ORIGINAL RESEARCH

Prevalence, Severity and Associated Risk Indicators of Molar Incisor Hypomineralization amongst 8–13-year-old Children of Vadodara District Gujarat: A Cross-sectional Study

Vaishnavi U Shah[1], Bhavna H Dave[2], Deepika N Chari[3], Kelvin A Shah[4]

Abstract

Context: Molar incisor hypomineralization (MIH) is an emerging clinical problem as the affected tooth is prone to dental caries with the lapse of time.

Aims: To assess the prevalence, severity, and associated risk indicators of MIH amongst 8–13 years of children of Vadodara District, Gujarat, India.

Materials and methods: A cross-sectional study with a sample size of 3,000 government schoolchildren. A total of 1,500 children each from urban and rural areas were randomly selected and examined. Only permanent incisors and first molars were examined. MIH was diagnosed clinically based on the diagnostic criteria established by the European Academy of Paediatric Dentistry (EAPD), 2003. To check the relation between the two variables—Pearson's Chi-squared test was applied. Fisher's exact test was applied when less than five expected values were found.

Results: A total of 286 children (9.6 %) had MIH, with 189 (rural) and 97 (urban) children. MIH was significantly higher in the rural population as compared to the urban. In the rural area, the cause was found to be a child suffering from an illness (>15 days) which was 35.98%, and in the urban area was due to prolonged use of antibiotics before 4 years of age, which was 28.87%.

Conclusion: The overall prevalence rate of MIH among the screened children between the age-group 8 and 13 was found to be 9.6%. Males were more affected. The severity of MIH was more in molars compared to incisors and more in children of rural areas.

Clinical significance: Protocol for early diagnosis and follow-up to access the squeal of breakdown should be undertaken along with parents and health workers.

Keywords: Enamel defects, First permanent molars, Molar incisor hypomineralization, Molar incisor hypomineralization diagnostic criteria, Prevalence of molar incisor hypomineralization.

International Journal of Clinical Pediatric Dentistry (2023): 10.5005/jp-journals-10005-2570

Introduction

According to Weerheijm et al., MIH is the clinical manifestation of morphological enamel abnormalities involving the occlusal and/or incisal third of one or more permanent dentition (molars or incisors) as a result of "hypomineralization" of systemic origin.[1] These systemic origins can include numerous ailments that might change the calcium-phosphate balance or cause the ameloblasts to receive insufficient oxygen, which can result in enamel abnormalities.[2,3]

Clinically, the hypomineralized enamel, which is frequently asymmetrical, can have a soft, porous appearance, or resemble old Dutch cheese or discolored chalk. The color of the enamel flaws might range from white to yellow or brown, but they typically show a clear separation between the damaged and healthy enamel structures. Under masticatory stresses, the porous, brittle enamel is easily broken off.

According to Chawla et al., white-opaque enamel flaws are less severe than yellow-brown ones.[4] Weerheijm et al. claims that infrequently, enamel flaws can also be seen in the second primary molars, second permanent molars, and the tips of the permanent canines.[5]

The EAPD criteria were then used in numerous prevalence studies, with a reported prevalence of 2.4–40.2%.[6] Yet, there is little information about the prevalence and origin of the condition in children living in the western part of India. So, the purpose of this study was to evaluate the incidence, severity, and associated risk factors of MIH in children aged 8–13 in the Vadodara District of Gujarat.

[1–3]Department of Pediatric and Preventive Dentistry, KM Shah Dental College & Hospital, Sumandeep Vidhyapeeth, Vadodara, Gujarat, India

[4]Department of Prosthodontics, Pacific Dental College & Hospital, Debari, Rajasthan, India

Corresponding Author: Bhavna H Dave, Department of Pediatric and Preventive Dentistry, KM Shah Dental College and Hospital, Vadodara, Gujarat, India, Phone: +919099442492, e-mail: charideepika@gmail.com

How to cite this article: Shah VU, Dave BH, Chari DN, *et al.* Prevalence, Severity and Associated Risk Indicators of Molar Incisor Hypomineralization amongst 8–13-year-old Children of Vadodara District Gujarat: A Cross-sectional Study. Int J Clin Pediatr Dent 2023;16(2):280–286.

