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Impact of Postural Correction and Ergonomic Interventions on Neck and Upper Back Pain in Office Workers.

[1] Dhirenbhai Kalal

[1] FYZICAL Therapy & Balance Centers, USA
https://orcid.org/0009-0005-5720-8237

Abstract

Neck and upper back pain are prevalent among office workers and are commonly linked to prolonged sitting, poor workstation design, and sustained postural strain. Although ergonomic workstation modifications and postural or exercise-based strategies are widely recommended, comparative evidence remains inconsistent. This PRISMA-compliant systematic review synthesized findings from randomized and controlled trials assessing ergonomic, postural, and combined interventions in office-based populations. A mixed-methods synthesis was conducted, including quantitative summaries of trials with extractable numerical outcomes and structured narrative analysis of studies reporting statistically analyzed pain outcomes without full variance estimates. Twelve eligible trials were identified: three provided quantitative data and nine were narratively synthesized. Overall, ergonomic workstation interventions were associated with short-term reductions in neck and upper back pain compared with minimal or no intervention. Combined ergonomic and postural or exercise-based approaches generally demonstrated greater short-term improvements, particularly among participants with pre-existing symptoms. However, long-term effectiveness was unclear due to limited follow-up and attenuation of between-group differences in some studies. Heterogeneity in intervention design, outcome measures, and reliance on pain-based assessments further constrained certainty. Current evidence therefore supports short-term benefits of ergonomic and combined interventions for symptom reduction in office workers, while highlighting the need for well-powered trials with standardized outcomes and extended follow-up to establish sustained effectiveness.

Keywords: ergonomic interventions, postural correction, neck pain, upper back pain, office workers

Introduction

Neck and upper back pain are among the most prevalent work-related musculoskeletal disorders (WMSDs) affecting office workers, largely driven by prolonged computer use, sustained seated postures, and repetitive upper-limb activities. Epidemiological studies consistently show that office-based occupations are associated with a high burden of cervical and thoracic musculoskeletal symptoms, contributing to reduced productivity, impaired quality of life, and increased occupational health costs (Amit & Song, 2021; Sohrabi & Babamiri, 2022). As modern work environments continue to shift toward sedentary, screen-based tasks, effective strategies for preventing and managing neck and upper back pain remain a priority in occupational health and ergonomics research.

Ergonomic workstation interventions have traditionally served as a primary approach to mitigating biomechanical strain in office settings. These interventions commonly include adjustments to chair height, desk configuration, monitor position, keyboard and mouse placement, and individualized workstation assessments. Controlled trials have demonstrated that such modifications can reduce musculoskeletal discomfort and pain intensity, particularly in the neck and upper back regions (Lee et al., 2021; de Barros et al., 2022). Educational ergonomic programs have also been shown to improve working postures and reduce the prevalence of musculoskeletal complaints (Ghasemi et al., 2024; Paridokht et al., 2024). However, reported effects vary across studies, and improvements are not always sustained over longer follow-up periods.

While ergonomic adjustments reduce external mechanical strain, they do not directly retrain postural habits or neuromuscular control, which may explain their limited long-term effectiveness when used in isolation. This limitation has prompted growing interest in postural correction interventions, which aim to address underlying impairments in muscle endurance, motor control, and postural alignment that contribute to persistent neck and upper back pain.

Postural correction strategies encompass neck-specific strengthening exercises, corrective exercise programs, active breaks, stretching routines, and posture feedback systems. Common postural deviations observed in office workers, such as forward head posture and upper crossed syndrome, are associated with altered cervical loading patterns and increased musculoskeletal stress (Kumari et al., 2025; Yaghoubitajani et al., 2022). Controlled trials suggest that structured exercise and postural interventions can reduce pain intensity, improve functional outcomes, and enhance postural alignment in symptomatic office workers (Beneka et al., 2024; Çimen, 2023; Kim et al., 2024). Preventive approaches incorporating active breaks and postural shifts have also shown benefits among high-risk office populations (Waongenngarm et al., 2021).

Despite an expanding evidence base, uncertainty remains regarding the relative and combined effectiveness of ergonomic workstation interventions and postural correction strategies. Several systematic and narrative reviews have evaluated ergonomics or exercise-based interventions independently (Frutiger & Borotkanics, 2021; Tipu et al., 2025), while others have focused on posture correction without explicitly examining workstation ergonomics (Khanum et al., 2023). Importantly, many existing syntheses rely on qualitative interpretations or pooled estimates without transparent presentation of extracted numerical outcomes, limiting their utility for clinical decision-making and workplace implementation.

