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Systematic review

Prevalence and Severity of Molar Incisor Hypomineralization Among Children in Saudi Arabia: A Systematic Review

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Abstract

Background: Molar incisor hypomineralization (MIH) is a qualitative enamel defect of systemic origin that affects first permanent molars and often the permanent incisors, and Saudi reports vary widely between cities and settings. This review aimed to synthesize

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the prevalence and severity of MIH among children in Saudi Arabia. Methods: Following PRISMA 2020, two authors independently searched PubMed, Scopus, Web of Science, and the Cochrane Library up to May 2026, screened records, extracted data, and appraised quality with the JBI checklist for prevalence studies. Observational studies reporting MIH prevalence among Saudi children diagnosed with standardized clinical criteria were eligible, and findings were synthesized narratively. Results: Ten cross-sectional studies including 9,659 children aged 6 to 16 years from eight cities met the criteria. Prevalence ranged from 8.0% to 53.0%, with a median of 19.7%. School-based surveys reported 15.2% to 53.0%, while clinic-based samples reported 8.0% to 38.5%. Demarcated white or creamy opacities covering less than one-third of the crown formed the dominant presentation, and five of six studies comparing boys and girls found no statistically significant sex difference. Advanced defects clustered in first permanent molars and made up 58.1% of affected teeth among children with special health care needs. Conclusion: MIH affects about one in five Saudi children, with marked regional variation and mostly mild lesions, which supports a national survey using standardized charting.

Keywords: Molar incisor hypomineralization; Prevalence; Severity; Developmental enamel defects; Children; Saudi Arabia

Introduction

Molar incisor hypomineralization (MIH) is a qualitative developmental defect of enamel of systemic origin that affects one to four first permanent molars (FPMs) and frequently involves the permanent incisors (1). Affected enamel contains less calcium and phosphate, shows lower hardness and modulus of elasticity, and has higher porosity, carbonate, and protein content than unaffected enamel (2). Children with severe hypomineralization of their FPMs received treatment of these teeth nearly ten times as often as unaffected children, often at short intervals and without local anaesthesia, and dental fear and behaviour management problems were more common among them (3). Restorative care is further complicated because hardness and elasticity are also reduced in the clinically sound-looking enamel that borders the lesion (2).

A global burden analysis of 99 studies from 43 countries estimated 878 million prevalent cases in 2015 and 17.5 million incident cases in 2016, with 27.4% of cases needing therapy for pain, hypersensitivity, or post-eruptive breakdown (PEB), and most of this burden fell on low- and middle-income countries (4). A pooled analysis of 70 studies reported a global prevalence of 14.2%, with individual estimates ranging from 0.5% to 40.2% and higher values among children aged ten years or younger (5). A later meta-analysis of 116 observational studies estimated a pooled prevalence of 13.5% (95% confidence interval 12.0-15.1%) with heterogeneity of 98.0%, to which sample size and publication year contributed slightly, and continental estimates ranged from 10.7% in Asia to 15.3% in America (6).

In the Middle East, a meta-analysis of 29 studies covering 32,636 children from 11 countries reported a mean prevalence of 15.05%, with values from 2.3% to 40.7%, and linked pregnancy and early childhood illnesses (odds ratio 2.26) and delivery-related factors (odds ratio 2.4) with MIH (7). Case definition also shifts these estimates, since studies that did not apply the 2003 European Academy of Paediatric Dentistry (EAPD) case definition produced different pooled values (6). Pooled data showed no sex difference in prevalence, a finding that national surveys need to confirm in each population (5). Because the Middle East synthesis included only three Saudi studies, with figures from 8.6% in Jeddah to 40.7% in Riyadh, and closed its search in January 2021, this systematic review aimed to estimate the prevalence and describe the severity of MIH among children in Saudi Arabia.

Methods

Protocol and eligibility criteria

This systematic review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. Studies were eligible when they

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used a cross-sectional or cohort design, examined children aged 6 to 18 years living in Saudi Arabia, diagnosed MIH clinically with the EAPD 2003 criteria, an EAPD-based charting form, or the MIH severity scoring system, and reported MIH prevalence or allowed its calculation. Case reports, reviews, editorials, conference abstracts, knowledge and attitude surveys, treatment studies, studies limited to hypomineralized second primary molars (HSPM), and articles in languages other than English were excluded. When two reports described the same sample, the report with the more complete prevalence data was retained.