Source of support: Nil

Conflict of interest: None

Materials and Methods

The study was started after the ethical approval by the Institutional Ethical Committee, SVIEC/ON/Dent/BNPG16/D17004. A cross-sectional study involving 3,000 kids was carried out (8–13 years of age) of both genders studying in government schools of Vadodara city, Gujarat. The consort chart of the study is depicted in Flowchart 1.

Phase I

The children included under inclusion-exclusion criteria (Table 1) were assessed using EAPD-2003 criteria (Table 2).

The schools, after random selection, were approached for permission. Once permission was obtained, dates for examination were priorly fixed with a screening of 30 children every alternate day. The whole study was carried out by one investigator, and the findings were noted, and clinical photographs were taken by the coinvestigator. Each tooth was examined with the help of diagnostic criteria for MIH given by Weerheijm et al. (Table 2). After the screening, all the children were given oral hygiene instructions and hand-washing techniques. The oral findings of all the screened children were noted in a referral card of the department and sent to the parents for future treatment needs.

Phase II

A 12 self-prepared close-ended questionnaire was distributed among parents of children diagnosed with MIH to help assess the possible risk factors of the defect. Those history pro formas which were filled completely by the parents were taken into consideration.

Results

Phase I

Overall Prevalence

Out of 3,000 participants between 8 and 13 years of age—1,500 children from urban and 1,500 from rural areas were screened. A total of 286 youngsters were diagnosed with MIH-affected teeth, translating to a prevalence rate of 9.53%.

Area Predilection

With a *p*-value of 0.0001, the prevalence of MIH was significantly higher in rural populations than the urban ones. In the urban population, the prevalence of MIH was 6.47% compared to the rural population; the prevalence was found to be 12.60% (Table 3).

Flowchart 1: The consolidated standards of reporting trials chart

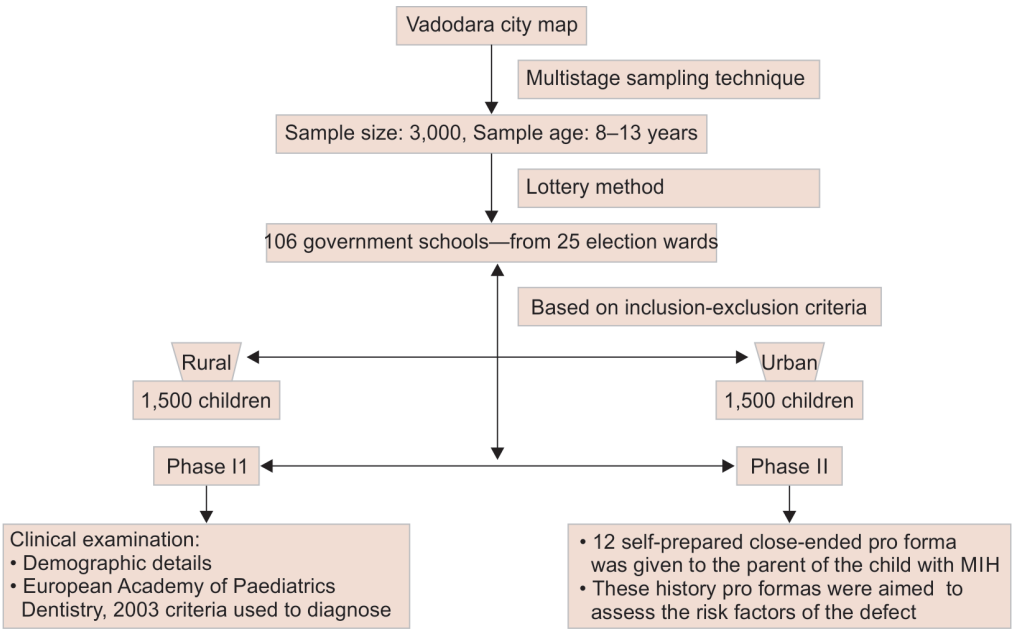

Table 1: Inclusion-exclusion criteria

Inclusion	*Exclusion*
Children between 8–13 years of age.	Children having any syndrome.
Children present in the school on the day of the examination.	Missing permanent first molar and incisors due to extraction.
Children whose parents will give permission for examination.	Participants who have undergone any restoration, pit, and fissure sealant, fluoride application, or any dental treatment.
Children with erupted FPMs and permanent incisors in the maxilla and mandible.	Children with dental fluorosis and amelogenesis imperfecta.