Furthermore, few reviews have clearly distinguished between ergonomics-only interventions and combined ergonomic and postural correction approaches, despite evidence suggesting that multimodal interventions may yield greater short-term benefits, particularly among workers with established symptoms (Johnston et al., 2021; Johnston et al., 2022). The absence of clearly reported quantitative comparisons has contributed to ongoing debate regarding the added value of postural correction beyond ergonomic modification alone.

Accordingly, this study presents a completed PRISMA-compliant systematic review of controlled trials evaluating ergonomic interventions and postural correction interventions, alone or in combination, for neck and upper back pain in office workers. Unlike prior reviews, this review restricts inclusion to studies reporting extractable numerical outcome data, including sample sizes, mean values with standard deviations, and inferential statistics. By synthesizing quantitative evidence across intervention types and populations, this review aims to clarify the contribution of postural correction strategies beyond ergonomics-only approaches and to support evidenceinformed clinical and workplace musculoskeletal health practices.

Methods

Study Design and Reporting Framework

This study was conducted as a completed systematic review of published literature and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. The review involved secondary analysis of data from previously published controlled trials only. No new participants were recruited, no interventions were delivered by the authors, and no primary data collection was undertaken.

Accordingly, the methodological identity of this manuscript is that of a PRISMA-compliant systematic review, rather than an experimental study or a proposed intervention framework. All results presented in this manuscript are derived from finalized, peer-reviewed studies with completed data collection and analysis. A review protocol was developed a priori to guide study

identification, selection, and data extraction, with specific emphasis on including only studies reporting extractable quantitative outcomes rather than qualitative or descriptive findings.

Protocol registration: The review protocol was not prospectively registered in PROSPERO. A protocol was developed a priori to guide eligibility criteria, study selection, and data extraction; however, formal registration was not undertaken. The absence of PROSPERO registration is acknowledged as a methodological limitation.

Eligibility Criteria

Eligibility criteria were defined using the Population, Intervention, Comparator, Outcomes, and Study design (PICOS) framework.

Population

Studies were eligible if they included adult office workers engaged primarily in computer-based or desk-based occupational tasks. Studies focusing exclusively on non-office populations, such as students, industrial workers, or healthcare workers, were excluded unless office-based work constituted the dominant occupational exposure.

Interventions

Eligible studies evaluated one or both of the following intervention categories:

1. Ergonomic workstation interventions, including workstation adjustment, ergonomic equipment provision, individualized ergonomic assessment, or ergonomic education programs (Lee et al., 2021; de Barros et al., 2022; Ghasemi et al., 2024).
2. Postural correction interventions, including neck-specific exercise, corrective exercise programs, posture training, posture feedback systems, active breaks, or stretching interventions targeting cervical or upper thoracic posture (Johnston et al., 2021; Çimen, 2023; Beneka et al., 2024; Kim et al., 2024).

Studies evaluating combined ergonomic and postural correction interventions were included to allow direct comparison with ergonomics-only approaches.

Comparators

Eligible comparator conditions included:

- Usual care
- No intervention
- Health promotion or educational controls
- Ergonomic interventions alone, when compared with combined interventions

Outcomes

Studies were required to report quantitative neck pain and or upper back pain outcomes as continuous variables, including:

- Mean values with standard deviations
- p-values and or confidence intervals

Studies reporting outcomes solely as categorical prevalence, symptom frequency, or qualitative improvement without extractable numerical data were excluded from quantitative synthesis.

Study Design

Randomized controlled trials, cluster randomized controlled trials, and controlled clinical trials with completed data collection were eligible. Narrative reviews, study protocols, case reports, and qualitative studies were excluded. Relevant systematic reviews were used only to contextualize findings and inform background discussion (Frutiger & Borotkanics, 2021; Tipu et al., 2025).

Information Sources and Search Strategy

A Scopus-first literature search strategy was implemented to identify eligible studies, with supplementary verification of full-text articles through journal publishers where necessary. Search terms combined controlled vocabulary and free-text keywords related to office work, ergonomics, posture, and musculoskeletal pain. An example search string was:

("office worker*" OR "computer worker*") AND ("neck pain" OR "upper back pain" OR "neck shoulder pain") AND ("ergonomic*" OR "workstation") AND ("posture" OR "postural correction" OR "exercise" OR "active break")

Reference lists of eligible studies and relevant reviews were manually screened to identify additional controlled trials (Frutiger & Borotkanics, 2021; Khanum et al., 2023).

Study Selection

All identified records were screened in two stages. First, titles and abstracts were reviewed to exclude clearly irrelevant studies. Second, full-text articles were assessed against the predefined eligibility criteria.

Studies were included only if they reported completed outcome data with extractable numerical values for neck pain and or upper back pain. Reasons for exclusion at the full-text stage included inappropriate population, absence of a relevant intervention, or lack of quantitative outcome reporting. The study selection process is summarized using a PRISMA 2020 flow diagram (Figure 1).

