

Impact of Molar Incisor Hypomineralization on Oral Health-Related Quality of Life in Mexican Schoolchildren

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Objective: To evaluate the impact of Molar Incisor Hypomineralization (MIH) in the OHRQoL in a group of 8 to 10 year-old Mexican schoolchildren. **Study design:** A cross-sectional study of 411 8 to 10 year-old schoolchildren selected from public schools in Naucalpan, in the State of Mexico. The presence and severity of MIH was evaluated using the European Academy of Pediatric Dentistry (EAPD) criteria. The OHRQoL was evaluated using the Child Perceptions Questionnaire (CPQ). Poisson regression models were performed for the analysis. **Results:** The prevalence of MIH in the permanent dentition was 40.4%. High scores were found in the four domains of the CPQ for children with MIH compared to children without MIH ($p < 0.001$). In the Poisson model, a greater negative impact in the four CPQ domains was found for schoolchildren with MIH: oral symptoms [RR=1.75 (CI95% 1.63–1.78)]; functional limitations [RR=2.17 (CI95% 2.01–2.35)]; emotional wellbeing [RR=1.94 (CI95% 1.80–2.08)]; and, social well-being [RR=2.62 (CI95% 2.49–2.77)]. A greater impact on the four CPQ domains were found for children with moderate/severe MIH compared to children without MIH ($p < 0.001$). **Conclusion:** Children with moderate/severe MIH experienced a greater negative impact on their OHRQoL compared to children without MIH.

Keywords: Molar-Incisor Hypomineralization, quality of life, schoolchildren, dental caries.

INTRODUCTION

The evaluation of Oral Health-Related to Quality of Life (OHRQoL) scores is increasingly used for both the study of the concept of health in all its dimensions and efforts relating it to epidemiological indicators.^{1,2} Much of the research published worldwide has focused on caries, as it is a highly prevalent disease in a large part of the population.^{3,4}

Defects in the Development of Enamel (DDE) have been reported to have an impact on OHRQoL, as they affect both aesthetics and masticatory function, with Molar Incisor Hypomineralization (MIH) included in such defects. MIH is a defect in the enamel that manifests itself with abnormal and delimited opacities that present a coloration that varies from whitish-creamy to yellowish-brown. It can present crown loss and, in severe cases, the early loss of the affected molars.⁵

MIH affects from one to four of the first permanent molars and its prevalence ranges from 2% to 40%.⁶

MIH is associated with dental problems, such as pain, discomfort when chewing, sleeping difficulties and hypersensitivity. According to published results, children with MIH may present a greater risk of caries⁷ and experience a negative impact on their quality of life. Instruments such as the Child Perceptions Questionnaire (CPQ)⁸ and the Child Oral Impacts on Daily Performances Index (Child-OIDP)⁹ are used to determine the impact of oral conditions on children emotionally, functionally and socially.

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Different studies have shown that oral conditions such as caries and dental fluorosis have a negative impact on quality of life.¹⁰⁻¹² However, there are few studies on the relationship between MIH and OHRQoL,^{13,14} where the pigmentation and changes produced in the tooth by MIH are likely to have a negative impact on both the child and adolescent population.

The hypothesis proposed in the present study is that the presence of moderate/severe MIH will affect the OHRQoL of children more than the mild categories of MIH. Therefore, the objective of the present study was to evaluate the impact of MIH on the OHRQoL of 8 to 10 year-old Mexican schoolchildren.

MATERIALS AND METHOD

This study comprised a cross-sectional design, carried out in 2018, of a representative sample of 8 to 10 year-old schoolchildren from the municipality of Naucalpan de Juarez in the State of Mexico. The area selected had a population of 844,219 inhabitants, of whom 78.9% had access to piped water, 98.0% had access to basic sanitation, and 77.6% were entitled to healthcare through a health service or program. According to the *Instituto Nacional de Estadística y Geografía* (INEGI, or the National Institute for Statistics and Geography), the municipality is classified as having a very low level of marginalization.¹⁵ For convenience, three schools of the study area were selected.

