

Knowledge, attitudes and clinical awareness of myogenous temporomandibular disorders among senior dental students: a cross-sectional study

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Abstract

Background

Myogenous temporomandibular disorders (M-TMD) require dentists to integrate pain science, structured clinical assessment, conservative management and appropriate interprofessional referral. This study evaluated senior dental students' knowledge, attitudes, self-efficacy and applied awareness of M-TMD, with particular attention to multidisciplinary and physiotherapy-related care.

Methods

A single-centre cross-sectional online survey included 158 fourth- and fifth-year dental students. The study-specific instrument comprised a 10-item knowledge test, a 14-item attitude scale, a three-item self-efficacy subset and an 11-item multiple-response awareness measure scored with partial credit; a five-item physiotherapy/multidisciplinary subscore was also examined. Internal consistency, group comparisons, Spearman correlations and multivariable linear regression for awareness were performed.

Results

Although 141/158 students (89.2%) reported previous TMD education, only two (1.3%) reported clinical-practice training; 21 (13.3%) had seen an M-TMD case and nine (5.7%) had treated a patient with TMD. Mean knowledge was 6.96/10, awareness 5.98/11 and self-efficacy 5.54/15. Only 18 students (11.4%) correctly rejected the statement that M-TMD is best diagnosed by magnetic resonance imaging. Conversely, 148 (93.7%) identified physiotherapists as an appropriate referral option, while performance on physical modalities and exercise/manual-therapy goals was low. Previous TMD education showed the largest unadjusted difference in awareness (6.15 vs 4.63; Cohen $d = 1.01$). In multivariable analysis, lack of previous education remained associated with lower awareness ($B = -1.06$, 95% CI -1.83 to -0.28; $p = 0.008$), whereas the fifth-year advantage was no longer independently significant ($B = 0.44$; $p = 0.072$). Self-efficacy was not correlated with awareness ($\rho = 0.076$; $p = 0.342$). All participants indicated that they wanted more clinical TMD training.

Conclusions

Senior dental students showed a marked gap between endorsement of contemporary multidisciplinary principles and readiness to operationalise them clinically. Structured case-based training, calibrated DC/TMD examination practice, interprofessional learning with physiotherapy and objective competency assessment may be more educationally informative than didactic exposure or self-confidence alone.

Background

Temporomandibular disorders (TMD) comprise a heterogeneous group of musculoskeletal and pain conditions affecting the temporomandibular joints, masticatory muscles and associated structures. Contemporary diagnostic frameworks distinguish pain-related conditions such as myalgia and arthralgia from intra-articular

disorders and emphasise a biopsychosocial rather than purely mechanical model of disease [1–3]. Population syntheses indicate that TMD are common across age groups and geographical regions, with particularly relevant burden in young and middle-aged adults [4, 5]. Beyond pain and jaw dysfunction, TMD may affect daily function, quality of life and healthcare use, creating a need for clinicians who can recognise common presentations, identify red flags and coordinate appropriate care [6, 7].

For most patients, contemporary management favours diagnosis-driven, reversible and conservative strategies before escalation to invasive care [8]. Manual therapy, therapeutic exercise, education and other musculoskeletal approaches form part of the non-invasive management repertoire, although the strength of evidence varies across modalities [9]. A recent randomised trial in chronic myogenic TMD further supports the potential value of adding musculoskeletal physiotherapy to splint therapy and education in selected patients [10]. Psychological factors are also clinically relevant and reinforce the need to integrate symptom history, functional assessment and psychosocial context [11]. Imaging can provide important anatomical information for specific joint disorders, but it complements rather than replaces a structured clinical examination; modality selection should follow the suspected pathology and clinical indication [12].

Dental education has repeatedly struggled to translate these evolving concepts into consistent predoctoral training. Surveys of North American and Brazilian dental schools have documented variability in TMD/orofacial pain curricula, limited clinical exposure and persistence of outdated or fragmented concepts [13–15]. Studies of dental students similarly report shortcomings in knowledge, perceived competence and satisfaction with TMD education [16]. Broader calls for improved orofacial pain education have therefore emphasised clinically meaningful competencies, patient-centred diagnosis and integration across disciplines rather than isolated teaching of occlusion or appliance therapy [17]. Recent student data also suggest that personal TMD experience may shape educational motivation, knowledge and professional behaviour [18], while studies among dentists indicate continuing gaps in chronic orofacial pain knowledge and in understanding the role of physiotherapy [19, 20]. Interprofessional collaboration between dentists and physiotherapists remains variable even in settings where both professions manage TMD [21].

Against this background, a key educational question is not simply whether students can endorse broad statements about multidisciplinary care, but whether they can operationalise those principles in diagnosis, referral and treatment reasoning. The present study therefore evaluated knowledge, attitudes, self-efficacy and applied awareness concerning M-TMD among fourth- and fifth-year dental students. Secondary objectives were to examine differences by study year, previous TMD education, case exposure, personal symptom experience, sex and data-collection wave; to characterise physiotherapy/multidisciplinary awareness; and to identify independent predictors of the awareness score. We hypothesised that greater educational and clinical exposure would be associated with higher objective knowledge and awareness, while recognising that perceived self-efficacy might not parallel measured performance.

Methods

Ethical considerations

The study protocol was approved by the Marmara University Faculty of Medicine Non-Drug and Non-Medical Device Research Ethics Committee (protocol no. 09.2025.25–0609; decision date 18 July 2025). The study was

conducted in accordance with the Declaration of Helsinki. Participation was voluntary, responses were analysed anonymously, and informed consent was obtained electronically from all participants before survey completion.

Study design and setting

This was a single-centre, cross-sectional, web-based survey conducted among senior dental students at Marmara University Faculty of Dentistry, Istanbul, Türkiye. Data were collected in August 2025. Reporting was prepared with attention to established guidance for observational and web-based survey research.

Participants and sample size

Students enrolled in the fourth or fifth year of the undergraduate dental programme were eligible to participate. Participation was voluntary. The source documents do not provide a complete denominator for all invited students; therefore, a response rate is not reported. A priori sample-size planning in the ethics application used G*Power for a one-way analysis of variance with four groups, a medium effect size of 0.30, alpha = 0.05 and 95% power, yielding a minimum target of 143 participants [22]. The final analytic sample comprised 158 students, exceeding this target.

Questionnaire and study measures

The questionnaire was investigator-developed for this study and was informed by the DC/TMD framework and the contemporary TMD literature [1, 8, 9, 12]. Good-practice guidance on questionnaire construction and measurement informed the reporting approach [23, 24]. Because the available source documents do not document a separate formal content-validation, cognitive-interview or pilot-validation phase, the instrument is described as study-specific rather than as a previously validated scale. Internal consistency and corrected item-total correlations were evaluated in the present sample; these reliability indices should not be interpreted as full construct validation [24, 25].

