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ORIGINAL ARTICLE

The Knowledge, Attitude, and Performance of Dental Professionals on Molar Incisor Hypomineralization

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Abstract

Background: Molar Incisor Hypomineralization (MIH) is a developmental enamel defect affecting at least one first permanent molar, often accompanied by incisor involvement. It poses diagnostic and therapeutic challenges and may affect the quality of life. This study aimed to assess the knowledge, attitudes, and performance of dental professionals across specialties regarding MIH.

Materials and Methods: This cross-sectional study was conducted in 2024 among 311 dental specialists and residents in Isfahan, Iran. Data were collected using a validated questionnaire covering knowledge, attitude, and performance. The mean scores for participants' knowledge, attitudes, and performance were assessed and reported. The data were analyzed using the Chi-square test, independent t-test, and one-way ANOVA ($\alpha = 0.05$).

Results: The study achieved a response rate of 90.93%, with 98.5% of participants having previously managed patients with MIH. The mean knowledge, attitude, and performance scores were 12.65 ± 2.69 (out of 18), 46.24 ± 3.89 (out of 65), and 13.00 ± 2.85 (out of 20), respectively. Knowledge levels differed significantly across specialties ($p = 0.005$), with pediatric dentists scoring the highest. Attitude also varied significantly among specialists ($p = 0.002$), with orthodontists showing the lowest scores. Performance scores were significantly different between groups ($p < 0.001$), with pediatric dentists performing best.

Conclusion: There is a high prevalence of MIH in all lines of specialty. The overall knowledge level was considered high, with the highest scores achieved by pediatric dentists. The attitude was generally positive, and the overall performance of the participants was relatively desirable, particularly among pediatric dentists.

Keywords: Molar Hypomineralization; Developmental Defects of Enamel; Surveys and Questionnaires; Dental Specialty; Postdoctoral Training; Dental Education

Introduction

Molar incisor hypomineralization (MIH) is a developmental enamel defect affecting at least one first permanent molar, frequently with involvement of the incisors (1). The defect results from disturbances in ameloblast function during the calcification or maturation stages, producing enamel of normal thickness but reduced mineral density and mechanical strength. (2, 3). In the primary dentition, second primary molars and canines may be affected (hypo mineralized second primary molars, HSPM), a condition that can predict MIH in the permanent dentition (4).

Global prevalence estimates for MIH range from approximately 11.8% to 14.5%, underscoring its clinical relevance. (5). Etiology is multifactorial and

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incompletely understood; proposed risk factors include systemic childhood illnesses (e.g., respiratory infections), prematurity, high fevers, antibiotic exposure, and other environmental and genetic influences. (6).

Clinically, MIH presents as white, creamy, yellow, or brown opacities that may progress to post-eruptive enamel breakdown, hypersensitivity, and accelerated caries. (7, 8). The variable and sometimes asymmetric presentation, together with similarities to fluorosis or other developmental defects, can complicate diagnosis (4). Affected teeth are prone to rapid structural loss after eruption, which may compromise function and aesthetics and negatively affect children's oral health-related quality of life (9-11).

Management strategies depend on lesion severity and patient factors, ranging from preventive measures and conservative restorations (such as adhesive restorations and glass ionomer cements) to micro-abrasion, indirect restorations, or preformed crowns in severe cases, and occasionally, extraction with consideration for orthodontic treatment. (1, 5, 12, 13). Treatment selection is influenced by factors such as sensitivity, dental age, socioeconomic status, and patient expectations. Because treatment options vary and consensus is limited, MIH represents both a clinical and public-health concern (10).

In Iran, previous studies have assessed dentists' familiarity with MIH (14, 15), but few have comprehensively evaluated knowledge, attitudes, and performance across multiple specialist groups and postdoctoral residents.

Therefore, the present study aimed to assess the knowledge, attitude, and performance regarding MIH among postdoctoral dental residents and dental specialists across relevant fields at two dental schools in Isfahan in 2024.

Materials and Methods

This descriptive-analytical cross-sectional study was conducted in 2024 and approved by the Research Ethics Committee of Isfahan University of Medical Sciences (ethics code: IR.MUI.RESEARCH.REC. 1401.393).

The study population included postdoctoral dental residents and board-certified dental specialists in five disciplines: pediatric dentistry, restorative dentistry, orthodontics, endodontics, and oral and maxillofacial diseases. The total accessible population was limited; therefore, a census method was applied. All eligible dental specialists working in Isfahan, as well as all residents enrolled in the dental faculties of Isfahan University of Medical Sciences and Azad University of Khorasgan, were invited to participate (n = 311). Specialists who were retired, working in another city, or otherwise unavailable were excluded. Since the census method was used, no further sample size estimation was necessary. This approach ensured maximum coverage of the target population and minimized the risk of sampling error.

Data were collected through a structured, self-administered questionnaire developed by the researchers based on existing literature and expert input. The questionnaire included 35 questions divided into four sections:

- Demographic information (7 items): age, years of experience, academic degree, specialty, prior exposure to MIH, and source of initial knowledge.
- Knowledge assessment (18 items): True/False/I don't know format, covering MIH definition, etiology, diagnosis, treatment, impact, and clinical identification.
- Attitude evaluation (13 items): Based on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree.'

- Performance evaluation (4 items): Also based on a 5-point Likert scale, ranging from 'never' to 'always.' Four of the questions were designed as case-based questions by presenting various clinical samples and images for the practical assessment of fundamental knowledge. As a result, both the valuable and clinical knowledge, as well as the theoretical information, were evaluated.

