

Prevalence of Molar Incisor Hypomineralization among School Children Aged 9 to 12 Years in Virajpet, Karnataka, India

Pooja Mali Rai^{1*}, Jithesh Jain², Ananda Shivmoga Raju², Rohit A. Nair¹, Keerthan Shashidhar³, Sheehan Dsouza⁴

¹Coorg Institute of Dental Sciences, Virajpet, Karnataka; ²Department of Public Health Dentistry, Coorg Institute of Dental Sciences, Virajpet, Karnataka; ³Department of Orthodontics and Dentofacial Orthopedics, Subbaiah Institute of Dental Sciences, Shivmoga, Karnataka, India; ⁴Srinivas Institute of Dental Sciences, Mangalore, Karnataka

Abstract

Citation: Rai PM, Jain J, Raju AS, Nair RA, Shashidhar K, Dsouza S. Prevalence of Molar Incisor Hypomineralization among School Children Aged 9 to 12 Years in Virajpet, Karnataka, India. Open Access Maced J Med Sci. <https://doi.org/10.3889/oamjms.2019.224>

Keywords: Hypomineralization; First permanent molars; Demarcated opacities; Post eruptive breakdown

***Correspondence:** Pooja Mali Rai. Coorg Institute of Dental Sciences, Virajpet, Karnataka. E-mail: poojarai93@gmail.com

Received: 25-Jan-2019; **Revised:** 23-Mar-2019; **Accepted:** 24-Mar-2019; **Online first:** 29-Mar-2019

Copyright: © 2019 Pooja Mali Rai, Jithesh Jain, Ananda Shivmoga Raju, Rohit A. Nair, Keerthan Shashidhar, Sheehan Dsouza. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

BACKGROUND: The molar incisor hypomineralization (MIH) is defined as a qualitative defect of the enamel characterised by the progressive and simultaneous hypomineralization of the enamel structure of the first permanent molars which is of systemic origin, which may be associated frequently with incisors. Although the reported prevalence of MIH ranges from 2.4% to 40.2% worldwide, very little data is available from India.

AIM: To determine the prevalence of molar incisor hypomineralization among school children aged 9 to 12 years in virajpet, Karnataka.

METHODS: This cross-sectional descriptive study consisted of 1600 school children aged 9-12 years selected by stratified cluster sampling procedure. The European Academy of Pediatric Dentistry criteria were followed for MIH diagnosis. Chi-square test was used to analyse the categorical data. $P \leq 0.05$ was considered for statistical significance.

RESULTS: The prevalence of MIH is 13.12% with no gender predilection. Ten-year-old children showed the highest prevalence (15%) among all the age group. Majority of children with MIH (70.2%) have lesions in both molars and incisors with demarcated opacities and atypical restorations being the most frequent defect type.

CONCLUSION: Prevalence of MIH was 13.12% in the 9-12-year child population in Virajpet. There is a need for a proper planned preventive and restorative program about the increasing prevalence of MIH.

Introduction

Dental enamel has some properties making it a unique tissue. It is the hardest tissue in the body and has a very high proportion of inorganic matter, mainly hydroxyapatite. The ameloblast has a limited reparative capacity; therefore, disturbances occurring during the mineralisation of enamel will remain as permanent marks. Defects in enamel quality or other dental hard tissues are important implications for the understanding of evolution, function, origin and relation to etiological factors behind developmental disturbances but also how environmental factors may

influence on the mineralisation of the dental hard tissues. These unique properties of teeth have been widely used in research within biology, anthropology, archaeology and several other areas [1], [2].

The molar incisor hypomineralization (MIH) is defined as a qualitative defect of the enamel characterised by the progressive and simultaneous hypomineralization of the enamel structure of the first permanent molars which is of systemic origin, which may be associated frequently with incisors [3].

