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ORIGINAL RESEARCH

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Prevalence of hypomineralised second primary molars among children aged 6–9 years in urban Beijing

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Abstract

Background: Despite growing global interest in hypomineralised second primary molars (HSPM), epidemiological data on their prevalence in Asian paediatric populations remain limited. This study aimed to evaluate the distribution of HSPM among children aged 6–9 years in urban Beijing. **Methods**: This retrospective study reviewed oral examination data from 1213 children aged 6–9 years in urban Beijing collected between February and June 2025, using the latest European Academy of Paediatric Dentistry diagnostic criteria for Molar-incisor hypomineralisation (MIH)/HSPM. Overall prevalence and distributions by age and sex were summarised using SPSS version 27.0 and R version 4.6.0. **Results**: Among the 1213 children, 39 were diagnosed with HSPM, corresponding to a prevalence of 3.2% (95% confidence interval (CI): 2.2%–4.1%). HSPM was identified in 26 males (3.9%) and 13 females (2.4%), with no significant sex-based difference. Within the HSPM-positive group, mild cases among males and females accounted for 43.6% and 25.6% of all affected children, respectively, whereas severe cases accounted for 23.1% and 7.7%; this distribution was not statistically significant. Prevalence increased with age, from 1.6% at 6 years, 1.8% at 7 years, to 4.5% at both 8 and 9 years ($Z = 2.345$, $p = 0.019$); however, no significant age-related trend was observed for HSPM severity ($Z = 0.260$, $p = 0.795$). The prevalence of MIH was 7.8% (95/1213), and the co-occurrence rate of MIH among children with HSPM was 76.9% (30/39), significantly higher than the 5.5% (65/1174) observed in those without HSPM ($\chi^2 = 266.48$, $p < 0.001$). **Conclusions**: The overall prevalence of HSPM among urban Beijing children aged 6–9 years was 3.2%, with a significant increasing trend with age ($p = 0.019$). The high co-occurrence rate of MIH among children with HSPM (76.9%) suggests that HSPM may be a useful indicator for identifying children at risk of MIH.

Keywords

Hypomineralised second primary molars (HSPM); Molar-incisor hypomineralisation (MIH); Prevalence; Epidemiological survey

1. Introduction

Hypomineralisation is a qualitative enamel defect resulting from disturbances during the calcification or maturation stage [1]. When this condition involves the first permanent molars and incisors, it is referred to as molar-incisor hypomineralisation (MIH). MIH is characterised by increased enamel porosity and a reduced calcium-to-phosphorus ratio in the affected enamel regions [2]. Similar enamel defects affecting the second primary molars are referred to as hypomineralised second primary molars (HSPM). The affected enamel in HSPM exhibits physicochemical properties and clinical characteristics similar to those observed in MIH [3], including demarcated opacities, post-eruptive enamel breakdown (PEB), atypical caries/restorations, and tooth extraction attributable to HSPM.

Reported prevalence rates of HSPM vary widely, ranging from 0% to 41%, largely because of differences in diagnostic criteria, examination methods, and age groups across studies [4]. In China, previous research on hypomineralisation has focused primarily on MIH, with relatively few studies investigating the prevalence of HSPM. To date, only two studies have been conducted in Henan and Shaanxi provinces [5, 6]. Based on the latest diagnostic guidance from the European Academy of Paediatric Dentistry (EAPD), published in 2022 [1, 7, 8], which builds on the criteria proposed by Weerheijm *et al.* [1] in 2003 and Lygidakis *et al.* [7] in 2010, this study investigated the prevalence of HSPM among children in urban Beijing at both the child and tooth levels. The findings may expand epidemiological evidence on HSPM in children and provide evidence for estimating future treatment needs related to HSPM and its complications.

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2. Materials and methods

2.1 Subject selection

2.1.1 Sample population

The target population comprised children aged 6–9 years (mean age 7.56 ± 0.85) living in urban Beijing.

