ORIGINAL PAPER

ASSESSMENT OF DENTAL FEAR IN CHILDREN WITH MOLAR-INCISOR HYPOMINERALIZATION

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ABSTRACT

Introduction: Dental fear is a common unpleasant emotional response that occurs in situations related to dental treatment. Since children affected by molar-incisor hypomineralization (MIH) receive much more dental treatment than their healthy peers, these children may have more dental fear and behavioral problems.

Objectives: The aim of the study was to assess the relation between the presence and severity of MIH and dental fear.

Material and methods: Study group involved a sample of 127 children, aged between 8 and 12 years with MIH, showing a high-risk of caries, and 99 children were included into control group. In the wake of intra-oral examination according to the American Academy of Pediatric Dentistry guideline and DMFT/dmft indices, Children's Fear Survey Schedule – Dental Subscale (CFSS-DS) was applied to each child. Mean value of independent groups for normally distributed data was compared using independent samples *t*-test. Spearman's correlation was applied for correlations between DMFT/dmft scores and CFSS-DS scores. *P*-value of < 0.05 was considered statistically significant.

Results: The final number of individuals affected by MIH in this study was 127 with approximately equal numbers for each age group. The mean CFSS-DS scores were 31.41 ± 10.73 for the MIH-group, and 31.60 ± 6.21 for the controls, respectively. The mean values did not differ significantly between children with and without MIH ($p = 0.870$). There were also no statistically significant differences in severe MIH (31.38 ± 10.93) compared with the control group (31.60 ± 6.21) ($p = 0.890$).

Conclusions: The study's findings revealed that there is no relation between the existence and severity of MIH and dental fear.

Key words: molar-incisor hypomineralization, dental fear, dental anxiety, developmental defects of enamel, pediatric dentistry.

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INTRODUCTION

Dental fear is a common unpleasant emotional reaction to particular threatening stimulating factors, which occur in situations related to dental treatment [1]. Negative dental treatment experiences throughout childhood and adolescence can frequently be attributed to the onset of dental fear [2]. This fear situation with varying degree of severity, has been at the core of research conducted in several geographical regions and age

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groups [2, 3]. A review conducted by Cianetti *et al.* [1] showed that dental fear is still a widespread problem, and it prevails at a percentage of 10-20% within all age groups. On the other hand, the incidence of dental fear among children has been rated between 5.7% and 46.8% in different countries [4].

Several methods are utilized to measure children's dental fear and/or anxiety, including behavioral assessments (in which the emotional and behavioral responses of children during dental procedures are evaluated by physicians and researchers), psycho-metric assessments for determining the fear of a child or parents against dental items before dental procedures, and physiological assessments, in which various biological and physiological parameters are measured [1]. Overall, psycho-metric self-reported dental fear evaluations completed by children themselves (if available) are the most accurate and valid approaches for measuring dental fear and anxiety, with several advantages for dentists [5]. Dental fear measurements can be used for various purposes, such as determining the prevalence of dental fear in children, measuring risk factors and symptoms, and evaluating changes in fear and anxiety before and after treatment [5]. For this above-mentioned purpose, Children's Fear Survey Schedule – Dental Subscale (CFSS-DS) was chosen as one of the most well-known tools for assessment [1].

Despite the decrease observed in the incidence of dental caries in recent years in industrialized countries due to improvements in oral hygiene conditions and increased access to dental health services [6], there is a group of defects defined as molar-incisor hypomineralization (MIH) that are not affected by the presence of these factors [6]. MIH was first introduced in 2001, and it is a type of a lesion, in which qualitative and developmental enamel defects in the maturation stage of amelogenesis affect one or more permanent first molars (PFMs), constantly in combination with demarcated opacities in permanent incisors [7]. Individuals affected by this condition apply to dentists because of rapid structural destruction, especially during and immediately after the eruption of PFMs [8]. When evaluated epidemiologically, MIH is the most common developmental enamel defect [9]. The prevalence of MIH has been reported to range from 0.5% to 40.2% in 70 research populations, with a pooled global prevalence of 14.2% [10].

