The Relationship Between Hypomineralized Second Primary Molars and Molar Incisor Hypomineralization

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ABSTRACT

Objective: To examine the relationship between the occurrence of molar incisor hypomineralization and hypomineralized second primary molars.

Method: A cross-sectional study was conducted on patients attending the pediatric dental clinic at Prince Rashed Bin Al-Hasan Military hospital The selected patients had either molar incisor hypomineralization or hypomineralized second primary molars or both. The diagnosis of both diseases was based on the definition and criteria of the European Academy of Pediatric Dentistry (EAPD). The severity of the lesion was classified into two categories: mild and severe. A Chi-square test of independence and Cramer's V were used to examine the relationship between the two diseases.

Results: The sample included 228 children whose ages ranged between 7 and 11 years with an average of 8.5. Of these, 49.1% had both hypomineralized second primary molars and molar incisor hypomineralization. However, 65.8% had hypomineralized second primary molars and among those, 74.7% also had molar incisor hypomineralization. Of the molar incisor hypomineralization cases, 67.3% were classified as severe, and 32.0% of the hypomineralized second primary molar cases. There was a statistically significant relationship between the occurrence of both conditions ($p < .05$).

Conclusion: There was a significant relationship between the occurrence of hypomineralized second primary molars and molar incisor hypomineralization in this study, which provides parents and dentists with the chance to predict the possibility of molar incisor hypomineralization occurrence. In addition, severe manifestations of hypomineralization were common, which necessitates early dental preventive measurements in these children.

Keywords: Children, Jordan, Molar Incisor Hypomineralization, Hypomineralized Second Primary Molar.

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Introduction

Hypomineralized dental defects are frequently seen in pediatric dental clinics. These developmental defects can be seen in both permanent and primary teeth. They are qualitative defects of systemic origin which occur as a result of reduced enamel mineralization, where the enamel becomes weak and breaks down easily.

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When hypomineralization affects permanent molars and incisors, the condition is called molar incisor hypomineralization (MIH), which can be observed in one or more of the permanent first molars with or without hypomineralized lesions in permanent incisors.[1, 2, 3, 4]
Comparatively, the condition that affects primary second molars is called deciduous molar hypomineralization (DMH) [1] or, more recently, hypomineralized second primary molars (HSPM).[5, 6]
Such developmental lesions are usually located on the occlusal third of the buccal surface or the incisal third of the labial surface of the affected teeth, with a size of less than one third of the affected surface.[7]
The hypomineralized teeth are a source of worry for dentists and parents because of their deformed appearance and poor function in the dental arch. MIH has therefore been described as a pandemic problem with a global burden that requires monitoring by the entire health care community.[8,9] The detrimental effects of hypomineralization on primary and permanent dentition include rapid caries progression, the breakdown of teeth under masticatory pressure, persistent hypersensitivity, and aesthetic concerns that have a psycho-social impact.[10,11] In addition, hypomineralization affects the ability to treat these teeth because of the difficulty in bonding restoration, the frequent failure of restorations, the need for multiple visits to a dental clinic, and the difficulty in achieving good local anesthesia before dental treatment, which subsequently leads to poor patient cooperation and compliance[12] and may result in losing these teeth.
The definitive cause of hypomineralized lesions is not well known, but it has been suggested that some predisposing factors that occur prenatally, perinatally or postnatally play a role. Recurrent upper respiratory tract infections, low birth weight, preterm birth,[13] and the presence of dioxins in breast milk are common examples of these factors.[14] Some researchers claim that genetics is a factor.[15] However, the cause could be a combination of more than one factor.[14]
Since the development of the second primary molar (SPM) starts before the development of permanent teeth, but both continue the process simultaneously,[1, 16] an injury that occurs in late pregnancy and early perinatal period could affect both.[5]
The prevalence of MIH varies around the world. It could be as low as 2.3% to as high as 40.2%.[17-32] In Jordan, one study estimated the prevalence of MIH as 17.6% in 2011,[20] while another reported a prevalence of 13.7% in 2020.[21]
Similarly, there was a great variation among studies that reported the prevalence of hypomineralized second primary molars (HSPM) [33-41].