2.1.2 Data source

Oral health data were obtained from the physical examination database of the Xicheng District School Health Institute in Beijing. Inclusion criteria were: (1) all four second primary molars had fully erupted; (2) all four first permanent molars had fully erupted for MIH assessment; and (3) complete survey data were available. Children were excluded if they had fixed orthodontic appliances or were unable to cooperate during the oral examination.

2.1.3 Sample size

The sample size was calculated using the following formula (Eqn. 1):

$$n = \frac{Z^2 \times p \times (1-p)}{E^2} \quad (1)$$

In this formula, Z represents the value from the standard normal distribution for a 95% confidence level (Z = 1.96), p represents the expected prevalence (approximately 3%), and E represents the margin of error (allowable estimation error; E = 0.01). The calculated sample size was 1118. After adding a 10% buffer to account for potential nonresponse or data loss, the target sample size was 1230. Ultimately, 1213 children met the eligibility criteria and were included in the analysis, comprising 666 males and 547 females. The age distribution was as follows: 128 children aged 6 years, 436 aged 7 years, 492 aged 8 years, and 157 aged 9 years.

2.2 Examination procedure

This was a retrospective cross-sectional study based on data extracted from the annual school health screening database in Beijing. Diagnoses of HSPM and MIH were established during the screening examinations using a two-step process as detailed below, and the relevant data were subsequently extracted from the database for analysis.

2.2.1 Examiners and training

The oral examination data were obtained from the annual health screening of urban primary school students in Beijing, which was conducted between February and June 2025. Three examiners participated in the screening. XYZ, a dentist at Beijing Children's Hospital with extensive experience in HSPM diagnosis, provided training to DJX and YL, two dentists from the same hospital who conducted the routine examinations. Before screening, XYZ trained DJX and YL using published diagnostic criteria and 29 clinical photographs covering MIH/HSPM, diffuse opacities, fluorosis, and amelogenesis imperfecta [9].

2.2.2 Examination method and equipment

Children were examined in a seated position, with their heads positioned at approximately 45° to the horizontal plane. Examinations were performed using fibre-optic dental unit lights, handheld flashlights, disposable dental examination kits, and gloves. Tooth surfaces were examined under moist conditions in the following sequence: right maxilla → left maxilla → left mandible → right mandible.

2.2.3 Two-step screening process

To improve efficiency and diagnostic accuracy, a two-step screening process was used:

Step 1 (initial screening): DJX and YL examined all children and identified those with any type of enamel defect, including MIH, HSPM, diffuse opacities, fluorosis, and amelogenesis imperfecta.

Step 2 (confirmation): XYZ re-examined all screen-positive children and confirmed HSPM and MIH cases according to EAPD criteria (Table 1, Ref. [1, 7, 8]). For confirmed cases, tooth position and enamel status were recorded. Uncertain cases were discussed by the three examiners. JH and CL were responsible for data recording and verification.

2.2.4 Data recording, storage, and extraction

Data were recorded on paper-based tooth charts and then entered electronically into the School Health Information System, which was managed by HJY from the School Health Institute. After the annual screening, data from 1213 eligible children were retrospectively extracted from the existing database with institutional authorisation. XYZ created an encrypted Excel spreadsheet using anonymous codes and recorded sex, date of birth, and diagnoses of HSPM and MIH (0 = unaffected, 1 = mild, 2 = severe). All data were anonymised before analysis.

2.3 Reference diagnostic criteria

The differential diagnosis of HSPM included the following: (1) diffuse enamel opacities, which are scattered, cloud-like lesions with ill-defined borders, in contrast to the demarcated opacities seen in HSPM; (2) enamel hypoplasia, which is characterised by reduced enamel thickness or partial/complete absence of enamel, with defects showing regular, smooth margins; (3) amelogenesis imperfecta, which typically affects multiple teeth or the entire permanent dentition; and (4) dental caries, which commonly presents as white-spot lesions in pits/fissures, on proximal surfaces, or adjacent to the gingival margin.