Table 2: Diagnostic criteria for MIH (Weerheijm et al.)

1	Absence or presence of demarcated opacities (defect altering the translucency of the enamel)
2	Posteruptive enamel breakdown (loss of surface enamel after tooth eruption, usually associated with a preexisting opacity)
3	Atypical restorations (frequently extended to the buccal or palatal smooth surfaces reflecting the distribution of hypoplastic enamel
4	Extracted molars due to MIH.
5	Failure of eruption of a molar or incisor.

Permanent first molars and incisors (12 index teeth) should be examined, and therefore the age of 8 years upwards is the best time for examination.

Examination for MIH should be performed on wet teeth after cleaning, and clearly visible opacities, regardless of size, should be recorded.

Table 3: Comparison of prevalence of MIH between age, gender, and area

	Rural				*Urban*				*Total*	
Age (year)	*Male (n)*	*%*	*Female (n)*	*%*	*Male (n)*	*%*	*Female (n)*	*%*	*Total (n)*	*%*
8	21	19.44	23	28.40	9	16.67	6	13.95	59	20.63
9	20	18.52	26	32.10	3	5.56	7	16.28	56	19.58
10	14	12.96	8	9.88	10	18.52	8	18.60	40	13.99
11	20	18.52	8	9.88	8	14.81	8	18.60	44	15.38
12	19	17.59	8	9.88	10	18.52	8	18.60	45	15.73
13	14	12.96	8	9.88	14	25.93	6	13.95	42	14.69
Total	108	100.00	81	100.00	54	100.00	43	100.00	286	100.00

Age Predilection

The prevalence of MIH in children of different ages was calculated, and it found that the rural area of Vadodara had MIH higher prevalence in 8 and 9-year-old children, whereas similarly, it was found in 13-year-old children in the urban area of Vadodara. The overall prevalence of MIH was found to be higher in 8-year-old children (Table 3).

Gender Predilection

Males were more likely to have MIH than females in the Vadodara district's rural and urban areas; however, this result was not statistically significant because the *p*-value was only 0.811. In rural areas, a total of 42.86% of females and 57.14% of males were affected by MIH, and similarly, in urban areas, 44.33% of females and 55.67% of males were affected by MIH (Table 3).

Frequency of Molar Hypomineralization (MH) in MIH-affected Children

Figure 5 shows that molars affected by hypomineralization were more in rural areas as compared to urban areas. A total of 40 children had seen all four molars affected with hypomineralization, and in a rural area, 32 children had seen all four molars affected with hypomineralization. In rural areas, 12 children, and in the urban area, only three of them had seen only one molar affected with hypomineralization (Figs 1 to 7).

Frequency of Incisor Hypomineralization (IH) in MIH-affected Children

Figure 6 shows that incisors affected by hypomineralization were more in rural areas when compared to urban areas. In rural areas, 40 children, and in urban areas, 10 children had seen all four incisors affected with hypomineralization. In rural areas, 32 children had seen all four molars affected by hypomineralization. In rural areas, two children and in the urban area, one child had seen all eight incisors affected with hypomineralization.

A substantial association ($p = 0.0001$) between the hypomineralization of molars and that of incisors was found in both urban and rural locations, with the involvement of incisors appearing to rise as more first permanent molars (FPMs) were affected.

Phase II

Distribution of factors in MIH in kids from urban and rural areas associated with kids' and moms' health status during and after pregnancy. Figure 7 shows that the maternal medical problems during pregnancy were 15.46 and 12.17% in mothers from urban and rural areas, respectively. It shows that in the initial 4 years of life, children with MIH were ill more frequently in rural areas as compared to urban areas.