The highly porous enamel observed in MIH combined with large dentinal tubules causes the dental pulp to be more sensitive to thermal and chemical irritations [11]. As a result of weakness in the structural features, pain and sensitivity can be observed in the teeth affected by MIH, especially when exposed to acidic, cold and/or hot foods and beverages, even while toothbrushing [12]. As children affected by MIH often undergo and anticipate hypersensitivity and/ or pain from normally harmless chemical, mechanical, and/ or thermal stimuli due to structural properties and atypical caries, it is highly possible to comprehend the underlying reason for their higher dental anxiety levels. In addition to that, as these children affected by MIH receive much more dental treatment than their healthy peers, these children present more dental fear and behavioral problems [8]. It is of crucial importance to treat these teeth with pain-free treatment approaches to refrain from behavioral management problems or dental fear [13].

OBJECTIVES

There are only a few studies on dental fear of children with MIH [13-17]. Considering the clinical symptoms and behavioral problems of children affected by MIH, this study aimed to assess the relation between MIH and dental fear in children that have no previous history of invasive dental treatments.

MATERIAL AND METHODS

The study was approved by clinical research ethics committee of the Marmara University School of Dentistry, and was conducted with all ethical principles of the Declaration of Helsinki of 1975 and revised in 2008.

STUDY POPULATION

The sample size calculation was performed based on a previous research conducted by Jälevik and Klingberg [14] using G*Power software (v. 3.1.9.7, Universitat Kiel, Kiel, Germany), with the following suppositions: allowable error $\alpha = 0.05$, study power of 0.95, mean CFSS-DS scores in the control and MIH groups equal to 20.8 and 23.3, and standard deviations equal to 5.4 and 7.5, respectively. The effect size was determined as 0.46. It was concluded that sample sizes for control and MIH groups should be at least 91 and 117, respectively, and therefore minimum required sample size was considered 208.

Clinical examination and application of a questionnaire for patients who applied to the Pediatric Dentistry Clinic, Dental School, Marmara University in İstanbul, Turkey, were used in the present study. The study group consisted of 127 children with MIH (68 girls and 59 boys), and 99 children (45 girls and 54 boys) were considered as the control group; all children were between the ages of 8 to 12.

INCLUSION CRITERIA

Criteria for selecting the subjects were as follows: being aged between 8 and 12 years old, residing in İstanbul and the same fluoridated area (main water of İstanbul contains between 0.10 and 0.20 mg F/l), having no previous history of invasive dental treatments, such as restorative or endodontic treatments and/or extraction, informed

consent from parents or caregivers, and verbal consent obtained from the child for participation in the study.

EXCLUSION CRITERIA

Primary exclusion criteria for the participants were systemic disease and/or syndrome, living outside of İstanbul, and previous history of invasive dental treatments.

STUDY DESIGN, CLINICAL EXAMINATION, AND DATA COLLECTION

Eligible patients were enrolled after obtaining verbal and written informed consent as well as verbal and written informed consent from their parents. Intra-oral examination was made by two calibrated and trained pediatric dentists (BS, NT), in same dental unit with a standardized dental mirror (#5) and probe (PCP11). Caries risk assessment was performed as per the American Academy of Pediatric Dentistry (AAPD) guideline [18]. According to the guideline, patients with enamel defects are considered to be at high-risk caries [18]. Caries risk assessment was performed in line with the AAPD guideline [18] for the control group patients, who met inclusion criteria. Evaluation categorization of low-, moderate-, or high-risk is based on the predominance of factors for the patient [18]. For this reason, medical and dental anamnesis were evaluated together with the findings of intra-oral and radiographic examination, according to recommendations of the guideline:

- patients with at least one of the findings of low health literacy;
- frequent exposure to sugar-containing snacks or drinks between meals per day;
- having more than one approximal dental caries lesions;
- having active non-cavitated dental caries were thought to be at high-risk caries [18] and included in the study.

Positive or negative invasive dental experiences may exert an impact on dental fear and child's coping abilities and feeling of control in dental situations [19]. For this reason, children with no previous invasive dental experience were included in the study. The status of caries of children was also evaluated with DMFT/dmft indices, which were approved by the World Health Organization (WHO) [20].