The instrument contained four domains. First, demographic and exposure items captured gender, year of study, previous TMD education, previous observation of an M-TMD case, clinical intervention in a patient with TMD, personal experience of TMD symptoms, preferred field of interest and preferred first approach to a patient presenting with TMD. Second, knowledge was measured with 10 true/false/don't-know items. Correct responses were scored 1 and incorrect or don't-know responses 0, producing a 0–10 knowledge score. Third, attitudes were assessed using 14 five-point Likert items. The negatively worded medication-only item was reverse-coded, yielding a 14–70 attitude score. Three items defined a prespecified self-efficacy subset (T3, T8 and T12; range 3–15) addressing perceived knowledge, ability to apply DC/TMD and confidence in evaluating an M-TMD patient.

Fourth, applied awareness was assessed using 11 multiple-response questions spanning common findings, DC/TMD diagnostic categories, physical examination, muscles associated with trigger points, differentiation from disc displacement, conservative treatment, exercise/manual-therapy goals, splint objectives, physical modalities, referral disciplines and the rationale for multidisciplinary care. For each question, partial credit was calculated as (number of correct options selected - number of distractors selected) divided by the number of

correct options; negative values were truncated to zero. Summed item scores formed a 0–11 awareness score. Five questions relating most directly to physiotherapy and multidisciplinary care were additionally combined as a 0–5 subscore. In two awareness items (F4 and F5), all listed response options were keyed as correct and no distractor was present; the robustness of conclusions to excluding these items was assessed in sensitivity analysis.

Outcomes

The primary outcome was the 0–11 awareness score because it required applied discrimination across diagnosis, examination, management and referral rather than simple endorsement of statements. Secondary outcomes were knowledge, attitude, self-efficacy and the physiotherapy/multidisciplinary subscore. Item-level performance, don't-know responding, preferred initial management and correlations among measures were prespecified descriptive and exploratory outcomes.

Statistical analysis

Continuous variables were summarised using mean and standard deviation and, where appropriate, median and interquartile range. Proportions were accompanied by 95% Wilson confidence intervals. Internal consistency was assessed with Kuder-Richardson 20 for the binary-scored knowledge test and Cronbach's alpha for the remaining multi-item measures; corrected item-total correlations were also examined. Distributional assumptions were evaluated using the Shapiro-Wilk test. For two-group comparisons, independent-samples Student t tests were used for normally distributed scores and Mann-Whitney U tests for non-normally distributed scores. Homogeneity of variance was evaluated with Levene's test and Welch correction was used when required. Where a Mann-Whitney comparison involved a group smaller than 20, a 50,000-permutation Monte Carlo p value was used.

Comparisons across three management-approach groups used the Kruskal-Wallis test followed, when significant, by Dunn-Bonferroni post hoc comparisons. Categorical comparisons used Fisher's exact test when expected cell counts were below five. Relationships among scale scores were assessed using Spearman correlation. Effect sizes were expressed as Cohen d for parametric two-group comparisons, rank-biserial r for non-parametric two-group comparisons and epsilon squared for Kruskal-Wallis analyses. Two-sided $p < 0.05$ was considered statistically significant. Reporting was aligned with the STROBE recommendations for cross-sectional studies and the CHERRIES principles for internet surveys [26, 27].

A multivariable linear regression model was fitted for awareness to estimate the independent contributions of study year, data-collection wave, previous TMD education, having seen an M-TMD case, personal TMD symptoms and sex. Data-collection wave was retained because exploratory analyses showed marked imbalance in previous TMD education between waves. Results are reported as unstandardised regression coefficients (B), standard errors and 95% confidence intervals.

Sensitivity analyses examined: (1) a nine-item awareness score excluding F4 and F5, which contained no distractors; (2) the ethics-approved 14-item attitude score versus an alternative 13-item version; and (3) exclusion of six unclassifiable responses to the initial-management item.

Results

Participant characteristics and educational exposure

All 158 respondents had complete data for the principal scale outcomes. Ninety-five (60.1%) were women and 93 (58.9%) were fourth-year students (Table 1). Previous TMD education was reported by 141 students (89.2%), but this was almost entirely theoretical: 139 (88.0%) reported theoretical teaching and only two (1.3%) reported clinical-practice training. Only 21 (13.3%) had seen or worked through an M-TMD case and nine (5.7%) had clinically intervened in a patient with TMD. In contrast, 73 (46.2%) reported having personally experienced TMD symptoms. All 158 students answered yes to the items asking whether TMD symptoms may be related to psychological factors and whether they wanted more clinical TMD training; these zero-variance items were therefore reported descriptively and excluded from comparative analyses.

Table 1
Participant characteristics and educational/clinical exposure

Variable	Category	n	%	95% CI
Gender	Female	95	60.1	52.3–67.4
	Male	63	39.9	32.6–47.7
Study year	Fourth year	93	58.9	51.1–66.2
	Fifth year	65	41.1	33.8–48.9
Data-collection wave	Wave 1 (11 Jun-8 Jul 2025)	72	45.6	38.0-53.3
	Wave 2 (11–16 Aug 2025)	86	54.4	46.7–62.0
Previous TMD education	Yes, theoretical classes	139	88.0	82.0-92.2
	Yes, clinical practice	2	1.3	0.3–4.5
	No / unsure	17	10.8	6.8–16.6
Seen an M-TMD case	Yes	21	13.3	8.9–19.5
	No	137	86.7	80.5–91.1
Treated a patient with TMD clinically	Yes	9	5.7	3.0-10.5
	No	149	94.3	89.5–97.0
Personal TMD symptoms	Yes	73	46.2	38.6–54.0
	No	85	53.8	46.0-61.4
Field of interest	Oral and maxillofacial surgery	55	34.8	27.8–42.5
	Orthodontics	31	19.6	14.2–26.5
	Prosthodontics	15	9.5	5.8–15.1
	Other clinical fields	24	15.2	10.4–21.6
	Uncertain / no specific interest	33	20.9	15.3–27.9
First approach to a patient with TMD	Request specialist consultation	83	52.5	44.8–60.2
	Apply a stabilisation splint	47	29.7	23.2–37.3
	Recommend muscle relaxant and rest	17	10.8	6.8–16.6
	Refer to physiotherapy	3	1.9	0.6–5.4
	Recommend an analgesic	2	1.3	0.3–4.5
	Unspecified	6	3.8	1.8-8.0

CI, confidence interval (Wilson score method); M-TMD, myogenous temporomandibular disorder; TMD, temporomandibular disorder.

When asked about their first approach to a patient with TMD, 83 (52.5%) selected specialist consultation, 47 (29.7%) a stabilisation splint, 17 (10.8%) a muscle relaxant/rest, three (1.9%) direct physiotherapy referral and two (1.3%) an analgesic. Six responses (3.8%) corresponded to an unlabelled option in the original survey and were retained as an 'unspecified' category in Table 1 but excluded from comparative management-group analyses.

