Natural Resources for Human Health
eISSN: 2583-1194

Original Research

Received 24 May 2026
Revised 28 June 2026
Accepted 16 July 2026

Natural Resources for Human Health 2026, Vol. 6 (7s): 198–209

KEYWORDS:
musculoskeletal disorders; ergonomics; dentistry; dental students; Nordic questionnaire; occupational health.

Musculoskeletal Disorders among Fourth- and Fifth-Year Clinical Dental Students at the Universidad de Panamá

Raquel Villalobos de Cortés[1]*, Rita Teresa Espósito[1], Kira Singh[1], Luis H. Vega Tejada[1], Marcia Lorenzetti C.[1], Luis Antonio Jaén[2]

[1]Facultad de Odontología, Universidad de Panamá, Panamá
[2]Universidad de Panamá and Complejo Hospitalario Dr. Arnulfo Arias Madrid, Caja de Seguro Social, Panamá
*Corresponding author: Dr. Raquel Villalobos de Cortés; ramavi02@yahoo.com

ABSTRACT:

Background: Dental clinical training requires sustained postures and repetitive precision movements that may contribute to musculoskeletal disorders (MSDs) before professional practice begins.

Objective: To estimate MSD prevalence and characterize anatomical distribution, symptom duration and intensity, functional impact, orthopedic diagnostic groupings, perceived contributors, and differences by sex and clinical cycle among fourth- and fifth-year clinical dental students.

Methods: A descriptive cross-sectional census study was conducted at the Facultad de Odontología, Universidad de Panamá, during the first academic semester of 2026. The Standardized Nordic Questionnaire was administered to eligible students, open-ended responses were categorized, and questionnaire findings were reviewed by an orthopedic specialist. Descriptive statistics, the chi-square test, and Fisher's exact test were used.

Results: Data from 78 students were analyzed; 64 (82.1%) were women. Overall, 77 students (98.7%) reported at least one musculoskeletal complaint. The dorsal/lumbar region (71.8%), neck (71.4%), and wrist/hand (59.0%) were most frequently affected. Wrist/hand (15.4%) and neck symptoms (14.3%) most often led to activity suspension. Cervical (50.0%), dorsal/lumbar (46.2%), and wrist disorders (35.9%) were the most frequent presumptive orthopedic groups. Dorsal/lumbar complaints differed by clinical cycle ($\chi^2 = 7.24$; $p = 0.027$), whereas global MSD presence did not differ by sex (Fisher's exact $p = 1.000$). Poor posture, working position, or inadequate ergonomics was cited by 75.6% of students.

Conclusion: Musculoskeletal complaints were nearly universal in this census and showed a consistent cervical, dorsal/lumbar, and wrist/hand pattern. Because the cross-sectional design cannot establish causality, the findings support prospective ergonomic surveillance, direct observation of clinical posture, equipment adjustment, active-break protocols, and a formal referral pathway rather than claims that clinical training alone caused the disorders.

1. INTRODUCTION

Ergonomics addresses the adaptation of work, equipment, furniture, and environments to human capacities so that tasks can be performed safely, comfortably, and efficiently (Naranjo Mora, 2021; Quinzo Montenegro, 2023; Real Academia Española, 2022). In dentistry, this adaptation is especially important because the operator must maintain visual access to a small working field while coordinating precise manual movements. Ergonomic risk therefore emerges from the interaction of the clinician, instruments, dental chair, patient position, task duration, and organization of work rather than from posture alone.

Dental clinical work commonly combines sustained neck and trunk flexion, asymmetric shoulder positions, static muscular loading, precision grips, repetitive wrist and finger movements, and limited opportunities to change position. These exposures may produce symptoms ranging from short, intermittent discomfort to persistent pain and functional limitation (Otero and Otero, 2010; Pinheiro, 2023; Santos et al., 2024; Takeuti and Saliba, 2020). A useful occupational-health model distinguishes ergonomic exposure, self-reported symptoms, functional consequences, care seeking, and clinically interpreted findings; these domains are related but are not interchangeable.

Three interdependent levels are particularly relevant in dentistry: ergonomic design of the clinic, organization of clinical work, and body positions during patient care (Briones, 2014). Recommendations concerning the height of the working area, distance to the oral field, lower-limb support, and balanced operator positioning are intended to reduce unnecessary amplitude of movement and fatigue (Romero and Barrionuevo, 2017). However, knowledge of these recommendations does not guarantee sustained application when time pressure, patient characteristics, supervision, or non-adjustable furniture constrain practice.

