Molar incisor hypomineralization and oral health-related quality of life in Brazilian children: A narrative review of current evidence

Hipomolarização de molares e incisivos e qualidade de vida relacionada à saúde bucal em crianças Brasileiras: Uma revisão narrativa das evidências atuais

Hipomolarización molar-incisiva y calidad de vida relacionada con la salud bucal en niños Brasileños: Una revisión narrativa de la evidencia actual

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Abstract
The aim of this narrative review was to explore the association between Molar Incisor Hypomineralisation (MIH) and Oral Health-Related Quality-of-Life (OHRQoL) in Brazilian children aged 8-10 years. The study was developed considering the PRISMA guidelines (2020). Five databases were consulted to identify potential studies that used clinical parameters for the detection of MIH; and (b) studies that described aspects of the experience and severity of MIH; (c) records that adopted instruments recommended in the literature to explore OHRQoL in children, according to their respective age groups. The risk of bias of the included studies was analyzed using the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies. Of the 155 initially found, three were included. Of these, two were cross-sectional and one was a case-control study. The diagnosis of MIH was made according to the criteria of the European Academy of Paediatric Dentistry, and OHRQoL was identified using the Child Perceptions Questionnaire (CPQ8-10). The qualitative synthesis of the findings shows that no statistically significant association was identified between MIH and OHRQoL. Only the "oral symptoms domain" of the CPQ8-10 was associated with MIH. The studies were classified as having a low risk of bias (mean: 6.6★/7★). Thus, this study concluded that no significant association was identified between MIH and OHRQoL in Brazilian children. However, MIH may have a negative effect on the perception of oral symptoms in this population group.
Keywords: Children; Dental enamel hypoplasia; Oral health; Quality of life.

Resumo
O objetivo desta revisão narrativa foi explorar a associação entre a hipomineralização molar-incisiva (MIH) e a qualidade de vida relacionada à saúde bucal (QVRSB) em crianças brasileiras de 8 a 10 anos. O estudo foi desenvolvido considerando as diretrizes PRISMA (2020). Cinco bases de dados foram consultadas para identificar potenciais estudos que utilizaram parâmetros clínicos para detecção de MIH; e (b) estudos que descreveram aspectos da experiência/gravidade da MIH; (c) registros que adotaram instrumentos recomendados na literatura para explorar a QVRSB em crianças, de acordo com suas respectivas faixas etárias. O risco de viés dos estudos incluídos foi analisado pela escala Newcastle-Ottawa para avaliação da qualidade dos estudos não randomizados. Dos 155 encontrados inicialmente, três foram incluídos. Destes, dois foram transversais e um foi um estudo caso-controle. O

diagnóstico de HMI foi feito de acordo com os critérios da Academia Europeia de Odontopediatria, e a QVRSB foi identificada por meio do Child Perceptions Questionnaire (CPQ8-10). A síntese qualitativa dos achados demonstrou que não foi identificada associação estatisticamente significativa entre MIH e QVRSB. Apenas o domínio "sintomas orais" do CPQ8-10 esteve associado à MIH. Os estudos foram classificados com baixo risco de viés (média: 6,6★/7★). Assim, este estudo concluiu que não foi identificada associação significativa entre MIH e QVRSB em crianças brasileiras. No entanto, a MIH pode ter um efeito negativo na percepção dos sintomas orais neste grupo populacional.

Palavras-chave: Crianças; Hipoplasia do esmalte dentário; Saúde bucal; Qualidade de vida.

