

PREVALENCE OF MOLAR-INCISOR HYPOMINERALIZATION (MIH) IN CHILDREN SEEKING DENTAL CARE AT THE SCHOOLS OF DENTISTRY OF THE UNIVERSITY OF BUENOS AIRES (ARGENTINA) AND UNIVERSITY OF LA REPÚBLICA (URUGUAY)

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ABSTRACT

The objectives of this study are to compare the prevalence of MIH in children seeking dental care spontaneously at the Department of Comprehensive Children's Dentistry of the University of Buenos Aires (UBA) and Department of Pediatric Dentistry of the University of La República (UdelaR) and to analyze the distribution according to year of birth, sex, age, number of affected teeth and maximum degree of severity in molars and incisors. During 2010, nine pediatric dentists from both schools (Kappa = 0.94) assessed all children born between 1993 and 2003 whose 4 first molars and 8 permanent incisors had erupted. Specially designed charts were used to record sex, year of birth, institution, presence of MIH, number of affected incisors and molars and maximum degree of severity for each tooth. Two groups were formed: UBA: A (n = 512) and UdelaR: B (n = 463). Results: 975 children (11.6 ± 2.67 years) were evaluated. The prevalence of MIH in

the total sample was 6.56%, without significant differences between A and B (p = 0.76). There was no significant difference between groups regarding age (p = 0.95) or sex (p = 0.30). A significant increase was found in both institutions according to year of birth during the study period. (A: p = 0.0017) B: p = 0.0058). Conclusions: The results of this study show a similar prevalence of MIH among patients seeking dental care at the Schools of Dentistry of the University of Buenos Aires (Argentina) and University of La República (Uruguay). No significant difference was found comparing the distribution by sex, affected teeth or severity of each tooth. A highly significant positive correlation was found regarding the year of birth. The relevance of MIH as an emerging pathology requires studies on larger samples covering the entire countries.

Keywords: Molar-incisor hypomineralization, Prevalence.

PREVALENCIA DE HIPOMINERALIZACIÓN MOLAR-INCISIVA (HMI) EN NIÑOS QUE DEMANDAN ASISTENCIA ODONTOLÓGICA EN LAS FACULTADES DE ODONTOLOGÍA DE LA UNIVERSIDAD DE BUENOS AIRES (ARGENTINA) Y DE LA UNIVERSIDAD DE LA REPÚBLICA (URUGUAY)

RESUMEN

Los datos sobre prevalencia de MIH en Latinoamérica son escasos. Los objetivos de este trabajo son comparar la prevalencia de MIH en niños que demandaron atención en las Cátedras de Odontología Integral Niños de la Universidad de Buenos Aires (FOUBA) y de Odontopediatría de la Universidad de la República (UdelaR) y analizar en ambas unidades académicas la distribución según la variable año de nacimiento, sexo, edad, número de piezas afectadas y máxima severidad en molares e incisivos. 9 docentes de ambas facultades (Kappa= 0.94) evaluaron durante el periodo lectivo del año 2010 a todos los niños nacidos entre 1993 y 2003 que presentaban erupcionados los 4 primeros molares y los 8 incisivos permanentes y que concurren espontáneamente a ambas unidades académicas para su atención odontológica integral. Después de una profilaxis, las piezas fueron clínicamente evaluadas con luz del foco, previamente secadas, registrando en planillas diseñadas para tal fin, sexo, año de nacimiento, institución de pertenencia, presencia de MIH, número de incisivos

