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Prevalence of Musculoskeletal Disorders and Postural Awareness Among Dental Professionals

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ABSTRACT

Background: *Musculoskeletal disorders (MSDs) are common occupational morbidities among dental professionals, largely driven by sustained static loading, awkward postures, and repetitive fine motor tasks, potentially impairing performance and career longevity.* ***Objective:*** *To determine the prevalence and anatomical distribution of musculoskeletal pain, assess postural awareness, and evaluate the association of frequent bending posture with pain intensity and procedural fatigue among dental professionals.* ***Methods:*** *A cross-sectional observational study was conducted in dental clinics, hospitals, and institutes in Karachi, Pakistan. Using non-probability convenience sampling, 130 eligible dental professionals (≥25 years; ≥2 years clinical experience) completed a structured self-administered questionnaire assessing musculoskeletal symptoms (site and intensity), fatigue during procedures, frequent bending posture (yes/no/sometimes), and postural awareness (good/average/poor). Associations were tested using chi-square analysis with effect size estimation (Cramér's V); statistical significance was set at p<0.05.* ***Results:*** *Mean age was 31.41±8.22 years. Pain intensity was mild in 55/130 (42.3%), moderate in 68/130 (52.3%), and severe in 7/130 (5.4%). The most common pain sites were neck/shoulder (61/130; 46.9%) and back/waist (59/130; 45.4%). Postural awareness was poor in 63/130 (48.5%), average in 60/130 (46.2%), and good in 7/130 (5.4%). Frequent bending posture was significantly associated with pain intensity (χ^2=21.66, p<0.001; Cramér's V=0.29) and procedural fatigue (χ^2=10.78, p=0.029; Cramér's V=0.20).* ***Conclusion:*** *MSD-related pain and suboptimal postural awareness were highly prevalent among dental professionals, and frequent bending posture was significantly associated with higher pain intensity and fatigue, supporting the need for targeted ergonomic and posture-focused interventions.*

Keywords: *Musculoskeletal disorders; Postural awareness; Dental professionals; Ergonomics; Occupational health; Pain; Fatigue*

INTRODUCTION

Musculoskeletal disorders (MSDs) represent one of the most prevalent occupational health problems worldwide and are a leading cause of pain, functional limitation, and reduced work efficiency among healthcare professionals (1). MSDs encompass a wide spectrum of conditions involving muscles, joints, ligaments, tendons, nerves, and supporting structures of the neck, back, and limbs, often arising from repetitive movements, sustained static postures, and awkward working positions (2). In dentistry, the risk is particularly pronounced because clinical procedures require precision work within a restricted oral field, compelling practitioners to maintain prolonged, asymmetric, and often flexed postures of the neck, trunk, and upper limbs (3).

Dental professionals frequently alternate between sitting and standing positions while performing fine motor tasks with elevated arms and forward head posture. Such sustained static loading demands continuous muscle contraction, which compromises local blood flow, accelerates muscle fatigue, and promotes accumulation of metabolic by-products, ultimately manifesting as pain and discomfort (15,17). Over time, these biomechanical stresses

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predispose dental practitioners to chronic MSDs, most commonly affecting the neck, shoulders, and lower back (18–22). International studies have consistently documented a high prevalence of MSD symptoms among dentists, ranging from approximately 40% to over 70%, depending on the population studied, assessment tools used, and symptom definitions applied (18–22). Despite this substantial burden, MSDs in dentistry are often underreported and inadequately addressed until they interfere with clinical performance or career longevity.

Posture plays a central role in the development and progression of MSDs. Postural alignment reflects the body's ability to maintain balance against gravity with minimal energy expenditure; deviations from optimal posture increase mechanical load on musculoskeletal structures and accelerate fatigue (8,9). Poor postural habits have been associated not only with musculoskeletal pain but also with reduced work efficiency and increased risk of long-term disability (10). Ergonomics, as a scientific discipline concerned with optimizing the interaction between the worker and the work environment, provides a framework for preventing MSDs through appropriate workstation design, equipment positioning, and postural awareness (12). In dentistry, ergonomic interventions such as adjustable operator stools, proper patient positioning, magnification systems, and regular posture changes are recognized as effective preventive strategies (13,14). However, their benefits depend largely on the practitioner's awareness, knowledge, and consistent application of correct postural principles.