Information sources and search strategy

Two authors independently searched PubMed, Scopus, Web of Science Core Collection, and the Cochrane Library from inception to 31 May 2026. The search combined condition and location terms: ("molar incisor hypomineralization" OR "molar incisor hypomineralisation" OR "molar-incisor hypomineralization" OR MIH OR "hypomineralized first permanent molars" OR "demarcated opacities" OR "enamel hypomineralization") AND ("Saudi Arabia" OR Saudi OR Riyadh OR Jeddah OR Makkah OR Madinah OR Dammam OR Qassim OR Abha OR Jazan OR Taif OR Hail OR Tabuk). The Medical Subject Headings "Molar Hypomineralization" and "Saudi Arabia" were added in PubMed, the syntax was adapted to each database, and the reference lists of included studies were screened by hand.

Study selection and data extraction

Records were exported to a reference manager, and duplicates were removed. The two authors independently screened titles and abstracts, then assessed the full texts of potentially eligible articles against the eligibility criteria, and resolved disagreements through discussion until consensus. Using a piloted form, both authors independently extracted the first author, publication year, city, setting, sampling method, sample size, age range, sex distribution, diagnostic criteria, examiner calibration, MIH prevalence, and severity data, including lesion type, lesion extent, PEB, atypical restorations, extractions due to MIH, severity grade, incisor involvement, and HSPM.

Quality appraisal and data synthesis

The two authors independently appraised each study with the Joanna Briggs Institute (JBI) critical appraisal checklist for studies reporting prevalence data, which covers sampling, sample size, description of participants and setting, coverage, measurement validity and reliability, statistical analysis, and response rate. Because diagnostic indices, settings, and age ranges differed across studies, the findings were synthesized narratively instead of by meta-analysis. Prevalence was summarized as the range and unweighted median and was compared by recruitment setting (school versus clinic or hospital) and population (general versus special health care needs), while severity was described according to the measures reported in each study.

Results

Study selection

The database searches identified 360 records (PubMed 96, Scopus 142, Web of Science 118, Cochrane Library 4). After removal of 171 duplicates, the two authors screened 189 titles and abstracts and excluded 158 records. Of the 31 full-text articles assessed, 21 were excluded because they reported no extractable child-level MIH prevalence (n = 9), reported only HSPM or caries outcomes (n = 4), used non-Saudi or pooled regional samples (n = 3), were reviews or editorials (n = 3), or overlapped with the sample of an included study (n = 2). Ten studies met the eligibility criteria and entered the synthesis (8-17).

Characteristics of included studies

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The ten cross-sectional studies enrolled 9,659 children aged 6 to 16 years, and Riyadh and Jeddah contributed two studies each (8,9,12,14). Single studies came from Makkah, Taif, Jazan, Buraydah, Madinah, and Abha (10,11,13,15-17). Six studies examined children in schools, one of them limited to girls and another to children with special health care needs (10-12,14-16). Three studies recruited hospital or university clinic attendees, and one combined school and clinic recruitment (8,9,13,17). One hospital study in Jazan used the MIH severity scoring system (MIH-SSS), whereas the remaining nine applied the EAPD criteria or EAPD-based charting forms (8-12,14-17). On the JBI checklist, the school surveys using random or stratified sampling met most items, while the three clinic-based samples lost points on the sampling frame and representativeness (8,13,17).

Prevalence of MIH

Prevalence ranged from 8.0% in a Jazan hospital sample to 53.0% in a Madinah school survey (13,16). The unweighted median across the ten studies was 19.7% (8-17). School-based estimates ranged from 15.2% in Riyadh to 53.0% in Madinah, with three surveys clustering between 18.3% and 20.96% (10,12,14-16). Clinic-based estimates were 8.6% in Jeddah and 8.0% in Jazan, while the Abha hospital survey reported 38.5% (95% confidence interval 34.4-42.7%) (8,13,17). The mixed school and clinic sample from Riyadh reported 40.5%, and the Taif survey of children with special health care needs reported 24.5% (9,11). No statistically significant sex difference appeared in Riyadh, Buraydah, or Madinah (12,15,16). In Jeddah, MIH affected 9.7% of boys and 7.5% of girls, and in Taif 18.3% of boys and 29.5% of girls, with neither difference reaching statistical significance (8,11). Only the Abha survey reported gender differences in MIH (17).