The sample size was calculated to detect an Odds Ratio (OR) = 2.5 with 80% power and an alpha of 0.05, and a probability of 0.30 for MIH. Considering the probability of those children with MIH have negative impact on OHRQoL. The study group comprised schoolchildren aged 8 to 10 presenting the eruption of at least one first permanent molar. The exclusion criteria were the presence of orthodontic attachments that prevented the examination of the tooth surface. A total of 500 parents were asked to consent to their children participating in the study, with 460 accepting and signing an informed consent form (a 92.0% response rate). Of the potentially eligible 460 subjects, 1 was excluded due to the presence of an orthodontic appliance, as were the 34 who did not attend school the days when the selection examinations were conducted and the 14 who did not present the eruption of any first permanent molars when the oral evaluation was performed. Therefore, the study was conducted on 411 schoolchildren. The Ethics Committee of the Faculty of Dentistry at the National Autonomous University of Mexico approved the study protocol. The research was conducted in full accordance with the World Medical Association Declaration of Helsinki (Protocol 20180515).

OHRQoL Evaluation

OHRQoL was evaluated using the Spanish version of the Child Perceptions Questionnaire (CPQ₈₋₁₀),¹⁶ which was designed exclusively for this age group and has been proven to be valid and reliable for use with Mexican children.¹¹ The CPQ consists of 25 questions (score range 0-100) divided into four domains: oral symptoms; functional limitation; emotional well-being; and, social well-being. All answers to these questions are given on a Likert scale (0-4) relative to the frequency of events in the last four weeks. In addition, the CPQ₈₋₁₀ has two global questions, one of which is related to the general perception that the child has about the state of their oral health, while the other relates to the extent to which the child's oral/oro-facial condition affects their general well-being. The higher the CPQ₈₋₁₀ value the greater deterioration in the child's quality of life.

Oral health status

After this questionnaire had been administered to the schoolchildren, an oral examination was performed in which a light source, plane mirror (#5) and WHO-type probe were used to evaluate the oral health status of the participants. The subject's teeth were brushed before the oral examination, which was conducted by a dentist, whose measurements had already been standardized, obtaining a Cohen's kappa coefficient for intra-examiner calibration of 0.84 and 0.81 for MIH and dental caries, respectively.

The evaluation of caries in both dentitions used ICDAS II, an index that classifies caries on a score between 0 and 6, with high values indicating an increase in the severity of dental caries.¹⁷

The evaluation of MIH included the inspection of all molars and erupted permanent incisors, which were then classified according to the European Academy of Pediatric Dentistry (EAPD) criteria.⁵ The severity of MIH was classified as follows: mild – one white or creamy demarcated opacity with a >1 mm diameter and affecting less than one third of the tooth surface; moderate – one yellow or brown demarcated opacity with a >1 mm diameter and affecting less than one third of the tooth surface, two or more white or creamy demarcated opacities with a >1 mm diameter affecting at least one third but less than two thirds of the tooth surface (on which rough enamel is frequently found), post-eruptive enamel breakdown ≤ 2 mm in diameter, or atypical restorations involving at least one third but less than two thirds of the affected tooth surface; or, severe – two or more yellow or brown demarcated opacities with a >1 mm diameter affecting at least one third or more of the tooth surface, two or more white or creamy demarcated opacities with a >1 mm diameter affecting at least two thirds of the tooth surface, post-eruptive enamel breakdown >2 mm in diameter, or atypical restoration involving more than two thirds of the affected tooth surface.^{18,19} The severity of MIH in each child was defined by the most severe defect observed in the first permanent molars or permanent incisors.

Variables

The variables used in this study comprised the following: age in years; gender (boy/girl); toothbrushing frequency (≥ 2 times a day/< 2 times a day); and, the Simplified Oral Hygiene Index (OHI-S) dichotomized into poor (OHI-S ≥ 2 score) and good hygiene (OHI-S < 2 score). Dental caries were evaluated by applying ICDAS II criteria, forming two categories: ICDAS <4 primary + permanent dentition; and, ICDAS II ≥ 4 primary + permanent dentition.

