

PREVALENCE AND SEVERITY OF MOLAR-INCISOR HYPOMINERALIZATION IN CHILDREN IN HUE CITY, VIETNAM

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ABSTRACT

Background: Data about molar-incisor hypomineralization (MIH) prevalence and its severity remains limited in Vietnam. This study aims to find the prevalence and severity of MIH in children in Hue, Vietnam, utilizing The European Academy of Paediatric Dentistry (EAPD; 2022) criteria. **Materials and methods:** This cross-sectional investigation took place at some of Hue's primary schools, in Vietnam, with 834 children aged between six and ten years being recruited for participation. Children were evaluated using the EAPD criteria to diagnose MIH and to determine its severity. **Result:** MIH prevalence was found to be 29.6%. Besides, no significant differences were found between genders with higher cases among males. Most of the lesions were mild (85.0%). Regarding the number of affected molars, one permanent first molar (47.8%) is affected mainly by MIH. **Conclusion:** The prevalence of MIH was high. Furthermore, MIH mild cases were the most prevalent.

Keywords: *European Academy of Paediatric Dentistry, Molar Incisor Hypomineralization, Pediatric Dentistry.*

I. INTRODUCTION

In recent years, molar incisor hypomineralization (MIH) has emerged as a significant topic of interest in dentistry. From 2000 to 2017, the global prevalence of MIH was estimated at 14.5%, affecting

approximately 17.5 million children and adolescents [4].

The first documented cases of unexplained enamel defects were reported in the 1970s [4]. MIH is characterized as a systemic hypomineralization that manifests as enamel defects, impacting one to four permanent first molars, and may involve permanent incisors [10].

When affected by MIH, rapid carious development occurs on the permanent first molars shortly after the eruption, leading to significant patient complications and presenting numerous challenges for pediatric dentistry [10]. The diagnosis and classification of MIH are crucial for determining treatment strategies and prognostic outcomes [8].

Epidemiological studies from various regions yield differing results. A recent meta-analysis published in 2021 indicated a global prevalence of MIH at 13.5%, with variations among countries; the highest prevalence was noted in the Americas at 15.3%, while Asia reported the lowest at 10.7% [5].

In Vietnam, research on hypomineralized teeth remains limited. In 2020, a study conducted by Vo Truong Nhu Ngoc, Nguyen Phuc Binh, and colleagues assessed 2,118 students aged 12-15 in Binh Dinh province, revealing an MIH prevalence of 25% among the subjects studied [7]. Another study exploring the relationship between MIH and early loss of primary teeth among students aged 12-15 across several provinces in Vietnam found an overall MIH prevalence

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rate of 20.1% [9]. It is important to note that the prevalence of MIH is often underestimated in the 12-15 age group due to previous cases being misdiagnosed as caries, treated restoratively, or extracted. Early detection of MIH can facilitate better treatment strategies. This study aims to investigate the current status of MIH among schoolchildren aged 6-10 years in Hue City.

II. MATERIALS AND METHODS

2.1. Participant

The study included 834 schoolchildren aged 6 to 10 years from two primary schools in Hue City, conducted from April 2023 to May 2023.

- **Inclusion Criteria:** Children aged 6 to 10 years residing and studying in Hue City. Participants voluntarily consented to participate in the study and had no psychiatric issues or congenital defects.
- **Exclusion Criteria:** Children unable to cooperate in the study, those undergoing orthodontic treatment, suffering from systemic or acute oral diseases, or having congenital defects affecting physical development, mobility, or psychological well-being were excluded.

2.2. Methods

Study Design and Settings: This cross-sectional investigation was conducted at two primary schools in Hue City: Quang Trung Primary School and Phu Hoa Primary School. A convenient sample size of 834 children was selected for our study.

Sample Size: Based on the formula for estimating a proportion, we set $p=0.25$ according to the study by Vo Truong Nhu Ngoc, Nguyen Phuc Minh, and colleagues, who researched 2,118 students aged 12-15 in

Binh Dinh province to evaluate the prevalence and related factors of MIH [7]. A significance level of 5% and an absolute error of 5% were established. The calculated sample size was $n=288$, adding a 10% anticipated loss, we obtained $n=317$. This represents the minimum sample size, while our study surveyed a total of 834 students.