The identities of dental specialists were obtained from the specialists' registry association and verified accurately to ensure they were not overlooked. Postdoctoral dental residents' identities were obtained from the departments of education of faculties, and the questionnaires were distributed in person or electronically upon request. In both the virtual and in-person methods, participants received brochures and educational videos after completing the questionnaires.

Regarding the knowledge questions, a score of +1 was given for the correct answer, 0 for the incorrect answer, and 0 for "I don't know". Therefore, the score obtained in the knowledge evaluation ranges from 0 to 18. Scores 0-5.99 indicate a low level of knowledge, scores 6-11.99 indicate average knowledge, and scores 12-18 suggest a high level of expertise.

A 5-point Likert scale was used for the attitude and performance questions as follows:

Regarding the attitude questions, the grades were as follows: completely agree (point 5), agree (point 4), have no opinion (point 3), disagree (point 2), and completely disagree (point 1), corresponding to the preferred answer of "completely agree" for each question. When the intended response was completely disagreed, the scoring was reversed, with 5 points assigned to the intended option.

Therefore, the score obtained in attitude evaluation ranges from 13 to 65. If the average attitude score is between 13 and 29.99, it indicates a negative attitude. A score of 30 to 47.99 suggests a generally positive attitude, and a score of 48 to 65 indicates a favorable attitude.

Regarding the performance evaluation, the grades were as follows: always (point 5), often (point 4), sometimes (point 3), rarely (point 2), and never (point 1). Therefore, the score ranges from 4 to 20. Scores from 4-8.99 indicate undesirable performance, scores from 9-14.99 indicate relatively desirable performance, and scores from 15-20 indicate desirable performance.

Content validity was verified by a panel of six experts in relevant dental specialties utilizing the Content Validity Index (CVI) and Content Validity Ratio (CVR). The questionnaire was subsequently revised based on expert feedback to enhance clarity and relevance.

A pilot study involving 46 participants (excluded from the final analysis) was conducted to assess the reliability of the questionnaire. Cronbach's alpha coefficients were 0.76 for knowledge, 0.82 for attitude, and 0.78 for performance. The test-retest reliability over a three-week interval demonstrated intraclass correlation coefficients (ICCs) of 0.97 (knowledge), 0.96 (attitude), and 0.98 (performance). Data obtained from this pilot study were not incorporated into the primary study.

The questionnaires were distributed in person or electronically. To ensure anonymity and ethical engagement, participation was voluntary, informed consent was obtained from all respondents, and educational brochures and videos were provided after completion of the survey.

Data analysis was conducted utilizing SPSS version 24 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Shapiro–Wilk test. Given that all variables demonstrated a normal distribution ($p > 0.05$), parametric tests were employed. Descriptive statistics, including means, standard deviations, and frequencies, were calculated. Inferential

statistical methods comprised an independent t-test and one-way ANOVA to compare group means, accompanied by post hoc tests where appropriate, as well as a Chi-square test for categorical variables. A significance threshold of $p < 0.05$ was adopted.

Results

A total of 298 questionnaires were sent (224 dental specialists and 74 postgraduate dental specialty students), with 271 completed (90.93%). The final study population consisted of 64 postdoctoral dental residents and 207 dental specialists, including 62 endodontists, 54 orthodontists, 63 restorative dentists, 56 pediatric dentists, and 36 experts in oral and maxillofacial diseases. Table 1 presents the distribution of dental specialists according to years of clinical experience. Postdoctoral dental residents were excluded from this table, as they were categorized separately by academic year (see Table 6).

Table 1. Years of clinical experience of dental specialists.

Field / Specialty	< 5 years	6–10 years	10–15 years	> 15 years
Endodontics	7	12	10	18
Orthodontics	14	14	5	10
Restorative Dentistry	9	14	11	14
Pediatrics	11	10	12	7
Oral diseases	2	6	10	11

Regarding participants' previous exposure to MIH, 98.5% reported having been to (99% of dental specialists and 96.9% of postdoctoral dental residents). Initially, dental specialists had been exposed to MIH more often than postdoctoral dental residents, although statistical analysis using the Chi-square test confirmed that the difference was not statistically significant ($p > 0.05$). The percentage of previous exposure to MIH among dental specialists and postdoctoral dental residents in each field is detailed in Table 2.

Similarly, 97.0% of participants were familiar with the image of an MIH lesion (97.1% of dental specialists and 96.9% of postdoctoral dental residents). Initially, dental specialists were more familiar with the image of an MIH lesion than postdoctoral dental residents; however, the statistical analysis using the Chi-square test confirmed that the difference was not statistically significant ($p > 0.05$). The chi-square test revealed a significant difference in the level of initial familiarity between different fields among all participants ($p = 0.007$) and among dental specialists alone ($p = 0.009$). However, postdoctoral dental residents from different lines did not show a significant difference. The rate of initial familiarity with MIH lesions among dental specialists and postdoctoral dental residents in each field is detailed in Table 2.

Table 2. The percentage of previous exposure and initial familiarity with MIH among dental specialists and postdoctoral dental residents in each field.

