Original Article

Prevalence of Molar Incisor Hypomineralization Among A Group Of Egyptian Children In Fayoum Governorate Schools: A Cross Sectional Study

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Abstract

Objective: The aim of this study is to assess the prevalence of MIH among a group of Egyptian children in Fayoum governorate schools.

Methodology: The study was performed on 450 child who attended primary and preparatory governmental and private schools in Fayoum governorate. Personal data, as well as the medical history and any previous dental history were recorded for each child in the diagnostic chart. Clinical examination was performed in the school laboratory or an empty class using day light. The first permanent molars and permanent incisors were examined to detect the presence of MIH and its severity based on European Academy of Pediatric Dentistry criteria and scores were recorded in the diagnostic chart.

Results: A group of Egyptian students were examined in Fayoum governorate schools with the mean age of (11.27±1.20) years, 263(58.4%) were boys and 187(41.6%) were girls, 22 students were diagnosed with MIH and MIH prevalence was (4.9%). Regarding MIH severity, out of all MIH affected teeth (65.7%) had mild MIH, (12.9%) had moderate MIH and (21.4%) had severe MIH.

Conclusion: Upper right central incisor was the most prevalent tooth with MIH. The most prevalent degree of MIH severity was mild, followed by severe, then moderate. White or creamy demarcated opacities was the most prevalent enamel defect form.

Key words: MIH, Molar incisor hypomineralization, prevalence, First permanent molars, permanent incisors.

INTRODUCTION

Dental enamel is the hardest tissue of the human body and its formation is controlled by differentiated cells called ameloblasts through five stages: pre-secretory, secretory, transition, maturation, and post-maturation (**Berkovitz et al., 2017**).

Generally, defects occurring during the secretory phase result in lower matrix secretion and, consequently, in the production of fragile and quantitatively defective enamel (hypoplasia), while; defects occurring during the maturation stage result in a normal enamel volume but with insufficient mineralization (hypomineralization). Molar Incisor Hypomineralization (MIH), is possible to be included as an example of hypomineralization defects (**Jacobsen et al., 2014; El-Abassery et al., 2021**).

Molar Incisor Hypomineralization (MIH) can be defined as demarcated, qualitative defects of enamel of systemic origin affecting one or more first permanent molars with or without incisor involvement (**Weerheijm et al., 2001; Allazzam et al., 2014**). MIH affected enamel is porous and weak, that leads to rapid breakdown upon eruption and exposure to masticatory forces and oral environment, this phenomenon is referred to as; post- eruptive breakdown (**Jälevik et al., 2022**).

Molar Incisor Hypomineralization is often presented as white to yellow to brown demarcated enamel opacities of different colors, these lesions commonly undergo post-eruptive breakdown due to soft and porous enamel (**Almuallem & Busuttil-Naudi, 2018; Almulhim, 2021**) These lesions have high degree of porosity, extending to the amelodentinal junction. It was discovered that the yellow and brown opacities present as microscopically porous (**Fagrell et al., 2010**), with a higher clinical risk of breakdown than that of the white opacities (**Da Costa-Silva et al., 2011**).

Post-eruptive breakdown is a defect that indicates a decrease in the enamel depth after eruption leading to dentin exposure and subsequent sensitivity, rapidly progressing

caries as the children cannot carry out oral hygiene very effectively, cavities and complete coronal distortion (**Shrestha et al., 2014; Jälevik et al., 2022**).

Other common clinical problems reported for patients with MIH are local anesthetic problems due to chronic pulp inflammation, behavioral management problems due to dental fear and anxiety which is related to the pain experienced by the patients during multiple treatment appointments and aesthetic problems in anterior teeth (**Kalkani et al., 2015; Ghanim et al., 2017 and Abd El Ghaffar et al., 2022**)**.**

The current study was performed to evaluate the prevalence of MIH among a group of Egyptian children, in Fayoum governorate schools.

PARTICIPANTS AND METHODS

Study design:

Observational, cross sectional study.

Ethical Approval:

The study was reviewed and approved by the Research Ethics Committee, Faculty of Dentistry, Cairo University with ID number 21-7-20.

Sample size determination:

Sample size was approved by the Medical biostatistics unit, Faculty of Dentistry, Cairo University.

A power analysis was designed to have adequate power to apply a 2-sided statistical test of the research question regarding the prevalence of MIH among a group of Egyptian children in Fayoum governorate schools.

According to the results of **(Yannam et al., 2016)** in which the prevalence of MIH was (9.7%) and by adopting a confidence interval of (95%), a margin of error of (5%) with finite population correction; the predicted sample size (n) was a total of (135) cases. Sample size calculation was performed using Epi info for windows version 7.2.

