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ORIGINAL SCIENTIFIC ARTICLE

Prevalence of molar incisor hypomineralisation in a group of Egyptian children using the short form: a cross-sectional study

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Abstract

Aim To estimate the prevalence of molar incisor hypomineralisation (MIH) in a group of Egyptian children aged from 8 to 12 years, seeking dental care in the Departments of Paediatric Dentistry, Faculty of Oral and Dental Medicine, Cairo and Future Universities in Egypt from December 2014 till November 2015 (1 year).

Methods After dental screening, the MIH short charting form by Ghanim et al. (Eur Arch Paediatr Dent 16:235–46, 2015) was used which is the most recent attempt to standardise epidemiological data collection for MIH. It included 16 index teeth to be evaluated for their eruption status, clinical status and lesion extension of MIH. This was done to allow extraction of more information by expanding findings into sub-categories, which could give suggestive information about patterns of the MIH defects. Statistical analysis was performed using IBM® SPSS® and data was presented as frequency and percentages.

Results 1001 children were included in the study (49.85%) males (50.14%) females. Prevalence rate calculated in the studied group was (2.3%); males (39.1%) and females (60.9%). The most prevalent clinical defect of MIH was the demarcated opacity.

Conclusion Prevalence of MIH in a convenience sample of Egyptian children aged 8–12 years old was (2.3%), Molars were the most prevalent teeth affected, and further studies are recommended to better understand the aetiology of the disease.

Keywords Molar incisor hypomineralisation · Enamel defect · Prevalence · Short form

Introduction

Molar incisor hypomineralisation (MIH) refers to hypomineralisation of systemic origin, which affects first permanent molars and is frequently associated with permanent incisors (Weerheijm et al. 2003). The condition is simply related to the disruption of ameloblastic action during the transitional and maturational stages of amelogenesis (Fearne et al. 2004). These disruptions may be the result of some systematic conditions during the child's first years of life which coincides with the periods of crowns' mineralisation.

Based on histological and radiographic studies, the first permanent molar (FPM) develops starting from the fourth month of gestation while the first sign of mineralisation appears in the cusp tips soon after birth. At 6 months cusps become united while by the end of first-year enamel matrix is complete in the occlusal half and maturation is taking place (Reid and Dean 2006).

A typical feature of these hypomineralised molars and incisors is the asymmetrical appearance, that is, the enamel of one molar can be severely affected while the enamel of the contra-lateral molar is clinically unaffected or has only minor subsurface defects. The asymmetry is typical also in the incisors, but here the defects do not usually involve a loss of enamel substance (Weerheijm et al. 2003).

The prevalence of MIH worldwide was reported from 2.4 to 40.2% this difference in the rates is due to the lack of both a consistent classification index and a standardised methodology of assessment for MIH. Most of the prevalence studies of MIH have been carried out in European countries. Knowledge about the magnitude of MIH seems