y molares afectados y máximo grado de severidad. La severidad se cuantificó a través de su aspecto en: Normal (0), Blanco crema (1), Amarillo marrón (2) y Pérdida de esmalte (3). Se conformaron dos grupos: UBA: A (n=512) y UdelaR: B (n=463). Los datos obtenidos fueron analizados estadísticamente utilizando porcentajes con sus correspondientes intervalos de confianza del 95% para la descripción de la prevalencia y otras variables cualitativas; Test Exacto de Fisher para la comparación de las proporciones y Test de Welch para la comparación de las edades. Resultados: Fueron evaluados 975 niños, edad media: 11.6 ± 2,67 años. No se observaron diferencias significativas entre los grupos en relación a las variables edad (p=0.95) y sexo (p=0.30). La prevalencia de MIH del total de la muestra fue de 6.56%, sin diferencias significativas entre A y B (p= 0.76). En los pacientes con MIH se encontraron afectados el 58.59% de los molares, y el 25.39% de los incisivos sin diferencias entre los valores hallados en ambos grupos (p= 1 y p=0.76). En relación a la severidad de las lesiones, el 12.66% de los molares y el

1.54% de los incisivos afectados, presentaban lesiones de grado 3, con pérdida de esmalte sin diferencias significativas entre ambos grupos ($p=0.71$ y 0.72 respectivamente). En relación al año de nacimiento se observó una correlación positiva y altamente significativa en ambas instituciones (A: $p=0.0017$; B: $p=0.0058$). Conclusiones: En este estudio los resultados muestran una prevalencia de MIH similar entre los pacientes que demandaron atención en las Facultades de Odontología de la Universidad de Buenos Aires (Argentina) y de la Universidad de la República (Uruguay). No se encontraron diferencias significativas al comparar la distribución por sexo, piezas dentarias afectadas o severidad de las lesiones pero sí una correlación positiva y altamente significativa en relación al año de nacimiento. La relevancia de MIH como patología emergente hace necesario estudios con muestras poblaciones mayores y de alcance nacional.

Palabras clave: Hipomineralización molar incisiva, prevalencia.

INTRODUCTION

Structural dental anomalies are associated with alterations occurring during the normal process of odontogenesis and may be related to hereditary, local or systemic factors. According to the time at which the factors act, they may affect primary dentition, permanent dentition or both. At the beginning of matrix secretion during amelogenesis, they may cause quantitative structural defects or hypoplasia in the teeth, while during the maturation or mineralization processes, they may produce qualitative defects or hypomineralization. In the late 1970s, the Sweden's Public Dental Service reported an increasing rise in the number of children with severe hypomineralization of permanent molars and incisors. The results of a study published in 1987 by Koch et al¹. revealed 15.4% prevalence of what they called "idiopathic hypomineralization" among children born in 1970. Subsequently, in 2001, by suggestion of Weerheijm et al². the pathology was called Molar-Incisor Hypomineralization. There is still controversy regarding its etiology, and to date, it seems to affect only permanent first molars and incisors. Clinical examination shows that the teeth have demarcated white, creamy, yellow or brown asymmetrical opacities, which differ from those due to incipient caries lesions, imperfect amelogenesis and endemic fluorosis. Mineral concentration in affected teeth decreases from the dentin-enamel junction towards the sub-surface zone, which is opposite to what happens in normal enamel³. The yellow/brown opacities are more porous and take up the entire thickness of the enamel, while the creamy-white ones are less porous, and are located within the enamel⁴. The

affected areas have well-defined borders between normal and hypomineralized enamel. Histologically, the microstructure is preserved, indicating normal functioning of ameloblasts during the secretion phase. However, the crystals seem less compact and organized in the porous areas, which may reveal an alteration in the maturation phase, so it is inferred that the problem may occur during the final prenatal period and the first years of life⁵. The severity of MIH varies among different teeth in the same patient, because not all permanent first molars and incisors are affected or have lesions of the same degree, even though they are formed during the same period⁶.

One of the main problems in patients with MIH is the hypersensitivity apparently caused by the penetration of bacteria in the dentinal tubules through the still intact hypomineralized enamel, inducing inflammatory reactions in the pulp⁷.

The micro-structural features of the enamel increase the risk of rapidly progressing caries which could even lead to loss of the tooth at very early ages. The frequency of restorative interventions and the need for re-treatment are significantly higher than in groups of patients without MIH, therefore early diagnosis is essential to preventing subsequent consequences⁸.