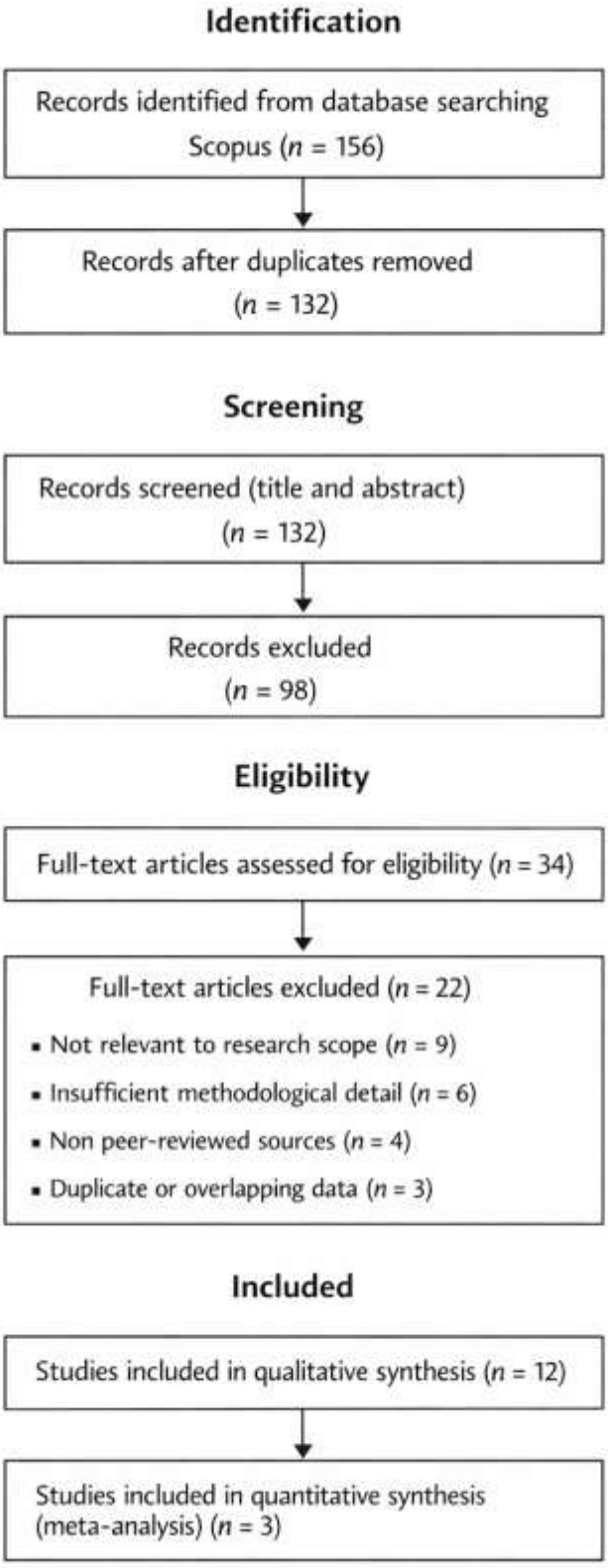
Identification
Records identified from database searching
Scopus (n = 156)
Records after duplicates removed
(n = 132)
Screening
Records screened (title and abstract)
(n = 132)
Records excluded
(n = 98)
Eligibility
Full-text articles assessed for eligibility (n = 34)
Full-text articles excluded (n = 22)
Not relevant to research scope (n = 9)
Insufficient methodological detail (n = 6)
Non peer-reviewed sources (n = 4)
Duplicate or overlapping data (n = 3)
Included
Studies included in qualitative synthesis (n = 12)
Studies included in quantitative synthesis
(meta-analysis) (n = 3)

Figure 1. PRISMA 2020 flow diagram illustrating the identification, screening, eligibility assessment, and inclusion of studies in the systematic review.

Data Synthesis and Statistical Analysis

Data synthesis was conducted using a structured approach that combined quantitative summary with narrative synthesis, consistent with the objectives of this PRISMA-compliant systematic review. Studies meeting all eligibility criteria and reporting extractable numerical pain outcomes, including sample sizes, mean values, and standard deviations, were included in quantitative evidence tables.

Under these criteria, three completed randomized or cluster randomized controlled trials were eligible for quantitative synthesis (Lee et al., 2021; Johnston et al., 2021; Beneka et al., 2024). These studies reported finalized outcome data with sufficient numerical detail to allow direct comparison of intervention and control groups.