In this study, HSPM-positive cases were classified as mild or severe according to lesion severity. Mild HSPM was defined as demarcated enamel opacities without enamel breakdown. Severe HSPM was defined as demarcated enamel opacities accompanied by post-eruptive enamel breakdown, atypical caries, atypical restoration, or missing teeth due to HSPM [7].

2.4 Quality control

To ensure diagnostic consistency and accuracy, XYZ trained DJX and YL to distinguish healthy enamel from various enamel defects using 29 case photographs before formal

TABLE 1. HSPM diagnostic criteria (adapted from MIH diagnostic criteria [1, 7, 8]).

Diagnostic Feature	Clinical Manifestation
Affected Teeth	Hypomineralisation of 1–4 second primary molars
Demarcated Opacities	Enamel defects appearing as white, cream, yellow, or brown lesions of varying size and shape. Only lesions larger than 1 mm are diagnosed as hypomineralisation.
Post-Eruptive Enamel Breakdown (PEB)	Due to the high porosity of the affected enamel, it often breaks down under masticatory forces, leading to dentin exposure and caries progression.
Sensitivity	Affected teeth often exhibit sensitivity, ranging from mild sensitivity to external stimuli to spontaneous sensitivity. Some affected teeth may present difficulties with anaesthesia.
Atypical Restorations	The extent and shape of restorations differ from those of typical carious lesions. Restorations in molars often extend to the buccal or lingual/palatal smooth surfaces.
Tooth Extraction due to MIH/HSPM	History of tooth extraction documented as being due to hypomineralisation, with evidence of hypomineralisation in other index teeth for MIH/HSPM.

MIH: molar-incisor hypomineralisation; HSPM: hypomineralised second primary molars.

screening [9]. The two examiners (DJX and YL) then conducted a pilot examination of 135 children who were not included in the final sample to distinguish healthy teeth and HSPM/MIH. This pilot phase allowed potential errors to be identified and corrected before the main screening. The inter-examiner kappa value between the two examiners was approximately 0.85, indicating good agreement.

2.5 Statistical methods

Data were entered and analysed using SPSS version 27.0 (IBM, Armonk, NY, USA) and R version 4.6.0. Categorical variables, including sex, age group (6, 7, 8, 9 years), tooth position, HSPM severity (mild *vs*. severe), and defect type, were summarised as frequencies (n) and percentages (%). Group comparisons for sex-based prevalence were performed using Pearson chi-square test; Fisher's exact test was used when expected frequencies were <5. Trends in HSPM prevalence and severity across age groups were assessed using the Cochran-Armitage trend test. The association between HSPM and MIH was evaluated using Pearson chi-square test, and the odds ratio (OR) with 95% confidence intervals (CI) was calculated. A two-sided p-value < 0.05 was considered statistically significant.

3. Results

3.1 HSPM prevalence analysis at the child level

3.1.1 HSPM prevalence

After excluding children with missing data or fixed orthodontic appliances, 1213 children (666 males and 547 females) were included. A total of 39 children were diagnosed with HSPM, yielding an overall prevalence of 3.2%. HSPM was identified in 26 males (3.9%, 26/666) and 13 females (2.4%, 13/547), with no statistically significant difference between males and females. The prevalence was approximately 1.6% (2/128) in the 6-year age group, 1.8% (8/436) in the 7-year age group, 4.5% (22/492) in the 8-year age group, and 4.5% (7/157) in the 9-year age group. A Cochran-Armitage trend test revealed a significant increasing trend in HSPM prevalence with age ($Z = 2.345$, $p = 0.019$) (Table 2).