Selection of samples:

For representation of Fayoum governorate 10% of primary schools was determined. The schools were coded to facilitate randomization and then entered in the excel sheet to determine the included final schools to avoid selection bias for schools. All students present at the day of examination were included and no attempts were performed to follow the absent students. A total of 450 children were examined from five different Fayoum governorate primary and preparatory schools.

Eligibility criteria:

Inclusion criteria:

- Acceptance for participants for the study.
- Eruption of four first permanent molars.
- Eruption of four permanent maxillary and mandibular incisors.
- Both genders.

Exclusion criteria:

- Uncooperative children.
- Children with orthodontic appliances.
- Children with systemic diseases that may affect tooth development.
- Children suffering from any other type of enamel defect as enamel hypoplasia or amelogenesis imperfect.

Study Setting:

1. Diagnostic chart:

Personal data including date, name, age, gender, address, school name, as well as the medical history and any previous dental history were recorded.

2. Clinical examination:

Examination was performed by single calibrated operator in the school laboratory or an empty class using day light. All present permanent teeth were recorded in a specially designed diagnostic chart and the severity of MIH if present.

A disposable diagnostic set (mirror, probe) were used for each child to examine the four first permanent molars and the four maxillary and four mandibular incisors to detect the presence of MIH and its severity based on EAPD criteria**(Weerheijm et al., 2003)**, and scores were recorded in the chart.

Mirrors were used for proper visualization especially for maxillary teeth. Blunt explorers were used to help in tactile sensation when needed, as during the differentiation between rough and smooth enamel edges and during the inspection of caries extent when it exists. No diagnostic radiographs were taken.

According to *Sönmez et al., (2013)*, to diagnose MIH, at least one affected first permanent molar is required. Extracted first permanent molar was recorded as "affected" when another first permanent molar had a defecting MIH. A verbal note was provided to the class teacher outlining the dental status of affected children with MIH.

Blinding:

Blinding was not feasible.

Data management:

-Data were stored on the investigator's personal computer, secured with a password with backup for the data on Google Drive and on a hard copy.

-The diagnostic charts were collected into an excel sheet to facilitate manipulation of the data.

Statistical methods:

Categorical data were presented as frequency and percentage values and were analyzed using Fisher's exact test. Numerical data were analyzed for normality using Shapiro-Wilk test. Ordinal non-parametric data were presented as median and range values. The significance level was set at $p<0.05$ within all tests. Statistical analysis was performed with R statistical analysis software version 4.1.2 for Windows1.

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"1R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/."

RESULTS

1-Demographic data:

The study was conducted on 450 children with the mean age of (11.27 ± 1.20) years, 263(58.4%) of which were boys and 187(41.6%) were girls. All children were apparently medically free, 442(98.2%) had no previous dental treatment and 8(1.8%) had previous dental treatment. The median and range values for def score for a selected sample of 246 children was 0.00 (8.00) while for DMF score they were 0.00 (12.00).

Prevalence of MIH:

Out of the 450 examined children, 22 children were diagnosed with MIH and MIH prevalence was (4.9%) as shown in table (1).

Prevalence of MIH in each tooth:

There was 19(4.2%) affected upper right centrals, 15(3.3%) affected upper left centrals, 6(1.3%) affected lower right centrals, 6(1.3%) affected lower left centrals, 11(2.4%) affected upper right laterals, 13(2.9%) affected upper left laterals, 3(0.7%) affected lower right laterals, 4(0.9%) affected lower left laterals, 16(3.6%) affected upper right first molars, 17(3.8%) affected upper left first molars, 17 (3.8%) affected lower right first molars and 13(2.9%) affected lower left first molars as shown in figure (1).

Severity of MIH :

Out of 5400 checked teeth, 5260(97.4%) were free and 140(2.6%) had MIH. Out of the affected teeth, 80(57.1%) had white or creamy demarcated opacities, 12(8.6%) had yellow or brown demarcated opacities, 18(12.9%) had enamel loss, 10(7.1%) had enamel and dentine loss, 18(12.9%) had atypical large cavities extended to pulp and covering one or more tubercle, single case had atypical restoration and extracted tooth as shown in table (2).

Degree of severity of MIH :

Out of 5400 checked teeth, 5260(97.4%) were free and 140(2.6%) had MIH. Out of the affected teeth, 92(65.7%) had mild MIH, 18(12.9%) had moderate

MIH and 30(21.4%) had severe MIH as shown in table (3).

Association between gender and MIH prevalence:

Out of 22 children diagnosed with MIH, 14(5.3%) boys and 8(4.3%) girls were presented with MIH and there was no statistical significant association between gender and MIH prevalence (p=0.664) as shown in table (4).