Resumen

El objetivo de esta revisión narrativa fue explorar la asociación entre la hipomineralización de los incisivos molares (MIH) y la calidad de vida relacionada con la salud bucal (OHRQoL) en niños brasileños de 8 a 10 años. El estudio se desarrolló considerando las guías PRISMA (2020). Se consultaron cinco bases de datos para identificar posibles estudios que utilizaran parámetros clínicos para la detección de MIH; y (b) estudios que describieron aspectos de la experiencia y la gravedad de la MIH; (c) registros que adoptaron instrumentos recomendados en la literatura para explorar la OHRQoL en niños, según sus respectivos grupos de edad. El riesgo de sesgo de los estudios incluidos se analizó mediante la escala de Newcastle-Ottawa para evaluar la calidad de los estudios no aleatorios. De los 155 encontrados inicialmente, se incluyeron tres. De ellos, dos fueron transversales y uno fue un estudio de casos y controles. El diagnóstico de MIH se realizó según los criterios de la Academia Europea de Odontología Pediátrica y la OHRQoL se identificó mediante el Child Perceptions Questionnaire (CPQ8-10). La síntesis cualitativa de los hallazgos muestra que no se identificó ninguna asociación estadísticamente significativa entre MIH y OHRQoL. Sólo el "dominio de síntomas orales" del CPQ8-10 se asoció con MIH. Los estudios se clasificaron como de bajo riesgo de sesgo (media: 6,6★/7★). Así, este estudio concluyó que no se identificó asociación significativa entre MIH y OHRQoL en niños brasileños. Así, MIH puede tener un efecto negativo en la percepción de los síntomas bucales en este grupo de población.

Palabras-clave: Niños; Hipoplasia del esmalte dental; Salud bucal; Calidad de vida.

1. Introduction

Molar Incisor Hypomineralization (MIH) manifests as demarcated opacities on permanent molars, exhibiting a spectrum of creamy-white or yellow to yellowish-brown discoloration. This systemic condition impacts one to four permanent first molars and frequently extends to involve the permanent incisors as well (Weerheijm et al., 2001). The MIH anomalies were also identified in the primary second molars, permanent second molars and the apices of the permanent canines. Notably, yellow/brown defects are regarded as more severe compared to white/creamy opacities (Lygidakis et al., 2010). In general, more than a quarter of MIH cases present symptoms and post-eruptive enamel degradation, requiring clinical intervention (Schwendicke et al., 2018).

Estimates indicated that MIH affected approximately 13% of the worldwide population in 2015, accounting for 878 million reported cases, and registering an incidence of 17.5 million new cases in 2016 (Schwendicke et al., 2018). In Brazil, recent studies have demonstrated a prevalence ranging from 12% to 16% among children (Portella et al., 2019; Silva et al., 2017). Recently, MIH has garnered attention as a burgeoning public health concern, given its substantial impact on children's oral health (Alzahrani et al., 2023). Teeth affected by MIH exhibit heightened susceptibility to the rapid development of caries due to increased enamel porosity, structural loss, and exposure of dentinal tubules, thereby facilitating pulpal inflammation (Crombie et al., 2009; Mangum et al., 2010). The complications in teeth affected by MIH are exacerbated by children's tendencies to avoid brushing, leading to increased dental plaque stagnation (Türkmen & Özüköç, 2022).

It is well established in the literature that children affected by MIH experience daily routine challenges (Amrollahi et al., 2023). Firstly, the porous nature of enamel severely affected by the condition makes it susceptible to breakage under masticatory forces, resulting in the underlying dentin being exposed in significant, irregular cavities. This exposed dentin contributes to greater sensitivity and the experience of tooth decay (Lygidakis et al., 2010). These teeth are not only sensitive to temperature variations, but also induce pain to mechanical stimuli, thus negatively affecting even fundamental daily activities such as brushing or eating (Neta et al., 2016). In addition, the aesthetic aspect plays a crucial role, particularly when

the incisors are impacted. Extensive defects on the buccal surface of incisors give rise to aesthetic concerns (Leal et al., 2016). The aforementioned issues have the potential to impact the Oral Health-Related Quality-of-Life (OHRQoL) among individuals with MIH (Amrollahi et al., 2023; Jawdekar et al., 2023).

OHRQoL, in particular, is a multidimensional concept that reflects how oral health affects a person's ability to function and enjoy life and involves subjective evaluation of oral health, functional limitation, pain, discomfort, physical disability, psychological disability, social disability, and handicap. Evaluating OHRQoL may represent the real needs of a population, combining perceived needs and normative and technical needs (Mehta & Kaur, 2011). Among children aged between 8 and 10 years, the predominant instrument for assessing OHRQoL is the Child Perceptions Questionnaire (CPQ8-10) (Barbosa et al., 2009). This instrument was specifically designed to cover a range of oral conditions - such as MIH - and has been used in national and international studies (Amrollahi et al., 2023; Jawdekar et al., 2023).