Fig. 1: Depicting the front view with hypomineralization of incisors

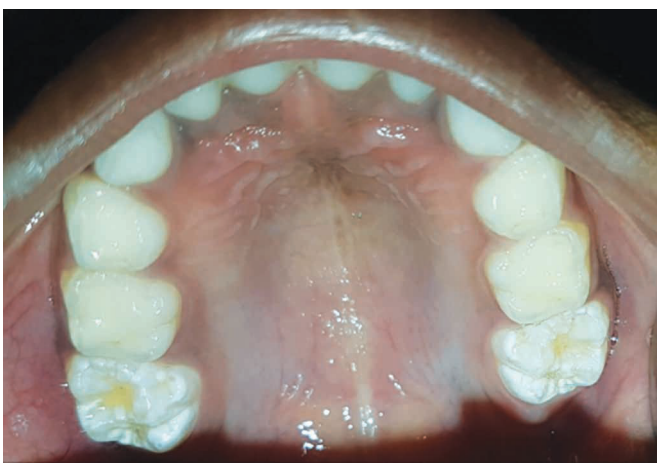

Fig. 2: Depicting the front view with hypomineralization of maxillary molars

Factors associated with MIH were determined by the answers of the parents to the questions mentioned in Table 2. The 12 questions were close-ended with only two options "yes" or "no." The selection of the "Yes" option is aimed toward the contributing risk factor. Table 4 shows the 12 different questions and the number of participants who selected "yes" for each question.

Discussion

Molar incisor hypomineralization (MIH) is a type of enamel defect that develops when the ameloblasts' normal function is interrupted, disrupting the mineralization of enamel during its

Fig. 3: Depicting the front view with hypomineralization of maxillary molars

Fig. 4: Health talk to the children

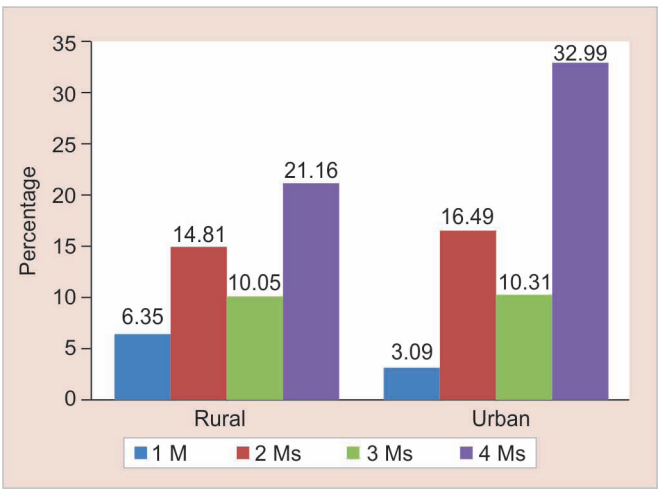

Fig. 5: Frequency of MH in MIH-affected children

maturation phase.[7,8] MIH is regarded as an illustration of lifetime prevalence because the defect was present at some point prior to the examination and is still present at the time the data were recorded.[9] For patients and dental professionals to limit the impact of MIH and for policymakers to have a reliable picture of the defect characteristics in a particular population in addition to arriving