No studies in Jordan assessed the relationship between MIH and HSPM in Jordanian children. Thus, the aim of this study was to examine if a relationship exists, and whether or not HSPM can be considered a predictive sign for the development of MIH.

Methods

Study Design and Settings

A cross-sectional study was conducted on patients attending the pediatric dental clinic at Prince Rashed Bin Al Hasan Military hospital

Sampling

Examining patients was completed between June and September 2021. The patients had all their permanent first molars, permanent incisors, and second primary molars erupted and accessible for examination. The patients had either molar incisor hypomineralization (MIH) or hypomineralized second primary molars (HSPM) or both. The diagnosis of the conditions was based on the criteria adopted by the European Academy of Pediatric Dentistry (EAPD) in 2003,[2] and adapted for diagnosing HSPM in 2008,[1] then revised in 2015.[5,6] The severity of the lesion was classified as mild or severe, in which the mild form showed demarcated patches of different colors, while post-eruptive breakdown and atypical caries or

restoration were considered severe hypomineralization, based on modified (EAPD) system[3,4] as shown below.

Mild	Severe
Demarcated enamel opacities of different colors either white, yellow, and brown without breakdown.[3, 4]	Post eruptive breakdown, atypical restorations, and extraction due to hypomineralization.[3, 4]

The children were examined directly in the clinic by one specialized pediatric dentists to ensure the reliability and repeatability, with a mirror and a probe under good illumination in the dental office, with the teeth dry (air blow was used to dry the teeth and gauze was used for removing debris when present). The hypomineralized permanent first molars, incisors, and second primary molars were then recorded.
According to Weerheijm KL *et al.*,[2] a child was considered to have MIH if at least one of the permanent first molars was affected by hypomineralization with or without affected incisors, and according to Elfrink ME *et al.*,[1] the child was considered to have HSPM if at least one second primary molar was hypomineralized. The teeth affected by hypomineralization were recorded.
Regarding the severity, the child was considered to have a severe MIH if at least one severe lesion (according to the criteria mentioned above) was found on the permanent first molars and/or incisors, and to have a severe HSPM if there was at least one severe lesion on the second primary molars. Otherwise, the case was recorded as a mild one.
The exclusion criteria included patients with dental developmental defects such as amelogenesis imperfect, fluorosis, and deformed teeth due to trauma or infection in the primary successors. In addition, patients with grossly carious teeth, those undergoing orthodontic treatment, and patients with systemic diseases or syndromes that may be associated with defective or stained enamel, such as tetracycline staining in cystic fibrosis, hyperbilirubinemia, or congenital porphyria, were excluded.
Statistical Analysis
The descriptive statistics included some demographic information and rates of MIH and HSPM in the examined sample. Pearson χ 2 or Fisher's exact test were used to evaluate the association between the co-occurrence of MIH and HSPM, and MIH and HSPM severity. Cramer's V value estimated the strength of these associations. The SPSS (version 23) software was used in the analyses and a p-value of 0.05 or less was considered statistically significant.

Ethical Considerations

This study gained approval from the local ethical committee of the Royal Medical Services in Jordan.

Results

This study included 228 (125 female and 103 male) patients whose ages ranged between 7 and 11 years, with an average of 8.5.
A total of 3648 teeth were examined for the presence of hypomineralized lesions. These were 912 of each tooth type of concern, which are: permanent first molar (PFM), permanent central incisors (PCI), permanent lateral incisors (PLI) and second primary molars (SPM). Hypomineralization was found in 1430 of them. However, the prevalence of hypomineralization in each tooth type is shown in **Table I.**

Table I: The prevalence of hypomineralization in type of teeth examined

Tooth type	Number of affected teeth (% among the same type)	Percentage from the total number of affected teeth
Permanent central incisors (PCI)	310 (34.0%)	21.7%
Permanent lateral incisors (PLI)	86 (9.4%)	6.0%
Permanent first molars (PFM)	586 (64.3%)	41.0%
Primary second molars (SPM)	448 (49.1%)	31.3%
Total	1430	100%

In addition, those who had all their second primary molars affected by hypomineralization (n = 4) comprised more than half (51.8%) of MIH cases, as shown in **Table II**. The mean for the number of affected SPM in patients with MIH is 3.07, while the mean for the number of affected SPM in patients without MIH is 2.7.