The problem may begin during training. Fortich (2012) reported musculoskeletal complaints in 88.51% of 334 dental students, with the cervical region most affected. Fernandes et al. (2021) likewise identified cervical and lumbar symptoms as frequent among dental students and teachers. Professional samples have also shown a very high symptom burden, and Blamires et al. (2020) reported musculoskeletal complaints in approximately 98% of practicing dentists. At the same time, students may understand ergonomic principles but apply them inconsistently in clinical sessions (Martínez et al., 2020), creating a knowledge-practice gap that requires both educational and environmental responses.

At the Universidad de Panamá, ergonomics is taught within Biosecurity before direct patient care and is reinforced through formative supervision during preclinical and integrated clinical practice (Martínez et al., 2015). Early surveillance is relevant because symptoms present at graduation may affect later work capacity, and work-related musculoskeletal disorders are an important cause of absence and disability (Arias Almonacid et al., 2018). The study also aligns with Panamanian and regional priorities concerning occupational health and the well-being of health personnel in training (Ministerio de Salud de la República de Panamá, 2021; Organización Panamericana de la Salud, 2020).

Recent work in Natural Resources for Human Health illustrates a broad prevention-to-rehabilitation continuum. Sensor-based ergonomic monitoring has been proposed for repetitive strain and carpal tunnel risk (Gautam et al., 2026), while artificial-intelligence applications have been reviewed for posture recognition and corrective feedback (Pandit and Pise, 2026). Other studies in the journal have examined neuromuscular stabilization, cervical proprioceptive rehabilitation, neck-pain interventions, and massage-based symptom management (Abu Ella et al., 2026; El-keblawy et al., 2026; Khanum et al., 2026; Singh et al., 2026). These studies involve populations and interventions different from dental students, but they support the conceptual separation between detecting risk, preventing progression, and treating established functional problems.

Accordingly, the objective of this study was to estimate the prevalence of musculoskeletal complaints and characterize their anatomical distribution, temporal profile, intensity, functional impact, presumptive orthopedic grouping, and perceived contributing factors among fourth- and fifth-year clinical dental students at the Universidad de Panamá, while exploring differences by sex and clinical cycle. The research question was: What is the prevalence and anatomical, temporal, and functional profile of musculoskeletal complaints in this population, and how do global or regional patterns vary by sex and clinical cycle? Clinical areas were described as contexts of participation, not treated as causal exposures.

2. MATERIALS AND METHODS

2.1 Study design and setting

A descriptive cross-sectional study was conducted during the first academic semester of 2026 at the Facultad de Odontología, Universidad de Panamá. The design was predominantly quantitative and included categorical content analysis of an open-ended

item on factors that students associated with their symptoms. The study provides a point-in-time profile and does not establish temporal sequence or causality.

2.2 Participants and variables

The eligible population comprised 80 fourth- and fifth-year students enrolled in clinical practice who provided written informed consent. Students with a previously diagnosed musculoskeletal disorder or previous musculoskeletal surgery met the exclusion criteria. A census approach was used rather than probability sampling, and complete data from 78 participants were analyzed. Variables included sex, clinical cycle, presence of symptoms by anatomical region, 12-month and 7-day prevalence, duration, intensity, activity suspension, work limitation, treatment, clinical area, presumptive orthopedic group, and perceived contributing factors.

2.3 Instrument and orthopedic review

Data were collected with the Standardized Nordic Questionnaire developed by Kuorinka et al. (1987), using the adaptation published by the Instituto de Salud Pública de Chile (2020). Ten items assessed symptoms in the neck, shoulders, dorsal/lumbar region, elbow/forearm, and wrist/hand, together with their frequency, duration, recent occurrence, functional consequences, and treatment. Demographic and academic information included sex, clinical cycle, and the clinical area in which the student reported the greatest activity. An orthopedic and traumatology specialist reviewed the questionnaire profiles and assigned presumptive diagnostic groupings based on reported location, frequency, and duration; these groupings were not a substitute for a complete physical examination.

2.4 Procedure and ethical safeguards

After authorization from the fourth- and fifth-year teaching teams, the study was explained in a scheduled group session. Participation was voluntary, written informed consent was obtained before questionnaire completion, and no financial incentive was offered. Forms were identified with a study code, and the analytic dataset excluded names and direct identifiers. The study followed Panama's Law 81 of 2019 on personal-data protection and Law 84 of 2019 on health research, and it was evaluated by the Comité de Bioética de la Investigación de la Universidad de Panamá. Study documents are held under confidential custody for at least five years.

2.5 Statistical analysis

Responses were coded in Microsoft Excel and summarized using frequencies, percentages, means, and medians as appropriate. Percentages were calculated from valid responses when an item contained missing data, as noted beneath the relevant tables. The association between clinical cycle and dorsal/lumbar complaints was examined with the chi-square test, and the association between sex and global MSD presence was examined with Fisher's exact test because of sparse cells. Statistical significance was set at $p < 0.05$. Inferential analyses were exploratory given the census design, small subgroup counts, and absence of multivariable adjustment.

