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Prevalence and aetiology of Molar–Incisor Hypomineralisation among children aged 8–10 years in Tirana, Albania

ABSTRACT

Aim *Molar incisor hypomineralisation (MIH) describes the clinical appearance of enamel hypomineralisation of systemic origin affecting one or more permanent first molars (PFMs) that are frequently associated with affected incisors. The aim of this study was to investigate the prevalence and aetiology of MIH in children living in Tirana, Albania.*

Materials and methods *Design**:** The study was conducted at the Department of Paediatric and Preventive Dentistry, Faculty of Dental Medicine, and Tirana Dental Public Health Service. A total of 1,575 school children aged 8-10 years were examined by 7 calibrated examiners (dentists) (kappa: 0.86). The Weerheijm criteria were used for the diagnosis of demarcated opacities, post-eruption breakdown, atypical restorations, and extracted PFMs due to MIH.*

Results *Prevalence of MIH was found to be 14% (n=227). In the 227 children with MIH, tooth 36 was the most affected PFM, and tooth 46 the least affected. Tooth 21 was the most affected incisor and tooth 32 the least affected incisor by MIH. MIH(+) children had significanly more childhood diseases in the first 3 years of life (p=0.006). Among the children who used antibiotics, MIH(+) cases were 1.41 (1.06-1.87) times higher than in children who did not usedantibiotics, MIH(-) cases.*

Conclusion *MIH was found to be common among 8-10 year-old Tirana children.*

Keywords *Aetiology; Enamel hypomineralisation; Molar incisor hypomineralisation MIH; Prevalence of MIH.*

Introduction

Molar incisor hypomineralisation (MIH) describes the clinical appearance of enamel hypomineralisation of systemic origin affecting one or more permanent first molars (PFMs) that are frequently associated with affected incisors [Weerheijm et al., 2001] While MIH-affected children feel discomfort due to dental ache and aesthetic problems, they also require extensive and often repeated restorative treatment [Kuscu et al., 2007; Jalevik and Klingberg, 2002; Leppaniemi et a., 2001; Fayle, 2003; Kotsanos Net al., 2005]. Following the establishment of the diagnostic criteria of the defect in 2003 by the EAPD, an Interim Seminar and Workshop on MIH was organised in Helsinki in 2009. A clear diagnostic proposal and a treatment decision-making guide were presented together with suggestions on aetiology and guidance [Lygidakis et al., 2010]. Related to this issue, in Europe, the prevalence for MIH (using the criteria of Weejheimj et al.) [2003]ranges from 4% to 25% [Koch et al., 1987; Leppaniemi et al., 2001; Weerheijm et al. , 2001; Alaluusua et al., 1996; Jalevik et al., 2001; Dietrich et al., 2003; Jasulaityteet al., 2007; Jaleviket al., 2001; Garcia-Margarit et al., 2013 ; Kuscu et al., 2008; Kuscu et al., 2009]. The majority of studies have been conducted in developed and western European countries and there is a lack of data on this issue in developing European countries. These data urged us to investigate for the status of MIH in small European communities such as Albania. There is limited data regarding dental and oral health conditions of Albanian children [Hysi et al., 2010; Hysi et al., 2014]. Despite being under the communist regime for almost half a century, in the last two decades, Albania underwent a dramatic transformation in all sectors and it is a candidate to become a member of the European Union. Tirana is the capital and main cultural, social and economic center of Albania. The city is located in the central part of the country and it is home to approximately a quarter of the population. In the last years, there has been migration of the population from other regions to Tirana. Therefore, the population in Tirana is a currently mixture of people from north, south and the central parts of the country.

No evidence has been found locally or in the international literature investigating the prevalence

and aetiology of molar-incisor hypomineralisation in Albanian children. Therefore the aim of this study was to determine the prevalence and possible aetiology of MIH in 8-10-year old children of Tirana, Albania.

Material and methods

This cross-sectional study was conducted in Tirana between December 2013 and February 2014, at the Department of Pediatric and Preventive Dentistry, Faculty of Dental Medicine and Tirana Dental Public Health Service.