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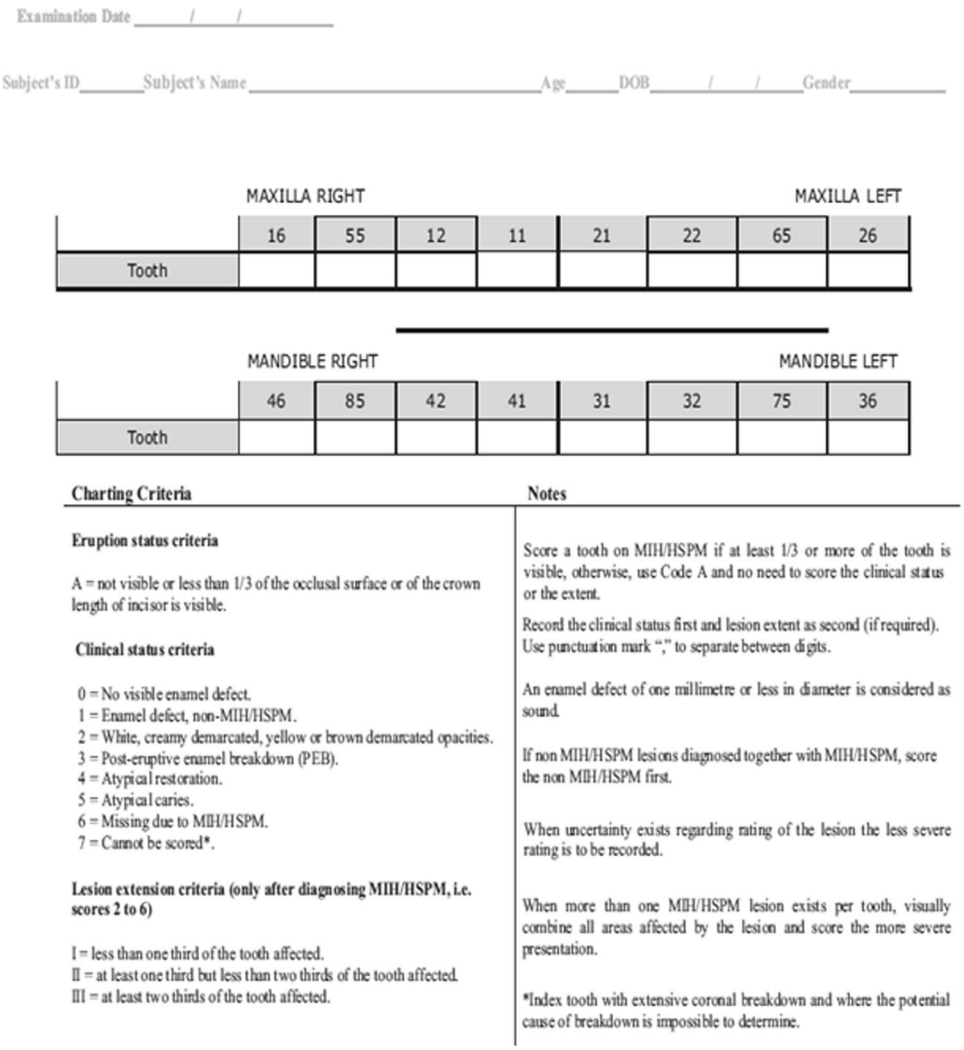
desirable, as it is vulnerable to consequences like rapid caries development, early enamel loss, soft structure and sensitivity.

Developmental defects of enamel can be qualitative or quantitative in nature and can present a range of clinical appearances. Hypomineralisation of enamel presents clinically as opacities, and hypoplastic defects present as deficiencies of enamel quantity. However, scoring of MIH clinical status had always been a challenge as accurately recording such defects is important for diagnostic, clinical as well as for aetiological studies. The Federation Dentaire Internationale modified index of Developmental Defects of Enamel index (FDI mDDE) had been a useful tool in a number of studies (Jälevik et al. 2001; Weerheijm et al. 2001; Zagdwon et al. 2002; Dietrich et al. 2003; Balmer et al. 2005; Calderara et al. 2005; Fleita et al. 2006; Arrow 2008), but has been found, by some researchers and clinicians, to be time consuming to use. In addition to this the mDDE index lacks the score for the post-eruption breakdown (PEB) which is an important feature of the MIH clinical status.

In 2003 the European Academy of Paediatric Dentistry (EAPD) published the diagnostic criteria for the clinical status of MIH which was the approach of choice for many prevalence studies since then (Muratbegovic et al. 2007; Cho et al. 2008; Jasulaityte et al. 2008; Kukleva et al. 2008; Kuscu et al. 2008, 2009; Lygidakis et al. 2008; Wogelius et al. 2008; Soviero et al. 2009).

As an attempt to standardise the epidemiological data collection globally regarding MIH a charting method was published by Ghanim et al. (2015). The proposed charting method integrates the elements of the EAPD criteria and the modified index of developmental defects of enamel (mDDE index) for grading the clinical status of MIH and its extent on the involved tooth surface as well as other enamel defects. In order to take into account the varied needs and objectives of studies, two forms of the chart are proposed, a short form (Fig. 1) for simple screening surveys and a longer form for more detailed, community- based or clinic-based studies. In both forms, EAPD criteria emerged as the key elements reflecting the theme of charting. The short data set form is



Examination Date ____/____/____

Subject's ID_____ Subject's Name _____ Age_____ DOB____/____/____ Gender_____

	MAXILLA RIGHT						MAXILLA LEFT	
	16	55	12	11	21	22	65	26
Tooth								

	MANDIBLE RIGHT						MANDIBLE LEFT	
	46	85	42	41	31	32	75	36
Tooth								

Charting Criteria

Eruption status criteria

A = not visible or less than 1/3 of the occlusal surface or of the crown length of incisor is visible.