Score distributions and internal consistency

The mean knowledge score was 6.96 ± 1.87 of 10, attitude 48.33 ± 5.45 of 70, self-efficacy 5.54 ± 2.06 of 15, awareness 5.98 ± 1.57 of 11 and physiotherapy/multidisciplinary awareness 2.53 ± 0.79 of 5 (Table 2). Knowledge, attitude and self-efficacy were non-normally distributed, whereas awareness and the physiotherapy/multidisciplinary subscore met the Shapiro-Wilk normality criterion. Internal consistency was KR-20 = 0.639 for knowledge, Cronbach's alpha = 0.722 for attitude, 0.705 for self-efficacy, 0.772 for awareness and 0.626 for the physiotherapy/multidisciplinary subscore (Table 3). Corrected item-total correlations for awareness ranged from 0.243 to 0.587.

Table 2
Score distributions and Shapiro-Wilk normality tests

Measure	Statistic	Value	Observed range	Shapiro-Wilk W	p	Distribution
Knowledge score (0–10)	Mean $\pm$ SD	6.96 ± 1.87	2.00–10.00	0.947	< 0.001	Non-normal
	Median (IQR)	7.00 (2.00)				
Attitude score (14–70)	Mean $\pm$ SD	48.33 ± 5.45	18.00–63.00	0.943	< 0.001	Non-normal
	Median (IQR)	48.00 (7.00)				
Self-efficacy (3–15)	Mean $\pm$ SD	5.54 ± 2.06	3.00–11.00	0.920	< 0.001	Non-normal
	Median (IQR)	5.00 (3.00)				
Awareness score (0–11)	Mean $\pm$ SD	5.98 ± 1.57	2.43–9.60	0.992	0.483	Normal
	Median (IQR)	5.99 (2.06)				
Physiotherapy/multidisciplinary (0–5)	Mean $\pm$ SD	2.53 ± 0.79	0.70–4.75	0.987	0.145	Normal
	Median (IQR)	2.45 (1.00)				

IQR, interquartile range; SD, standard deviation. Normality classification is based on the Shapiro-Wilk test.

Table 3
Internal consistency of study measures

Measure	Items	Coefficient	Value
Knowledge scale	10	KR-20	0.639
Attitude scale	14	Cronbach's alpha	0.722
Self-efficacy subset (T3, T8, T12)	3	Cronbach's alpha	0.705
Awareness scale	11	Cronbach's alpha	0.772
Physiotherapy/multidisciplinary subscore	5	Cronbach's alpha	0.626
<i>KR-20, Kuder-Richardson 20. The self-efficacy subset was specified a priori from three items reflecting perceived competence.</i>			
<i>Reliability coefficients describe internal consistency in this sample and do not by themselves establish construct validity.</i>			

Knowledge scores

Knowledge-item accuracy ranged from 11.4% to 98.7% (Table 4). Nearly all students recognised that stress can aggravate TMD symptoms (98.7%), that TMD are not exclusively joint-derived (94.9%), that temporomandibular joint disorders are musculoskeletal dysfunctions (91.8%) and that physiotherapy/exercise are not ineffective (89.9%). In contrast, only 18 students (11.4%) correctly rejected the statement that M-TMD is best diagnosed with magnetic resonance imaging; 74 (46.8%) selected don't know. Don't-know responses also exceeded 40% for the item about antibiotic treatment of M-TMD. Fifth-year students had higher total knowledge than fourth-year students (7.46 ± 1.42 vs 6.61 ± 2.07 ; $p = 0.010$), with significant item-level differences for the masticatory-muscle activity item ($p = 0.036$) and antibiotic item ($p = 0.003$). The mean number of don't-know responses was 2.27 ± 2.05 per student and was strongly inversely correlated with knowledge ($\rho = -0.884$) and inversely correlated with awareness ($\rho = -0.410$; both $p < 0.001$).

Table 4
Knowledge item performance and comparison by study year

No.	Statement	Key	Correct n (%)	95% CI	Don't know n (%)	Fourth year n (%)	Fifth year n (%)	p
K1	TMD are caused only by the joint.	False	150 (94.9)	90.3–97.4	8 (5.1)	86 (92.5)	64 (98.5)	0.142
K2	Myogenous TMD are caused by excessive activity of the masticatory muscles.	True	86 (54.4)	46.7–62.0	66 (41.8)	44 (47.3)	42 (64.6)	0.036
K3	A stabilisation splint is used only to reduce pain.	False	105 (66.5)	58.8–73.3	42 (26.6)	58 (62.4)	47 (72.3)	0.232
K4	Splint therapy controls pain by reducing muscle activity.	True	118 (74.7)	67.4–80.8	34 (21.5)	65 (69.9)	53 (81.5)	0.136
K5	Ultrasound can be used to measure masseter muscle thickness.	True	91 (57.6)	49.8–65.0	53 (33.5)	50 (53.8)	41 (63.1)	0.257
K6	Physiotherapy and exercise are not effective in TMD treatment.	False	142 (89.9)	84.2–93.7	9 (5.7)	81 (87.1)	61 (93.8)	0.191
K7	Stress can increase TMD symptoms.	True	156 (98.7)	95.5–99.7	2 (1.3)	92 (98.9)	64 (98.5)	1.000
K8	TMJ disorders are musculoskeletal dysfunctions.	True	145 (91.8)	86.4–95.1	7 (4.4)	85 (91.4)	60 (92.3)	1.000
K9	Myogenous TMD can be reduced using antibiotics.	False	89 (56.3)	48.5–63.8	64 (40.5)	43 (46.2)	46 (70.8)	0.003
K10	Myogenous TMD are best diagnosed with MRI.	False	18 (11.4)	7.3–17.3	74 (46.8)	11 (11.8)	7 (10.8)	1.000
Total knowledge score (0–10)			6.96 ± 1.87			6.61 ± 2.07	7.46 ± 1.42	0.010

Item-level year comparisons used Fisher exact tests. The total-score comparison used the Mann-Whitney U test. Bold p values in the source report were $p < 0.05$; values are shown without multiplicity adjustment. MRI, magnetic resonance imaging; TMD, temporomandibular disorder; TMJ, temporomandibular joint.

Attitudes and self-efficacy

Attitudes were most favourable for comprehensive history-taking (4.56 ± 0.74), rejection of medication-only treatment after reverse coding (4.47 ± 0.72), combined splint/exercise management (4.42 ± 0.73), multidisciplinary care (4.40 ± 0.79) and psychosocial assessment (4.31 ± 0.72) (Table 5). These positive conceptual attitudes contrasted with low confidence. Mean scores were 1.71 ± 0.88 for knowing and being able to apply DC/TMD criteria, 1.87 ± 0.85 for feeling competent to evaluate an M-TMD patient and 1.96 ± 0.87 for

perceived knowledge sufficient to manage TMD. Only 3.2% of students were categorised in the source analysis as feeling competent to evaluate an M-TMD patient. Perceived adequacy of educational material was also low (2.37 ± 0.97).

