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Prevalencija molarno-incizivne hipomineralizacije u skupini španjolske školske djece

First Permanent Molars and Permanent Incisors Teeth by Tooth Prevalence of Molar–Incisor–Hypomineralisation in a Group of Spanish Schoolchildren

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Sažetak

Svrha rada: Molarno-incizivna hipomineralizacija (MIH) poremećaj je u razvoju zuba koji zahvaća prve trajne kutnjake i trajne sjekutiće. Prevalencija MIH-a u literaturi varira između 2,5 i 40 posto svjetske dječje populacije. Malo je informacija o pojavnosti toga poremećaja među djecom u Španjolskoj. Svrha rada bila je ispitati njegovu učestalost među školskom djecom iz Barcelone (Španjolska). **Materijali i metode:** Provedeno je istraživanje poprečnog presjeka koje je uključivalo 705 djece u dobi od 6 do 14 godina i 11 mjeseci. Svi su klinički pregledani u skladu s kriterijima Europske akademije za dječju stomatologiju za dijagnozu MIH-a. **Rezultati:** Pronađeno je ukupno 56 slučajeva MIH-a – 22 (39,3 %) kod dječaka i 34 (60,7 %) kod djevojčica. Prevalencija je iznosila 7,94 posto (6,39 % za dječake i 9,41 % za djevojčice). Lezije MIH-a češće su zabilježene kod djevojčica negoli kod dječaka ($\chi^2 = 4,9$, $p = 0,023$) – omjer muških/ženskih osoba iznosi 1:1,54. U oba spola gornji zubi bili su češće zahvaćeni negoli donji, s omjerom gornji/donji od 1,86/1 za dječake i 1,68/1 za djevojčice. **Zaključak:** S obzirom na spol i zahvaćene zube, češće su bili pogođeni gornji zubi i djevojčice.

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Uvod

Caklina je najtvrdije tkivo u organizmu i strukturno se sastoji od milijuna visoko mineraliziranih prizmi. Prozirna je i sve prozirnija što se više mineralizira. Kemijski se sastoji od organske (1 – 2 %) i anorganske matrice (95 %) s vodom (3 – 5 %) (1). Poremećaji koji nastaju tijekom početnog stadija sekrecije matriksa u procesu amelogeneze mogu rezultirati kvantitativnim strukturnim defektima koji se manifestiraju kao dentalna hipoplazija, a oni koji utječu na stupanj sazrijevanja ili mineralizacije potiču nastanak hipomineralizacije ili kvalitativnih defekata (2).

Problemi mineralizacije ili sazrijevanja cakline pojavljuju se na području zuba koji odgovara razvojnom stadiju jer se tvrdo zubno tkivo ne može reparirati (3). Smatra se da su uzroci problema mineralizacije poremećaj svojstva resorpcije organske matrice i inhibicije proteolitičkih enzima, što zna-

Introduction

Enamel is the hardest tissue of the human body and is structurally made up of millions of highly mineralised prisms. It is translucent, and is even more translucent as it becomes mineralised. Chemically, it is made up of an organic (1-2%) and inorganic matrix (95%) with water (3-5%), (1). The disorders that arise during the initial matrix secretory stage in the process of amelogenesis can lead to quantitative structural defects that manifest as dental hypoplasia while those affecting the maturation or mineralisation stages lead to hypomineralisation or qualitative defects (2).

Mineralisation or maturation problems of the enamel occur in the area of the tooth that corresponds to the developmental stage, since the hard dental tissue cannot be repaired (3). It is thought that the origin of mineralisation problems are disturbances in the resorption capability of the organic

či zadržavanje proteina i ometanje stvaranja kristala jer nema dovoljno prostora za odlaganje minerala (4).

Sintagmu *molaro-incizivna hipomineralizacija* predložili su Weerheijm i suradnici 2001. godine (4). Ovaj naziv prihvaćen je na skupu EAPD-a u Ateni 2003. kao definicija, ali i danas s nepoznatom etiologijom, pri čemu su zahvaćeni prvi trajni kutnjaci i povremeno trajni sjekutići (5).

Histološki mikrostruktura ostaje sačuvana i ameloblasti normalno funkcioniraju tijekom sekrecijske faze. No kristali su manje kompaktni i organizirani u porozne nakupine, što upućuje na poremećaj u fazi sazrijevanja. Koncentracija minerala u caklini u pogođenim područjima smanjuje se od amelodontinskog spoja do površine ispod cakline, a to je suprotno od onoga što se uočava u normalnoj caklini (6). Caklina je porozna, a morfologija prizmi je poremećena, pa su mehanička svojstva u ovom caklinskom poremećaju slična dentinu jer su tvrdoća i elastičnost smanjeni (7).

