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ORIGINAL RESEARCH

Work-Related Musculoskeletal Pain and Analgesic Use Among Undergraduate Dental Students in Iraq: A Multi-Institutional Cross-Sectional Study

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Purpose: This study aimed to evaluate the prevalence of work-related musculoskeletal pain (WMSP), analgesic use practices, pharmacological knowledge, attitudes toward unsupervised analgesic use, and ergonomic/non-pharmacological behaviors in this cohort.

Patients and Methods: An online questionnaire was sent to third- to fifth-year Iraqi dental students using WhatsApp, Facebook, and Telegram platforms. The link was shared three times weekly during March–May 2026. The survey collected sociodemographic data, musculoskeletal pain experience, analgesic use patterns (especially non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol), pharmacological knowledge, attitudes toward unsupervised analgesic use, and ergonomic/non-pharmacological behaviors. Skip logic was applied to direct pain-related and analgesic-use items to eligible participants only.

Results: Out of 1081 collected responses, 791 dental students reported WMSP (73.2%; 95% CI: 70.5–75.8). A significantly higher prevalence of WMSP was recorded among female students than among male students (75.3% vs 68.7%; $p = 0.020$), and WMSP prevalence differed significantly across academic years, ranging from 66.3% among 3rd-year to 77.5% among 5th-year respondents ($p = 0.001$). The most commonly reported affected areas were neck, lower back, and shoulders, with prevalences of 58.4%, 53.9%, and 42.2%, respectively. About half of students with WMSP used analgesics, mainly paracetamol (46.9%) and ibuprofen (33.6%). Analgesic users demonstrated lower knowledge and safer-attitude scores than non-users (both $p \leq 0.002$). The multivariable analysis revealed that higher analgesic-related pharmacological knowledge was independently associated with lower odds of analgesic use (OR = 0.828, 95% CI: 0.793–0.864; $p < 0.001$).

Conclusion: A high prevalence of WMSP was reported among Iraqi dental undergraduates, with nearly half of affected students reporting analgesic use. Higher analgesic-related pharmacological knowledge was independently associated with lower odds of reported analgesic consumption. A combined approach utilizing ergonomic and pharmacological education may promote better pain-management behaviors and safer analgesic use; however, longitudinal or interventional studies are needed to evaluate its effectiveness.

Keywords: work-related musculoskeletal symptoms, dental education, analgesic use, ergonomic training, pharmacological knowledge, analgesics and NSAIDs

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Introduction

Work-related musculoskeletal disorders (WMSDs) are considered one of the main occupational health issues and include conditions of inflammatory or degenerative origin that can impair nerves, muscles, tendons, ligaments, and joints.[1–3] These occupational health problems are mainly attributed to constrained working positions, awkward repetitive movements, prolonged immobile positions, and excessive physical effort.[3–6] Dental practice renders these occupational issues very marked during routine dental work as the dentists require prolonged neck flexion, trunk rotation, repetitive hand movements, and constrained working postures within the oral cavity.[1,3,7,8]

In the present study, work-related musculoskeletal pain (WMSP) is defined as the musculoskeletal pain or discomfort self-reported by students in relation to their preclinical or clinical dental education. The broader term work-related musculoskeletal disorders (WMSDs) is utilized only when referring to previously published studies related to occupational musculoskeletal conditions.

Although WMSD symptoms are well established among qualified dentists, some research suggested that musculoskeletal complaints are also reported throughout dental school training (the undergraduate study course),[1,3,5,9] especially when students start direct patient care after passing the simulated clinical and lab-based training.[4,7,10,11] Compared with dental practitioners, undergraduate dental students are likewise exposed to high static muscle loads, poor ergonomic postures, and repetitive clinical tasks, factors that have been shown to be associated with musculoskeletal pain.[3,12] International prevalence of the musculoskeletal complaints among undergraduate dental students has been described in a wide range between 44% to 93%, with neck, lower back, and shoulder areas are frequently recognized as the most anatomical regions that experience pain.[1,4–6,13]

Students experiencing training-related pain may adopt unsupervised self-medication, which is defined as the use of medications to manage self-recognized symptoms without professional supervision.[14–16] Within this study, the behavioral outcome was defined as reported analgesic use to manage WMSP, because the study could not verify if each episode of analgesic use involved a prescription or professional advice. Hence, analgesic use is used for the measured behavior, whereas "self-medication" is used to describe the unsupervised medication consumption discussed in the previous literature and for the attitude items that specifically addressed this behavior.

Paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs) are considered as first-line pharmacological options for many cases of short-term, mild-to-moderate pain if used properly.[17,18] Yet, frequent uncontrolled long-term use may heighten medicine-related harm such as hepatic dysfunction, gastrointestinal complications, renal dysfunction, and clinically relevant analgesics–drug interactions.[19–22]

A potential knowledge–practice gap regarding self-medication has been reported among health-care students, which can be attributed to the fact that pharmacological knowledge does not always translate into safe medication behavior.[20,23,24] A recent study among Iraqi dental students has highlighted a discrepancy between medication-related knowledge and prescribing practices, supporting the need for further investigation into how medication-related knowledge affects medication-use behaviors in this cohort.[25]

Students' pharmacological knowledge may influence their selection and use of analgesics, specifically their understanding of correct doses, contraindications, adverse events, and drug-drug interactions. Their attitudes may also shape whether they view analgesic use without professional guidance as acceptable or necessary. Taking knowledge and attitudes into account may therefore help explain variation in analgesic-use behavior among dental students.[19,20,23,24]

During clinical-dental training years, analgesics may be taken not only to relieve pain but also to support and maintain academic and clinical performance despite the presence of complaints.[19,26] This practice warrants attention because analgesic consumption may temporarily palliate symptoms without curing or managing the ergonomic factors driving the pain.[8,19,26] If such practice occurs during undergraduate dental study, it may be linked to less appropriate pain-management and ergonomic behaviors.[19,23]

In Iraq, Al-Ameri et al (2017) reported a high rate (up to 92.4%) of self-medication among students at Al-Mustansiriyah and Al-Nahrain universities, in which analgesics represented 40.1% of the self-medicating drugs.[27] Another study conducted by Thijeel in 2020 assessed the prevalence of MSDs among qualified dentists and found a high prevalence (around 70%).[28] Nevertheless, previous local studies have primarily assessed musculoskeletal

complaints and medication self-use separately. As a result, there is still limited evidence on how work-related musculoskeletal pain relates to analgesic use among undergraduate dental students during clinical study. It also remains ambiguous if students' analgesic-related pharmacological knowledge and their attitudes toward unsupervised analgesic use are linked to their actual analgesic-use behavior.

Thus, this study aimed to assess the prevalence and distribution of WMSP among Iraqi undergraduate dental students and evaluate analgesic-use behaviors, analgesic-related pharmacological knowledge, attitudes regarding non-prescribed analgesic use, and ergonomic/non-pharmacological pain-relief practices. The rationale behind this study is that linking musculoskeletal assessment with analgesic use and ergonomic aspects may inform educational strategies for the optimal use of analgesics and enhance ergonomic education and training within the dental curriculum.