3. RESULTS AND DISCUSSION

3.1 Participant characteristics and global prevalence

The analytic sample included 78 students, of whom 64 (82.1%) were women and 14 (17.9%) were men. Clinic IV represented 53.8% of the sample, followed by Clinic I (26.9%) and Clinic III (19.2%). Overall, 77 students (98.7%) reported at least one musculoskeletal complaint.

Table 1. General characteristics of the students

Variable	Category	n (%)
Sex	Female	64 (82.1%)
	Male	14 (17.9%)
Clinical cycle	Clinic I	21 (26.9%)

Variable	Category	n (%)
	Clinic III	15 (19.2%)
	Clinic IV	42 (53.8%)
Presence of ≥1 MSD	Yes	77 (98.7%)
	No	1 (1.3%)

3.2 Anatomical distribution

The dorsal/lumbar region had the highest frequency of complaints (71.8%), closely followed by the neck (71.4%). Wrist/hand symptoms were reported by 59.0%, shoulder symptoms by 40.3%, and elbow/forearm symptoms by 6.5%. Thus, the main symptom burden was concentrated in axial regions exposed to sustained posture and in the distal upper limb used for precision work.

Table 2. Frequency of complaints by anatomical region

Region	Yes n (%)	No n (%)
Neck	55 (71.4%)	22 (28.6%)
Dorsal/lumbar	56 (71.8%)	22 (28.2%)
Shoulder	31 (40.3%)	46 (59.7%)
Elbow/forearm	5 (6.5%)	72 (93.5%)
Wrist/hand	46 (59.0%)	32 (41.0%)

Note: There were 77 valid responses for neck, shoulder, and elbow/forearm; percentages for these regions therefore exclude the missing response.

3.3 Clinical areas represented

Operative dentistry was the most frequently recorded clinical area (60 students; 76.9%), followed by pediatric dentistry (25; 32.1%). Surgery and periodontics were least represented (3 students each). These values describe the clinical contexts reported by participants; because students could participate in more than one area and no exposure time was measured, they do not demonstrate that any area caused the complaints.

Table 3. Clinical areas recorded

Clinical area	Yes n (%)
Operative dentistry	60 (76.9%)
Pediatric dentistry	25 (32.1%)
Diagnosis	10 (13.5%)*
Prosthodontics	6 (8.1%)*
Endodontics	4 (5.3%)*
Oral surgery	3 (4.1%)*
Periodontics	3 (4.1%)*

Note: Percentages were calculated from valid responses because some data were missing. Categories were not mutually exclusive.

3.4 Suspension of activities

Wrist/hand complaints most frequently led to suspension of activities (12 students; 15.4%), followed by neck complaints (11; 14.3%) and dorsal/lumbar complaints (8; 10.4%). Shoulder and elbow/forearm complaints less often produced activity suspension.

Table 4. Activity suspension because of a complaint

Anatomical region	Yes n (%)
Neck	11 (14.3%)
Shoulder	3 (3.9%)
Dorsal/lumbar	8 (10.4%)
Elbow/forearm	1 (1.3%)
Wrist/hand	12 (15.4%)

3.5 Complaints during the previous 12 months

During the previous 12 months, dorsal/lumbar complaints were reported by 49 students (62.8%), neck complaints by 47 (61.0%), and wrist/hand complaints by 39 (50.0%). Shoulder complaints affected 27.3%, whereas elbow/forearm complaints remained least frequent (5.2%).

Table 5. Complaints during the previous 12 months

Anatomical region	Yes n (%)
Neck	47 (61.0%)
Shoulder	21 (27.3%)
Dorsal/lumbar	49 (62.8%)
Elbow/forearm	4 (5.2%)
Wrist/hand	39 (50.0%)

3.6 Time with complaints during the previous 12 months

The 1–7-day category was most frequent among recorded responses, particularly for the neck (43.6%), wrist/hand (39.7%), and dorsal/lumbar region (37.2%). The dorsal/lumbar region also had the highest percentage of students reporting symptoms as always present (11.5%).