Općenito, MIH se razvija tijekom prve tri godine života dok traje proces mineralizacije kruna prvih trajnih kutnjaka i sjekutića (8). Klinički se u demarkacijskim područjima cakline uočava pojava abnormalnosti translucencije zbog gubitka mineralnog sadržaja, što ne utječe na njezinu debljinu. Asimetrični mutni areali opažaju se u bijeloj, bež, žutoj ili smeđoj boji, a mogu biti zahvaćeni jedan ili sva četiri kutnjaka. Razlikuju se prema veličini i stupnju izraženosti bez utjecaja na gingivu (9). Ove se mutne mrlje uglavnom pojavljuju na kvržicama ili u incizalnoj trećini krune zahvaćenih zuba, a karakteriziraju ih dobro definirane granice između normalne i zahvaćene cakline (4, 10). Jälevik i Norén (8) zaključili su da su mutne mrlje, koje se razlikuju po boji od žute do žuto-smeđe, uzrokovane ireverzibilnim oštećenjem ameloblasta.

Većina istraživanja o učestalosti MIH-a provedena je u Europi, iako je odnedavno porastao interes i diljem svijeta. Trenutačno, ovisno o istraživanju, raspon prevalencije kreće se od 2,8 do 40,2 posto (11).

Stupanj MIH-a varira i ne razlikuje se samo od pacijenta do pacijenta, nego i između različitih zuba istog pacijenta. Nisu svi prvi trajni kutnjaci jednako zahvaćeni, čak i kada su pogođeni istim sistemskim poremećajem (12 – 14). U slučaju sjekutića čini se da oštećenja cakline imaju manju tendenciju lomljenja i češće nastaju na bukalnim površinama (15). U ekstremnim slučajevima caklina se raspada nakon erupcije, što pogoduje karijesu i znatno utječe na potrebu za liječenjem (10, 16).

Zbog nedostatka podataka o prevalenciji MIH-a u španjolskoj populaciji, svrha ovog istraživanja bila je analizirati pojavnost ovog defekta zuba u skupini školske djece iz Barcelone (Španjolska).

Materijali i metode

Protokol (P15/022) ovog istraživanja poprečnog presjeka o prevalenciji MIH-a odobrio je etički odbor.

Procjena potrebne veličine uzorka za najmanje 80 posto snage i $\alpha = 0,05$ pokazuje da je bilo potrebno najmanje 600 djece. Uzorak u istraživanju sastojao se od 705 španjol-

matrix and the inhibition of the proteolytic enzymes, which entails the retention of proteins and interferes with the formation of crystals as there is not enough space for depositing minerals (4).

The term “molar-incisor-hypomineralisation” was proposed by Weerheijm and co-workers in 2001 (4). This description was accepted at the EAPD meeting in Athens in 2003 as a definition. It affects first permanent molars (FPM) and occasionally permanent incisors (PI). At present, its unknown etiology presents a challenge to the clinician (5).

Histologically, the microstructure is preserved and ameloblasts will function normally during the secretion stage. However, the crystals appear less compact and organized in the porous areas, which points to a disturbance in the maturation phase. The mineral concentration of the enamel is reduced from the amelodontinal junction to the subsurface area of the enamel in the areas affected, which is contrary to what is observed in normal enamel (6). The enamel is porous and the morphology of the prisms is disturbed, hence the mechanical properties in this enamel disorder are similar to dentin as the hardness and elasticity are reduced (7).

Generally, MIH develops during the first three years of life when the mineralisation process of the crowns of the FPM and PI takes place (8). Clinically, it can be observed how, in demarcated areas of the enamel, abnormalities will appear in the translucent area due to a loss of mineral content that does not affect its thickness. Asymmetric opacities can be observed in white, cream, yellow or brown colour that may affect only one molar or all four molars. They vary in extension and severity without affecting the gingival area (9). These opacities appear mainly in the cusp or incisal third of the crown of the affected teeth and they are characterised by well-defined borders between the normal and affected enamel (4,10). Jälevik and Norén (8) concluded that the opacities that vary in colour from yellow to a yellow-brown colour are due to irreversible damage of the ameloblasts.

So far, most of the reports on the prevalence of MIH have been carried out in Europe. More recently, there has been an increased interest in the prevalence of MIH worldwide.

Currently, depending on the different studies reviewed, there is a wide range of prevalence from 2.8% to 40.2% (11).

The severity of MIH varies and it does not vary only from patient to patient but also between different teeth in the same patient. Not all FPM are compromised to the same degree even when their tooth buds have been affected by the same systemic disturbance (12-14). In PI the enamel defects seem to show less of a tendency to fracture and are most commonly found on the buccal surface (15). In extreme cases the enamel disintegrates following eruption favouring the onset of caries, which will have a significant effect on the need for treatment (10,16).

Materials and methods

The research protocol (P15/022) for this cross-sectional study on the prevalence of MIH was approved by the Governmental Health Service Ethics Committee.

A power calculation to assess the sample size needed, for at least 80% power and $\alpha = 0.05$ indicated a minimum of 600

ske školske djece – 344 dječaka (48,72 %) i 361 djevojčice (51,28 %) u dobi od 6 do 14 godina i 11 mjeseci. Svi su nasumično odabrani u španjolskoj pokrajini Barceloni u kojoj je 51 grad.