Materials and Methods

Study Design and Participants

A cross-sectional, questionnaire-based study was conducted among 3rd -, 4th -, and 5th -year Iraqi undergraduate dental students, who voluntarily agreed to participate anonymously. These academic years were selected because during these stages, students practice preclinical and/or clinical dental training. A Google form-based electronic survey was used to evaluate WMSP, analgesic-use behaviors, analgesic-related pharmacological knowledge, attitudes toward unsupervised analgesic consumption, and ergonomic/non-pharmacological pain-management practices. Dental students were recruited from 38 Iraqi dental schools across the northern, central, and southern geographical regions, with most responses obtained from central Iraq.

Sample Size and Data Collection

The estimated sample requirement was derived using a prevalence-based approach. Because no reliable estimate was available for the target population, a prevalence of 50% was assumed, with a 95% confidence level and a 5% margin of error. This resulted in a minimum required sample of 385 participants. Recruitment beyond this minimum was planned to enhance the precision of the estimates and allow subgroup analyses.[29]

Different students' online platforms, including WhatsApp, Facebook, and Telegram, were used to distribute structured and self-administered electronic questionnaires from March to May 2026. During the data-recruitment period, the survey link was recirculated three times weekly. A response rate of about 70% was expected during the planning stage. Yet, because the survey distribution link was openly circulated across participating schools, the precise number of eligible students who received the invitation was not known, so the observed response rate could not be estimated.

Questionnaire and Study Measures

The questionnaire was developed using six main domains, which were organized into: sociodemographic and academic features of participants; musculoskeletal discomfort profile; analgesic consumption and drug preferences; analgesic-related pharmacological knowledge; attitudes regarding unsupervised analgesic use; and ergonomic/non-pharmacological pain management behaviors. In the present study, WMSP referred to musculoskeletal pain or discomfort that students experienced and reported as being associated with their preclinical or clinical dental training (as defined in the introduction section).

No specific recall timeframe was set; undergraduate students reported WMSP depending on their experiences during preclinical or clinical dental training. The musculoskeletal-related questions were developed by the study team based on the study objectives and prior published evidence and were not adopted from a single validated questionnaire. The instrument was designed in English by the study researchers based on the study objectives and relevant existing literature. Translation was not needed. Prior to data collection, the questionnaire was reviewed by experts and students, and their feedback was considered to enhance the wording, understandability, and overall flow of the survey.

The knowledge domain consisted of 15 multiple-choice items addressing: analgesic-use practices, safety of NSAIDs and paracetamol, mode of action, restrictions for use, side effects, dosing considerations, and analgesic-drug interactions.

The attitude domain included three 5-point Likert-scale questions evaluating attitudes toward self-medication with analgesics and one question about awareness of the potential for misuse or abuse of analgesics.

The main outcomes included estimating the prevalence of training-related musculoskeletal pain and analgesic use among those students. Additional outcomes included: analgesic-related pharmacological knowledge score, safer-attitude score, pain severity, pain frequency, pain-related interference, and ergonomic/non-pharmacological behaviors.

Validation, Reliability, and Skip Logic

The questionnaire was reviewed for face and content validity by experts in dental and pharmacological disciplines (n= 5 from each specialty) and by dental students from the target academic years (n=10 from each year). A pilot study was conducted before data collection to assess item clarity, feasibility, survey flow, and respondents' comments. Feedback from the expert review and pilot study helped us enhance the final version of the instrument.

Skip logic was implemented to minimize the irrelevant responses. That led all participants to complete four domains: demographic, knowledge, attitude, and ergonomic/non-pharmacological. On the other side, the pain-related items were merely answered by participants reporting training-related musculoskeletal pain. Analgesic-use-related items were answered only by undergraduate students with WMSP who reported taking analgesics to relieve their pain. As long as the survey did not verify whether each use involved a prescription or professional advice, this outcome was classified as analgesic use rather than confirmed self-medication. Items not displayed because of the predefined survey skip logicwere treated as not applicable rather than incomplete responses. Because the questionnaire was fairly comprehensive and participation offered no direct advantage or incentive, duplicate submissions were considered unlikely. However, duplicate responses could not be entirely excluded because respondent identifiers were not collected.

Based on this instrument structure, statistical analyses were conducted using the appropriate denominators: full sample (N = 1081), WMSP subgroup (n = 791), and analgesic-use subgroup (n = 369).

The analgesic-related pharmacological knowledge scoring system ranged from 0 to 15, with 1 point per correct response. The safer-attitude score was estimated to use three reverse-coded items reflecting unsafe self-medication, with total scores ranging from 3 to 15; higher scores indicated safer attitudes. The fourth attitude item evaluated awareness of the analgesic potential of misuse or abuse. Hence, this item was analyzed separately as a single ordinal item.

Reliability analysis of knowledge scale indicated good internal consistency, with Guttman split-half and Spearman–Brown coefficients of 0.831 and 0.838, respectively. The three-item safer-attitude scale demonstrated modest internal consistency (Cronbach's alpha = 0.64), that was regarded acceptable regarding this exploratory behavioral evaluation. A Summary of the study design, recruitment process, questionnaire main domains, and populations considered for analysis is illustrated in Figure 1.

Statistical Analysis

Recruited data were analyzed using IBM SPSS Statistics, version 26. Frequencies and percentages were used to represent categorical variables (demographic characteristics, WMSP status, pain locations, analgesic-use behaviors, individual 5-point Likert attitude items, and ergonomic practices). Means and standard deviations were used to represent continuous variables (ie analgesic-related pharmacological knowledge, safer-attitude, and pain intensity scores). Estimated prevalence values were reported with 95% confidence intervals, and statistical significance was set at $p < 0.05$.

Chi-square tests with Cramer's V, independent-samples *t*-tests, one-way ANOVA, and Spearman's rank correlation were applied as appropriate. All selected predictors were entered simultaneously into each multivariable model using the Enter method. Binary logistic regression examined factors associated with WMSP in the full sample and with analgesic use among undergraduate dental students reporting WMSP. Multiple linear regression evaluated factors associated with knowledge and safer-attitude scores. For the WMSP model, fifth-year students, females, those with more than 20 clinical hours per week, and those who had received ergonomic training were selected as the reference groups. In the analgesic-use model, the fifth-year students, females, and those who had received ergonomic training represented the reference groups. For the linear regression models, male and students without WMSP were used as the reference groups. Tolerance and variance inflation factor (VIF)