Clinical status criteria

0 = No visible enamel defect.
1 = Enamel defect, non-MIH/HSPM.
2 = White, creamy demarcated, yellow or brown demarcated opacities.
3 = Post-eruptive enamel breakdown (PEB).
4 = Atypical restoration.
5 = Atypical caries.
6 = Missing due to MIH/HSPM.
7 = Cannot be scored*.

Lesion extension criteria (only after diagnosing MIH/HSPM, i.e. scores 2 to 6)

I = less than one third of the tooth affected.
II = at least one third but less than two thirds of the tooth affected.
III = at least two thirds of the tooth affected.

Notes

Score a tooth on MIH/HSPM if at least 1/3 or more of the tooth is visible, otherwise, use Code A and no need to score the clinical status or the extent.

Record the clinical status first and lesion extent as second (if required). Use punctuation mark "," to separate between digits.

An enamel defect of one millimetre or less in diameter is considered as sound.

If non MIH/HSPM lesions diagnosed together with MIH/HSPM, score the non MIH/HSPM first.

When uncertainty exists regarding rating of the lesion the less severe rating is to be recorded.

When more than one MIH/HSPM lesion exists per tooth, visually combine all areas affected by the lesion and score the more severe presentation.

*Index tooth with extensive coronal breakdown and where the potential cause of breakdown is impossible to determine.

Fig. 1 MIH short charting form (Ghanim et al. 2015)

designed to grade only index teeth which have been mentioned in the definition of MIH and hypomineralised second primary molars (HSPM), namely first permanent molars, permanent incisors, and second primary molars. The use of the proposed scoring method enables the total spectra of MIH to be determined. This is considered an advantage over the use of the current EAPD guidelines and mDDE index individually (Ghanim et al. 2015).

In the Middle East a prevalence study was performed in Jordan. A cross-sectional national study with a representative sample was used. A multistage random sampling system of 7 to 9-year-old school children. The total number of children in the sample was 3241, molar hypomineralisation (MH) was diagnosed clinically based on the diagnostic criteria established by Weerheijm 2003. Clinical examinations were done by calibrated investigators at school. By the end of the study, 570 children with MIH were identified, indicating an overall prevalence of 17.6% in Jordan (Zawaideh et al. 2011).

One of the studies took place in Iran where the study population comprised 433 children 7 to 9-year-olds, from four schools in Zahedan. 55 (12.7%) children showed MIH. The overall mean number of affected teeth was 0.2. The mean value of DMFT in MIH children was greater than in normal children. Demarcated opacities were the most frequent (76%) enamel defect. Mothers and children medical problems during prenatal, perinatal and postnatal period were significantly remarkable in MIH children (Ahmadi et al. 2012).

Another example of prevalence studies held in the Middle East region was in Saudi Arabia where a total of 267 children (134 males and 133 females) were included in the study. The mean age of the recruited children was 9.4 ± 1.379 years. A total of 23 children were diagnosed with MIH representing an overall prevalence of 8.6%. The condition was found more among males (9.7%) than females (7.5%) and more among Saudis (9.3%) than non-Saudis (7.8%) (Allazzam et al. 2014).

In 2012 a study was conducted in Egypt aiming to determine the prevalence of enamel hypoplasia and hypomineralisation all collectively in permanent dentition. The study included 1000 children of both genders 6–14 years old attending the paediatric dentistry department faculty of oral and dental medicine at Cairo University. The grades of enamel hypoplasia were detected by hypocalcification/hypoplasia index. Out of the 1000 children, 38.9% had enamel hypoplasia and/or hypocalcification (Said and Ezz El-Din 2012).

