Molar incisor hypomineralization: review and prevalence data from a study of primary school children in Kaunas (Lithuania)

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Abstract

Aims: These were to determine the prevalence of MIH in a group of primary school children in Kaunas, Lithuania and to compare the prevalence of MIH in Lithuania with the reported prevalence in other countries. **Methods:** First permanent molars and all permanent incisors were examined in 1,277 children, aged 7 to 9 years and having at least one erupted permanent molar. Examinations were for demarcated opacities, post-eruptive enamel breakdown, atypical restorations and extractions due to MIH, according to the criteria, provided by the EAPD guidelines. Examinations were performed by two calibrated observers (kappa=0.829). **Results:** Of all the children 190 (14.9%) had hypomineralization defects in at least one index tooth, 124 (9.7%) had at least one affected molar and were considered as having MIH. Teeth having only demarcated opacities were present in 68 (54.8%) of children with MIH, 35 (28.2 %) had at least one tooth with breakdown, 21 (16.9%) had atypical restorations. No teeth had been extracted due to MIH. Children with 3-6 affected teeth were 3.5 times more likely to have enamel breakdown and/or atypical restorations when compared with the children having only one or two affected teeth. Of the 124 children with MIH 96 (77.4%) had lesions only in molars, 28 (22.6%) had both (molars and incisors) affected. **Conclusions:** MIH was common among 7-9 years old Lithuanian children and the majority of the affected children were affected mildly. Severity of the lesions was increasing with the number of affected teeth. Compared to the other studies MIH in Lithuania was moderately prevalent.

Introduction

In recent years dental research has been frequently focused on mineralization defects of the first permanent molars. Dentists and dental researchers have noticed that a variable percentage of children born in different countries and in different years have non-fluoride enamel hypomineralization and undergo post-eruptive breakdown of the first permanent molars. This situation is associated with developmental enamel opacities of the molars. Frequently the incisors have opacities as well, with rarely occurring disintegration [Koch et al., 1987; Jälevik et al., 2001a; Leppäniemi et al., 2001].

Weerheijm et al. [2001b] suggested the term Molar Incisor Hypomineralization (MIH) for this developmental disorder of the teeth. MIH describes the clinical picture of hypomineralization of systemic origin of one to four permanent first molars, frequently in combination with affected incisors. Sometimes defects can also be noticed on the second primary molars and the tips of the permanent canines [Weerheijm et al., 2003], without clear-cut indications of having a comparable cause.

Clinically MIH presents as demarcated enamel opacities of different colour, ranging from whitish to yellowish-brown and abnormal translucency. In these areas the enamel can be soft and porous [Weerheijm et al., 2001b]. Some opacities have significant subsurface porosity, leading to surface disintegration after eruption. Histologically, the disturbed enamel is severely hypo-mineralized at the cusps of an affected tooth, with a well defined border between the hypomineralized and normal enamel at the cervical third [Jälevik and Norén, 2000].

MIH varies in severity between patients and also within the mouth of a patient; the pattern may be asymmetrical. Not all opacities undergo post-eruptive breakdown. In affected teeth, where the porous enamel has chipped off, dental caries may develop rapidly, especially in the first period after eruption [Weerheijm, 2003]. This may lead to atypical cavities and sometimes to complete coronal breakdown, requiring extensive treatment [Leppäniemi et al., 2001]. Even with intact enamel MIH molars can be very sensitive to air, cold or warmth. Due to sensitivity these teeth create problems for the patients as well as for the dentists. Children often avoid brushing the sensitive molars, and this will aggravate the situation. Treatment may be painful due to difficulties in gaining effective analgesia. The affected teeth often require repeated treatment due to continuous disintegration of the enamel and difficulties with bonding [Fayle, 2003; Kotsanos et al., 2005; Jälevik et al., 2005; William et al., 2006a]. Children with hypomineralized first molars often have to undergo a considerable amount of dental treatment. Therefore they are at risk of developing dental fear, anxiety and behaviour management problems [Jälevik and Klingberg, 2002].