The sample size required for a confidence interval 95%, was n ≥1440 children. The final sample was composed of 1,575 children aged 8-10 years, attending public schools in Tirana. A clustering sampling technique was used, and schools representing clusters were randomly selected. Dental examination was performed after having obtained parental and school informed consent. Examinations were carried out in the classrooms by seven trained and calibrated paediatric dentists (kappa:0.86). The children were examined seated and under artificial light. The 4 PFMs and 8 erupted permanent incisors were examined wet for demarcated opacities, post-eruption breakdown (PEB), atypical restorations and extracted PFMs according to the diagnostic MIH criteria developed by Weerheijm et al. [2003]. The location of demarcated opacities and enamel breakdown were recorded on a specially designed dental chart modified from Kuscu et al. [2008; 2009]. Details of medical history and various confounding factors (such as living location of parents in the last 5 years before giving birth to their child, birth details, place of residence during pregnancy and tooth development, place and duration of breast-feeding, childhood diseases, upper respiratory diseases, medications) of MIH patients were recorded. This information was completed and signed by the parents in a standard questionnaire, which was then sent back to school before the dental examination took place. Healthy school children aged 8-10 years having 4 PFMs and 8 permanent incisors erupted were included in the study. At this age, PFM's have just erupted and caries prevalence is still low, minimising the probability for hypomineralisation lesions to be misdiagnosed as carious lesions. The collected data was analysed using NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA) and the significance level was set as p= 0.05 . Chi Square, t test, and Fisher exact test were used for statistical analysis.

		Total	
Sex	Male	831	52,76%
	Female	744	47,24%
Mother Health	Healthy	1536	97,52%
	with Disease	39	2,48%
Last 5 Years Living Before Gestation	Tirana	1242	78,86%
	Abroad	333	21,14%
Health in Pregnancy	Healthy	1548	98,29%
	With Disease	27	1,71%
Pregnancy in	Tirana	1292	82,03%
	Abroad	283	17,97%
Birth	Healthy, normal range	1555	98,73%
	Early birth, premature, etc	20	1,27%
Breast Fed in	Tirana	1324	84,06%
	Abroad	251	15,94%
First 3 Years Living in	Tirana	1359	86,29%
	Abroad	216	13,71%
First 3 Years Health-Diseases	Healthy	771	50,20%
	With Disease	765	49,80%
Antibiotic usage in first 3 years	No	780	50,85%
	Yes	754	49,15%

TABLE 1 Demographics of children examined and their mothers in Tirana study.

Results

The mean age of the 1,575 children (744 females and 831 males) participating in the study was 8.84±0.85 years (range 8-10 years). The prevalence of MIH was 14% (n=227). The majority of children (86%, n=1348) were not affected with MIH. Table 1 shows the demographic data of children and their mothers' responses to the questionnaires. Regarding gender, there were no statistically significant differences between the MIH (114 F, 113 M) and non-MIH (630 F, 718 M) groups (p>0.05). Considering the 227 children

Tooth no	16	26	36	46	12	11	21	22	32	31	41	42
n	60	54	90	46	34	100	101	30	10	23	23	12
(%)	(3.80)	(3.42)	(5.70)	(2.92)	(2.15)	(6.39)	(6.41)	(1.90)	(0.63)	(1.46)	(1.46)	(0.76)

TABLE 2 Distribution of permanent teeth effected (n).

		MIH(-)		MIH(+)		p	OR %95 GA
Age		8,82±0,82		9±1,02		0,04	
Sex	Male	718	53,26%	113	49,78%	0,331	1,15
	Female	630	46,74%	114	50,22%		0,86-1,52
Mother Health	Healthy	1313	97,40%	223	98,24%	0,454	0,87
	With Disease	35	2,60%	4	1,76%		0,30-2,48
Breast Feeding Duration		13,46±8,40		13,54±8,67		0,902	
Last 5 Years Living Before Gestation	Tirana	1070	79,38%	172	75,77%	0,218	0,81
	Abroad	278	20,62%	55	24,23%		0,58-1,13
Health in Pregnancy	Healthy	1325	98,29%	223	98,24%	0,952	1,03
	With Disease	23	1,71%	4	1,76%		0,35-3,02
Pregnancy in	Tirana	1115	82,72%	177	77,97%	0,085	0,73
	Abroad	233	17,28%	50	22,03%		0,52-1,04
Birth	Healthy, normal	1331	98,74%	224	98,68%	0,940	1,05
	Early birth, premature	17	1,26%	3	1,32%		0,31-3,61
Breast Fed in	Tirana	1145	84,94%	179	78,85%	0,020	0,66
	Abroad	203	15,06%	48	21,15%		0,46-0,94
First 3 Years Living in	Tirana	1175	87,17%	184	81,06%	0,013	0,63
	Abroad	173	12,83%	43	18,94%		0,44-0,91
First 3 Years Health-Diseases	Healthy	676	51,64%	95	41,85%	0,006	1,48
	With Disease	633	48,36%	132	58,15%		1,11-1,97
Antibiotic usage	No	681	52,10%	99	43,61%	0,018	1,41
	Yes	626	47,90%	128	56,39%		1,06-1,87

TABLE 3 Distribution of MIH(-) and MIH(+) children regarding various conditions.

with MIH, tooth 36 was the most affected PFM, and tooth 46 the least affected. Tooth 21 was the most affected incisor and tooth 32 the least affected incisor by MIH. Distribution of affected permanent teeth is shown in Table 2.