Degree	Field	Exposure rate (%)	P value	Initial familiarity (%)	P value
Postgraduate dental specialty students	Endodontics	93.3	0.30	93.3	0.67
	Orthodontics	100		100	
	Oral and maxillofacial diseases	85.7		100	
	Restorative dentistry	100		93.3	
	Pediatric dentistry	100		100	
	Total	96.9		96.9	
Dental specialists	Endodontics	97.9	0.43	89.4	0.009
	Orthodontics	100		100	
	Oral and maxillofacial diseases	96.6		100	
	Restorative dentistry	100		97.9	
	Pediatric dentistry	100		100	
	Total	99		97.1	
Whole study population	Endodontics	96.8	0.09	90.3	0.007
	Orthodontics	100		100	
	Oral and maxillofacial diseases	94.4		100	
	Restorative dentistry	100		96.8	
	Pediatric dentistry	100		100	
	Total	98.5		97	

Acquaintance with MIH was evaluated using a 4-option question. Table 3 summarizes the distribution of initial familiarity among postdoctoral dental residents and dental specialists in each field. Academic education and the combined method were reported as the most common sources of initial acquaintance. Statistical analysis using the Chi-square test (or Fisher's exact test when expected counts were <5) revealed no significant association between specialty and the way of acquaintance ($p > 0.05$). Similarly, no significant differences were observed in familiarity sources between postdoctoral residents and specialists, except in pediatric dentistry and orthodontics, where minor variations were noted.

Table 3. Distribution of the frequency of the participants by field and degree in terms of acquaintance with MIH

Line of Specialty	Degree	Academic education	Extra-curricular trainings	Reference books and articles	combined method	P value
		n (%)	n (%)	n (%)	n (%)	
endodontics	postdoctoral dental residents	5 (33.3)	1 (6.7)	2 (13.3)	6 (46.7)	0.52
	dental specialists	29 (46.8)	3 (4.3)	13 (21.2)	17 (27.7)	
	total	33 (43.5)	4 (4.8)	15 (19.4)	24 (32.3)	
orthodontics	postdoctoral dental residents	4 (36.4)	2 (18.2)	4 (36.3)	1 (9.1)	0.03
	dental specialists	24 (44.2)	6 (11.6)	4 (7.0)	20 (37.2)	
	total	28 (42.6)	8 (13.0)	8 (13.0)	21 (31.4)	
Oral and maxillofacial diseases	postdoctoral dental residents	3 (29.6)	3 (29.6)	1 (11.2)	3 (29.6)	0.67
	dental specialists	7 (20.7)	5 (13.8)	5 (13.8)	19 (51.7)	
	total	10 (22.2)	8 (16.7)	6 (13.9)	22 (47.2)	
Restorative dentistry	postdoctoral dental residents	7 (40.0)	1 (6.7)	1 (20.0)	6 (33.3)	0.94
	dental specialists	25 (39.6)	7 (10.4)	9 (14.6)	22 (35.4)	
	total	32 (39.7)	8 (9.5)	12 (15.9)	28 (34.9)	
Pediatric dentistry	postdoctoral dental residents	4 (20.0)	4 (20.0)	0 (0.0)	9 (60.0)	0.03
	dental specialists	22 (40.0)	1 (2.5)	6 (10.0)	27 (47.5)	
		25 (35.7)	6 (8.9)	5 (7.2)	35 (48.2)	
All participants	postdoctoral dental residents	23 (32.9)	10 (15.6)	10 (15.6)	24 (35.9)	0.31
	dental specialists	107 (39.6)	22 (8.2)	37 (13.5)	105 (38.7)	
	total	128 (38.0)	34 (10.0)	48 (14.0)	128 (38.0)	

The mean knowledge score of all participants was 12.65 ± 2.69 (12.43 ± 2.56 for postdoctoral dental residents and 12.73 ± 2.74 for dental specialists). Knowledge levels were categorized as follows: 0–5.99 indicates poor knowledge, 6–11.99 moderate knowledge, and 12–18 high knowledge. Overall, the participants demonstrated a high level of knowledge regarding MIH.

Normality of knowledge scores was confirmed using the Shapiro–Wilk test in all groups, supporting the use of parametric tests. No significant differences were observed in the mean knowledge scores between postdoctoral dental residents and dental specialists within the same specialty (Independent t-test, $p > 0.05$).

When comparing knowledge scores across different specialties, postdoctoral dental residents did not show significant differences between fields (One-way ANOVA, $p > 0.05$). In contrast, knowledge scores among dental specialists differed significantly across specialties (One-way ANOVA, $p = 0.018$), with pediatric dentists demonstrating higher scores than restorative dentists, orthodontists, and endodontists. Table 4 presents

the mean knowledge scores of postdoctoral dental residents and dental specialists in each specialty. Figure 1 represents the frequency of participants' responses to each knowledge question.