3.1.2 Distribution of mild and severe HSPM by sex and age group

HSPM-positive cases were classified as mild or severe. Mild cases included white, cream, yellow, or brown demarcated opacities without enamel breakdown. Severe cases included post-eruptive enamel breakdown, atypical caries, atypical restorations, or tooth extraction due to HSPM [7]. Among the 39 HSPM-positive children, mild cases among males and females accounted for 43.6% (17/39) and 25.6% (10/39) of all affected children, respectively, whereas severe cases accounted for 23.1% (9/39) and 7.7% (3/39), respectively. The sex-based distribution was not statistically significant (Fig. 1A). Regarding age distribution, the 6-, 7-, 8-, and 9-year age groups had 2, 6, 16, and 3 mild cases, and 0, 2, 6, and 4 severe cases, respectively. Mild cases were most frequent in the 8-year age group (16/39, 41.0% of all HSPM-positive children), followed by the 7-year (15.4%, 6/39), 9-year (7.7%, 3/39), and 6-year (5.1%, 2/39) groups. Severe cases were also most common in the 8-year age group (15.4%, 6/39), followed by the 9-year (10.3%, 4/39) and 7-year (5.1%, 2/39) groups, with no severe cases observed in the 6-year group. A Cochran-Armitage trend test revealed no significant increasing trend in HSPM severity with age ($Z = 0.260$, $p = 0.795$) (Fig. 1B).

3.2 HSPM prevalence analysis at the tooth level

3.2.1 Distribution of HSPM in the maxillary and mandibular arches

A total of 89 teeth exhibited HSPM, distributed across the maxillary (n = 46) and mandibular (n = 43) arches. Mild cases were more frequent than severe cases in both arches, although the distribution did not differ significantly between the maxillary and mandibular arches (Table 3).

TABLE 2. HSPM prevalence.

Group	Non-HSPM	HSPM	Total	χ^2	*Z*	*p*
Sex						
Male, n (%)	640 (96.1)	26 (3.9)	666 (100)			
Female, n (%)	534 (97.6)	13 (2.4)	547 (100)	2.251		0.133
Total, n (%)	1174 (96.8)	39 (3.2)	1213 (100)			
Age group						
6 yr, n (%)	126 (98.4)	2 (1.6)	128 (100)			
7 yr, n (%)	428 (98.2)	8 (1.8)	436 (100)			
8 yr, n (%)	470 (95.5)	22 (4.5)	492 (100)		2.345	0.019*
9 yr, n (%)	150 (95.5)	7 (4.5)	157 (100)			
Total, n (%)	1174 (96.8)	39 (3.2)	1213 (100)			

*HSPM: hypomineralised second primary molars; χ^2: chi-square value; Z: Cochran-Armitage trend test value; *, $p < 0.05$.*