MIH was classified in terms of the presence/absence and severity of the lesion and classified in two categories – mild and moderate/severe.¹⁹ OHRQoL was measured using the Spanish version of the Child Perceptions Questionnaire (CPQ).¹⁶

Statistical analysis

The data was described using means and Standard Deviations (SD) for continuous variables and percentages for categorical variables. A bivariate analysis was performed using nonparametric tests (Pearson's Xi square, Kruskal-Wallis and Wilcoxon's Rank Test) to evaluate the association between the variables used in the study and the CPQ. Two different multiple regression models were built, one with presence/absence of MIH and confounding variables, and the other with severity of MIH and the same confounding variables. Poisson Regression Models with robust variance were used for the

association between the dependent OHRQoL variable (CPQ₈₋₁₀ and the respective domains), the independent variables and confounding variables (Age, sex, toothbrushing frequency and OHI-S) a type of analysis used in other similar studies.^{13,20}

Overall, CPQ₈₋₁₀ and specific domain scores were compared in terms of the rate ratios (RRs) and respective 95% confidence intervals (95% CIs) of interest and confounding variables, with values of $p \leq 0.05$ considered statistically significant. The analysis was undertaken using the program Stata/SE 14 (Stata Corp, College Station, TX, USA).

RESULTS

A total of 411 schoolchildren aged 8 to 10, with a mean age of 8.99 (± 0.82), were included in the study. The percentage of girls and boys examined was 52.8% and 47.2% respectively. It was found that 48.7% of the sample brushed their teeth less than twice a day, with 99.0% using toothpaste. According to the OHI-S, 30.9% of schoolchildren have poor oral hygiene.

The prevalence of MIH was found to be 40.4% in the schoolchildren (166/411), 48.2% in boys and 51.8% in girls ($p = 0.740$). The majority of defects caused by MIH were classified as moderate (27.2%), followed by mild (6.8%) and severe (6.3%). Poor oral hygiene (OHI-S ≥ 2) was associated with the presence of MIH in children with and without MIH, 60.8% and 50.6%, respectively ($p = 0.041$).

The prevalence of caries in primary dentition (ICDAS ≥ 4) was 49.1% and 42.8% in permanent dentition (ICDAS ≥ 4). Moreover, 89.8% of schoolchildren presented large carious lesions (ICDAS ≥ 4) in both primary and permanent dentition. The mean for carious lesions (ICDAS ≥ 4) was 3.96 (± 2.64) and 2.72 (± 2.16), for primary and permanent dentition, respectively.

Child Perceptions Questionnaire in 8 to 10 year-old schoolchildren (CPQ₈₋₁₀)

In response to the general question about the schoolchildren's perception of their oral health, 16.6% rated their oral health as very good, 21.9% as good, 25.5% as regular and 36.0% as poor. Regarding general well-being, 65.0% of children experienced a negative impact on their quality of life due to the condition of their mouth, with their answers distributed as follows: 35.0% indicated no impact; 24.6% indicated a low impact; 8.5% indicated a medium impact; and, 31.9% indicated a high impact. The CPQ₈₋₁₀ results revealed that 65.0% of the schoolchildren had experienced some degree of impact on their quality of life as a result of their mouth conditions, breaking down per domain as follows: 54.5% for oral symptoms; 54.7% for functional limitations; 49.8% for emotional well-being; and, 61.3% for social well-being. The mean CPQ₈₋₁₀ score in children who had experienced one impact (CPQ > 0) was 40.0 (± 32.6), with a median of 28 (IQR 11, 76).

Dental caries and MIH

The prevalence of caries [primary + permanent dentition (ICDAS II ≥ 4)] was higher in schoolchildren with MIH than in children without MIH (58.4% vs 32.2%, $p < 0.001$). In terms of severity, the prevalence of caries was higher in the moderate/severe MIH category compared to the mild and normal MIH category – 63.0%, 35.7% and 32.2%, respectively ($p < 0.001$).

OHRQoL in 8 to 10 year-old schoolchildren – MIH and dental caries

The bivariate analysis of the relationship between the two global CPQ₈₋₁₀ questions and MIH found that the subjects' general perception of their regular/bad oral health was higher in those with MIH compared to those without MIH – 78.9% vs. 49.8% ($p < 0.001$), respectively. On the other hand, 63.2% of children with MIH indicated that the state of their oral health somewhat affected their general well-being compared to 24.9% of children without MIH ($p < 0.001$).