Latin American pediatric dentists identify it as a clinical entity, and although they consider it a problem in their zone of residence, they recognize the current lack of information⁹. In a previous paper it was concluded that in Buenos Aires Autonomous City, MIH was a frequent pathology (15.9%) increasing significantly with year of birth during the study period¹⁰.

The aims of this study are to compare MIH prevalence in children requiring attention at the Department of Comprehensive Children's Dentistry of the University of Buenos Aires (FOUBA) and the Department of Pediatric Dentistry at the University of La República (UdelaR) and to analyze distribution according to the variables year of birth, sex, age, number of teeth affected and maximum severity in molars and incisors, at both academic units.

SUBJECTS AND METHODS

Design: A project was prepared for a transversal descriptive study on the population spontaneously visiting the Department of Comprehensive Children's Dentistry (FOUBA) and Department of Pediatric Dentistry (UdelaR).

Standardization of diagnostic criteria: 9 teachers from both schools were calibrated in three stages to record MIH: homogenization of theoretical criteria, observation and discussion of criteria using photographs, and determination of concordance among evaluators by means of a Power Point file using the designated Gold Standard. Thirty pictures of 106 teeth were used to evaluate variation in visual diagnosis of an observer compared to him/herself (by showing the same pictures in different positions and forms), and among examiners in the group. The process was repeated 15 days later. Agreement in diagnosis was determined by the Kappa coefficient, which was 0.94 (IC 0.92-0.96).

Exclusion criteria: Children with amelogenesis imperfecta, tetracycline tooth stains, extensive destruction due to caries and/or crowns or orthodontic bands on the first permanent molars preventing adequate clinical examination, and fluorosis or living in areas with high fluorine content.

Data collection: During the school year 2010 all children born between 1993 and 2003 with 4 erupted first molars and 8 erupted permanent incisors who visited either of the academic units spontaneously for comprehensive dental care were evaluated. To ensure between-examiner reproducibility, the clinical examinations were performed jointly by two examiners. After prophylaxis and drying, teeth were evaluated clinically under a lamp, and specially designed charts were used to record sex, year of birth, school, presence of MIH, number of affected incisors and molars and maximum degree of severi-

ty. Severity was quantified according to appearance as: Normal (0), Creamy-white (1), Yellow-brown (2) and Loss of enamel (3) ¹¹ (Table 1).

Methods: Two groups were established: UBA: A (n=512) and UdelaR: B (n=463). The data recorded were analyzed statistically using descriptive and inferential non-parametric tests and subjected to linear correlation. Percentages with their 95% confidence intervals were used to describe prevalence and other qualitative variables, Exact Fisher's Test to compare proportions and Welch's Test to compare ages.

The Project was approved by the Ethics Committee at the School of Dentistry of the University of Buenos Aires (UBA 20020090200068).

RESULTS

975 children were evaluated, mean age 11.6 ± 2.67 years (11.43-11.77). No significant difference was found between groups regarding the variables age ($p=0.95$) or sex ($p=0.30$).

MIH prevalence for the total sample was 6.56% (5.09-8.31), with no significant difference between A and B ($p=0.76$). Patients with MIH showed a greater proportion of females, but the difference was not statistically significant ($p=0.08$). Groups A and B with MIH had similar distribution of male patients ($p=0.47$).

In patients with MIH, it was found that 58.59% (52.28-64.70) of molars and 25.39% (21.66-29.40) of incisors were affected. Comparison of the two groups showed no statistical difference for molars ($p=1$) or incisors ($p=0.76$).

Table 1: Criteria for evaluating Molar-Incisor Hypomineralization (MIH) severity (Mathu-Muju y Wright, 2006)¹¹.