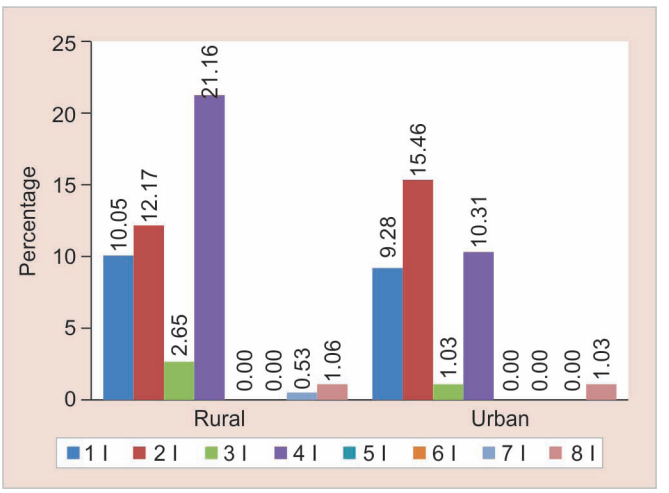

Fig. 6: Frequency of IH in MIH-affected children

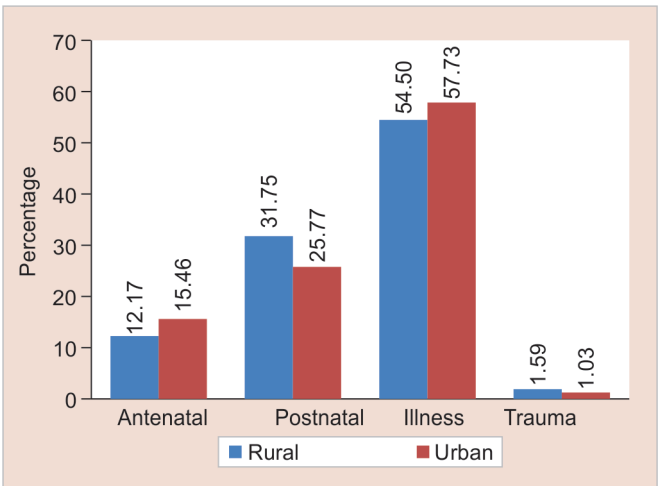

Fig. 7: Maternal medical problems faced during pregnancy to relate with an incidence of MIH

at the proper diagnosis and prognosis at both the individual and population level, prevalence studies are crucial.[1,10]

This study was conducted to provide baseline data for the prevalence and severity of MIH along with an evaluation of the related risk markers because there is little information available regarding its prevalence and severity, especially in Gujarat, India.

Diagnostic Criteria

To identify enamel flaws and distinguish between diffuse opacities, defined opacities, and white spot carious lesions, a dental examination of clean, wet teeth was performed.[2,11,12] The developmental defects of enamel (DDE) index or the modified DDE index[13,14] the diagnostic criteria of Jälevik,[6] and the criteria suggested by the EAPD in 2003.[15–17] have all been employed by different researchers to document the existence of MIH. The EAPD criteria, which were created in 2003[12] and further amended in 2009,[18] were used in the current investigation.

Small enamel opacities (<2 mm) have a low reproducibility, according to Lygidakis et al.[15] numerous studies,[16,17] and in order to prevent the possibility of misdiagnosing white spot lesions, white cuspal ridges, or a patchy appearance of amelogenesis

Table 4: Response to the questionnaire by the parents of the MIH-affected children

Questions	*Rural (n)*	*%*	*Urban (n)*	*%*
Did you suffer from any medical illness during pregnancy?	1	3.70%	6	6.19%
Did you have any nutritional deficiency during pregnancy?	12	6.35%	8	8.25%
Were you exposed to radiation (X-ray) during pregnancy?	4	2.12%	1	1.03%
Did you have any complications at the time of delivery?	7	3.70%	2	2.06%
Was the baby full-term?	5	2.65%	3	3.09%
Was the weight of the child less than 2.5 kg?	18	9.52%	9	9.28%
Did you follow the vaccination schedule for your child?	30	15.87%	11	11.34%
Did the child suffer from any illness for more than 15 days	68	35.98%	13	13.40%
Did your child hospitalize before 4 years of age?	11	5.82%	15	15.46%
Was the child exposed to prolonged use of any antibiotic before 4 years of age?	24	12.70%	28	28.87%
What is the source of drinking water?	0	0.00%	0	0.00%
Did the child have any trauma or Infection to primary teeth (milk teeth)	3	1.59%	1	1.03%

Table 5: Summary of published data from different countries on MIH prevalence

Authors	*Year*	*Country/city*	*Number of subjects*	*Age range of subjects*	*Prevalence*
Weerheijm et al.[19]	2001	The Netherlands	497	11	9.7%
Jasulaityte et al.[20]	2007	Lithuania/Kaunas	1277	7–9	9.7%
Kühnisch et al.[22]	2009	Turkey/BozcaadaTurkey/Kocaeli	153	7–10	9.1%9.2%
Bhaskar and Hegde[21]	2014	India/Udaipur	1173	8–13	9.46%
Kuhnisch et al.[24]	2014	Munich/Germany	693	9–13	9.4%
Temilola et al.[22]	2015	Nigeria/Ile Ife	236	8–10	9.7%
Kirthiga et al.[23]	2015	India (Davanagere)	2000	11–16	8.9%
Yannam et al.[24]	2016	India/Chennai	2864	8–12	9.7%