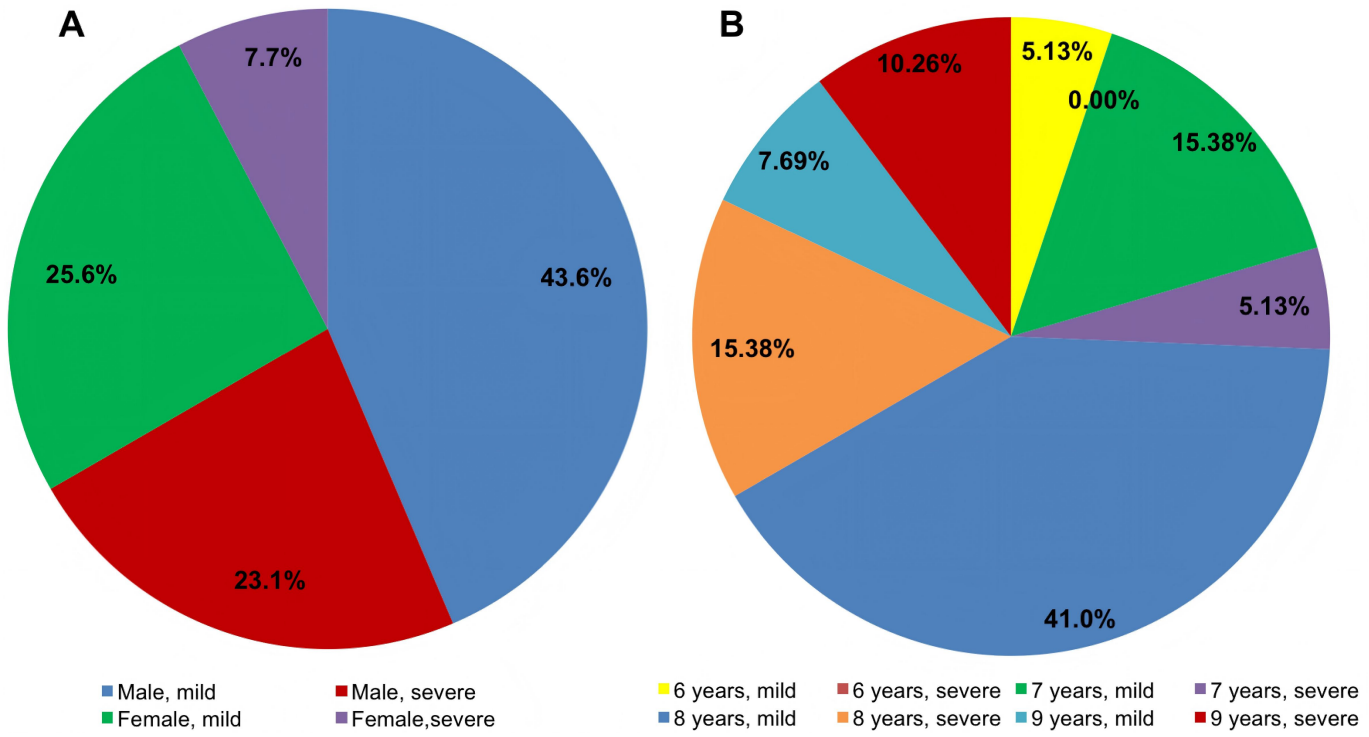


FIGURE 1. Distribution of mild and severe HSPM according to sex and age group. (A) Distribution of mild and severe HSPM by sex (n = 39, two-sided Fisher's exact test, $p = 0.714$). (B) Distribution of mild and severe HSPM by age group (n = 39, Cochran-Armitage trend test, $Z = 0.260$, $p = 0.795$).

TABLE 3. Distribution of HSPM in the maxillary and mandibular arches (n = 89).

Dental arch	Non-HSPM	Mild	Severe	Total	χ^2	*p*
Maxilla, n (%)	2380 (98.1)	31 (1.3)	15 (0.6)	2426 (100)	0.335	0.846
Mandible, n (%)	2383 (98.2)	31 (1.3)	12 (0.5)	2426 (100)		
Total, n (%)	4763 (98.1)	62 (1.3)	27 (0.6)	4852 (100)		

HSPM: hypomineralised second primary molars; n = 89 affected index teeth at the tooth level.

3.2.2 Distribution of different defect types in HSPM index teeth

A total of 89 index teeth (World Dental Federation (FDI) codes 55, 65, 75, and 85) were affected. The most prevalent defect was white/cream-coloured opacities (38.2%, 34/89), followed by yellow/brown opacities (31.5%, 28/89), atypical caries/restorations (21.3%, 19/89), and enamel breakdown (9.0%, 8/89). Defect type varied slightly by tooth position. White/cream-coloured opacities were most common in the maxillary right second primary molar (tooth 55: 40.0%, 8/20) and maxillary left second primary molar (tooth 65: 46.2%, 12/26), whereas yellow/brown opacities predominated in the mandibular left (tooth 75: 36.4%, 8/22) and mandibular right (tooth 85: 42.9%, 9/21) second primary molars. However, these differences were not statistically significant ($\chi^2 = 5.817$, $p = 0.758$), indicating a weak association between tooth position and defect type (Fig. 2).

3.3 Prevalence of MIH and its co-occurrence with HSPM

We examined the prevalence of MIH in our study population and further assessed its co-occurrence with HSPM. A total of 1213 participants were included. The prevalence of MIH was 7.8% (95/1213), with age-specific prevalence of 3.9% (5/128) at 6 years, 3.9% (17/436) at 7 years, 11.4% (56/492) at 8 years, and 10.8% (17/157) at 9 years, showing a significant increasing trend with age (Cochran-Armitage trend test, $Z = 4.026$, $p < 0.001$).