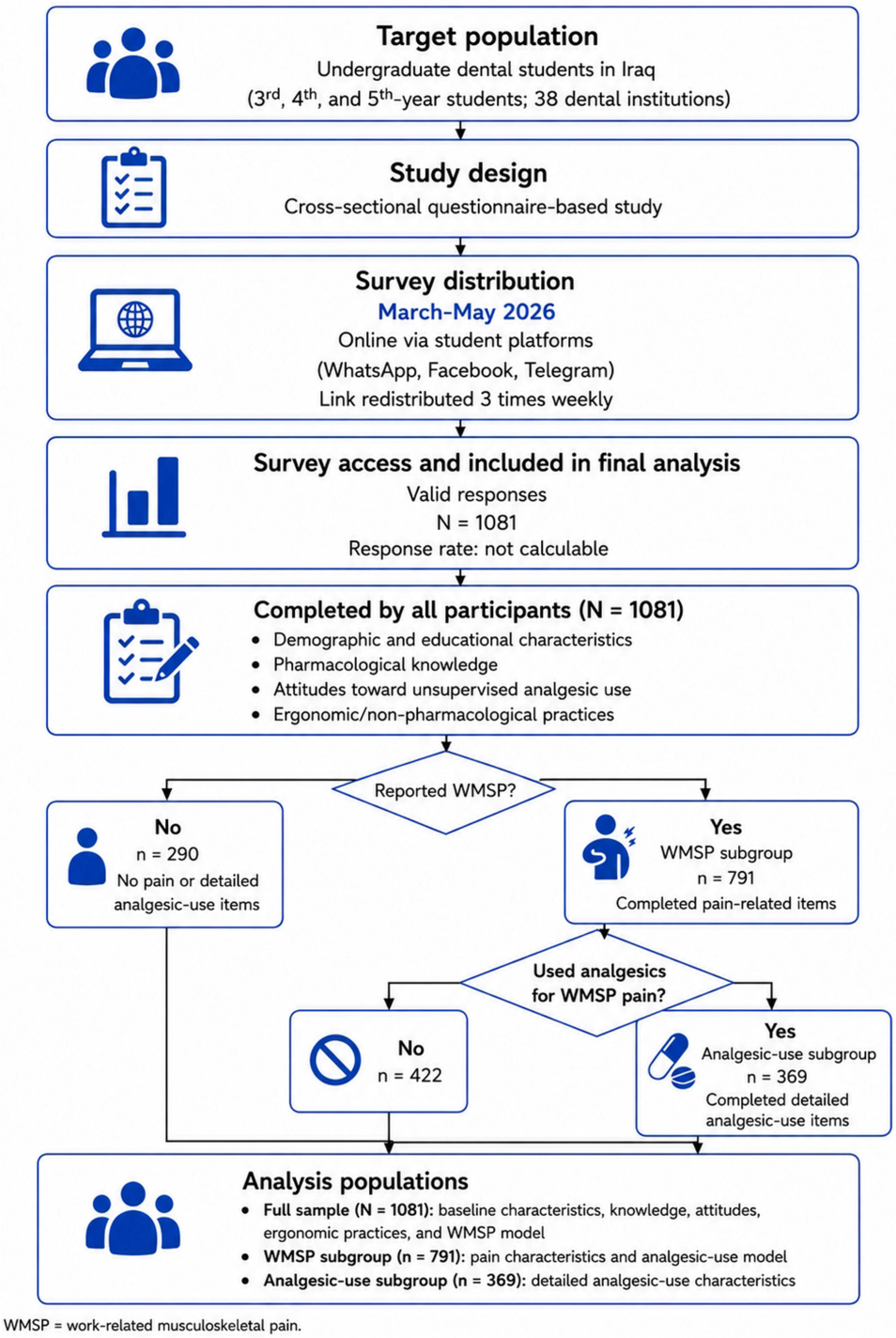

Figure 1 Summary of the study design, recruitment process, questionnaire main domains, and populations considered for analysis.

values were used to evaluate multicollinearity. Tolerance values were consistently greater than 0.20, while VIF values were less than 5 in all models, suggesting no evidence of problematic multicollinearity. Logistic model fit was evaluated using the Hosmer–Lemeshow test, which indicated an adequate fit for both the WMSP model (χ^2 = 4.250, *df* = 8, p = 0.834) and the analgesic-use model (χ^2 = 9.903, *df* = 8, p = 0.272).

The assumptions of the linear regression models were investigated by assessing the residual histograms, normal P–P plots, and standardized residual plots against predicted values. No major violations were detected.

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Adjusted odds ratios or unstandardized regression coefficients were reported with 95% confidence intervals and *p*-values. Analgesic-use status was omitted in the full-cohort linear regression models because it was reported only among participants with WMSP and was structurally absent for students without WMSP.

Given the exploratory nature of the study, no formal adjustment for multiple comparisons was applied. Accordingly, the resulting p-values should be interpreted with caution, especially because several statistical comparisons were made.

Ethical Considerations

The study protocol was evaluated and approved by the Ethical Committee of the Department of Oral Diagnosis, College of Dentistry, University of Baghdad, Baghdad, Iraq, under approval reference number 1186 on 16-3-2026. It was approved before participant recruitment and data collection. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Participants received information regarding the aims of the study, the voluntary nature of participation, confidentiality of responses, and their right to refuse participation. Completion and submission of the online questionnaire were considered evidence of informed consent.

Results

Baseline Characteristics and Musculoskeletal Pain Prevalence

Overall, 1081 participants, representing all dental undergraduates who participated in the study, were 67.5% female. The distribution of samples by year of study was 33.5%, 27.0%, and 39.5% for 3rd-year, 4th-year, and 5th-year students, respectively. Less than half of the sample was recruited from the University of Baghdad (44.5%), followed by Dijlah University (29.0%) and the University of Karbala (19.1%), with lower participation from the University of Sulaimani and other dental institutes. No missing data were detected for the variables used in the main statistical analyses. Questions skipped because of the survey routing were treated as not applicable rather than missing.

Work-related musculoskeletal pain was confirmed by 791 students (73.2%; 95% CI: 70.5–75.8). Female students demonstrated a significantly higher prevalence of WMSP than male students (75.3% vs 68.7%, $p < 0.05$). WMSP prevalence differed significantly across academic years, from 66.3% in the 3rd-year group to 75.3% in the 4th-year group and ending at 77.5% in the 5th-year group ($p < 0.05$) (Table 1).

Table 1 Characteristics of the Study Participants and Prevalence of Work-Related Musculoskeletal Pain (N = 1081)

Characteristic	Category	Total n (%)	WMSP n/N (%)	*p*-value	Effect Size (Cramer's V)
Gender	Male	351 (32.5)	241/351 (68.7)	0.02	0.068
	Female	730 (67.5)	550/730 (75.3)		
Study year	3rd year	362 (33.5)	240/362 (66.3)	0.001	0.112
	4th year	292 (27.0)	220/292 (75.3)		
	5th year	427 (39.5)	331/427 (77.5)		
University	University of Baghdad	481 (44.5)	—	—	—
	Dijlah University	313 (29.0)	—	—	—
	University of Karbala	206 (19.1)	—	—	—
	University of Sulaimani	40 (3.7)	—	—	—
	Other universities	41 (3.8)	—	—	—

(*Continued*)

Table 1 (Continued).

Characteristic	Category	Total n (%)	WMSP n/N (%)	*p*-value	Effect Size (Cramer's V)
Ergonomic training	No	683 (63.2)	477/683 (69.8)	0.001	0.096
	Yes	398 (36.8)	314/398 (78.9)		
Clinical hours/ week	<5 hours	285 (26.4)	196/285 (68.8)	0.18	0.076
	5–10 hours	404 (37.4)	298/404 (73.8)		
	11–15 hours	240 (22.2)	178/240 (74.2)		
	16–20 hours	92 (8.5)	75/92 (81.5)		
	>20 hours	60 (5.6)	44/60 (73.3)		

Notes: *P*-values were derived from chi-square tests comparing WMSP prevalence across categories. Effect sizes are illustrated as Cramér's V. Institution was analyzed as a descriptive variable and was not involved in between-group testing.