Oralni pregledi obavljani su u sklopu državnog programa zdravstvenog nadzora nakon što je dobiven informirani pristanak za svako dijete.

Djecu je pregledao jedan dječji stomatolog nakon niza kalibracijskih vježbi. Za to je korišten dijagram od 50 kliničkih slika zahvaćenih zuba, a obuhvaćale su sve stupnjeve MIH-a i drugih lezija kao što su hipoplazija, *amelogenesis imperfecta* i fluorozna. Koristeći se faktorskom analizom Kappa, pronađena je kod ispitivača podudarnost od 97,6 posto.

Pregled očišćenih i vlažnih zuba obavljen je na temelju kriterija EAPD-a iz 2003. za dijagnozu MIH-a (5). Djeca su pregledana dentalnim zrcalom u stomatološkoj ordinaciji s dobrim osvjetljenjem. Svi su zubi prije toga očišćeni i bili su vlažni (5). Isključeni su generalizirani caklinski defekti i mutne mrlje manje od 2 milimetra. Nepotpuno izniklim zubima smatrani su oni kojima je vidljivi dio bio manji od trećine i takvi nisu uključeni kako se ne bi precijenila prevalencija MIH-a te osigurala ponovljivost i usporedba s drugim istraživanjima. Podatci su uneseni u program IBM SPSS Statistics za Windowse, verzija 22.0 (Armonk, NY: IBM Corp.). Za utvrđivanje razlika u prevalenciji MIH-a u odnosu na spol korišten je hi kvadrat (χ^2) test.

Rezultati

Tablica 1. pokazuje distribuciju sudionika u istraživanju. Od 705 uključene djece njih 56 (22 dječaka i 34 djevojčice) imalo je više ili manje izražen MIH, što upućuje na prevalenciju od 7,94 posto; 6,39 posto za dječake i 9,41 posto za djevojčice. MIH je češće zabilježen kod djevojčica (60,71 %) negoli kod dječaka ($c^2 = 4,9$, $p = 0,023$) – muško-ženski omjer iznosio je 1 : 1,54.

Distribucija MIH-a prikazana je u tablici 2. za zahvaćene zube prema spolu i zub po zub, s c^2 testom, p vrijednosti i različitim omjerima. Ukupan broj zuba s MIH-om bio je 215 (137 gornjih i 78 donjih) – 86 (40 %) kod dječaka i 129 (60 %) kod djevojčica ($c^2 = 5,8$, $p = 0,014$) s omjerom između dječaka/djevojčica od 1 : 1,5. Od 137 gornjih zuba 56 oštećenih uočeno je kod dječaka (40,9 %), a 81 (59,1 %) kod dje-

children. The study sample consisted of 705 Spanish school children, 344 boys (48.72%) and 361 girls (51.28%) aged 6-14 years and 11 months old. Children were recruited from two towns. They were randomly selected from the central region of the province of Barcelona, Spain, composed of 51 towns.

The oral examinations were performed as part of the governmental health control programme after informed consent had been obtained for each child.

The children were examined by one pediatric dentist (MH) following a series of calibration exercises. This was completed using a chart of 50 clinical pictures of affected teeth covering all the degrees of MIH and other lesions such as hypoplasia, *amelogenesis imperfecta* and fluorosis. Using Kappa factor analysis, an intra-examiner agreement of 97.6% was found.

Full mouth inspection of cleaned and wet teeth was completed using the EAPD 2003 criteria for diagnosis of MIH⁵. Children were examined in a dental surgery/office with good lightning under direct vision with the aid of a dental mirror. All teeth had been previously cleaned and were wet⁵. General enamel defects such as opacities less than 2mm were excluded. Incompletely erupted teeth were considered as if the visible part of them was less than a third and were also excluded to avoid an overestimation of the prevalence of MIH and to favor the reproducibility and comparison of with different studies. Data were entered into IBM SPSS Statistics for Windows, version 22.0 (Armonk, NY: IBM Corp.) and a Chi square (χ^2) test was used to determine differences in MIH prevalence regarding gender.

Results

Table 1 shows the distribution of the participants in the study. Out of 705 examined children 56 (22 boys and 34 girls) showed MIH to a greater or lesser degree, which implies a population prevalence of 7.94%; 6.39% for boys and 9.41% for girls. MIH lesions were more commonly observed in girls (60.71%) than boys ($c^2 = 4.9$, $p = 0.023$) with a male/female ratio of 1:1.54.