To further examine the co-occurrence of MIH among children with HSPM, we cross-tabulated the presence of HSPM and MIH (Table 4). Among the 39 children with HSPM, 30 (76.9%) also presented with MIH, compared with 65 (5.5%) among the 1174 children without HSPM (chi-square test, $\chi^2 = 266.48$, $p < 0.001$). To assess the diagnostic utility of HSPM for identifying MIH, we calculated sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

TABLE 4. Cross-tabulation of MIH and HSPM.

	MIH, n (%)	Non-MIH, n (%)	Total, n (%)
HSPM, n (%)	30 (76.9)	9 (23.1)	39 (100)
Non-HSPM, n (%)	65 (5.5)	1109 (94.5)	1174 (100)
Total, n (%)	95 (7.8)	1118 (92.2)	1213 (100)

Co-occurrence rate of MIH among children with HSPM was 76.9% (30/39). $\chi^2 = 266.48$, $p < 0.001$; OR = 56.87 (95% CI: 25.92–124.78); sensitivity = 31.6%; specificity = 99.2%; PPV = 76.9%; NPV = 94.5%. MIH: molar-incisor hypomineralisation; HSPM: hypomineralised second primary molars.

4. Discussion

The prevalence of HSPM varies considerably across regions, ranging from 0% to 41%, largely because of differences in study populations and methodologies. A recent meta-analysis

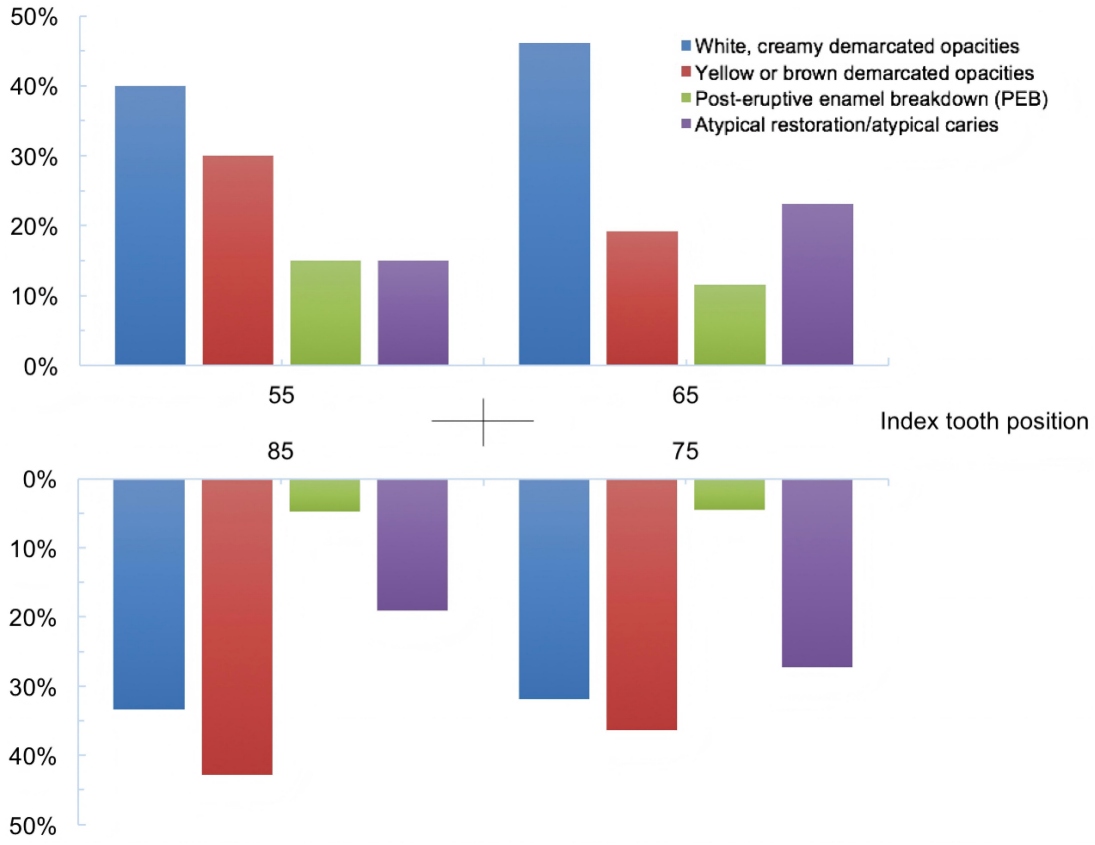


FIGURE 2. Distribution of different defect types in HSPM index teeth (n = 89, $\chi^2 = 5.817$, $p = 0.758$).