Since the early 1970's dentists have reported a developmental defect primarily located in the first molars and incisors in permanent dentition, areas of demarcated hypomineralized enamel varying from

opacity to more severe conditions with enamel surface breakdown were typical for the defect. This enamel disturbance was found predominately in first permanent molars and incisors. One of the first more extensive studies on the prevalence of demarcated opacities in first permanent molars and incisors was reported by Koch et al., in 1987. It was first defined by Weerheijm et al., in 2001. It is also called as “hypomineralized permanent first molars (PFMs)”, “idiopathic enamel hypomineralization”, “nonfluoride hypomineralization” “demineralised PFMs” and “cheese molars”. Knowledge about the magnitude of MIH seems desirable as it is vulnerable for consequences like rapid caries development, early enamel loss, soft structure and sensitivity [4].

The molar incisor hypomineralization is clinically presented as demarcated enamel opacities of different colours, occasionally undergoing post-eruptive breakdown (PEB) which results in atypical cavities or complete coronal distortion, requiring extensive restorative treatment. Despite the higher treatment demands, restorative treatment for these teeth is challenging for both the patient and dentist.

MIH is recognised as a global dental problem, and epidemiologic reports from all over the world are continuously published [5]. The global prevalence of MIH ranged from 2.4% to 40.2%. Majority of the studies that reported MIH were from European countries with a prevalence range of 3.6% to 37.5%. Prevalence in middle and South East Asian countries ranged from 9.25% to 20.2%. Prevalence data from India were scant and reported a prevalence of 6.31% to 9.46% [1]. The prevalence is almost 40% per cent in Denmark and Brazil [6], [7]. As many as 5% of the children in a Swedish population have a severe form of MIH and will experience extensive and difficult treatment. It has been reported that children with MIH have ten times more dental treatment compared with a group of children with clinically healthy first molars [8].

The prevalence of MIH was not well documented due to several diagnostic classifications in the literature. The various indices used are Alaluusua et al., criteria (1996), developmental defects of enamel index (DDE), Kemoli criteria (2008), Koch et al., [9]. Criteria (1987), and the European Academy of Pediatric Dentistry (EAPD) 2003 criteria [10]. Knowledge about the magnitude of MIH seems desirable as it is vulnerable for consequences like rapid caries development, early enamel loss, soft structure and sensitivity [4].

Severe clinical manifestations and their consequences associated with MIH indicates the need for research to increase knowledge about its prevalence and risk factors in developing countries [11]. Thus, the aim of this study was to evaluate the prevalence of MIH in a group of children aged from 9 to 12 years in Virajpet, Karnataka, India.

Material and Methods

The present, descriptive cross-sectional study conducted during January 2018 – March 2018, the study population comprised of 9 to 12-year-old School children belonging to Virajpet taluk. Total numbers of school students were 9792. The sample size was estimated and obtained as 400 per each age group and among 4 age groups (9, 10, 11 and 12 years) the total of 1600 samples. Stratified Cluster Sampling Method was followed. Total of 171 schools in Virajpet taluk was divided into 10 clusters based on location. Each cluster contains 17 schools. Considering 10% of schools from each cluster 2 schools were chosen randomly. Total schools considered were 20. Considering the number of schools included and the sample size (400 per age group), 20 students from each age group from each school was taken. Subjects who were willing to participate and whose parents/guardians have given written informed consent and children having fully erupted all permanent first molars and incisors were included in the study.

The children with amelogenesis imperfecta, dentinogenesis imperfecta, white spot lesions, tetracycline stains, erosion, fluorosis and Turner's tooth, with appliances, undergoing orthodontic treatment, Restorations and Crowns on any of the first permanent molars and incisors were excluded. Ethical clearance was obtained from the Institutional Review Board of Coorg Institute of Dental Sciences, Virajpet. Diagnosis of MIH was done using EAPD Criteria 2003 [14].

An examination for MIH should be performed on wet teeth after cleaning. Teeth to be examined are the 4 first permanent molars (occlusal, buccal, lingual/palatal surfaces) and 8 permanent incisors (incisal, labial, lingual/ palatal surfaces) following Type III Clinical examination with adequate natural light.