Severity and clinical presentation

Demarcated opacities were the most frequent lesion type, accounting for 78.5% of affected teeth in Buraydah and 71.5% in Abha (15,17). White or creamy opacities made up about 80% of affected FPMs in Jeddah and dominated the Madinah sample (14,16). Most lesions covered less than one-third of the crown, as reported for 59.2% of affected teeth in Buraydah and 71.1% in Abha (15,17). Graded severity in Makkah was mild in 87.2%, moderate in 12.1%, and severe in 0.7% of affected girls (10). Among children with special health care needs, PEB (23.4%), atypical restorations (21.0%), and tooth loss due to MIH (13.7%) together made up 58.1% of 291 affected teeth (11). Molar defects were more severe than incisor defects in Riyadh and Jazan (12,13). Incisor involvement accompanied molar defects in 79.4% of affected Riyadh children, and 55.9% of them also had HSPM (12). HSPM occurred in 11.4% of Buraydah children and 1.8% of Jeddah children, and both studies found a strong association between HSPM and MIH (14,15). MIH-positive children in Abha reported pain, sensitivity, and tooth decay more often than unaffected children (17).

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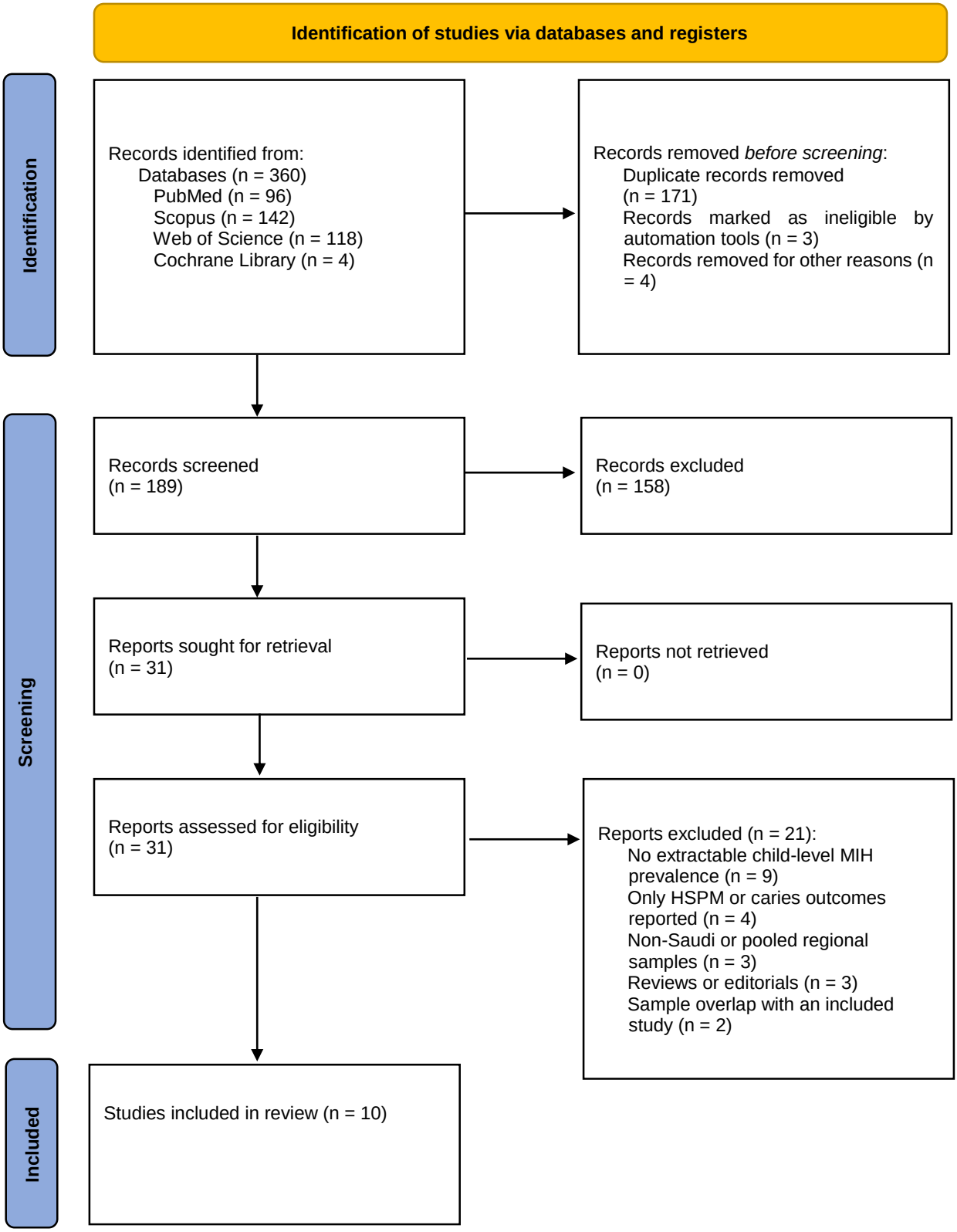