Recently (2023), a systematic review and meta-analysis synthesized global findings that explored the association between the severity/experience of MIH and OHRQoL assessed by the CPQ8-10 in children. The evidence showed that in MIH children, a significant increase was observed in the total score of CPQ 810 with the pooled mean of 15.89 (95% confidence interval [CI]:8.95-22.84; p = 0.001) and in oral symptoms (OS = 6.25, 95%CI: 4.01-8.50; p = 0.001), functional limitation (FL = 3.88, 95%CI: 1.93-5.83; p = 0.001), and emotional well-being (EW = 3.24, 95%CI: 0.96-5.52; p = 0.01) domains (Amrollahi et al., 2023. Interestingly, similar results have been observed in other studies, especially among Brazilian studies. Significant differences have been reported between the severity of MIH and the impact on OHRQoL in children and adolescents in the country (Portella et al., 2019; Neta et al., 2016).

Thus, it can be suggested that the global synthesis of the findings of the association between MIH and OHRQoL in Brazilian children could expand knowledge about this relationship to the local geographical spectrum. In this context, the aim of this review was to summarize the findings of studies that explored the association between MIH and OHRQoL in Brazilian children aged 8 to 10 years.

2. Methodology

This narrative review was carried out based on the specific suggestions of Preferred Reporting Items for Systematic Reviews and Meta-analyses - PRISMA (2020) in the phases of methodological design and execution, and reporting of information (Page et al., 2020). In accordance with the FAIR Data Principles (Wilkinson et al., 2016), any data and/or information related to this study can be requested from the corresponding author (JAA) via email. The authors declare that there are no conflicts of interest related to this study. Furthermore, no artificial intelligence resources were used during the execution and description of this literature review

Using the PECOS strategy (acronym for Population, Exposition, Comparator, Outcome and Study design) (Morgan et al., 2018), the following research question was used in this investigation: *"Is MIH associated with OHRQoL in Brazilian children with 8-10 years?"*. This strategy, also used in the design of the research searches with MeSH terms/free terms and Boolean operators, considered the items according showed below:

- (Population) Children between 8 to 10 years of age with primary, permanent or mixed dentition;
- (Exposure): Experience or severity of MIH;
- (Comparator): Absence of the MIH condition, if applicable;
- (Outcome): OHRQoL – mean (SD) and/or prevalence of impact on OHRQoL, domains and subscales of impact;
- (Study design): Case-controls, cross-sectional, and randomized or not clinical trials.

The following databases were screened to identify potential studies: Scopus, Web of Science, and PubMed (Search updated on December 6, 2023) (MSF). In general, the descriptors used in the search key were: "molar incisor hypomineralization", "quality of life" and "child". We conducted manual searches in all volumes released in Dental Traumatology, International Journal of Pediatric Dentistry, and European Archives of Pediatric Dentistry from 2003 to 2023. Additionally, grey literature searches were carried in Google Scholar, with the evaluation of the first 100 records based on eligibility criteria. No restrictions related with date of publication or language of studies were imposed.

The literature searches were uploaded in Endnote© X9 (Thomson Reuters, New York, NY, USA) - version 20.0, and duplicate records were removed automatically (Bramer et al., 2017). An independent researcher (JASG) selected the studies based on the eligibility criteria and the data was paired with a gold standard reviewer with experience in oral health epidemiology (JAA). Kappa coefficients were calculated between researchers. Only studies that met the following eligible criteria were included: (a) studies that used clinical parameters for the detection of MIH; and (b) study that described aspects of the experience and severity of MIH; (c) records that adopted instruments recommended in the literature to explore OHRQoL in children, according to their respective age groups. Case reports, editorial letters, pilot studies, cohorts, historical reviews studies. Investigations that included children with behavioral or intellectual disabilities were not included. Investigations that included children with intellectual disabilities were not included.

The risk of bias of the included studies was assessed according to the criteria of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies (Wells, 2023). Aspects related to sample selection, care, handling and analysis of the data, and reporting of the individuals' information were considered in this evaluation stage, where: (A) selection (maximum four stars) - representativeness of the sample, selection of the control groups, ascertainment of the exposure (disease), non-respondents; (B) comparability (maximum two stars) - control for important or additional factors; (C) Exposure (maximum 3 stars) - independent structured assessment, record linkage, self-report.