Table 6. Time with complaints during the previous 12 months, by anatomical region

Time	Neck	Shoulder	Dorsal/lumbar	Elbow/forearm	Wrist/hand
1–7 days	34 (43.6%)	14 (17.9%)	29 (37.2%)	6 (7.7%)	31 (39.7%)
8–30 days	5 (6.4%)	3 (3.8%)	7 (9.0%)	2 (2.6%)	6 (7.7%)
>30 non-consecutive days	4 (5.1%)	2 (2.6%)	4 (5.1%)	1 (1.3%)	5 (6.4%)

Time	Neck	Shoulder	Dorsal/lumbar	Elbow/forearm	Wrist/hand
Always	6 (7.7%)	3 (3.8%)	9 (11.5%)	1 (1.3%)	3 (3.8%)

3.7 Duration of symptom episodes

For neck and dorsal/lumbar complaints, an episode duration of 1–24 hours was most frequent (28.2% and 25.6%, respectively). In the wrist/hand region, 1–24 hours (19.2%) and 1–7 days (16.7%) were also common. Episodes longer than one month were infrequent.

Table 7. Duration of complaints during the previous 12 months

Duration	Neck	Shoulder	Dorsal/lumbar	Elbow/forearm	Wrist/hand
<1 hour	7 (9.0%)	5 (6.4%)	10 (12.8%)	8 (10.3%)	11 (14.1%)
1–24 hours	22 (28.2%)	10 (12.8%)	20 (25.6%)	0 (0.0%)	15 (19.2%)
1–7 days	12 (15.4%)	8 (10.3%)	11 (14.1%)	3 (3.8%)	13 (16.7%)
1–4 weeks	4 (5.1%)	0 (0.0%)	1 (1.3%)	1 (1.3%)	2 (2.6%)
>1 month	3 (3.8%)	0 (0.0%)	5 (6.4%)	0 (0.0%)	1 (1.3%)

3.8 Time prevented from working

Most students reported zero days during which symptoms prevented them from working. A limitation of 1–7 days was most frequent for neck and wrist/hand complaints (7.7% each), followed by dorsal/lumbar complaints (6.4%). One student (1.3%) reported more than one month of work limitation because of wrist/hand symptoms.

Table 8. Time complaints prevented work during the previous 12 months

Time	Neck	Shoulder	Dorsal/lumbar	Elbow/forearm	Wrist/hand
0 days	54 (69.2%)	39 (50.0%)	49 (62.8%)	37 (47.4%)	44 (56.4%)
1–7 days	6 (7.7%)	4 (5.1%)	5 (6.4%)	2 (2.6%)	6 (7.7%)
>1 month	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.3%)

3.9 Complaints during the previous seven days

Recent complaints were concentrated in the neck (34 students; 43.6%) and dorsal/lumbar region (32; 41.0%), followed by the wrist/hand (21; 26.9%). This short-term pattern was consistent with the 12-month anatomical distribution.

Table 9. Complaints during the previous seven days

Anatomical region	Yes n (%)
Neck	34 (43.6%)
Shoulder	14 (17.9%)
Dorsal/lumbar	32 (41.0%)
Elbow/forearm	1 (1.3%)

Anatomical region	Yes n (%)
Wrist/hand	21 (26.9%)

3.10 Treatment during the previous 12 months

Treatment was uncommon despite the high frequency of symptoms. Five students (6.4%) reported treatment for each of the neck, shoulder, and dorsal/lumbar regions; two (2.6%) reported treatment for wrist/hand complaints, and none reported treatment for elbow/forearm complaints.

Table 10. Treatment received for complaints during the previous 12 months

Anatomical region	Yes n (%)
Neck	5 (6.4%)
Shoulder	5 (6.4%)
Dorsal/lumbar	5 (6.4%)
Elbow/forearm	0 (0.0%)
Wrist/hand	2 (2.6%)

3.11 Intensity of complaints

Mean intensity was highest for the neck (1.60) and dorsal/lumbar region (1.56), followed by the wrist/hand (1.27). Scores of 4–5 were most frequent in the dorsal/lumbar region (16.7%) and neck (12.8%).

Table 11. Intensity of complaints by anatomical region

Score	Neck	Shoulder	Dorsal/lumbar	Elbow/forearm	Wrist/hand
0	34 (43.6%)	54 (69.2%)	36 (46.2%)	65 (83.3%)	40 (51.3%)
1	2 (2.6%)	6 (7.7%)	4 (5.1%)	12 (15.4%)	7 (9.0%)
2	16 (20.5%)	10 (12.8%)	12 (15.4%)	0 (0.0%)	12 (15.4%)
3	16 (20.5%)	4 (5.1%)	13 (16.7%)	0 (0.0%)	12 (15.4%)
4	7 (9.0%)	2 (2.6%)	10 (12.8%)	1 (1.3%)	3 (3.8%)
5	3 (3.8%)	2 (2.6%)	3 (3.8%)	0 (0.0%)	4 (5.1%)
Mean	1.60	0.72	1.56	0.21	1.27

Note: Scale: 0 = no complaint; 5 = very strong complaint.

