

REVIEW ARTICLE

Factors Associated with Low Back Pain in Dental Students and Practising Dentists: A Systematic Review and Implications for Occupational Health Promotion

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ABSTRACT

Introduction: Low back pain (LBP) is an important occupational health concern among dental students and practising dentists. This systematic review aimed to synthesise evidence on ergonomic and individual factors associated with LBP, distinguish directly measured findings from hypothesised biomechanical or anatomical pathways, and identify implications for multilevel occupational health promotion.

Methods: This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidance. PubMed/MEDLINE, Scopus, Web of Science Core Collection, and Google Scholar were searched for English-language studies published from 1 January 2021 through 31 May 2026. Two reviewers independently screened records and extracted data. Of 327 records identified, 24 full-text reports were assessed and 6 studies were included in a qualitative synthesis because populations, exposures, outcomes, and analytical methods were heterogeneous.

Results: Six studies were included. The studies directly assessed self-reported LBP or disability, working posture, sitting duration, physical activity, age, body mass index, years of practice, and, in one study, trunk-movement parameters. Estimates from students and practising dentists were not directly comparable. Non-neutral posture and selected occupational or individual factors were associated with LBP in some studies, but findings were inconsistent for sitting duration, physical activity, and years of practice. Proposed changes in lumbar loading, alignment, or stability were not directly measured in most studies.

Conclusion: Available evidence suggests associations between selected ergonomic or individual factors and LBP among dental students and practising dentists, but heterogeneous populations, predominantly cross-sectional designs, and self-reported measures limit causal inference. The findings may inform candidate occupational health-promotion actions at the individual, professional-education, work-organisation, and clinical-environment levels; however, the included studies did not evaluate their effectiveness. Prospective controlled studies are required before preventive effectiveness can be inferred.

Keywords: Low Back Pain; Lumbar Vertebrae; Ergonomics; Occupational Health; Biomechanical Phenomena

INTRODUCTION

Low back pain (LBP) is an important occupational health concern in dentistry and may affect work functioning and quality of life (1,2). Dental professionals are exposed to occupational demands that may include sustained sitting, forward trunk flexion, repetitive movements, and work in confined clinical spaces (2). Musculoskeletal disorders are common among dental professionals, with the lower back frequently affected (2).

The lumbar spine contributes to load bearing and postural control through the coordinated function of vertebrae, intervertebral discs, facet joints, ligaments, and paraspinal muscles. In this review, the term 'anatomical imbalance' is used only as a hypothesis-generating framework for possible departures from neutral alignment, balanced muscular demand, or load distribution. Most included studies did not directly measure lumbar curvature, disc pressure, facet-joint loading, muscle activity, or segmental stability; therefore, such changes cannot be treated as observed outcomes of the review (3–8).

External biomechanical and dental-ergonomics literature proposes that sustained or asymmetric trunk postures may alter muscular demand and trunk motor control (9,10). However, the included dental studies did not directly measure compressive or shear forces, degenerative change, or injury risk. These pathways are therefore considered plausible explanations for observed ergonomic associations rather than mechanisms demonstrated by the included evidence. Workstation and posture assessments should likewise be interpreted as exposure indicators, not proof of anatomical dysfunction (11).

Existing reviews have mainly estimated musculoskeletal-disorder prevalence, summarised occupational risk factors, or evaluated ergonomic and rehabilitation interventions among oral-health professionals (1,2,12–14). This systematic review therefore aimed to synthesise recent evidence on ergonomic and individual factors associated with LBP among dental students and practising dentists, distinguish directly measured exposures and outcomes from hypothesised biomechanical or anatomical explanations, and consider how the findings may inform multilevel occupational health-promotion priorities. The review did not assume a causal exposure–mechanism–disease pathway or evaluate intervention effectiveness.

METHODS

Study Design and Protocol

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. Before screening, the review team specified the research question, eligibility criteria, information sources, study-selection process, data items, critical-appraisal approach, and qualitative-synthesis plan. The review was not registered.

Eligibility Criteria

Studies were eligible when they included practising dentists or dental professionals, or dentistry students engaged in preclinical or clinical training; evaluated ergonomic or biomechanical exposures relevant to dental work; and reported LBP, lower-back disability, or objectively measured lumbar or trunk biomechanical outcomes. Student and professional populations were retained as distinct exposure contexts and were not assumed to be directly comparable. Eligible designs included cross-sectional, case–control, cohort, and relevant experimental biomechanical studies published in English from 1 January 2021 through 31 May 2026. Case reports, editorials, conference abstracts, narrative reviews, studies unrelated to dental work, and studies without a lower-back or relevant biomechanical outcome were excluded. Publications before 2021 were used only as background or mechanistic references and were not eligible for the primary synthesis.