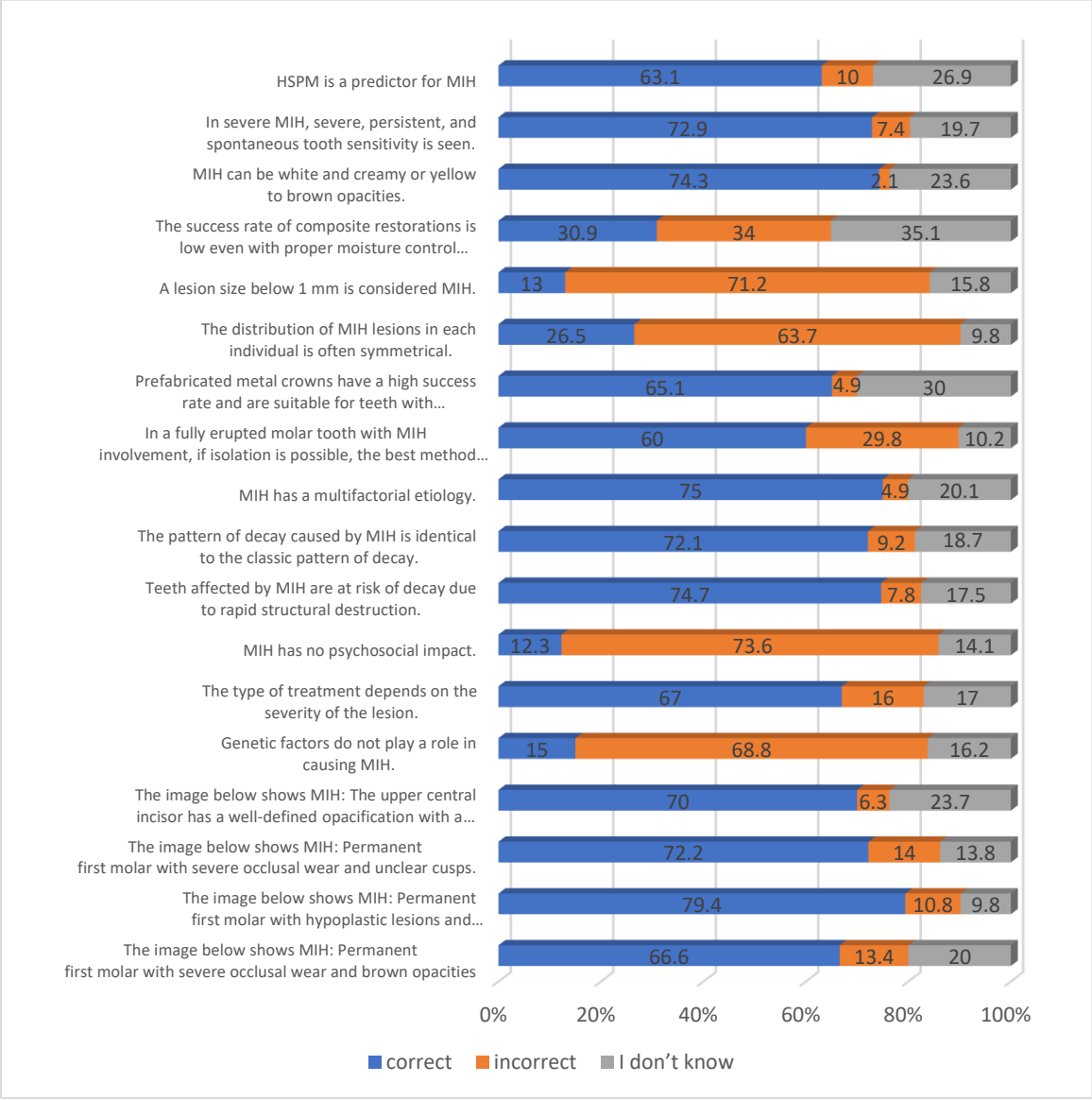

Figure 1. Frequency distribution of responses of dental specialists and postdoctoral dental residents participating in the study to knowledge questions regarding MIH

The mean attitude score was 46.24 ± 3.89 for all participants (45.89 ± 3.99 for postdoctoral dental residents and 46.35 ± 3.87 for dental specialists). Based on predefined score intervals, the overall attitude of participants was generally positive.

No significant differences were found in the average attitude score between postdoctoral dental residents and dental specialists in their respective fields (Independent t-test, $p > 0.05$).

When comparing different lines of specialty, postdoctoral dental residents did not show significant differences, whereas attitude scores among dental specialists were significantly associated with the field (One-way ANOVA, $p = 0.002$). Orthodontists had lower attitude scores than pediatric dentists and

specialists of oral and maxillofacial diseases. Table 4 shows the mean attitude scores of postdoctoral dental residents and dental specialists in each field, and Figure 2 displays the frequency of responses to each attitude question.