Two thirds of the children, 150 (65.8%) had HSPM, (32.0% severe, 68.0% mild) of whom 74.7% had MIH concomitantly, indicating that 49.1% of the patients had both MIH and HSPM. There were 95 children with MIH, two thirds (64) of whom were categorized as severe (67.4%) and one third (31) as mild (32.6%).

Table II: Number of patients with MIH/without MIH in relation to the number of affected primary second molar (SPM)

No. of affected SPM/patient	Patients with MIH (%)	Patients without MIH (%)
1	8 (7.1%)	4 (10.5%)
2	34 (30.4%)	16 (42.1%)
3	12 (10.7%)	4 (10.5%)
4	58 (51.8%)	14 (36.9%)
Total	112 (100%)	38 (100%)

There were almost equal numbers of mild cases of HSPM among males and females, but females had more severely hypomineralized teeth than males, as shown in **Table III.**

Table IV demonstrates the relationship of MIH with HSPM. There is a significant relationship between MIH and the presence of HSPM, as indicated by the table ($p < .001$). Cramer's V indicated a moderate strength of the association between MIH and HSPM ($V = .322$, p-value = .001) with a mean square canonical correlation ($V^2 = .103$). The relative risk of developing MIH among patients is 1.34 [95% CI: 1.17–1.53].

In **Table V** there was a higher rate of MIH among patients with severe HSPM compared to patients with mild HSPM (79.2% vs. 72.5%, respectively), which is also illustrated in **Figure 1**. Nonetheless, this difference was not significant (p-value = .539).

Table III: Distribution of HSPM according to severity and gender

Severity	N	Female	Male
Severe	48 (32.0%)	28(58.3%)	20 (41.7%)
Mild	102 (68.0%)	50(49.0%)	52 (51.0%)
Total	150 (100%)	78 (52.0%)	72 (48.0%)

Table IV: The relationship of MIH and HSPM

	MIH Absent	MIH present	Total	*p-value
Patients without HSPM	0 (0%)	78 (100%)	78 (100%)	
Patients with HSPM	38 (25.3%)	112 (74.7%)	150 (100%)	< .001
Total	38 (16.7%)	190 (83.8%)	228 (100%)	

*Fisher's exact test

Table V: The occurrence of MIH according to the severity of HSPM

	MIH Absent	MIH present	Total	*p-value
Mild HSPM	28 (27.5%)	74 (72.5%)	102 (100%)	
Severe HSPM	10 (20.8%)	38 (79.2%)	48 (100%)	.385
Total	38 (25.3%)	112 (74.7%)	150 (100%)	

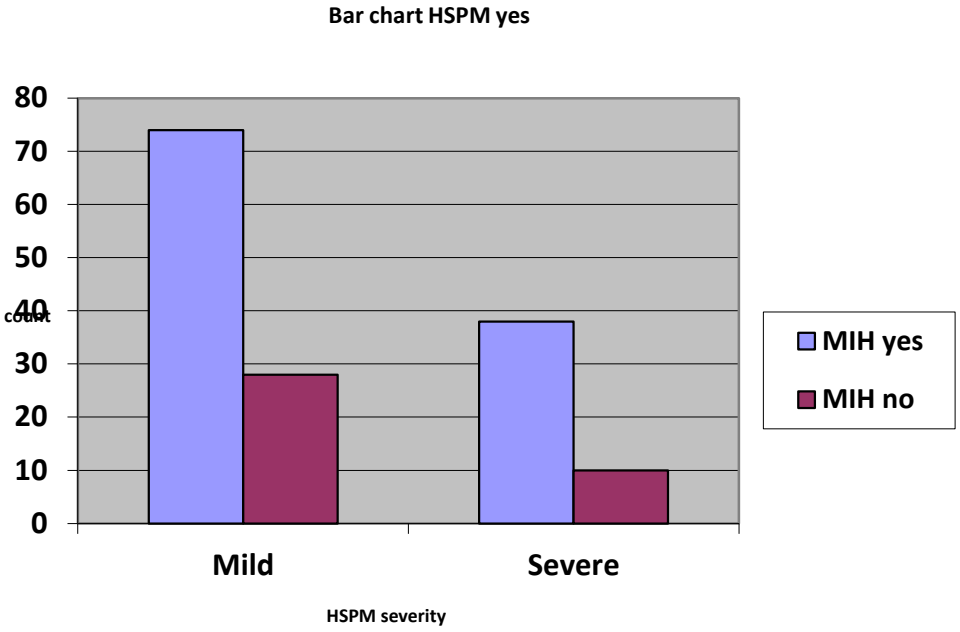

Figure 1: The distribution of MIH cases among patients with mild and severe HSPM.

