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Original Article / Оригинални рад

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Prevalence, characteristics and severity of hypomineralization of the first permanent molars and incisors in children from the northern part of Kosovo and Metohija

Распрострањеност, карарктеристике и израженост хипоминерализације на првим сталним моларима и инцизивима код деце у северном делу Косова и Метохије

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SUMMARY

Introduction/Objective Hypomineralization of molars and incisors (HMI) is relatively common developmental anomaly characterized by hypomineralized enamel defects in the first permanent molars and incisors.

The aim of this study was to determine the prevalence of hypomineralization of the first permanent molars and incisors in children aged 8 and 10 years who live in the northern part of Kosovo and Metohija.

Methods The study included 712 respondents, 289 of them aged 8 (40.6%) and 423 of them aged 10 years (59. 4%). Criteria according to Weerhejm were used for diagnosis of hypomineralization. The severity of changes was determined in the respondents with DO, PEB and AR.

Results The frequency of hypomineralized changes in the first permanent molars and incisors of the examined children in this area was 12.2%. It was lower in children aged 8 years (10.7%) compared to those aged 10 (13. 2%). Demarcated enamel opacity was more common in younger children, whereas both atypical restoration and tooth extraction due to hypomi-neralization were more common in older children. Mild form is more common in children aged 8 years, whereas both severe form and severe form with extra-cted teeth are more common in children aged 10 years. The results indicatedthat the first permanent molars were most commonly affected by HMI changes.

Conclusion The percentage of the respondents with HMI changes in the northern part of Kosovo and Metohija, which is 12.2%, is not negligible.This situation points to the necessity of early diagnosis in order to prevent and reduce the complications of the condition by timely prevention and treatment.

Keywords: hypomineralisation; molars; incisor; child; prevalence

САЖЕТАК

Увод/Циљ Хипоминерализација молара и инцизива (ХМИ) је релативно честа развојна аномалија која се карактерише појавом хипоминерализованих дефеката глеђи на првим сталним моларима и инцизивима.

Циљ овог рада био је да се испита учесталост хипоминерализације на првим сталним моларима и инцизивима код деце узраста 8 и 10 година на подручју северног дела Косава и Метохије.

Материјал и методе: У истраживање је укључено 712 испитаника: 289 узраста 8 година, (40.6%) и 423 (59.4%) узраста10 година. За дијагнозу обољења примењени су критеријуми по Weerhejim-у и одређен је степен израженост промена.

Резултати Учесталост хипоминерализованих промена на првим сталним моларима и инцизивима код испитиване деце на овом подручју износио је 12,2%. Код деце од 8 година учесталост ових промена је мања (10,7%) у односу на испитанике од 10 година (13,2%). Ограничена замућеност глеђи била је учесталија код деце млађег узраста док је код деце старијег узраста учесталија атипична рестаурација и екстракција зуба као последица хипоминерализације. Блага форма је учесталија код деце са 8 година док је код деца са 10 година учесталија тешка форма као и тешка форма која укључује и екстрахиране зубе. Резултати показују да су први стални молари најчешће захваћени ХМИ променама.

Закључак Проценат од 12,2% испитаника са ХМИ променама на подручју северног дела Косова и Метохије је значајан и указује на неопходност ране дијагностике да би се благовременом превенцијом и терапијом спречиле и ублажиле компликације овог обољења.

Кључне речи: хипоминерализација; молари; инцизиви; деца; учесталост

INTRODUCTION

In addition to dental caries and periodontal disease, developmental tooth disorders have been a problem in dentistry for more than two centuries. In economically developed countries, the problem of dental caries has been solved using targeted prevention programs, and significant results are being achieved in prevention of periodontal disease as well. Thus it has been proved that dental diseases can be prevented and controlled [1].

However, in the last ten years, especially in these countries, with a decrease in incidence of dental caries in children and adolescents, irregularities in the structure of hard dental tissues, which

occur as a consequence of disorders at the time of their formation, apposition, mineralization and maturation, have become more and more common. Special attention has been paid to isolated hypomineralized enamel defects of the first permanent molars and incisors.