The data available regarding MIH from studies performed in the Middle East is deficient relative to data from those performed in Western Europe. During the workshop on MIH that was held in association with the 12th EAPD Congress in Sopot, Poland, 2014 a call was made encouraging the formulation of studies in the areas of the Middle East due to lack of data. Since data collection helps in understanding the nature of the disease, managing the clinical condition properly and raising targeted awareness; therefore, conducting such a study in Egypt is of prime importance. This study aimed to estimate the prevalence of molar incisor hypomineralisation (MIH) in a group of Egyptian children aged from 8 to 12 years, using the short charting form of (EAPD).

Subjects and methods

Ethical approval

The methodology of this study was primarily revised and approved by the ethical committee of Faculty of Oral and Dental Medicine, Cairo University.

Consent

Prior to clinical examination, the study was explained to the mother and informed consent was obtained. Referred patients were called and the study was explained by telephone. Only those who showed up for the examination appointments during the 1 year duration period of the study were considered part of the sample.

Setting and location

Clinics at Paediatric Departments at the educational dental hospital of Faculty of Oral and Dental Medicine Cairo university and those of Future University in Egypt.

Operator

The single evaluator was a Master Degree student in Department Pediatric of Dentistry and Dental Public Health, Cairo University and a teaching assistant at Department Pediatric of Dentistry and Dental Public Health, Future University in Egypt.

Calibration

Theoretical training for MIH was performed. Intra-examiner calibration took place using 30 photographs of 18 patients with MIH and 12 cases with other enamel defects were used to calibrate the examiner (Ahmadi et al. 2012) before the beginning of the study and after 6 months. The selection of photographs and supervision of the theoretical training and calibration was performed with the help of a clinical pathologist from the Department of Oral Pathology, Future University in Egypt.

During the first 6 months, sampling took place at the outpatient clinic of Future University in Egypt. Three other paediatric dentists at the Department Paediatric of Dentistry and Dental Public Health, Future University in Egypt went through the theoretical training mentioned above. They were asked to refer any suspected or preliminary diagnosed case of MIH. The final examination and scoring were done by the single examiner.

During the last 6 months sampling took place at the outpatient clinic of Cairo University, Department Paediatric of Dentistry and Dental Public Health, Due to the increased number of residents performing diagnosis and referral, theoretical training was not applicable and accordingly they were asked to refer any case with visible enamel defects to be evaluated by the calibrated examiner.

Population

Sampling was done per unit of time (convenience sample) from 1st of December 2014 till 30th of November 2015 (1 year) in the same pattern as (Biondi et al. 2011). During the first 6 months (1st December 2014–31st of May 2015) 400 patients were examined ranging in age from 8 to 12 years who were seeking dental care at educational dental hospital of Faculty of Oral and Dental Medicine, Future University in Egypt. Then from (1st June 2015–30th of November 2015) another 650 patients were examined ranging in age from 8 to 12 years who were seeking dental care at educational hospital of Faculty of Oral and Dental Medicine, Cairo University.

Eligibility criteria

Inclusion criteria

Patient aged from 8 to 12 years; patient seeking dental care in educational dental hospitals; Positive patient's acceptance for participation in the study; Eruption of at least 2 mandibular permanent first molars.

Exclusion criteria

Presence of orthodontic appliance; Patient with any other type of enamel defect.

Clinical examination

The clinical visual examination took place on the dental unit, using natural light, teeth were cleaned gently using gauze and were wet with saliva when examined. A disposable diagnostic set was used for each patient where mirrors were used for proper visualisation, especially for maxillary teeth. Explorers were used to aid tactile sensation when needed, like during the differentiation between rough and smooth enamel edges and/or during the inspection of caries extent when present. They were used with very light force.

The clinical examination took place in the following sequence.

Screening

Examined patients were primarily screened based on the exclusion criteria determined before the study began. They were considered enrolled if their age was between 8 and 12 years, they had no space maintainers or any other orthodontic appliances and there was from no other visible enamel defect such as AI and hypoplasia that was not associated with demarcated opacity (as hypoplasia can be associated with MIH). This was performed by the calibrated evaluator.