Information Sources and Search Strategy

PubMed/MEDLINE, Scopus, Web of Science Core Collection, and Google Scholar were searched from database inception for records published between 1 January 2021 and 31 May 2026. Search concepts covered dental personnel, low back pain, ergonomic exposure, posture, and lumbar biomechanics. The confirmed PubMed/MEDLINE strategy was: (dentist OR “dental professional*” OR “dental practitioner*” OR “dental student*”) AND (“low back pain” OR “lower back pain” OR lumbago OR “lumbar pain”) AND (ergonomic OR posture OR biomechanic OR “static load*” OR “trunk flexion” OR “lumbar spine”). English-language and publication-date limits were applied, and reference lists of included studies and relevant reviews were hand-searched. The exact final search execution date, the final database-specific search strings for Scopus and Web of Science Core Collection, and the Google Scholar screening and stopping rule could not be confirmed from the review documentation available at revision and were therefore not reconstructed.

Study Selection

Two reviewers (SRNH and NL) independently screened titles and abstracts and then assessed full-text reports against the predefined eligibility criteria. Decisions and full-text exclusion reasons were recorded in a standardised screening form. Disagreements were resolved through discussion; unresolved cases were adjudicated by a third reviewer (IER or SR). The PRISMA flow diagram was reconstructed from the original reference-management and screening records.

Data Extraction

Two reviewers (SR and NFW) independently extracted data using a piloted standardised form. Extracted items included bibliographic details, country and setting, study design, recruitment method, participant characteristics, clinical or training context, exposure duration, ergonomic or biomechanical variables and instruments, LBP definition and recall period, effect

estimates with confidence intervals or p-values, covariates included in adjusted analyses, and authors' conclusions. Completed forms were cross-checked against the full texts, and discrepancies were resolved by consensus with a third reviewer when necessary.

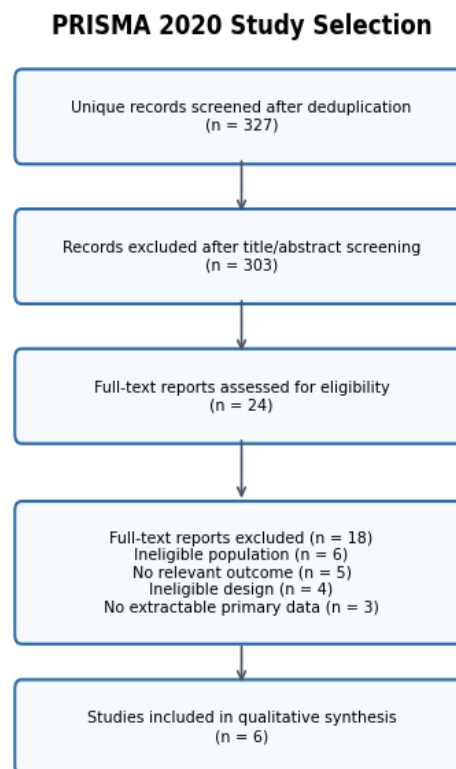


Figure 1. PRISMA flowchart

Quality Assessment

Two reviewers independently appraised each included study using design-appropriate Joanna Briggs Institute (JBI) critical appraisal checklists. Analytical cross-sectional studies were assessed with the JBI Checklist for Analytical Cross Sectional Studies, and the prospective cohort was assessed with the JBI Checklist for Cohort Studies. The biomechanical investigation was assessed using applicable JBI analytical criteria supplemented by prespecified domains for task standardisation, comparator clarity, validity and reliability of movement measurement, outcome measurement, confounding, and statistical analysis. Each domain was judged as Yes, No, Unclear, or Not applicable, with disagreements resolved through discussion and third-reviewer adjudication. Figure 2 summarises the domain-level judgements. Because the appraisal identified recurrent limitations in sampling, confounding control, and adjusted analysis, study findings were interpreted according to their design and were not converted into an overall numerical quality score.

Data Synthesis

Because populations, exposure definitions, LBP recall periods, measurement instruments, and analytical methods were heterogeneous, meta-analysis was not undertaken. The synthesis first summarised directly measured exposures and outcomes and then compared the direction, magnitude, precision, and adjustment of reported associations. Biomechanical or anatomical explanations not directly measured in the primary studies were presented separately as mechanistic interpretations supported by external literature. Evidence was not considered causal when temporality was absent, and differences between students and practising dentists were retained.

