B, which were carried out on 39.70% and 38.97% of the teeth, respectively. The next most common treatment was therapy E, performed on 13.97% of teeth. On the contrary, the least frequently required treatments were therapy C and therapy D, which were carried out on 7.35% of teeth in both groups, respectively.

Discussion

This cross-sectional study was conducted to determine the prevalence and treatment needs of MIH in children of Lucknow, in the Department of Paediatric and Preventive Dentistry, BBDCODS, Babu Banarasi Das University (BBDU), Lucknow.

The prevalence of MIH varies considerably across the world, primarily due to the inconsistent use of criteria and indices, which makes it challenging to compare data.[16] Several other countries have also reported a significant range in the prevalence of MIH, ranging from as low as 2.8% in Hong Kong to as high as 40.2% in Brazil.[17,18]

In the present study, the prevalence of MIH was examined by the two calibrated examiners using the Würzburg MIH concept: MIH-TNI. The prevalence of MIH was reported to be 5.12% in the current study, which is comparable to studies done in Cairo, Egypt (2.3%)[19] and other regions of India (3.96% in Moradabad[20] and 5.7% in Odisha[21]). However, MIH is more prevalent in other parts of India (9.46% in Udaipur,[12] 14.9% in Jammu,[22] 8.9% in Devangere,[23] and 9.7% in Chennai[24]). The wide range in MIH prevalence may be attributed to variations in ethnicity, age-groups, sample sizes, diagnostic criteria, and the presence of caries. In older children, the presence of caries and occlusal wear may alter the diagnosis of MIH.

The present study examined visible enamel defects larger than 1 mm based on MIH-TNI criteria, which is in accordance with the previous studies that have also included defects equal to or larger than 1 mm, as recommended by the EAPD in 2003.[7]

The EAPD recommends diagnosing MIH at 8 years old when most permanent incisors and molars are present while the signs of MIH will still be visible.[7] In our study, the age-groups of children examined for MIH did not show a significant difference in prevalence, which is similar to a study in Sudan.[25] In mild cases, MIH may go unnoticed in younger children; these signs become more apparent as the child ages.

In our present study, the prevalence of MIH was higher in males (7%) compared to females (3.25%), which aligns with the results of studies conducted in Iraq by Ghanim et al.[26] and in Iran by Ahmadi et al.[27] However, this finding is in contrast to a study in Jordan by Zawaideh et al.,[28] which showed a higher prevalence of MIH in females. This was attributed to the fact that during the growing years, females are more advanced than males in dental development, affecting their FPMs.

The present study found a higher prevalence of MIH in mandibular teeth compared to maxillary teeth, which is comparable with the results of Jasulaityte et al.[29] Higher prevalence in mandibular arch may be due to the early eruption of mandibular teeth than maxillary, which resulted in earlier recognition of the defect.

A study done by Abdalla et al. in Sudan showed the distribution in the occurrence of MIH with mandibular molars more affected

Table 3: Distribution of teeth on the basis of severity of molar incisor hypomineralization

MIH-TNI index	*N = 136*	*Percentage*
Score 1 (teeth with MIH having no breakdown and hypersensitivity)	75	55.14%
Score 2 (teeth with MIH having breakdown but no hypersensitivity)	10	7.35%
Score 3 (teeth with hypersensitivity but no breakdown)	41	30.14%
Score 4 (teeth with both hypersensitivity and breakdown)	10	7.35%
Total	136	100%

MIH-TNI: molar incisor hypomineralization treatment need index

Table 4: Distribution of teeth on the basis of treatment intervention

Intervention	*N = 136*	*Percentage*
Therapy A [use of fluoride toothpaste and CPP–ACP remineralizing agents (at home) and varnish application (in office)]	54	39.70%
Therapy B (application of sealants and low-viscosity GIC)	53	38.97%
Therapy C and D (short-term and long-term restorations including SSC crown)	10	7.35%
Therapy E (extraction)	19	13.97%

CPP-ACP: casein phosphopeptide-amorphous calcium phosphate; GIC: glass ionomer cement; SSC: stainless steel crown

Table 2: Arch-wise distribution of teeth according to molar incisor hypomineralization and distribution of teeth according to maxillary and mandibular sextants and severity of molar incisor hypomineralization