The aetiology of MIH is not yet understood. The combination of the affected first molars and incisors suggests a systemic origin due to a specific influence on the developing enamel

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during a limited period of time [Weerheijm et al., 2003]. The development of enamel opacities implies that ameloblasts are affected during the enamel maturation stage. Some ameloblasts are irreversibly damaged, but others have a potential to recover after attack. This influences the demarcated pattern of the opacities and variation in severity of the lesions [Jälevik and Norén, 2000].

In the literature a number of possible causes for MIH are mentioned, such as environmental toxins, exposure to dioxin due to prolonged breast-feeding, or prenatal, perinatal and neonatal medical problems. Other suggested causes include oxygen shortage due to respiratory diseases possibly combined to low birth weight, disturbances in the calcium/phosphate metabolism, otitis media and frequent childhood diseases with high fever [Alaluusua et al.; 1996a; Beentjes et al.; 2002; Jälevik et al. 2001b; Hölttа et al., 2001]. Ethnicity had no reported influence on prevalence of MIH among children living in one area.

Paediatric dentists in Europe are aware of MIH and the majority consider it to be a clinical problem [Weerheijm and Mejàre, 2003]. Today only a limited number of studies concerning prevalence data of MIH are available; comparable and representative prevalence studies are lacking. Based on the available data MIH prevalence ranges from 2.4 to 25 %, and varies among children born in different years and in different countries. However, in previous studies different criteria have been used, making it difficult to compare the prevalence data. Therefore dental scientists have expressed an urgent need of comparable and representative studies of child populations in Europe. A list of definitions of the judgement criteria to be used in diagnosing MIH for prevalence studies has been developed [Weerheijm et al., 2003].

The aim of the study was to assess the prevalence of MIH in a representative group of primary school children in Lithuania and to compare this with the prevalence in other countries, using published data.

Materials and methods

Study population. For this study we chose the first and second grade secondary school children, living in Kaunas, the second largest city in Lithuania, with 360,637 inhabitants [Dept. Statistics, Republic of Lithuania, 2006]. Children aged 6.5-9.49 (born in 1995-1998) and having at least one erupted permanent molar, were included. At this age the first molars are erupting or recently have erupted, caries prevalence is still low, and thus minimizes the probability that hypomineralization lesions were masked by carious lesions. [Milciuviene et al. 1999] found that 66.3% of 7-8-year-old children in Kaunas were caries free, 23.4% had first permanent molars affected by caries and DMFT was 0.71.

The level of fluoride in the drinking water in this area is low (0.16-0.18 ppm) and prevalence of diffuse opacities in the permanent first molars and incisors among children is low as well (0.3 -1.7%) [Narbutaite, 2000].

Subject selection. A list of the schools in Kaunas and the permission to perform the studies at schools had been obtained from the Department of Education of Kaunas municipality. Sixteen larger schools, representing the major districts of Kaunas city and containing several classes with the first and second grade pupils, were randomly selected from the school list. The school directors were contacted with an introductory letter inviting their school take part in the study. One out of the selected 16 schools did not reply and one school replied too late, resulting in exclusion from the study. After the directors of the remaining 14 schools had confirmed their agreement to participate, each first and second grade class received a package with an introductory letter to the teachers and informed consent forms for the parents of each child (totally 1,534). The signed forms were collected by the teachers and presented on the day of examination. The children included in the study were those present at school on the day of examination and with an informed consent form, signed by the parents.

Study setting and data collection. The following procedures were performed at the schools. All the participating children received toothbrushes and were instructed to brush their teeth in their classroom. The dental examinations were performed in a school chair using a mouth mirror, a head light and a portable light (Penlight torch). If necessary, cotton rolls were used to remove any residual debris. The presence and status of the first permanent molars and the permanent incisors were evaluated and recorded, according to the diagnostic judgement criteria (Fig. 1). Children were considered as having MIH when one or more first permanent molars or the first permanent molars and the permanent incisors had demarcated enamel lesions [Weerheijm et al., 2001b].

All children with diagnosed MIH and having disintegrated enamel received a specially designed booklet with information about MIH and were advised to see a dentist.