Table 6: Interpretation of various criteria and their comparison with other relevant studies

Criteria/aspect	*Interpretation and possible reasons*	*Supporting studies*	*Reasons*	*Contradictory studies*
Rural/urban	Rural (12.6%) > Urban (6.47%)	Lygidakis et al.,[15] William V[12]	Lack of enough information on MIH and less awareness among the rural population Lygidakis et al.	–
Gender	Males > Females	Opydo-Szymaczek et al.[25]	–	Kemoli et al.[29] Australian[15]
Age	Older children had more severely affected FPMs than younger children	Lithuanian,[26] Greek,[27] and Gujarati Indian[30]	The dynamic nature of hypomineralized lesions. With increasing age and exposure to challenges in the oral environment, mild defects worsen, resulting in clinically detectable loss of structure or its consequences, such as atypical restorations.[30]	
Jaw	Mandible > maxillary	Lithuanian,[26] Gujarati Indian[28]	Molars—the early eruption of mandibular molars with resultant early posteruptive enamel breakdown or caries makes them more obviously affected than maxillary molars.[31] Incisors—buccal surfaces of the maxillary FPM are thinner than that of the lower molars.[32]	Chinese[5] and Australian[15] (similar distribution) Maxilla > mandible
Tooth affected	Molars > Incisors	Kono et al.[32]	No or minimal masticatory forces on the affected surfaces.	Chawla et al., Muratbegovic et al.,[4,33]

imperfecta/fluorosis, defects measuring less than 2 mm have been disregarded. As advised by the EAPD in 2009,[18] flaws smaller than 1 mm were not taken into account in the current investigation in order to identify a "truer" prevalence of MIH in the study group. Recording defect severity—defect severity was assessed following the standards suggested by the EAPD in 2009.[6] MIH has been categorized in earlier research into mild, moderate, and severe defects.[6,16,17] In order to increase repeatability, the moderate and severe groups have recently been amalgamated into one category, disintegrated or severe.[18]

The reported prevalence of MIH varies widely among research, ranging from 2.8 to 40.2%, which may be an accurate reflection of regional and national disparities. A few of the studies that have a prevalence rate near that of the present study are listed in the Table 5. Cross-comparing the findings of different research, however, is challenging due to the use of multiple indices and criteria, examination variability, recording methodologies, and distinct age-groups.[9]

Table 6 summarizes various criteria taken in this study with the interpretations and comparisons with other similar studies. The study's age range was set at 8 to 12 years old since EAPD 2003 recommends starting any screening for MIH at age 8. Around this age, the majority of the incisors and all of the permanent first molars have emerged. The permanent first molar teeth will also be in a generally healthy state with minimal post-eruptive degradation. And 11-year-old children were included in the study to determine the extent to which the factors affect how severe the problem is.[20–28]

The majority of research has shown that the aetiology of Molar Incisor Hypo-mineralization is extremely complicated and linked to systemic and genetic variables that disturb normal amelogenesis in the affected tooth. Concerns during pregnancy, preterm delivery, cyanosis, exanthamatous diseases of early childhood like chickenpox, otitis media, urinary tract infections, tonsillitis, high fever, gastrointestinal disorders, and frequent use of antibiotics are just a few of the risk factors that have been linked to Molar Incisor Hypo-mineralization. Such circumstances most likely affect the calcium-phosphate balance or can result in inadequate oxygen delivery to ameloblasts, which causes enamel abnormalities.[29–35]

In our study, the maximum cause of MIH in rural areas was seen due to the child suffering from illness for >15 days which was 35.98%. In urban areas, the maximum cause of MIH was seen due to prolonged use of antibiotics before 4 years of age, which was 28.87%. According to Lygidakis et al.,[10] rural mothers have poor general health as compared to urban mothers as they are less aware of medical problems such as maternal diabetes.[33]

Limitations

- The part of the cross-sectional study (questionnaire) was based on the recall ability of the parents regarding the past history of illness and drug intake.
- Prevalence study was done only in a small part of Gujarat-Vadodara. Need for further studies to find the prevalence of MIH throughout India.
- A wide range in prevalence of MIH has been found due to variations in the usage of different diagnostic criteria; hence a standardized criterion has to be adopted.