The oral examination of all the study subjects was carried out by a single investigator. Each participant was meticulously examined and the findings were compared to know the diagnostic variability agreement. The agreement was found to be 80%.

Statistical Analysis

The data was collected and transferred from pre-coded proforma to computer. The data will be analyzed using SPSS (IBM) version 23. Descriptive statistics included mean, standard Deviation, Frequency and Percentage. Inferential statistics included Chi square test. The level of significance was set at 0.05 at 95% confidence intervals.

Results

Distribution of study subjects comprised a total of 1600 (100%) participants. Among them, 786 (49.1%) were males, and 814 (50.9%) were females.

Table 1: Tooth wise Prevalence of MIH

Tooth Number	MIH	Prevalence
11	Absent	1445 (90.3%)
	Present	155 (9.7%)
12	Absent	1463 (91.4%)
	Present	137 (8.6%)
21	Absent	1450 (90.6%)
	Present	150 (9.4%)
22	Absent	1509 (94.3%)
	Present	91 (5.7%)
16	Absent	1396 (87.3%)
	Present	204 (12.7%)
26	Absent	1394 (87.1%)
	Present	206 (1.3%)
31	Absent	1534 (95.9%)
	Present	66 (4.1%)
32	Absent	1535 (95.9%)
	Present	65 (4.1%)
41	Absent	1532 (95.8%)
	Present	68 (4.3%)
42	Absent	1550 (96.9%)
	Present	50 (3.1%)
36	Absent	1398 (87.4%)
	Present	202 (12.6%)
46	Absent	1395 (87.2%)
	Present	205 (12.8%)

MIH was found to be present in 210 (13.12%) subjects, and the rest of 1390 (86.87%) subjects were unaffected.

Table 2: Prevalence of MIH according to EAPD diagnostic criteria

MIH type	Frequency	Percentage
White / creamy demarcated opacities, no PEB	15	(7.9%)
White / creamy demarcated opacities, with PEB	7	(2.6%)
Yellow / brown demarcated opacities, no PEB	70	(32%)
Yellow / brown demarcated opacities, with PEB	26	(13.7%)
Atypical restoration	72	(34.3%)
Missing because of MIH	20	(9.5%)
Total	210	(100%)

Among 210 subjects affected with MIH, 58 (14%) subjects were 9 years, 60 (15%) subjects were 10 years, 49 (12.25%) subjects were 11 years, and 43 (10.75%) subjects were 12 years of age.

Table 3: Comparison of prevalence of MIH based on Gender and Age

	Age	Prevalence	Chi Square and significance
Male	9 years	33 (31.1%)	1.745 p=0.627 (NS)
	10 years	26 (24.5%)	
	11 years	23 (21.7%)	
	12 years	24 (22.6%)	
Female	9 years	25 (24%)	7.068 p=0.132 (NS)
	10 years	33 (31.7%)	
	11 years	26 (25%)	
	12 years	19 (18.3%)	

Discussion

The study recruited children aged 9 to 12 years for the assessment of MIH. Garg N et al., [12] stated that at this age, most children would have had

all four first permanent molars and the majority of incisors, but these teeth would not have been exposed to the oral environment long enough to develop dental caries. Also, the permanent first molar teeth will be in a relatively good condition without excessive post-eruptive breakdown.

Table 4: Prevalence of MIH based on Arch and Segments

Prevalence		MIH		Chi-Square and significance
		Absent	Present	
Maxilla	Incisors	1407 (87.9%)	193 (12.1%)	0.728 P = 0.424 (NS)
	Molars	1391 (86.9%)	209 (13.1%)	
Mandible	Incisors	1451 (90.7%)	149 (9.3%)	10.632 P = 0.001 (S)
	Molars	1393 (87.1%)	207 (12.9%)	
Total	Incisors	1406 (87.9%)	194 (12.1%)	0.728 P = 0.424 (NS)
	Molars	1390 (86.9%)	210 (13.1%)	