During 1970s, Swedish dentists were the first to point to the changes in the form of hypomineralization of the first permanent molars [2]. In 2001 a Dutch dentist Karin Weerhejim and her colleagues suggested the term of Molar-Incisor Hypomineralization (MIH) [3], hypomineralization of molars and incisors, to describe the clinical findings of hypomineralization of systemic origin of one or more of the four first permanent molars, which may be associated with changes in the maxillary, and less frequently in the permanent mandibular incisors.

Although the definition suggests that the influence of systemic factors is important, no specific systemic cause has been determined. It is the multifactorial etiology that is important, and inadequately explored genetic background in the etiology of MIH as well [4,5].

Factors mentioned in the literature as possible etiological factors that might cause hypomineralization of molars and incisors are: premature birth, low birth weight, twins, ear , nose and throat infections, respiratory problems, epileptic seizures, hypoxia, disorder of calcium and phosphate metabolism, urinary tract infections, infant exposure to dioxins and biphenyls, childhood illnesses and chronic diseases. Recent studies have shown that frequent antibiotic use and vitamin D deficiency may affect tooth hypomineralization [6,7,8,9].

Hypomineralization of the first permanent molars and incisors (MIH), defined as reduced enamel mineralization, is a clinical condition in which enamel defects range from demarcated opacities to cracked, severely hypomineralized enamel. Defective opaque (porous) enamel is of normal thickness, with a smooth surface and can be whitish, white-yellow or yellow-brown and the defect typically has a clear line between affected and healthy enamel [10].Teeth affected by MIH are susceptible to thermal, mechanical and chemical stimuli. Therefore, oral hygiene is difficult, and these teeth are more prone to cavities, which disturbs the oral health of children and represents a significant problem in pediatric dentistry [11].

The frequency of this phenomenon varies significantly. Studies in different countries show different results, ranging from 2.5 - 40.2 % [12-16].

There are no precise data on the frequency of hypomineralization of the first permanent molars and incisors in the territory of Kosovo and Metohija.

Therefore, the aim of this study was to determine the disrtibution of hypomineralization of the first permanent molars and incisors in children who live in the northern part of Kosovo and Metohija as well as to assess the characteristics and determine the severity of hypomineralization.

METHODS

The study was approved by the Ethics Committee of Faculty of Medicine in Kosovska Mitrovica (nr. 09-2440/ 26 November 2015), and it was conducted by the researcher who had

previously been trained and calibrated for assessing hypomineralization of the first permanent molars and incisors and other developmental enamel defects. Examiner reliability for the accurate diagnosis of MIH was tested on 10% of respondents of the total sample. A high inter-rater diagnostic accuracy of MIH (κ=0.97) was received.

Children examinations were carried out at Department of Pediatric and Preventive Dentistry of Faculty of Medicine in Kosovska Mitrovica and in school dental office. Dental mirrors, probes and common lighting were used to examine children. The probes were used only when necessary, for removing dental plaque.

We examined only children who had written parental consent to participate in the study, and who had previously been fully informed, orally and in writing, about the aims of the study.

A total of 712 schoolchildren, 289 (40. 6%) of them aged 8 and 423(59. 4%) aged 10, were examined in the following elementary schools: "Sveti Sava" and "Branko Radičević" in Kosovska Mitrovica (393 schoolchildren examined), " Vuk Karadzic " in Zvečan (134 schoolchildren examined) and "Leposavić" (185 schoolchildren examined).

Criteria used in this study and commonly used in the literature, are those proposed by Weerhejim et al. These are: demarcated opacity (DO); post-eruptive enamel breakdown; (PEB); atypical-restoration (AR); extracted molar due to MIH (E-MIH); unerupted teeth (UT) [17].