Mild MIH	Moderate MIH	Severe MIH
Opacities in nonstress bearing areas No caries associated with the affected enamel No hypersensitivity Incisor involvement is usually mild if present	Demarcated opacities present on molars and incisors Posteruptive enamel breakdown limited to 1 or 2 surfaces without cuspal involvement. Atypical restorations can be needed Normal Dental sensitivity	Posteruptive enamel breakdown Crown destruction Caries associated with affected enamel History of dental sensitivity Aesthetic concerns
		

Regarding severity of lesions, 12.66% (7.79-19.09) of affected molars and 1.54% (0.17-5.45) of affected incisors had level 3 lesions with loss of enamel. There was no significant difference between A and B for molars (p=0.71) or incisors (p=0.72). Table 2 and Fig. 1 show the values for the two groups.

The highest prevalence value was found in both groups for 2001; 15.71% for A and 13.88% for B (Table 3 and Fig. 2).

A highly significant positive correlation with year of birth was found at both institutions (A: p=0.0017; B: p=0.0058) (Fig. 2).

Table 2: Results compared for the two groups.

	A:UBA	B:UdelaR	p=
n=	512	463	
Age	11,59±2,71 (8,88-14,3)	10,96±2,58 (8,38-13,54)	0,95
Male	48,4%	44,92%	0,30
MIH Prevalence	6,44% (4,31-8,56)	7,12% (4,95-9,87)	0,76
MIH in Male	35,48%	39,39%	0,47
Affected Molars	58,9%	59,8%	1
Affected Incisors	24,6%	26,1	0,76
Relation affected molars incisors (RR)	2,4:1	2,3:1	0,41
Maximum degree of severity in molars	13,7%	11,39%	0,71
Maximum degree of severity in incisors	1,64%	1,44%	0,72

A: University of Buenos Aires. Argentina; B: University of La República. Uruguay.

Table 3: Percentage of children affected according to year of birth.

Year of Birth	A:UBA	B: UdelaR
1993	0,00	0,00
1994	2,56	0,00
1995	0,00	0,00
1996	1,75	0,00
1997	2,43	6,06
1998	0,00	7,69
1999	12,72	7,35
2000	5,33	8,10
2001	15,71	13,88
2002	11,11	4,76
2003	14,28	7,69

A: University of Buenos Aires. Argentina; B: University of La República. Uruguay

Fig. 1: Distribution of severity of Molar-Incisor Hypomineralization (MIH).

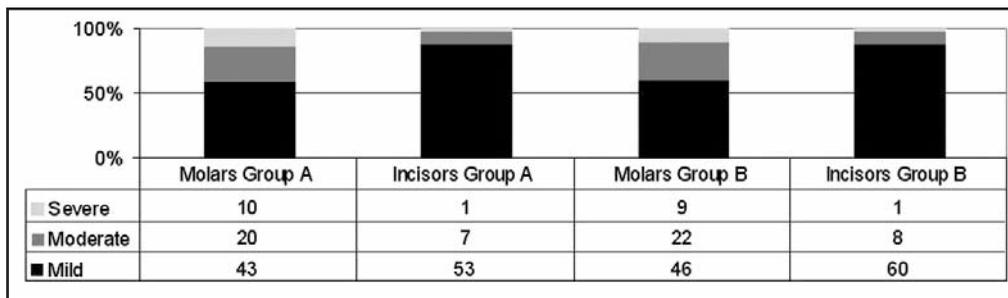
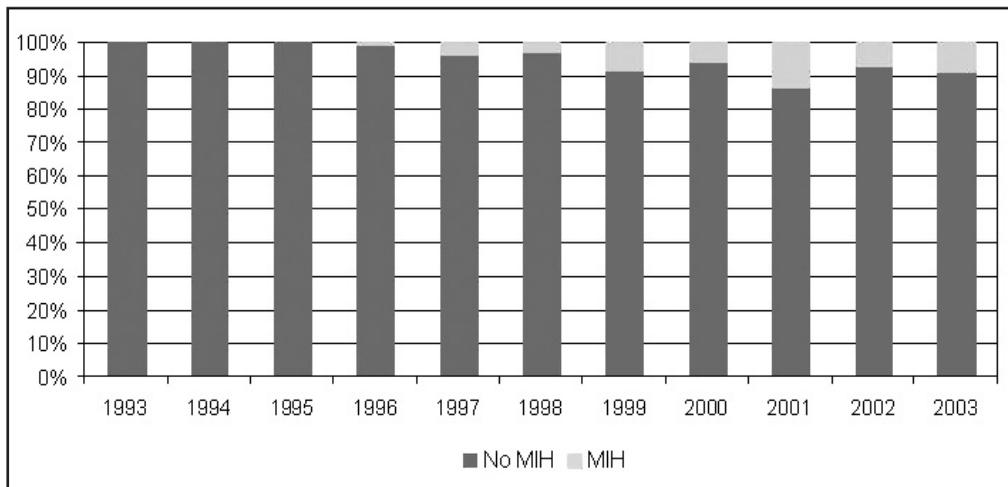