Enrolled patients

They were either both free of MIH and got dismissed yet contributed in being part of the sample, or diagnosed with MIH which was confirmed by the calibrated evaluator only when at least one of the FPM showed the presence of a demarcated opacity more than 1 mm in size.

Only then the purpose of the study was explained to the guardian and informed consent was obtained. When a patient was referred by a resident informed consent was obtained through telephone and only patients who showed up for the clinical examination with MIH were enrolled in the study.

Scoring of MIH

The short charting form is the most recent attempt to standardise epidemiological data collection for MIH. It includes 16 index teeth to be evaluated for their clinical status criteria, lesion extension criteria and eruption status criteria as shown in (Fig. 1) (Ghanim et al. 2015).

Eruption status criteria: (Ghanim et al. 2015)

Visual examination of each index tooth showed that some teeth had less than 1/3 of their clinical crown visible in the oral cavity, according to the short form these index teeth did not have enough visible surface for a numerical score and were scored by the letter (A). If the tooth had 1/3 or more of its clinical crown visible then it was scored according to the clinical status criteria. The evaluator excluded normally shed HSPM from the scoring by using the letter E indicating "exfoliated" when it was confirmed with age and history. The normally shed HSPM were excluded from the results.

Clinical status criteria: (Ghanim et al. 2015)

0 No visible enamel defect: absence of any evidence of visual enamel defects either diffuse/demarcated opacities, hypoplasia or amelogenesis imperfecta.
1 Enamel defect, non-MIH/HSPM: any visual enamel defects that were not included in the clinical features of MIH/HSPM.
2 Demarcated opacities: A defect due to translucency alteration which clinically varied from white/creamy to yellow/brown in colour. The defective enamel was normal in thickness and was marked with defined boundaries from sound enamel.
3 Post-eruptive enamel breakdown (PEB): a defect due to loss of the first formed layer of enamel following tooth eruption that was presented clinically as if there was no enamel. The loss was usually accompanied with a previous demarcated opacity. PEB found on (i.e. cuspal ridges and smooth surfaces) which were considered low caries risk areas with rough and uneven margins.
4 Atypical restorations: unusual restorations not following the well-known pattern of plaque-related caries. Posterior restorations were usually extended to the buccal or palatal smooth surfaces with residual defective enamel near the margins. Anterior restorations were not related to trauma or else it was seen in caries-free mouths.
5 Atypical caries: The extension of the caries lesion did not follow the pattern of caries distribution in the patient's oral cavity.
6 Atypical extraction (Missing due to MIH/HSPM): absence of an FPM or second primary molar (SPM) in a sound dentition and accompanied with either opacities, PEB, atypical restorations or atypical caries one of the FPM or SPM. It was uncommon that permanent incisors (PIs) were extracted due to MIH.
7 Cannot be scored: Index tooth was massively broken down with an unknown cause.

Lesion extent criteria: (Ghanim et al. 2015)

Index tooth was divided into thirds and scored as follows: code I: less than 1/3 of the tooth was affected; code II: at least 1/3 but less than 2/3 of the tooth was affected; code III: at least 2/3 of the tooth is affected. The total area involved was related to the total visible tooth surface area of index tooth.

Other instructions Teeth are named according to the FDI notation. Any enamel defect of one millimetre or less was considered sound. When the examiner was in doubt the tooth/tooth surface was considered defect-free. Similarly, when uncertainty existed regarding lesion severity, the less severe rating was recorded. When in doubt consider the lower score. (Ghanim et al. 2015).

Statistical analysis was performed with IBM® SPSS® (SPSS Inc., IBM Corporation, NY, and the USA) Statistics Version 23 for Windows and MidCalc® Version 12.2.1 (MedCalc Software bvba, Ostend, Belgium).

Results

In this study, the prevalence of MIH of the studied sample was calculated. Also, the prevalence of each featured defect in each indexed tooth and prevalence of the type of tooth affected by MIH were calculated.

Data presented as mean, standard deviation (SD), frequency and percentage when appropriate.

In this study 1001 children aged 8 to 12 years old, 502 females (50.2%) and 499 males (49.8%), 9 were males diagnosed by MIH (39.1%) and 14 were females diagnosed by MIH (60.9%) (Fig. 2) through the distribution of the studied sample between both genders was almost equal.