For patients with demarcated opacities, posteruptive enamel breakdown (PEB) and atypical fillings, we determined the severity of changes. There are three degrees of severity: mild, moderate and severe form. Mild form of the tooth mineralization disorder is characterized by stained changes in the tooth enamel. Moderate form is characterized by changes in color (white / opaque, yellow or brown) and minimal loss of tooth substance with no need for restoration, or minimally invasive treatment is sufficient to repair defects. Loss of damaged enamel and dentin which require restoration represent severe form.

In case when there were more defects on one tooth, the most severe change was recorded as valid. Teeth with more than half erupted crowns were included in the study while lesions less than 1mm were not.

Of statistical tests, Student's t test and χ^2 (Chi-Square) test were used, and the significance test was performed at the level of probability $p < 0.01$ and $p < 0.001$.

RESULTS

Based on the set aims and with appropriate methodology used in the study, the following results were collected:

Table 1 shows a comparative analysis of respondents by gender and age in relation to the occurrence of hypomineralized changes**.** The frequency of hypomineralized changes in the first permanent molars and incisors in the examined children in this area was 12.2%. It was found that the percentage of female respondents with hypomineralization of the first permanent molars and incisors

Table 1. Distribution of children by gender and age in relation to the occurrence of molar and incisor hypomineralization.

MIH	Boys		Girls		8 years		10 years		Total sample	
	n	%	n	%	n	%	n	%	n	%
There are	38	11.5	49	12.7	31	10.7	56	13.2	**87**	**12.2**
No MIH	291	88.5	334	87.3	258	89.3	367	86.8	**625**	**87.8**
Total	329	100	383	100	289	100	423	100	**712**	**100**

(MIH) was higher than of males, but with no statistically significant difference (χ^2=0.69, p=0.4058). Analysis of the MIH prevalence in relation to age has lower values in children aged 8 years (10.7%) compared to these in respondents aged 10 (13.2%). The analysis of data shows there is no statistically significant difference (χ^2=1.01, p=0.314).

When analysing individual criteria for MIH, neither the difference in the frequency of hypomineralized changes in form of demarcated enamel opacities(χ^2=1.72, p=0.190) nor in form of posteruptive enamel breakdown (χ^2=1.16, p=0.686) due to MIH, is statistically significant in relation to age groups of children. An atypical restoration is statistically more common in children aged 10 years(χ^2=8.83, p=0.003) as well as tooth extraction due to hypomineralization (MIH) (χ^2=8.23, p=0.004).

A demarcated opacity in molars is statistically more common in children aged 8 years (χ^2=46.96, p<0.001) whereas both an atypical restoration (χ^2=18.89, p<0.001) and tooth extraction due to MIH (χ^2=12.01, p<0.001) are statistically more common in molars in children aged 10 years.There is no statistically significant difference in either frequency of demarcated opacities in incisors (χ^2=2.05, p=0.152) or in posteruptive enamel breakdown (χ^2=2.05, p=0.152) in relation to age groups of children.

A demarcated opacities in teeth with MIH changes is statistically more common in children aged 8 years (χ^2=41.61, p < 0.001) whereas both an atypical restoration (χ^2=18.79, p<0.001) and tooth extraction due to MIH (χ^2=12.20, p < 0.001) are statistically more common in children aged 10 years. Posteruptive enamel breakdown in all teeth with MIH changes is with no statistically significant difference in relation to age groups (χ^2=0.67, p=0.414) (Table 2).

Table 2. Prevalence of MIH per individual criterion.

MIH criteria	Children %			Molars %			Incisives %			Teeth with MIH %		
	Years			Years			Years			Years		
	8	10	8+10	8	10	8+10	8	10	8+10	8	10	8+10
Demarcated opacity	10.7	12.5	11.8	58.1†	18.9	32.9	100.0	91.2	94.6	65.4†	29.9	42.7
Post-eruptive enamel breakdown	4.5	6.1	5.5	27.6	30.0	29.2	0.0	8.8	5.4	22.8	26.7	25.3
Atypical restoration	1.7	6.4*	4.5	11.4	34.7†	26.4	0.0	0.0	0.0	9.4	29.5†	22.2
Extracted molar due to MIH	0.7	4.5*	2.9	2.9	16.3†	11.5	0.0	0.0	0.0	2.4	13.8†	9.6
Unerupted teeth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*p< 0.01; †p< 0.001

Frequency of some severity degrees by number of the respondents and affected teeth present in the respondent's mouth is shown in Table 3.