The distribution of MIH, shown in Table 2, for affected teeth by gender and tooth by tooth, with c^2 test, p values and for different ratios are demonstrated. The total number of teeth with MIH was 215 (137 maxillary and 78 mandibular); 86 (40%) in boys and 129 (60%) in girls ($c^2 = 5.8$, $p = 0.014$) with a ratio boys/girls of 1:1.5. The data for the 137 maxillary teeth recorded 56 were in boys (40.9%) and

Tablica 1. Distribucija ispitanika; prevalencija MIH-a bila je veća među djevojčicama negoli među dječacima ($p = 0,023$)
Table 1 Distribution of study participants. The prevalence of MIH was higher in girls than in boys ($p = 0.023$)

	Ukupno • Total (%)	Isključeno • Excluded (%)	Konačno • Final simple (%)	MIH (%)	Prevalencija MIH-a • MIH prevalence		χ^2	p
					Ukupno • Total (%)	Po spolu • By gender (%)		
Dječaci • Boys (B)	372 (48.2)	28 (7.52)	344 (48.8)	22 (39.3)	22 (3.12)	22 (6.39)		
Djevojčice • Girls (G)	400 (51.8)	39 (9.75)	361 (51.2)	34 (60.7)	34 (4.82)	34 (9.41)	4.9	0.023
Ukupno • Total	772 (100)	67 (8.67)	705 (100)	56 (100)	56 (7.94)			
Omjer dječaka/djevojčica • Ratio B/G				1:1.54				

Tablica 2. Distribucija zuba zahvaćenih MIH-om prema spolu, po čeljusti i zub po zub, hi kvadrat test, p vrijednosti i različiti omjeri u španjolskoj populaciji; prevalencija MIH-a bila je veća u slučaju gornjih zuba negoli donjih ($p = 0,014$)
Table 2 Distribution of MIH affected teeth by gender group and tooth by tooth, chi square test, p values and different ratios found in a Spanish population. The prevalence of MIH was higher in maxillary compared to mandibular teeth ($p = 0.014$)

	Zub – maksila • Tooth – Maxilla n (%)						Gornji • Upper n (%)	Ukupno zubi • Total teeth	Omjer • Ratio
	#16	#12	#11	#21	#22	#26	Total		
Dječaci • Boys (B)	14 (25.0)	3 (5.35)	9 (16.1)	11 (19.6)	3 (5.35)	16 (28.6)	56 (40.9)		
Djevojčice • Girls (G)	22 (27.2)	6 (7.40)	16 (19.7)	13 (16.0)	5 (6.17)	19 (23.4)	81 (59.1)		
Ukupno • Total	36 (26.3)	9 (6.56)	25 (18.2)	24 (17.5)	8 (5.83)	35 (25.5)	137 (63.7)		
χ^2 (p)							5.8 (0.014)		
Omjer dječaka/djevojčica • Ratio B/G							1/1.44		
	Zub – mandibula • Tooth – Mandible n (%)						Donji • Lower n (%)	Ukupno zubi • Total teeth	Omjer • Ratio
	#36	#32	#31	#41	#42	#46	Total		
Dječaci • Boys (B)	9 (30.0)	1 (3.33)	2 (6.66)	3 (10.0)	5 (16.7)	10 (33.3)	30 (38.5)	86 (40%)	1.86/1
Djevojčice • Girls (G)	14 (29.2)	6 (12.5)	2 (4.16)	5 (10.4)	4 (8.3)	17 (35.4)	48 (61.5)	129 (60%)	1.68/1
Ukupno • Total	23 (29.5)	7 (8.97)	4 (5.12)	8 (10.2)	9 (11.5)	27 (34.6)	78 (36.3)	215 (100%)	
χ^2 (p)									
Omjer dječaka/djevojčica • Ratio B/G							1/1.6	1/1.5	

vojčica – omjer dječaka/djevojčica bio je 1 : 1,44. Od 78 zahvaćenih donjih zuba, 30 (38,5 %) je bilo kod dječaka i 48 (61,5 %) kod djevojčica, s omjerom između dječaka/djevojčica 1 : 1,6. Omjer gornje i donje čeljusti iznosio je 1,86 : 1 kod dječaka i 1,68 : 1 kod djevojčica.

Najčešće pogođeni prvi trajni kutnjak – u slučaju 28,6 posto dječaka bio je zub 26, te zub 16 kod 27,2 posto djevojčica. Kad je riječ o sjekutićima, 19,7 posto otpadalo je na zub 21 kod dječaka, a odgovarajući nalaz za djevojčice bio je 19,7 posto za zub 11. U donjoj čeljusti najčešće zahvaćeni kutnjak bio je zub 46 – 35,4 posto kod djevojčica i 33,3 posto kod dječaka. Uzimajući u obzir podatak o donjim bočnim sjekutićima, zabilježeno je da je prevalencija kod djevojčica za zub 32 bila 12,5 posto, a kod dječaka 16,7 posto za zub 42.

U tablici 3. je distribucija prvih trajnih kutnjaka i trajnih sjekutića s MIH-om prema spolu. Uočeno je da je kod djevojčica učestalost bila veća u svim skupinama, iako su u skupini sa sva četiri prva trajna kutnjaka zahvaćena MIH-om razlike bile manje. Treba istaknuti da je 7,14 posto djece imalo neki oblik defekta na trajnim sjekutićima.

81 (59.1%) in girls with a boy/girl ratio of 1:1.44. The results for the 78 affected mandibular teeth were 30 (38.5%) in boys and 48 (61.5%) in girls with a boy/girl lower jaw ratio of 1:1.6. The maxilla to mandibular ratio was 1.86:1 in boys and 1.68:1 in girls.