In the present study, the following was observed regarding the prevalence of MIH in the studied sample of this population, out of 1001 enrolled children aged from 8 to 12 years old 23 children were diagnosed with MIH which represents (2.3%) of the studied sample (Fig. 3).

The eruption, clinical status and lesion extent criteria of examined incisors, FPMs and HSPM are shown in Tables 1, 2 and 3 respectively.

In the present study, the following were observed regarding the data collected from all examined teeth, according to the short charting form the most prevalent score observed in the record of the clinical status were demarcated opacities occupying (49%) almost half the affected teeth (Fig. 4).

The prevalence of affected HSPM was calculated from the whole number of indexed teeth in the short charting form (368 teeth), with 25 primary molars affected occupying only (6.79%).

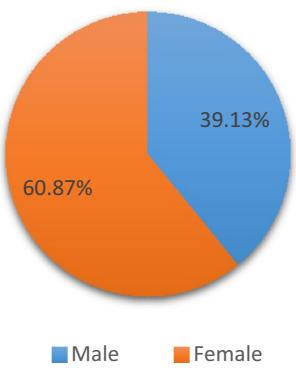


Fig. 2 Pie chart showing the percentage of male and female MIH cases

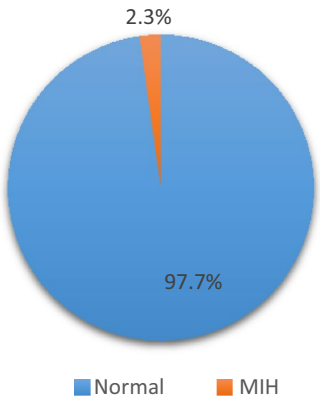


Fig. 3 Pie chart showing the percentage of MIH within the sampled population

According to the lesion extension criteria it was observed that among all affected teeth the most prevalent lesion extension was (I) indicating lesion extension to only less than 1/3 of the crown representing (54%) of all affected teeth (Fig. 5).

Discussion

Molar incisor hypomineralisation is considered an example of life time prevalence where its occurrence has taken place at some time before the examination and till the time of recording the data the defect still exists. Prevalence studies are important for patients and dental practitioners to apply appropriate measures in order to limit the effect of MIH and for policymakers to have a reliable picture of the defect characteristics in a specific population in addition to reaching appropriate diagnosis and prognosis at both the individual and population level.

It should be noted that in contrast to some other studies, that included defects equal or larger than 2 mm (Jälevik et al. 2001), the present study included any visible defect larger than 1 mm and teeth were examined wet as extensively dried enamel may result in overestimated data which is in accordance with (Jälevik 2010). Both the size and wetness were also recommended by (Ghanim et al. 2015) short charting form.

In this study, 23 children were diagnosed with MIH, of which 9 were males (39.1%) and 14 were females (60.9%) which suggests that in the studied population MIH was observed more in females than in males. This is against other studies performed earlier showing no significant difference

Table 1 Frequency (N) and percentage (%) for the distribution within incisor teeth according to short charting form

	Tooth																	
	11		12		21		22		31		32		41		42		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Eruption status criteria																		
A	1	100.0	6	100.0	1	100.0	6	100.0	1	100.0	4	100.0	1	100.0	4	100.0	24	100.0
Total	1	100.0	6	100.0	1	100.0	6	100.0	1	100.0	4	100.0	1	100.0	4	100.0	24	100.0
Clinical status criteria																		
0	3	13.6	11	64.7	6	27.3	12	70.6	7	31.8	6	31.6	6	27.3	8	42.1	59	36.9
1	1	4.5	1	5.9	1	4.5	1	5.9	1	4.5	1	5.3	1	4.5	1	5.3	8	5.0
2	17	77.3	5	29.4	14	63.6	4	23.5	14	63.6	12	63.2	15	68.2	10	52.6	91	56.9
3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	1	4.5	0	0.0	1	4.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1.3
5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	22	100.0	17	100.0	22	100.0	17	100.0	22	100.0	19	100.0	22	100.0	19	100.0	160	100.0
Lesion extension criteria																		
I	12	63.2	4	66.7	10	62.5	3	60.0	5	33.3	7	53.8	7	43.8	5	45.5	53	52.5
II	7	36.8	2	33.3	6	37.5	2	40.0	7	46.7	2	15.4	6	37.5	3	27.3	35	34.7
III	0	0.0	0	0.0	0	0.0	0	0.0	3	20.0	4	30.8	3	18.8	3	27.3	13	12.9
Total	19	100.0	6	100.0	16	100.0	5	100.0	15	100.0	13	100.0	16	100.0	11	100.0	101	100.0

