Molar Incisor Hypomineralization Prevalence in Arab Children in UAE and its Association with Risk Factors- A Cross Sectional Study

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Abstract

Molar Incisor Hypomineralization (MIH) is observed on permanent molars as demarcated opacities that vary from creamy-white or yellow to yellowish-brown discoloration. The condition is of systemic origin, affecting one to four permanent first permanent molars and often involving the permanent incisors. The current study was designed to determine the prevalence, pattern, distribution of MIH in Arab children in schools of United Arab Emirates. The associated risk factors like perinatal variables and early childhood illnesses were also assessed.

A total of 1200 children with 656 boys and 544 girls were included in the study. The children belonged to the age group of 8-12 years of age. The children were examined for prevalence and distribution of MIH and risk factors like perinatal variables and early childhood illnesses were also assessed. The tabulated data was analyzed using SPSS version 20.

The prevalence of MIH was reported at 21.16%. It was seen that MIH is more prevalent in girls when compared to boys with the p value being <0.001. The mandibular molars had a higher prevalence of MIH when compared to the maxillary molars with the results being statistically significant. MIH though associated with the perinatal variables but the results were not statistically significant. MIH had a strong association with the factors of early childhood illnesses and the results were statistically significant.

The prevalence of MIH in Arab children in Ras Al Khaimah, United Arab Emirates (UAE) was 21.6%. The demarcated opacity type of MIH being the most common form of defect followed by post-eruptive breakdown. Further studies are recommended to better understand the possible etiologies of MIH in Arab children and the associated risk factors.

Clinical article (J Int Dent Med Res 2021; 14(3): 1100-1106)

Keywords: MIH, Dental Opacities, First Permanent Molars, Hypomineralization.

Received date: 19 June 2021 **Accept date:** 01 August 2021

Introduction

Molar Incisor Hypomineralization (MIH) refers to a qualitative, developmental defect of enamel that affects one to four first permanent molars (FPMs) with or without permanent incisors (PIs) involvement.[1] MIH as a term was first introduced early in 2001.[1] The term was used to describe the presence of Hypomineralization of enamel which was of systemic origin and affected one or more first permanent molars (FPMs) and frequently was associated with permanent incisors.[1] This condition is also known by terms like idiopathic enamel Hypomineralization, internal enamel hypoplasia, opaque spots, non-endemic mottling of enamel, idiopathic enamel opacities, enamel opacities, and no fluoride enamel opacities.[2] The prevalence percentage of MIH worldwide according to reports vary widely between 5.6% to 40%.[3, 4, 12-15]

Defects or abnormalities of enamel may be a result of depressed activity of the enamel forming ameloblast. This can be triggered due to

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numerous factors such as perinatal/prenatal/postnatal illnesses, antibiotic abuse/misuse and excessive fluoride intake which result in the abnormal formation of enamel.[6] These malformations can be found in two different stages: the Secretion phase or Enamel matrix formation and Maturation phase or enamel mineralization. The resultant defect is called Hypoplasia if it occurs during the Secretion phase and Hypomineralization if it occurs during the Maturation phase.[6, 7]

Clinically, a hypo mineralized enamel looks like discolored chalk or Old Dutch cheese and is usually soft and porous.[2] The defective enamel may vary in color from white to yellow or brown. However, there is always a clear distinction between the sound and affected enamel.[2]

MIH may present with opacities in the upper and lower permanent incisors. Usually the upper permanent incisors are affected when compared to the lower permanent incisors.[8] The second permanent molars and premolars are rarely affected by these enamel defects.[9] However it has been reported that there can be occasional occurrence of these defects on the permanent and deciduous second molars and tips of permanent canines.[10]

The management of children with these defects are challenging due to profound difficulties in pain management of these teeth owing to the increased sensitivity of exposed dentine and also due to subclinical inflammation of the pulpal cells caused by the porosity. These children exhibit increased behavior problems because of these defects.[11]

As there is a paucity of studies which have discussed the prevalence of MIH in Arab children of United Arab Emirates (UAE) and especially from Ras Al Khaimah (RAK), which is one of the northern emirates, this study was designed to determine the prevalence, clinical pattern and distribution of MIH in children visiting schools of RAK in UAE. The study also tried to understand the association between MIH and certain risk factors like perinatal variables and early childhood illnesses which could occur more commonly in the first 3-4years of life after birth.