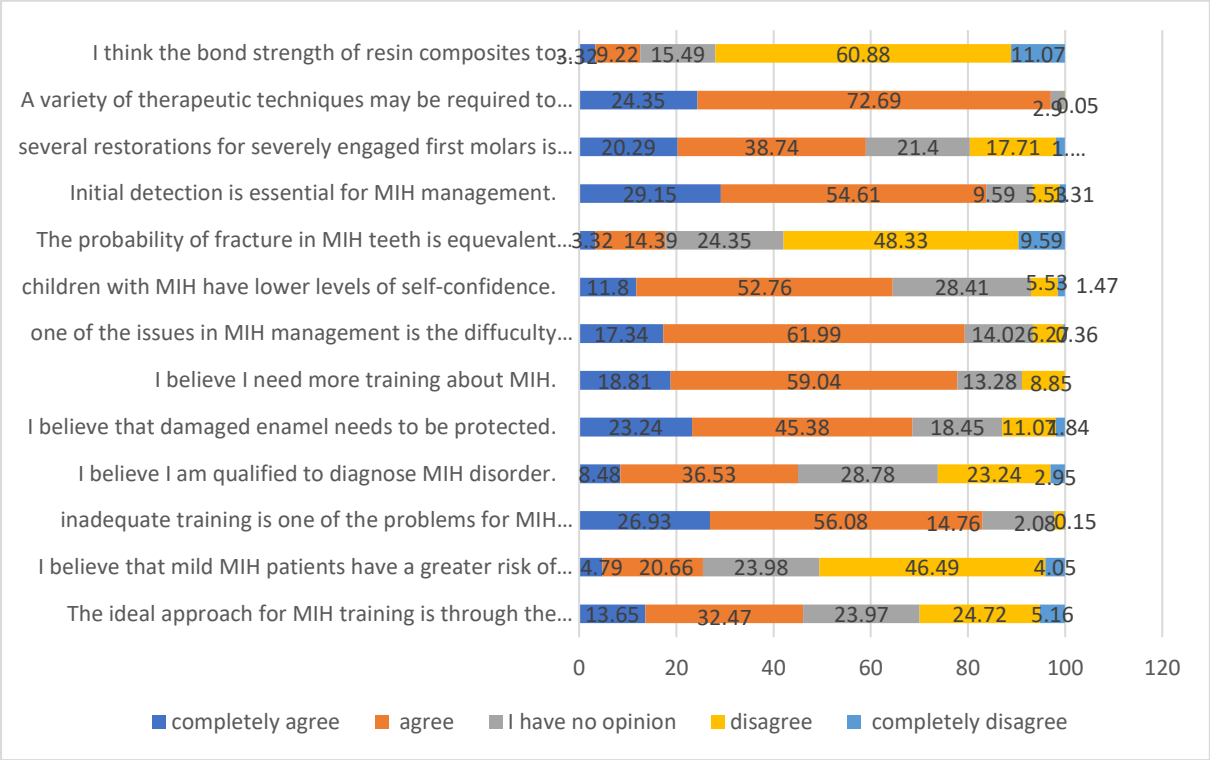

Figure 2. Frequency distribution of responses of dental specialists and postdoctoral dental residents participating in the study to attitude statements regarding MIH

The mean performance score of all participants was 13.00 ± 2.85 (13.17 ± 2.71 for postdoctoral dental residents and 12.95 ± 2.90 for dental specialists). Performance scores were categorized as follows: unsatisfactory (0–49), fairly satisfactory (50–74), and satisfactory (75–100), facilitating interpretation of the results. Based on these intervals, the performance of all participants, as well as postdoctoral dental residents and dental specialists individually, was generally satisfactory, with pediatric dentists showing particularly desirable performance.

No significant differences were found in the mean performance scores between dental specialists and postdoctoral dental residents within respective fields (Independent t-test, $p > 0.05$).

When comparing different fields, performance scores were significantly associated with specialty (One-way ANOVA). Postdoctoral dental residents in pediatric dentistry had significantly higher scores than those in orthodontics and endodontics. Among dental specialists, orthodontists and endodontists had significantly lower scores than the other three fields. Pediatric dentists showed the highest performance scores, although differences between pediatric dentists, restorative dentists, and experts of oral and maxillofacial diseases were not significant ($p > 0.05$). Table 4 presents the average performance score for dental specialists and postdoctoral dental residents in each specialty line. The frequency of participants' responses to each performance question is displayed in Figure 3.

Table 4. The average score of knowledge, attitude, and performance among dental specialists and postdoctoral dental residents in each field.

Degree	n	Field	Knowledge score Mean ± SD	P value	Attitude score Mean ± SD	P value	Performance score Mean ± SD	P value
Postgraduate dental specialty students	14	Endodontics	13.06 ± 1.94	0.20	47.20 ± 3.48	0.19	12.13 ± 2.99	0.02
	11	Orthodontics	10.90 ± 3.11		43.81± 3.12		11.81± 3.37	
	10	Oral and maxillofacial diseases	12 ± 3.65		45.71 ± 4.88		13.57± 1.81	
	17	Restorative dentistry	12.46 ± 2.38		45.13± 4.18		13.26± 2.01	
	15	Pediatric dentistry	13.06 ± 2.08		46.87± 4.08		14.81± 2.10	
	67	Total	12.43 ± 2.56		45.89± 3.99		13.17± 2.71	
Dental specialists	62	Endodontics	12.55 ± 3.76	0.005	46.38± 4.30	0.002	10.80± 3.15	<0.001
	54	Orthodontics	12.11 ± 1.96		44.44± 3.31		12.02± 2.49	
	36	Oral and maxillofacial diseases	12.51 ± 2.72		47.86 ± 3.37		13.89± 1.91	
	63	Restorative dentistry	12.39 ± 2.30		46.41 ± 3.37		13.60± 2.47	
	56	Pediatric dentistry	14.20 ± 2.11		47.22 ± 3.80		15.02± 1.96	
	271	Total	12.73 ± 2.74		46.35± 3.87		12.95± 2.90	

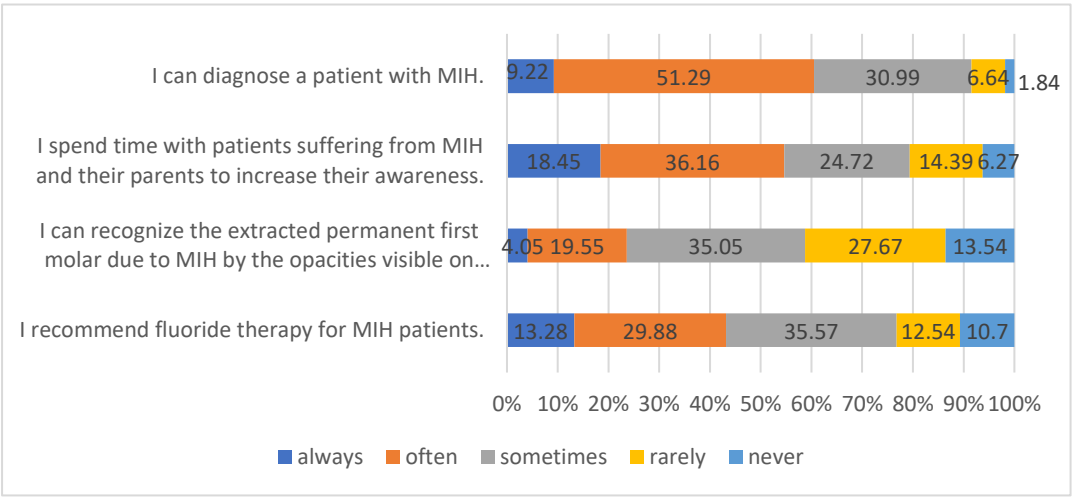

Figure 3. Frequency distribution of responses of dental specialists and postdoctoral dental residents participating in the study to each performance question

The influence of the years of clinical experience on the qualification of dental specialists was also evaluated in this research. The years of clinical experience of dental specialists have been classified into four levels. The average

score and standard deviation of each domain knowledge, attitude, and performance across different years of clinical experience for each field are shown in Table 5, allowing for comparison.