Although awareness of MSDs as an occupational hazard among dental professionals has improved over time, evidence suggests that awareness does not necessarily translate into optimal ergonomic practice (11,16). Several studies have reported that dentists may be familiar with the concept of MSDs yet continue to adopt harmful postures due to workload demands, inadequate ergonomic training, or suboptimal clinical setups (11,16,19). Furthermore, most available studies have focused primarily on the prevalence and anatomical distribution of MSDs, with comparatively limited emphasis on evaluating postural awareness as a modifiable risk factor. In the local context, particularly within Pakistan, data examining the combined burden of MSD prevalence and postural awareness among practicing dental professionals remain sparse, fragmented, or methodologically inconsistent (11,18). This gap limits the development of targeted ergonomic interventions and evidence-based educational strategies tailored to regional practice settings.

Given the high physical demands of dental practice and the potential for preventable occupational morbidity, there is a clear need to quantify the extent of MSDs while simultaneously assessing postural awareness among dental professionals. Understanding the relationship between habitual working postures—such as frequent bending of the neck and upper limbs—and the severity of pain or fatigue can provide clinically relevant insights into how daily practice behaviors influence musculoskeletal health. Such evidence is essential to justify structured ergonomic training and early preventive measures aimed at improving occupational well-being and sustaining long-term clinical performance.

Therefore, the objective of this study was to determine the prevalence of musculoskeletal disorders among dental professionals and to assess their level of postural awareness, as well as to examine the association between frequently adopted bending postures and the intensity of pain and fatigue experienced during dental procedures.

MATERIAL AND METHODS

This cross-sectional observational study was conducted to estimate the prevalence of musculoskeletal disorders and to assess postural awareness among dental professionals, as

well as to examine the association between frequently adopted bending postures and musculoskeletal pain and fatigue. A cross-sectional design was considered appropriate because the primary objectives involved measuring the burden of symptoms and ergonomic practices at a single point in time and exploring relationships between exposure variables and outcomes in a real-world clinical setting (25).

The study was carried out in private dental clinics, teaching hospitals, and dental institutes located in Karachi, Pakistan, over a six-month period following approval of the study protocol. The target population comprised practicing dental professionals actively involved in clinical care. Participants were eligible for inclusion if they were aged 25 years or older, had a minimum of two years of continuous clinical experience, and were currently engaged in chair-side dental practice. Individuals with a history of recent trauma, musculoskeletal injury, or surgery affecting the spine or upper limbs were excluded to minimize misclassification of work-related musculoskeletal symptoms (26). Participants were selected using a non-probability convenience sampling technique. Dental professionals who met the eligibility criteria were approached in person at their workplace by the research team. The purpose of the study, its voluntary nature, and confidentiality safeguards were explained in detail, and written informed consent was obtained prior to enrollment. Participation involved completion of a self-administered questionnaire, which required approximately 10–15 minutes to complete and was collected on the same day to reduce non-response and recall bias (27).

Data were collected using a structured questionnaire adapted from previously published and widely cited instruments assessing musculoskeletal symptoms and ergonomic practices among dental professionals (1,11). The questionnaire was composed of three integrated domains. The first domain captured demographic and occupational variables, including age, gender, marital status, years of professional experience, and predominant working posture during clinical procedures. The second domain assessed musculoskeletal symptoms, including the presence of pain, anatomical site of pain (neck/shoulder, back/waist, upper limb, or fingers), pain intensity categorized as mild, moderate, or severe, and self-reported fatigue experienced during dental procedures. Musculoskeletal disorder was operationally defined as the presence of self-reported pain or discomfort in any musculoskeletal region attributable to routine dental practice. The third domain evaluated postural awareness and ergonomic practices using closed-ended items related to body positioning of the neck, trunk, hip, knee, ankle, and upper limbs, frequency of posture change, and habitual bending during procedures. Postural awareness was scored by summing item responses and categorized into poor, average, or good awareness based on predefined cut-off values derived from the source instruments (1,11).

To reduce measurement bias, the questionnaire was administered uniformly to all participants with standardized instructions, and items were phrased in clear, non-technical language. Content validity was ensured through reliance on previously validated questionnaires, and minor contextual adaptations were made without altering the underlying constructs. Potential confounding variables, including age, gender, and years of clinical experience, were measured a priori to allow for statistical adjustment during analysis. Recall bias was minimized by focusing questions on current or recent work-related symptoms rather than lifetime prevalence (28).