Figure 1: PRISMA flow chart

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Table 1. Characteristics of the included studies (n = 10)

Study (reference)	City	Setting and sampling	Sample (n)	Age (years)	Diagnostic criteria	MIH prevalence (%)
Allazzam et al., 2014 (8)	Jeddah	University paediatric dental clinics	267	8-12	EAPD 2003	8.6
Alhowaish et al., 2021 (9)	Riyadh	Elementary schools and university dental clinics	893	8-10	EAPD 2003	40.5
Sulaimani et al., 2021 (10)	Makkah	Girls' schools, stratified random	711	7-9	EAPD 2003; Wetzel and Reckel severity scale	20.96
Mohamed et al., 2021 (11)	Taif	Schools for children with special health care needs	400	6-16	EAPD 2003	24.5
Almuallem et al., 2022 (12)	Riyadh	Public and private schools, random	1,562	8-12	EAPD short charting form	15.2
Zameer et al., 2024 (13)	Jazan	Armed Forces Hospital, convenience	1,405	8-12	MIH-SSS	8.0
Sabbagh et al., 2025 (14)	Jeddah	12 schools, stratified random	2,019	7-9	EAPD 2003	18.3
Al-Huzaimi and Ibrahim, 2025 (15)	Buraydah	6 schools, stratified random	325	8-10	EAPD short charting form	18.5
Alqadi et al., 2026 (16)	Madinah	9 schools, stratified random	1,557	7-10	EAPD 2003	53.0
Mustafa et al., 2026 (17)	Abha	University dental hospital	520	7-12	EAPD-based MIH/HSPM charting	38.5
Abbreviations: EAPD, European Academy of Paediatric Dentistry; MIH-SSS, molar incisor hypomineralization severity scoring system; HSPM, hypomineralized second primary molars.						

Table 2. Severity and clinical presentation of MIH in the included studies

Study (reference)	Predominant lesion	Advanced defects	Lesion extent or severity grade	Other clinical findings
Allazzam et al. (8)	Demarcated opacities	NR	NR	Maxillary central incisors more affected than mandibular
Alhowaish et al. (9)	NR	NR	NR	Neonatal jaundice associated with MIH
Sulaimani et al. (10)	NR	Severe in 0.7%	Mild 87.2%, moderate 12.1%	Molar hypomineralization in a further 26.6%

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Study (reference)	Predominant lesion	Advanced defects	Lesion extent or severity grade	Other clinical findings
Mohamed et al. (11)	Demarcated opacity, 41.9% of 291 teeth	PEB 23.4%, atypical restoration 21.0%, tooth loss 13.7%	NR	Maxillary FPMs most affected
Almuallem et al. (12)	Demarcated opacities	FPM defects more severe than incisor defects	NR	Incisors involved in 79.4%; HSPM in 55.9% of affected children
Zameer et al. (13)	NR	Molar lesions severe	Incisor lesions mild to moderate	All four FPMs affected in 66.1%
Sabbagh et al. (14)	White or creamy opacities, about 80% of affected FPMs	NR	NR	HSPM 1.8%; mean dmft/DMFT 5.99
Al-Huzaimi and Ibrahim (15)	Demarcated opacity, 78.5% of 191 teeth	PEB 7.9%, atypical restoration 7.9%	Less than one-third in 59.2%	HSPM 11.4%; otitis media associated with MIH
Alqadi et al. (16)	White or creamy opacities	NR	Two-thirds or more in 0.6-11.9% per tooth	Four affected teeth in 29.1% of examined children
Mustafa et al. (17)	Demarcated opacities, 71.5%	NR	Less than one-third in 71.1%	Upper right FPM affected in 63%; more pain and sensitivity
Abbreviations: NR, not reported; PEB, post-eruptive breakdown; FPM, first permanent molar; HSPM, hypomineralized second primary molars; dmft/DMFT, decayed, missing, and filled primary/permanent teeth.				