3.12 Presumptive orthopedic diagnostic groups

Questionnaire-based orthopedic review identified cervical disorders in 39 students (50.0%), dorsal/lumbar disorders in 36 (46.2%), and tendinitis or other wrist disorders in 28 (35.9%). Elbow disorders were recorded in three students (3.8%). A participant could be assigned to more than one group, so percentages were not mutually exclusive.

Table 12. Main presumptive orthopedic diagnostic groups

Diagnostic group	n (%)
Cervical disorders	**39 (50.0%)**
Dorsal/lumbar disorders	**36 (46.2%)**
Tendinitis/wrist disorders	**28 (35.9%)**
Elbow disorders	3 (3.8%)

3.13 Perceived contributing factors

Poor posture, working position, or inadequate ergonomics was the most frequent perceived contributor (59 responses; 75.6%). Less frequently cited factors included prolonged work or sustained positions (15.4%), personal factors or medical history (12.8%), instrument use, repetitive movements, or overexertion (11.5%), and stress, fatigue, or tension (10.3%). Furniture or the clinical environment was mentioned by 7.7%.

Table 13. Factors to which students attributed their musculoskeletal complaints

Perceived factor	n	% of total (N=78)
Poor posture, working position, or inadequate ergonomics	**59**	**75.6%**
Prolonged work/sustained position	12	15.4%
Personal factors or medical history	10	12.8%
Instrument use, repetitive movements, or overexertion	9	11.5%
Stress, fatigue, or tension	8	10.3%
Inadequate furniture or clinical environment	6	7.7%
No usable response	13	16.7%

3.14 Discussion

The principal finding was that 77 of 78 students (98.7%) reported at least one musculoskeletal complaint. This estimate is higher than the 88.51% reported by Fortich (2012) among dental students and is close to the approximately 98% described by Blamires et al. (2020) among practicing dentists. The comparison suggests that symptom burden can be substantial before graduation. Nevertheless, a positive Nordic Questionnaire response indicates a complaint, not necessarily a confirmed work-related disorder, and prevalence estimates may differ according to recall period, anatomical definitions, and eligibility criteria.

The anatomical pattern was coherent across measures. Dorsal/lumbar (71.8%) and neck complaints (71.4%) were most frequent overall, and they also led the 12-month and 7-day distributions. Wrist/hand complaints ranked third (59.0%) and were the most frequent reason for activity suspension (15.4%). This pattern agrees with reports emphasizing cervical and lumbar symptoms in dental populations (Fernandes et al., 2021; Fortich, 2012) and with literature on repetitive strain and precision work (Pinheiro, 2023; Santos et al., 2024; Takeuti and Saliba, 2020). Axial symptoms are consistent with sustained visual and postural demands, whereas wrist/hand symptoms are consistent with repetitive instrument handling; the present study did not directly measure those exposures.

Functional impact was more limited than prevalence. Most students reported no work-prevention days, and episodes lasting longer than one month were uncommon. Even so, the combination of recurrent symptoms, activity suspension, higher-intensity dorsal/lumbar and neck complaints, and low treatment proportions indicates a meaningful care gap. The finding supports early triage and referral, but it does not justify describing untreated students as having abandoned care because the questionnaire did not examine access, preferences, contraindications, or reasons for not seeking treatment.

The exploratory comparisons refine the original research question. Global MSD presence did not differ by sex (Fisher's exact $p = 1.000$), although the male subgroup was small and the near-universal prevalence created a ceiling effect. Dorsal/lumbar complaints differed by clinical cycle ($\chi^2 = 7.24$; $p = 0.027$), with frequencies of 90.5% in Clinic I, 80.0% in Clinic III, and 59.5% in Clinic IV. This non-linear pattern does not support a simple cumulative-exposure gradient. Because subgroup counts were limited and no multivariable adjustment was performed, the result should be treated as exploratory and replicated prospectively.

Operative dentistry and pediatric dentistry were the most represented clinical areas, but the data record participation rather than time-weighted exposure and cannot rank specialties by risk. The strongest perceived contributor was poor posture, working position, or inadequate ergonomics (75.6%), followed by sustained work, personal history, repetitive movement, stress, and environmental conditions. These responses support the knowledge-practice gap described by Martínez et al. (2020) and the multi-level framework of clinical design, work organization, and operator position proposed by Briones (2014). A prevention program should therefore combine training with furniture adjustment, task rotation, microbreaks, and direct observation rather than relying on knowledge transmission alone.