Fig. 2: Prevalence of Molar-Incisor Hypomineralization (MIH) according to year of birth.



DISCUSSION

Developmental defects of the enamel diagnosed as MIH result in an emerging pathology, which poses a challenge to dentistry regarding its diagnosis and difficult management as a result of its microstructural characteristics.^{2,12,13} The most severe lesions have significant impact on treatment, requiring complex rehabilitating therapies with difficulties for local anesthesia, isolation of the operating field of newly erupted teeth and behavior of adhesive materials^{14,15}. Prevalence values reported by different authors are heterogeneous, varying from 2.4% to 44% in different countries (Table 4). Traditionally, most results are from studies in Europe. The values for prevalence in this study are lower than those reported by other researchers in Latin America, such as 16.8% by Jans et al.⁶ in Chile, and 19.8% by da Costa Silva et al.¹⁶ and 40.2% by Soviero et al.¹⁷ in Brazil.

Jälevik et al.¹⁸ note the increase in MIH prevalence over the past decade, which this study also found to be true at both institutions. Early diagnosis is therefore recommended and researchers are encouraged to study MIH further.

Table 4: Reported prevalence values.

Author	Year	Place	Prevalence (%)
Jalevik et al. ¹⁸	2001	Sweden	18,4
Höltkää P et al. ¹⁹	2001	Kotka and Anjalankoski (Finland)	142-5,6
Dietrich et al. ²⁰	2003	Dresden (Germany)	5,6
Păsăreanu et al. ²¹	2006	Iasi (Romania)	14,5
Comes Martínez et al. ²²	2007	Madrid (España)	12,4
Muratbegovic et al. ²³	2008	Sarajevo (Bosnia and Herzegovina)	12,3
Lygidakis et al. ²⁴	2008	Athens (Greece)	14,9
Kukleva et al. ²⁵	2008	Plovdiv (Bulgaria)	2,4
Mahoney and Morrinson ²⁶	2009	Wainuiomata (New Zealand)	14,9
Soviero et al. ¹⁷	2009	Río de Janeiro (Brazil)	40,2
Balmer et al. ²⁷	2011	Northern England (United Kingdom)	15,9
Jans Díaz et al. ⁶	2011	Temuco (Chile)	16,8
Mahoney and Morrinson ²⁶	2011	Wellington (New Zealand)	18,8
Biondi et al. ¹⁰	2011	Buenos Aires (Argentina)	15,9

A systematic review published in 2010²⁹ on MIH prevalence and diagnosis shows the methodological differences between studies published by different authors, such as diagnostic criteria, evaluator standardization, examination conditions, ages and social conditions of groups included in the samples. In this study, data were collected at public universities in the capital cities of countries in the same geographic region, where children at social risk receive care. As the study was prospective, examiners underwent a rigorous calibration process and samples were formed according to the same inclusion criteria. Table 2 shows that the samples were homogenous in distribution of sexes and ages.

The precision error (2.12 % for Group A (UBA) and 2.46% for Group B (UdelaR) is low, revealing an adequate sample size and a reasonably sized confidence interval for the prevalence found.