More than half (55%) of the examinations were performed by the principle investigator (LJ) alone and 45% were performed by two investigators (LJ and JN), changing roles after each class. Both investigators were calibrated beforehand by analyzing together the list of judgement criteria, viewing together a set of photographs as published by Weerheijm et al., [2003]. They also viewed together a set of selected digital photographs, resembling each criterion of children not taking part in the study. Both investigators re-examined 59 children.

Severity gradation. This was not included in the original judgement criteria. For comparison of the severity of MIH between the genders and age groups, the three groups of

1	Demarcated opacity	A demarcated defect involving an alteration 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 colour
2	Post-eruptive breakdown	A defect that indicates deficiency of the surface after the eruption of the tooth. Loss of initially formed surface enamel after tooth eruption. The loss is often associated with a pre-existing demarcated opacity
3	Atypical restoration	The size and shape of restorations are not confirming to the temporary caries picture. In most cases in molars there will be restorations extended to the buccal or palatal smooth surface. At the border of the restorations frequently opacity can be noticed. In incisors a buccal restoration can be noticed not related to trauma
4	Extracted	Absence of a first permanent molar should be molar related 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 the first permanent molar. Also the absence of the 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
5	Not erupted	The first permanent molar or the incisor to be examined is not yet erupted (or erupted less than one half of the crown)*

* We modified the original criteria and considered the teeth which are erupted less than one half of the crown as not erupted.

Notes

1. In cases of a large caries lesion with demarcated opacities at the border of the cavity or on the non-caries surfaces, these teeth should be judged as MIH
2. Other changes in dental enamel such as amelogenesis imperfecta, hypoplasia, diffuse opacities, white spot lesions, tetracycline staining, erosion, fluorosis, white cuspal and marginal ridges should be excluded from the types of enamel defects outlined as above.

Figure 1. Judgement criteria used in diagnosing MIH [Weerheijm et al., 2003].

MIH lesions (opacities, enamel breakdown and atypical restorations) were recoded into two severity levels: opacities and disintegration defects. Opacities were considered as a milder lesion. Enamel breakdown and atypical restorations both include lesions with disintegrated enamel, in one case restored, in the other not. Therefore these lesions were added into one disintegration category, representing moderate to severe lesions.

In order to compare whether a larger number of affected teeth is related to more severe lesions, the affected children were divided into two groups: children having 1-2 affected teeth and children having 3-6 affected teeth.

Statistical analysis. This was performed using SPSS 12.0 for Windows, applying odds ratio, Chi-square and Mann Whitney tests. The level of significance was set at $p<0.05$.

Results

In total 1,317 first and second grade primary school children, born in 1995-98, were examined. After exclusion of 40 children not fulfilling the selection criteria (having no permanent teeth erupted or too young age), 1,277 remained for statistical analysis. Inter-examiner agreement was good (kappa = 0.829), intra-examiner agreement was good (kappa = 0.894).

Distribution of the subjects by age and gender. This is presented in Table 1. The majority (94.4 %) of the children of both genders had all four first permanent molars (M1) erupted. Only about half (51.4%) of them had all incisors present, girls significantly more than boys (57.2% and 45.7% respectively, chi-square test, $p<0.001$). To assess the influence of non-erupted teeth on the prevalence results, we compared the 'total group' with the following groups: 'children with four erupted molars', 'children with all twelve erupted index teeth', 'children with less than four erupted molars' and 'children with less than twelve erupted index teeth'. We found no significant difference for any parameter.

Prevalence of demarcated hypomineralization lesions. Among the 7-9 year old children hypomineralization was distributed in a skew pattern. The majority of the children was not affected and 190 (14.9%) had one to six teeth with demarcated hypomineralization lesions (these children will be further named as 'affected children'). At least one molar or molars and incisors with demarcated lesions were present in 124 (9.7 %) of the children, which is the true MIH prevalence according to the MIH definition [Weerheijm et al., 2001b]. These children will be further named as 'children with MIH'. (Table 2). The remaining 66 (5.2 %) had opacities only in incisors. There were no significant prevalence differ-

Table 1 Distribution of study population in Lithuania by age and gender.