Table 5. Average score of knowledge, attitude, and performance of dental specialists of each field with different years of clinical experience

Line of Specialty	Years of Clinical Experience	Knowledge	P value	Attitude	P value	Performance	P value
		Mean ± SD		Mean ± SD		Mean ± SD	
Endodontics	<5	12.42 ± 2.63	0.65	44.42 ± 6.94	0.55	8.42 ± 4.11	0.002
	6–10	12.58 ± 5.82		47.41 ± 4.33		9.0 ± 1.80	
	11–15	13.80 ± 2.74		46.50 ± 2.67		12.10 ± 2.55	
	>15	11.80 ± 2.92		46.38 ± 3.85		12.22 ± 2.77	
	Total	12.55 ± 3.76		46.38 ± 4.30		10.80 ± 3.15	
Orthodontics	<5	12.28 ± 1.93	0.09	43.28 ± 2.84	0.36	10.92 ± 3.07	0.05
	6–10	11.14 ± 1.61		45.42 ± 3.27		13.35 ± 1.69	
	11–15	13.40 ± 2.07		44.00 ± 3.39		11.20 ± 1.64	
	>15	12.60 ± 2.06		44.90 ± 3.87		12.10 ± 2.23	
	Total	12.11 ± 1.96		44.44 ± 3.31		12.02 ± 2.49	
Oral & Maxillofacial Diseases	<5	10.00 ± 7.07	0.23	50.00 ± 5.65	0.76	14.00 ± 0.00	0.74
	6–10	14.16 ± 1.60		47.33 ± 6.31		14.50 ± 1.97	
	11–15	12.00 ± 2.00		47.40 ± 2.06		13.40 ± 2.54	
	>15	12.54 ± 2.76		48.18 ± 1.88		14.00 ± 1.41	
	Total	12.51 ± 2.72		47.86 ± 3.37		13.89 ± 1.91	
Restorative Dentistry	<5	13.55 ± 1.87	0.40	46.55 ± 1.87		13.77 ± 1.39	0.99
	6–10	12.00 ± 2.54		46.64 ± 2.87		13.64 ± 2.67	
	11–15	12.36 ± 2.90		43.81 ± 4.68		13.54 ± 2.69	
	>15	12.07 ± 1.68		48.14 ± 3.65		13.50 ± 2.84	
	Total	12.39 ± 2.30		46.41 ± 3.70		13.60 ± 2.47	
Pediatric Dentistry	<5	13.09 ± 1.64	0.01	45.18 ± 3.68		15.18 ± 2.22	0.04
	6–10	13.70 ± 2.26	—	48.30 ± 2.75		13.70 ± 2.21	
	11–15	14.50 ± 2.11	—	48.33 ± 4.65	0.17	16.00 ± 1.27	
	>15	16.14 ± 1.21	—	47.00 ± 2.88		15.00 ± 1.29	
	Total	14.20 ± 2.11	—	47.22 ± 3.80		15.02 ± 1.96	

Normality of the knowledge, attitude, and performance scores was confirmed using the Shapiro–Wilk test. The effect of work experience on these scores among specialists was analyzed using one-way ANOVA. The difference in average performance scores in the endodontics field, attitude in the restorative dentistry line, and knowledge and performance in the pediatric dentistry line was significant between different levels of clinical experience (p-value < 0.05). In other cases, there was no significant relationship between scores and the level of experience (p-value > 0.05).

The influence of the academic years on the qualification of postdoctoral dental residents was also assessed. The average scores for each domain of knowledge, attitude, and performance among postdoctoral dental residents with varying academic years in each field are presented in Table 6. The effect

of postgraduate year on knowledge, attitude, and performance scores was analyzed using one-way ANOVA after confirming normality with the Shapiro–Wilk test. Only the difference in knowledge scores between pediatric dentistry residents in different academic years was statistically significant; the third-year residents demonstrated a significantly higher knowledge score than those in the first two years. There was no significant relationship between academic year and knowledge, attitude, or performance scores in the other lines of specialty.

Table 6. The average score of knowledge, attitude, and performance of postdoctoral dental residents of each line of specialty across different academic years