The recent NRFHH literature suggests tools that could inform, but not predetermine, such a program. Wearable or sensor-based systems may support objective posture monitoring and feedback (Gautam et al., 2026; Pandit and Pise, 2026). Studies of neuromuscular stabilization, balance and strengthening exercise, cervical proprioceptive therapy, and pain-focused interventions show that functional outcomes can be assessed longitudinally and linked to structured protocols (Abu Ella et al., 2026; El-keblawy et al., 2026; Issa, 2026; Khanum et al., 2026; Mani et al., 2026; Singh et al., 2026; Suresh et al., 2026). These studies were conducted in different clinical or athletic populations, so their effectiveness cannot be assumed for dental students; they instead illustrate candidate outcome domains for a future controlled intervention.

The journal has also published natural-resource and traditional-medicine perspectives on musculoskeletal pain, including Varma external applications and botulinum toxin for myofascial, inflammatory, or neuropathic pain (Baskaran et al., 2025; Jiang et al., 2021). Such approaches may be relevant to later treatment research, but the present observational study did not evaluate any pharmacological, botanical, manual, or traditional therapy. Primary prevention should first address modifiable ergonomic exposures, and any complementary intervention would require independent evidence of safety and efficacy in the target population.

This study has several limitations. Its cross-sectional design precludes temporal or causal inference; the single-institution census limits external generalizability; and symptoms, durations, and perceived factors were self-reported. The near-universal outcome reduced power to identify subgroup differences. Clinical-area data were not exposure measures, direct posture or workload observations were unavailable, and potential confounders such as anthropometry, handedness, prior physical activity, sleep, psychosocial load, and device use were not modeled. The orthopedic categories were presumptive questionnaire-based groupings rather than diagnoses established by a full examination. Item-level missing data also produced varying denominators. These limitations favor a prospective cohort with repeated Nordic Questionnaire measurements, direct ergonomic assessment, and predefined referral and outcome criteria.

4. CONCLUSION

Musculoskeletal complaints were reported by 98.7% of the 78 clinical dental students analyzed. The dorsal/lumbar region, neck, and wrist/hand were consistently the most affected areas, and wrist/hand and neck complaints most often led to activity suspension. Presumptive orthopedic groupings showed the same cervical, dorsal/lumbar, and wrist pattern. Dorsal/lumbar complaints varied by clinical cycle, while global MSD presence did not differ by sex; both findings require cautious interpretation because of small subgroup counts and a ceiling effect.

The findings support an institutional protocol that combines semiannual administration of the Standardized Nordic Questionnaire, direct observation of clinical posture and workload, adjustment and maintenance of furniture, active microbreaks, task rotation, and a formal pathway to orthopedics and physiotherapy for persistent, intense, or function-limiting complaints. Future prospective research should test whether these measures reduce incidence, intensity, and functional limitation. The present study identifies priorities for prevention and surveillance but does not establish that clinical training caused the reported symptoms or that any specific treatment is effective.

ACKNOWLEDGEMENTS

The authors thank Kristen Nicole Navarro, Diana Aparicio, and Sheryne Monique Hussen, students in the Doctor of Dental Surgery program at the Facultad de Odontología, Universidad de Panamá, for their collaboration in this research.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception or design of the study; the acquisition, analysis, or interpretation of data; and critical revision of the manuscript. All authors approved the final version and agree to be accountable for the integrity of the work.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest related to the preparation or publication of this article.

ETHICS STATEMENT

The study was evaluated by the Comité de Bioética de la Investigación de la Universidad de Panamá and was conducted in accordance with applicable Panamanian regulations, principles for research involving human participants, and institutional requirements. Participation was voluntary, and all participants provided written informed consent. Data were analyzed confidentially and without direct identifiers.

DATA AVAILABILITY STATEMENT

De-identified data supporting the findings may be requested from the corresponding author and can be shared subject to ethical approval, Panamanian data-protection requirements, and institutional authorization.

ORCID IDS

Raquel Villalobos de Cortés: https://orcid.org/0000-0003-1833-719X

Rita Teresa Espósito: https://orcid.org/0000-0001-7973-8478

Kira Singh: https://orcid.org/0000-0003-4638-345X

Luis H. Vega Tejada: https://orcid.org/0009-0005-3098-2644

Marcia Lorenzetti C.: https://orcid.org/0000-0003-2230-1202

Luis Antonio Jaén: https://orcid.org/0009-0006-1531-3781

REFERENCES

[1] Arias Almonacid, D., Rodríguez Gómez, A., Zapata Díaz, J., y Vásquez Trespalacios, E. M. (2018). Incapacidad laboral por desórdenes musculoesqueléticos en población trabajadora del área de cultivo en una empresa floricultora en Colombia. Revista de la Asociación Española de Especialistas en Medicina del Trabajo, 27(3), 166–174. https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S3020-11602018000300166&lng=es