In this study, which was conducted in the cities of Montevideo and Buenos Aires on children at social risk and according to spontaneous demand for care, prevalence values were similar. However, a paper published by Biondi et al.¹⁰ which was conducted in Buenos Aires Autonomous City and another by Salveraglio et al.³⁰ in Montevideo, on children not at social risk, the prevalence values were higher. This difference agrees with that reported by Balmer et al.²⁷ for a group of children of low socio-economic status in England. Nevertheless, the MIH risk factors mentioned to date do not seem to be related to this condition, and in general come from exploratory surveys of parents' responses about children's 3 first years of life regarding birth weight and weeks' gestation; lactation on special formulas, causes and type; place of residence, low weight and nutritional difficulties; history of fever, taking ibuprofen, amoxicillin and other antibiotics, causes and number of episodes, and other medical history. However, there is still controversy regarding the etiology^{31,32}. Further studies are needed to enquire into other variables that might explain the lower prevalence values found in these studies in patients at social risk.

Although the European Academy of Paediatric Dentistry (EAPD) in 2003³³ recommended the age of 8 years for MIH evaluation, incisors have often not yet all erupted at that age, which is why the inclusion criterion in this study was not age but rather that all permanent incisors and molars should be present in children born within a given period of time. Considering the results reported for groups of

different ages and in agreement with the recommendations of Jälevik in 2010 on specifying prevalence in each age group separately, samples in this study were broken down for analysis according to year of birth. The results from both health care centers showed highest prevalence in children born in 2001. Older children with MIH may have been excluded from the sample because they had lost molars or had crowns as a result of the pathology¹⁶.

The ratio between affected molars and incisors is lower than the 4:1 ratio found by Weerheijm² et al. (2001) and Păsăreanu et al. (2006)²¹.

Considering that the degree of severity seems to vary according to the dental group affected^{2,34} but not with MIH prevalence¹⁷ it is very important to express it separately for molars and incisors. The values recorded for molars and incisors with severity degree 3 did not differ significantly between groups. In order to evaluate the severity of Molar-Incisor Hypomineralization, this study used the criteria described by Mathu-Muju and Wright in 2006, qualifying it as Mild, Moderate or Severe, because

the DDE index was considered inadequate for MIH studies, in addition to taking up too much time. Some authors currently suggest combining moderate and severe in a single group called severe or dis-integrated^{19, 24,35}.

Sex does not seem to be a determining factor, nevertheless, in this study, in agreement with Mejáre in 2005³⁶; there was a higher proportion of female patients with MIH, although the difference was not statistically significant.

CONCLUSIONS

The results of this study showed similar MIH prevalence in patients seeking attention at the Schools of Dentistry of the University of Buenos Aires (Argentina) and the University of La República (Uruguay). No significant difference was found when distribution was compared between sexes, affected teeth or severity of the lesions, but there was a highly significant positive correlation with year of birth. The relevance of MIH as an emerging pathology calls for studies using larger populations and national scope.