Conclusion

A total of 9.6% prevalence of MIH in children of age-group 8–13 years. Males were more affected than female participants. Rural participants showed greater prevalence when compared to urban participants. MIH was seen more in mandibular molars and incisors when to maxillary teeth.

References

1. Leppäniemi A, Lukinmaa PL, Alauusua S. Nonfluoride hypomineralizations in the permanent first molars and their impact on the treatment need. Caries Res 2001;35(1):36–40. DOI: 10.1159/000047428
2. Weerheijm KL, Jälevik B, Alaluusua S. Molar-incisor hypomineralisation. Caries Res 2001;35;390–391. DOI: 10.1159/000047479
3. Mathu-Muju K, Wright JT. Diagnosis and treatment of molar incisor hypomineralization. Compend Contin Educ Dent 2006;27(11):604–610.
4. Chawla N, Messer LB, Silva M. Clinical studies on molar-incisor-hypomineralisation part 1: distribution and putative associations. Eur Arch Paediatr Dent 2008;9(4):180–190. DOI: 10.1007/BF03262634
5. Weerheijm KL, Duggal M, Mejàre I, et al. Judgment criteria for molar incisor hypomineralization (MIH) in epidemiologic studies: a summary of the European meeting on MIH held in Athens, 2003. Eur J Paediatr Dent 2003;4(3);110–113.
6. Jälevik B. Prevalence and diagnosis of molar-incisor-hypomineralisation (MIH): a systematic review. Eur Arch Paediatr Dent 2010;11(2);59–64. DOI: 10.1007/BF03262714
7. Smith BH. Standards of human tooth formation and dental age assessment. In: Kelley MA, Larsen CS, editors. Advances in dental anthropology. New York: Wiley-Liss; 1991;143–168.
8. Garg N, Jain AK Saha S, et al. Essentiality of early diagnosis of molar incisor hypomineralization in children and review of its clinical presentation, etiology and management. Int J Clin Pediatr Dent 2012;5(3):190–196. DOI: 10.5005/jp-journals-10005-1164
9. Souza JF, Costa-Silva CM, Jeremias F, et al. Molar incisor hypomineralization: possible aetiological factors in children from urban and rural areas. Eur Arch Paediatr Dent 2012;13(4):164–170. DOI: 10.1007/BF03262865
10. Lygidakis NA, Dimou G, Marinou D. Molar-incisor-hypomineralisation (MIH). A retrospective clinical study in Greek children. II. Possible medical aetiological factors. Eur Arch Paediatr Dent 2008;9(4):207–217. DOI: 10.1007/BF03262637
11. Dietrich G, Sperling S, Hetzer G. Molar incisor hypomineralization in a group of children and adolescents living in Dresden (Germany). Eur J Paediatr Dent 2003;4(3);133–137.
12. William V, Messer LB, Burrow MF. Molar incisor hypomineralization: review and recommendations for clinical management. Pediatric Dent 2006;28(3);224–232.
13. Jälevik B, Klingberg GA. Dental treatment, dental fear and behaviour management problems in children with severe enamel hypomineralization of their permanent first molars. Int J Paediatr Dent 2002;12(1);24–32.
14. Jälevik B, Möller M. Evaluation of spontaneous space closure and development of permanent dentition after extraction of hypomineralized permanent first molars. Int J Paediatr Dent 2007;17(5):328–335. DOI: 10.1111/j.1365-263X.2007.00849.x
15. Lygidakis NA, Dimou G, Briseniou E. Prevalence and defect characteristics of molar-incisor-hypomineralisation, retrospective clinical study in Greek children. Eur Arch of Paediatr Dent 2008;9(4):200–206. DOI: 10.1007/BF03262636
16. Da Costa-Silva CM, Jeremias F, De Souza JF, et al. Molar incisor hypomineralization: prevalence, severity and clinical consequences in Brazilian children. Int J Paediatr Dent 2010;20(6):426–434. DOI: 10.1111/j.1365-263X.2010.01097.x
17. Balmer R, Toumba J, Godson J, et al. The prevalence of molar incisor hypomineralization in Northern England and its relationship to socioeconomic status and water fluoridation. Int J Paediatr Dent 2012;22(4):250–257. DOI: 10.1111/j.1365-263X.2011.01189.x
18. Jasulaityte L, Weerheijm KL, Veerkamp JS. Prevalence of Molar-Incisor-Hypomineralisation among children participating in