Regarding MIH(-) and MIH(+) children's maternal health conditions (infectous, systemic and chronic diseases) there was no statistical differences (p>0.05) (Table 3).

Of the 1,575 children examined, 1,242 children's parents lived in Tirana in the last 5 years before gestation. There were no statistical difference between the MIH(-) and MIH(+) children whose parents lived in Tirana in the last 5 years before gestation or abroad (p>0.05) (Table 3).

There was no statistical differences between MIH (-) and MIH(+) children groups whose mothers stated having had an infectious or epidemic disease during pregnancy (p>0.05)) (Table 3). Mothers also indicated where they had lived during pregnancy. State of living in Tirana or abroad was found to be nonsignificant regarding MIH(-) and MIH(+) groups (p>0.05) (Table 3). Health issues during birth (early birth, premature, low weight: < 1.5 kg) did not have a significant effect on MIH (p>0.05) (Table 3). Regarding breast feeding duration, 1,324 children were breastfed in the present city (whether in Tirana or abroad), there was no statistical difference between MIH(+) and MIHn (-) children (p>0.05). However among the children breastfed in Tirana, the number of children (179, 78.85%) who exhibited MIH(+) was significantly lower than the number of children who were MIH(-) (1145, 82,72%)(p:0.020) (Table 3).

Regarding diseases in the first 3 years of life, from children examined 765 of them (50,2%) stated to have a childhood disease in the first 3 years of life. 58,15% of MIH(+) and 48,36% of MIH(-) children had a disease history (Table 3). MIH(+) children had significantly more disease during the first 3 years of life (p:0.006). MIH(+) children had mostly suffered from upper and lower respiratory tract infections including acute otitis media.

From children who lived in Tirana in the first 3 years, MIH(+) group was significantly lower than MIH(-) group (p=0,013) (Table 3). From children who lived abroad in the first 3 years of life and exhibiting MIH, the defect was 1,59 (1,09-2,29) times higher than in children who lived in Tirana and exhibiting MIH.

MIH(+) children had significantly more childhood diseases in first 3 years of life (p=0,006). The odds of beeing MIH(+) and having disease was 1.48 (1.11-1.97)

(Table 3). Acute otitis media was found to be the most common disease in the first 3 years of life.

MIH(+) children significantly had more antibiotic usage during the first 3 years of life than MIH(-) children (p=0.018) (Table 3). Among the children who used antibiotics, MIH(+) cases were 1.41 (1.06-1.87) times higher than MIH(-) cases.

Discussion

MIH is a multifactorial disease of the enamel organ. Fearne et al. [1994] recently stated that ''Because enamel is not remodelled like bone, disturbances acquired during its development leave a permanent record in the tooth''. A recent work from Fagrell et al. [2013] indicate that the ameloblasts in the hypomineralised enamel are capable of forming an enamel of normal thickness, but with a substantial reduction of their capacity of maturation of enamel. Authors using X-ray micro-computed tomography (XMCT) concluded that MIH is estimated to occur during the first 6-7 months of life. While timing seems important, many confounding factors should not be underestimated.

In the present study, tooth 36 was the most affected FPM from MIH while teeth 11 and 21 were significantly more affected by MIH than other incisors. Tooth 32 was the most unaffected incisor by MIH.