Discussion

This study is leading in exploring the relationship between MIH and HSPM in Jordanian children. Both diseases share many similarities regarding their etiology, mechanism of occurrence, and clinical presentation, but they are different in respect to the teeth involved. MIH affects permanent first molars and permanent incisors, while HSPM affects second primary molars. There is no clear consensus on whether having HSPM necessitates the occurrence of MIH in the permanent dentition.

The significant relationship results for the co-occurrence of both diseases in many children of this study – about half (49.1%) of the patients had both HSPM and MIH – are supported by other studies in the literature. For instance, Mittal *et al.* found that both diseases were concurrently occurring in 48% of the examined patients,[6] which was very close to the percentage found in our study. Moreover, the findings of our study reported that more than two thirds (74.7%) of the patients with HSPM had also MIH, close to the findings of Negre-Barber *et al.*, which showed that among children with HSPM, 76.0% of them had MIH as well.[39] However, this is higher than the findings of Ghanim *et al.*, who found that 39.6% of children with HSPM suffered MIH, [40] and much higher than many other studies.[34, 36, 42]

Alternatively, more than half (58.9%) of patients with MIH in this study also had HSPM. This is higher than the findings of Negre-Barber *et al.* and Costa-Silva CM *et al.* (46.0% and 30.4%, respectively).[39,42] The higher percentage found among this group of Jordanian children could be explained by genetic or environmental factors. Nevertheless, HSPM can be considered a warning sign for the prediction of development of MIH in any community, regardless of their genetic or environmental background, as reported by a number of studies.[36, 39, 42, 43]

In the current study, two thirds (67.4%) of MIH cases were severe, and severe HSPM cases formed 32.0% of the total cases of HSPM. Such findings indicate a higher prevalence of severe manifestations of hypomineralization in both primary and permanent teeth than that published by Negre-Barber *et al.*, who found the percentage of severe cases was 28% and 8.3% in MIH and HSPM, respectively.[39] These rates were supported by others as well.[36,37] Furthermore, the higher prevalence of severe HSPM, which entails a higher prevalence of MIH – in many cases – leads to a higher number of hypomineralized teeth that are

prone, over time, to breakdown under normal occlusal forces, which develop caries. A higher DMFT (decayed, missing and filled teeth) index is the result of that.[31]

Although there were almost equal numbers of mild cases among males and females, severely hypomineralized SPM were more prevalent among females. This contradicts the findings of Singh *et al* [48]in India, Temilola *et al*[34] in Nigeria and Halal *et al* [41] in Syria that indicated no difference between males and females regarding the distribution of the lesions.

Hence, the early diagnosis of hypomineralization is important for preserving these teeth, particularly among high-risk children, such as those with poor oral hygiene, limited access to dental care, and those from low socio-economic communities.

Chronologically, it is known that the developmental periods of permanent first molars, incisors, and primary second molars overlap, which has led many researchers to claim that MIH and HSPM are related and occur together,[36,37,39] and therefore, they share a similar clinical presentation, structural properties, and putative.[44] Thus, if a risk was imposed during the overlapping period of development, then the second primary molar (SPM), first permanent molar (PFM) and permanent incisors (PI) will be affected.[13] The longer period of mineralization and slower process of maturation of the PFM and PI in comparison to those of the SPM explain the higher prevalence of MIH in comparison with HSPM.