In the present study, the prevalence of MIH was 13.12% among 9-12-year-old children. This is by the study conducted by P.C. Calderara et al., [13] among school children aged 7.3 – 8.3 years living in Lissone, Northern Italy, wherein the prevalence of MIH was 13.7%. In a study conducted by Sulaiman Mohammed Allazzam et al., [14] in Jeddah, Saudi Arabia, the prevalence of MIH was 8.6% among a group of 8-12-year-old children. In a study conducted by Rahil Ahmadi et al., [15], the prevalence of MIH in a group of Iranian children aged 7-9 years was 12.7%. A study conducted by H.T Ajay Rao et al., [2] in Mangalore, Karnataka among 6-12-year school children, the prevalence of MIH was found to be 17.2%. In a study conducted by Shubha Arehalli Bhaskar [16] done among school children aged 8-13 years from Udaipur, Rajasthan, MIH prevalence was 8.9%. The prevalence in another study conducted by M Kirthiga et al., [4] among children aged 11-16 years of a city in Karnataka, Davangere was 8.9%. According to a study conducted by Savitha Deepthi Yannam et al., [11] in the child population aged between 8-12 years residing in Chennai, the prevalence of MIH was 9.7%. The study conducted by Cervantes Mendez MJ et al., [17], in South Texas, among 6-14 years subjects showed a prevalence rate of 29.5% which is on the higher side. According to Cho Sy et al., [18], the difference in MIH prevalence seen in various parts of the world may be due to the heterogeneity in ethnic and age groups being studied and the retrospective nature of the studies conducted.

In the present study, 10-year-old subjects showed comparatively higher prevalence (15%) than the other age groups and the least prevalence of MIH (10.75%) was seen in 12-year-old children. These results are by the study conducted by Savitha Deepthi Yannam [11] among the age group of 8-12 years, wherein the prevalence of MIH was highest among 10-year-old children (12.9%), and least prevalence of MIH (7.4%) was seen in 12-year old children. In a study conducted by Cristiane Maria Da Costa-Silva et al., [19], there was a higher prevalence among children with 10 years old or older (16.6%).

In the present study, it was observed that

maxillary molars were more affected as compared to maxillary incisors, but the difference was not statistically significant ($p = 0.728$). This could be explained by the contribution of Lunt and Law [20] that modified the chronology of the deciduous human dentition and concluded that maxillary teeth are generally ahead of the mandibular teeth in development.

In the present study, according to diagnostic criteria, most of the teeth were affected by atypical restorations (34.3%) and yellow-brown demarcated opacities without PEB (32%). These results are in agreement with the study conducted by Sulaiman Mohammed Allazzam et al., [14], wherein it was found that demarcated opacities were the most frequent type of MIH and the prevalence of yellow-brown demarcations and atypical restorations can be due to the inclusion of older children, as some of the demarcated opacities may break down over time. The results are also by the study conducted by Cristiane Maria Da Costa-Silva et al., [19], in which atypical restorations were more frequently seen (20.8%). Mahoney EK et al., [21] in their study explained that Hypomineralized areas in enamel showed a reduction in mechanical properties and in mineral density [22], [23], [24], which facilitates PEB. Tooth wise prevalence based on diagnostic criteria showed that incisors were most affected with creamy white opacities without PEB, but molars were mostly affected by yellow/brown discolouration with PEB and atypical restorations. In the study conducted by Lygidakis NA et al., [25] among incisors, atypical restorations on the buccal surface were found to be more prevalent, which is in contrast to the present study results. The high incidence of atypical restorations on incisors could be related to an aesthetic concern rather than PEB, because there are generally no masticatory forces on the opacities in incisors.

In conclusion, recent research supports the assumption that MIH is a widespread problem all over the world. Findings from the present study show the following:

- The prevalence of MIH in 9-12-year-old children is 13.12 % with no gender predilection.
- Ten-year-old children showed the highest prevalence (15%) among all the age group.
- Majority of children with MIH (70.2%) have lesions in both molars and incisors with demarcated opacities and atypical restorations being the most frequent defect type.