Table 3. Frequency of some severity degrees of hypomineralized changes

MIH expression level	Children %			Molars %			Incisives %			Teeth with MIH %		
	Years			Years			Years			Years		
	8	10	8+10	8	10	8+10	8	10	8+10	8	10	8+10
Mild form	10.7	12.5	11.8	50.9*	20.1	32.1	100.0	91.2	94.6	59.7*	32.6	43.2
Moderate form	3.8	4.5	4.2	33.4	34.7	34.1	0.0	8.8	5.4	27.4	30.0	29.0
Severe form	2.4	8.0*	5.8	15.7	45.2*	33.8	0.0	0.0	0.0	12.9	37.3*	27.8
Severe form (present + extracted teeth)	3.1	12.5*	8.7	18.1	54.2*	41.2	0.0	0.0	0.0	15.0	46.0*	34.8

*p<0.001

There is no statistically significant difference in either frequency of mild (χ^2=0.54, p=0.46) or moderate form (χ^2= 0.20, p = 0.65) in relation to age groups of children. Severe form is statistically more common in children aged 10 years (χ^2=11.64, p<0.001) as well as severe form with extracted teeth (χ^2=19.15, p<0.001).

Mild form in molars is statistically more common in children aged 8 years (χ^2=35.47, p<0.001) whereas both severe form (χ^2=16.58, p < 0.001) and severe form with extracted teeth (χ^2=36.37, p<0.001) are statistically more common in molars in children aged 10 years. There is no statistically significant difference in frequency of moderate form in relation to age groups of children (χ^2=0.20, p=0.65). There is no statistically significant difference in either frequency of mild (χ^2=2.05, p=0.152) or moderate form (χ^2=2.05, p=0.152) in incisors in relation to age groups of children.

Mild form in all teeth with MIH changes is statistically more common in children aged 8 years (χ^2= 30.94, p<0.001) whereas both severe form (χ^2=16.48, p<0.001) and severe form with extracted teeth (χ^2=34.39, p<0.001) are statistically more common in children aged 10 years. There is no statistically significant difference in moderate form in all teeth with MIH changes in relation to age groups (χ^2=0.03, p=0.86).

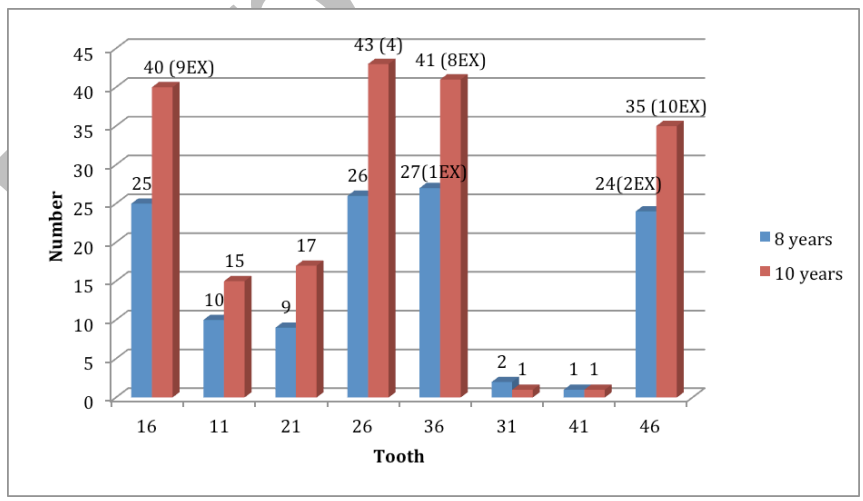

Figure 1. Frequency of hypomineralized changes in molars and incisors per individual teeth and extracted teeth due to MIH.