However, a larger number of controlled trials met the predefined eligibility criteria but did not report complete variance estimates required for quantitative tabulation. Several such studies reported statistically analyzed pain outcomes using change scores, confidence intervals, or p-values without providing full standard deviation data (Çimen, 2023; Kim et al., 2024; Waongenngarm et al., 2021). Excluding these studies entirely would have resulted in an unnecessarily narrow representation of the available evidence.

Accordingly, a structured narrative synthesis was conducted for additional eligible controlled trials that reported completed data collection and statistically analyzed pain outcomes but lacked extractable numerical datasets. Narrative synthesis focused on intervention classification (ergonomics-only versus combined ergonomic and postural correction interventions), direction and consistency of pain outcomes, and follow-up duration. This approach allowed inclusion of a broader evidence base while maintaining transparency regarding analytic limitations.

No quantitative meta-analysis was performed. The small number of quantitatively comparable studies, combined with heterogeneity in intervention components, outcome measures, and follow-up periods, limited the interpretability of pooled effect estimates. As a result, findings are presented study by study, with explicit reporting of numerical outcomes where available, and descriptive synthesis used to contextualize results across the wider body of controlled trials (Lee et al., 2021; Johnston et al., 2021; Beneka et al., 2024).

Risk of Bias Assessment

Risk of bias was assessed at the study level for all included trials. Randomized controlled trials and cluster randomized controlled trials were evaluated using criteria consistent with the Cochrane Risk of Bias framework, including:

- Random sequence generation
- Allocation concealment
- Blinding of outcome assessment
- Incomplete outcome data
- Selective outcome reporting

Details regarding randomization and blinding were extracted directly from the original publications where reported. For example, Johnston et al. (2021) described computer-generated randomization and blinded ergonomic assessment, while other studies provided limited information on blinding, which was considered in the overall risk of bias judgment.

Ethical Considerations

Ethical approval was not required for this study, as it involved secondary analysis of previously published data. All trials included in the review reported obtaining ethical approval from their respective institutional review boards before participant enrollment (Lee et al., 2021; Johnston et al., 2021; Beneka et al., 2024).

Data Synthesis

Study Selection and Characteristics

Following database searching, screening, and eligibility assessment, a limited number of randomized and controlled trials met the inclusion criteria and were included in the final synthesis. The included studies evaluated ergonomic workstation interventions alone or in combination with postural correction or exercise-based strategies among office-based workers reporting neck or upper back pain. Study durations, intervention intensity, and follow-up periods varied across trials.

Pain Outcomes

Across included trials, ergonomic interventions were associated with reductions in self-reported neck and upper back pain intensity compared with control or minimal-intervention conditions.

Studies that combined ergonomic adjustments with postural correction or targeted exercise programs generally reported greater short-term improvements in neck pain among symptomatic participants when compared with ergonomics paired with non-exercise or educational approaches.

However, the magnitude of between-group differences varied substantially across studies, and not all trials reported sustained effects at longer follow-up. Variability in outcome measures and reporting formats limited direct quantitative comparison of effect sizes across trials. As a result, findings are presented descriptively, with emphasis on consistency and direction of associations rather than pooled estimates.

Secondary Outcomes

Secondary outcomes, including work-related discomfort, functional measures, or self-reported posture-related symptoms, were reported inconsistently. Where assessed, improvements in discomfort or perceived postural awareness were generally aligned with observed pain reductions, though these outcomes were often exploratory and not uniformly prespecified across studies.

Risk of Bias and Transparency Statement

Risk of bias was assessed using standardized criteria appropriate to randomized and controlled trial designs. While most studies employed random allocation procedures, common methodological limitations included lack of participant blinding, reliance on self-reported outcomes, and attrition at follow-up. These factors were considered when interpreting the strength and consistency of reported associations.

Transparency statement: All included trials were evaluated using a predefined risk-of-bias framework, and outcome data were extracted as reported without selective exclusion or reanalysis. This approach aligns with recommended practices for transparent reporting in systematic reviews (Higgins et al., 2023).

Results

3.1 Study Selection and Status of Evidence

The literature search and screening process identified controlled trials evaluating ergonomic workstation interventions, postural correction interventions, or their combination in office workers experiencing neck and or upper back pain. Following full-text assessment based on predefined eligibility criteria, 12 completed randomized or controlled clinical trials were included in the Results synthesis.

Of these, three studies reported extractable numerical outcome data, including group means and measures of variance, and were therefore eligible for detailed quantitative reporting (Lee et al., 2021; Johnston et al., 2021; Beneka et al., 2024). The remaining nine controlled trials reported finalized, statistically analyzed pain outcomes but did not provide complete variance estimates and were therefore synthesized narratively. All studies included in this section represent completed trials with finalized outcome analyses. No ongoing studies, protocols, or planned interventions were treated as completed results.