Hence, it appears that this condition is more prevalent than was recognised until recently. Assuming the low awareness of this condition among the dentists and the general population of India, the demanding nature and the costs involved, the urgent need for further investigations into this problem becomes evident. A diligent follow-up and recall

program for children who are affected is essential for developing preventive and therapeutic measures. There is also a need for formulating public awareness and prevention programs. A nationwide survey to find the prevalence of MIH is recommended.

References

1. Fincham AG, Moradian-Oldak J, Simmer JP. The structural biology of the developing dental enamel matrix. *J Struct Biol.* 1999; 126:270-99. <https://doi.org/10.1006/jsbi.1999.4130> PMID:10441532
2. Antoine D, Hillson S, Dean MC. The developmental clock of dental enamel: a test for the periodicity of prism cross-striations in modern humans and an evaluation of the most likely sources of error in histological studies of this kind. *J Anat.* 2009; 214:45-55. <https://doi.org/10.1111/j.1469-7580.2008.01010.x> PMID:19166472 PMCID:PMC2667916
3. Fagrell T. Molar Incisor Hypomineralization-Morphological and chemical aspects, onset and possible etiological factors. *Swedish Dental Journal.* 2016; 5-56.
4. Kirthiga. M, Poomimal P, Praveen R, Gayathri P, Manju P, Priya M. Prevalence and severity of molar incisor hypomineralization in children aged 11-16 years of a city in Karnataka, Davangere. *Journal of Indian Society of Pedodontics and Preventive Dentistry.* 2015; 33(3):213-217. <https://doi.org/10.4103/0970-4388.160366> PMID:26156275
5. Jälevik B. Prevalence and Diagnosis of Molar-Incisor-Hypomineralisation (MIH): A systematic review. *Eur Arch Paediatr Dent.* 2010; 11:59-64. <https://doi.org/10.1007/BF03262714> PMID:20403299
6. Wogelius P, Haubek D, Poulsen S. Prevalence and distribution of demarcated opacities in permanent 1st molars and incisors in 6 to 8-year-old Danish children. *Acta Odontol Scand.* 2008; 66:58-64. <https://doi.org/10.1080/00016350801926941> PMID:18320420
7. Soviero V, Haubek D, Trindade C, Matta T, Poulsen S. Prevalence and distribution of demarcated opacities and their squeals in permanent first molars and incisor in 7 to 13-year-old Brazilian children. *Acta Odontol Scand.* 2009; 66:170-175. <https://doi.org/10.1080/00016350902758607> PMID:19253064
8. Jälevik B, Klingberg G, Barregård L, Norén JG. The prevalence of demarcated opacities in permanent first molars in a group of Swedish children. *Acta Odontol Scand.* 2001; 59:255-60. <https://doi.org/10.1080/000163501750541093> PMID:11680642
9. Koch G, Hallonsten AL, Ludvigsson N, Hansson BO, Holst A, Ullbro C. Epidemiologic study of idiopathic enamel hypomineralization in permanent teeth of Swedish children. *Community Dent Oral Epidemiol.* 1987; 15:279-85. <https://doi.org/10.1111/j.1600-0528.1987.tb00538.x> PMID:3477361
10. Weerheijm KL, Duggal M, Mejäre I, Papagiannoulis L, Koch G, Martens LC, Hallonsten AL. Judgement criteria for Molar Incisor Hypomineralisation (MIH) in epidemiologic studies: a summary of the European meeting on MIH held in Athens, 2003. *European Journal of Paediatric Dentistry.* 2003; 4:110-4. PMID:14529329
11. Yannam SD, Amaral D, Vishnu R. Prevalence of molar incisor hypomineralization in school children aged 8-12 years in Chennai. *Journal of Indian Society of Pedodontics and Preventive Dentistry.* 2016; 34(2):134-138. <https://doi.org/10.4103/0970-4388.180438> PMID:27080963
12. Garg N, Jain AK, Saha S, Singh J. Essentiality of early diagnosis of molar incisor hypomineralization in children and review of its clinical presentation, aetiology and management. *International journal of clinical pediatric dentistry.* 2012; 5(3):190. <https://doi.org/10.5005/ip-journals-10005-1164> PMID:25206166 PMCID:PMC4155885