Ethical Considerations

Ethical approval was not required for this study because it was a systematic review based exclusively on previously published data and did not involve human participants, patient data, or animal subjects.

RESULTS

Study Selection

A total of 327 unique records remained for title-and-abstract screening after deduplication. Of these, 303 were excluded, and 24 full-text reports were assessed for eligibility. Eighteen full-text reports were excluded because the population was ineligible (n=6), a lower-back or relevant biomechanical outcome was not reported (n=5), the article design was ineligible (n=4), or the report did not provide extractable primary data (n=3). Six studies published between 2022 and 2025 were included in the qualitative synthesis (3–8).

Study Characteristics

Six studies were included in the final synthesis: one prospective cohort study, four cross-sectional studies, and one biomechanical investigation (3–8). The populations comprised dentistry students and practising dentists from Europe, the Middle East, and Southeast Asia. Sample sizes were 73–134 in the five studies that clearly reported participant numbers in the accessible report. Variation in population, exposure measurement, outcome definition, and analysis supported qualitative rather than quantitative synthesis.

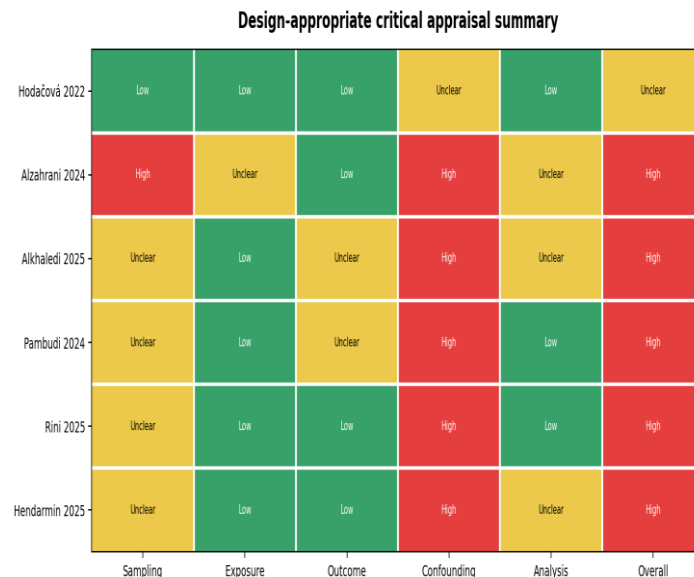


Figure 2. Study-level critical appraisal summary based on design-appropriate JBI criteria and prespecified biomechanical-study domains. Green indicates low concern, yellow indicates some concern or unclear reporting, and red indicates high concern.

Prevalence of Low Back Pain

LBP was reported in several included populations, but estimates varied across non-comparable groups, definitions, and instruments. In the prospective student study, lower-back complaints were reported by 49.3% of fifth-year students; the increase from the first to the fifth year was 6.8 percentage points and was not statistically significant ($p = 0.44$) (3). In the Saudi cross-sectional study, 83 of 116 practising dentists (71.5%) reported LBP (4). These estimates should not be interpreted as a pooled range or as evidence of progression with occupational exposure.

Table 1. Synthesis of Included Studies

No.	Author (Year)	Study Design	Population	Ergonomic Exposure	Anatomical/ Biomechanical Findings	LBP Outcome	Key Findings
1	Hodačová et al. (2022)	Prospective cohort	Dentistry students (n=73)	Prolonged static posture, repetitive tasks	Questionnaire-based potential risk factors; no direct lumbar structural measurement	Self-reported lower-back complaints; fifth-year prevalence 49.3%	Increase from first to fifth year: 6.8 percentage points, $p = 0.44$; not statistically significant
2	Alzahrani et al. (2024)	Cross-sectional	Dentists (n=116)	Bending, prolonged standing, poor posture	Self-reported work characteristics; no objective lumbar load measurement	83/116 reported LBP (71.5%); modified Oswestry disability grading	Convenience sample; descriptive/chi-square analyses; causal determinants cannot be inferred
3	Alkhaledi (2025)	Experimental biomechanical study	Dentists	Standardised dental-task trunk-movement assessment; detailed task sequence was incompletely reported	Sagittal flexion and twisting/lateral-movement velocity measured objectively; device specifications were incompletely reported	Work-related lower-back-pain status; outcome instrument was not clearly reported	Selected movement parameters were reported as statistically significant; effect estimates and adjusted model were not reported
4	Pambudi et al. (2024)	Cross-sectional	Dentists (n=76)	Static posture, low physical activity	Questionnaire-based physical activity; no direct measure of lumbar stability	LBP disability assessed using the Oswestry Disability Index (ODI)	Bivariable chi-square: $\chi^2 = 9.147$, $df=1$, $p = 0.002$; directionality and confounding remain uncertain