reported a global mean HSPM prevalence of 6.8% at the child level and 4.1% at the tooth level [4]. In the present study, the prevalence of HSPM among children aged 6–9 years in urban Beijing was 3.2%, which is lower than both the global child-level prevalence (6.8%) and the prevalence reported in Henan (8.76%) and Shaanxi (7.09%) provinces in China [5, 6]. Notably, the low HSPM prevalence observed in our urban Beijing cohort is consistent with the pattern of low prevalence of hypomineralisation reported in other high-income regions. For instance, a study in Hong Kong reported a MIH prevalence of 2.8% among 12-year-old children [10], and previous Beijing-based MIH data also showed lower prevalence in central urban areas (7.8%) than in suburban areas (12.8%) [11]. One possible explanation is the higher socioeconomic status and parental education levels characteristic of urban Beijing populations— a hypothesis supported by Shaanxi [6] and Mexican [12] studies. However, this relationship has not been consistently observed. For example, a study in Brazil found no significant association between HSPM and socioeconomic characteristics [13]. Given the cross-sectional design and the absence of directly collected socioeconomic data in our study, this hypothesis warrants further analytical investigation.

Another notable finding was the significant age-related increase in HSPM prevalence, from 1.6% at 6 years to 4.5% at both 8 and 9 years ($Z = 2.345$, $p = 0.019$). This trend is consistent with the age-related increase in MIH prevalence in the same cohort and with previous Beijing-based MIH surveys [11], suggesting that hypomineralisation defects may become more detectable with age—presumably as masticatory exposure leads to post-eruptive enamel breakdown and easier visual identification. However, this interpretation warrants caution. The lower prevalence in the 6- and 7-year groups may partly reflect incomplete crown emergence, limiting visual detection of demarcated opacities, whereas the plateau at 4.5% in the 8- and 9-year groups may be influenced by exfoliation of severely affected primary molars in the oldest children. These competing possibilities highlight the inherent limitation of cross-sectional data in distinguishing age effects from cohort effects. Longitudinal studies with sequential follow-up of the same individuals are needed to determine whether the observed age-related increase reflects true lesion progression.

In this study, the proportion of severe HSPM cases varied across age groups. Specifically, severe cases were most frequent in the 8-year age group (15.4%, 6/39), followed by the 9-year (10.3%, 4/39) and 7-year (5.1%, 2/39) groups, with no severe cases observed in the 6-year group. However, a Cochran-Armitage trend test did not reveal a statistically significant increasing trend in severity with age ($Z = 0.260$, $p = 0.795$). This finding appears to contrast with a previous MIH survey conducted in Beijing in 2016, which reported a decreasing proportion of severe cases with age among children aged 12–15 years [11]. However, direct comparisons should be made cautiously because the two studies targeted different age ranges. One possible explanation for the age-related increase in severe cases in our sample is that initially mild lesions may progress over time under the influence of poor oral hygiene and cumulative masticatory stress, leading to enamel breakdown and caries progression. Nevertheless, this interpretation remains speculative because lesion progression was not assessed longitudinally and oral hygiene status was not evaluated. Future studies incorporating these measures are warranted to test this hypothesis.

For this retrospective analysis, we included a large urban cohort of 1213 children aged 6–9 years from Beijing. The sample size was larger than that of several comparable studies. All researchers involved in this study were trained and calibrated according to the latest EAPD diagnostic criteria and the MIH/HSPM epidemiological survey training manual [9], and a two-step screening process (initial screening followed by expert confirmation) was implemented, with an inter-examiner kappa of 0.85 indicating excellent diagnostic reliability. These procedures support the reliability of the data and provide valuable HSPM-related evidence for Asian populations.

