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Molar Incisor Hypomineralization among School Children in Eastern Nepal: Prevalence, Clinical Patterns, and Predictors

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Introduction: Molar Incisor Hypominerlization is notable condition that affects the enamel of first permanent molars, incisors and second deciduous molars, increasing sensitivity, dental decay risk and aesthetic concerns.

Objective: This study aims to assess the prevalence and patterns of Molar Incisor Hypominerlization in children aged 6-12 years in schools within Phidim Municipality, Panchthar District, Nepal.

Methods: An analytical, school-based study was conducted with 352 children aged 6- 12 years old students from Phidim Municipality. Ethical approval, parental consent and assent forms were obtained. Oral examinations guided by WHO Oral Health Assent Form (2013) and European Academy of Pediatric Dentistry criteria were conducted by a trained dental surgeon. Data were analyzed using IBM SPSS Statistics 25.

Results: Molar Incisor Hypominerlization prevalence was 17.6% (62 children: 28 boys, 34 girls) where nine-year-old showed the highest prevalence (25.6%). Affected children with Molar Incisor Hypominerlization averaged 2.58 teeth per child, 2.11 affected molars and 1.76 affected incisors. Permanent first molars were most commonly affected (58.13%), followed by permanent incisors (27.5%). Mandibular molars were more frequently affected than maxillary molars ($p < 0.05$). No significant gender differences were observed. Molar Incisor Hypominerlization in deciduous molars were over 4 times likely to have it in their permanent molars with an OR = 4.9, 95% CI (1.74, 13.81); (15.1% versus 4.5%, respectively).

Conclusion: School based oral health programs are a vital strategy for improving children's access to dental care and reducing the burden of enamel defects.

Keywords: Enamel defects; molar incisor hypomineralization; nepal; oral health; school children.

INTRODUCTION

Oral health is integral to overall well-being, yet dental diseases remain a global burden, particularly for children in low- and middle-income countries (LMICs). [1]Among these conditions, Molar Incisor Hypomineralization (MIH), a developmental enamel defect, presents a growing clinical challenge.

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MIH is characterized by demarcated opacities on first permanent molars and incisors due to poor mineralization during tooth development. [2, 3] The global prevalence of MIH is estimated at 14.2% but varies widely (2.4%–40.2%), and its etiology is considered multifactorial.[4-8] The condition predisposes children to dental sensitivity, rapid caries progression, and aesthetic issues, which can negatively impact their quality of life. [9] Early diagnosis is therefore critical for effective management.

In Nepal, a significant knowledge gap exists regarding the burden of MIH, especially in rural regions with limited access to care. This study aimed to determine the prevalence and clinical pattern of MIH among school children aged 6-12 years in the Phidim Municipality of Panchthar District, Nepal, to provide essential baseline data for this underserved population.

METHODS

An analytical, cross-sectional study was conducted in Phidim Municipality, Panchthar District of Koshi Province, Nepal, from December 2023 to March 2024. A school-based approach was used to recruit children from diverse socioeconomic backgrounds. From a complete list of schools provided by the municipality, four schools were selected using a convenience sampling method. The study population comprised children aged 6 to 12 years. The required sample size was calculated using the standard formula for prevalence studies: $n = [Z^2 * \hat{p} (1-\hat{p})] / \varepsilon^2$. Based on an estimated MIH prevalence ($\hat{p}$) of 13.7% from a prior study [10], a 95% confidence interval (Z=1.96), and a 5% margin of error (ε), the minimum required sample was calculated to be 182 participants.

Ethical approval for this study was obtained from the Institutional Review Committee, IRC-KUSMS (Approval no.

252/23). Written informed consent was secured from the parents or legal guardians of all participants, and verbal or written assent was obtained from the children themselves. Permission to conduct the study was also granted by the administrative authorities of the selected schools.

All clinical examinations were performed by a single dental surgeon registered with the Nepal Medical Council, who was trained and calibrated prior to the study to ensure diagnostic consistency and minimize inter-examiner variability. The diagnostic criteria for MIH were based on the 2003 guidelines from the European Academy of Paediatric Dentistry (EAPD). [11] Examinations were conducted in a classroom setting with children seated upright, adhering to a Type 3 examination as per American Dental Association guidelines. [12] A portable LED headlamp provided standardized illumination. [13] Before assessment, the surfaces of all index teeth were gently wiped with sterile gauze to remove plaque or food debris. A systematic evaluation was performed, assessing permanent first molars (buccal, lingual/palatal, occlusal surfaces) and permanent incisors (labial surfaces) for demarcated opacities and enamel breakdown.

Participants were included aged 6–12 years, provided consent/assent, were cooperative, and had at least one fully or partially erupted permanent first molar and incisor. Children were excluded if they presented with generalized enamel defects (e.g., amelogenesis imperfecta, fluorosis), wore fixed orthodontic appliances that obscured tooth surfaces, were uncooperative, or were systemically unwell at the time of examination. Data were entered and analyzed using IBM SPSS Statistics for Windows, Version 25.0 (Armonk, NY: IBM Corp). Descriptive statistics (frequencies, percentages, mean) were calculated for all relevant variables. The Chi-square test was used to evaluate the association between the prevalence of MIH and categorical variables, including age, gender, and tooth position. A p-value of <0.05 was considered statistically significant.