Aspects of the study selection process were described, as well as the methodological characterization of the records, the risk of bias and the qualitative synthesis of the findings reported in the included studies.

3. Results

The PRISMA 2020 flow diagram with included searches of databases, registers inclusion process is showed in Figue 1. Initially, all database search strategies identified 155 potential studies; 83 records were duplicates and were removed. After title/abstract screening, 54 studies were excluded. The reference list of all the studies included after this stage was analyzed and no relevant records were identified or those that were not included in the preliminary search. Subsequently, 18 publications were screened according to the eligibility criteria in the full-text reading. Of these, three records were included in this review. The Kappa coefficients between the two researchers were 0.75 and 0.79 for the title/abstract and full-text selection, respectively.

A total of 1021 children were included in the three studies. Two studies were cross-sectional and one was a case-control study. All the studies used the EAPD criteria to diagnose MIH. Additional information about the methodological aspects and the assessment of the risk of bias of the studies can be found in Table 1.

Figure 1 - Flowchart of the search process according to PRISMA guidelines.
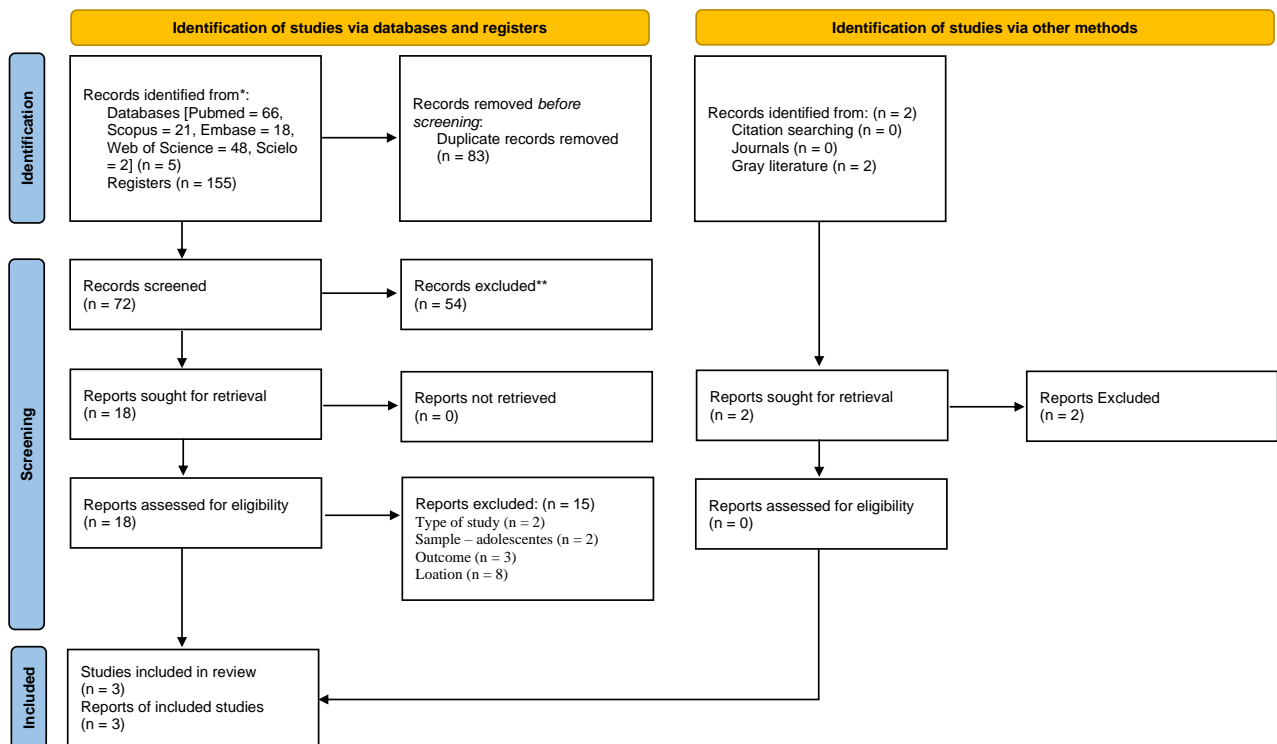
Source: Authors.