The analysis of data has revealed that the upper right (16) and lower left first permanent molar (36) are most often affected by hypomineralized changes 21.5% in children aged 10 years. In children aged 8 years, lower left first permanent molar (36) is the most common tooth with

hypomineralized changes. Of all the incisors in both jaws, upper right and upper left central incisors are most often affected by MIH in both age groups of children. Central lower incisors are slightly affected by the mentioned changes. Lateral incisors in the upper and lower jaw, in the examined children, are not affected by the changes. All the teeth extracted due to hypomineralization are molars. The results have shown that the lower right first permanent molar (46) is the most common extracted tooth, which is 2.9% of teeth affected by MIH. The upper right (2.6%) and lower left first permanent molar (2.2%) are also commonly extracted teeth due to MIH, in children aged 10 years, which represents a statistically significant difference (Figure 1).

DISCUSSION

Analysing and determining the frequency, prevalence and severity of hypomineralization of the first permanent molars and incisors is not easy. Particularly difficult is the inevitable subjectivity in assessing the severity of the changes, and also non-standardized criteria used in various studies to diagnose the disease. However, the current findings of the prevalence of MIH in the northern part of Kosovo and Metohija are comparable to those from international studies conducted in the same age groups, which indicates that MIH is a significant problem [14,18,19,20].

Prevalence of hypomineralized defects was first tested in this area and found in 12.2% of the total children examined. The same percentage of prevalence of MIH, as in our study, was found in Bosnia and Herzegovina (12.3%) in children aged 12 years [21], while in children aged 8 years, in the municipality of Foča in 2008, MIH was recorded in 12.8% of the examined children [19]. Approximate percentage of MIH was found in the study conducted in Italy (Lissone) in 2005 with 8-year-old children, and was 13.7% [22].The relatively high prevalence of MIH (17.85%) was found in children aged 6 and 14 in Spain [20]. In 2012 in Turkey, in the study conducted with children aged between 8 and 11 years, the distribution of MIH was lower (7.7%) [23]. The study done in Libya in 2006 with children aged 7 to 9 years, showed significantly lower percentage of MIH (2.9%) [24]. Also, the study of prevalence of MIH in the permanent dentition in Chinese children aged 12 years in Hong Kong showed a low prevalence percentage of 2.8% [12]. Analysis of previous epidemiological studies confirms that the percentage of MIH prevalence is not negligible. Large differences in the results on the prevalence of hypomineralization of the molars and incisors in different countries can be explained by different age groups of the respondents, local environmental factors and different criteria used in the studies. [13,18,20,25].

The selected children were aged 8 years, because in that age group all four first permanent molars and incisors were present, prevalence of dental caries wass still low, so there was less chance that carious lesions mask hypomineralisation. This study also included children aged 10 years to examine the progression of changes in molars, which largely depend on the posteruptive tooth age or patient age. By analyzing the results of the hypomineralized changes in this study, it was found that there was no statistically significant difference in the occurrence of these changes in respondents aged

8 and 10 years. Contrary to this study, Sönmez et.al. found that MIH was more common in children aged 8 compared to children aged 11 years (8. 5% versus 6. 5%).[23]

Some studies speculated about the possible significance of gender in the development of MIH. Studies pointed to a slightly higher prevalence of MIH in male respondents (Jälevik 2001) [6]. Neither this, nor the studies in Libya (Fteita et al., 2006)) [24] nor in Bosnia and Hercegovina (Muratbegović A. et al., 2007) [21], nor other studies that addressed these issues confirmed gender predisposition [19,23,25,26].

Review of literature shows that there is little data about individual criteria for MIH. The prevalence of certain criteria is difficult to compare. Despite the criteria being clearly determined, the details of the criteria are not clearly defined. One of the first concerns is the size of the lesion. In our research, we included only defects (opacities), larger than 1mm in diameter. The same criterion, considering the size of the lesion, was used by Jälevik et al. (2001) to determine the prevalence of MIH [27]. Some studies included only defects larger than 2mm [21,22,28].