Table 5
Attitude items by gender- and study year

No.	Statement	Overall	Female	Male	p	Fourth year	Fifth year	p
T1	A stabilisation splint is an effective method in TMD treatment.	3.85 ± 0.74	3.94 ± 0.74	3.73 ± 0.72	0.084	3.76 ± 0.70	3.98 ± 0.78	0.093
T2	Medication alone is sufficient for TMD treatment. (reverse-coded)	4.47 ± 0.72	4.43 ± 0.81	4.52 ± 0.56	0.918	4.39 ± 0.82	4.58 ± 0.53	0.284
T3	As a dentist, I think I have sufficient knowledge to manage patients with TMD.	1.96 ± 0.87	1.83 ± 0.77	2.14 ± 0.98	0.055	1.78 ± 0.88	2.20 ± 0.79	< 0.001
T4	I would like to encounter more TMD cases during clinical training.	4.13 ± 0.86	4.15 ± 0.89	4.10 ± 0.84	0.544	3.99 ± 0.95	4.32 ± 0.69	0.035
T5	Splint therapy and muscle exercises are more effective when used together.	4.42 ± 0.73	4.45 ± 0.68	4.37 ± 0.81	0.660	4.33 ± 0.74	4.54 ± 0.71	0.044
T6	A comprehensive history is highly important in TMD diagnosis.	4.56 ± 0.74	4.51 ± 0.84	4.65 ± 0.57	0.463	4.55 ± 0.83	4.58 ± 0.61	0.687
T7	Ultrasound is effective for identifying myofascial trigger points.	3.68 ± 0.87	3.71 ± 0.92	3.65 ± 0.81	0.744	3.62 ± 0.86	3.77 ± 0.90	0.279
T8	I know and can apply the DC/TMD criteria for M-TMD diagnosis.	1.71 ± 0.88	1.69 ± 0.90	1.73 ± 0.87	0.701	1.67 ± 0.86	1.77 ± 0.91	0.483
T9	Assessment of psychosocial factors contributes to the diagnostic process.	4.31 ± 0.72	4.34 ± 0.74	4.27 ± 0.70	0.447	4.33 ± 0.71	4.28 ± 0.74	0.666
T10	I think patients diagnosed with M-TMD should be referred to a physiotherapist.	3.65 ± 0.94	3.78 ± 0.92	3.44 ± 0.95	0.027	3.58 ± 0.95	3.74 ± 0.94	0.176
T11	A multidisciplinary approach is a core principle in M-TMD management.	4.40 ± 0.79	4.48 ± 0.77	4.27 ± 0.81	0.051	4.39 ± 0.77	4.42 ± 0.83	0.569
T12	I feel competent to evaluate a patient with M-	1.87 ± 0.85	1.83 ± 0.79	1.94 ± 0.93	0.628	1.66 ± 0.81	2.18 ± 0.81	< 0.001

Values are mean ± SD on a 1–5 Likert scale unless otherwise stated. Sex and year comparisons used Mann-Whitney U tests. DC/TMD, Diagnostic Criteria for Temporomandibular Disorders; M-TMD, myogenous

temporomandibular disorder; TMD, temporomandibular disorder.

No.	Statement	Overall	Female	Male	p	Fourth year	Fifth year	p
TMD.								
T13	The educational material/course content on this topic was adequate.	2.37 ± 0.97	2.44 ± 0.96	2.25 ± 0.98	0.218	2.34 ± 0.95	2.40 ± 1.01	0.861
T14	The most effective treatment I have observed was occlusal splint therapy.	2.96 ± 0.93	2.98 ± 0.96	2.92 ± 0.90	0.464	2.84 ± 0.96	3.12 ± 0.88	0.113
	Total attitude score (14–70)	48.33 ± 5.45	48.56 ± 5.97	47.98 ± 4.58	0.440	47.24 ± 5.84	49.89 ± 4.43	< 0.001
<i>Values are mean ± SD on a 1–5 Likert scale unless otherwise stated. Sex and year comparisons used Mann-Whitney U tests. DC/TMD, Diagnostic Criteria for Temporomandibular Disorders; M-TMD, myogenous temporomandibular disorder; TMD, temporomandibular disorder.</i>								

There were few sex differences: women more strongly endorsed physiotherapy referral than men (3.78 ± 0.92 vs 3.44 ± 0.95 ; $p = 0.027$). Fifth-year students reported higher self-perceived knowledge ($p < 0.001$), greater confidence in evaluating M-TMD ($p < 0.001$), stronger desire for clinical exposure ($p = 0.035$) and stronger endorsement of combined splint/exercise treatment ($p = 0.044$). Total attitude score was also higher in fifth-year students (49.89 ± 4.43 vs 47.24 ± 5.84 ; $p < 0.001$).

Applied awareness and the referral-content gap

Awareness performance varied substantially across questions (Table 6). The highest partial-credit performance concerned physical examination (0.74 ± 0.27) and common clinical findings (0.69 ± 0.29). The weakest performance concerned physical modalities (0.33 ± 0.21), exercise/manual-therapy goals (0.44 ± 0.22), DC/TMD M-TMD categories (0.44 ± 0.27) and muscles in which trigger points may develop (0.46 ± 0.23). Only one student (0.6%) answered the exercise/manual-therapy goal question completely correctly, and only three (1.9%) answered the physical-modality question completely correctly.

Table 6
Awareness item-level performance and psychometric indices

Item	Topic	Correct/options	Correct selections	Distractor selections	Partial credit	Fully correct n (%)	Item-total r
F1	Most common clinical findings of M-TMD	4/6	2.84 ± 1.14	0.09 ± 0.35	0.69 ± 0.29	54 (34.2)	0.311
F2	M-TMD diagnostic categories according to DC/TMD	3/5	1.69 ± 0.86	0.44 ± 0.60	0.44 ± 0.27	16 (10.1)	0.243
F3	Physical examination methods for M-TMD diagnosis	4/5	2.98 ± 1.11	0.02 ± 0.14	0.74 ± 0.27	67 (42.4)	0.587
F4	Muscles in which trigger points may develop	5/5	2.28 ± 1.13	0.00 ± 0.00	0.46 ± 0.23	10 (6.3)	0.502
F5	Differentiation of M-TMD from disc displacement	5/5	2.51 ± 1.34	0.00 ± 0.00	0.50 ± 0.27	21 (13.3)	0.450
F6	Conservative treatment methods	4/6	2.61 ± 1.17	0.53 ± 0.66	0.53 ± 0.29	19 (12.0)	0.454
F7	Goals of exercise and manual therapy	4/6	2.31 ± 0.96	0.56 ± 0.69	0.44 ± 0.22	1 (0.6)	0.349
F8	Purpose of splint therapy	3/5	2.05 ± 0.81	0.16 ± 0.40	0.63 ± 0.27	41 (25.9)	0.418
F9	Physical modalities that may be used	5/6	1.73 ± 1.14	0.11 ± 0.32	0.33 ± 0.21	3 (1.9)	0.410
F10	Specialties/disciplines for referral	4/6	2.54 ± 0.89	0.05 ± 0.25	0.62 ± 0.22	23 (14.6)	0.407
F11	Rationale for multidisciplinary care	4/5	2.45 ± 1.16	0.03 ± 0.18	0.61 ± 0.29	35 (22.2)	0.547
	Total awareness score	45/59	25.99 ± 7.41	2.01 ± 1.83	5.98 ± 1.57	-	alpha = 0.772

Values are mean ± SD unless otherwise indicated. F4 and F5 had no distractors because all options in the source answer key were designated correct. Partial credit=(correct selections - distractor selections)/number of correct options, truncated at zero. DC/TMD, Diagnostic Criteria for Temporomandibular Disorders; M-TMD, myogenous temporomandibular disorder.