Examiners were trained during their postgraduate education period, and were further trained with intra-oral photographs taken from 30 patients with MIH and other developmental enamel defects. The validity of these photographs was established by Elfrink *et al*. [21]. Moreover, examiners evaluated intra-oral findings of 20 children with different severity of MIH for one month before the study, and these patients were not included in the study. Intra- and inter-examiner κ-values were outstanding (both were 0.95) for MIH.

Throughout the examination, in the presence of any dental plaque that could affect diagnosis, the teeth were cleaned with a standard polishing brush. Teeth affected by the diagnosis of MIH was based on the published index representing a combination of the European Academy of Pediatric Dentistry (EAPD) criteria and modified developmental defects of enamel (mDDE) index [22]. This index has recently been shown to be a reliable and accurate diagnostic tool [23]. It is graded according to diagnostic criteria: the lack of observable defects of enamel, enamel defects not associated with MIH, white/ creamy and/ or yellow/ brown demarcated opacities, post-eruptive enamel breakdown (PEB), atypical restorations and caries, extraction of teeth affected by MIH, and unscored situations [22]. EAPD criteria were used to assess lesion severity [24]. According to the criteria, MIH-affected teeth were divided into two severity levels: 1) mild cases that contain demarcated opacities of different colors without PEB, occasional hypersensitivity to extraneous stimuli, and mild aesthetic problems, especially in incisors; 2) severe cases with demarcated opacities with PEB and/or atypical caries, spontaneous hypersensitivity even with toothbrushing, and aesthetic problems that clearly affect quality of life [24]. When severe MIH findings were observed in at least one index tooth, this individual was included in the severe group [24].

QUESTIONNAIRE

In the wake of clinical examination, the Turkish version of CFSS-DS was administered to the patient by a third calibrated and trained examiner (CÇ), who was blinded to intra-oral examination findings.

CFSS-DS is a well-known psycho-metric questionnaire introduced in 1982 to assess dental fear and anxiety in children. It has been shown to have good reliability and validity, and has recently been used in numerous countries and populations, and translated into many languages [25, 26]. Validity and reliability of Turkish version of CFSS-DS have been performed by Kuscu *et al*. [25], with Cronbach's α coefficient for questionnaire calculated as 0.8298. CFSS-DS includes 15 different components related to dental and medical treatment situations. These components are associated to highly invasive dental items (e.g., dentists, injections, dentists drilling, the sight and noise of the dentist's drill), less invasive dental items (e.g., doctors, having somebody examine your mouth, having to open your mouth, having somebody put instruments in your mouth, having to go to the hospital, people in white uniforms, and having the nurse clean your teeth), and general anxiety/fear (e.g., having a stranger touch you, having somebody look at you, fear of choking, etc.) [19]. Children score

their fear on each item using a Likert-type scale with scores from one to five, with one meaning 'not afraid', two 'a little afraid', three 'fairly afraid', four 'quite afraid', and five meaning 'very afraid'. The overall score range was between 15 and 75, and children with a total CFSS-DS score of 38 and above were clinically defined as having dental fear [27].

STATISTICAL ANALYSIS

The descriptive analyses of data were performed using Microsoft Excel® 2013 (Microsoft, Inc., Redmond, WA, USA), and statistical analyses were done with SPSS® Software version 22.0 (IBM Corp., Chicago, IL, USA). The majority of participants included in the study were 8-years-old, and the total number of participants in the 9, 10, 11, and 12 age groups was approximately equal to the number of participants aged 8 years. Therefore, in order to make the statistical evaluation more expressive, individuals over the age of 8 were clustered in a group, and 8-year-olds' children were evaluated in a separate group. The mean of independent groups for normally distributed data was compared using independent samples *t*-test. Spearman's correlation was applied for correlations between DMFT/dmft scores and CFSS-DS scores. *P*-value of < 0.05 was considered statistically significant.

RESULTS

The final number of individuals affected by MIH in this study was 127 with approximately equal numbers for each age group: the number of 8-year-old children was 68 (53.5%) and the number of age over 8-year-old was 59 (46.5%). In addition, severe MIH findings were observed in 80 of these individuals. 99 children: the number of 8-year-old children was 54 (54.5%), and the number of age over 8-year-old was 45 (45.5%), had normally mineralized enamel (control group).