The PFM is considered a cornerstone tooth in function and occlusion, and its loss means that the masticatory function and occlusion will be compromised. Unfortunately, in this study PFM was the most affected tooth by hypomineralization, which is in line with other studies.[45, 39, 46]. The early detection of MIH can preserve affected PFM. HSPM can serve as an early alarm for parents and dentists to start a prevention program for a hypomineralized PFM as early as it erupts. A good approach in dealing with these hypomineralized PFMs was proposed by William V *et al*. which is a six-step protocol including risk assessment, early diagnosis, remineralization and desensitization, prevention of caries and post-eruptive breakdown, restoration or extraction, and maintenance.[47] Adjusting dental programs as William V *et al*. suggested will help in preserving hypomineralized primary and permanent teeth, and ultimately the whole dentition.

Limitations

The study was a dental clinic-based survey and conducted in a single hospital, so the results cannot be applied to the general population. Furthermore, the sample size was relatively small compared to studies with larger sample sizes. These limitations could be overcome by conducting other studies with larger samples and from different hospitals and schools so that the results can then represent the general population of children in Jordan.

In conclusion, a significant co-occurrence between hypomineralized second primary molar and molar incisor hypomineralization is noted. There are biological and developmental changes around this age of childhood that contribute to such incidences, which necessitate considering the occurrence of hypomineralized second primary molars as a warning sign to expect a higher possibility for the occurrence of molar incisor hypomineralization. This should prepare parents to take early precautionary measures to protect their children's permanent teeth.

References

1. **Elfrink ME, Ten Cate JM, Jaddoe VW, Hofman A, Moll HA, Veerkamp JS.** Deciduous molar hypomineralization and molar incisor hypomineralization. J Dental Res 2012; 91(6):551-5
2. **Weerheijm KL, Duggal M, Mejare I, Papagiannoulis L, Koch G, Martens LC, Hallonsten AL.** Judgment criteria for molar incisor hypomineralisation (MIH) in epidemiologic studies: a summary of the European meeting on MIH held in Athens, 2003. Eur J Paediatr Dent 2003; 4(3):110-3
3. **Kevrekidou A, Kosma I, Arapostathis K, Kotsanos N.** Molar incisor hypomineralization of eight and 14-year old children: prevalence, severity, and defect characteristics. Paediatr Dent 2015; 37(5):455-61
4. **Jeremias F, de Souza JF, Silva CM, Cordeiro RC, Zuanon AC, Santos-Pinto L.** Dental caries experience and molar incisor hypomineralization. Acta Odontol Scand 2013; 71(3-4):870-6
5. **Elfrink ME, Ghanim A, Manton DJ, Weerheijm KL.** Standardized studies on molar incisor hypomineralization and hypomineralized second primary molars. Eur Arch Paediatr Dent 2015; 16(3):247-55
6. **Mittal LR, Chandak S, Chandwani M, Singh P, Pimale J.** Assessment of association between molar incisor hypomineralization and hypomineralized second primary molar. J Int Soc Prev Community Dent 2016; 6(1):34-38
7. **Sidhu N, Wang Y, Barrett E, Casas M.** Prevalence and presentation patterns of enamel hypomineralization among paediatric hospital dental patients in Toronto, Canada: a cross-sectional study. Eur Arch Paediatr Dent 2020; 21(2):263-70
8. **Schwendicke F, Elhennawy K, Reda S, Bekes K, Manton DJ, Krois J,** Global burden of molar incisor hypomineralization. J Dent 2018; 68(1):10-18
9. **Schneider PM, Silva M.** Endemic molar incisor hypomineralization: a pandemic problem that requires monitoring by the entire health care community. Curr Osteoporos Rep 2018;16(3):283-8
10. **Lygidakis NA, Wong F, Jalevik B, Vierrou A-M, Alaluusua S, Espeild I.** Best clinical practice guidance for clinicians dealing with children presenting with molar incisor hypomineralisation: an EAPD Policy Document. Eur Arch Paediatric Den 2010; 11(2):75-81
11. **Kar S, Sakar S, Mukherjee A.** Prevalence and distribution of developmental defects of enamel in the primary dentition of IVF children of west Bengal. J Clin Diagn Res 2014; 8(7):ZC73-6
12. **Jalevik B, Klingberg GA.** Dental treatment, dental fear and behavior management problems in children with severe enamel hypomineralization of their permanent first molars. Int J Paediatr Dent 2002; 12(1):24-32
13. **Aine L, Backstrom MC, Maki R, Kuusela AL, Koivisto AM, Ikonen RS, Maki M.** Enamel defects in primary and permanent teeth of children born prematurely. J Oral Pathol Med 2000; 29(8):403-9
14. **Beentjes VE, Weerheijm KL, Groen HJ.** Factors involved in the etiology of molar incisor hypomineralization (MIH). Eur J Paediatr Dent 2002; 3(1):9-13
15. **Vieira AR, Kup E.** On the etiology of molar incisor hypomineralization. Caries Res 2016; 50(2):166-9
16. **Profitt W, Fields H.** Contemporary orthodontics. 3rd ed. St. Louis: Mosby Inc; 2000
17. **Woullet E, Laisi S, Salmela E, Ess A, Alaluusua S.** Background factors of molar incisor hypomineralization in a group of Finnish children. Acta Odontol Scand 2014; 72(8):963-9
18. **Se MJSF, Ribeiro APD, dos Santos-Pinto LAM, Loiola RC, Cordeiro RCL Cabral RN, Leal SC.** Are hypomineralized primary molars and canines associated with molar incisor hypomineralization? Paediatr Dent 2017; 39(7):445-9
19. **Zhao D, Dong B, Yu D, Ren Q, Sun Y.** The prevalence of molar incisor hypomineralization: evidence from 70 studies. Int J Paediatr Dent 2018; 28(2):170-9
20. **Zawaideh FI, AlJundi SH, AlJaljoli MH.** Molar incisor hypomineralization: prevalence in Jordanian children and clinical characteristics. Eur Arch Paediatr Dent 2011; 12(1):31-6