Numerous studies across different geographic regions and in various population settings have suggested that hypomineralised primary molars may predict MIH [14–17]. To explore the association between HSPM and MIH in our cohort, we cross-tabulated the presence of HSPM and MIH. Among the 12 studies included in the meta-analysis by Zhang *et al*. [17], the prevalence of HSPM ranged from 4.0% to 25.1%, and the co-occurrence rate of MIH among HSPM-positive children ranged from 2.1% to 90.3%, with a pooled co-occurrence rate of 63.7% (424/666). In our study, the HSPM prevalence (3.2%) fell below the lower bound of this range, whereas the co-occurrence rate (76.9%) exceeded the pooled level and was comparable to that reported by Negre-Barber *et al*. [14] (76.7%). This combination of low HSPM prevalence and high MIH co-occurrence among HSPM-affected children in our cohort may partly explain the relatively high OR observed. However, given the cross-sectional design of our study, which demonstrates co-occurrence of HSPM and MIH in our sample population without establishing temporality or causality, this OR should be interpreted with caution and requires further validation in prospective cohorts. In terms of diagnostic utility, the PPV of HSPM for identifying MIH was 76.9%, comparable to the 76.7% reported in Spanish populations [14, 18], and the sensitivity (31.6%) and specificity (99.2%) were also consistent with previous findings [18]. The consistency of these diagnostic utility metrics across studies conducted in different countries, by different examiners, and in different years suggests that our findings are reproducible and reliable, further supporting the potential value of HSPM as an early clinical marker for MIH.

Several limitations should be acknowledged. First, the cross-sectional and retrospective design, based on an existing examination database, precludes causal inference. Second, individual-level socioeconomic data were unavailable, and within-subject clustering could not be adjusted for in tooth-level analyses. Third, the slightly older age of the participants relative to the EAPD-recommended optimal age [7] may have led to an underestimation of prevalence. Finally, the urban Beijing setting limits the generalisability of the findings to broader populations. Future prospective studies with comprehensive data collection—including longitudinal follow-up, oral hygiene assessment, and collection of socioeconomic and perinatal factors—are needed to validate these observations and to elucidate the causal pathways linking HSPM and MIH.

5. Conclusions

The prevalence of HSPM among children aged 6–9 years in urban Beijing was relatively low compared with both global and national estimates. No significant sex-based difference was observed; however, HSPM prevalence increased significantly with age ($Z = 2.345$, $p = 0.019$), whereas severity did not differ significantly across age groups. Notably, the co-occurrence rate of MIH among children with HSPM was 76.9%, suggesting a potential role for HSPM as an early clinical indicator for MIH. These findings provide baseline epidemiological data on HSPM from northern China. Longitudinal studies are needed to confirm the predictive value of HSPM and to clarify its temporal progression. In particular, multicentre studies involving geographically diverse populations across China would enhance the generalisability of future findings, as relevant epidemiological data from Asian populations remain limited.

AVAILABILITY OF DATA AND MATERIALS

Data are available from the corresponding author on reasonable request but are not publicly available because of privacy and ethical restrictions.

AUTHOR CONTRIBUTIONS

GXY—designed the study, led the writing, reviewed the manuscript, and contributed to the discussion. XYZ—designed the study, contributed to data analysis, and contributed to the discussion. HJY—provided data support and performed data de-identification. JH, CL, DJX and YL—were responsible for data entry, data verification, and statistical analysis. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This cross-sectional study reviewed oral examination data from 1213 children aged 6–9 years from urban areas of Beijing between February and June 2025. The study protocol was approved by the Ethics Committee of Beijing Children's Hospital (approval number: [2026]-E-073-R). We obtained approval for a waiver of the informed consent requirement during the ethics review process. The entire research process was conducted strictly in accordance with the principles of medical ethics. All participant data were de-identified and stored separately, precluding any possibility of tracing back to individual students.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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