When the means for the four CPQ₈₋₁₀ domains and presence MIH were compared, significant differences were found for the following: oral symptoms ($p < 0.001$); functional limitations ($p < 0.001$); emotional well-being ($p < 0.001$); social well-being ($p < 0.001$); and, for the overall score ($p < 0.001$). Moreover, the following significant differences were found between caries (ICDAS ≥ 4) and the four domains: oral symptoms ($p = 0.006$); functional limitations ($p = 0.004$); emotional well-being ($p = 0.001$); social well-being ($p = 0.005$); and, for the global score ($p = 0.010$). Table 1 presents the total distribution and by domain of the CPQ₈₋₁₀ with the levels of severity of MIH and the association between the variables included in the study, demonstrating that most of the children with moderate/severe forms of MIH presented a higher CPQ₈₋₁₀ score. The variables of OHI-S and toothbrushing were not significant in the four CPQ₈₋₁₀ domains.

Poisson regression analysis did not detect multicollinearity among the independent variables. The model showed that schoolchildren with MIH experienced a higher rate of negative impact compared to schoolchildren without MIH in terms of the overall score [RR=2.07 (CI95% 2.00 – 2.14)] and the four CPQ₈₋₁₀ domains: oral symptoms [RR=1.75 (CI95% 1.63 – 1.78)]; functional limitations [RR=2.17 (CI95% 2.01 – 2.35)]; emotional well-being [RR=1.94 (CI95% 1.80 – 2.08)]; and, social well-being [RR=2.62 (CI95% 2.49 – 2.77)]. Furthermore, schoolchildren with caries (ICDAS ≥ 4) experienced a higher rate of negative impact compared to schoolchildren without caries, in terms of both the overall score [RR=1.05 (CI95% 1.01 – 1.08)] and the four CPQ₈₋₁₀ domains: oral symptoms [RR=1.09 (CI95% 1.02 – 1.17)]; functional limitations [RR=1.13 (CI95% 1.05 – 1.21)]; emotional well-being [RR=1.12 (CI95% 1.04 – 1.21)]; and, social well-being [RR=1.06 (CI95% 1.01 – 1.12)]. Oral hygiene presented no association with the four CPQ₈₋₁₀ domains (Table 2).

In terms of the severity of MIH, schoolchildren with moderate/severe MIH indicated a higher negative impact rate compared to those without MIH in the four CPQ₈₋₁₀ domains: oral symptoms [RR=1.78 (CI95% 1.65 – 1.92)]; functional limitations [RR=2.24 (CI95% 2.07 – 2.43)]; emotional well-being [RR=2.00 (CI95% 1.85 – 2.16)]; and, social well-being [RR=2.66 (CI95% 2.51 – 2.81)] (Table 3).

Table 1. Overall CPQ8–10 score and subscales by Molar Incisor Hypomineralization (MIH), dental caries (ICDAS II) sex, OHI-S and toothbrushing frequency in schoolchildren 8 to 10 years of age (n=411).

		n (%)	Total score CPQ		Oral symptoms		Functional limitation		Emotional well-being		Social well-being	
			mean (SD) ^b	median ^c	mean (SD) ^b	median ^c	mean (SD) ^b	median ^c	mean (SD) ^b	median ^c	mean (SD) ^b	median ^c
Sex	Girls	194 (47.2)	43.2 (33.5)	33	8.6 (6.6)	7	7.9 (7.4)	5	8.5 (7.4)	6	16.4 (15.7)	9
	Boys	217 (52.8)	37.2 (31.6)	24	7.6 (6.3)	6	6.6 (7.1)	4	7.1 (6.8)	5	13.6 (15.2)	5
MIH	No	245 (59.6)	27.6 (28.0)**	17**	6.0 (5.9)**	4**	4.8 (6.2)**	2**	5.5 (6.4)**	3**	8.8 (13.0)**	3**
	Yes	166 (40.4)	58.2 (30.3)	71	11.1 (6.1)	13	10.9 (7.2)	14	11.1 (6.9)	15	24.0 (14.4)	33
Severity MIH	Normal	245 (59.6)	27.6 (31.2)**	17**	6.0 (5.9)**	4**	4.8 (6.3)**	2**	5.5 (6.4)**	3**	8.8 (13.0)**	3**
	Mild	28 (6.8)	52.6 (31.5)	57	10.1 (6.6)	8.5	9.2 (7.9)	7.5	9.4 (7.8)	7	22.7 (15.7)	31.5
	Moderate/severe	138 (33.6)	59.4 (28.9)	73.5	11.3 (6.1)	14	11.2 (7.0)	14.5	11.4 (6.7)	15	24.3 (14.2)	33
Dental caries^a	ICDAS <4	42 (10.2)	35.7 (31.7)*	24*	7.3 (6.2)*	6	6.2 (6.9)*	3*	6.8 (6.9)*	4*	12.9 (14.8)*	5*
	ICDAS ≥4	369 (89.8)	45.7 (33.0)	37.5	9.4 (6.9)	7	8.7 (7.5)	6	9.2 (7.3)	7	17.9 (16.1)	11
OHI-S	Good hygiene	186 (45.3)	37.8 (31.5)	25.5	7.8 (6.3)	6	7.0 (7.0)	4	7.3 (7.1)	4.5	13.5 (15.1)	5
	Poor hygiene	225 (54.7)	41.8 (33.5)	28	8.3 (6.6)	6	7.5 (7.5)	4	8.3 (7.2)	6	16.1 (15.7)	9
Toothbrushing frequency	≥ 2 times a day	211 (51.3)	42.1 (33.1)	29	8.5 (6.6)	7	7.8 (7.4)	5	8.3 (7.2)	6	16.1 (15.8)	8
	< 2 times a day	200 (48.7)	37.8 (32.0)	25.5	7.6 (6.3)	5	6.7 (7.1)	4	7.3 (7.0)	5	13.8 (15.2)	5