WMSP prevalence was significantly associated with ergonomic training status. Students who received ergonomic training had a higher prevalence of WMSP than those who did not (78.9% vs 69.8%, $p < 0.05$). Surprisingly, no significant association was found between weekly clinical hours and WMSP prevalence among students ($p > 0.05$), as illustrated in Table 1.

Item-Level Analgesic- Related Pharmacology Knowledge and Attitude Responses

The average pharmacological knowledge score was 10.03 ± 3.83/15, whereas the mean safer-attitude score was 11.41 ± 2.41/ 15. Female participants significantly recorded higher knowledge scores were compared to male students (10.32 ± 3.83 vs 9.42 ± 3.77; mean difference = 0.89, 95% CI: 0.41–1.38; $p < 0.001$). In addition, they had significantly higher safer-attitude scores than the male students (11.65 ± 2.33 vs 10.91 ± 2.49; mean difference = 0.74, 95% CI: 0.43–1.04; $p < 0.001$). On the other hand, the statistical differences across academic years did not reach significance for either the knowledge ($F = 2.848$, $p = 0.058$) or attitude ($F = 2.896$, $p = 0.056$) scores.

Item-level analysis recorded variation in correct-response rates across the pharmacological knowledge questions. Participants performed best and showed the highest score for awareness of common NSAID-drug interactions (Q29; 86.8%). Coming second, recognition of NSAID / paracetamol as a first-line option to treat mild-to-moderate work-related musculoskeletal pain (Q18; 83.2%). Comparable results between identification of the safer NSAID management options in patients with a history of gastric ulcer and realization that chronic or high-dose NSAIDs may be associated primarily with renal problems were recorded with (Q26; 79.2%) and (Q27; 78.2%), respectively.

On the other side, lower rates of correct answers were recognized for acknowledging the diclofenac as the NSAID mostly related to cardiovascular problems (Q28; 48.1%), identifying the dual effect of acetaminophen as antipyretic and analgesic medication (Q20; 49.0%), and recognizing the maximum recommended adult dose of paracetamol per day (Q21; 50.0%). Overall, respondents demonstrated satisfactory medication-related knowledge, with specific educational gaps in NSAID and paracetamol dosing, paracetamol pharmacology, and cardiovascular safety considerations.

Attitude findings suggested a cautious tendency toward self- medication of analgesics. Most participants disagreed that NSAIDs and OTC analgesics are safe for long-term use without medical supervision (74.2%), and most of the participants (67.7%) disagreed that they would advise a colleague to use analgesics without professional advice. However, response patterns were varied for the attitude item that self-medication is a necessary part of managing dental practice-related pain, reflecting differences in perceived legitimacy of self-medication (Table 2). The standalone misuse-awareness item demonstrated broad response dispersion as well, indicating inconsistent understanding of the potential risk of misuse or abuse of non-prescribed analgesics.

Table 2 Analgesic-Related Knowledge and Attitude Scores, Reliability Indices, and Highest- and Lowest-Item Knowledge Performance Among Participants (N = 1081)

A. Summary scores and psychometric properties					
Measure			**Value**		
Knowledge score (mean ± SD; range 0–15)			10.03 ± 3.83		
Safer attitude score (mean ± SD; range 3–15)			11.41 ± 2.41		
Knowledge scale reliability: Spearman–Brown coefficient			0.838		
Knowledge scale reliability: Guttman split-half coefficient			0.831		
Knowledge score by gender			Male: 9.42 ± 3.77; Female: 10.32 ± 3.83; p < 0.001		
Safer-attitude score by gender			Male: 10.91 ± 2.49; Female: 11.65 ± 2.33; p < 0.001		
Knowledge score by study year (ANOVA)			F = 2.848; p = 0.058		
Safer-attitude score by study year (ANOVA)			F = 2.896; p = 0.056		
B. Knowledge item rates with the highest and lowest correct responses					
Question			**Correct response rate**		
Q29. Awareness of common NSAID drug interactions			86.8%		
Q18. First-line treatment for mild-to-moderate musculoskeletal pain			83.2%		
Q26. Safest NSAID option in patients with a gastric ulcer history			79.2%		
Q27. Primary organ affected by chronic/high-dose NSAID use			78.2%		
Q28. NSAIDs are most associated with cardiovascular risk			48.1%		
Q20. Paracetamol has both antipyretic and analgesic effects			49.0%		
Q21. Maximum safe daily dose of paracetamol in adults			50.0%		
C. Attitude item response profile and misuse potential					
Statement	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Q33. OTC analgesics are safe for long-term use without supervision	510 (47.2%)	292 (27.0%)	193 (17.9%)	57 (5.3%)	29 (2.7%)
Q34. Self-medication is necessary for practice-related pain	177 (16.4%)	335 (31.0%)	363 (33.6%)	158 (14.6%)	48 (4.4%)
Q35. Would recommend analgesics to a colleague without advice	384 (35.5%)	348 (32.2%)	238 (22.0%)	81 (7.5%)	30 (2.8%)
Q36. Some OTC painkillers have abuse/misuse potential	430 (39.8%)	249 (23.0%)	226 (20.9%)	104 (9.6%)	72 (6.7%)

Notes: Q33–Q35 were reverse-scored and summed to generate the safer-attitude score, with higher scores indicating safer attitudes toward analgesic use without professional supervision. Q36 was treated as a standalone ordinal item because it reflects awareness of the potential for misuse rather than an unsafe self-medication tendency.
Abbreviations: OTC, over the counter; CI, confidence interval.

Pain Characteristics and Functional Consequences Among Dental Students with WMSP

Students experiencing WMSP (n = 791) recorded the main anatomical sites that frequently hurt, starting from the neck (58.4%), lower back (53.9%), and shoulders (42.2%), wrist or hand pain (25.7%), knee pain (12.8%), and ending with other body sites by 5.9% (Figure 2). As long as students could report multiple affected sites, the cumulative percentage could exceed 100%.

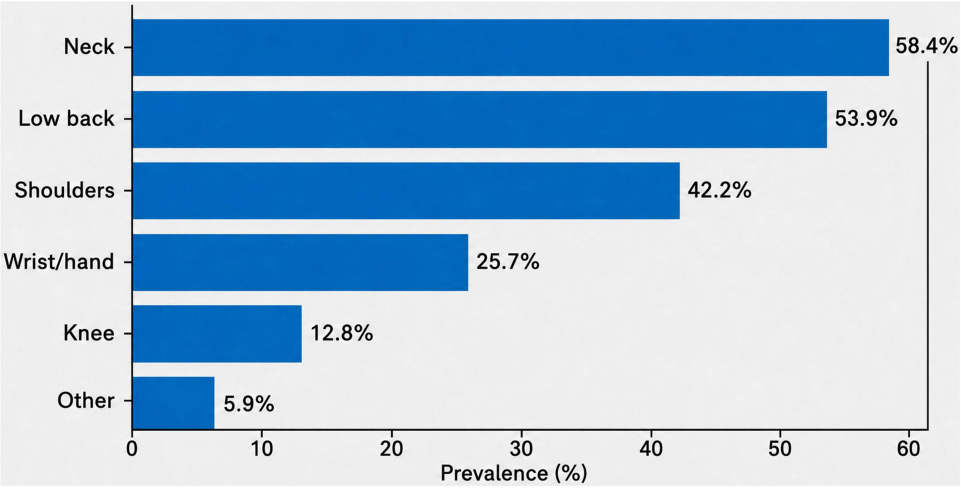

Figure 2 Distribution of pain sites among respondents with WMSP (n = 791).