Specialty	Academic Year	Knowledge	Attitude	Performance
		Mean ± SD	Mean ± SD	Mean ± SD
Endodontics	Year 1	13.60 ± 0.89	48.00 ± 2.91	10.60 ± 0.89
	Year 2	13.66 ± 1.52	48.00 ± 5.19	12.66 ± 3.51
	Year 3	12.42 ± 2.57	46.28 ± 3.45	13.00 ± 3.65
	All years	13.06 ± 1.94	47.20 ± 3.48	12.13 ± 2.99
	P value	0.52	0.67	0.39
Orthodontics	Year 1	12.66 ± 1.52	46.00 ± 1.00	13.00 ± 2.64
	Year 2	11.75 ± 3.20	43.75 ± 3.30	13.75 ± 3.77
	Year 3	8.75 ± 3.20	42.25 ± 3.59	9.00 ± 1.41
	All years	10.90 ± 3.11	43.81 ± 3.12	11.81 ± 3.37
	P value	0.21	0.32	0.09
Oral & Maxillofacial Diseases	Year 1	13.20 ± 2.38	46.20 ± 5.89	12.80 ± 1.09
	Year 2	13.00 ± 0.00	44.00 ± 0.00	17.00 ± 0.00
	Year 3	5.00 ± 0.00	45.00 ± 0.00	14.00 ± 0.00
	All years	12.00 ± 3.65	45.71 ± 4.88	13.57 ± 1.81
	P value	0.08	0.93	0.059
Restorative Dentistry	Year 1	11.80 ± 1.30	44.60 ± 4.03	13.00 ± 1.73
	Year 2	13.75 ± 1.50	48.00 ± 3.26	14.25 ± 2.87
	Year 3	12.00 ± 3.74	43.20 ± 4.86	13.00 ± 1.87
	All years	12.42 ± 2.47	45.07 ± 4.34	13.35 ± 2.06
	P value	0.48	0.26	0.62
Pediatric Dentistry	Year 1	12.50 ± 1.64	46.66 ± 3.14	14.83 ± 2.22
	Year 2	11.83 ± 1.32	45.50 ± 4.54	14.50 ± 2.26
	Year 3	15.75 ± 0.95	49.25 ± 4.57	15.25 ± 1.25
	All years	13.06 ± 2.08	46.87 ± 4.08	14.81 ± 2.10
	P value	0.002	0.38	0.87

Discussion

More than 87% of the statistical population participated in the present study with a response rate of 90.93%, which was higher than that of previous studies by Bagheri(14) and Crombie et al. (13). Although a response rate of 91% was achieved in Negrescu et al.'s study, they only evaluated 30 participants(16). In contrast, the present study included 271 participants.

Nearly all participants had been previously exposed to MIH in the present study, as well as in Crombie's (13), Bagheri's (14), and Gamboa's(17) studies, demonstrating the significance and high prevalence of MIH. Negrescu's study noted an exposure rate of 70% for postdoctoral dental residents (16). This can change our perceptions of the lesser importance of MIH awareness in some lines of specialty. The lowest exposure rate is among postdoctoral dental residents in oral and maxillofacial diseases (85.7%), which is still relatively high. Moreover, considering the exposure rate of 96.6% among experts in this field, the lower exposure rate among postdoctoral dental residents may be due to their limited clinical work, which is expected to increase in the future.

In the study conducted by Gamboa et al., it was observed that pediatric dentists reported a significantly higher exposure to MIH, corroborating the findings of Gambetta-Tessini et al. (18) The exposure rate was assessed at 100% within the fields of pediatric dentistry, orthodontics, and restorative dentistry in our research. This may be attributed to the increased referral of children and patients with MIH to these specialties, as well as the higher likelihood of early diagnosis prior to the progression of the lesion and severe destruction of the tooth due to the prolonged presence of biofilm. Bagheri's research indicated the highest exposure rate among endodontists (14).

Despite a 100% exposure rate in the fields of pediatric dentistry, orthodontics, and restorative dentistry, only 94.64% of pediatric dentists, 72.22% of orthodontists, and 79.36% of restorative dentists correctly distinguished MIH from fluorosis, amelogenesis imperfecta, and dentinogenesis imperfecta. Additionally, according to Yahia et al., 98.2% of pediatric dentists and 96.2% of other experts were aware that MIH is a distinct developmental abnormality from fluorosis and hypoplasia.

This high exposure suggests the necessity of awareness of MIH. In Crombie's study (13), most dentists were familiar with the typical MIH appearance, which was consistent with the results of European studies. Almost everyone in the statistical population was familiar with MIH in the present study. It is a matter of honor. Nevertheless, an initial familiarity of 97% does not mean that there is no need for further training. Although most participants (77.85%) initially showed high familiarity, they still demand more training. This difference should not be considered a contradiction, since the participants have a basic familiarity with lesions, but they also require further training for diagnosis, management, and caries prevention. It should also be noted that only 87.07% of the participants knew the basic definition of MIH; therfore, the initial familiarity may be limited to hearing the name of the lesion.

All participants in the pediatric dentistry line were familiar with MIH, as well as the fields of orthodontics and oral and maxillofacial diseases. Endodontists showed the least initial familiarity (89.4%). As a result, since the difference is statistically significant, special attention should be paid to this group through the educational topics.

Regarding the initial acquaintance, the least amount of acquaintance has been obtained from non-academic sources, such as conferences and pamphlets. Therefore, this lesion should be given utmost priority in congresses and brochures. The Spanish pediatric dentists have identified in-person continuing education (44.26%) and books and articles (24.58%) as the primary sources of the acquired knowledge in Serna-Muñoz et al.'s study (4). In the current study, only 2.5% of pediatric dentists obtained their information from extracurricular education, such as brochures and congresses, and 10% used articles and books, which is lower than Serna-Muñoz et al.'s study (4).

The overall knowledge score in our study was 12.65 ± 2.69, indicating a high level of knowledge regarding MIH among the participants. In comparison, previous studies have reported lower knowledge levels: Sajadi et al. found a moderate level of knowledge among general and specialist dentists in Kerman (15), while studies in Egypt (12) and Hong Kong(17) also indicated moderate awareness among dental practitioners. Differences in knowledge levels across studies may be attributed to variations in the study populations, educational curricula, and local training programs.

In the current study in Isfahan city, 70.27% of the statistical population achieved the highest knowledge score, which is higher than the score reported in Bagheri's study (14). Isfahan experts seem more knowledgeable than the teaching staff of Shiraz and Tehran faculties; the reason for this may be the high prevalence of MIH in Isfahan. The accuracy of this issue requires further investigation.