Training and calibration of the examiner: To ensure the reliability of the MIH investigator, before the field examination training programs were carried out. The examination was conducted by a pediatric dentist. Both individuals were then assessed with the same set of 40 pictures that covered all the degrees of MIH to be assessed as well as those that should not be classified as MIH like fluorosis, hypoplasia, and amelogenesis. During the field visits, a pediatric dental specialist accompanied the investigator to both schools and conducted a re-evaluation of all study participants, achieving kappa scores that ranged from 0.86 to 0.93.

Study protocol

Research Instruments:

- Examination tools: trays, explorers, mirrors, tweezers, air syringes, probes.
- Cotton gauze, antiseptic solution, gloves, and adequate lighting.
- Preparation of investigators: composed of dental specialists trained in standardized examination and data recording on survey forms.
- The study was conducted in well-lit areas utilizing both natural and artificial light to ensure adherence to research protocols.

Diagnostic Criteria: In this study, we employed the diagnostic criteria established by the European Academy of Paediatric Dentistry (EAPD) in 2022 [6].

Diagnostic feature	Description of the defect
Teeth involved	One to all four permanent first molars (FPM) with enamel hypomineralisation. Simultaneously, the permanent incisors can be affected. At least one FPM has to be affected for a diagnosis of MIH. The more affected the molars, the more incisors involved and the more severe the defects. The defects may also be seen at the second primary molars, premolars, second permanent molars and the tip of the canines.
Demarcated opacities	Clearly demarcated opacities presenting with an alteration in the translucency of the enamel. Variability in colour, size and shape. White, creamy or yellow to brownish colour. Only defects greater than 1 mm should be considered.
Post-eruptive enamel breakdown	Severely affected enamel breaks down following tooth eruption, due to masticatory forces. Loss of the initially formed surface and variable degree of porosity of the remaining hypomineralized areas. The loss is often associated with a pre-existing demarcated opacity. Areas of exposed dentine and subsequent caries development.
Sensitivity	Affected teeth frequently reveal sensitivity, ranging from mild response to external stimuli to spontaneous hypersensitivity. MIH molars may be difficult to anesthetize.
Atypical restorations	The size and shape of restorations are not conforming to the typical caries picture. In molars the restorations are extended to the buccal or palatal/lingual smooth surface. An opacity can be frequently noticed at the margins of the restorations. First permanent molars and incisors with restorations having similar extensions as MIH opacities are recommended to be judged as that.
Extraction of molars due to MIH	Extracted teeth can be defined as having MIH when there are: - Relevant notes in the records. - Demarcated opacities or atypical restorations on the other first molars. - Typical demarcated opacities in the incisors.

Classification of MIH Severity: We utilized the EAPD classification from 2022 for severity assessment [6].

Severity level	Signs and symptoms
Mild	Demarcated enamel opacities without enamel breakdown. Induced sensitivity to external stimuli e.g., air/water but not brushing. Mild aesthetic concerns on discolouration of the incisors.
Severe	Demarcated enamel opacities with breakdown and caries. Spontaneous and persistent hypersensitivity affecting function e.g., brushing, mastication. Strong aesthetic concerns that may have socio-psychological impact.

2.3. Statistical analysis

SPSS 26.0 for Windows software (IBM, USA) was used for statistical analysis. In this study, the Chi-square test was employed to

evaluate associations between various categorical variables. Specifically, the relationship between gender and the prevalence of MIH was assessed.

Additionally, the association between age groups and the prevalence of MIH was analyzed. The test was further applied to determine the relationship between the number of affected molars and the number of

affected incisors. Finally, the association between index teeth and types of defects was examined. A significance level of $p < 0.05$ was set for all statistical tests to determine meaningful associations.

III. RESULTS

3.1. Demographics

Table 1. Distribution of gender and age in children with and without MIH

(* Statistically significant difference by Chi-square test at $p < 0.05$.)

Variables		Total sample	MIH	Non MIH	p-value (*)
		n (%)	n (%)	n (%)	
Gender	Boys	462 (55.4)	133 (28.8)	329 (71.2)	0.559
	Girls	372 (44.6)	114 (30.6)	258 (69.4)	
Age	6	255 (30.6)	79 (30.9)	176 (69.1)	0.317
	7	107 (12.8)	32 (29.9)	75 (70.1)	
	8	169 (20.3)	53 (31.4)	116 (68.6)	
	9	148 (17.7)	48 (32.4)	100 (67.6)	
	10	155 (18.6)	35 (22.6)	120 (77.4)	

Table 1. A total of 834 children were examined for the presence of MIH, including 462 boys (55.4%) and 372 girls (44.6%). The largest group is the 6-year-old students, totaling 255 (30.6%), while the smallest group is the 7-year-olds, totaling 107 (12.8%). Among all examined children, 247 had MIH with an overall prevalence of 29.6%. The prevalence of MIH was 28.8% in males and 30.6% in females, with no significant gender difference ($p > 0.05$). The prevalence of MIH was 30.9%, 29.9%, 31.4%, 32.4% and 22.6% in the 6, 7, 8, 9 and 10 years age groups, respectively. The difference among different age groups was not significant ($p > 0.05$).