the Dutch National Epidemiological Survey (2003). Eur Arch Paediatr Dent 2008;9(4):218–223. DOI: 10.1007/BF03262638
19. Weerheijm KL, Groen HJ, Beentjes V, et al. Prevalence of cheese molars in eleven year old Dutch children. J Dent Child 2001;68(4):259–262.
20. Jasulaityte L, Veerkamp JS, Weerheijm KL. Molar-incisorhypomineralisation: review and prevalence data from a study of primary school-children in Kaunas/Lithuania. Eur Arch Paediatr Dent 2007;8(2):87–94. DOI: 10.1007/BF03262575
21. Kukleva MP, Petrova SG, Kondeva VK, et al. Molar incisor hypomineralization in 7-to-14-year old children in Plovdiv, Bulgaria—an epidemiologic study. Folia Med (Plovdiv) 2008;50(3):71–75.
22. Kühnisch J, Heitmüller D, Thiering E, et al. Proportion and extent of manifestation of molar-incisor-hypomineralizations according to different phenotypes. J Public Health Dent 2014;74(1):42–49. DOI: 10.1111/j.1752-7325.2012.00365.x
23. Kevrekidou A, Kosma I, Arapostathis K, et al. Molar incisor hypomineralization of eight- and 14-year-old children: prevalence, severity, and defect characteristics. Pediatr Dent 2015;37(5):455–461.
24. Yannam SD, Amarlal D, Rekha CV. Prevalence of molar incisor hypomineralization in school-children aged 8-12 years in Chennai. J Indian SocPedodPrev Dent 2016;34:134–138. DOI: 10.4103/0970-4388.180438
25. Krishnan R, Ramesh M, Chalakkal P. Prevalence and characteristics of MIH in school-children residing in an endemic fluorosis area of India: an epidemiological study. Eur Arch Paediatr Dent 2015;16(6):455–460. DOI: 10.1007/s40368-015-0194-8
26. Da Costa-Silva CM, Ambrosano GM, Jeremias F, et al. 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(5);333–341. DOI: 10.1111/j.1365-263X.2011.01128.x
27. Mejàre I, Bergman E, Grindefjord M. Hypomineralized molars and incisors of unknown origin: treatment outcome at age 18 years. Int J Paediatr Dent 2005;15(1):20–28. DOI: 10.1111/j.1365-263X.2005.00599.x
28. Kilpatrick N. New developments in understanding development defects of enamel: optimizing clinical outcomes. J Orthod 2009;36(4)277–282. DOI: 10.1179/14653120723310
29. Subramaniam P, Gupta T, Sharma A. Prevalence of molar incisor hypomineralization in 7–9-year-old children of Bengaluru City, India. Contemp Clin Dent 2016;7(1):11–15. DOI: 10.4103/0976-237X.177091
30. Farah RA, Swain MV, Drummond BK, et al. Mineral density of hypomineralised enamel. J Dent 2010;38(1):50–58. DOI: 10.1016/j.jdent.2009.09.002
31. Jälevik B, Norén JG. Enamel hypomineralization of permanent first molars: a morphological study and survey of possible aetiological factors. International Journal of Paediatric Dentistry. 2000;10(4);278–289. DOI: 10.1046/j.1365-263x.2000.00210.x
32. Kono RT, Suwa G, Tanijiri T. A three-dimensional analysis of enamel distribution patterns in human permanent first molars. Arch Oral Biol 2002;47(12):867–875. DOI: 10.1016/s0003-9969(02)00151-6
33. Muratbegovic A, Markovic N, GanibegovicSelimovic M. Molar incisor hypomineralization in Bosnia and Herzegovina: aetiology and clinical consequences in medium caries activity population. Eur Arch Paediatr Dent 2007;8(4):189–194. DOI: 10.1007/BF03262595