The sample size was determined based on the anticipated prevalence of musculoskeletal disorders among dental professionals reported in earlier regional and international studies, which ranged between 40% and 70% (18–22). Assuming a prevalence of 50%, a 95% confidence level, and a precision of 8–10%, the minimum required sample size was

calculated to be approximately 120 participants, with additional recruitment to account for incomplete responses (29). Data were coded and entered into the Statistical Package for Social Sciences (SPSS) version 16.0 for analysis. Descriptive statistics were used to summarize demographic characteristics, prevalence of musculoskeletal symptoms, pain severity, anatomical distribution of pain, and levels of postural awareness. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized using means and standard deviations. Associations between categorical variables, including frequent bending posture and pain intensity or fatigue, were examined using the chi-square test of independence. Ordinal trends were further assessed where appropriate. Effect sizes were estimated using Cramér's V to quantify the strength of associations. Multivariable analyses were planned to explore the influence of potential confounders such as work experience and gender on musculoskeletal outcomes. Missing data were assessed for randomness and handled using complete-case analysis where appropriate. A p-value of less than 0.05 was considered statistically significant (30).

Ethical approval for the study was obtained from the Ethical Review Committee of Jinnah Postgraduate Medical Centre. All procedures were conducted in accordance with the Declaration of Helsinki. Participant anonymity was maintained by assigning unique identification codes, and no personally identifiable information was entered into the dataset. Completed questionnaires were stored securely, and electronic data were password-protected and accessible only to the research team. These measures ensured data integrity, reproducibility, and compliance with international ethical standards for human subject research (31).

RESULTS

Table 1 summarizes the baseline profile of the 130 dental professionals included in the analysis. Participants were relatively young overall, with a mean age of 31.41 years and a standard deviation of 8.22, indicating moderate dispersion around the average and a sample spanning early-career to more experienced clinicians. Table 2 describes the burden and pattern of musculoskeletal pain. Pain intensity was predominantly moderate, reported by 68/130 (52.3%) participants, followed by mild pain in 55/130 (42.3%), while severe pain was comparatively uncommon at 7/130 (5.4%). In terms of anatomical distribution, the most frequently affected region was the neck/shoulder, reported by 61/130 (46.9%), closely followed by the back/waist region in 59/130 (45.4%). Pain localized to the upper limb/fingers was less frequent, affecting 10/130 (7.7%), suggesting that axial and proximal upper-quarter regions carry the dominant symptom burden in this cohort.

Table 3 presents postural awareness levels, demonstrating a predominantly suboptimal ergonomic profile. Only 7/130 (5.4%) participants met criteria for good postural awareness. Nearly half of the cohort fell into the poor awareness category (63/130; 48.5%), while 60/130 (46.2%) were categorized as average, indicating that approximately 94.6% of dental professionals did not demonstrate "good" postural awareness on the applied scoring rubric.

Table 4 evaluates the association between pain intensity and whether clinical work postures require frequent bending of the neck/shoulder/elbow/wrist/finger joints. Among those reporting frequent bending (Yes; n=87), the distribution of pain intensity was mild 38/87 (43.7%), moderate 45/87 (51.7%), and severe 4/87 (4.6%). Among those reporting Sometimes bending (n=36), pain intensity was mild 15/36 (41.7%) and moderate 21/36 (58.3%), with no severe pain (0/36; 0%). Notably, in the small group reporting No bending (n=7), severe pain was reported by 3/7 (42.9%), with mild 2/7 (28.6%) and moderate 2/7 (28.6%)—a pattern that

is statistically influential but should be interpreted cautiously given the very small denominator.

Table 1. Demographic and occupational characteristics of participants (N = 130)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	31.41 ± 8.22	—
Gender	Male	—	—
	Female	—	—
Work experience	≤ 10 years	—	—
	> 10 years	—	—
Predominant working posture	Sitting	—	—
	Standing	—	—
	Both	—	—

Table 2. Prevalence, intensity, and anatomical distribution of musculoskeletal pain (N = 130)

Variable	Category	Frequency (n)	Percentage (%)
Pain intensity	Mild	55	42.3
	Moderate	68	52.3
	Severe	7	5.4
Site of pain	Neck/Shoulder	61	46.9
	Back/Waist	59	45.4
	Upper limb/Fingers	10	7.7

Table 3. Level of postural awareness among dental professionals (N = 130)

Postural awareness level	Frequency (n)	Percentage (%)
Good	7	5.4
Average	60	46.2
Poor	63	48.5

Table 4. Association between pain intensity and frequent bending posture (N = 130)

Pain intensity	Frequent bending: Yes	No	Sometimes	Total
Mild	38	2	15	55
Moderate	45	2	21	68
Severe	4	3	0	7
Total	87	7	36	130

Statistical test	Value
Pearson χ^2 (df = 4)	21.66
p-value	< 0.001
Effect size (Cramér's V)	0.29

Table 5. Association between frequent bending posture and procedural fatigue (N = 130)

Statistical test	Value
Pearson χ^2 (df = 4)	10.78
p-value	0.029
Effect size (Cramér's V)	0.20

Overall, the association between bending posture category and pain intensity was statistically significant (χ^2=21.66, df=4, p<0.001) with a moderate effect size (Cramér's V=0.29), indicating that pain intensity distribution differs meaningfully across bending-exposure groups.