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REFERENCES

- Koch G, Hallonsten A L, Ludvigsson N, Hansson B O, Holst A, Ullbro C Epidemiologic study of idiopathic enamel hypomineralization in permanent teeth of Swedish children. *Community Dent Oral Epidemiol.* 1987;15(5): 279-285.
- Weerheijm KL, Jälevik B, Alaluusua S. Molar-incisor hypomineralisation. *Caries Res* 2001;35:390-391.
- Fearne J, Anderson P, Davis GR. 3D X-ray microscopic study of the extent of variations in enamel density in first permanent molars with idiopathic enamel hypomineralization. *Br Dent J* 2004;194:634-638.
- Jälevik B, Norén JG. Enamel hypomineralization of permanent first molars: a morphological study and survey of possible aetiological factors. *Int J Paed Dent.* 2000;10: 278-289.
- Jälevik B, Dietz W, Norén JG. Scanning electron micrograph analysis of hypomineralized enamel in permanent first molars. *Int J Paediatr Dent.* 2005; 15(4):233-40.
- Jans, M. A.; Díaz, M. J.; Vergara, G. C. & Zaror, S. C. Frecuencia y severidad de la hipomineralización molar incisal en pacientes atendidos en las clínicas odontológicas de la Universidad de La Frontera. *Int. J. Odontostomat.* 2011; 15(2):133-140.
- Fagrell TG, Lingström P, Olsson S, Steiniger F, Norén JG. Bacterial invasion of dentinal tubules beneath apparently intact but hypomineralized enamel in molar teeth with molar incisor hypomineralization. *Int J Paediatr Dent.* 2008; 18(5):333-340.
- Biondi AM, Cortese SG, Ortolani A. Therapeutic alternatives in children with Molar Incisor Hypomineralisation. *J Dent Res.* 2010; Vol. 89, Special Issue B.
- Biondi AM, Cortese SG. Hipomineralización Molar Incisiva: Encuesta a Odontopediatras de Universidades de Latinoamérica. *Bol AAON* 2009;38(3):20-25.
- Biondi AM, Cortese SG, Martínez K, Ortolani AM, Sebelli PM, Ienco M, Paván VH, Mendel N, Bertolino M, Hecht P Prevalence of molar incisor hypomineralization in the city of Buenos Aires. *Acta Odontol Latinoam* 2011; 24(1):81-5.
- Mathu-Muju K, Wright JT. Diagnosis and treatment of molar incisor hypomineralization. *Compend Contin Educ Dent.* 2006;27(11):604-610.
- Kotsanos, N.; Kaklamanos, E. G. & Arapostathis, K. Treatment management of first permanent molars in children with Molar-Incisor Hypomineralisation. *Eur J Paediatr Dent.* 2005;6(4):179-84.
- Jälevik, B. & Klingberg, G. A. Dental treatment, dental fear and behaviour management problems in children with