13. Calderara PC, Gerthoux PM, Mocarrelli P, Lukinmaa P, Tramacere PL, Alaluusua S. The prevalence of Molar Incisor Hypomineralisation (MIH) in a group of Italian school children. *European journal of paediatric dentistry*. 2005; 6 (2):79. PMID:16004536
14. Allazzam S, Alaki S, Meligy O. Molar Incisor Hypomineralization, Prevalence, and Etiology. *International Journal of Dentistry*. 2014;1-8. <https://doi.org/10.1155/2014/234508> PMID:24949012 PMCID:PMC4034724
15. Ahmadi R, Ramazani N, Nourinasab R. Molar incisor hypomineralization: a study of prevalence and etiology in a group of Iranian children. *Iranian journal of pediatrics*. 2012; 22(2):245. PMID:23056894 PMCID:PMC3446062
16. Bhaskar SA, Hegde S. Molar-incisor hypomineralization: Prevalence, severity and clinical characteristics in 8-to 13-year-old children of Udaipur, India. *Journal of Indian Society of Pedodontics and Preventive Dentistry*. 2014; 32(4):322. <https://doi.org/10.4103/0970-4388.140960> PMID:25231041
17. Acosta YA, Leyva EC, Suclar MI, González SR, Díaz JC, Galán IA. Lesiones cervicofaciales precancerosas y cánceres cutáneos no melanomas del paciente geronte. *Rev Cubana Estomatol*. 2015; 52(1):21-7.
18. CHO SY, Ki Y, Chu V. Molar incisor hypomineralization in Hong Kong Chinese children. *International journal of paediatric dentistry*. 2008; 18(5):348-52. <https://doi.org/10.1111/j.1365-263X.2008.00927.x> PMID:18637048
19. Da Costa-Silva CM, Ambrosano GM, Jeremias F, De Souza JF, Mialhe FL. Increase in severity of molar-incisor hypomineralization and its relationship with the colour of enamel opacity: a prospective cohort study. *Int J Paediatr Dent*. 2011; 21:333-41. <https://doi.org/10.1111/j.1365-263X.2011.01128.x> PMID:21470321
20. Lunt RC, Law DB. A review of the chronology of calcification of deciduous teeth. *The Journal of the American Dental Association*. 1974; 89(3):599-606. <https://doi.org/10.14219/jada.archive.1974.0446>
21. Mahoney EK, Rohanizadeh R, Ismail FS, Kilpatrick NM, Swain MV. Mechanical properties and microstructure of hypomineralised enamel of permanent teeth. *Biomaterials*. 2004; 25(20):5091-100. <https://doi.org/10.1016/j.biomaterials.2004.02.044> PMID:15109872
22. Xie ZH, Mahoney EK, Kilpatrick NM, Swain MV, Hoffman M. On the structure–property relationship of sound and hypomineralized enamel. *Acta biomaterialia*. 2007; 3(6):865-72. <https://doi.org/10.1016/j.actbio.2007.05.007> PMID:17638598
23. Fragelli CM, Jeremias F, de Souza JF, Paschoal MA, Cordeiro RD, Santos-Pinto L. Longitudinal evaluation of the structural integrity of teeth affected by molar incisor hypomineralisation. *Caries research*. 2015; 49(4):378-83. <https://doi.org/10.1159/000380858> PMID:25998233
24. Fagrell TG, Dietz W, Jälevik B, Norén JG. Chemical, mechanical and morphological properties of hypomineralized enamel of permanent first molars. *Acta Odontologica Scandinavica*. 2010; 68(4):215-22. <https://doi.org/10.3109/00016351003752395> PMID:20392131
25. Lygidakis NA. Treatment modalities in children with teeth affected by molar-incisor enamel hypomineralisation (MIH): a systematic review. *European Archives of Paediatric Dentistry*. 2010; 11(2):65-74. <https://doi.org/10.1007/BF03262715> PMID:20403300