The FPM most affected was found in the maxilla with 28.6% of tooth #26 in boys and the 27.2% of tooth #16 in girls. Concerning the incisors 19.7% of tooth #21 was in boys while the corresponding finding for girls was 19.7% of tooth #11. In the mandible, the most affected molars were 35.4% of tooth #46 in girls and 33.3% in boys. When the data for mandibular lateral incisors was considered it was noted that the prevalence was 12.5% in girls for tooth #32 while the prevalence in boys was 16.7% for tooth #42.

Table 3 shows the distribution of FPM and PI affected with MIH by gender group. It was noted that girls showed a higher prevalence in all the groups, even though in the group with all four FPM affected the differences are lower. It should be emphasized that 7.14% of children did show any defect in their permanent incisors.

Tablica 3. Distribucija prvih trajnih kutnjaka i trajnih sjekutića zahvaćenih MIH-om prema spolu
Table 3 Distribution of affected MIH first permanent molars and permanent incisors by gender group.

	KUTNJACI • MOLARS					SJEKUTIĆI • INCISORS		
	1PTK • 1FPM (%)	2PTK • 2FPM (%)	3PTK • 3FPM (%)	4PTK • 4FPM (%)	Svi PTK • All FPM (%)	1 to 4 (%)		Br TS • No PI (%)
						Maksila • Maxilla	Mandibula • Mandible	
Dječaci • Boys	5 (38.5)	8 (40)	4 (33.3)	5 (45.5)	22 (39.3)	16 (28.6)	7 (12.5)	
Djevojčice • Girls	8 (61.5)	12 (60)	8 (66.7)	6 (54.5)	34 (60.7)	21 (37.5)	8 (14.3)	
Ukupno • Total	13 (23.2)	20 (35.7)	12 (21.4)	11 (19.6)	56 (100)	52 (92.8)	4 (7.14)	

(PTK = prvi trajni kutnjak, TS = trajni sjekutić)

Rasprava

Istraživanja MIH-a provode se u mnogim zemljama diljem svijeta. Zabilježena je velika razlika u prevalenciji tog poremećaja (11) – kreće se od 2,8 posto (17) do čak 40,2 posto (18). Ti podatci pokazuju varijabilnost različitih dijagnostičkih kriterija te iskustvo, uvježbanost i kalibraciju istraživača. Varijacije u veličini uzorka, dobi i dokumentaciji mogu rezultirati pogreškama u procjeni prevalencije MIH-a.

Te varijacije u prevalenciji mogu se pripisati metodološkim razlikama kao što je uzorkovanje, jer se u istraživanja ne uključuju uvijek djeca jednake dobi, a ne odabiru se ni jedinstvene metode kliničkih pregleda i sustava bilježenja. Predložene su različite metode poput Kochove iz 1987. (19), Alaluusuaove iz 1996. (20), modificiranog indeksa razvojnih defekata cakline (mDDE) iz 2001. (1) ili EAPD-ovi kriteriji za procjenu MIH-a iz 2003. godine (5).

Jednostavnost kriterija EAPD-a pomogla je u osiguravanju ponovljivosti kliničkih pregleda radi otkrivanja oštećenja cakline. Epidemiološka istraživanja prije prihvaćanja EAPD-ovih kriterija 2003. godine vjerojatno nisu otkrila pravu prevalenciju MIH-a zbog neujednačenih kriterija kojima su se koristili istraživači na početku istraživanja tog poremećaja. Na kongresu EAPD-a održanom 2003. u Ateni potvrđeno je da se pregled mora obaviti na vlažnim zubima i to se od tada poštuje u većini istraživanja MIH-a. Veća prevalencija toga poremećaja zabilježena je u istraživanjima u kojima su se pregledavali suhi zubi u odnosu na vlažne (5, 11). Slijedeći primjer gore spomenutih autora, smatrali smo da zub nije niknuo ako je vidljivi dio krune bio manji od trećine (5, 21).

Prevalencija MIH-a korištenjem kriterija EAPD-a iz 2003. godine u ovom je radu bila slična drugim istraživanjima provedenima na djeci u različitim zemljopisnim područjima. Ustanovili smo prevalenciju od 7,94 posto u španjolskoj populaciji, što je bilo unutar raspona ostalih dječjih populacija (11, 21 – 38). Prevalencija MIH-a u ovom istraživanju u Barceloni bila je najniža jer su ostali španjolski autori zabilježili prevalencije od 21,8 posto u uzorku osmogodišnjaka i 17,8 posto primjenom transiluminacije (25, 32).

Distribucija djece prema dobi u ovom istraživanju bila je u rasponu od 6 godina i 6 mjeseci do 14 godina 11 mjeseci, iako smjernice EAPD-a navode da je najprikladnija dob za obavljanje pregleda 8 godina. Ovaj dobni raspon odabran je za ovo istraživanje poprečnog presjeka zbog veličine potrebnog uzorka.