Discussion

Across ten Saudi studies, MIH prevalence ranged from 8.0% to 53.0%, and the median of 19.7% indicates that about one in five examined children was affected (13,16). This median exceeds the global pooled estimates of 14.2% and 13.5% (5,6). It also exceeds the weighted mean of 12.8% reported in a meta-analysis of 167 studies that applied the EAPD definition (18). Values from neighbouring Arab populations sit closer to the Saudi school-based figures, with 17.6% in Jordan and 18.6% in Iraq (19,20). The Madinah estimate of 53.0% lies above the upper limit of 40.7% reported for the Middle East as a whole (7).

Recruitment setting explains part of this spread, since the Jeddah clinic and Jazan hospital samples produced the lowest values (8,13). The Abha hospital survey reported 38.5%, and its affected children more often reported pain and sensitivity, which suggests that symptomatic children were overrepresented (17). Diagnostic charting also shapes estimates, and the EAPD short form records lesion status and extent on standard index teeth to harmonize survey data (21). Riyadh illustrates this effect, since a random school survey using the short form reported 15.2%, whereas a mixed school and clinic sample from the same city reported 40.5% (9,12). Recording thresholds also differ, with opacities of 1 mm or less scored as sound in Riyadh and Taif (11,12). A global meta-analysis likewise called for calibrated examiners and standardized

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examination conditions in future prevalence surveys (18).

Most affected teeth in the included studies carried demarcated white or creamy opacities limited to less than one-third of the crown (15-17). This pattern matches Iraqi data, in which demarcated creamy white opacities outnumbered enamel breakdown and lesion severity rose with the number of affected teeth (20). Mild opacities still require follow-up, because yellow or brown opacities progressed to post-eruptive breakdown more often than white or creamy opacities over 36 months (22). Advanced defects concentrated in FPMs, and among children with special health care needs, 13.7% of affected teeth had already been lost (11,13). The strong association between HSPM and MIH in Buraydah and Jeddah agrees with a meta-analysis showing that children with HSPM are more likely to develop MIH (14,15,23). The updated EAPD guidance accepts HSPM as a predictive sign of MIH, noting a higher MIH prevalence in the presence of mild HSPM (24).

Saudi studies linked MIH with early childhood ear infections, respiratory distress, tonsillitis, and neonatal jaundice (9,12,15). A meta-analysis similarly found that perinatal hypoxia and prematurity raised the odds of MIH, with peri- and postnatal factors carrying more weight than prenatal factors (25). Most Saudi general dentists (76.9%) and specialists (86.3%) had already encountered MIH in practice, which confirms the clinical weight of these prevalence figures (26).

This review added large school surveys from Jeddah, Buraydah, and Madinah published after the last regional synthesis (7,14-16). Three studies relied on clinic or hospital attendees and one examined girls only, which restricts generalization to the wider child population (8,10,13,17). Wide differences in indices, age ranges, and settings prevented a meta-analysis, a problem also faced by a global synthesis that reported heterogeneity of 98.0% (6). The included studies came from the western, central, and southern regions, leaving the Eastern Province and the northern regions without published estimates.

Conclusion

MIH is common among Saudi children, with prevalence ranging from 8.0% to 53.0% in eight cities and a median close to one in five children. School-based surveys generally reported higher values than clinic-based samples, and the highest figures came from Madinah, Riyadh, and Abha. Most lesions were demarcated white or creamy opacities limited to less than one-third of the crown, while PEB, atypical restorations, and tooth loss concentrated in FPMs and in children with special health care needs. A national survey using the EAPD short charting form and calibrated examiners is needed to guide screening and preventive programmes.

List of Abbreviations

dmft/DMFT: decayed, missing, and filled primary/permanent teeth; EAPD: European Academy of Paediatric Dentistry; FPM: first permanent molar; HSPM: hypomineralized second primary molars; JBI: Joanna Briggs Institute; MIH: molar incisor hypomineralization; MIH-SSS: molar incisor hypomineralization severity scoring system; NR: not reported; PEB: post-eruptive breakdown; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

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