By analysing individual criteria for MIH, in this study, it was found that demarcated opacity is the most common, which is in agreement with other studies [19,23,25]. Posteruptive enamel breakdown was found in 25.3% of the teeth and it was more common in molars compared to incisors.This finding is in agreement with other studies because the changes in incisors are not as extensive as in the first permanent molars and rarely, except for the colour change, result in posteruptive enamel breakdown, primarily because of no pressure during mastication [18,25]. An atypical restoration, in our study, was found in 22.2% of the examined teeth and only in molars. The same percentage of teeth with an atypical restoration was found in the respondents in Bosnia and Herzegovina [21]. In the study in Lithuania, atypical restoration was found in 16.9% of the respondents with MIH [26].

In this study, all teeth extracted due to hypomineralized changes or their complications were molars. In the study in the municipality of Foča (2008), tooth extraction due to MIH was found in 5. 6% of children, i.e. 19 % of the total number of teeth with MIH, and they were all molars[19]. In a study from Lithuania there were no teeth extracted due to MIH [26].

Unerupted teeth due to hypomineralized changes were not found in this study. These data are in agreement with the majority of studies that dealt with MIH [19,22,23,29].

By analysing individual criteria for MIH, in relation to age, it was found that both atypical restoration and tooth extraction due to MIH are statistically more common in children aged 10 years.This finding points to the necessity of early diagnosis of MIH, which will enable timely prevention and treatment of this condition.

Mild form of hypomineralized changes in this study is the most common in all teeth with MIH. Compared to all MIH studies, we confirmed that a mild form prevailed [19,23]. Severe form of hypomineralization was found in 5. 8% of chiildren i.e. 27. 8% of teeth, all of which were molars. Severe form was not found in incisors. In a study in Sweden in 2001, a similar percentage was

recorded. Severe form was found in 6.3% of the respondents [27], while significantly lower percentage in the group of children who lived in the Italian city Lissone (0,4%) [22]. By analysing the presence of some degrees of severity in relation to age, it was found that the severe form was more common in children aged 10 years, while the mild form was more common in younger children.There were no significant differences in the mean values of moderate forms. These results are in agreement with findings of other authors [18,23,25,30]. Frequent prevalence of severe form in older children can be explained by the fact that hypomineralized molars, depending on the degree of hypomineralization, are brittle, fragile and as such prone to posteruptive enamel breakdown under the influence of chewing forces. Also, due to hypersensitivity to temperature stimuli, children with these changes can have painful sensations when brushing teeth. This is the reason why they avoid regular oral hygiene This leads to accumulation of dental plaque, together with rapid progression of caries lesions that result in crown destruction and tooth loss.

This study confirms the findings of other studies, where the first permanent molars are most often affected by MIH changes, while the lateral incisors are the least affected [12,18, 21,29]. When analyzing the presence of MIH in each tooth, it can be concluded that the upper right (16) and lower left first permanent molar (36) are most often affected by hypomineralized changes. Data from the literature suggest that the changes are more common in maxillary incisors [19,23,27,29] which is also confirmed in our study.

CONLUSION

Hypomineralization of the first permanent molars and incisors is very common in children in many European countries, as well as in our country, which was confirmed by our study. In this study, no significant difference in frequency of MIH changes was found in respondents in relation to age and gender. In relation to the degree of severity of MIH changes, it was found that severe form was more common in children aged 10 years, while the mild form was more common in younger children.This finding indicates that MIH is inadequately treated and not recognized on time due to the rapid posteruptive enamel loss, hypersensitivity of the affected teeth, rapid and early caries progression (especially in the first permanent molars) and dental fear. Therefore, monitoring teeth eruption and making an accurate and timely diagnosis of MIH would significantly contribute to better prevention and treatment of these developmental defects.

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