The average pain intensity score was 4.77 ± 2.12 on a 0–10 scale, indicating moderate pain. Most of the participants evidenced weekly pain experience with 43.0%, while merely 19.0% reported daily pain problem. Functional impact of the pain was reported by about 38.0% of participants who agreed or strongly agreed about the interference of pain with their practical work. In contrast, 25.1% of participants disagreed or strongly disagreed, and 36.8% were neutral (Table 3). These findings suggest that WMSP may be associated with interference in students' clinical and/or academic activities, particularly in terms of pain in different body areas. Percentages exceed 100% because students with WMSP could report multiple affected sites.

Ergonomic and Non-Pharmacological Behaviors

Different ergonomic and non-pharmacological methods were listed in the survey, but students adopted them heterogeneously. Regular micro-breaks and stretching exercises were recorded as the most commonly used aids to reduce the pain, with 37.5%. The next most reported preventive measures were ergonomic/saddle chairs (31.5%) and dental loupes/

Table 3 Pain Frequency, Pain Intensity, and Functional Interference Among Students with WMSP (N = 791)

Characteristic	Category	Value
Pain score	Mean ± SD	4.77 ± 2.12
Pain frequency	Rarely	137 (17.3%)
	Monthly	164 (20.7%)
	Weekly	340 (43.0%)
	Daily	150 (19.0%)
Pain interference with dentistry -training-work	Strongly disagree	80 (10.1%)
	Disagree	119 (15.0%)
	Neutral	291 (36.8%)
	Agree	238 (30.1%)
	Strongly agree	63 (8.0%)

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magnification (31.0%). However, the least effective preventive aids were the arm supports and wrist rests, and about one-fifth of students reported using none of the ergonomic aids listed in the survey.

Despite some students adopting micro-breaks throughout dental sessions to reduce musculoskeletal symptoms, this practice was inconsistently used. Most participants (46.6%) chose "sometimes taking micro-breaks and/or performing stretching exercises", and 35.4% reported always doing so. In contrast, about 18% never adopted or practiced these preventive measures.

The most frequently used nonpharmacological pain-relief methods were stretching (45.0%), massage (42.6%), and hot or cold packs (34.4%). These results support the partial implementation of preventive ergonomic behaviors, with substantial scope for structured ergonomic teaching and consistent practices during clinical training.

Analgesic-Use Patterns and Knowledge–Attitude Comparisons

Among 791 students with WMSP, just 369 participants reported analgesic use to relieve work-related musculoskeletal pain, resulting in an analgesic-use rate of 46.6% (95% CI: 43.2–50.1). As expected, the oral route of administration was the most used one (58.5%), followed by the topical route (17.3%), while 16.0% of 369 students preferred these routes equally. On the other hand, the parenteral route using intramuscular or intravenous routes was recorded by only 4.6% of analgesic users.

Fortunately, the smallest proportion of the cohort reported the use of analgesics for more than two weeks (8.7%) and for 1–2 weeks with a rate of 11.4%, while the most used duration of analgesic was 2–3 days (32.0%), followed by a comparable percentage for one-day use (31.4%). Despite the majority of analgesic users (73.4%) reporting good awareness of the maximum safe dose, 26.6% were unaware. Regarding analgesic intake timing, the highest percentage of the cohort (43.1%) reported NSAID intake after meals, while 19.2% preferred intake before meals and 37.7% on an as-needed basis, regardless of mealtime.

The well-known pain relief medication (paracetamol) recorded the highest percentage of use (46.9%), followed by ibuprofen (33.6%), diclofenac (11.9%), and naproxen (9.2%). Regarding the driving factors that influenced the students' selection of analgesics, perceived effectiveness (39.6%) and advice from family or friends (22.5%) were the main influencing factors. In comparison, previous personal experience (17.1%) and ready availability (15.2%) were the least effective influencers (Table 4).

Among dental students with WMSP, those who used analgesics had significantly lower knowledge scores than non-users (8.39 ± 3.92 vs 11.14 ± 3.39; mean difference = 2.75, 95% CI: 2.24–3.26; $p < 0.001$). The safer-attitude scores were also significantly lower than those of non-users (11.17 ± 2.41 vs 11.71 ± 2.41; mean difference = 0.54, 95% CI: 0.20–0.88; $p = 0.002$) (Figure 3). These findings suggest that students who used analgesics tended to have lower pharmacological knowledge and less safety-oriented attitudes toward unsupervised analgesic use.

Table 4 Analgesic-Use Characteristics Among Students with WMSP (n = 369)

Characteristic	Value
Analgesic-use prevalence	369 / 791 (46.6%; 95% CI 43.2–50.1)
Route of use	
Oral	58.5%
Topical	17.3%
Both equally	16.0%
Injection	4.6%
Others	3.5%

(*Continued*)

Table 4 (Continued).

Characteristic	Value
Duration of use	
1 day	31.4%
2–3 days	32.0%
4–6 days	16.5%
1–2 weeks	11.4%
>2 weeks	8.7%
Most common analgesics	
Paracetamol	46.9%
Ibuprofen	33.6%
Diclofenac	11.9%
Naproxen	9.2%
Main driving factors	
Effectiveness	39.6%
Family/friends	22.5%
Prior experience	17.1%
Availability	15.2%

Note: Percentages for analgesic type and driving factors may exceed 100% because dental students could select more than one response.