Pronađene su značajne razlike prema spolu ($p = 0,023$) jer su lezije MIH-a bile češće kod djevojčica (60,7 %) negoli kod dječaka. U ovom istraživanju MIH je bio 1,54 puta češći kod djevojčica, što je uobičajeno u mnogim istraživanjima o njegovoj prevalenciji, a također je zabilježena veća učestalost u gornjoj čeljusti, što se podudara s nalazima drugih ranijih istraživanja (11). Tablica 2. prikazuje postotak zahvaćenih gornjih i donjih zuba kod dječaka i djevojčica. Omjer gornje i donje čeljusti kod dječaka (1,86 : 1) bio je nešto veći negoli kod djevojčica (1,68 : 1). No ovi se rezultati razlikuju od onih ostalih autora koji su utvrdili veću učestalost kod dječaka. Oyedele i suradnici (21) izvijestili su o prevalenciji od 6,8

Discussion

MIH studies have become generalised and investigations are being conducted in many countries around the world. A wide disparity in the prevalence rate of MIH has been reported (11) ranging from as low as 2.8% (17) to as high as 40.2% (18). These data reflect the variability of the different diagnostic criteria as well as the experience, training and calibration of the examiners. Variations in sample size, age and dental records may result in errors in the estimation of MIH prevalence.

These variations in prevalence can be attributed to methodological differences such as sampling, because the studies do not always consider children of the same age, and uniform methods of clinical examination and recording systems have not been used. Various methods such as those established by Koch in 1987 (19), Alaluusua in 1996 (20), the *Modified Developmental Defects of Enamel Index* (mDDE) (1) in 2001 or the EAPD, (5) criteria for evaluation of MIH in 2003 have been proposed.

The simplicity of EAPD criteria has aided in the reproducibility of clinical examinations for the recording of enamel defects. Epidemiological studies before the establishment of the EAPD criteria in 2003 probably did not reveal the true prevalence of MIH due to the disparity of criteria used at the very beginning of the period of MIH investigations. At the EAPD congress held in Athens in 2003, it was confirmed that dental examinations should be performed on wet teeth and this has been the case in most of the MIH studies since. There is a higher MIH prevalence recorded in studies with teeth examined dry teeth than wet (5,11). Following the example of previous authors, we considered teeth as 'not erupted' if any visible part of the enamel crown was less than a third (5,21).

The prevalence of MIH using EAPD 2003 criteria herein was found to be similar to other studies evaluating children in different geographic locations. A prevalence of 7.94% was found in this Spanish population sample, which was within the range of those found in other child populations (11,21-38). The MIH prevalence found in this study in Barcelona was the lowest reported as other Spanish authors have recorded prevalences of 21.8% in a sample of eight-year-old children and 17.8% using transillumination (25,32).

The age distribution of children in this study ranged from 6 years 6 months to 14 years 11 months, although the EAPD guidelines state that the most convenient age for carrying out an examination is at age 8. This age range was chosen for the present cross-sectional study due to the sample size identified as necessary.

Significant gender differences were found ($p = 0.023$) as MIH lesions were seen more often in girls (60.7%) than boys. In the present study, MIH was 1.54 times greater than in boys, a finding that is common in many MIH prevalence studies and also the higher prevalence in the maxilla coincided with the findings of other previous studies (11). Table 2 shows the percentage of affected maxillary and mandibular teeth for boys and girls. The maxilla to mandible ratio in boys (1.86:1) was slightly higher than in girls (1.68:1). However these results differ from other authors who have found a higher prevalence in boys. Oyedele et al. (21) reported a prev-

postu kod djevojčica i 10,9 posto kod dječaka u nigerijskom uzorku, iako razlika nije bila statistički značajna. Allazzam i njegovi kolege (23) također su pokazali da postoji veća učestalost kod dječaka (9,7 %) negoli kod djevojčica (7,5 %) među stanovništvom Saudijske Arabije.

Oba prva gornja kutnjaka (zubi 16 i 26) bili su zahvaćeni MIH-om u 53,6 posto slučajeva kod dječaka i 50,6 posto kod djevojčica, a donji kutnjaci (zubi 36 i 46) u 63,3 posto kod dječaka i 64,6 posto kod djevojčica. Ovaj nalaz u skladu je s rezultatima većine dosadašnjih istraživača (3, 12, 22, 28), ali se ne slaže s opažanjima istraživanja na nizozemskoj (4), australskoj (15) i kineskoj (17) populaciji koja su imala sličnu distribuciju hipomineralizacije kutnjaka u objema čeljustima.

U ovom radu distribucija zahvaćenih zuba podudara se s izvješćima drugih autora (17, 24, 25, 33, 34) koji su zabilježili da su prvi trajni kutnjaci bili najčešće zahvaćeni zubi, često u kombinaciji s gornjim sjekutićima. No ta otkrića nisu se slagala s rezultatima ovog istraživanja prema kojima su donji sjekutići rijetko zahvaćeni. Pronađena je prevalencija od 36,6 posto na donjim trajnim sjekutićima kod dječaka i 35,4 posto kod djevojčica. Uočen je veći broj zahvaćenih gornjih nego donjih sjekutića, što je u skladu s većinom istraživanja na različitim populacijama (3, 12, 17, 22, 34).