The mean DMFT scores were 3.27 ± 1.86 for the MIH group, and 3.42 ± 1.92 for the control group. No statistically significant difference was observed between the groups in terms of DMFT scores ($p = 0.867$). When the frequency of caries in the primary dentition was examined, the mean dmft score was 4.67 ± 3.61 in the MIH group, and 4.2 ± 3.59 in the control group. The difference in mean dmft scores between the groups was not statistically significant ($p = 0.921$). No correlation existed between DMFT/dmft scores and CFSS-DS scores for both the MIH group and the control group ($r = –0.103$, $p = 0.168$; $r = 0.055$, $p = 0.467$, respectively).

CFSS-DS mean scores were similar in all genders and age groups. These data, which were observed in both the groups regardless of the presence of MIH, and the distribution of cases by gender and age groups are shown in Table 1.

The mean CFSS-DS scores were 31.41 ± 10.73 for the MIH group and 31.60 ± 6.21 for the control group. The mean values did not differ significantly between the groups of children with MIH or without MIH ($p = 0.870$).

Although the mean CFSS-DS scores were higher in the control group in boys and in the MIH group in girls, the differences were not statistically significant ($p = 0.792$, $p = 0.390$, respectively). In children aged 8-year-old and over 8-year-old, the mean CFSS-DS scores were higher in the control group than in the MIH group, but the differences were not statistically significant ($p = 0.976$, $p = 0.861$, respectively).

TABLE 1. Mean Children's Fear Survey Schedule – Dental Subscale (CFSS-DS) scores for children with and without molar-incisor hypomineralization (MIH) for all genders, age groups, and total sample

Groups	MIH group ($n = 127$) Mean ± SD	Control group ($n = 99$) Mean ± SD	*p*-value†
Total	31.41 ± 10.73	31.60 ± 6.21	0.870
Gender			
Boys	31.58 ± 11.94	32.00 ± 5.59	0.792
Girls	31.29 ± 9.76	29.84 ± 5.58	0.390
Age (years)			
8 years old	32.19 ± 11.06	32.24 ± 6.76	0.976
> 8 years old	30.51 ± 10.39	30.82 ± 5.44	0.861

†*Independent samples' t-test*

TABLE 2. Distribution of dental fear in children with and without molar-incisor hypomineralization (MIH) and severe MIH

Group	Dental fear (CFSS-DS ≥ 38), *n* (%); CFSS-DS, mean ± SD	No dental fear (CFSS-DS < 38), *n* (%); CFSS-DS, mean ± SD	Mean difference	95% CI	*p*-value†
MIH	57 (44.9); 45.82 ± 8.01	70 (55.1); 26.39 ± 5.92	19.43	16.29-22.56	**< 0.001**
Severe MIH	21 (26.3); 46.05 ± 8.36	59 (73.7); 26.15 ± 5.76	19.89	16.59-23.19	**< 0.001**
Control	10 (10.1); 42.80 ± 5.96	89 (89.9); 30.34 ± 4.83	12.46	15.74-9.18	**< 0.001**

CFSS-DS – Children's Fear Survey Schedule – Dental Subscale. †Independent samples' t-test. P-value in bold indicates statistical difference (p < 0.05)

TABLE 3. Mean Children's Fear Survey Schedule – Dental Subscale (CFSS-DS) items scores with and without molar-incisor hypomineralization (MIH)