Table (1): Prevalence of MIH:

MIH presence		Value
No	**N**	428
	%	95.1%
Yes	**N**	22
	%	4.9%

Table (2): Frequency and percentage values of MIH severity:

MIH severity (n=140)		Value
White or creamy demarcated opacities	**N**	80
	%	57.1%
Yellow or brown demarcated opacities	**N**	12
	%	8.6%
Enamel loss	**N**	18
	%	12.9%
Enamel and dentin loss	**N**	10
	%	7.1%
Atypical large cavities extended to pulp and covering one or more tubercle	**n**	18
	%	12.9%
Atypical restoration	**n**	1
	%	0.7%
Extracted tooth	**n**	1
	%	0.7%

Table (3): Frequency and percentage values of MIH severity degree:

MIH severity (n=140)		Value
Mild	n	92
	%	65.7%
Moderate	n	18
	%	12.9%
Severe	n	30
	%	21.4%

Table (4): Frequency and percentage values of MIH prevalence:

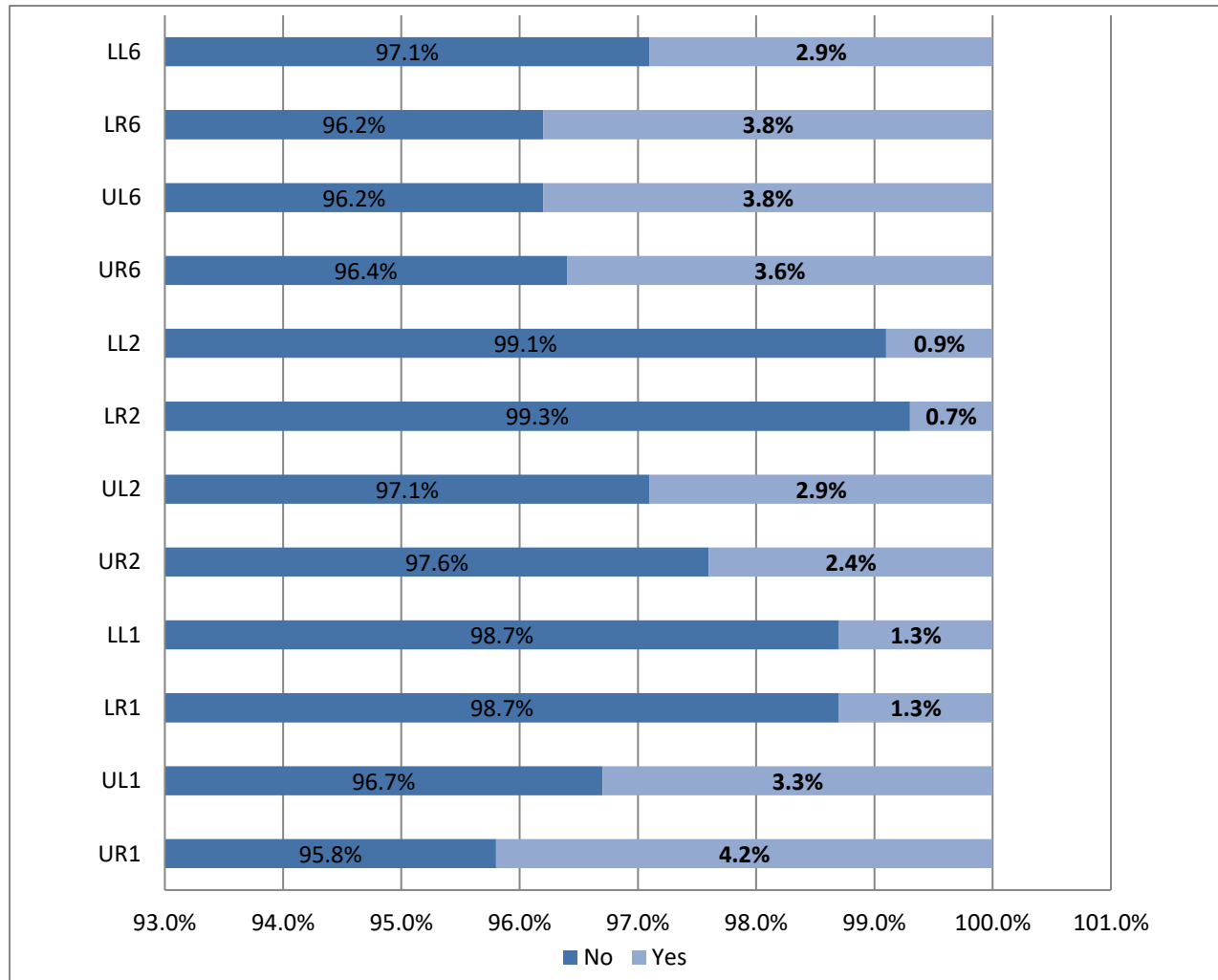| MIH presence		Male	Female	*p*-value
No	n	249	179	**0.664**
	%	94.7%	95.7%	
Yes	n	14	8	
	%	5.3%	4.3%	

Figure (1): A bar chart showing MIH prevalence in each tooth.