Tablica 2. prikazuje najčešće zahvaćene prve trajne kutnjake i trajne sjekutiće u gornjoj i donjoj čeljusti. Naši rezultati u skladu su s istraživanjima različitih autora (17, 22, 35) koji tvrde da su najčešće zahvaćeni zubi prvi trajni kutnjaci, a među njima zub 46. Kad je riječ o sjekutićima, najčešće su bili pogođeni zubi 11 i 21. U istraživanju Martíneza i suradnika (32) zub 16 bio je najčešće pogođen.

Na lijevoj strani čeljusti ustanovili smo da je postotak pogođenih zuba bio veći kod dječaka, s iznimkom gornjih i donjih lijevih bočnih sjekutića. Na desnoj strani djevojčice su imale veću prevalenciju od dječaka, osim za zub 42 za koji je postojala veća učestalost kod dječaka (16,7 %) negoli djevojčica (8,3 %).

U našoj populaciji 23,2 posto imalo je jedan zahvaćen kutnjak, što je u skladu s drugim autorima (22, 23, 27) koji su prijavili prevalenciju od 23, 21,7 i 21,4 posto. No naši nalazi razlikovali su se od onih Jinga i suradnika (34) koji su naveli 46,7 posto, iako je njihov uzorak bio sastavljen od triju različitih populacija (kineske, malajske i indijske).

U nekim istraživanjima nisu se odvajali podaci za dječake i djevojčice, što je rezultiralo većim razlikama u rezultatima. Različita istraživanja pokazala su veće nejednakosti u prevalenciji, primjerice 53,7 posto kod iranske školske djece (31), 41,1 posto kod španjolske djece (32), 23 posto u dječjoj populaciji iz Indije (22) i 5,8 posto u grupi talijanske školske djece (33).

U našem su uzorku 52 djeteta od njih 56 pregledanih (92,8 %) imala lezije na jednom do osam trajnih sjekutića. Samo 7,1 posto imalo je oštećenja na trajnim kutnjacima, a sjekutići nisu bili zahvaćeni. Ghanim i suradnici (31) naveli su da 81,5 posto djece ima blage defekte na sjekutićima, a Wogelius i njegovi kolege (37) izvijestili su da su trajni sjekutići bili 2,5 puta češće pogođeni među djecom s jednim ili više pogođenih prvih trajnih kutnjaka. Balmer i suradnici (38) proveli su istraživanje na 3233 dječaka i djevojčica u Sjever-

alence of 6.8% in girls and 10.9% in boys in a Nigerian sample although the difference was not statistically significant. Allazzam et al. (23) also found a higher prevalence in boys (9.7%) than in girls (7.5%) in a Saudi Arabian population.

Both maxillary molars (#16 and #26) presented MIH in 53.6% in boys and the 50.6% in girls, while the mandibular data (#36 and #46) recorded 63.3% in boys and 64.6% in girls. This finding is in agreement with the observations of most previous researchers (3,12,22,28) but disagrees with the observations of studies on Dutch (4), Australian (15) and Chinese (17) populations that found a similar distribution of molar hypomineralisation in both arches.

In the present study the distribution of the affected teeth coincided with the reports of other authors (17,24,25,33,34) who found that FPM were the most affected teeth with a frequent association with maxillary incisors. However, the previous findings did not agree with the observations of the study herein, which reported that mandibular incisors are rarely involved. A prevalence of 36.6% of affected mandibular permanent incisors in boys and 35.4% in girl was found. A higher number of maxillary incisors than mandibular was observed, a finding which is in accordance with those of most studies on different populations (3,12,17,22,34).

Table 2 shows the most commonly affected FPM and PI in the maxilla and the mandible. Our findings are consistent with the studies of different authors (17,22,35) who claimed that the most frequently affected teeth are the FPM, and #46 being more frequently affected. Regarding incisors, the most affected were #11 and #21, but those findings disagree with those reported by Martínez et al. (32) who found the #16 as the FPM to be the most commonly affected in their sample.

On the left side of the jaws, we found that the percentage of affected teeth was higher in boys with the exception of maxillary and mandibular left lateral incisors. On the right side, girls had a higher prevalence than boys except for the #42, which showed a higher prevalence in boys (16.7%) than girls (8.3%).

A 23.2% of our population had one molar affected, which is in agreement with other authors (22,23,27) who reported a prevalence of 23%, 21.7% and 21.4% respectively. However our findings were in disagreement with Jing et al. (34) who reported a prevalence of 46.7%, although their sample was made up of three distinct races (Chinese, Malaysian and Indian).

Some studies have not separated data for boys from that for girls, and by doing so higher differences in the results may have resulted. Different studies have found greater disparities in prevalence's, for example 53.7% in Iranian school children (31), 41.1% in Spanish children (32), 23% in a child population from India (22) and 5.8% in a group of Italian school children (33).