Materials and methods

This was a cross sectional study conducted at RAK College of Dental Sciences (RAKCODS), RAK Medical and Health Sciences University (RAKMHSU), RAK, UAE. The objective of the study was to understand the prevalence of MIH in school going children of RAK in UAE. This research was approved by the Research and Ethics committee of the university and the RAK Research and Ethics Committee, Ministry of Health and Prevention UAE (MOHAP/RAK/SUBC/NO:34-2018). Eight private schools were approached of which three private schools approved of the research. There were a total of 2300 children going to these schools between the ages of 8 and 12 years. At a 5% error and 95% confidence, the sample was calculated to be 330. The parents of the children were requested through school authorities to provide a consent for the research including intra oral examination. The parents were requested to provide their consent within three weeks of the request. Children belonging to the ages between 8 and 12 years were included in the study. Children whose parents did not provide consent or had any medical condition were not included in the study so as to prevent any bias in the findings of the study. The research was done as a part of the community outreach program of the university. Finally screening was done for 1200 students of these schools which was higher than the sample size determined. There were 656 boys and 544 girls who were included in the study according to convenience. Children who were born and raised in the UAE were included.

Statistical Analysis

The prevalence of MIH was reported by age and gender, and in total. The data were analyzed by the statistical program SPSS version 20. Descriptive statistics for prevalence percentage were calculated. The Chi-square test was used to test the association between MIH and gender; the difference in proportions between two groups like molars and incisors, maxillary and mandibular teeth. Chi Square test was used also to test the association between MIH and perinatal variables and early childhood illnesses. In all these tests the P-value was pegged at < 0.05, which was considered to be significant.

Results

A total of 1200 children (656 boys and 544 girls) were included in the study. The mean age of the children were 10.54$\pm$1.4 years. All the

children included in the study were Arab nationals.

A total of 254 children were diagnosed with MIH out of the 1200 children included in the study with a prevalence rate of 21.16%. MIH was more prevalent in girls with 170 of them diagnosed with MIH at a prevalence percentage of 66.92% when compared to 84 (33.07%) who were diagnosed with MIH. The results were statistically significant (p<0.001) (Table 2).

Demarcated Opacity (DO)	Post-eruptive Enamel Breakdown (PEB)
Alterations in the translucency of the enamel, variable in degree. The defective enamel is of normal thickness with a smooth surface and can be white, yellow, or brown in color	A defect that indicates deficiency of the surface after eruption of the tooth. Loss of initially formed surface enamel after tooth eruption. The loss is often associated with a preexisting demarcated opacity.
Atypical Restoration (AR)	**Extracted Molar due to MIH**
The size and shape of a restoration are not conforming to the temporary caries picture. In most cases in molars there will be restorations extended to the buccal or palatal smooth surfaces. At the border of the restorations frequently an opacity can be noticed. In incisors a buccal restoration can be noticed not related to trauma.	Absence of a first permanent molar should be compared to the other teeth of the dentition. Suspected for extraction due to MIH are opacities or atypical restorations in the other first permanent molars combined with absence of a first permanent molar. Also the absence of first permanent molars in a sound dentition in combination with demarcated opacities on the incisors is suspected for MIH. It is not likely that incisors will be extracted due to MIH.

Table 1. Diagnostic criteria used in diagnosing MIH [10].

Gender	MIH n (%)	Non-MIH n (%)	Total	p value
Male	84 (33.07%)	572 (66.92%)	656 (54.66%)	p<0.001*
Female	170 (66.92%)	374 (68.75%)	544 (45.33%)	

Table 2. Comparison of MIH between males and females.
*VHS- very highly significant.

When the maxillary molars were compared to the mandibular molars the results were statistically significant (p<0.004) with a higher prevalence of mandibular molars when compared to the maxillary molars. When the maxillary incisors were compared to the mandibular incisors, the results were found to be statistically significant (p<0.002), with the maxillary incisors having higher prevalence when compared to the mandibular incisors. When the right and left incisors or the lateral incisors compared, there were no statistically significant results found (p=0.4)

When the pattern of MIH defects were evaluated it was seen that out of the 254 children diagnosed with MIH, Demarcated Opacities (DO) was seen in 124 children (48.81%). Post Eruptive Breakdown (PEB) was seen in 69 children with a prevalence rate of 27.16%. Atypical Restorations (AR) was seen in 54 children with a prevalence of 21.25%. The least common defect observed was Extractions which was seen in 7 children with a prevalence rate of 2.75%. (Table 3)

Type	N (%)
Demarcated Opacities (DO)	124 (48.81%)
Post Eruptive Breakdown (PEB)	69 (27.16%)
Atypical Restorations (AR)	54 (21.25%)
Extractions (E)	7 (2.75%)

Table 3. Pattern of MIH Defects.

In terms of distribution of MIH defects on the MIH index teeth, 88 children (34.64%) had one molar affected, 69 children (27.16%) had 2 molars, 33 children (12.99%) had 3 molars while 64 children (25.19%) had 4 molars. The mean number of affected incisors was found to increase with increasing number of affected molars. This difference was found to be statistically significant with the p value <0.001 (Table 4).