CFSS-DS items	MIH group ($n = 127$); mean ± SD	Control group ($n = 99$); mean ± SD	p-value[†]
1. Dentists	1.78 ± 1.12	2.23 ± 1.24	0.185
2. Doctors	1.50 ± 0.92	2.04 ± 0.97	0.185
3. Injections	2.72 ± 1.46	3.11 ± 1.25	0.138
4. Having somebody examine your mouth	1.62 ± 1.00	1.76 ± 0.96	0.068
5. Having to open your mouth	1.44 ± 0.84	1.90 ± 0.83	0.268
6. Having a stranger touch you	1.72 ± 1.08	2.00 ± 0.96	0.131
7. Having somebody look at you	1.81 ± 1.26	1.79 ± 1.01	**0.013**
8. Dentist drilling	2.18 ± 1.25	2.61 ± 1.13	0.170
9. The sight of dentist drilling	2.14 ± 1.24	2.42 ± 0.96	**0.040**
10. The noise of dentist drilling	2.11 ± 1.26	2.70 ± 1.56	0.229
11. Having somebody put instruments in your mouth	1.67 ± 0.99	2.18 ± 0.91	0.253
12. Choking	1.70 ± 1.04	1.55 ± 0.77	0.082
13. Having to go to the hospital	1.48 ± 0.93	1.48 ± 0.81	0.990
14. People in white uniform	1.38 ± 0.76	2.13 ± 0.92	0.570
15. Having the dentist clean your teeth	1.56 ± 0.93	1.96 ± 0.83	0.250

[†]*Independent samples' t-test. P-value in bold indicates statistical difference ($p < 0.05$)*

When children were grouped as children with dental fear (CFSS-DS score ≥ 38) and without dental fear (CFSS-DS score < 38), the CFSS-DS score of children with dental fear was 44.9% in the MIH group and 10.1% in the control group.

There were statistically significant differences in the CFSS-DS mean scores of the children with and without dental fear in the MIH, severe MIH, and control groups ($p < 0.001$) (Table 2).

Regarding the items in the survey, 'Injections' seemed to be the most feared item in the groups with and without MIH. Items 'Dentist drilling' and 'The sight of dentist drilling' in the MIH group and 'The noise of dentist drilling' and 'Dentist drilling' in the group without MIH, followed by 'Injections', were the ones with the highest scoring. There were statistically significant differences between individuals with and without MIH for 'Having somebody look at you' and 'The sight of dentist drilling' items, with $p = 0.013$ and $p = 0.04$, respectively (Table 3).

DISCUSSION

Dental fear is considered to be an emotional reaction that is unraveled for procedures and/or items related to dentistry. The reasons underlying dental fear can vary. Socio-demographic and socio-cultural factors, including age, gender, education level, family structure, persistent maternal depression, number of siblings, and/or income level as well as dental factors, such as presence of dental experience, painful dental stimuli, and/or hypersensitivity on dental fear, were investigated [28-31]. The objective of the study was to reveal how MIH, a type of developmental enamel defect, affects dental fear in the group of 8 to 12 years old children.

The reasons for using CFSS-DS for evaluation in the study are its' practicality, well internal consistency, high reliability, appropriate criterion availability, and that it was used in many populations and previous researches [26, 31, 32]. CFSS-DS was conducted directly among children in this study. This is because when applying the parents' version of this questionnaire, some parents underestimated children's dental fear and some anxious parents exaggerated the fear situation, and therefore the results may be inaccurate [15].

A considerable amount of researches has been published in many countries on dental fear of children and adults. Nevertheless, there are quite a few research in the dental scientific literature examining the relation between children's dental fear and the presence of MIH. The results of two studies from Sweden [13, 14], two from Brazil [15, 16], and one from Greece [17] on this subject have been reported to date.

The effect of age on dental fear is another subject that has been studied. It is known that children are more sensitive to adopt and display fearful behaviors at an early age. As children grow up, they gain self-control and confidence, becoming more assured and independent. Therefore, they become stronger psycho-socially. This condition significantly sustains their ability to cope with fear and undesirable exter-

nal factors [33]. Previous studies have established that as age increases, medical and dental fear decreases, which improve the individuals ability to cope with these matters [34]. On the other hand, in long-term studies of Jälevik and Klingberg [13, 14] investigating dental fear in children with MIH, no statistically significant differences were observed between different age groups. In a study of Kosma *et al*. [17], dental fear with CFSS-DS in children with MIH aged 8 and 14 was examined, and no statistically significant difference was observed between the scores of both age groups. In parallel, although the mean CFSS-DS scores of 8-year-olds children were found higher than the older children in the groups with MIH, with severe MIH, and control, the difference was not statistically significant in this study.