Table 2. Distribution of MH and MIH affected incisor and permanent first molars

Number affected molars	Number affected incisors									Total (%)
	0	1	2	3	4	5	6	7	8	
1	88	20	8	0	2	0	0	0	0	118
2	52	17	8	2	1	0	0	0	0	80
3	15	6	5	0	1	0	1	0	0	28
4	13	3	2	2	1	0	0	0	0	21
Total	168	46	23	4	5	0	1	0	0	247
%	68.0	18.6	9.3	1.6	2.0	0	0.4	0	0	100.0

Table 2. Presents the distribution of MH and MIH in affected incisors and permanent first molars across 247 samples. The majority had no affected incisors (68%), The highest rate is 1 permanent first molar is affected (118 cases).

3.2. Distribution of MIH severity

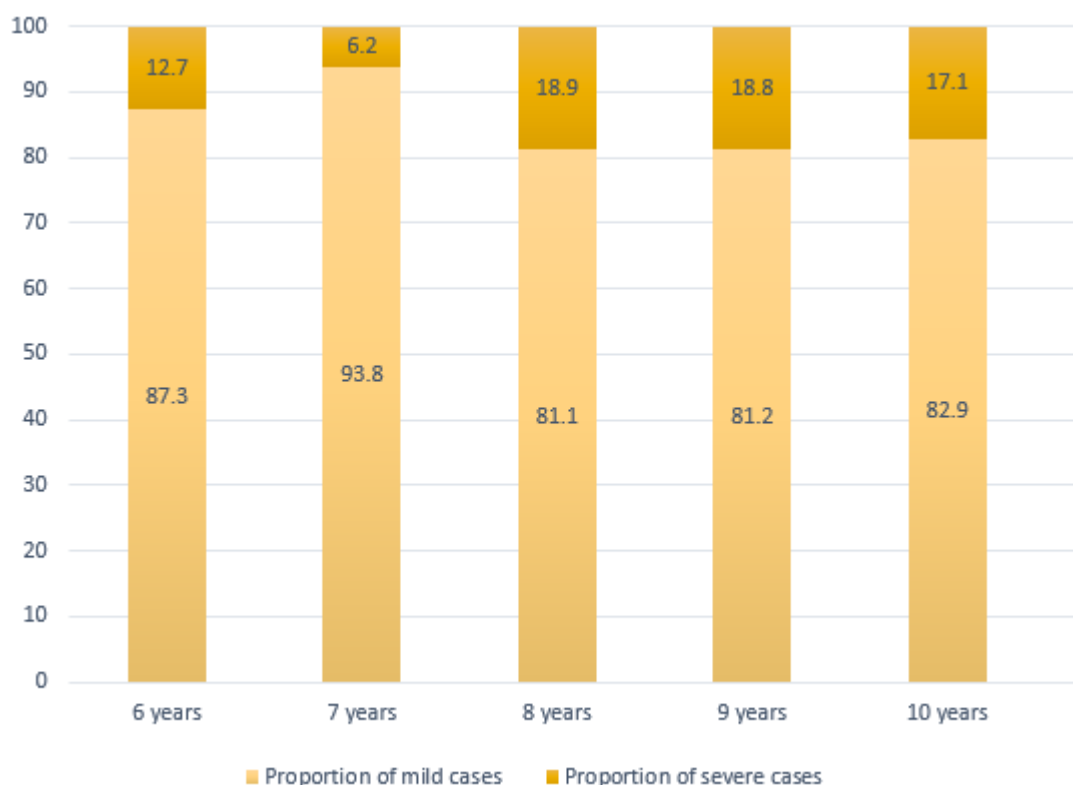


Fig 1. Proportion of mild and severe MIH in each age group

Fig 1. Among the 247 students with MIH, 210 students (85%) had mild lesions and 37 students (15%) had severe MIH. The majority of students in all age groups are classified as mild.