^aICDAS II (ICDAS II primary + permanent), ^bKruskal-Wallis tests, ^cWilcoxon rank-sum (Mann–Whitney) test, *p<0.05 ** p≤0.001

Table 2. Adjusted rate ratio (RR) from Poisson regression analysis for the Oral health-related quality of life (OHRQoL) and Molar Incisor Hypomineralization (presence/absence MIH) and confounding variables in schoolchildren 8 -10 years of age (n=411).

		Total score CPQ	Oral symptoms	Functional limitation	Emotional well-being	Social well-being
		Robust RR (95% CI)				
Sex	Boys	1.00	1.00	1.00	1.00	1.00
	Girls	1.14 (1.11-1.18) p<0.001	1.11 (1.04-1.19) p=0.001	1.17 (1.09-1.26) p<0.001	1.18 (1.10-1.26) p<0.001	1.18 (1.12-1.24) p<0.001
MIH	No	1.00	1.00	1.00	1.00	1.00
	Yes	2.07 (2.00-2.14) p<0.001	1.75 (1.63-1.88) p<0.001	2.17 (2.01-2.35) p<0.001	1.94 (1.80-2.08) p<0.001	2.62 (2.49-2.77) p<0.001
Dental caries^a	ICDAS <4	1.00	1.00	1.00	1.00	1.00
	ICDAS ≥4	1.05 (1.01-1.08) p=0.002	1.09 (1.02-1.17) p=0.008	1.13 (1.05-1.21) p=0.001	1.12 (1.04-1.21) p=0.001	1.06 (1.01-1.12) p=0.017
OHI-S	Good hygiene	1.00	1.00	1.00	1.00	1.00
	Poor hygiene	0.98 (0.94-1.01) p=0.239	1.01 (0.94-1.08) p=0.746	0.95 (0.88-1.03) p=0.309	0.96 (0.89-1.04) p=0.359	1.00 (0.95-1.06) p=0.727

^aICDAS II: (ICDAS II primary + permanent), RR: Rate Ratio, CI: Confidence Interval.

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Table 3. Adjusted rate ratio (RR) from Poisson regression analysis for the Oral health-related quality of life (OHRQoL) and severity of Molar Incisor Hypomineralization (MIH) and confounding variables in schoolchildren 8-10 years of age (n=411).