While aetiology of MIH is complicated, Kuscu et al. [2008; 2009; 2013] used the criteria of 'where and how human beings lived the 5 years prior to gestation', as this might be related to environmental, dietary and lifestyle factors affecting ovum and sperm quality. Environmental pollution may be a targeting factor at this point. Every year 370,000 people in Europe die prematurely from diseases linked to environmental pollution [Commission of the European Communities. 2006 Environment Policy Review]. Industrialisation of the Western world may be a contributing factor for MIH as a North African study showed that MIH was rare (only 1.1%) in North Africa [Fteita et al., 2006]. In the present study, prevalence of MIH was 14%. This was similar with the rest of European studies [Leppaniemi, 2001; Koch et al., 1987; Leppaniemi et al., 2001; Weerheijm et al. , 2001; Alaluusua et al., 1996; Jalevik et al., 2001; Dietrich et al., 2003; Jasulaityteet al., 2007; Jaleviket al., 2001; Garcia-Margarit et al., 2013; Kuscu et al., 2008; Kuscu et al., 2009; Calderara et al., 2005]. In a recent study [Kuscu et al., 2009], prevalance of MIH in children living in a green energy island was found to be 9.09%, while prevalance of MIH was 9.17% in a urban highly industrialised area. The PCDD/F levels in soil samples collected from both areas were determined at 1.12 and 8.4 I-TEQ ng kg-1. dry soil, respectively. However prevalence of MIH did not seem to be associated with the levels of PCDD/Fs in the environment. Although there is a unclear link between MIH and environment, further research is needed.

From the Tirana children examined, 78.86% of the parents had lived in Tirana in the 5 years before gestation. An important portion of parents lived in other Albanian cities and abroad, mainly in Greece and Italy. MIH did not seem to be affected by recent parental life experience.

No differences were found between MIH(-) and MIH(+) children's mothers' health conditions (infectous, systemic and chronic diseases). When mothers were questioned on their living location during pregnancy, they answered Tirana, other Albanian cities, Italy and Greece. State of living in Tirana or abroad was nonsignificant regarding MIH.

Preterm birth has been associated with increased prevalence of enamel defects, including hypomineralisation and hypoplasia in the permanent dentition [Martinez et al., 2002; Seow, 1996, 1997; Aine et al., 2000]. In the present study, health issues during birth (early birth, premature, low weight: <1.5 kg) did not have a significant effect on MIH.

Regarding breastfeeding duration (whether in Tirana or abroad) there was no statistical difference between MIH(+) and MIH(-) children. A large portion of Tirana children were breastfed in the present city. Breastfeeding abroad seems to be more questionable than breastfeeding in Tirana. This might be due to environmental factors. The increasing level of tropospheric sulfur dioxide and other gases in urban areas play a contributing role in causing detrimental effects of air pollutants on human health and aquatic-terrestrial ecosystems. Regarding other toxins such as chemicals, associations have been made between the presence of polyhalogenated aromatic hydrocarbons, mainly PCDDs, in breast milk and enamel hypomineralisation in both clinical and laboratory studies [Alaluusua et al., 1999, 1996]. Living in Tirana for the first 3 years of life might be another contibuting factor in affecting MIH conditions. In the children who lived abroad in their first 3 years of life, exhibiting MIH, the defect was 1.59 (1.09-2.29) times higher than in children who lived in Tirana and exhibiting MIH. It is interesting to remark that, as lifestyle in Albania, Greece and Italy are generally Mediterranean, it is not clear what made the children living in Tirana during their first 3 years have less MIH than others.

Recent studies indicate that frequent preschool age infections such as upper respiratory diseases, asthma, otitis media, tonsillitis, chicken pox, measles, and rubella, appear to be associated with MIH [Jalevik and Noren, 2000;1 van Amerongen and Kreulen, 1995]. In the present study, MIH(+) children had significanly more childhood diseases in the first 3 years of their life, and acute otitis media was found to be the most common disease during the same time. Childhood diseases were not in high numbers among Tirana children.

This observation could be related to vaccinations that might have prevented the destructive effects of some childhood diseases [Kuscu, 2008].

While MIH is a multifactorial disturbance, some studies found a relationship between amoxicillin use and MIH. A recent study conducted by Kuscu et al. [2013] stated that MIH did not seem to be associated with amoxicillin usage in clinical examination. However, X-ray microtomography (XMT) examination shows that amoxicillin usage affects the mineral density of enamel tissue which might have an effect on MIH. In the current study, MIH(+) children significantly had more antibiotic usage during their first 3 years of life than MIH(-) children.

Conclusion

The frequency of MIH was 14% among children in Tirana, Albania, which is in line with most European studies. The data indicated that maternal health conditions, preterm birth, breastfeeding duration did not seem to have any significant association with MIH, while upper respiratory infections and antibiotic usage shows a significant relationship with this condition. Early diagnosis might be important for an appropriate management. Further studies are needed to investigate for MIH and other aetiological factors and their strength of association.

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