No.	Author (Year)	Study Design	Population	Ergonomic Exposure	Anatomical/ Biomechanical Findings	LBP Outcome	Key Findings
5	Rini et al. (2025)	Cross-sectional	Dentists (n=134)	Poor posture (RULA), workload, prolonged work duration	RULA posture observation, BMI, and work duration; no direct lumbar-load measurement	LBP disability assessed using the Oswestry Disability Index (ODI)	Bivariable chi-square analyses: work duration >8 h/day, PR 10.55 (95% CI 2.69–41.42), $p = 0.002$; BMI was associated with LBP in the reported bivariable analysis ($p = 0.002$), but the published effect estimate and confidence interval were internally inconsistent and were therefore not interpreted; risky posture, PR 9.15 (95% CI 0.54–155.16), $p = 0.199$. No multivariable model was reported
6	Hendarmin et al. (2025)	Cross-sectional	Dentists (n=106)	Prolonged sitting, static posture	Questionnaire-based sitting duration and physical activity; no direct spinal-load measurement	RMDQ; previous-year LBP; prevalence 23.6%	Age $p = 0.008$; sitting $p = 0.617$; physical activity $p = 0.662$; years of practice $p = 0.057$; no adjusted estimates reported

Ergonomic Exposure

The included studies assessed heterogeneous ergonomic and individual exposures (3–8). Non-neutral posture or selected work characteristics were associated with LBP in some studies, whereas sitting duration and physical activity were not associated in the Jakarta study (8). In the Jambi study, work duration longer than eight hours was associated with LBP in bivariable analysis (PR 10.55, 95% CI 2.69–41.42; $p = 0.002$), whereas work posture was not statistically significant (PR 9.15, 95% CI 0.54–155.16; $p = 0.199$) (7). These findings do not support a uniform set of ergonomic contributors across populations.

Biomechanical Loading of the Lumbar Spine

One biomechanical investigation objectively measured trunk-movement parameters and reported associations between selected movement characteristics and a lower-back-pain outcome. The remaining studies relied mainly on questionnaires or posture assessment and did not directly quantify lumbar compression, shear force, muscle activity, or tissue loading. Statements about these processes are therefore mechanistic interpretations from external literature rather than results of the included studies.

Anatomical Imbalance of the Lumbar Spine

None of the included studies directly demonstrated lumbar anatomical imbalance as a mediator between ergonomic exposure and LBP. Most did not measure spinal alignment, disc or facet-joint loading, paraspinal muscle activity, or segmental stability. Anatomical imbalance is therefore retained only as a hypothesis-generating concept for future research.

Factors Associated with Low Back Pain

Associations differed across studies and should not be interpreted as consistent predictors. Work posture, body mass index, or work duration were reported as associated with LBP in one cross-sectional study; physical activity was associated in one study but not another; age was associated in the Jakarta study, whereas years of practice did not reach conventional statistical significance. Most analyses were cross-sectional and incompletely adjusted.

Synthesis of Results

Across the included studies, directly measured evidence was limited to LBP or disability outcomes, selected ergonomic and individual exposures, and trunk-movement parameters in one biomechanical investigation. Associations were not uniform, and the evidence did not demonstrate a consistent temporal sequence from ergonomic exposure to biomechanical loading, anatomical dysfunction, and pain. Cross-sectional designs, incomplete adjustment, and possible reverse causation further limit causal interpretation.

DISCUSSION

This review identified LBP as an occupational-health concern among dental students and practising dentists, but reported estimates arose from different populations, instruments, and exposure contexts and should not be interpreted as a directly comparable prevalence range. The 49.3% estimate described lower-back complaints among fifth-year dentistry students,

whereas the 71.5% estimate described self-reported LBP among practising dentists in a Saudi Arabian cross-sectional sample. In the prospective student study, the increase from the first to the fifth year was not statistically significant (6.8 percentage points; $p = 0.44$). The included evidence therefore does not establish a progressive exposure-duration gradient or a mechanistically driven disease process.

Anatomical Perspective: Lumbar Spine Imbalance and Biomechanical Loading

The primary evidence supports associations between some ergonomic or individual factors and LBP but provides limited direct evidence of lumbar anatomical change. Except for objective trunk-movement measurements in one biomechanical study, the included studies did not assess lumbar curvature, disc pressure, facet-joint loading, paraspinal electromyographic fatigue, or segmental stability. External biomechanical literature suggests that sustained flexion, rotation, and static muscle activity may alter muscular demand and tissue loading; in this review, however, these remain plausible explanations rather than empirically demonstrated anatomical changes. The transition from exposure to functional or structural dysfunction and pain remains unconfirmed in dental populations.