Table 3. Distribution of defect types in permanent index teeth

Index teeth	Not affected (%)	Affected					Total
		Demarcated opacity	Post-eruptive enamel breakdown	Atypical filling	Atypical caries	Extracted due to MIH	
16	153	82	3	5	4	0	247
	61.9	33.2	1.2	2.0	1.6	0.0	100.0
12	234	9	1	3	0	0	247
	94.7	3.6	0.4	1.2	0.0	0.0	100.0
11	210	33	1	1	2	0	247
	85.0	13.4	0.4	0.4	0.8	0.0	100.0
21	222	22	1	0	2	0	247
	89.9	8.9	0.4	0.0	0.8	0.0	100.0
22	230	10	3	0	4	0	247
	93.1	4.0	1.2	0.0	1.6	0.0	100.0
26	141	95	6	1	3	1	247
	57.1	38.5	2.4	0.4	1.2	0.4	100.0
36	131	98	1	7	10	0	247
	53.0	39.7	0.4	2.8	4.0	0.0	100.0

Index teeth	Not affected (%)	Affected					Total
		Demarcated opacity	Post-eruptive enamel breakdown	Atypical filling	Atypical caries	Extracted due to MIH	
32	241	5	1	0	0	0	247
	97.6	2.0	0.4	0.0	0.0	0.0	100.0
31	237	10	0	0	0	0	247
	96.0	4.0	0.0	0.0	0.0	0.0	100.0
41	237	10	0	0	0	0	247
	96.0	4.0	0.0	0.0	0.0	0.0	100.0
42	235	11	1	0	0	0	247
	95.1	4.5	0.4	0.0	0.0	0.0	100.0
46	118	115	2	4	8	0	247
	47.8	46.6	0.8	1.6	3.2	0.0	100.0

Table 3. Compares the distribution of defects in 247 permanent teeth of MIH. Among them, the rate of incisors with affected enamel is higher than that of permanent first molars. The demarcated opacity accounts for the highest proportion with 501 cases, 19 presented atypical restorations, 19 presented post-eruptive enamel breakdown, 36 presented atypical caries, and 1 tooth had been extracted because of MIH. In patients with MIH (n=247), opacity was the most frequent defect (n=115) in the lower right first molars. Tooth loss associated with MIH was detected only in 1 lower left first molar.

IV. DISCUSSION

The study was conducted on 834 primary school students aged 6 to 10 years from two primary schools in Hue City. The overall ratio of males and females in the study population was 55.4% and 44.6%, respectively. In examining the prevalence of MIH, both domestic and international studies have also selected similar gender and age distributions as in our research. For instance, a study by Vo Truong Nhu Ngoc (2021) involving students aged 12-15 reported a

male prevalence of 48.55% and a female prevalence of 51.45% [9]. This finding is consistent with international studies, such as Ahmad et al. (2019), which examined children aged 6-10 with male and female ratios of 33.89% and 66.11%, respectively [2]; Abdalla et al. (2021) with a sample of children aged 8-11 showing a 50% male and 50% female distribution [1]; and Alhowaish et al. (2021) studying children aged 8-10, reporting ratios of 48.37% male and 51.62% female [3].

We recorded a high prevalence of MIH among primary school students in Hue City at 29.6%. This rate is relatively high compared to domestic studies, such as that by Vo Truong Nhu Ngoc et al., which reported a prevalence of 25.0% in Binh Dinh province, and an overall rate of 20.1% across several provinces in Vietnam [7]. Furthermore, this prevalence is more than double the global average reported in various studies (13.5%) [5].

Regarding the classification of MIH severity, our study found that the majority of MIH cases were classified as mild (85%), which is higher than the global average reported in other studies (63.7%). In terms of the number of affected teeth, we observed

that one permanent first molar was affected most frequently (47.8%), while the incidence of all four first molars being affected was the lowest at 8.5%. These results differ from general estimates from other studies, which reported that one molar was affected at a rate of 24.3%, while four molars were affected at the highest rate of 27.4% [5].

The observed differences may be attributed to regional variations, geographical factors, and insufficient assessment of MIH cases and their severity in various studies, potentially due to diagnostic criteria that overlook atypical restorations, atypical caries, and tooth loss due to MIH. Additionally, differences in study age groups may contribute to more severe MIH conditions in older children if timely care and treatment are not provided.

V. CONCLUSION

This study demonstrated a high prevalence of MIH among children in Hue City, with the majority classified as mild cases. Incorporating MIH into initial oral health care for children and school dental programs in Vietnam is essential. Additionally, further studies in different geographical regions should be conducted to determine disease prevalence as well as other risk factors to develop appropriate prevention and treatment plans.

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