		Total score CPQ	Oral symptoms	Functional limitation	Emotional well-being	Social well-being
Robust RR (95% CI)						
Sex	Boys	1.00	1.00	1.00	1.00	1.00
	Girls	1.14 (1.11-1.18) p<0.001	1.12 (1.04-1.20) p=0.001	1.18 (1.09-1.26) p<0.001	1.18 (1.10-1.27) p<0.001	1.18 (1.12-1.24) p<0.001
MIH	Normal	1.00	1.00	1.00	1.00	1.00
	Mild	1.88 (1.78-1.99) p<0.001	1.63 (1.44-1.85) p<0.001	1.88 (1.64-2.16) p<0.001	1.67 (1.47-1.91) p<0.001	2.48 (2.27-2.71) p<0.001
	Moderate/severe	2.11 (2.04-2.19) p<0.001	1.78 (1.65-1.92) p<0.001	2.24 (2.07-2.43) p<0.001	2.00 (1.85-2.16) p<0.001	2.66 (2.51-2.81) p<0.001
Dental caries^a	ICDAS <4	1.00	1.00	1.00	1.00	1.00
	ICDAS ≥4	1.04 (1.00-1.07) p=0.015	1.09 (1.01-1.17) p=0.016	1.11 (1.03-1.20) p=0.005	1.10 (1.03-1.19) p=0.005	1.05 (1.00-1.11) p=0.037
OHI-S	Good hygiene	1.00	1.00	1.00	1.00	1.00
	Poor hygiene	0.98 (0.95-1.02) p=0.494	1.01 (0.94-1.09) p=0.634	0.97 (0.89-1.05) p=0.486	0.97 (0.90-1.05) p=0.552	1.01 (0.96-1.07) p=0.588

aICDAS II: (ICDAS II primary + permanent), RR: Rate Ratio, CI: Confidence Interval.

DISCUSSION

In 8 to 10 year-old schoolchildren, the presence of MIH was associated with a negative impact on the quality of life both in the four CPQ domains and in the overall CPQ₈₋₁₀ score. Few studies have evaluated the impact of MIH on OHRQoL in the child population. For example, applying the CPQ₈₋₁₀ with 8-10 year-old Colombian schoolchildren, Velandia *et al.* found differences for each of the four CPQ₈₋₁₀ domains and the overall CPQ score in terms of the presence of MIH.¹⁴ A study in Brazil conducted on children aged 11-14 and using CPQ₁₁₋₁₄ found that MIH was associated with a negative impact on OHRQoL for the domains of oral symptoms (RR=1.30; 95%CI=1.06 – 1.60) and functional limitations (RR = 1.42; 95%CI = 1.08 – 1.86).¹³

In terms of the severity of MIH, in the present study, schoolchildren with moderate/severe MIH experienced a greater negative impact across the four CPQ domains compared to schoolchildren without MIH: oral symptoms; functional limitations; emotional well-being; and, social well-being. Similar results were found for children in Brazil, where the presence of severe MIH was associated with a negative impact on their quality of life for oral symptoms and functional limitations.¹³

The association found in the present study, namely between MIH and OHRQoL, could be due to the effect on masticatory function. This is due to the fact that, during mastication, teeth with MIH can present a loss of enamel continuity as well as fractures that facilitate the accumulation of biofilm in the enamel, thus causing dentin exposure^{21,22} and dental sensitivity.²³ Dental sensitivity in children with MIH causes children to brush their teeth less frequently and, as a consequence, means that they experience an accumulation of biofilm and food and the presence of halitosis,²⁴ producing a greater number of carious lesions on the affected teeth.²⁵

MIH can have consequences through such functional limitations as discomfort when chewing food, and difficulty both in sleeping and brushing teeth. Approximately 54.5% and 54.7% of children in the present study experienced some negative impact through oral symptoms and functional limitations, respectively. Moreover, it was observed that, in the child population aged 6 to 12; problems with eating are negatively related to OHRQoL.²⁶

The present study found that approximately half of the 8 to 10 year-old schoolchildren experienced a negative impact in the domains of emotional and social wellbeing due to the condition of their mouth (49.8% and 61.3%, respectively). These aspects are important to consider due to the emotional insecurity of children at this age; therefore, preventive treatments are required to prevent oral diseases that may have a negative impact on their emotional and social status.

In the schoolchildren studied for this research, the presence of carious lesions (ICDAS ≥4) was associated with a negative impact on their quality of life. This association between caries and quality of life has been reported in other studies conducted in both Mexico^{11,12} and Brazil.²⁷

For example, a study conducted in Mexico on children aged 8 to 10 found that high rates of caries were associated with the four CPQ domains,¹⁶ while a Brazilian study conducted on 8 to 10 year-old children and which used CPQ found that the oral condition with the greatest negative impact on OHRQoL is caries.²⁸ The results of the present study show that the prevalence of caries (ICDAS ≥4) in primary and permanent dentition was high (89.8%). It is possible that the presence of these cavitated lesions does cause pain or discomfort, as 54.5% of subjects reported having oral symptoms in the CPQ. However, CPQ results for Nigerian children show that the presence of dental caries does not have a significant impact on their quality of life.²⁹