21. **Hamdan MA, Ahmad EA, Al-Abdullah M, Rajab LD.** The prevalence and severity of molar incisor hypomineralization among 8 year-old children in Amman, Jordan. Egyptian Dental Journal 2020; 66(4):1989-97
22. **Saber F, Waly N, Moheb D.** Prevalence of molar incisor hypomineralization in Egypt as measured by enamel defect index a cross sectional study. Future Dental Journal 2018; 4(1):59-63
23. **Parikh DR, Ganesh M, Bhaskar V.** Prevalence and characteristics of molar incisor hypomineralization in the child population residing in Gandhinagar, Gujarat, India. Eur Arch Paediatr Dent 2012; 13(1):21-26
24. **Cho SY, Ki Y, Chu V.** Molar incisor hypomineralization in Hong Kong Chinese children. Int J Paediatr Dent 2008; 18(5):348-52
25. **Buchgraber B, Kqiku L, Ebeleseder KA.** Molar incisor hypomineralization: proportion and severity in primary public school children in Graz, Austria. Clin Oral Invest 2018; 22(2):757-62
26. **Ng JJ, Eu OC, Nair R, Hong CH.** Prevalence of molar incisor hypomineralisation in Singaporean children. Int J Paediatr Dent 2015; 25(2):73-8
27. **Abdullah HE, Abuaffan AH, Kemoli, AM.** Molar incisor hypomineralization: prevalence, pattern and distribution in Sudanese children. BMC Oral Health 2021; 6; 21(1):9
28. **Yi X, Chen W, Liu M, Zhang H, Hou W, Wang Y.** Prevalence of molar incisor hypomineralization in children aged 12 to 15 years in Beijing, China. Clin Oral Investig 2021; 25(1):355-61
29. **Koruyucu M, Ozel S, Tuna EB.** Prevalence and etiology of molar incisor hypomineralization in the city of Istanbul. J Dent Sci 2018; 13(4):318-28
30. **Davenport M, Welles AD, Angelopoulou MV, Gonzalez C, Okunseri C, Barbeau L, *et al.*** Prevalence of molar incisor hypomineralization in Milwaukee, Wisconsin, USA: a pilot study. Clin Cosmet Investig Dent 2019; 11(4):109-17
31. **Jurlina D, Uzarevic Z, Ivanesevic Z, Matijevic M.** Prevalence of molar incisor hypomineralization and caries in eight-year-old children in Croatia. Int J Environ Res Public Health 2020; 17(7):6358
32. **Soviero V, Haubek D, Trindade C, da Matta T, Poulsen S.** Prevalence and distribution of demarcated opacities and their sequelae in permanent first molars and incisors in 7 to 13-year-old Brazilian children. Acta Odontol Scand 2009; 67(3):170-5
33. **Elfrink ME, Veerkamp JS, Aartman IH, Moll HA, Ten Cate JM.** Validity of scoring caries and primary molar hypomineralization (DMH) on intraoral photographs. Eur Arch Paediatr Dent 2009; 10(suppl 1):5-10
34. **Temilola OD, Folayan MO, Oyedele T.** The prevalence and pattern of deciduous molar hypomineralization and molar incisor hypomineralization in children from a suburban population in Nigeria. BMC Oral Health 2015; 15(1):73-9
35. **Owen ML, Ghanim A, Elsby D, Manton D.** Hypomineralized second primary molars: prevalence, defect characteristics and relationship with dental caries in Melbourne preschool children. Aust Dent J 2018 63(1):72-80
36. **Mittal N, Sharma BB.** Hypomineralised second primary molar: prevalence, defect characteristics and possible association with molar incisor hypomineralisation in Indian children. Eur Arch Paediatr Dent 2015; 16(6):441-7
37. **Reyes MRT, Fatturi AL, Menezes J, Fraiz FC, Assuncao LRDS, Souza JF.** Demarcated opacity in primary teeth increases the prevalence of molar incisor hypomineralization. Braz Oral Res 2019 Aug; 15:33
38. **Kuhnisch J, Heitmuller D, Thiering E, Brockow I, Hoffmann U, Neumann C, Heinrich-Weltzien R, Bauer CP, von Berg A, Koletzko S, Garcia-Godoy F, Hickel R, Heinrich J.** Proportion and extent of manifestation of molar incisor hypomineralisation according to different phenotypes. J Public Health Dent 2014; 74(1):42-9
39. **Negre-Barber A, Montiel-Company JM, Boronat-Catala M, Catala-Pizarro M, Almerich-Silla JM.** Hypomineralized second primary molars as predictor of MIH. Sci Rep 2016; 6(3):1-6