In the investigation conducted by Dias et al. (2020), the prevalence rates of mild and severe MIH were documented as 94.1% and 5.9%, respectively. The composite score [mean (standard deviation)] of the CPQ8-10 was ascertained as 15.11 (10.93), with specific domain breakdowns: OS – 5.52 (3.19), FL – 3.31 (3.25), EW – 3.07 (3.57), SW – 3.21 (4.47). Children afflicted with severe MIH exhibited an elevated prevalence of adverse effects, particularly discernible in the domains of LF and EW. Within the CPQ8-10 domains, the OS domain demonstrated the highest mean score. But the study concluded that MIH did not impart a statistically significant impact on OHRQoL based in the multivariate analysis.

In the cross-sectional study by Portela (2019), 12.7% were diagnosed with MIH, of which 71.6% were classified as mild severity and 8.4% as severe. The mean (SD) of the CPQ8-10 and its respective domains was 18.37 (15.65) - OS 5.66 (3.79), FL 3.77 (3.86), EW 4.20 (4.49), SW 4.74 (6.32). The results showed that, in the adjusted model, only the OS domain of the CPQ8-10 was associated with MIH (mild/severe) - OR: 1.07 (1.09-1.11), p<0.001.

Lastly, in the case-control study by Portela et al. (2018), the difference in the total CPQ8-10 score between the groups was not statistically significant in the bivariate analysis (case group - 17.84 (15.01) vs. 23.53 (15.00), p = 0.100. However, no statistically significant differences were identified between the scores of the domains investigated, as follows: OS - 5.42 (3.01) vs. 7.53 (3.76), p = 0.068; FL - 3.84 (4.46) vs. 4.58 (3.83), p = 0.322, EW - 4.00 (4.64) vs. 5.42 (4.73), p = 0.165. No adjusted analysis was performed.

Table 1 - Methodological description and risk of bias of the studies included.

Author Year Location (BR)	Type of study Objective	Sample (N) Sex/age-group	Diagnosis/detection method – (1) MIH	(2) OHRQoL.	Risk of bias (NOS - total score ★)	Use of reporting guidelines
Dias et al., (2020) São Luís, Maranhão (BR)	Cross-sectional To evaluate the perception of parents and children and the impact of MIH on the OHRQoL.	N = 253 Male (n = 125, 49.4%), female (n = 128, 50.6%). 6-12-years, where: 6-7y (n = 42, 16.6%), 8-12y (n = 211, 83.4%).	EAPD (2003). MH severity: mild (demarcated opacities) and severe (enamel breakdown).	CPQ_{8-10} (6-7 years) CPQ_{11-14} (8-12 years) Domains: oral symptoms, functional limitations; emotional well-being and social well-being.	7 ★	×
Portela et al., (2019) Curitiba, Paraná (BR)	Cross-sectional To assess the impact of MIH on OHRQoL in children with early mixed dentition.	N = 728 Male (n = 372, 51,5%). 8 years.	EAPD (2003) MIH severity: mild injury (opacity) and severe injury (post-eruptive fractures, atypical restorations, and tooth extraction attributable to MIH)	CPQ_{8-10} Domains: oral symptoms, functional limitations, emotional well-being, social well-being	7 ★	×
Portela et al., (2018) Curitiba, Paraná (BR)	Case-control To evaluate systemic factors those are related to MIH, its association with dental caries, and the impact on OHRQoL in Brazilian children	Case group (n = 31) and control group (n = 62). 8-14 years of age Mean: 8.5 years (1.48) in the case group and 8.3 years (1.49) in the control group.	Opacities were considered mild defects and divided into white, yellow, and brown. Post-eruptive enamel breakdown, atypical restorations, and extraction due to MIH were categorized as severe defects	CPQ_{8-10} Domains: oral symptoms, functional limitations; emotional well-being.	6 ★	×

Search process according to PRISMA guidelines. Source: Authors.

4. Discussion

The aim of this review was to explore the association between the experience/severity of MIH and OHRQoL in studies with Brazilian children. None of the included studies found a significant association between MIH and OHRQoL. Among the CPQ$_{8\text{-}10}$ domains, only one record identified, through hierarchical analysis, that MIH was associated with a greater impact on OHRQoL in children's oral symptoms. Based on a previous evaluation, this is apparently the first review that synthesized the findings of this association in samples of Brazilian children.