RESULT

A total of 352 school children (182 boys, 170 girls) aged 6 to 12 years (mean age: 9.1 ± SD years) from the Panchthar district participated in this study. No significant demographic differences were observed between participants based on age or gender. The overall prevalence of Molar Incisor Hypomineralization (MIH) in the study population was 17.6% (n=62). Although prevalence was slightly higher in girls (20 %, n=34) compared to boys (15.4%, n=28), the difference was not statistically significant. The highest prevalence by age was observed in the 9-year-old group, where 25.6% (n=23) of children were affected (Table 1).

Table 1: Distribution of Molar Incisor Hypomineralization (MIH) among different ages and gender.

Variables	Children with MIH n (%)	Children without MIH n (%)	Total number of children n (%)
Boys	28 (15.4%)	154 (84.6%)	182 (51.7%)
Girls	34 (20.0%)	136 (80.0%)	170 (48.3%)
Total	62 (17.6%)	290 (82.4%)	352 (100%)
Age			
6	2 (6.5%)	29 (93.5%)	31 (8.8%)
7	6 (15.0%)	34 (85.0%)	40 (11.4%)
8	8 (11.8%)	60 (88.2%)	68 (19.3%)
9	23 (25.6%)	67 (74.4%)	90 (25.6%)
10	5 (13.5%)	32 (86.5%)	37 (10.5%)
11	9 (26.5%)	25 (73.5%)	34 (9.7%)
12	9 (17.3%)	43 (82.7%)	52 (14.8%)
Total	62 (17.6%)	290 (82.4%)	352 (100.0%)

Across the 62 children diagnosed with MIH, a total of 160 teeth exhibited defects, corresponding to a mean of 2.58 affected teeth per child. Permanent first molars (PFMs) were the most frequently affected tooth type (n=93), followed by permanent incisors (n=44) and deciduous molars (n=23). There was no statistically significant difference in the mean number of affected teeth between girls and boys. Of the children with MIH, 13.1% (n=46) presented with hypomineralization exclusively in their PFMs, whereas 4.8% (n=17) had both PFM and incisor involvement. Regarding the number of affected permanent molars per child, 5.7% (n=20) had one affected PFM, while 3.4% (n=12) had two, and 2.0% (n=7) had three or four affected PFMs (Table 2).

Table 2: Number of affected deciduous first molars and permanent first molars.

Deciduous first molars			Permanent first molars		
No. of affected molars in an individual	Frequency	Mean +SD	No. of affected molars in an individual	Frequency	Mean ± SD
1	11 (3.1%)	0.07 ± 0.34	1	20 (5.7%)	0.26 ± 0.79
2	3 (0.9%)		2	12 (3.4%)	
3	2 (0.6%)		3	7 (2%)	
			4	7 (2%)	
Total	23		**Total**	93	
No.: number; SD: Standard Deviation					

A significant association was identified between the presence of MIH in deciduous molars and its occurrence in the permanent dentition. Children with hypomineralized deciduous molars were 4.9 times more likely to have MIH in their permanent molars (OR = 4.9; 95% CI [1.74, 13.81]) Analysis of arch distribution revealed that mandibular molars were significantly more affected than maxillary molars (76 vs. 40, respectively; $p < 0.05$) (Table 3).

The most commonly affected individual teeth were the mandibular first molars (teeth 36 and 46), which primarily presented with demarcated cream-white opacities. Among incisors, the maxillary left central incisor (tooth 21) and mandibular left central incisor (tooth 31) were most frequently affected (Table 4)

Table 3: Number of affected maxillary and mandibular first molars.

Maxillary first molars			Mandibular first molars		
No. of teeth affected	Frequency	Mean ± SD	No. of teeth affected	Frequency	Mean ± SD
1	14	0.11 ± 0.42	1	23	0.22 ± 0.61
2	13		2	21	
			3	1	
			4	2	
Total	40		**Total**	76	

Table 4: Distribution of hypomineralization features in index teeth of MIH-affected children according to European Academy of Pediatric Dentistry criteria for MIH.

Index tooth	Demarcated cream-white opacity	Demarcated yellow-brown opacity	Enamel loss	Enamel and Dentin loss	Atypical large cavities extending to pulp and covering one or more tubercle	Atypical restoration	Extended tooth
16	8 (2.3%)	5 (1.4%)	2 (0.6%)	0 (0%)	1 (0.3%)	0 (0%)	0 (0%)
55	0 (0%)	2 (0.6%)	1 (0.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
11	0 (0%)	13 (3.7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
21	10 (2.8%)	1 (0.3%)	1 (0.3%)	0 (0%)	1 (0.3%)	0 (0%)	0 (0%)
65	2 (0.6%)	0 (0%)	1 (0.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
26	11 (3.1%)	3 (0.9%)	1 (0.3%)	1(0.3%)	2 (0.6%)	0 (0%)	0 (0%)
46	17 (4.8%)	3 (0.9%)	1 (0.3%)	4(1.1%)	2 (0.6%)	0 (0%)	0 (0%)
85	2 (0.6%)	3 (0.9%)	3 (0.9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
41	6 (1.7%)	1 (0.3%)	1 (0.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
31	10 (2.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
75	3 (0.9%)	2 (0.6%)	0 (0%)	2(0.6%)	2 (0.6%)	0 (0%)	0 (0%)
36	15 (4.3%)	5 (1.4%)	2 (0.6%)	7(2.0%)	3 (0.9%)	0 (0%)	0 (0%)
Total	84	38	13	14	11	0	0