External biomechanical models provide plausible explanations for how sustained trunk flexion, rotation, or static muscle activity could alter tissue loading and muscular demand (9,10). Nevertheless, most included studies did not directly measure these processes, and the single biomechanical investigation does not establish future pain, structural change, or mediation. Physical activity was associated with LBP in one cross-sectional study but not in another, so reduced activity cannot be presented as a confirmed cause of lumbar instability.

Ergonomic Posture and Occupational Exposure

Dental work may involve static or non-neutral postures to obtain visual access within a confined field, but the included studies did not establish that these exposures drive anatomical change (11,15–18). Associations varied by exposure and population: sitting duration was not associated with LBP in the Jakarta study, and years of practice approached but did not reach conventional statistical significance. Ergonomic exposure should therefore be considered a multidimensional candidate correlate requiring objective and longitudinal assessment.

LBP is likely multifactorial, but the included evidence does not identify a uniform set of determinants. Age, body mass index, posture, physical activity, sitting duration, and years of practice showed different patterns across studies, and several analyses were bivariable or incompletely adjusted. These variables should be treated as candidate correlates that may interact with psychosocial, clinical, and organisational conditions rather than as established causal factors.

The findings may inform hypotheses for multilevel occupational health promotion, but the six included studies did not evaluate intervention effectiveness. At the individual level, posture awareness, active breaks, and physical conditioning may be considered for prospective testing. At the professional-education level, ergonomic competencies could be integrated into preclinical simulation and reinforced during clinical training. At the work-organisation level, scheduling, task rotation, recovery time, workload, and organisational support should be evaluated as modifiable conditions. At the clinical-environment level, operator stools, patient positioning, magnification, lighting, and instrument layout may be evaluated for their capacity to reduce sustained non-neutral posture. These are candidate strategies rather than established effective measures; controlled studies are needed to determine effectiveness, feasibility, adherence, cost, and unintended consequences.

Strengths and Limitations

This review's principal contribution is the explicit separation of directly measured ergonomic exposures and LBP outcomes from biomechanical and anatomical mechanisms inferred from external literature. However, the synthesis is limited by six studies, heterogeneous student and professional populations, inconsistent LBP definitions and recall periods, predominantly cross-sectional designs, self-reported measures, limited adjusted effect estimates, and incomplete control of psychosocial, clinical, and workstation-related confounding. The absence of direct measures of lumbar structure, tissue loading, muscle activity, or segmental control prevents confirmation of an anatomical pathway. Publication and language restrictions may also have excluded relevant evidence. These limitations precluded meta-analysis and require cautious interpretation of observed associations and proposed preventive implications. The exact final search execution date, full database-specific search strings beyond PubMed/MEDLINE, and the Google Scholar stopping rule could not be confirmed from the documentation available at revision, which limits search reproducibility.

CONCLUSION

Recent studies suggest that non-neutral posture and selected occupational or individual characteristics are associated with LBP in some dental-student and practising-dentist populations. However, the evidence is heterogeneous, largely cross-sectional, and commonly based on self-reported exposures and outcomes. A sequential pathway from ergonomic exposure to biomechanical loading, lumbar anatomical dysfunction, and LBP is biologically plausible but was not directly demonstrated by most included studies. Ergonomic education, work-organisation changes, environmental redesign, and physical-conditioning strategies should be evaluated as prospective occupational health-promotion interventions rather than considered effective on the basis of this review alone.

DECLARATIONS

Author contributions: SRNH contributed to conceptualization, methodology development, literature searching, data curation, formal analysis, interpretation of findings, and preparation of the original manuscript draft. NL contributed to supervision, validation of the review process, critical revision of the manuscript, and project administration. IER contributed to methodology refinement, investigation, interpretation of the reviewed evidence, and manuscript review. SR contributed to data extraction, analysis, and manuscript review. NFW contributed to visualization, validation, manuscript editing, and final approval of the submitted version. All authors read and approved the final manuscript.

Conflicts of interest: The authors declare no conflicts of interest.

Declaration of Generative AI And AI-Assisted Technologies in the Writing Process: During the preparation of this manuscript, the authors used ChatGPT (OpenAI; the specific model version was not recorded) for language refinement, grammatical improvement, readability enhancement, and organisational support. The authors reviewed and edited the AI-assisted output and take full responsibility for verifying the scientific statements and references and for the accuracy, integrity, and originality of the final manuscript.

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