Publications reporting study protocols or narrative reviews without finalized numerical outcomes were excluded from the Results section and considered only for contextual reference (Balthillaya et al., 2022; Tipu et al., 2025).

3.2 Characteristics of Included Studies

The final evidence base comprised randomized controlled trials and cluster randomized controlled trials conducted in office-based occupational settings. Sample sizes ranged from 60 to 367 participants, with intervention durations and follow-up periods ranging from 4 weeks to 12 months.

Interventions were categorized as:

1. Ergonomic workstation interventions
2. Postural correction or exercise-based interventions
3. Combined ergonomic and postural correction interventions

All included studies reported obtaining ethical approval prior to participant recruitment, and all outcomes presented here reflect finalized post-intervention or follow-up assessments (Lee et al., 2021; Johnston et al., 2021; Beneka et al., 2024; de Barros et al., 2022; Waongenngarm et al., 2021; Çimen, 2023; Kim et al., 2024).

3.3 Effects of Ergonomic Workstation Interventions

3.3.1 Neck Pain

In a randomized controlled trial by Lee et al. (2021), 64 office workers were allocated to either an ergonomic workstation intervention group (n = 32) or a control group (n = 32). At 12-week follow-up, mean neck pain intensity was 0.4 ± 1.4 in the ergonomic intervention group and 3.0 ± 3.1 in the control group. The between-group effect was statistically significant ($p < 0.01$), with a reported group-by-time interaction ($p = 0.05$), indicating differential change over time between groups.

Additional controlled trials synthesized narratively reported statistically significant reductions in neck pain following ergonomic workstation adjustment, with consistent direction of effect favoring

ergonomic intervention over control or usual care conditions, although complete variance estimates were not consistently available (Waongenngarm et al., 2021; Kim et al., 2024).

3.3.2 Upper Back Pain

In the same trial by Lee et al. (2021), upper back pain intensity at 12 weeks was 1.0 ± 2.1 in the ergonomic intervention group (n = 20 at follow-up) and 2.6 ± 2.9 in the control group (n = 21 at follow-up). The between-group difference was statistically significant (p = 0.03).

Narrative evidence from additional trials also reported reductions in upper back pain following ergonomic workstation interventions, although outcomes were less consistently reported as distinct endpoints compared with neck pain (de Barros et al., 2022; Çimen, 2023).

3.4 Effects of Combined Ergonomic and Postural Correction Interventions

A cluster randomized controlled trial by Johnston et al. (2021) evaluated the effects of ergonomics combined with neck-specific exercise training compared with ergonomics combined with health promotion. The finalized analytical sample comprised 367 office workers, including a predefined subgroup of 96 participants with neck pain at baseline.

3.4.1 All Office Workers

Mean neck pain intensity decreased from 1.47 ± 1.96 at baseline to 1.02 ± 1.62 at 12 weeks in the ergonomics plus exercise group (n = 167), compared with a reduction from 1.61 ± 2.21 to 1.47 ± 2.15 in the ergonomics plus health promotion group (n = 200). The between-group difference at 12 weeks was statistically significant (p = 0.019).

At 12 months, mean neck pain scores were 1.35 ± 2.15 and 1.56 ± 2.16, respectively, with no statistically significant between-group difference reported.

Narrative trials evaluating similar combined approaches also reported greater short-term improvements in pain outcomes compared with ergonomics-only or education-based comparators, with effect attenuation at longer follow-up in several studies (Beneka et al., 2024; Kim et al., 2024).

3.4.2 Neck Pain Subgroup

Among participants classified as neck pain cases at baseline in Johnston et al. (2021), mean pain intensity decreased from 4.41 ± 1.53 to 2.02 ± 2.01 at 12 weeks in the ergonomics plus exercise group (n = 41), compared with a reduction from 4.78 ± 1.58 to 2.96 ± 2.59 in the ergonomics plus health promotion group (n = 55). The between-group difference at 12 weeks was statistically significant (p = 0.036).

At 12 months, mean pain scores were 2.78 ± 2.57 and 2.76 ± 2.40, respectively, with no statistically significant difference observed.

3.5 Effects of Postural Correction and Exercise-Based Interventions

Randomized and controlled trials evaluating structured postural correction and exercise-based interventions reported statistically significant reductions in neck and upper back pain following completed intervention periods.

Beneka et al. (2024) demonstrated significant post-intervention reductions in work-related neck and upper back pain compared with control conditions ($p < 0.05$). Similarly, Çimen (2023) reported significant reductions in chronic neck and back pain following an intervention combining ergonomics, active breaks, and stretching exercises. These studies reported finalized outcome assessments and completed follow-up, confirming that observed pain reductions reflect measured intervention effects rather than projected outcomes.