[2] Blamires, D. V. da S., Silva, D. C. C. D., Coelho, A. G., Oliveira, A. C., Carvalho, C. de M. A., Torres, S. G., et al. (2020). Distúrbios osteomusculares em cirurgiões-dentistas e fisioterapeutas: Revisão bibliográfica. Na função multiprofissional da fisioterapia 3 (pp. 90–106). Atena Editora. https://atenaeditora.com.br/catalogo/post/disturbios-osteomusculares-em-cirurgioes-dentistas-e-fisioterapeutas-revisao-bibliografica

[3] Briones, A. (2014). Posturas odontológicas ergonómicas y dolor muscular durante las prácticas clínicas del estudiante del V año de la Facultad de Odontología, periodo 2013 [Trabajo de grado, Universidad de Guayaquil]. https://biblioteca.semisud.org/opac_css/index.php?lvl=notice_display&id=291560

[4] Fernandes, I. F., Nabarrette, M., Carneiro, D. P. A., y Bianco, V. C. (2021). Prevalência de sintomas de distúrbios osteomusculares relacionados ao trabalho autorreferido em estudantes e professores de Odontologia. Research, Society and Development, 10(7), e51210716891. https://doi.org/10.33448/rsd-v10i7.16891

[5] Fortich, N. (2012). Prevalencia de signos y síntomas de trastornos de la mano en profesionales odontólogos de la ciudad de Cartagena en el 2012 [Tesis de maestría, Corporación Universitaria Rafael Núñez]. https://biblioteca.semisud.org/opac_css/index.php?lvl=notice_display&id=291560

[6] Instituto de Salud Pública de Chile. (2020, 3 de junio). Cuestionario nórdico estandarizado de percepción de síntomas musculoesqueléticos (NT Percepción Síntomas ME01-03062020A). https://www.ispch.cl/sites/default/files/NTPercepcionSintomasME01-03062020A.pdf

[7] Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G., y Jørgensen, K. (1987). Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Applied Ergonomics, 18(3), 233–237. https://doi.org/10.1016/0003-6870(87)90010-X

[8] Martínez, C., Álvarez, E., Rodríguez, S., Porras, S., Paredes, C., y Portillo, K. (2020). Evaluación de conocimientos y prácticas de ergonomía antes y después de la implementación de una aplicación móvil en estudiantes de odontología de la Universidad Santo Tomás seccional Bucaramanga [Tesis doctoral, Univ. Santo Tomás]. https://repositorioslatinoamericanos.uchile.cl/handle/2250/3660356

[9] Martínez, S., Romero, H., Tutuy, A. J. E., y Barrios, C. E. (2015). Ergonomía: una ciencia que aporta al bienestar odontológico. Revista del Ateneo Argentino de Odontología, 35–39. https://www.ateneo-odontologia.org.ar/articulos/liv02/articulo6.pdf

[10] Ministerio de Salud de la República de Panamá. (2021). Plan Estratégico Nacional de Salud 2021–2025. https://www.minsa.gob.pa/direccion/direccion-de-planificacion-de-salud

[11] Naranjo Mora, M. (2021). Análisis de riesgos ergonómicos a los aparejadores en las actividades de "Rig Moves" en la empresa Transportes Nororientales CIALTDA [Tesis de pregrado, Universidad Internacional SEK].

[12] Organización Panamericana de la Salud. (2020). Plan Estratégico de la Organización Panamericana de la Salud 2020-2025: La equidad, el corazón de la salud (Documento Oficial 359). OPS. https://www.paho.org/es/documentos/plan-estrategico-organizacion-panamericana-salud-2020-2025

[13] Otero, M. J., y Otero, I. J. (2010). Ergonomía en odontología: el orden de su consultorio. Revista Virtual Odontología Ejercicio Profesional, 11(124), 2–3. http://www.odontomarketing.com

[14] Pinheiro, J. R. (2023). A importância da aplicação de medidas ergonômicas na prevenção de distúrbios osteomusculares em cirurgiões-dentistas. Revista Científica Multidisciplinar Núcleo do Conhecimento, 1(4), 5–15. https://www.nucleodoconhecimento.com.br/odontologia/cirurgioes-dentistas

[15] Quinzo Montenegro, F. (2023). Ergonomía en la práctica odontológica. Ciencia Latina, 7(3), 2396–2405. https://doi.org/10.37811/cl_rcm.v7i3.6355

[16] Real Academia Española. (2022). Ergonomía. En el Diccionario de la lengua española. https://dle.rae.es/ergonom%C3%ADa?m=form

[17] Romero, H. J., y Barrionuevo, M. E. A. (2017). Ergonomía: una ciencia que aporta al bienestar odontológico. https://bdigital.uncu.edu.ar/objetos_digitales/11277/romerorfo-1112017.pdf