Number of First Permanent Molars (FPM) affected	Number of Children n (%)	Number of Children with incisors also affected n (%)	p value
1	88 (34.64%)	37 (42.04%)	p<0.001**
2	69 (27.16%)	34 (49.27%)	
3	33 (12.99%)	16 (48.88%)	
4	64 (25.19%)	54 (84.37%)	
Total	**254**	**141**	

Table 4. Prevalence of MIH teeth type.
** VHS- Very Highly Significant.

Variables	MIH n=254 n (%)	Non-MIH n=946 n (%)	p value
Prolonged labor	29 (11.41%)	97 (10.14%)	0.934
Caesarian Delivery	189 (74.4%)	785 (83.0%)	0.879
Premature Birth	33 (13.0%)	121 (12.7%)	0.956
Birth Complications	6 (2.36%)	18 (1.9%)	0.874
Breast feeding birth – 6months	102 (40.15%)	398 (42.07%)	0.836
Breast feeding 6 months -1 year	86 (33.8%)	369 (39.0%)	0.857
No Breast feeding	26 (2.75%)	28 (2.9%)	0.912

Table 5. Perinatal variables and MIH.

Perinatal variables especially those linked with the delivery and the first year thereafter of the child were assessed. The variables included

factors like prolonged labor, caesarian delivery, premature birth, complications during birth and breastfeeding by the mother. The results were tabulated and found to be not statistically significant (Table 5).

Early childhood illnesses and drug usages were assessed and associated with MIH. The illnesses considered include frequent fever and medications, adenoiditis, tonsillitis, asthma. Drug usages including antibiotic usage during the early childhood up to 4 years of age was assessed. The results were found to be statistically significant showing a higher correlation between the presence of early childhood illnesses and MIH in children and also a statistically significant relationship was seen between the usage of antibiotics in early life and the prevalence of MIH (Table 6).

Variables	MIH (n=254) n (%)	Non MIH (n=946) n (%)	p value
Frequent Fever	56 (22.04%)	18 (2.0%)	< 0.001*
Adenoiditis	42 (16.53%)	13 (1.37%)	<0.001*
Tonsillitis	39 (15.35%)	8 (0.84%)	<0.001*
Asthma	47 (18.5%)	14 (1.4%)	<0.001*
Frequent Antibiotic Usage	43 (16.92%)	10 (1.05%)	<0.000*
No History	27 (10.6%)	785 (83.0%)	<0.000*
Total	254 (100%)	946 (100%)	

Table 6. Early childhood illnesses and medication and its association with MIH.
* VHS-Very Highly Significant.

Discussion

Early detection of MIH is critical as patients because with this condition is difficult to clinically manage because of the hypersensitivity associated with this condition. The availability of details regarding the prevalence of MIH and associated risk factors are relatively scanty in this part of the world and therefore this study will help understand the condition and associated factors in the Arab population residing here. This was a cross sectional study done amongst the Arab population of Ras Al Khaimah (RAK), United Arab Emirates (UAE). Hypomineralization defects were recorded in accordance with EAPD scoring criteria for MIH.10

Prevalence of MIH

The prevalence of MIH in the present study was found to be at 21.16%. The worldwide prevalence rates are reported between 5.6%-40%. 12-15, 23 In a similar study reported from Dubai, UAE, the prevalence rate was at 27.2%.16 A study from Germany reported with a prevalence rate of 5.9%.12 Studies from other parts of Europe like Bosnia-Herzogovina, Sweden and Greece reported to have prevalence rates of 12.3%, 18.4% and 10.2%.14, 17, 18 A study from Iraq reported a prevalence rate of 18.2%.19 Other countries of Middle East like Kingdom of Saudi Arabia, Iran and Jordan reported prevalence rates of 8.6%, 20.2% and 17.6%.20, 21, 22 The prevalence rates from UAE according to the present study is comparable to the rest of the world and is neither too high or too low.

Gender Predilection

When genders were compared it was seen that the girls have a higher prevalence rates at 66.92% when compared to boys who had a prevalence rate of 33.07% and the results were of statistical significance with a p value <0.001 (Table 1). The findings of the present study are in agreement with a few studies which similarly reported higher prevalence rates in girls.24, 25 However there are other studies which have reported a higher prevalence rate in boys when compared with girls.25, 26 A plausible reason for finding high prevalence in girls can be owing to the fact that in girls the physiological development is faster and also that the teeth erupt earlier in girls and therefore giving it more exposure to the possible causative factors when compared to in boys where the physiological development and teeth eruption are late.27

Maxillary and Mandibular Teeth

When the maxillary and mandibular molar prevalence rates are compared it was found that the mandibular molars had a higher prevalence compared to the maxillary molars and the results were statistically significant with a p value <0.004. These findings were similar to results reported in studies done elsewhere.[22, 28] The authors of the present study believe that the cause for a higher prevalence rate in the mandibular molars can be attributed to the reason that the mandibular molars develop and erupt earlier than the maxillary molars.