DISCUSSION

This study provides a comprehensive analysis of molar hypomineralization (MIH) prevalence and its characteristics among school children aged 6-12 years in eastern region of Nepal, particularly in Panchthar district. These findings help in understanding the burden of MIH in this population and its implications for oral health.

The overall prevalence of MIH was 17.6%, aligning with the global prevalence rate [5], but suggests a substantial burden within the studied population. The results showed that MIH affected slightly more girls than boys, which is a similar result to research in Nepal and other places. [10,14] Moreover, the absence of statistically significant differences noted in mean affected teeth between boys and girls ($p = 0.26$) led to the most widely held explanation that MIH is more reliant on environmental and genetic determinants than gender. The lack of variation in this emphasizes that MIH is a widespread concern rather than one concentrated specific group. The high prevalence of MIH among nine-year-old children (25.6%) highlights the importance of targeted preventive measures and early intervention during this critical age, thus making a great impact.

Children with MIH exhibited a mean of 2.11 molars and 1.76 incisors per child, suggesting that molars are highly susceptible to hypomineralization. These findings suggest that MIH tend to occur more commonly in molars than incisors, which is similar to the research by Zuhair Al-Nerabieah. [15] Hypomineralization of permanent first molars (PFMs; 58.13%) was found to be most common, followed by permanent incisors (PIs; 27.5%) being the second most common. Other studies conducted in India also showed higher prevalence in Mandibular Right and Left First Permanent Molars (FPMs). [16] 15.1% of participants presented with either PFMs or PIs hypomineralization suggesting that these teeth should be prioritized during clinical assessments and treatment plans. Demarcated opacities were the most common pattern of MIH defect. [16, 18]

Results of the study showed that mandibular molars were significantly greater affected than maxillary molars. Such asymmetrical distribution of MIH is interesting and raises questions about anatomic and developmental factors, which should be investigated further for understanding this phenomenon of difference in the prevalence between lower and upper arches. Deciduous molars were less frequently affected, suggesting a strong predisposition of permanent molar to MIH.

Demarcated cream-white opacities being the most common presentation of MIH defects similar to other studies, [18] particularly in the index molars 46 and 36 (mandibular first molars), affecting 17 and 15 teeth respectively. This pattern of defect impacts the functional capacity and esthetic of teeth causing psychological and social implications in school-going children.

High prevalence of MIH in the population pushes the need for preventive strategies such as toothpastes, mouthwashes, oral gels based on calcium phosphates, fluoride therapy [19] and curative strategies for clinical management may require restorative interventions such as filling, veneers, crowns or extractions to address the functional and esthetic challenges due to MIH. [20] Parents, children, teachers and dental professionals should be made aware about the implications of MIH and the ways to recognize it. The sooner the diagnosis and the effective is the treatment.

To determine the possibility of the occurrence of MIH in permanent molars when present in deciduous molars, Odds Ratio (OR) was assessed. Person having MIH in deciduous molars were over 4 times likely to have it in their permanent molars with an OR = 4.9, 95% CI (1.74, 13.81); (15.1% vs 4.5%, respectively). Thus, an association exists between the second deciduous molar and first permanent molar incisor hypomineralization (MIH). [21, 22]

The single-district design restricts the generalizability of the results to the national level, as MIH prevalence can vary by region. Furthermore, the non-random selection of schools carries a risk of selection bias, potentially affecting how representative the sample is of the entire district. Therefore, larger-scale epidemiological surveys with robust random sampling are needed to provide a definitive national estimate.

CONCLUSION

This study concludes that Molar Incisor Hypomineralization (MIH) is a significant oral health issue among school children in Panchthar, Nepal, with a prevalence of 17.6%. The findings confirm that permanent first molars are the most susceptible teeth. Furthermore, this research establishes a strong predictive link between MIH in the primary and permanent dentitions, where affected deciduous molars indicate a 4.9 times more likelihood of MIH in succeeding permanent teeth.

The data generated by this research are crucial for informing public health policy in a region with limited access to dental care. The high prevalence highlights an urgent need to develop and implement targeted, school-based oral health programs that

focus on early detection and prevention. Raising awareness among children, parents, and educators about MIH is a critical first step. Ultimately, these findings should guide policymakers and healthcare providers in prioritizing preventive strategies to reduce the functional and aesthetic consequences of enamel defects in underserved Nepalese communities.

Conflict of interest: None

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