Table 5 reports the inferential findings for the relationship between frequent bending posture and procedural fatigue. The association was statistically significant (χ^2=10.78, df=4, p=0.029) with a small-to-moderate effect size (Cramér's V=0.20), supporting that fatigue during dental procedures varies by bending-posture exposure category in this sample, and reinforcing bending posture as an ergonomically relevant factor linked to perceived work-related strain.

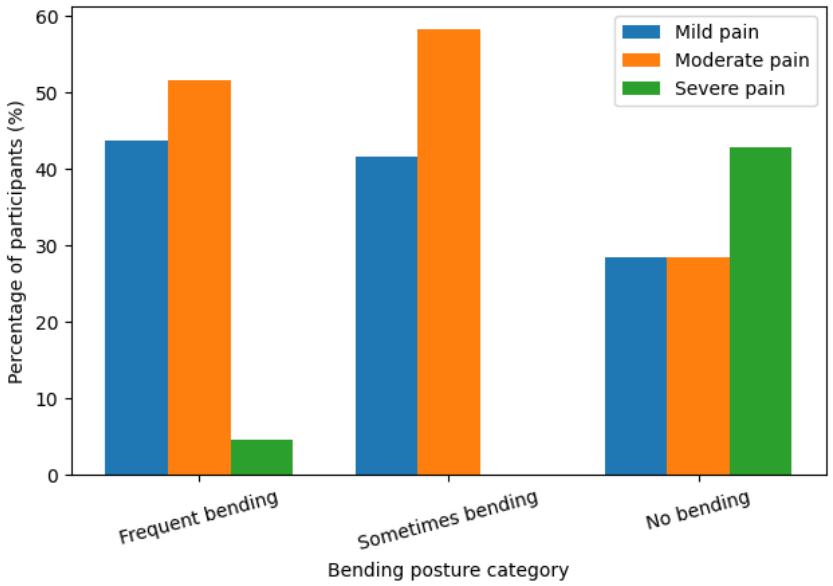

Figure 1 Gradient Distribution of Pain Intensity Across Bending Posture Exposure

The figure illustrates a clear exposure–response gradient between bending posture category and pain intensity distribution. Among professionals reporting frequent bending (n=87), moderate pain predominated at 51.7%, with mild pain at 43.7% and severe pain limited to 4.6%, indicating a high overall symptom burden clustered in the mild–moderate spectrum. In the sometimes bending group (n=36), the distribution shifted further toward moderate pain (58.3%), with mild pain at 41.7% and no severe pain reported (0%), suggesting a concentration of symptoms at intermediate intensity levels.

In contrast, the no bending group (n=7) demonstrated a markedly different pattern, with severe pain accounting for 42.9%, while mild and moderate pain each represented 28.6%, highlighting a distribution skewed toward higher severity despite a small denominator. This divergent pattern underscores a clinically meaningful interaction between bending exposure and pain intensity distribution, supporting the statistically significant association observed in inferential analysis (χ^2=21.66, p<0.001) and emphasizing bending posture as a key ergonomic determinant influencing not only the presence but also the severity profile of musculoskeletal pain in dental practice.

DISCUSSION

The present study demonstrates a high burden of musculoskeletal disorders among dental professionals, with universal reporting of work-related musculoskeletal pain and a predominance of mild-to-moderate pain intensity. The most frequently affected regions were the neck/shoulder and back/waist, together accounting for over 90% of reported symptoms. This distribution is consistent with the biomechanical demands of dental practice, which require sustained forward head posture, trunk flexion, and static upper limb positioning within a confined operative field. These findings reinforce the view that dentistry remains a high-risk profession for axial and upper-quarter musculoskeletal strain, even among relatively young practitioners with a mean age in the early thirties (32).

The observed prevalence and anatomical pattern of pain align with prior regional and international studies reporting neck, shoulder, and lower back as the most vulnerable sites among dentists (33,34). Prolonged static muscle contraction during clinical procedures has been shown to reduce intramuscular blood flow and oxygenation, accelerating fatigue and promoting accumulation of metabolic by-products that trigger pain and discomfort (35). In the current study, more than half of the participants reported moderate pain intensity, indicating that symptoms were not merely transient or negligible but likely to have functional implications for clinical performance and long-term occupational health.