40. **Ghanim A, Manton D, Marino R, Morgan M, Bailey D.** Prevalence of demarcated hypomineralised defects in second primary molars in Iraqi children. Int. J Paediatr Dent 2013; 23(1):48-55
41. **Halal F, Raslan N.** Prevalence of hypomineralized second primary molars (HSPM) in Syrian preschool children. Eur Arch Paediatr Dent 2020; 21(6):711-7
42. **Costa-Silva CM, de Paula JS, Bovi Ambrosano GM, Mialhe FL.** Influence of deciduous molar hypomineralization on the development of molar incisor hypomineralization. Braz. J Oral Sci 2013; 12(4):335-8
43. **Garot E, Denis A, Delbos Y, Manton D, Silva M, Rouas P.** Are hypomineralised lesions on second primary molars (HSPM) a predictive sign of molar incisor hypomineralisation (MIH)? A systematic review and a meta-analysis. J Dent 2018; 72:8-13
44. **Zakirulla M, Alasiri MA, Alshahrani M, Alkhairy SI, Laheq MT, Althuqaiby AA *et al*.** Prevalence of hypomineralization in second primary molars (HSPM) in 7 to 10 year-old Saudi children. Journal of Research in Medical and Dental Sciences 2020; 8(6):124-7
45. **Mittal NP, Goyal A, Gauba K, Kapur A.** Molar incisor hypomineralization: prevalence and clinical presentation in schoolchildren of the northern region of India. Eur Arch Paediatr Dent 2014; 15(1):11-8
46. **Kilinc G, Cetin M, Kose B, Ellidokuz H.** Hypomineralization in children living in Izmir city. Int J Paediatr Dent 2019; 29(6):775-82
47. **William V, Messer LB, Burrow MF.** Molar incisor hypomineralization: review and recommendation for clinical management. Paediatr Dent 2006; 28(3):224-32
48. **Singh R, Srivastava B, Gupta N.** Prevalence and pattern of Hypomineralized Second Primary Molar in children in Delhi-NCR. Int J Clin Paediatr Dent 2020; 13(5):501-503.