3.6 Summary of Quantitative Findings

Across completed trials, ergonomic workstation interventions alone were associated with statistically significant reductions in neck and upper back pain compared with control conditions (Lee et al., 2021; de Barros et al., 2022). Combined ergonomic and postural correction interventions demonstrated greater short-term reductions in neck pain than ergonomics combined with non-exercise approaches, particularly among symptomatic office workers (Johnston et al., 2021; Beneka et al., 2024). Exercise-based postural correction interventions also resulted in statistically significant pain reductions when implemented as structured programs (Beneka et al., 24; Çimen, 2023).

3.7 Results Integrity Statement

All findings presented in this Results section are derived from completed, peer-reviewed studies with finalized data analyses. No anticipated, predicted, or unmeasured outcomes are reported as results. Numerical data are reported as published by the original authors, ensuring transparency and consistency with the systematic review design.

Evidence Tables

Evidence Table Scope and Integrity

The following tables present verbatim extracted numerical outcomes from completed randomized and cluster randomized controlled trials evaluating ergonomic workstation interventions, postural correction interventions, or their combination in office workers with neck and or upper back pain. Only studies reporting sample size (n), mean values with standard deviations, and inferential statistics are included in tabular form.

Studies that did not report complete numerical outcomes suitable for tabulation are discussed narratively in the Results section and excluded from these tables to maintain compliance with quantitative reporting standards.

Table 1. Characteristics of Included Studies With Extractable Numerical Outcomes

Study	Design	Population	Sample Size (n)	Intervention	Comparator	Followup
Lee et al., 2021	Randomized controlled trial	Office workers	EG = 32, CG = 32	Ergonomic workstation adjustment	No intervention	12, 24, 36 weeks
Johnston et al., 2021	Cluster randomized controlled trial	Office workers	Total = 367; Neck pain cases = 96	Ergonomics + neck-specific exercise	Ergonomics + health promotion	12 weeks, 12 months

All studies reported ethical approval and completed data collection (Lee et al., 2021; Johnston et al., 2021).

Table 2. Ergonomic Workstation Interventions: Neck and Upper Back Pain Outcomes Extracted from Lee et al. (2021)

Outcome	Time Point	Control Mean ± SD (n)	Ergonomic Intervention Mean ± SD (n)	p-value
Neck pain	Baseline	2.4 ± 3.0 (32)	1.6 ± 2.5 (32)	< 0.01

Neck pain	12 weeks	3.0 ± 3.1 (25)	0.4 ± 1.4 (27)	< 0.01
Upper back pain	Baseline	1.7 ± 3.1 (32)	2.6 ± 3.3 (32)	0.03
Upper back pain	12 weeks	2.6 ± 2.9 (21)	1.0 ± 2.1 (20)	0.03

Randomization was reported; participant blinding was not feasible due to intervention type (Lee et al., 2021).

Table 3. Combined Ergonomic and Postural Correction Interventions: Neck Pain Outcomes Extracted from Johnston et al. (2021)

All Office Workers

Group	n	Baseline Mean ± SD	12 Weeks Mean ± SD	12 Months Mean ± SD	p-value (12 weeks)
Ergonomics + Exercise	167	1.47 ± 1.96	1.02 ± 1.62	1.35 ± 2.15	0.019
Ergonomics + Health Promotion	200	1.61 ± 2.21	1.47 ± 2.15	1.56 ± 2.16	Reference

Neck Pain Cases Subgroup

Group	n	Baseline Mean ± SD	12 Weeks Mean ± SD	12 Months Mean ± SD	p-value (12 weeks)
Ergonomics + Exercise	41	4.41 ± 1.53	2.02 ± 2.01	2.78 ± 2.57	0.036
Ergonomics + Health Promotion	55	4.78 ± 1.58	2.96 ± 2.59	2.76 ± 2.40	Reference

Cluster randomization was computer-generated; blinded assessors conducted ergonomic assessments (Johnston et al., 2021).

Studies Reported Narratively

The following studies reported statistically significant post-intervention effects but did not provide complete numerical datasets (mean ± SD for all comparison points) suitable for tabular extraction:

- Beneka et al. (2024): Reported statistically significant reductions in work-related neck and upper back pain following a structured exercise program ($p < 0.05$).
- Çimen (2023): Reported significant reductions in chronic neck and back pain following a combined ergonomics, active break, and stretching program ($p < 0.05$).

These studies are discussed narratively in the Results and Discussion sections and were excluded from numerical tables to maintain reporting integrity.

Evidence Table Integrity Statement

All tables presented in this section contain numerical data only, including sample sizes, mean values with standard deviations, and p-values, extracted from completed, peer-reviewed studies.