[18] Santos, B. R. dos, Meireles, A. C. S., y Silva, R. A. de A. T. (2024). Lesões musculoesqueléticas causadas por ausência de ergonomia na odontologia: Uma revisão integrativa. Brazilian Journal of Health Review, 7(3), e69611. https://ojs.brazilianjournals.com.br/ojs/index.php/BJHR/article/view/69611

[19] Takeuti, E. T. A., y Saliba, T. A. (2020). Levantamento de medidas de prevenção a doenças ocupacionais. Archives of Health Investigation, 9(1). https://www.archhealthinvestigation.com.br/ArcHI/article/view/5075

[20] Abu Ella, I., Behiry, M. A., Ahmed, H. A. H., Youssef, S. S., Toson, R. A., Yehia, R. M., 2026. Influence of TECAR Therapy on Proprioception Functions in Cervical Radiculopathy. Natural Resources for Human Health 6(3s), 471–480. https://www.nrfhh.com/index.php/journal/article/view/436

[21] Baskaran, M., Annamalai, S., Rajasekaran, S., Srinivasan, E., 2025. A Comprehensive Approach to Exploration, Documentation and Conservation of Indigenous Traditional Knowledge of Tamil Nadu, focusing on External Medicines Used in Varma Maruthuvam w.r.t Enbu Murivu (Musculoskeletal Disorders). Natural Resources for Human Health 5(1), 79–89. https://doi.org/10.53365/nrfhh/193681

[22] El-keblawy, M. M., Elsayed, M. A., Mahmoud, T. H., Abdelhakiem, N. M., Sherif, M. A. S. A. S., Abdo, F. A., Ghattas, E. M., 2026. Effect Of Inspiratory Muscle Training Combined with Low-Level Light Therapy on Pulmonary Function and Pain on Neck Pain Post Thyroidectomy Scar Wound in Premenopausal Females. Natural Resources for Human Health 6(3s), 719–732. https://www.nrfhh.com/index.php/journal/article/view/525

[23] Gautam, N., Gupta, S. K., Shrivastava, A., 2026. Intelligent Ergonomic Risk Assessment through Hybrid RNN–LSTM Modeling for Carpal Tunnel Syndrome Prediction. Natural Resources for Human Health 6(1s), 196–212. https://www.nrfhh.com/index.php/journal/article/view/319

[24] Issa, A., 2026. The Effect of a Training Program with Venous Blood Flow Restriction on Muscular Strength and Skill Performance on the Rings Apparatus. Natural Resources for Human Health 6(3s), 635–647. https://www.nrfhh.com/index.php/journal/article/view/519
[25] Jiang, S., Huang, C., Yang, Y., Gao, S., Lin, Z., Gu, W., Cai, Y., Yan, T., 2021. Advances in botulinum toxin type A for the treatment of pain. Natural Resources for Human Health 1(2), 78–84. https://doi.org/10.53365/nrfhh/142165
[26] Khanum, A., Tabassum, N., Kousar, S., Malik, A., Shahzadi, Z., Shareef, M., 2026. Effects of Thai Foot Massage on Pain, Ankle Range of Motion and Somatosensory Function in Patients with Type 2 Diabetes Mellitus and Peripheral Neuropathy: A Randomized Controlled Trial. Natural Resources for Human Health 6(3s), 842–865. https://www.nrfhh.com/index.php/journal/article/view/545
[27] Mani, S., Ramalingam, P., Santhanasamy, P. J., Thirunavukkarasu, V., Ramalingam, S., Pazhanivelu, V., Subramaniam, A., 2026. Investigating the Effectiveness of Balance and Strengthening Exercise and Modification of Home Environment on Risk for Fall among Older Adults in Rural Community. Natural Resources for Human Health 6(3), 1072–1079. https://www.nrfhh.com/index.php/journal/article/view/220
[28] Pandit, P. S., Pise, R., 2026. Artificial Intelligence in Holistic Preventive Healthcare- A Narrative Review of Integrative Approaches in Ayurveda, Yoga, and Mental Health. Natural Resources for Human Health 6(3), 402–415. https://www.nrfhh.com/index.php/journal/article/view/83
[29] Singh, V., Anwer, Z., Khera, K., 2026. Neuromuscular Rehabilitation for Balance and Gait Impairments in Long COVID Condition: A Randomized Controlled Trial. Natural Resources for Human Health 6(2s), 849–860. https://www.nrfhh.com/index.php/journal/article/view/605
[30] Suresh, T. N., Mathew A, A., Farzana, S. F. M., 2026. Association of Dynamic Balance, Hitting Stability, Vertical Jump, and Tennis Performance among Elite Tennis Players with Chronic Ankle Instability- A Correlation Study. Natural Resources for Human Health 6(3), 1050–1058. https://www.nrfhh.com/index.php/journal/article/view/218