Firstly, it is important to highlight that there has always been conflicting evidence about the effect of MIH on OHRQoL in children. Some studies revealed that MIH does not affect OHRQoL (Vanhée et al, 2022; Neta et al., 2016; Portella et al., 2018), while some others showed that suffering from MIH leads to decreased OHRQoL (Portella et al., 2019; Elhennawy et al., 2022). But a recent meta-analysis demonstrated that the experience of MIH negatively affected the OHRQoL assessed by total score of the CPQ8-10 questionnaire. Yet, interestingly, it was also demonstrated that the different severities of MIH had no significant impact on OHRQoL in children, which is in line with the findings of the studies included in this investigation (Amrollahi et al., 2023). It is suggested that this finding may be related to the development of develop symptoms later in the course of their life, as injuries tend to progress. The authors suggest that, considering the age of the children and their period of dentition, it is possible that they have not been affected by other dental disorders that are predisposed to MIH. Thus, the perceived impact of this condition on OHRQoL could be realized with the development of oral disorders in the course of their life, or even with the late progression of primary dental lesions. In addition, having anterior teeth with aesthetic alterations may not be an important factor for a substantial proportion of the children included in the studies, which would also justify this result. In this way, the association between MIH and OHRQoL could be clearly identified in longitudinal studies (Portella et al., 2018), as this association has already been confirmed in studies with adolescents (Jälevik et al., 2021).

Only two studies included in this review carried out multivariate analysis to explore the association between MIH and the domains of the CPQ$_{8\text{-}10}$ (Dias et al., 2020; Portella et al., 2019). The third study only described the non-association between the variables of interest through bivariate analysis (Portella et al., 2018). In one of the cross-sectional studies, children with mild/severe MIH had a significantly greater perceived impact on the oral symptom's domain of the CPQ$_{8\text{-}10}$ than those without the condition. This is a predictable outcome, since the loss of tooth structure contributes to an increase in the accumulation of biofilm, facilitating the transport of bacteria to the dentin and intensifying sensitivity due to greater exposure of the dentinal tubules (Fagrell et al., 2008; Raposo et al., 2019). Therefore, it is essential that professionals correctly diagnose and treat the dental alterations caused by MIH, since in fact, treating these conditions in children with MIH can improve the perceived impact on OHRQoL (Dias et al., 2020).

Evidence showed that the analysis of OHRQoL according to disease severity revealed that MIH severity had no significant relation to OHRQoL. In this context, it is understood that this phenomenon manifests itself due to the predominant influence of the presence or absence of MIH compared to its severity. In addition, it is worth emphasizing that divergent studies have used different categories and indicators to report severity. In this sense, further research is needed to compare the severity of MIH using standardized severity indicators in order to achieve more reliable results (Amrollahi et al., 2023).

One of the strengths of this study is certainly the inclusion of studies with methodological rigour and a low risk of bias. Furthermore, the innovative proposal to investigate the association between MIH and OHRQoL in a specific population is also a strength of this research. Although this is a narrative review, internationally recommended approaches were employed during the design and execution of the study, as well as in the reporting of information. The fact that the stages of selecting studies, extracting data and analyzing the risk of bias were carried out in duplicate should also be highlighted as a strength.

Although the results of this study provide an important discussion on the impact of MIH on OHRQoL in Brazilian children, it is essential that further studies on the subject are carried out. In particular, longitudinal studies should be performed

with recognized and valid diagnostic and detection methods for MIH and OHRQoL - respectively, assessing the association between children grouped into standardized age-group, as well as exploring the impact of invasive and non-invasive approaches in the management of MIH. It is crucial that further research uses robust statistical models to elucidate the findings on this subject with greater credibility. It was observed that none of the studies included in this review utilized the use of reporting guides to base the description of the information. Therefore, the authors recommend that this methodology be implemented in new studies.

5. Conclusion

Based on the synthesis of cross-sectional and case-control studies classified as low risk of bias, no statistically significant association was identified between MIH and OHRQoL in Brazilian children between 8-10 years of age. Furthermore, it was observed that MIH may have a negative effect on the perception of oral symptoms in this population group.

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