Option-level results exposed a particularly informative educational mismatch (Table 7). Physiotherapists were recognised as an appropriate referral discipline by 148 students (93.7%), and 138 (87.3%) identified the need to address psychological, musculoskeletal and functional components together. However, only 15 (9.5%) selected extracorporeal shock-wave therapy and 35 (22.2%) low-level laser therapy as physical modalities in the predetermined answer key; 19 (12.0%) selected increasing pain threshold as an exercise/manual-therapy target, while 45 (28.5%) selected the distractor 'increase muscle strength'. Similarly, 58 (36.7%) selected both non-

steroidal anti-inflammatory drugs (keyed correct) and botulinum toxin injection (keyed distractor) in the conservative-treatment item. Thus, students appeared much more familiar with the destination of referral than with the content and rationale of the receiving discipline's interventions.

Table 7
Selected response-option findings from awareness items

Item	Option	Key status	Selected n (%)	95% CI
F10	Physiotherapist	Correct	148 (93.7)	88.7–96.5
F11	Psychological, musculoskeletal and functional components addressed together	Correct	138 (87.3)	81.3–91.7
F4	Masseter	Correct	152 (96.2)	92.0–98.2
F3	Halitosis test	Distractor	3 (1.9)	0.6–5.4
F6	Botulinum toxin injection	Distractor	58 (36.7)	29.6–44.5
F6	Non-steroidal anti-inflammatory drugs (NSAIDs)	Correct	58 (36.7)	29.6–44.5
F2	Temporalis spasm	Distractor	47 (29.7)	23.2–37.3
F2	Local myalgia	Correct	60 (38.0)	30.8–45.7
F7	Increase muscle strength	Distractor	45 (28.5)	22.0–36.0
F7	Increase pain threshold	Correct	19 (12.0)	7.8–18.0
F9	Extracorporeal shock-wave therapy (ESWT)	Correct	15 (9.5)	5.8–15.1
F9	Low-level laser therapy (LLLT)	Correct	35 (22.2)	16.4–29.2
F10	Otorhinolaryngologist	Correct	45 (28.5)	22.0–36.0
F4	Digastric	Correct	19 (12.0)	7.8–18.0

CI, confidence interval. "Correct" and "distractor" reproduce the predetermined study answer key and should be interpreted in that context.

Group comparisons

Sex was not significantly associated with any of the five summary scores and effect sizes were negligible to small (Table 8). Fifth-year students had higher knowledge ($p = 0.010$), attitude ($p < 0.001$), self-efficacy ($p = 0.002$) and awareness ($p = 0.010$; $d = 0.42$), but not physiotherapy/multidisciplinary awareness ($p = 0.194$).

Previous TMD education was the most consistent discriminator: students reporting education had higher knowledge, attitude, self-efficacy, awareness and physiotherapy/multidisciplinary scores. The differences were largest for awareness (6.15 ± 1.51 vs 4.63 ± 1.47 ; $p < 0.001$; $d = 1.01$) and the physiotherapy/multidisciplinary subscore (2.60 ± 0.77 vs 1.96 ± 0.69 ; $p = 0.001$; $d = 0.84$). Having seen an M-TMD case was associated with higher knowledge (8.00 ± 1.22 vs 6.80 ± 1.91 ; $p = 0.007$) but not statistically higher awareness ($p = 0.100$). Students with personal TMD symptoms had higher knowledge ($p = 0.020$), attitude ($p = 0.024$), awareness ($p = 0.002$; $d = 0.49$) and physiotherapy/multidisciplinary awareness ($p = 0.028$).

Table 8
Score comparisons across participant subgroups

Variable / score	Statistic	Group 1	Group 2	p	Effect size
Sex - Female (n = 95) / Male (n = 63)					
Knowledge (0–10)	Mean ± SD	7.01 ± 1.94	6.89 ± 1.77	0.597	r = 0.04
	Median (IQR)	7.00 (3.00)	7.00 (2.50)		negligible
Attitude (14–70)	Mean ± SD	48.56 ± 5.97	47.98 ± 4.58	0.440	r = 0.06
	Median (IQR)	49.00 (7.00)	48.00 (6.50)		negligible
Self-efficacy (3–15)	Mean ± SD	5.36 ± 1.96	5.81 ± 2.21	0.220	r = 0.10
	Median (IQR)	5.00 (3.00)	6.00 (4.00)		negligible
Awareness (0–11)	Mean ± SD	6.05 ± 1.70	5.88 ± 1.36	0.481	d = 0.11
	Median (IQR)	6.10 (2.22)	5.93 (1.66)		negligible
Physio/multidisciplinary (0–5)	Mean ± SD	2.60 ± 0.86	2.41 ± 0.66	0.137	d = 0.24
	Median (IQR)	2.65 (1.00)	2.30 (0.95)		small
Study year - Fourth year (n = 93) / Fifth year (n = 65)					
Knowledge (0–10)	Mean ± SD	6.61 ± 2.07	7.46 ± 1.42	0.010	r = 0.20
	Median (IQR)	7.00 (3.00)	8.00 (3.00)		small
Attitude (14–70)	Mean ± SD	47.24 ± 5.84	49.89 ± 4.43	< 0.001	r = 0.30
	Median (IQR)	47.00 (6.00)	50.00 (5.00)		small
Self-efficacy (3–15)	Mean ± SD	5.11 ± 1.94	6.15 ± 2.10	0.002	r = 0.25
	Median (IQR)	5.00 (3.00)	6.00 (4.00)		small

Normally distributed outcomes were compared with independent-samples t tests; non-normal outcomes with Mann-Whitney U tests. For Mann-Whitney comparisons involving a group < 20, 50,000-permutation Monte Carlo p values were used. Effect sizes are Cohen d for parametric comparisons and rank-biserial r for non-parametric comparisons. IQR, interquartile range; SD, standard deviation.