- severe enamel hypomineralization of their permanent first molars. *Int. J. Paediatr. Dent.* 2002;12(1):24-32.
14. Bozal CB, Ortolani A, Cortese GS, Biondi AM Caracterización ultraestructural de la superficie del esmalte en molares permanentes con diagnóstico de Hipomineralización Molar-Incisiva (MIH). XLIII Reunión Anual de la Sociedad Argentina de Investigación Odontológica. 2010. Disponible en <http://www.saio.org.ar/XLIII.pdf>
 15. Bozal CB, Kaplan A, Ortolani A, Cortese GS, Biondi AM. Caracterización ultraestructural de la superficie del esmalte grabado en molares permanentes con diagnóstico de Hipomineralización Molar-Incisiva (MIH). XLIV Reunión Anual de la Sociedad Argentina de Investigación Odontológica. 2011. Disponible en <http://www.saio.org.ar/XLIV.pdf>
 16. da Costa-Silva CM, Jeremias F, de Souza JF, Cordeiro Rde C, Santos-Pinto L, Zuanon AC. Molar incisor hypomineralization: prevalence, severity and clinical consequences in Brazilian children. *Int J Paediatr Dent.* 2010;20(6):426-34.
 17. Soviero V, Haubek D, Trindade C, Da Matta T, Poulsen S. Prevalence and distribution of demarcated opacities and their sequelae in permanent 1st molars and incisors in 7 to 13-year-old Brazilian children *Acta Odontol Scand.* 2009; 67:3, 170-175.
 18. Jälevik B, Klingberg G, Barregard L, Noren JG. The prevalence of demarcated opacities in permanent first molars in a group of Swedish children. *Acta Odontol Scand.* 2001; 59:255-260.
 19. Hölttä P, Kiviranta H, Leppäniemi A, Vartiainen T, Lukinmaa PL, Alaluusua S. Developmental dental defects in children who reside by a river polluted by dioxins and furans. *Arch Environ Health.* 2001; 56(6):522-528.
 20. Dietrich G, Sperling S, Hetzer G. Molar Incisor Hypomineralisation in a group of children and adolescents living in Dresden (Germany). *Eur J Paed Dent.* 2003;4:133-137.
 21. Păsăreanu M, Bălan A, Maxim A. Systemic impact of MIH Syndrome on the child and adolescent. *J Prev Med.* 2006; 14(1-2):96-102
 22. Comes Martínez Á, Puente Ruiz C, Rodríguez Salvanés F. Prevalencia de Hipomineralización en primeros molares permanentes (MIH) en población infantil del Área 2 de Madrid. *RCOE.* 2007; 12(3): 129-134. Disponible en: http://scielo.isciii.es/scielo.php?script=sci_arttext&
 23. Muratbegovic A, Zukanovic A, Markovic N. Molar- Incisor- Hypomineralisation impact on developmental defect of enamel prevalence in a low floridate area. *Eur Arch Pediatr Dent.* 2008; 9(4):228-231.
 24. Lygidakis NA, Dimou G, Briseniou E Molar-incisor-hypomineralisation (MIH). Retrospective clinical study in Greek children. I. Prevalence and defect characteristics *Eur Arch Paediatr Dent.* 2008 Dec; 9(4):200-6.
 25. Kukleva MP, Petrova SG, Kondeva VK, Nihtyanova TI. Molar incisor hypomineralisation in 7-to-14-year old children in Plovdiv, Bulgaria-an epidemiologic study. *Folia Med (Plovdiv).* 2008;50:71-75.
 26. Mahoney EK, Morrison DG. The prevalence of Molar Incisor Hypomineralisation (MIH) in Wainuiomata children. *NZ Dent J.* 2009;105(4): 121-127.
 27. Balmer R, Toumba J, Godson J, Duggal M. The prevalence of molar incisor hypomineralisation in Northern England and its relationship to socioeconomic status and water fluoridation. *Int J Paediatr Dent.* 2011 Oct 20. doi:10.1111/j.1365-263X.2011.01189.x. [Epub ahead of print]
 28. Mahoney EK, Morrison DG. Further examination of the prevalence of MIH in the Ewllington Region. *NZ Dent J.* 2011; 107 (3):79-84.
 29. Jälevik B. Prevalence and Diagnosis of Molar-Incisor-Hypomineralisation (MIH): A systematic review. *Eur Arch Paediatr Dent.* 2010; 11:59-64.
 30. Salveraglio I, López MC, Alvarez L. Comparison of Prevalence of Molar Incisor Hypomineralization (MIH) in Children. IADR General Session, 2012. Disponible en <http://iadr.confex.com/iadr/2012rio/webprogram/Paper161579.html#top>
 31. Alaluusua S. Aetiology of Molar-Incisor Hypomineralisation: A systematic review. *Eur Arch Paediatr Dent.* 2010 Apr;11(2):53-8
 32. Biondi AM, Cortese SG, Ortolani AM, Argentieri ÁB Características clínicas y factores de riesgo asociados a Hipomineralización Molar Incisiva. *Revista de la Facultad de Odontología (UBA)* 2010;25(58):11-15.
 33. Weerheijm KL, Duggal M, Mejäre I, Papagiannoulis L, Koch G, Martens LC, Hallonsten AL. Judgement 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):110-113.
 34. Jasulaityte L, Veerkamp J.S, Weerheijm KL. Molar-incisor-hypomineralisation: review and prevalence data from a study of primary school children in Kaunas (Lithuania). *Eur Arch Paediatr Dent.* 2007; 8(2):87-94.
 35. Calderara PC, Gerthoux PM, Mocarelli P, Lukinmaa PL, Tramacere PL, Alaluusua S. The prevalence of Molar Incisor Hypomineralisation (MIH) in a group of Italian school children. *Eur J Paediatr Dent.* 2005; 6(2):79-83.
 36. Mejäre I, Bergman E, Grindefjord M. Hipomineralized molars and incisors of unknown origin: treatment outcome at age 18 years. *Int Paed Dent.* 2005; 15:20-28.