		GENDER		Total
		Female	Male	
Age Categories	7 years old	211	210	421
	8 years old	295	304	599
	9 years old	123	134	257
Total		629 (49.3%)	648 (50.7%)	1277

Table 2 Distribution of demarcated hypomineralization lesions in the dentition of the 7-9 year old children in Lithuania and among the genders, age groups and children with erupted all first permanent molars (M1) and all 12 index teeth.

		Prevalence of hypomineralization lesions in children % (n)							
		Total group n=1277	Girls n=629	Boys n=648	7-year-olds n=421	8-year-olds n=599	9-year-olds n=257	With erupted 4 M1 n=1206	With 12 erupted permanent n=652
	Single front tooth	**3.7** (47)	**3.3** (21)	**4.0** (26)	**3.6** (15)	**3.8** (23)	**3.5** (9)	**3.8** (46)	**4.6** (30)
	Only 2-3 front teeth	**1.5** (19)	**1.7** (11)	**1.2** (8)	**1.4** (6)	**1.5** (9)	**1.6** (4)	**1.4** (17)	**1.7** (11)
MIH	Single molar	**3.6** (46)	**3.3** (21)	**3.9** (25)	**3.3** (14)	**3.7** (22)	**3.9** (10)	**3.5** (42)	**3.4** (22)
MIH	Only 2-4 molars	**3.9** (50)	**4.8** (30)	**3.1** (20)	**4.0** (17)	**3.0** (18)	**5.8** (15)	**4** (48)	**3.7** (24)
MIH	Molars + incisors	**2.2** (28)	**3.0** (19)	**1.4** (9)	**2.4** (10)	**2.3** (14)	**1.6** (4)	**2.2** (26)	**2.6** (17)
MIH	Total children with MIH	**9.7** (124)	**11.1** (70)	**8.3** (54)	**9.7** (41)	**9.0** (54)	**11.3** (29)	**9.6** (116)	**9.7** (63)
	Total affected children	**14.9** (190)	**16.2** (102)	**13.6** (88)	**14.7** (62)	**14.4** (86)	**16.3** (42)	**14.8** (179)	**16.0** (104)

ences of hypomineralization between the genders and the age groups.

Prevalence of demarcated hypomineralization lesions among children with MIH. Severity of the lesions between children having a different number of the affected teeth and divided by gender were noted. Of the 124 children with MIH 68 (54.8%) had only demarcated opacities, but no breakdown or atypical restorations. At least one tooth with breakdown was present in 35 (28.2 %) of the children and 21 (16.9%) had at least one tooth with atypical restorations. No teeth were extracted due to MIH.

Only one tooth with a hypomineralization lesion was present in 46 (37.1%) children; 35 (28.2 %) had two, 19 (15.3 %) had three, 15 (12.1 %) had four, 8 (6.5%) had five affected teeth and there was one child (0.8%) with six affected teeth. Distribution of opacities and disintegration defects among the children with a different number of affected teeth and divided between genders is presented in the Table 3. Children with one or two affected teeth were more likely to have only opacities and no disintegration, while children with three or more affected teeth had significantly more disintegrated defects. They were 3.5 times more likely to have post-eruptive enamel breakdown or an atypical restoration, than the children having only one or two affected teeth (OR=3.533). If affected children with opacities only on incisors are included in the calculation, then the likelihood of enamel disintegration among children with three or more affected teeth is even higher (OR= 7.375). Girls were two times more likely to have disintegrated enamel, while the boys were more likely to have only opacities (OR=2.065).

Mean number of affected teeth per child and tooth prevalence. The children with MIH had on average 2.25 affected teeth and 1.95 affected molars. The prevalence of hypomineralization defects among the teeth of all children was 2.7%. Demarcated opacities made out the largest part of the teeth with the lesions (2.0%) and only a small percentage of the teeth had enamel breakdown or atypical restorations (0.5 and 0.2% respectively). Of all the molars 4.8% had MIH lesions. Demarcated opacities were found in 3.1% of the molars, post-eruptive breakdown in 1.3% and atypical restorations in 0.5%.

Both types of disintegration lesions were more common in the mandibular molars than in the maxillary; the difference was significant for atypical restorations (Chi-square =22.154; df=1; $p<0.001$).