	Score 1	*Score 2*	*Score 3*	*Score 4*	*p-value*
Arch					
Maxillary	32 (23.52%)	4 (2.94%)	17 (12.5%)	4 (2.94%)	0.032 (Sig.)
Mandibular	43 (31.61%)	6 (4.41%)	24 (17.64%)	6 (4.41%)	
Sextants					
Maxillary right	0 (0%)	4 (2.94%)	8 (5.88%)	3 (2.20%)	
Maxillary front	31 (22.79%)	0 (0%)	7 (5.14%)	0 (0%)	
Maxillary left	1 (0.73%)	0 (0%)	2 (1.47%)	1 (0.73%)	
Mandibular right	24 (17.64%)	0 (0%)	1 (0.73%)	0 (0%)	
Mandibular front	17 (12.5%)	3 (2.20%)	9 (6.61%)	3 (2.20%)	
Mandibular left	2 (1.47%)	3 (2.20%)	14 (10.29%)	3 (2.20%)	

than the maxillary molars and maxillary incisors more affected than mandibular incisors. This distribution pattern of MIH is consistent with the present study in which the occurrence of MIH was most frequent in mandibular molars (28.65%) followed by maxillary incisors (23.10%), mandibular incisors (19.50%), and maxillary molars (11.50%).

The severity of the defect in this study was determined by the Würzburg MIH concept: MIH-TNI. In the present study, majority of the teeth (75 teeth or 55.14%) that were examined received a score of 1, which meant they had no hypersensitivity or breakdown. The second largest group consisted of 41 teeth (30.14%) that received a score of 3, which indicated that they had hypersensitivity but no breakdown (Table 3). Both lower and upper molars showed higher severity with scores of 3 and 4, while severity was less in the upper and lower incisors, with scores of 1 and 2. Parikh et al.,[30] Kevrekidou et al.,[31] Mejia et al.,[32] and Silva et al.[33] determined the severity of MIH by Lygidakis et al.'s[34] criteria, which is recorded as mild or severe. The main advantage of employing the Würzburg MIH concept criteria compared to Lygidakis et al.'s criteria is that it not only identifies the presence of MIH but also considers the extent of damage and hypersensitivity. This added dimension assists in evaluating the appropriate treatment for the defect based on the degree of MIH extension. The MIH-TNI determines a treatment plan for each case of MIH. In the present study, as the most prevalent MIH defect was demarcated opacities without any breakdown or hypersensitivity, minimal intervention and noninvasive procedures such as prophylaxis followed by the use of fluoride toothpaste and remineralizing agents were enough to treat them. According to a systematic review by Elhennawy et al.,[35] the most commonly recommended treatment approach for managing MIH was to use desensitizing agents (CPP-ACP) followed by applying sealants, composite restorations, or crowns, which also supports our present study. The least required option was extraction (Table 4).

A gap still exists in establishing a standardized and straightforward assessment criterion that can effectively link defect size and hypersensitivity in individual teeth to the overall oral health of an individual, along with providing treatment recommendations.[36] In recent years, various indices have been improved with a primary focus on opacities and the extent of damage caused by MIH. Subsequently, efforts have been made to incorporate hypersensitivity as a relevant parameter in the assessment of MIH. However, none of the existing assessment criteria has accounted for the significant impact hypersensitivity can have on a patient's eating habits, oral hygiene, and willingness to cooperate with necessary restoration procedures.

The index used in this present study helps in recording hypersensitivity in its early stages, which is crucial for delivering comprehensive care and including them in a thorough follow-up program. This index can be used to evaluate both population groups and individuals taking into account key factors related to MIH, including opacity, loss of substance, and hypersensitivity. This approach enhances the likelihood of achieving a successful rehabilitation, addressing both functional and aesthetic aspects satisfactorily.

However, this study has some limitations. Being a cross-sectional study, it does not assess the progression of disease over time but only measures it at a specific moment in the participants' lives. Also, it does not take into account all the faces of teeth examined for MIH.

It can be concluded that despite some inherent limitations, the present study can prove to be useful for early diagnosis, intervention, and management of MIH for dental practitioners. We recommend further studies with larger sample sizes related to the diagnosis and treatment needs of MIH patients, which can substantiate the findings of the present study.

Clinical Significance

This study incorporates a recent diagnostic tool to assess the prevalence and treatment needs of MIH among children in Lucknow city, utilizing the Würzburg MIH concept: MIH-TNI. This index serves to evaluate the extent of defects in MIH as well as the presence of hypersensitivity in individuals. By categorizing the severity of these defects, the study proposes tailored treatment plans for each individual, contributing to early detection, prevention, and effective management of these MIH lesions, ultimately leading to improved oral health outcomes for individuals.

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