Variable / score	Statistic	Group 1	Group 2	p	Effect size
Sex - Female (n = 95) / Male (n = 63)					
Awareness (0–11)	Mean ± SD	5.71 ± 1.48	6.36 ± 1.63	0.010	d = 0.42
	Median (IQR)	5.78 (1.90)	6.38 (2.13)		small
Physio/multidisciplinary (0–5)	Mean ± SD	2.46 ± 0.71	2.63 ± 0.89	0.194	d = 0.21
	Median (IQR)	2.45 (1.00)	2.45 (1.20)		small
Data wave - Wave 1 (n = 72) / Wave 2 (n = 86)					
Knowledge (0–10)	Mean ± SD	7.43 ± 1.72	6.57 ± 1.91	0.004	r = 0.23
	Median (IQR)	8.00 (3.00)	7.00 (3.00)		small
Attitude (14–70)	Mean ± SD	48.97 ± 4.58	47.79 ± 6.05	0.164	r = 0.11
	Median (IQR)	49.00 (4.25)	47.50 (7.75)		small
Self-efficacy (3–15)	Mean ± SD	5.81 ± 1.90	5.31 ± 2.18	0.066	r = 0.15
	Median (IQR)	6.00 (3.00)	5.00 (4.00)		small
Awareness (0–11)	Mean ± SD	6.45 ± 1.47	5.59 ± 1.56	< 0.001	d = 0.56
	Median (IQR)	6.55 (1.80)	5.64 (1.76)		moderate
Physio/multidisciplinary (0–5)	Mean ± SD	2.69 ± 0.77	2.39 ± 0.78	0.017	d = 0.38
	Median (IQR)	2.70 (1.01)	2.30 (1.00)		small
Previous TMD education - Yes (n = 141) / No (n = 17)					
Knowledge (0–10)	Mean ± SD	7.13 ± 1.81	5.59 ± 1.87	0.002	r = 0.24
<i>Normally distributed outcomes were compared with independent-samples t tests; non-normal outcomes with Mann-Whitney U tests. For Mann-Whitney comparisons involving a group < 20, 50,000-permutation Monte Carlo p values were used. Effect sizes are Cohen d for parametric comparisons and rank-biserial r for non-parametric comparisons. IQR, interquartile range; SD, standard deviation.</i>					

Variable / score	Statistic	Group 1	Group 2	p	Effect size
Sex - Female (n = 95) / Male (n = 63)					
	Median (IQR)	7.00 (3.00)	5.00 (3.00)		small
Attitude (14–70)	Mean ± SD	48.66 ± 5.34	45.59 ± 5.77	0.022	r = 0.18
	Median (IQR)	49.00 (6.00)	46.00 (8.00)		small
Self-efficacy (3–15)	Mean ± SD	5.68 ± 2.08	4.35 ± 1.50	0.010	r = 0.20
	Median (IQR)	6.00 (3.00)	4.00 (2.00)		small
Awareness (0–11)	Mean ± SD	6.15 ± 1.51	4.63 ± 1.47	< 0.001	d = 1.01
	Median (IQR)	6.13 (2.00)	4.63 (2.12)		large
Physio/multidisciplinary (0–5)	Mean ± SD	2.60 ± 0.77	1.96 ± 0.69	0.001	d = 0.84
	Median (IQR)	2.65 (0.95)	1.95 (1.00)		large
Seen an M-TMD case - Yes (n = 21) / No (n = 137)					
Knowledge (0–10)	Mean ± SD	8.00 ± 1.22	6.80 ± 1.91	0.007	r = 0.22
	Median (IQR)	8.00 (2.00)	7.00 (3.00)		small
Attitude (14–70)	Mean ± SD	50.14 ± 5.60	48.05 ± 5.39	0.208	r = 0.10
	Median (IQR)	50.00 (9.00)	48.00 (6.00)		small
Self-efficacy (3–15)	Mean ± SD	6.19 ± 2.50	5.44 ± 1.98	0.220	r = 0.10
	Median (IQR)	6.00 (4.00)	5.00 (3.00)		negligible
Awareness (0–11)	Mean ± SD	6.51 ± 1.14	5.90 ± 1.62	0.100	d = 0.39
<i>Normally distributed outcomes were compared with independent-samples t tests; non-normal outcomes with Mann-Whitney U tests. For Mann-Whitney comparisons involving a group < 20, 50,000-permutation Monte Carlo p values were used. Effect sizes are Cohen d for parametric comparisons and rank-biserial r for non-parametric comparisons. IQR, interquartile range; SD, standard deviation.</i>					

Variable / score	Statistic	Group 1	Group 2	p	Effect size
Sex - Female (n = 95) / Male (n = 63)					
	Median (IQR)	6.60 (1.42)	5.85 (2.08)		small
Physio/multidisciplinary (0–5)	Mean ± SD	2.66 ± 0.68	2.51 ± 0.81	0.412	d = 0.19
	Median (IQR)	2.70 (0.80)	2.45 (1.00)		negligible
Personal TMD symptoms - Yes (n = 73) / No (n = 85)					
Knowledge (0–10)	Mean ± SD	7.37 ± 1.59	6.61 ± 2.02	0.020	r = 0.18
	Median (IQR)	8.00 (3.00)	7.00 (3.00)		small
Attitude (14–70)	Mean ± SD	49.38 ± 4.62	47.42 ± 5.95	0.024	r = 0.18
	Median (IQR)	49.00 (7.00)	47.00 (5.00)		small
Self-efficacy (3–15)	Mean ± SD	5.71 ± 2.18	5.39 ± 1.96	0.410	r = 0.07
	Median (IQR)	6.00 (3.00)	5.00 (3.00)		negligible
Awareness (0–11)	Mean ± SD	6.39 ± 1.45	5.63 ± 1.60	0.002	d = 0.49
	Median (IQR)	6.25 (1.78)	5.70 (2.25)		small
Physio/multidisciplinary (0–5)	Mean ± SD	2.68 ± 0.80	2.40 ± 0.76	0.028	d = 0.35
	Median (IQR)	2.65 (1.00)	2.45 (1.00)		small
<i>Normally distributed outcomes were compared with independent-samples t tests; non-normal outcomes with Mann-Whitney U tests. For Mann-Whitney comparisons involving a group < 20, 50,000-permutation Monte Carlo p values were used. Effect sizes are Cohen d for parametric comparisons and rank-biserial r for non-parametric comparisons. IQR, interquartile range; SD, standard deviation.</i>					

Data-collection wave was also associated with performance. Wave 1 respondents had higher knowledge (7.43 ± 1.72 vs 6.57 ± 1.91 ; $p = 0.004$), awareness (6.45 ± 1.47 vs 5.59 ± 1.56 ; $p < 0.001$; $d = 0.56$) and physiotherapy/multidisciplinary scores (2.69 ± 0.77 vs 2.39 ± 0.78 ; $p = 0.017$). The waves differed markedly in previous TMD education: only one wave 1 respondent (1.4%) reported no previous education compared with 16 wave 2 respondents (18.6%; Fisher exact $p < 0.001$; OR = 16.2), while year distribution did not differ significantly ($p = 0.194$). This supported inclusion of wave in the regression model.

Preferred initial management approach

For exploratory comparison, direct specialist/physiotherapy referral responses were combined as 'referral/consultation' (n = 86), splint as a separate group (n = 47), and muscle relaxant/rest plus analgesic responses as 'medication/rest' (n = 19); the six unspecified responses were excluded (Table 9). Scores showed a consistent gradient. The referral/consultation group had the lowest knowledge, attitude, self-efficacy and awareness, with overall group differences of $p = 0.005$, $p = 0.015$, $p = 0.039$ and $p = 0.027$, respectively. Dunn-Bonferroni analysis identified a significant knowledge difference between referral/consultation and medication/rest ($p = 0.006$). Because these were cross-sectional preference data, this pattern should not be interpreted as evidence that referral itself is inappropriate; rather, in this sample, immediate referral preference co-occurred with lower measured confidence and knowledge.