It has been suggested that gender, just like age, can be a factor on dental fear. Thus far, a number of studies have shown that girls tend to have more dental fear and anxiety than boys [35]. The current study found that the mean CFSS-DS scores were higher in girls than in boys, regardless of age, in the groups with MIH, with severe MIH, and without MIH, but the difference was not statistically significant. This finding is contrary to the results of a review by Klingberg and Broberg [35] in 2007. Nonetheless, this finding is consistent with that reported by Winer [36] in 1982.

Studies investigating the effect of past dental experience on patients' dental fear levels showed that painful procedures and anticipations of trauma trigger dental fear [37, 38]. In addition, it has been highlighted that procedures that include injection and drill items are the factors that trigger the most fear. More pain has been reported with invasive procedures, such as sub-gingival operations, deep periodontal and/or dental probing, excessive fillings, extraction, and root canal treatment, in patients with a high level of dental fear. For these reasons, non-invasive treatments help minimize dental fear [39]. Additionally, painful dental procedures and dental fear are more common in children with poor oral health [40]. It can be proposed that children affected by MIH, which can lead to more plaque accumulation, with the effect of aggressive and rapid PEB, rapid and atypical caries progression, and hypersensitivity, have a history of painful and invasive dental experience. Furthermore, the obstacles to providing local anesthesia in MIH-affected children increase the level of dental fear [41]. Chronical inflammatory effect observed in teeth affected by MIH causes a series of morphological and cytochemical changes in the sensory neurons, and thus trigger hypersensitivity of the nerve fibers [14]. This may lead to more behavioral problems in children with MIH. A study conducted by Jälevik and Klingberg [13] showed that 9-year-old Swedish children with MIH were more anxious and problematic in behavioral management compared with their healthy peers. Considering all this information, to evaluate the dental fear of children with and without MIH more objectively, unlike previous studies investigating the relation between MIH and dental fear, children who had not undergone an invasive dental procedure before were selected in both the groups in the present study. The fact that the evaluated children had no previous invasive dental experience may have decreased their dental fear levels. Therefore, in future investigations, it may be essential to be sensible in terms of behavioral problems in invasive procedures, especially in achieving local anesthesia in children with MIH.

When studies investigating the relationship between MIH and dental fear are examined, results of Jälevik and Klingberg's studies [13, 14], which started in 2002 and evaluated long-term results in 2012, showed that MIH did not create a statistically significant effect on dental fear in both study and control groups. Similarly, in the study of Kosma *et al.* [17], the effect of MIH on dental fear was evaluated in a group of Greek children, and it was identified that MIH did not produce a statistically significant effect on dental fear. In a population-based cross-sectional study of Menoncin *et al.* [15] among a group of Brazilian children, dental anxiety question (DAQ) was applied to evaluate dental anxiety, and it was concluded that no significant relationship between MIH and dental anxiety was evident. Finally, Laureano *et al.* [16] showed that there was no statistically significant correlation between MIH and dental fear in a group of Brazilian children. In parallel with the results of these five studies examining the relationship between MIH and dental fear, it was observed in the study that the presence of MIH, regardless of the severity, did not result in a statistically significant difference on dental fear.

This study did not engage with examining the change in dental fears in the later ages of the same group of children in a certain time period. The possibility that dental fear and behavior management problems are not related was not encompassed in this research. Moreover, the relatively small sample size may be a limitation of this research. On the other hand, there are strengths, such as the application of a valid and reliable questionnaire, the patient's self-reporting dental fear, standardization of the sample group, and children with previous dental experience who had undergone invasive dental procedures previously were not included in this study for objective responses. Therefore, in order to develop a full picture of the relationship between MIH and dental fear, further research need to be conducted with a higher sample size for generalizability, using different dental fear and anxiety scales and methods.

CONCLUSIONS

Despite the limitations of this study, the following conclusions can be drawn, and regardless of the severity of the presence of MIH, there is no significant effect

on dental fear in children. Apart from that, the level of hypersensitivity and/ or aesthetic problems used to determine the severity of MIH also lacks a relationship with dental fear. Age and gender determinants in the 8-12 age range and different genders evaluated by the study population at the time of application to the dentist are not pivotal on dental fear.

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CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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