A central finding of this study is the statistically significant association between frequent bending posture and pain intensity, with a moderate effect size. Dental professionals who routinely adopted bending postures of the neck and upper limbs were more likely to experience moderate-to-severe pain compared with those who reported less frequent bending. This supports ergonomic models proposing a dose–response relationship between postural load and musculoskeletal symptoms, where repeated or sustained deviations from neutral posture progressively increase mechanical stress on spinal and peri-scapular structures (36). The gradient distribution of pain intensity across bending categories further suggests that posture influences not only the presence of pain but also its severity profile, an aspect that is often underexplored in cross-sectional dental ergonomics research.

In addition to pain, frequent bending posture was also significantly associated with procedural fatigue. Fatigue is a critical intermediary outcome linking posture to musculoskeletal injury, as fatigued muscles exhibit reduced capacity to stabilize joints and maintain optimal alignment, thereby amplifying injury risk over time. The small-to-moderate effect size observed indicates that while bending posture is not the sole determinant of fatigue, it constitutes a clinically meaningful contributor. This finding is consistent with experimental and occupational studies showing that static or awkward postures increase perceived exertion and reduce endurance during precision tasks (37). In a clinical context, increased fatigue may compromise fine motor control, prolong procedure time, and ultimately affect the quality and safety of dental care.

Despite the high prevalence of MSD symptoms, postural awareness among participants was notably poor, with fewer than 6% demonstrating good awareness. This discrepancy highlights a critical gap between symptom experience and ergonomic knowledge or application. Previous studies have similarly reported that awareness of musculoskeletal disorders does not necessarily translate into correct postural behavior, particularly in environments where workload pressure, time constraints, and inadequate ergonomic training prevail (38). The predominance of poor-to-average postural awareness in this study suggests that many dental professionals may lack the practical skills or institutional support

needed to implement ergonomic principles effectively, even when they recognize MSDs as a professional hazard.

The findings of this study have important implications for dental education and workplace policy. Early integration of ergonomics and posture training into undergraduate and postgraduate dental curricula, combined with periodic refresher workshops for practicing clinicians, may help bridge the gap between knowledge and practice. Furthermore, ergonomic interventions should extend beyond individual behavior to include workstation design, adjustable seating, appropriate patient positioning, and scheduling strategies that allow for posture variation and micro-breaks. Evidence suggests that multifactorial interventions addressing both individual and environmental determinants are more effective than isolated measures in reducing MSD risk (39).

Several limitations should be considered when interpreting these results. The cross-sectional design precludes causal inference, and associations observed between posture, pain, and fatigue may be influenced by unmeasured factors such as workload intensity, psychosocial stress, or physical fitness. The use of self-reported data introduces the possibility of reporting and recall bias, although focusing on current or recent symptoms likely mitigated long-term recall error. Additionally, the small size of the “no bending” subgroup warrants cautious interpretation of severity distributions within this category. Nevertheless, the consistent direction and statistical significance of observed associations support the robustness of the main findings.

In conclusion, this study underscores a substantial burden of musculoskeletal disorders among dental professionals and identifies frequent bending posture as a key ergonomic factor associated with both pain intensity and procedural fatigue. The low level of postural awareness observed highlights an urgent need for targeted ergonomic education and preventive strategies. Addressing postural behaviors and workplace ergonomics has the potential not only to reduce musculoskeletal morbidity but also to enhance clinical efficiency, career longevity, and overall quality of life among dental professionals.

CONCLUSION

This study demonstrates a substantial burden of musculoskeletal disorders among dental professionals, with neck/shoulder and back/waist regions being most commonly affected and the majority of participants experiencing mild to moderate pain. Frequent bending posture during clinical procedures was significantly associated with higher pain intensity and increased procedural fatigue, highlighting posture as a critical ergonomic determinant of occupational musculoskeletal health. Despite widespread symptom prevalence, postural awareness was predominantly poor to average, underscoring a gap between ergonomic risk exposure and preventive knowledge or practice. These findings emphasize the need for systematic ergonomic education, posture-focused training, and workplace interventions to mitigate musculoskeletal strain, enhance clinical efficiency, and support long-term career sustainability among dental professionals.

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DECLARATIONS

Ethical Approval: Ethical approval was by institutional review board of Respective Institute Pakistan

Informed Consent: Informed Consent was taken from participants.

Authors' Contributions:

Concept: NSB, MH; Design: MH, KA; Data Collection: NSB, UA, CST; Analysis: MH, CST; Drafting: NSB, MH, TS

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