Correlation and Multivariable Regression Analyses

A weak yet significant positive association between analgesic-related pharmacological knowledge and safer-attitude scores was observed in the Spearman correlation analysis ($r = 0.234$, $p < 0.001$), suggesting that higher pharmacological knowledge scores were positively correlated with safer-attitude scores. Pharmacological Knowledge recorded an inverse

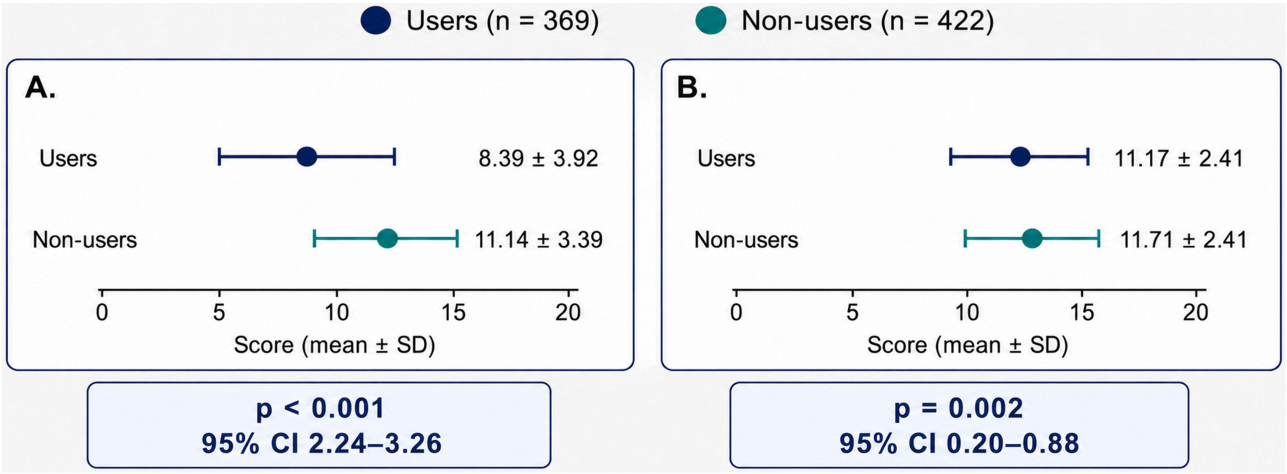

Figure 3 Comparison of knowledge and safer-attitude scores by analgesic-use status among participants with WMSP. (**A**) shows the analgesic-related pharmacological knowledge score, and (**B**) shows the safer-attitude score. Values are presented as mean ± SD. Confidence intervals represent the 95% CIs for the between-group mean differences.

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correlation with the standalone misuse-potential item (Q36; r = −0.228, p < 0.001). In addition, the safer-attitude score was strongly and inversely correlated with Q36 (r = −0.494, p < 0.001). Among participants who reported WMSP, pain level demonstrated a moderate correlation with functional interference due to pain (r = 0.439, p < 0.001) as demonstrated in Table 5.

In the multivariable logistic regression model for WMSP rate, third-year participants had significantly lower odds of WMSP than fifth-year dental students (OR = 0.577, 95% CI: 0.415–0.804, p = 0.001). Following the same trend, male participants had lower odds of WMSP than female students (OR = 0.626, 95% CI: 0.467–0.840, p = 0.002). In contrast, participants without ergonomic training had lower odds of WMSP than those who had received ergonomic training (OR = 0.566, 95% CI: 0.418–0.767, p < 0.001). The number of clinical hours categories and reversed break-taking frequency were not significantly associated with WMSP in the adjusted model (Table 6 and Figure 4A).

The adjusted logistic regression model for analgesic use among respondents with WMSP showed that higher independent knowledge was associated with lower odds of analgesic use (OR = 0.828, 95% CI: 0.793–0.864, p < 0.001). Lower odds of analgesic use were observed among untrained students compared with those who received ergonomic training (OR = 0.594, 95% CI: 0.433–0.814, p = 0.001). Pain score, pain interference, safer-attitude score, gender, and academic year were not significantly associated with analgesic use after adjustment as demonstrated in Table 6 and Figure 4B.

In the multiple linear regression model for knowledge score, a higher academic year was positively associated with knowledge (B = 0.305, 95% CI: 0.036–0.574, p = 0.026). Female gender was also independently associated with a higher knowledge score (B = 0.986, 95% CI: 0.500–1.472, p < 0.001), whereas the presence of WMSP was associated with a lower knowledge score (B = −0.760, 95% CI: −1.275 to −0.245, p = 0.004) (Table 6 and Figure 4C).

In the attitude model, a positive association was observed between knowledge score and safer-attitude score (B = 0.125, 95% CI: 0.088–0.162, p < 0.001). In addition, being female was independently associated with a higher safer-attitude score (B = 0.612, 95% CI: 0.312–0.912, p < 0.001). In contrast, a nonsignificant association between WMSP status and safer-attitude score was observed after adjustment (B = 0.190, 95% CI: −0.128 to 0.508, p = 0.241) (Table 6 and Figure 4D).

Multivariable statistical analyses suggest that analgesic-related pharmacological knowledge was the factor most consistently associated with analgesic use, whereas being female and higher levels of dental undergraduate study were associated with greater knowledge and safer attitudes. An unexpected relationship between ergonomic training and higher WMSP or analgesic use requires cautious interpretation, as it may suggest reverse causality, in which participants who report pain experience may recall ergonomic training more than others (Table 6 and Figure 4).

Discussion

This multi-institutional cross-sectional study showed a high prevalence of work-related musculoskeletal pain (73.2%) among Iraqi undergraduate dental students. This result suggests that work-related musculoskeletal pain is already common among undergraduate dental students and is not limited to qualified practitioners. The observed prevalence is compatible with the broad range documented internationally. It aligns with previous evidence indicating that the neck,

Table 5 Spearman Correlation Analysis of Knowledge, Attitudes, Misuse-Awareness, Pain Intensity, and Pain Interference

Analysis Set	Variable Pair	Spearman's rho	*p*-value
Full sample (N=1081)	Knowledge score vs safer-attitude score	0.234	<0.001
	Knowledge score vs Q36 misuse-awareness item	−0.228	<0.001
	Safer-attitude score vs Q36 misuse-awareness item	−0.494	<0.001
WMSP subgroup (N= 791)	Pain score vs pain interference	0.439	<0.001

Note: Q36 = Standalone awareness item on misuse potential.

Table 6 Complete Multivariable Regression Results

Predictor/ Model	B	SE	Adj. OR	95% CI	p-value
A. Binary logistic regression for WMSP in the full sample (N = 1081)					
Third year vs fifth year	−0.549	0.169	0.577	0.415–0.804	0.001
Fourth year vs fifth year	−0.096	0.184	0.909	0.633–1.303	0.602
Male vs female	−0.468	0.150	0.626	0.467–0.840	0.002
<5 h/week vs >20 h/week	−0.061	0.327	0.941	0.496–1.786	0.852
5–10 h/week vs >20 h/week	0.086	0.320	1.090	0.582–2.041	0.787
11–15 h/week vs >20 h/week	0.064	0.333	1.066	0.555–2.048	0.849
16–20 h/week vs >20 h/week	0.544	0.403	1.724	0.782–3.796	0.177
No ergonomic training vs received training	−0.569	0.155	0.566	0.418–0.767	<0.001
Break frequency (higher score)	−0.056	0.101	0.945	0.776–1.153	0.577
Model fit: Omnibus χ^2 = 38.522, df = 9, p < 0.001; Nagelkerke R^2 = 0.051; Hosmer–Lemeshow χ^2 = 4.250, df = 8, p = 0.834.					
B. Binary logistic regression for analgesic use among participants with WMSP (n = 791)					
Third year vs fifth year	0.232	0.186	1.261	0.876–1.816	0.213
Fourth year vs fifth year	−0.214	0.192	0.807	0.554–1.176	0.263
Male vs female	0.216	0.172	1.241	0.886–1.739	0.210
No ergonomic training vs received training	−0.521	0.161	0.594	0.433–0.814	0.001
Pain score	0.047	0.042	1.048	0.965–1.138	0.269
Pain interference score	0.071	0.082	1.073	0.914–1.261	0.387
Safer-attitude score	−0.025	0.033	0.975	0.914–1.040	0.441
Knowledge score	−0.189	0.022	0.828	0.793–0.864	<0.001
Model fit: Omnibus χ^2 = 125.496, df = 8, p < 0.001; Nagelkerke R^2 = 0.196; Hosmer–Lemeshow χ^2 = 9.903, df = 8, p = 0.272.					
C. Multiple linear regression for the knowledge score (N = 1081)					
Study year (higher year)	0.305	0.137	—	0.036 to 0.574	0.026
Female vs male	0.986	0.248	—	0.500 to 1.472	<0.001
WMSP present vs absent	−0.760	0.263	—	−1.275 to −0.245	0.004
Model fit: R^2 = 0.023; adjusted R^2 = 0.020; F (3, 1077) = 8.388, p < 0.001.					
D. Multiple linear regression for the safer-attitude score (N = 1081)					
Knowledge score	0.125	0.019	—	0.088 to 0.162	<0.001
Female vs male	0.612	0.153	—	0.312 to 0.912	<0.001
WMSP present vs absent	0.190	0.162	—	−0.128 to 0.508	0.241
Model fit: R^2 = 0.060; adjusted R^2 = 0.057; F (3, 1077) = 22.736, p < 0.001.					