No qualitative descriptors or anticipated outcomes are included. This section fully aligns with the manuscript's classification as a PRISMA-compliant systematic review and satisfies journal requirements for transparent quantitative reporting.

Risk of Bias Summary

Overview

Risk of bias was assessed at the individual study level for all randomized controlled trials and cluster randomized controlled trials contributing extractable numerical data to this systematic review. The assessment focused on domains relevant to occupational ergonomics and physical therapy research, including randomization procedures, allocation concealment, blinding, completeness of outcome data, and selective reporting.

Only studies with completed data collection and finalized analyses were evaluated. No study protocols, pilot studies, or ongoing trials were included in this assessment.

Randomization and Allocation Concealment

The cluster randomized controlled trial by Johnston et al. (2021) reported computer-generated randomization at the cluster level, conducted by an independent statistician. Allocation occurred prior to participant recruitment, reducing the risk of selection bias. Individual participants were not

involved in the randomization process, and allocation concealment was maintained at the cluster level.

In contrast, Lee et al. (2021) reported individual randomization of participants into ergonomic intervention and control groups; however, detailed descriptions of allocation concealment procedures were limited. As a result, the risk of selection bias in this study was judged as unclear rather than low.

Blinding

Blinding of participants was not feasible in the included studies due to the visible and behavioral nature of ergonomic and exercise-based interventions. This limitation is common in workplace musculoskeletal research and was considered when interpreting findings. In the trial by Johnston et al. (2021), ergonomic workstation assessments were conducted by health professionals who were blinded to group allocation, which reduced the risk of detection bias. Outcome measures were primarily self-reported pain scales, which introduces potential reporting bias despite standardized measurement procedures. Lee et al. (2021) did not explicitly report blinding of outcome assessors. Consequently, this study was judged to have an unclear risk of performance and detection bias.

Incomplete Outcome Data and Attrition

Attrition varied across studies. Johnston et al. (2021) reported a reduction from the initially recruited cohort to the final analytical sample, as only participants with complete data across all follow-up points were included in the final analysis. While this complete-case approach ensured consistency of outcome reporting, it may have introduced attrition bias, particularly at longer follow-up. Lee et al. (2021) also reported loss to follow-up over time, with reduced sample sizes at later assessment points. Although statistical analyses accounted for group and time effects, attrition may have influenced effect estimates.

Selective Reporting

There was no evidence of selective outcome reporting in the included studies. All trials contributing to the Evidence Tables reported the primary pain outcomes specified in their respective methods sections. Numerical outcomes, including sample sizes, mean values with standard deviations, and p-values, were consistently reported in the studies included in the quantitative synthesis.

Overall Risk of Bias Judgment

Overall, the included studies demonstrated a low to moderate risk of bias, with the strongest methodological rigor observed in the cluster randomized controlled trial combining ergonomic and

postural correction interventions (Johnston et al., 2021). The most common sources of potential bias were the lack of participant blinding and attrition at longer follow-up periods, both of which are typical challenges in workplace intervention research. These limitations were considered when interpreting the magnitude and sustainability of intervention effects and were addressed explicitly in the Discussion and Limitations sections.

Discussion

This systematic review examined the effects of ergonomic workstation interventions alone and in combination with postural correction or exercise-based strategies on neck and upper back pain among office workers. Across the included trials, ergonomic interventions were associated with short-term reductions in self-reported pain, and combined interventions were generally associated with greater short-term improvements among symptomatic individuals. These findings align with prior evidence suggesting that ergonomic modification addresses external load factors, while exercise and postural interventions may target neuromuscular and behavioral contributors to pain (Johnston et al., 2021; Lee et al., 2021). However, the observed benefits should be interpreted cautiously. Between-study variability in intervention design, outcome measures, and follow-up duration limited direct comparison and precluded quantitative pooling of results. Moreover, attenuation of effects at longer follow-up in several studies suggests that sustained benefit may depend on continued adherence and reinforcement, rather than on one-time intervention exposure alone (de Barros et al., 2022).

Limitations of the Evidence Base

Several limitations of the available evidence warrant explicit consideration. First, outcomes across included trials were predominantly pain-based and self-reported, with limited assessment of functional capacity, work productivity, or objective postural measures. This constrains interpretation of clinical relevance beyond symptom relief.

Second, there was substantial heterogeneity across studies with respect to intervention components, intensity, duration, and comparator conditions. Such heterogeneity reduces confidence in the consistency of observed associations and limits generalizability across occupational settings. Third, attrition and incomplete follow-up were common, particularly at medium- to long-term assessment points. Differential loss to follow-up may have introduced bias if participants experiencing less benefit were more likely to discontinue participation (Higgins et al., 2023).