Among the postdoctoral dental residents, the fields of pediatric dentistry and endodontics achieved the highest knowledge scores in our study, although the difference was not statistically significant. Negrescu et al.'s study reported a significant difference between postdoctoral dental residents from various specialty lines, with the highest awareness among pediatric dentistry residents (16). The higher knowledge score of the pediatric dentistry residents in the present study and Negrescu et al.'s study may be explained by the closer association of MIH lesions with their field and more comprehensive training in the pediatric dentistry curriculum. The higher knowledge score of the line of pediatric dentistry was also confirmed when comparing it among the specialists. Moreover, pediatric dentists with 15 years or more of clinical experience obtained a higher score in knowledge. Despite the high level of knowledge, orthodontists had the lowest knowledge score among the study groups. This may be due to their lower engagement with the management and treatment of this lesion and, as a result, less effort to learn.

The attitude of all participants was generally positive, as well as that of the specialists and postdoctoral dental residents alone. Other publications have not disclosed the mean attitude score. Considering that the attitude was not favorable in our study, even in pediatric dentistry, it seems necessary to identify the weak points to further focus training.

No significant differences had been observed between dental specialists and postdoctoral dental residents in the same field, which can be attributed to the consistent opinion on MIH from the past to the present.

Pediatric dentists and experts of oral and maxillofacial diseases have a significantly more favorable attitude than orthodontists. Perhaps the reason is that this lesion exhibits clinical symptoms such as pain, sensitivity, a clinical appearance of white, yellow, or brown spots, and enamel breakdown. In such cases, the first choice for referral is probably a pediatric dentist. More patients lead to more experience and exploration, enabling the best possible management, and as a result, they develop a more favorable attitude.

One of the primary goals of all training and evaluation in any field is to enhance performance. Because if an individual's knowledge and attitude of perfection do not lead to improved performance, they will not reach their goal. Nevertheless, the average performance score and its comparison in different statistical populations have not been investigated in other studies. This is considered a significant weakness.

In addition to the attitude, the performance was also described as relatively desirable in most groups, although knowledge was high. This issue highlights the need for selective educational topics and a focus on less-discussed areas to provide cost-efficient training. Only pediatric dentists showed a desirable

performance. Although not undesirable, this level of performance is unsatisfactory due to the high importance of the lesion and its role in caries prevention and management. Notably, the field of restorative dentistry, which is one of the key areas regarding MIH, also exhibits a relatively desirable performance.

In general, the highest performance score belongs to the line of pediatric dentistry in both dental specialists and postdoctoral dental residents. Pediatric dentists had the highest knowledge score among specialists, and residents in pediatric dentistry and endodontics showed the highest knowledge score among postdoctoral dental residents. As a result, this more favorable performance can be attributed to their greater knowledge. The higher frequency of patients in the field of pediatric dentistry can also lead to improved performance.

The lowest performance score among postdoctoral dental residents belongs to the field of orthodontics. This group also received the lowest score in the knowledge and attitude section. Among the specialists, the lowest performance score belongs to orthodontists and endodontists; the orthodontists also received the lowest score in the other two sections. This issue indicates that the orthodontists had not yet achieved adequate knowledge, attitude, and performance, despite their high exposure to MIH. Regarding endodontists, they likely encounter an MIH tooth when the caries lesion has progressed and infected the pulp tissue; as a result, preventive interventions are no longer beneficial.

Dental specialists and postdoctoral dental residents in the same specialty tend to have similar performance. This may be due to the closeness of their knowledge and attitude. More studies should be conducted to clarify the role of experience; however, another possible reason could be the similar clinical work of dental residents and specialists.

The average performance score in the endodontics field increases with the longer years of experience. This can be explained by the fact that as experience increases, performance tends to improve.

The most favorable attitude in restorative dentistry is associated with more than 15 years of clinical experience, which appears to be acquired over time.

In the field of pediatric dentistry, the highest performance was observed among those with 11-15 years of experience, and the highest knowledge score was associated with clinical experience of 15 years or more. In the same field, professionals in the first level of clinical experience (less than 5 years) had the lowest knowledge score, but in terms of optimal performance, they had taken the second rank. This suggests that these specialists may have experienced this lesion without proper information and knowledge. A step should be taken to increase the awareness of younger dentists so that they can provide treatment for patients with more correct information. Gamboa's study (17) states that diagnostic criteria for MIH were introduced in 2001 , and, likely, the older generation of dentists did not receive any information about it in dental school. This issue indicates that experienced dentists in our study have taken steps to update their information in different areas. In Bagheri's study, which investigated 95 teaching staff members from the Tehran and Shiraz Faculties of Dentistry, no significant relationship was reported between the duration of clinical practice and the perception of the professionals (14).

In the field of pediatric dentistry, the knowledge of postdoctoral dental residents in their third year was higher than in the first two years, indicating that their competency increases throughout the residency period.

In other fields, there was no significant difference among the postdoctoral dental residents with different academic years. This is the sign that shows the

educational curriculum and even extra-curricular education in this period were not helpful. The relationship between knowledge, attitude, and performance and the academic years of postdoctoral dental residents has not been examined in other studies; therefore, further investigations are needed.

Conclusions

Nearly all dental specialists and postdoctoral dental residents encounter patients with MIH. Despite the high initial familiarity rate with MIH, further training is still necessary, particularly in the field of endodontics. Dental specialists from different fields showed a significant difference in the scores across all three domains. The overall knowledge level was considered high, with the highest score achieved by pediatric dentists. The attitude was evaluated as generally positive but not favorable, even for pediatric dentists. The overall performance of the participants was relatively satisfactory, while pediatric dentists demonstrated a commendable performance. Orthodontists had the lowest scores in knowledge, attitude, and performance.

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