Notes: B represents the log-odds coefficient in logistic regression and the unstandardized coefficient in linear regression. Adjusted ORs apply only to logistic regression models. Confidence intervals refer to adjusted ORs for logistic models and B coefficients for linear models.
Abbreviations: WMSP, work-related musculoskeletal pain; SE, standard error; OR, odds ratio; CI, confidence interval.

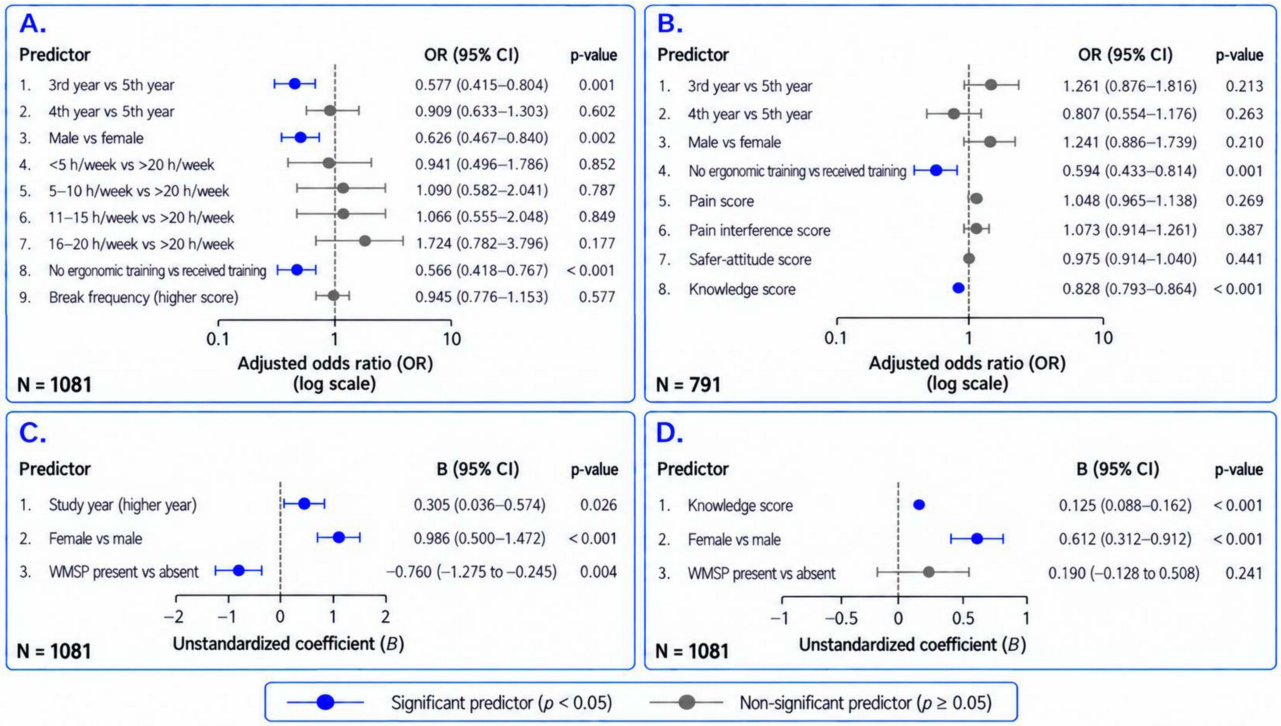

Figure 4 Multivariable regression models for WMSP, analgesic use, knowledge, and safer-attitude scores. (**A** and **B**) present adjusted odds ratios for predictors of WMSP in the full sample (*N* = 1081) and analgesic use among students with WMSP (*N* = 791), respectively. (**C** and **D**) present unstandardized regression coefficients for predictors of knowledge and safer-attitude scores (*N* = 1081). Error bars show 95% confidence intervals; blue and gray markers indicate significant and non-significant predictors, respectively. Dashed lines indicate the null value (OR = 1 or B = 0).

shoulders, and back are the most commonly involved regions among dental students.[3,6,30,31] Similarly, Almeida et al reported high involvement of the cervical and lumbar regions in their systematic review and meta-analysis.[1] The anatomical distribution reported in this study is consistent with the biomechanical demands of dental training, although the cross-sectional design does not allow us to determine whether these factors directly caused the reported pain.

Dental procedures require prolonged static postures, repetitive fine-motor activity, sustained neck flexion, and restrained working positions to perform good visualization of the oral cavity.[1,4,7] These factors are associated with greater mechanical load on the cervical, lumbar, and shoulder regions and may contribute to fatigue and musculoskeletal strain. In literature, some studies have also emphasized that undergraduate dental students often maintain fixed postures for long periods while performing precise clinical tasks, a pattern that has been associated with musculoskeletal symptoms.[4,7]

These findings suggest that the undergraduate dental training may be an important opportunity to address musculoskeletal pain and enhance preventive strategies. As students transition from preclinical simulation to patient-based clinical care, they may prioritize procedural precision and visibility over preserving ergonomic posture.[4,6,11,32] Although students from 38 institutions took part, most responses were received from only three institutions and recruitment was not probability-based. Hence, the findings should be interpreted cautiously when applied to all Iraqi dental students. The lower odds of WMSP among third-year students compared with fifth-year students are also in agreement with previous studies reporting a greater musculoskeletal burden in the advanced years of dental training.[4,5,33]

Sex-related differences observed in this study should be analyzed with caution. Male students had lower odds of WMSP than female students after adjustment, consistent with some literature findings, although the findings remain heterogeneous.[1–4] Such differences are unlikely to be purely biological and may rather reflect multifactorial effects, including anthropometry, muscle strength, posture, clinical workload, and reporting behavior. Future studies should investigate these factors utilizing more detailed ergonomic and exposure assessments.