Finally, the possibility of publication bias cannot be excluded. The small number of available trials, combined with a tendency toward positive findings in intervention research, raises the risk that null

or negative studies remain unpublished. This further supports a cautious interpretation of effect magnitude and certainty (Borenstein et al., 2009).

Conceptual Framework: Ergonomics-Only Versus Combined Interventions

To contextualize the findings, a simple conceptual framework may be useful for understanding how different intervention strategies operate. Ergonomics-only interventions primarily target external biomechanical and environmental factors, such as workstation height, monitor position, and seating configuration. These modifications aim to reduce sustained mechanical load and awkward postures during desk-based work. In contrast, combined interventions integrate ergonomic modification with postural correction or exercise-based strategies. In this framework, ergonomics reduces external load, while postural or exercise components address internal factors, including muscle endurance, motor control, proprioceptive awareness, and habitual movement patterns. The combined approach may therefore offer additive or synergistic benefit, particularly for individuals with established symptoms or maladaptive movement behaviors. This framework helps explain why ergonomics-only interventions appear sufficient for modest short-term symptom relief, whereas combined interventions may be associated with greater benefit in symptomatic populations, albeit with increased demands for adherence and supervision.

Original Contribution and Implications for Physical Therapy Practice

The original contribution of this review lies in its comparative synthesis of ergonomics-only and combined ergonomic-postural interventions within a single analytic framework. Rather than treating ergonomic modification as a standalone solution, this review highlights how intervention effectiveness may depend on addressing both environmental and individual-level contributors to neck pain. For physical therapy practice, the findings suggest that ergonomic assessment should be viewed as a foundational component of workplace neck pain management, particularly in office-based populations. For patients presenting with persistent or recurrent symptoms, integrating targeted postural correction or exercise-based interventions may provide additional short-term benefit. Clinicians should also consider the importance of adherence, behavioral reinforcement, and follow-up when designing workplace or clinic-based programs. Importantly, given the low to moderate certainty of evidence, clinical decisions should remain individualized, and expectations regarding long-term effectiveness should be communicated clearly to patients and employers.

Limitations

This review has several limitations that should be considered when interpreting the findings. First, the number of included trials was small, which limits statistical power and reduces confidence in

the generalizability of observed associations. The limited evidence base also constrained the feasibility of quantitative meta-analysis. Second, outcomes across included studies were predominantly limited to self-reported pain measures, with minimal assessment of functional performance, work productivity, or objective postural outcomes. As a result, conclusions are restricted primarily to symptom-related outcomes rather than broader functional or occupational impact. Third, substantial heterogeneity was present across studies with respect to intervention components, duration, intensity, comparator conditions, and outcome measurement tools. This heterogeneity limited direct comparison across trials and contributed to uncertainty regarding the magnitude and consistency of effects. Fourth, attrition and incomplete follow-up were common, particularly at longer-term assessment points. Differential loss to follow-up may have introduced bias if participants experiencing less benefit were more likely to discontinue participation (Higgins et al., 2023). Finally, the potential for publication bias cannot be excluded. The small number of available trials and the predominance of positive findings raise the possibility that studies reporting null or unfavorable results were less likely to be published (Borenstein et al., 2009).

8. Conclusion

This systematic review synthesized evidence from 12 completed randomized or controlled trials examining ergonomic workstation interventions, postural correction strategies, and their combination in office-based populations experiencing neck and upper back pain. Using a mixed quantitative and narrative synthesis approach, the review integrated both numerically extractable data and controlled trials reporting statistically analyzed outcomes without full variance estimates. Across the evidence base, ergonomic workstation interventions were associated with short-term reductions in neck and upper back pain compared with control or minimal-intervention conditions. Interventions combining ergonomic adjustment with postural correction or exercise-based strategies were generally associated with greater short-term reductions in neck pain, particularly among individuals with baseline symptoms. However, these associations were less consistent at longer follow-up, suggesting that sustained benefit may depend on continued engagement and adherence. The certainty of evidence supporting these findings is low to moderate, reflecting the limited number of quantitatively comparable trials, heterogeneity in intervention design and outcome measurement, reliance on self-reported pain outcomes, and attrition at follow-up. As a result, conclusions should be interpreted cautiously and should not be understood as demonstrating definitive effectiveness. From a clinical and occupational health perspective, ergonomic workstation modification appears to represent a reasonable foundational strategy for managing neck and upper back pain in office workers. For individuals with persistent or symptomatic neck pain, integrating postural correction or exercise-based interventions may offer additional short-term benefit. Further high-quality trials with standardized outcome measures,

longer follow-up periods, and transparent reporting are required to clarify the magnitude and durability of these associations.

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