Relationship of the affected molars and incisors. Of the 124 children with MIH, 96 (77.4%) had only lesions in molars and 28 (22.6%) had both molars and incisors affected. Children with only incisor involvement (66) had only opacities. Of the children with only affected molars 57 (59.4%) had only opacities and 39 (40.6%) had enamel breakdown or atypical restoration. Of the children with both molars and incisors affected 11 (39.9%) had only opacities and 17 (60.7%) had enamel breakdown or atypical restoration.

Comparison of prevalence figures. Comparison of the prevalence data of MIH in Lithuania with the published data from MIH studies in other countries is presented in Table 4. In these studies children having demarcated hypomineralization lesions in molars and both (molars and incisors) were

Table 3 Distribution of disintegration defects and opacities among 124 Lithuanian children with MIH in relation to the number of affected teeth, genders and age groups.

	Breakdown and/or restoration	Only opacity	Total	Odds	OR
All children with MIH	56 (45.2%)	68 (54.8%)	124		
Children with 3 and more affected teeth	28 (65.1%)*	15 (34.9%)	43	1.87	3.533
Children with 1-2 affected teeth	28 (34.6%)*	53 (65.4%)	81	0.53	
Female	37 (52.9%)	33 (47.1%)	70	1.12	2.065
Male	19 (35.2%)	35 (64.8%)	54	0.54	

* Significant difference (Chi-square test, χ^2=10.584; df=1; p=0.001)

considered as having MIH. Compared with other countries, MIH in Lithuania was found to be moderately prevalent.

Similar to other studies, the most common lesions in Lithuania were mild demarcated opacities. The prevalence of moderate to severe lesions was lower than in Finland and Sweden. A comparison of severity was compromised due to the use of different criteria, in previous studies. Only a few studies presented the average number of affected teeth/molars per child and tooth prevalence. Some studies presented the number of all children having more than one affected molar, others presented the number of children with all four first molars with lesions. When compared with the presented data, children in Lithuania had a low number of affected teeth/ molars.

Discussion

MIH was a common finding among seven- to 9-year-old school children born in 1995-98 and living in Kaunas, Lithuania. For purposes of convenience, in this study only children attending larger schools were included and very small primary schools were not. Even though exclusion of small schools might have created a bias, most of the children traditionally attend large schools and these include children of different backgrounds. Therefore, the population may be considered as representative for the area, as the schools were representing the major districts of Kaunas city.

Based on our findings we may assume that eruption status had no influence on the results. This is in agreement with the findings of Fteita et al. [2006]. In future, assessments of children with less than four erupted first permanent molars may be included, as well as children with all erupted first permanent molars. For this study, the criteria suggested by EAPD guidelines [Weerheijm et al, 2003], were used for the first time. The size of the lesions was not included in the criteria. Therefore, some over-registration as compared with the other studies may have been possible.

All opacities of 1 mm and larger were included, as recommended by the FDI Working Group on DDE [1992]. They were clearly visible, because all the children had brushed their teeth prior to examination. Some studies [Alaluusua et al., 1996a; Höltta et al., 2001; Jälevik et al., 2001a; Leppäniemi et al., 2001; Calderara et al., 2005] included lesions, which were equal to or larger than 2 mm.

The inclusion of small lesions has been criticized by Calderara et al. [2005] because of difficulties in reproducibility and comparability of different studies. Even though the size of the opacities was not measured in this study, we noticed that very small demarcated opacities involved only one or two teeth, were usually located on incisors and had white-yellowish colour. Such a defect has low clinical significance and it is questionable whether it should be included in MIH prevalence data. Other causes than MIH aetiology, such as trauma and infection of primary incisors, may induce opacities on permanent incisors only, without involvement of the molars. Even though some of these incisor opacities may have been caused by the same aetiological factors as the molar opacities, it is impossible to differentiate the causes retrospectively. Additional research is necessary to clarify this issue.

Even though not specifically described in the original criteria, we included teeth which were erupted at least half of the crown, based on the findings of Jälevik and Norén [2000]. Calderara et al. [2005] also suggested including teeth which are at least one half erupted.