Table 9
Scores according to preferred initial management approach

Score	Statistic	Referral/consultation (n = 86)	Splint (n = 47)	Medication/rest (n = 19)	H	p	epsilon ²
Knowledge (0–10)	Mean $\pm$ SD	6.60 $\pm$ 1.86	7.19 $\pm$ 1.68	7.95 $\pm$ 1.81	10.67	0.005	0.071
	Median (IQR)	7.00 (3.00)	8.00 (2.00)	9.00 (2.00)			
Attitude (14–70)	Mean $\pm$ SD	47.44 $\pm$ 4.81	49.04 $\pm$ 6.74	50.68 $\pm$ 4.36	8.38	0.015	0.055
	Median (IQR)	47.00 (5.00)	50.00 (7.00)	49.00 (4.00)			
Self-efficacy (3–15)	Mean $\pm$ SD	5.13 $\pm$ 1.91	5.85 $\pm$ 2.03	6.32 $\pm$ 2.36	6.51	0.039	0.043
	Median (IQR)	5.00 (3.75)	6.00 (2.50)	6.00 (3.50)			
Awareness (0–11)	Mean $\pm$ SD	5.68 $\pm$ 1.60	6.29 $\pm$ 1.60	6.47 $\pm$ 1.23	7.21	0.027	0.048
	Median (IQR)	5.73 (2.05)	6.15 (2.16)	6.65 (1.29)			

Kruskal-Wallis test with Dunn-Bonferroni post hoc analysis. The six unspecified responses were excluded. The knowledge difference between referral/consultation and medication/rest was significant on post hoc testing ($p = 0.006$). IQR, interquartile range; SD, standard deviation.

Correlations and multivariable prediction of awareness

Knowledge correlated with attitude ($\rho = 0.451$; $p < 0.001$) and awareness ($\rho = 0.424$; $p < 0.001$) (Table 10). Self-efficacy correlated moderately with attitude ($\rho = 0.591$; $p < 0.001$) but was essentially unrelated to awareness ($\rho = 0.076$; $p = 0.342$) and to the physiotherapy/multidisciplinary subscore ($\rho = -0.035$; $p = 0.661$). The strong correlation between total awareness and the physiotherapy/multidisciplinary subscore ($\rho = 0.858$) is expected because the subscore is mathematically contained within the total and should not be treated as an independent construct.

Table 10
Spearman correlations among study measures

Variable 1	Variable 2	rho	p	Descriptor
Knowledge	Attitude	0.451	< 0.001	Weak
	Self-efficacy	0.206	0.009	Very weak
	Awareness	0.424	< 0.001	Weak
	Physiotherapy/multidisciplinary	0.265	< 0.001	Weak
Attitude	Self-efficacy	0.591	< 0.001	Moderate
	Awareness	0.258	0.001	Weak
	Physiotherapy/multidisciplinary	0.140	0.080	Very weak
Self-efficacy	Awareness	0.076	0.342	Very weak
	Physiotherapy/multidisciplinary	-0.035	0.661	Very weak
Awareness	Physiotherapy/multidisciplinary	0.858	< 0.001	Strong
Number of 'don't know' response	Knowledge	-0.884	< 0.001	Strong
	Awareness	-0.410	< 0.001	Weak
<i>Qualitative descriptors reproduce the thresholds used in the source statistical report. The correlation between total awareness and the physiotherapy/multidisciplinary subscore is not independent because the latter is part of the former.</i>				

The multivariable model for awareness was statistically significant ($R^2 = 0.188$; adjusted $R^2 = 0.155$; $F(6,151) = 5.81$; $p < 0.001$) (Table 11). Lack of previous TMD education was independently associated with a 1.06-point lower awareness score ($B = -1.06$, 95% CI -1.83 to -0.28; $p = 0.008$). Wave 2 participation also remained independently associated with lower awareness ($B = -0.55$, 95% CI -1.04 to -0.07; $p = 0.026$). The fifth-year coefficient was positive but no longer statistically significant after adjustment ($B = 0.44$, 95% CI -0.04 to 0.91; $p = 0.072$). Personal TMD symptoms were borderline ($B = 0.49$; $p = 0.051$), whereas seeing an M-TMD case and sex were not independently associated with awareness.

Table 11
Multivariable predictors of awareness score

Predictor	B	SE	t	p	95% CI
Intercept	5.99	0.25	23.57	< 0.001	5.49 to 6.50
No previous education (ref: yes)	-1.06	0.39	-2.69	0.008	-1.83 to -0.28
Wave 2 (ref: Wave 1)	-0.55	0.25	-2.25	0.026	-1.04 to -0.07
Personal TMD symptoms: yes	0.49	0.25	1.97	0.051	0.00 to 0.97
Fifth year (ref: fourth year)	0.44	0.24	1.81	0.072	-0.04 to 0.91
Seen an M-TMD case: yes	0.37	0.36	1.03	0.303	-0.34 to 1.07
Male (ref: female)	-0.12	0.24	-0.51	0.608	-0.59 to 0.35
<i>Multiple linear regression: R² = 0.188; adjusted R² = 0.155; F(6,151) = 5.81; p < 0.001. B, unstandardised coefficient; CI, confidence interval; SE, standard error; M-TMD, myogenous temporomandibular disorder; TMD, temporomandibular disorder.</i>					

Sensitivity analyses

The nine-item awareness score excluding F4 and F5 correlated very strongly with the 11-item score ($\rho = 0.973$; $p < 0.001$). Associations with data wave ($p = 0.001$), previous education ($p < 0.001$) and personal symptom history ($p = 0.022$) remained significant, while the year comparison became non-significant at the conventional threshold ($p = 0.055$). The 14-item and alternative 13-item attitude scores were also highly concordant ($\rho = 0.989$), and substantive group-comparison conclusions were unchanged; internal consistency was higher for the 14-item score ($\alpha = 0.722$ vs 0.697). Finally, excluding the six unclassifiable first-approach responses changed the mean knowledge, attitude and awareness scores only trivially (6.96 to 6.95, 48.33 to 48.34 and 5.98 to 5.97, respectively).

Discussion

This study identified a consistent educational gap between conceptual endorsement of contemporary M-TMD care and readiness to apply that knowledge. Most students recognised the musculoskeletal, psychosocial and multidisciplinary nature of TMD, yet objective awareness was only moderate, self-efficacy was low, and clinically consequential uncertainties persisted. The most striking example was diagnostic imaging: fewer than one in eight students correctly rejected the proposition that M-TMD is best diagnosed with MRI, despite DC/TMD placing clinical history and provocation-based examination at the centre of pain-related TMD diagnosis [1, 12]. At the same time, almost all students endorsed physiotherapist referral, but many could not identify the goals or modalities of physiotherapy. These findings suggest that curricular exposure may be producing recognition of broad principles without equivalent procedural or decision-making knowledge.