Significant differences were found in this study between girls and boys in terms of the presence of MIH. Also it was found that the score for the four CPQ domains was higher for girls compared to boys, and, in the multivariate model, girls experienced a greater negative impact on their quality of life compared to the boys CPQ scores across the four domains. Worldwide, it has been found in the literature that CPQ scores are higher for girls than boys,¹³ because women are considered to be more concerned than men about their appearance and others' perception of them.³⁰

One limitation of this study is its cross-sectional design, as the child's perception of their oral health was obtained at a particular time in their life. Another important aspect is that the children studied were not randomly selected, which is a limitation of the study. Thus, the data obtained in this study should be extrapolated with caution to other groups of schoolchildren, due to the sociocultural characteristics in the specific population studied.

CONCLUSION

This study found a significant association between MIH and OHRQoL after adjusting for other variables of interest. Schoolchildren with moderate/severe MIH experience a greater impact across the four CPQ₈₋₁₀ domains compared to children without MIH. Identifying an association between MIH and OHRQoL is of great importance, particularly in the school population, where the main risk factors are related with different oral conditions and low availability and accessibility to oral health services in populations with low levels of financial resources.

It is important to encourage ensure the early identification of MIH in order to avoid oral health problems and, above all, to reduce its impact on schoolchildren's OHRQoL.¹³