Using the EAPD criteria it was impossible to differentiate whether the lesions were mild, moderate or severe from the collected data. Therefore, we divided demarcated hypomineralization lesions into two groups: opacities and disintegration lesions, in order to determine the severity level. The rationale for this division was that post-eruptive enamel breakdown and atypical restorations both include lesions with disintegrated enamel. In some cases the lesions were

Table 4 Comparison of the published data on MIH prevalence with the present study.

Country	Study	Age of children	Sample size	MIH prevalence	% of all children with moderate and severe defects (% of MIH teeth affected moderately and severely)	Average number of affected teeth/molars per child	Percentage of the affected molars (overall tooth prevalence)	% of all children with >1 affected molar
European countries								
Finland	Alaluusua et al. 1996a and 1996b	12 6-7	97 102	25% * 17% *				
Finland	Leppäniemi et al. 2001	7-13	488	19.3% *	1.4% moderate, 8.4% severe			3,9% = 4 molars
Sweden	Jälevik et al. 2001a	7.6-8.8	516	18.4% *	4.8% moderate, 6.4% severe	3.2 / 2.4	11.1%	14.9% >1 molar
Denmark	Esmark and Simonsen in Weerheijm and Mejàre 2003	7	5277	15-25%				
Sweden	Koch et al. 1987	8-13	2226	3.6-15.4% depending on year	1.5– 8% depending on year			
Turkey	Alpöz and Ertugrul 1999	7-12	250	14.8%				
Slovenia	Kosem et al. in William et al. 2006b	12-18	2339	14%				
Italy (Lissone)	Calderara et al. 2005	7.3-8.3	227	13.7% *	0 moderate, 0.4% severe	2.0 / 1.6	--- (5.8%)	6.2% >1 molar
Netherlands	Weerheijm et al. 2001a	11	497	9.7%	--- (44% of MIH molars needed treatment, 9% major treatment)	--- / 2.6	6.4%	7.6% >1 molar
Lithuania	Present study	6.5-9.5	1277	9.7%	4.4% with disintegration** (37% of MIH molars with disintegration**)	2.25 / 1.95	4.8% (2.7%)	5.5% >1 molar 1.3% = 4 molars
Switzerland (Zurich)	Clavadetscher 1997	7-8	1671	6.4%				
Greece	Lygidakis et al. in William et al 2006b		2640	6%				
Germany (Giessen)	Preusser et al. 2006	6-12	1022	5.9%	--- (25.4% moderately, 7.4% severely affected teeth)	--- / 2.2	3.4%	
Germany (Dresden)	Dietrich et al. 2003	10-17	2408	5.6% (2.4 – 11.0% depending on year)	--- (6.1% moderately, 9.4% severely affected teeth)	4.8 / 2.2		3.7% >1 molar
Studies outside Europe								
Libya (Benghazi)	Fteita et al. 2006	7-8.9	378	2.9% *	0	---/ 1.5	1.1	1.1% >1 molar 0.3% = 4 molars

* - lesions ≤2mm included ** - moderate and severe defects

already restored, while some children, even with extensive disintegration, had not yet seen a dentist for restorations.

Having compared the children with a different number of affected teeth, we found that the higher number of affected teeth gave a greater probability of more severe lesions. This is in concordance with the findings of Jälevik et al. [2001a] and Leppäniemi et al. [2001]. Such findings may be explained by the time, severity and duration of the insult, or combination of insults during the maturation stage of the enamel. The enamel maturation and secretory cells are very sensitive to disorders at the early stage of maturation. When a factor is mild or short in duration, they are less affected and have the potential to recover, leaving only small areas of hypomineralized enamel on fewer teeth. A more severe insult may affect part of the cells irreversibly, leading to a higher degree of porosity in larger areas of the teeth. These areas present as yellow-brown opacities and may involve more teeth [Jälevik and Norén, 2000].

Responses of ameloblasts to environmental or systemic effects are very limited. More studies are needed to determine, whether these responses are related to any particular agent or combination of them, or degree of exposure. We can not exclude the possibility that MIH may reflect some predisposition of a child to react more sensitively to the causative factors in some way as yet not understood. Additional research is needed to shed more light on this matter.