The pattern is consistent with earlier educational literature. Klasser and Greene documented heterogeneity and outdated content in predoctoral TMD teaching in North America [13], while Simm and Guimaraes described fragmented and limited undergraduate orofacial pain teaching in Brazil [15]. Tormes et al. later reported limited agreement with contemporary standards, low confidence and a perceived lack of clinical practice among predoctoral students [16]. The present sample showed a similar didactic-clinical imbalance in unusually

concrete terms: 89.2% reported some prior TMD education, but only 1.3% described clinical-practice training, 13.3% had seen an M-TMD case and 5.7% had intervened clinically. All participants wanted more clinical training. This convergence across settings supports the international relevance of moving beyond content coverage toward demonstrable clinical competencies [14, 17].

The physiotherapy results add a distinct interprofessional dimension. Previous work among dentists has shown limited awareness of physiotherapy's role in TMD [20], and recent French data indicate that real-world dentist-physiotherapist collaboration is variable [21]. Our students, by contrast, overwhelmingly knew that physiotherapists were an appropriate referral resource, suggesting that the referral message itself has reached the curriculum. What was missing was 'collaboration literacy': understanding what the physiotherapist evaluates, which goals are pursued and how conservative modalities fit into a stepped management pathway. This distinction matters because interprofessional education should support shared mental models and coordinated decision-making, not simply knowledge of another profession's existence. The evidence base for exercise/manual therapy and multimodal conservative care [8–10] provides an appropriate platform for case-based joint teaching.

The discrepancy between self-efficacy and objective awareness is also educationally important. Fifth-year students felt more knowledgeable and more capable of evaluating M-TMD, but self-efficacy was not associated with the awareness score. In competency-based education, 'knows' and 'knows how' are distinct from demonstrated performance [28]. Health-professions research has repeatedly shown that self-assessment has limited correspondence with externally observed competence [29, 30]. The current data reinforce that principle: confidence should be treated as one educational outcome, not as a substitute for structured assessment. The moderate correlation between attitude and self-efficacy should also be interpreted cautiously because the three self-efficacy items are included within the 14-item attitude total, creating partial mathematical overlap.

Previous TMD education showed the largest unadjusted difference in awareness and remained independently associated in regression, whereas the apparent fifth-year advantage weakened after adjustment for education and data wave. Because the design is cross-sectional, this cannot establish a causal effect of teaching. Nonetheless, the pattern is more compatible with specific exposure than with maturation by year alone. It also argues for evaluating what students actually encounter within a curriculum rather than assuming that seniority is a proxy for competence. The independent wave effect, despite adjustment for reported education, warns that unmeasured temporal or selection factors may have influenced the survey and should temper causal interpretation.

Personal TMD symptoms were associated with higher knowledge, attitude and awareness in unadjusted analyses, broadly paralleling recent findings that students' personal TMD experiences may shape educational motivation and professional behaviour [18]. This association may reflect heightened attention to relevant teaching, informal learning, or greater interest in the topic. However, personal symptoms were self-reported rather than diagnosed with DC/TMD, and the adjusted association with awareness was borderline. The finding is therefore best viewed as hypothesis-generating rather than evidence that personal illness experience improves competence.

The results support a curriculum that explicitly bridges conceptual knowledge to observable performance. First, students should practise a standardised M-TMD history and DC/TMD-informed examination using calibrated

case scripts, peer examination or simulation before encountering patients. Second, diagnostic exercises should require students to distinguish myogenous pain from joint-dominant disorders and justify when imaging is or is not indicated. Third, interprofessional sessions with physiotherapy and, where feasible, pain psychology should ask students to formulate shared conservative-management goals rather than simply choose a referral destination. Fourth, progression should be assessed with objective case-based or OSCE-style tasks that sample examination, differential diagnosis, patient education, initial conservative management and referral reasoning. Finally, pre/post curriculum evaluation should combine knowledge and applied performance with self-efficacy rather than relying on confidence alone.

Strengths include a multidimensional assessment of knowledge, attitudes, self-efficacy and applied awareness; item-level analysis rather than reliance on a single total score; reporting of effect sizes; multivariable adjustment for relevant exposures; and sensitivity analyses addressing scoring decisions. The partial-credit awareness format also reduced the information loss that would occur if multi-response items were scored only as entirely correct or incorrect.

Several limitations require emphasis. This was a single-institution study, and the invitation denominator was not available, limiting assessment of response bias and generalisability. The survey was investigator-developed and had not undergone a fully documented external validation process; internal consistency alone does not establish construct validity. KR-20 for knowledge (0.639) and alpha for the physiotherapy/multidisciplinary subscore (0.626) were modest, and some items use simplified propositions or answer keys that may not capture all nuances of contemporary TMD evidence. Results for individual items should therefore be interpreted as performance against the predetermined study key, not as definitive certification of clinical competence. The self-efficacy subset is embedded within the attitude scale, and the physiotherapy/multidisciplinary subscore is embedded within awareness, so correlations involving these pairs are not statistically independent.

In addition, personal TMD symptoms and prior exposure were self-reported, the cross-sectional design precludes causal inference, and multiple exploratory comparisons increase the probability of chance findings. The two data-collection waves differed in previous education and remained independently associated with awareness even after adjustment, suggesting possible residual confounding or selection effects. Small subgroups, particularly students without previous education and those who had seen M-TMD cases, limit precision. Finally, the 100% endorsement of additional clinical training and psychological relevance may reflect true consensus but also creates ceiling effects and potential social-desirability bias.

Conclusions

Senior dental students in this study generally endorsed biopsychosocial and multidisciplinary principles of M-TMD care, yet this conceptual orientation did not translate consistently into diagnostic, physiotherapy-related or self-perceived clinical readiness. Previous TMD education was the strongest measured correlate of awareness, whereas study year was not independently associated after adjustment. The absence of a relationship between self-efficacy and objective awareness further suggests that curricular evaluation should prioritise demonstrated performance. A structured, case-based and interprofessional approach - anchored in DC/TMD-informed examination, conservative management, appropriate imaging indications and explicit collaboration with physiotherapy - may better prepare graduates for first-contact TMD care.

Abbreviations

DC/TMD - Diagnostic Criteria for Temporomandibular Disorders

IQR - interquartile range

MRI - magnetic resonance imaging

M-TMD - myogenous temporomandibular disorder(s)

NSAID - non-steroidal anti-inflammatory drug

TMD - temporomandibular disorder(s)

TMJ - temporomandibular joint

Declarations

Ethics approval and consent to participate

The study protocol was approved by the Marmara University Faculty of Medicine Non-Drug and Non-Medical Device Research Ethics Committee (protocol no. 09.2025.25-0609; decision date 18 July 2025). Informed consent was obtained electronically from all participants.

Consent for publication

Not applicable. The manuscript reports aggregate survey data and contains no identifiable individual participant information.

Availability of data and materials

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request, subject to applicable ethical and institutional requirements.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

EE, GK, FNP and YKÖ contributed to the conception and design of the study, interpretation of the findings, and drafting or critical revision of the manuscript. All authors read and approved the final manuscript and agree to be accountable for the work.

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