A distinguishing contribution of this study is the integration of WMSP burden with analgesic use behavior. Among students reporting WMSP, almost half used analgesics for pain relief, suggesting that musculoskeletal pain in this population is not solely an occupational health problem but also a medication-use matter. Similar traditions have been reported among practicing dental professionals, in which analgesics are frequently used to sustain clinical performance despite continued pain.[26] The present findings show that analgesic use is already present during undergraduate dental training, highlighting concerns about potentially inappropriate pain-management practices at this period.

Analgesic use in this population needs careful consideration. While paracetamol and NSAIDs are suitable for short-term management of mild-to-moderate pain, unsupervised or prolonged use has risks, including gastrointestinal, renal, hepatic, and cardiovascular complications.[17,20–22,24] Despite their medical knowledge, students may perceive over-the-counter analgesics as inherently safe, especially in the context of recurrent self-managed pain.[21,24] Therefore, assessing analgesic use should extend beyond prevalence to include evaluation of pharmacological knowledge, risk awareness, and safe-use practices.

The most consistent medication-related result was the inverse relationship between analgesic-related pharmacological knowledge and its use. Students who achieved higher knowledge scores had lower odds of analgesic use, suggesting an association between greater pharmacological knowledge and more cautious analgesic consumption. This is consistent with previous studies reporting that greater awareness of adverse effects and drug interactions is associated with more rational analgesic use.[19] However, knowledge alone may not be sufficient, as a knowledge–practice gap has been described among health-professional students.[20,23,24]

In the Iraqi context, studies have reported high rates of self-medication among medical students, often influenced by informal information sources such as peers or family members.[15] These findings highlight the importance of combining both knowledge and behavioral components when addressing self-medication practices.

This study extends the existing Iraqi literature by linking analgesic-use behavior to a specific occupational exposure. Previous studies in Iraq have reported high rates of self-medication among university students,[15,27] but have not discussed its relationship with WMSP. By focusing specifically on dental students and WMSP, the current study provides more context-specific knowledge of analgesic use in a clinical training setting.

The association between ergonomic training and higher WMSP or analgesic use should be interpreted carefully. Because of the cross-sectional design, this finding does not reflect that ergonomic training itself might increase pain or analgesic use. A suggested explanation is reverse causality, whereby students experiencing pain or clinical exposure may have been more likely to have received, sought, or recalled ergonomic training. Institutional variation and other unmeasured factors may also have contributed to this association.

Previous studies have also suggested that the observed relationship between ergonomic interventions and musculoskeletal pain may be influenced by clinical experience and individual characteristics.[12] Moreover, evidence demonstrates that ergonomic knowledge does not necessarily translate into consistent clinical practice.[8,34] Future research should therefore consider not only the presence of ergonomic education, but also its timing, quality, and practical performance.

Non-pharmacological and ergonomic interventions remain central to the prevention and management of WMSP. Dependence on analgesics without managing underlying ergonomic factors may provide temporary relief but does not resolve the mechanical causes of pain.[7] Studies have indicated the effectiveness of ergonomic interventions, including magnification devices, posture training, and structured exercise programs, in relieving musculoskeletal symptoms among dental students.[5,8] These results support the incorporation of comprehensive ergonomic training within dental curricula, highlighting practical application and behavioral reinforcement.

The study results have important educational implications. Iraqi dental schools may embed preventive methods of WMSP within undergraduate dental education as a sustained curricular competency rather than a single or short theoretical lecture. This recommendation is consistent with an earlier Iraqi study from the dental institute, which highlighted the need for practice-oriented clinical training to enhance students' preparedness for real-world clinical practice.[35] Key elements should include early ergonomic posture training, continuous ergonomic evaluation during clinical work, personalized feedback, proper operator chair and patient positioning, appropriate use of magnification and lighting, planned microbreak intervals, regular stretching exercises, and a supportive physical routine. Moreover, an earlier Iraqi questionnaire-based dental study focused on the benefits of structured evaluation, clear communication with

students, and respondents' input in optimizing clinical and dental teaching settings.[36] In parallel, pharmacology teaching should emphasize clinically based sessions on the appropriate use of analgesics, the highest daily allowable dose, analgesics-disease interactions, NSAID-related adverse effects, possible liver impairment from paracetamol use, analgesic-drug interactions, and when medical advice should be considered. These combined educational approaches may support better ergonomic practices and safer analgesic use, but their effectiveness would need to be investigated and assessed in longitudinal or interventional studies. These findings are relevant to dental education, occupational health and ergonomics, and pharmacology because they demonstrate how musculoskeletal pain, training-related factors, and analgesic use are connected in dental students.

This study has several strengths, including a large sample size and participation from multiple institutions across Iraq. Further, the questionnaire captured multiple domains, including WMSP, analgesic use, knowledge, attitudes, and ergonomic practices. However, several limitations should be acknowledged. The cross-sectional design prevents causal inference, and all findings should be interpreted as associations. The use of an openly circulated survey link may also have introduced selection and non-response bias, as students who chose to take part may have differed from those who did not. Sample was mainly collected from three institutions, and differences between institutions may have influenced the results. Moreover, WMSP was based on students' own reports and was not clinically assessed, so the study could not independently confirm that all reported pain was directly related to undergraduate dental training. Clustering by institution was not considered because several universities were combined under the "Other universities" category, so separate identifiers were not available for all participated schools. The uneven number of participants from each university should therefore be considered when explaining the findings. The safer-attitude scale showed only modest internal consistency (Cronbach's $\alpha = 0.64$), so findings based on this measure should be interpreted carefully. Because WMSP was reported without a specific recall period, students may have differed in how far back they considered their symptoms. Because musculoskeletal questions were developed by the researcher rather than taken from a single validated questionnaire, comparisons with studies using established instruments may be more limited.

Conclusion

This multi-institutional study recorded a high prevalence of WMSP among Iraqi dental undergraduates, with WMSP being reported by nearly three-quarters of the cohort. Almost half of this student group (with WMSP) reported analgesic use to manage their pain symptoms. WMSP prevalence was higher among female students and among those with advanced years of dental education, although, given the cross-sectional design, we cannot determine when these symptoms started or whether WMSP accumulated across study years. Higher analgesic-related pharmacological knowledge was associated with lower odds of reported analgesic use. These findings demonstrate that WMSP and analgesic use are related concerns among dental undergraduate students, with relevance to both ergonomic behaviour and medication safety. Integrated ergonomic and pharmacological education may warrant further evaluation as potential approach to improving pain-management practices and enhance safer analgesic use among dental students.

Abbreviations

WMSP, work-related musculoskeletal pain; WMSDs, work-related musculoskeletal disorders; NSAIDs, non-steroidal anti-inflammatory drugs; OTC, over-the-counter; CI, confidence interval; OR, odds ratio; VIF, variance inflation factor.

Data Sharing Statement

The original questionnaire and raw data are available from the corresponding author upon reasonable request.

Consent for Publication

Not applicable, as no identifiable participant information is included in this manuscript.

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The authors declare that they have no financial or non-financial competing interests relevant to this work.

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