Even though there were no significant prevalence differences between children of different age, 8- and 9-year-old children were approximately twice as likely to have lesions with disintegrated enamel as the 7-year-olds. This is in agreement with the findings of Leppäniemi et al. [2001], where older children were found to have significantly more severe lesions than younger children. This finding may be explained by the fact that even though the number of the affected teeth is not increasing with age, the breakdown of the hypomineralized enamel is progressing due to masticatory forces and possible caries attack. This supports the idea that molars affected by MIH, even if only opacities are present, need continuous follow-up for several years to detect the broken down enamel, as it is not known which part of the enamel will disintegrate and which part will remain intact [Weerheijm et al., 2001a].

Due to the overlap in development time of the permanent first molars and incisors, one may assume that hypomineralization concomitantly affects molars and incisors. Correlation between affected molars and incisors has been found by a number of authors [Koch et al., 1987; Weerheijm et al., 2001a; Fteita et al., 2006; Preusser et al., 2006]. Our study does not support this finding. Approximately one third of all affected children had only incisors, but no molars affected. Less than one quarter of the children, having affected molars, also had affected incisors.

A higher percentage of children with affected molars and incisors had disintegrated enamel than the children with only one type of affected teeth. This may lead to an assumption that involvement of both molars and incisors may be related to higher severity of MIH. It is in agreement with the findings of Jälevik et al. [2001].

About one third of the children with disintegrated enamel had restorations. This may indicate that unrestored teeth had minimal breakdown or that treatment needs were not met. In this sample we did not find any children having extracted first permanent molars for any reason. This might suggest that in our study the teeth with hypomineralization were not too severely affected to be extracted. On the other hand, at the age of 7-9 years, extractions might not be optimal yet [Mejàre et al., 2005] and less likely to be performed. The treatment of MIH molars with severe enamel breakdown also depends on the chosen treatment strategy in a given situation: an attempt may be made to restore molars or a decision is made to extract them, allowing the second molars to migrate or closing the space orthodontically [Fayle, 2003; Mejàre et al., 2005; William et al., 2006b].

The comparison between countries is compromised due to differences in judgement criteria, size of the lesions included, sample differences, the way the data is presented. However, all the mentioned studies evaluated the prevalence of demarcated opacities, post-eruptive breakdown and atypical restorations of the first permanent molars and incisors. Based on this comparison, MIH in Lithuania was moderately prevalent. Comparison of severity among countries is impossible because our criteria did not include severity gradation. Some of the studies included mild, moderate and severe lesions, the others presented treatment need. Only after regrouping of our data into opacities and disintegration defects we could differentiate mild lesions from moderate to severe ones.

Similar to the other studies, the most common lesions in Lithuania were mild demarcated opacities. The prevalence of moderate to severe lesions was clearly lower than in Finland and Sweden. The clinical significance of this finding is that MIH in Lithuania does not pose such a clinical problem as in Sweden and Finland. Taking into account that only one third of all teeth with broken-down enamel had been restored, the treatment needs may be judged as moderate.

Comparable studies in European countries are still needed to give a clearer picture of MIH prevalence. Interpretation of the prevalence data should shed more light as to the possible aetiological factors. This was the aim of the suggested EAPD criteria [Weerheijm et al., 2003]. However, a more accurate and internationally accepted definition of MIH is needed. It is important to determine, whether part of the opacities only on incisors have the same aetiology as opacities on the molars, and whether they should be included in the MIH count. It is not yet known, how to differentiate them

retrospectively from the opacities due to the other causes, such as trauma and infection. The size of the lesions needs to be described, and we suggest a standardized differentiation for severity of the lesions be included in future studies. Also firm lines for sample comparison, and therefore comparable conclusions between the prevalence of MIH in different countries, are imminent.

Conclusions

Demarcated hypomineralization defects were common among 7-9 year old Lithuanian children; most of the affected children were affected mildly. Severity of the lesions was increasing with the number of affected teeth. Compared with other studies MIH in Lithuania was moderately prevalent with moderate treatment needs. More standardized prevalence studies are needed in many countries to shed more light on possible MIH aetiology.

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