NS non-significant

Table 2 Frequency (N) and percentage (%) for the distribution within first permanent molar teeth

	Tooth									
	16		26		36		46		Total	
	N	%	N	%	N	%	N	%	N	%
Eruption status criteria										
A	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Clinical status criteria										
0	1	4.3	0	0.0	2	8.7	1	4.3	4	4.3
1	0	0.0	1	4.3	0	0.0	0	0.0	1	1.1
2	17	73.9	17	73.9	12	52.2	11	47.8	57	62.0
3	3	13.0	2	8.7	3	13.0	3	13.0	11	12.0
4	0	0.0	0	0.0	3	13.0	4	17.4	7	7.6
5	1	4.3	3	13.0	3	13.0	4	17.4	11	12.0
6	1	4.3	0	0.0	0	0.0	0	0.0	1	1.1
7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	23	100.0	23	100.0	23	100.0	23	100.0	92	100.0
Lesion extension criteria										
I	10	47.6	12	52.2	10	47.6	9	40.9	41	47.1
II	9	42.9	9	39.1	10	47.6	13	59.1	41	47.1
III	2	9.5	2	8.7	1	4.8	0	0.0	5	5.7
Total	21	100.0	23	100.0	21	100.0	22	100.0	87	100.0

NS non-significant

Table 3 Frequency (N) and percentage (%) for the distribution within HSPM teeth

	Tooth									
	55		65		75		85		Total	
	N	%	N	%	N	%	N	%	N	%
Clinical status criteria										
0	16	69.6	16	69.6	17	73.9	18	78.3	67	72.8
1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	7	30.4	6	26.1	4	17.4	3	13.0	20	21.7
3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	0	0.0	0	0.0	1	4.3	1	4.3	2	2.2
5	0	0.0	1	4.3	1	4.3	1	4.3	3	3.3
6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	23	100.0	23	100.0	23	100.0	23	100.0	92	100.0
Lesion extension criteria										
I	6	85.7	6	85.7	4	66.7	4	80.0	20	80.0
II	1	14.3	1	14.3	2	33.3	1	20.0	5	20.0
III	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	7	100.0	7	100.0	6	100.0	5	100.0	25	100.0

NS non-significant

between the genders (Ghanim et al. 2011; Parikh et al. 2012).

In the present study, the prevalence of MIH was 2.3% which is slightly below the international estimated numbers ranging from 2.4% in Germany and Bulgaria (Dietrich et al. 2003; Kukleva et al. 2008) to 40.2% in Rio de Janeiro (Soviero et al. 2009). Actually, one study (Balmer et al. 2005) reported that 40% of children in Leeds and 44% of children

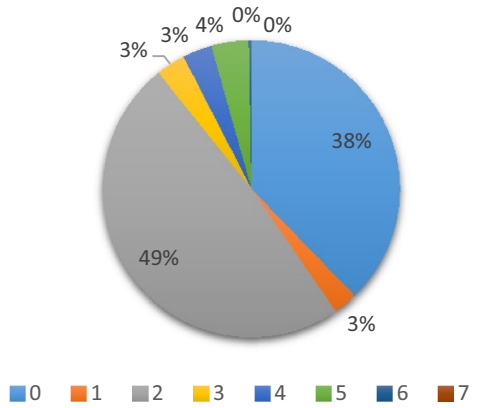


Fig. 4 Pie chart showing the frequency of clinical status criteria for all affected teeth