REFERENCES

1. Do LG, Spencer AJ. Evaluation of oral health-related quality of life questionnaires in a general child population. *Community Dent Health* 25:205-10, 2008.
2. Barbosa TS, Gavião MB. Oral health-related quality of life in children: part II. Effects of clinical oral health status. A systematic review *Int J Dent Hyg* 6:100-7, 2008.
3. Dye BA, Hsu KL, Afful J. Prevalence and Measurement of Dental Caries in Young Children. *Pediatr Dent* 37:200-16, 2015.
4. Pontigo-Loyola AP, Medina-Solis CE, Borges-Yañez SA, Patiño-Marín N, Islas-Márquez A, Maupome G. Prevalence and severity of dental caries in adolescents aged 12 and 15 living in communities with various fluoride concentrations. *J Public Health Dent* 67:8-13, 2007.
5. Weerheijm KL, Duggal M, Mejare I, Papagiannoulis L, Koch G, Martens LC, Hallonsten AL. Judgement criteria for molar incisor hypomineralisation (MIH) in epidemiologic studies: a summary of the European meeting on MIH held in Athens, 2003. *Eur J Paediatr Dent* 4:110-13, 2003.
6. Schwendicke F, Elhennawy K, Reda S, Bekes K, Manton DJ, Krois J. Global burden of molar incisor hypomineralization. *J Dent* 68:10-18, 2018.
7. Wuollet E, Laisi S, Alaluusua S, Waltimo-Sirén J. The Association between Molar-Incisor Hypomineralization and Dental Caries with Socioeconomic Status as an Explanatory Variable in a Group of Finnish Children. *Int J Environ Res Public Health* 15(7). pii: E1324, 2018.
8. Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G. Validity and reliability of a questionnaire for measuring child oral-health-related quality of life. *J Dent Res* 81:459-63, 2002.
9. Gherunpong S, Tsakos G, Sheiham A. Developing and evaluating an oral health-related quality of life index for children; the CHILD-OIDP. *Community Dent Health* 21:161-169, 2004.
11. Paula JS, Sarracini KL, Ambrosano GM, Pereira AC, Meneghim MC, Mialhe FL. Impact of a dental care program on the quality of life of children with and without caries. *Braz Oral Res* 30(1):e139, 2016.
- [1] Aguilar-Díaz FC, Irigoyen-Camacho ME, Borges-Yañez SA. Oral-health-related quality of life in schoolchildren in an endemic fluorosis area of Mexico. *Qual Life Res* 20:1699-706, 2011.
12. García-Pérez Á, Irigoyen-Camacho ME, Borges-Yañez SA, Zepe-da-Zepeda MA, Bolona-Gallardo I, Maupomé G. Impact of caries and dental fluorosis on oral health-related quality of life: a cross-sectional study in schoolchildren receiving water naturally fluoridated at above-optimal levels. *Clin Oral Investig* 21:2771-2780, 2017.
13. Dantas-Neta NB, Moura LF, Cruz PF, Moura MS, Paiva SM, Martins CC, Lima MD. Impact of molar-incisor hypomineralization on oral health-related quality of life in schoolchildren. *Braz Oral Res* 30:e117, 2016.
14. Velandia LM, Álvarez LV, Mejía LP, Rodríguez MJ. Oral health-related quality of life in Colombian children with Molar-Incisor Hypomineralization. *Acta Odontol Latinoam* 31:38-44, 2018.
15. INEGI. Instituto Nacional de Estadística y Geografía, México. Panorama sociodemográfico de Estado de México 2015. http://internet.contenidos.inegi.org.mx/contenidos/Productos/prod_serv/contenidos/espanol/bvinegi/productos/nueva_estruc/inter_censal/panorama/702825082246.pdf (accessed 13.08.18)
16. del Carmen Aguilar-Díaz F, Irigoyen-Camacho ME. Validation of the CPQ8-10ESP in Mexican school children in urban areas. *Med Oral Patol Oral Cir Bucal* 16:e430-5, 2011.
17. Ismail AI, Sohn W, Tellez M, Amaya A, Sen A, Hasson H, Pitts NB. The International Caries Detection and Assessment System (ICDAS): an integrated system for measuring dental caries. *Community Dent Oral Epidemiol* 35:170-8, 2007.
18. Mathu-Muju K, Wright JT. Diagnosis and treatment of molar incisor hypomineralization. *Compend Contin Educ Dent* 27:604-10, 2006.
19. Leppäniemi A, Lukinmaa PL, Alaluusua S. Nonfluoride hypomineralizations in the permanent first molars and their impact on the treatment need. *Caries Res* 35:36-40, 2001.
20. Lima SLA, Santana CCP, Paschoal MAB, Paiva SM, Ferreira MC. Impact of untreated dental caries on the quality of life of Brazilian children: population-based study. *Int J Paediatr Dent* 28:390-399, 2018.
21. Americano GC, Jacobsen PE, Soviero VM, Haubek D. A systematic review on the association between molar incisor hypomineralization and dental caries. *Int J Paediatr Dent* 27:11-21, 2017.
22. Fagrell TG, Lingström P, Olsson S, Steiniger F, Norén JG. Bacterial invasion of dentinal tubules beneath apparently intact but hypomineralized enamel in molar teeth with molar incisor hypomineralization. *Int J Paediatr Dent* 18:333-40, 2008.
23. da Costa-Silva CM, Jeremias F, de Souza JF, Cordeiro Rde C, Santos-Pinto L, Zuanon AC. Molar incisor hypomineralization: prevalence, severity and clinical consequences in Brazilian children. *Int J Paediatr Dent* 20:426-34, 2010.
24. William V, Messer LB, Burrow MF. Molar incisor hypomineralization: review and recommendations for clinical management. *Pediatr Dent* 28:224-32, 2006.
25. Oyedele TA, Folayan MO, Adekoya Sofowora CA, Oziegbe EO. Comorbidities associated with molar incisor hypomineralisation in 8 to 16 year old pupils in Ileife, Nigeria. *BMC Oral Health* 15:37, 2015.
26. Montero J, Rosel E, Barrios R, López-Valverde A, Albaladejo A, Bravo M. Oral health-related quality of life in 6- to 12-year-old schoolchildren in Spain. *Int J Paediatr Dent* 26:220-30, 2016.
27. Freire MDCM, Corrêa-Faria P, Costa LR. Effect of dental pain and caries on the quality of life of Brazilian preschool children. *Rev Saude Publica* 52:30, 2018.
28. Martins MT, Sardenberg F, Bendo CB, Vale MP, Paiva SM, Pordeus IA. Dental caries are more likely to impact on children's quality of life than malocclusion or traumatic dental injuries. *Eur J Paediatr Dent* 19:194-198, 2018.
29. Kolawole KA, Otuyemi OD, Oluwadaisi AM. Assessment of oral health-related quality of life in Nigerian children using the Child Perceptions Questionnaire (CPQ 11-14). *Eur J Paediatr Dent* 12:55-9, 2011.
30. Arrow P. Dental enamel defects, caries experience and oral health related quality of life: a cohort study. *Aust Dent J* 62:165172, 2017.