When the maxillary and mandibular incisors prevalence rates were compared it was

found that the maxillary incisors have a higher prevalence rate of Hypomineralization when compared to the mandibular incisors. These findings are similar to studies conducted with different populations.[21, 28] The authors of the present study believe that the findings of the present study may be because of the reason that the surface area of the maxillary incisors is larger when compared to the mandibular incisors and also that the mandibular incisors could have a more protected environment owing to a greater number of minor salivary gland duct openings and also the protective shielding by tongue.

Patterns of MIH Defects

The patterns of the defect reveal that the most commonly seen type is that of the Demarcated Opacities at 48.81% followed by Post-eruptive Breakdown at 27.16%, these findings are comparable to studies done elsewhere which showed the same pattern of appearance.4, 29, 30 These defects are predominantly seen in molars affected with MIH than the incisors and this is found in other studies too, the reason suggested being the masticatory forces which bring about the breakdown of the molars when compared to the incisors.13, 30, 33, 35 In the present study the Post-Eruptive Breakdown is seen to be higher in prevalence when compared to other studies, however this could be due to the reason of including the higher age group children into the study.31, 32

MIH Index Teeth and MIH

It is seen in the present study that the FPMs are more commonly affected when compared with the Incisors and that when the number of FPMs involved increase then the involvement of incisors also increase. It is also seen that the number of molar teeth affected by MIH is about twice the number of incisor teeth suggesting that the concentration of the defect is mainly on the first permanent molars and the involvement of the incisor teeth suggest a higher severity of the condition. These findings are similar to the results of other studies.4, 30

Perinatal Variables and MIH

Perinatal variables including prolonged labor, premature birth, breastfeeding and complications during birth were associated with the prevalence of MIH. Though there was a higher prevalence rates in children who had problems associated with the perinatal variables but the results were not statistically significant. The reason why the present study did not find any statistically significant results could be due to the higher number of variables associated with MIH. However there are studies which did report a statistically significant result suggesting a increased prevalence of MIH in children with problems during the perinatal period.33, 34

Early Childhood Illnesses, antibiotic usage and MIH

Illnesses commonly seen in early childhood up to 4 years of age were included like, tonsillitis, adenoiditis, asthma, frequent fevers. The possible excessive antibiotic usage was also evaluated. In the present study it was seen that a statistically significant percentage of children with MIH had histories of early childhood illnesses during the first four years of their life. These findings are supported by results from other studies.31, 36 Health conditions like adenoiditis, tonsillitis or asthma infections can have an adverse effect on ameloblastic activity during the stages of mineralization of enamel, and this can be because of the influence of the disease or because of hypocalcaemia, hypoxia, fever, and/or malnutrition due to the illness. 37, 38 The Corticosteroid therapy more commonly used in asthmatic children is known to suppress osteoblast formation and activity, resulting in decreased bone formation and a similar effect is possible in the ameloblast formation and activity too resulting in MIH.[39, 40] When antibiotic usage is related it is again found that the results are statistically significant, however it is not clear whether the drugs caused the condition or the disease for which the antibiotics were used caused the disease. The association of MIH with fever is also inconclusive. Fever, however, is also a common symptom associated with most childhood respiratory infections so it may be the illness and not the fever that is causing the defect.[20]

It is of importance to note that MIH defects, whether mild or severe, can become more and more symptomatic over time. The condition can affect the quality of life of the individual and also the general health will be affected. It is of importance to dentistry as it becomes difficult to treat these patients because of the hypersensitivity they have. Therefore it is important to identify the condition as early as possible and provide preventive care to the patient as much as possible.

Conclusions

The following can be concluded from the present study,

1. The prevalence rate of MIH is 21.16% in children of RAK, UAE.
2. The prevalence of MIH is more in girls when compared to boys and it is statistically significant.
3. MIH was found to be significantly associated with early childhood illnesses like adenoiditis, tonsillitis and asthma.
4. MIH was not found to be significantly associated with perinatal variables included in this study.
5. MIH is more commonly found in the maxillary teeth and included the FPMs more commonly than the mandibular teeth and incisors. The results were statistically significant.
6. The most common MIH defective pattern was the Demarcated Opacities type with a prevalence rate of 48.81% followed by Post Eruptive Breakdown with a prevalence rate at 27.16%.
7. Preventive and therapeutic measures are of paramount importance in these patients.

Declaration of Interest

The authors report no conflict of interest.

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