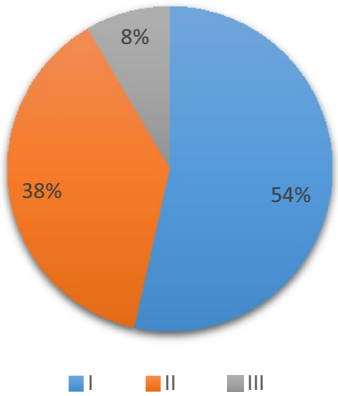


Fig. 5 Pie chart showing the frequency of lesion extension criteria for all affected teeth

in Sydney had demarcated opacities in at least one FPM. When compared to other studies conducted in the Middle East, in Libya 2.9% (Fleita et al. 2006), in Jordan 17.6% (Zawaideh et al. 2011), in Iran 12.7% (Ahmadi et al. 2012) and in Saudi Arabia 8.6% (Allazzam et al. 2014).

Overall differences in the prevalence of the defect might be associated with the health status of pregnant women and infants in each country being the results of the morbidity rates and the particular health services. MIH is not an independent defect. In the majority of the cases, it is a developmental enamel defect resulting from systematic insult during amelogenesis, therefore closely linked to the morbidity rates of each country and population (Lygidakis et al. 2008).

The short charting form was divided into three compartments, they are: the eruption status which dictates the need for an indexed tooth to have more than 1/3 of its crown visible to be recorded, the clinical status which scores from 1 to 7 and finally the extent of the lesion dividing the crown into 3 thirds. In the eruption status of the form, only 24 incisors were scored as (A) having less than 1/3 of their crowns visible. None of the FPM or HSPM was scored as (A) as the age range selected in this study ensured the proper eruption status for both. The short charting form did not mention any codes for the normally shed HSPM as the eruption criteria included permanent incisors and FPM. Normally shed HSPM also could not be scored as 7 in the clinical status as it indicates a broken down structure for unknown cause. To avoid confusion of the results the evaluator excluded normally shed HSPM from the scoring by using the letter E indicating "exfoliated" when it was confirmed with age and history. The normally shed HSPM were excluded from the results.

The prevalence of affected HSPM agrees with studies suggesting that hypomineralisation of primary molars can serve as an alert for possible MIH in the permanent dentition (Combrie et al. 2009; Elfrink et al. 2012). However, the percentage of HSPM is smaller compared to the total teeth affected. This is also consistent with (Elfrink et al. 2015) where it was concluded that MIH is associated with HSPM.

The most frequent score in the clinical status was the demarcated opacity (2) by (49%), followed by (38%) of examined teeth scored as healthy enamel. In the affected indexed incisors (56.9%) showed demarcated opacities while in the affected indexed FPMs (62%) showed demarcated opacities. This duration or magnitude of insult is a related feature as suggested by (Lygidakis et al. 2010).

According to the final section of the short charting form, the extent of the lesion observed in the present study in both molars and incisors were above 2/3 of the surface of the crown, among all tested teeth it was found (54%) of the observed lesions were less than 1/3 of their crown (I), while (38%) were extending beyond the incisal 1/3 but less than 2/3 of the crown (II) and only (8%) extended beyond that. This may be explained by the findings of (Alaluusua 2010) suggesting that it is due to the degree of development that varies among the areas of the crown and the duration of the insult altogether.

A developing first permanent molar around 1-year of age have ameloblasts in the occlusal half are at the maturation stage, more cervically ameloblasts are at a short, so-called transitional stage before entering the maturation stage (transitional-stage ameloblasts, Secretion of enamel matrix is still ongoing in the most cervical part of the crown by secretory ameloblasts). This was also discussed by (Lygidakis et al. 2010) stating that there is no good explanation as to why enamel defects are more commonly found on the occlusal/buccal surface(s).

Conclusions

The prevalence of MIH in a convenience sample of Egyptian children aged 8–12 years old was 2.3%. Females were more frequently observed to have MIH than males. Molars were the most prevalent teeth affected. The short charting form is a promising tool when studying MIH.

Recommendations

- Adding the letter E indicating exfoliated HSPM could be useful.
- Further population-based studies are needed to evaluate the prevalence of MIH.
- Further prospective studies are needed to evaluate the effect of systemic conditions during the child's first 3 years of life on the mineralisation of enamel in this population.

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