DISCUSSION

MIH is defined as "hypomineralization of systemic origin, presenting as demarcated, qualitative defects of enamel of one to four first permanent molars frequently associated with affected incisors" according to **Weerheijm et al., 2001**. At first, the condition was considered to be affecting the first permanent molars and incisors but more recently it has been noted that any primary or permanent tooth could be affected **Almuallem & Busuttil-Naudi, 2018.**

The current study is an observational, cross-sectional study. It was conducted in order to assess the prevalence of MIH among a group of Egyptian children in Fayoum governorate schools during the period from February to April 2021.

As the reported prevalence of MIH world-wide ranges from 2.4% to 40%. This

wide range of variation could be due to lack of standardization in assessment methodology of MIH as well as a consistent classification index **Jälevik, 2010 and Saber et al., 2018.** According to **Saber et al., 2018** they mentioned that knowledge about MIH is mandatory as the condition often leads to undesirable consequences like post-eruptive breakdown, rapidly progressing caries and sensitivity.

This study is a part of a group project aiming to investigate MIH prevalence in a number of Egyptian governorates in order to allow for the investigation of a wider demographic area with larger sample for more descriptive data.

Both genders were included in this study in order to investigate the association between gender and MIH prevalence. All participants included in the study were cooperative, apparently medically free from any systemic disease, free from any other enamel defects as hypoplasia or amelogenesis imperfect, free from any orthodontic appliance in order to allow proper diagnosis and had all their index teeth erupted (four FPMs along with four permanent maxillary and mandibular incisors.

Examination was performed by single and calibrated examiner in order to minimize classification bias, with the help of the diagnostic chart. For more standardized results, diagnosis of MIH was carried out according to EAPD criteria in their meeting in Athens in 2003 according to **Weerheijm et al., 2003**. Severity of MIH was classified into mild, moderate and severe.

In the present study; MIH prevalence in a group of Egyptian children in Fayoum governorate schools was similar to the findings of **El-Abassery et al., 2021** among a group of Egyptian children in Dakahlia governorate schools.

On the contrary, the results of our study are more than what was found by **Cho et al., 2008** among a group of Chinese children, by **Saber et al., 2018; Zaki et al., 2018 and Abd El Ghaffar et al., 2022** among a group of Egyptian children.

On the other hand; the results of our study was less than what was found by **Soviero et al., 2009** in Brazil, **Martínez Gómez et al., 2012** in Spain, and **Allazzam et al., 2014** in Jeddah, Saudi Arabia, **Yannam et al., 2016** in Chennai, and **Abo ElSoud & Mahfouz, 2019** and **Osman et al., 2020** in Egypt.

Regarding MIH severity, "white or creamy demarcated opacities", was the most prevalent form of severity, followed by "enamel loss", "atypical large cavities extended to pulp and covering one or more tubercle", and a single case had atypical restoration and extracted tooth. These findings were consistent with **Shrestha et al., 2014; Osman et al., 2020** and **Abd El Ghaffar et al., 2022** studies where "white or creamy demarcated opacities" was the most prevalent enamel defect.

The most prevalent degree of severity was "mild", followed by "severe" then "moderate". This order of severity was

in agreement with the findings of **Kirthiga et al., 2015; El-Abassery et al., 2021** and **Osman et al., 2020.** But disagreed with **Martínez Gómez et al., 2012** where the most prevalent degree of severity was "mild", followed by "moderate" then "severe".

In the Current study there was no statistically significant association between gender and MIH prevalence. This finding was consistent with **Martínez Gómez et al., 2012, Koruyucu et al., 2018** and **Abd El Ghaffar et al., 2022** studies that showed no statistical significant association between gender and MIH prevalence, but contradicted **El-Abassery et al., 2021** that showed a higher prevalence rate of MIH in girls than boys.

CONCLUSIONS

From the results of this study, it is concluded that:

1. The prevalence of MIH in a group of Egyptian children in Fayoum governorate schools was (4.9%) children .

2. There was no statistical significant association between gender and MIH prevalence.

3. The most prevalent degree of severity was "mild", followed by "severe" then "moderate".

4. "White or creamy demarcated opacities" was the most reported enamel defect.

5. Maxillary right central incisor was the most prevalent tooth with MIH.

Conflict of Interest:

The authors declare no conflict of interest.

Funding:

Ethics:

This study protocol was approved by the ethical committee of the faculty of dentistry- Cairo university on: 28-7-2020, approval number: 21-7-20.

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