In our sample, 52 out of 56 children (92.8%) examined also had lesions in one to eight PI. Only 7.1% of them had lesions in permanent molars without the incisors involved. Ghanim et al. (31) reported 81.5% of mild defects in incisors while Wogelius et al. (37) stated that permanent incisors were 2.5 times more frequently affected among children with one or more affected FPM. Balmer et al. (38) examined 3,233

noj Irskoj i pronašli snažnu pozitivnu korelaciju ($p = 0,037$) između prevalencije MIH-a i hipomineralizacije sjekutića.

Mnogi autori (4, 12, 17, 32) pripremili su svoje kalibracijske vježbe koristeći se kliničkim fotografijama, iako je u dosadašnjim radovima malo informacija o načinu kako je to obavljeno. U novijim istraživanjima (27, 29, 38) korišten je modificirani indeks razvojnih defekata cakline (mDDE) kojim se ocjenjuju zubne površine određenih zuba (prvi trajni kutnjak i trajni sjekutić), ovisno o prisutnosti demarkacijskih, difuznih ili hipoplastičnih defekata ili kombinacije navedenoga. Za kolekciju kliničkih slika s posebnim naglaskom na hipoplaziju, genetske defekte, fluorozne i mutne mrlje od bijele do smeđo-žučkaste korištene su kalibracije istraživača u ovom istraživanju, čime je postignuta veća dijagnostička usklađenost (Kappa faktor 0,97).

Zaključak

Ovo istraživanje otkrilo je prevalenciju MIH-a od 6,39 posto kod dječaka i 9,41 posto kod djevojčica. Stopa među djevojčicama bila je 1,54 puta veća negoli među dječacima, što je zajednički nalaz u većini istraživanja o prevalenciji MIH-a na temelju korištenja EAPD-ovih kriterija. U ovom je istraživanju učestalost toga defekta bila veća na gornjim zubima, a omjer gornje/donje čeljusti kod dječaka (1,86 : 1) bio je veći negoli kod djevojčica (1,68 : 1). Buduća istraživanja o prevalenciji MIH-a trebala bi uzeti u obzir preporuke EAPD-a iz 2003. i klasifikaciju MIH-a u svrhu donošenja jedinstvenog protokola koji bi olakšao usporedbu između različitih istraživanja.

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children in Northern Ireland and found a strong positive correlation ($p=0.037$) between the prevalence of MIH and incisor hypomineralisation.

Many authors (4,12,17,32) have performed calibration exercises using clinical photographs although there is little information in previous papers concerning the way it was performed. In more recent studies (27,29,38), the index chosen was the modified Developmental Defects of Enamel (mDDE) which scored tooth surfaces of index teeth (FPM and PI) for the presence of demarcated, diffuse, or hypoplastic defects or combinations of them. A collection of clinical pictures, with special emphasis on hypoplasia, genetic defects, fluorosis stains and opacities from white to brown-yellowish was used to calibrate the examiner in this study, who achieved a higher diagnostic agreement (0.97 Kappa factor).

Conclusions

This study found a MIH prevalence of 6.39% in boys and 9.41% in girls. The rate among girls was 1.54 times greater than in boys, a common finding in most MIH prevalence studies using the EAPD criteria. In the present study, there was a higher prevalence of MIH in maxillary teeth and the maxilla/mandible ratio in boys (1.86:1) was larger than in girls (1.68:1). Future studies on the prevalence of MIH should take into consideration the 2003 recommendations of the EAPD and the severity classification of MIH in order to adopt a uniform protocol, which would facilitate the comparison between different studies.

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Conflict of interest

The authors have no conflict of interest to declare.

Abstract

Background: Molar-incisor-hypomineralisation (MIH) is a disturbance in dental development that commonly involves first permanent molars but permanent incisors may also be compromised. The prevalence of MIH in the literature varies between 2.5% and 40% of the world child population. Little information is gained on the prevalence of MIH among children in Spain. **Aim:** The aim of this study was to investigate the prevalence of MIH among school children from Barcelona, Spain. **Material and methods:** A cross-sectional study which included 705 children, aged 6-14 years and 11 months was carried out. Full mouth examinations were performed using the European Academy of Paediatric Dentistry (EAPD) criteria for the diagnosis of MIH. **Results:** A total of 56 cases of MIH were found, 22 (39.3%) boys and 34 (60.7%) girls. The prevalence was 7.94% (6.39% for boys and 9.41% for girls). MIH lesions were seen more often in girls than boys ($\chi^2 = 4.9, p = 0.023$) the male/female ratio being 1:1.54. Upper teeth were more prevalent than lower teeth in both genders with an upper/lower ratio of 1.86/1 for boys and 1.68/1 for girls. **Conclusion:** Considered either by gender or by teeth, upper teeth and girls were ahead in our sample.

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Key words

Tooth Demineralization; Dental Enamel Hypoplasia; Odontodysplasia; Amelogenesis Imperfecta; Incisor; Molar

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