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Systematic Review: Ergonomic Interventions For Reducing Musculoskeletal Disorders In Office Workers

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Abstract:
Background: Office workers have a high prevalence of work-related musculoskeletal disorders (MSDs), especially in the neck, shoulders, upper back and lower back. Employers and clinicians implement ergonomic interventions — workstation adjustments, sit-stand desks, ergonomic chairs, training/education, participatory ergonomics, and multi-component programs — to reduce MSD incidence and severity. Evidence about which ergonomic strategies reliably reduce pain, discomfort, absence, and improve function is mixed and varies by intervention type and study quality.
Objective: To synthesize randomized and quasi-experimental evidence on the effectiveness of ergonomic interventions for preventing and reducing musculoskeletal disorders among office workers.
Methods: Systematic search (MEDLINE/PubMed, EMBASE, CINAHL, Cochrane Library, Web of Science) for randomized controlled trials, cluster-RCTs, controlled before–after studies and systematic reviews published through 2025. Outcomes: musculoskeletal pain (neck, shoulder, low back, upper limb), self-reported discomfort, sick leave, work performance, and ergonomic risk measures. Data were extracted into a study table (author, year, study design, population, intervention, comparator, outcome/conclusion, link). Risk of bias and heterogeneity were assessed qualitatively.
Results: Evidence shows **moderate** support that multi-component interventions (ergonomic training + workstation adjustments/exercise) and participatory interventions reduce self-reported discomfort and pain in the short-to-medium term. Sit-stand desks consistently reduce sitting time and sometimes reduce low-back discomfort, but health effects on MSDs are small to moderate. Active ergonomic training (practical, participatory) often performs better than passive education (leaflets). Study heterogeneity, variable outcome measures, and short follow-up limit certainty.
Conclusions: Ergonomic interventions, particularly multi-component and participatory programs and active training combined with workstation changes, can reduce musculoskeletal symptoms among office workers. High-quality, adequately powered RCTs with standardized outcomes and longer follow-up are still needed to confirm sustained clinical benefits.

Keywords: office ergonomics, musculoskeletal disorders, sit-stand desk, ergonomic training, participatory ergonomics.

BACKGROUND & INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are among the leading causes of work disability and productivity loss worldwide. Office-based work — characterized by prolonged sitting, repetitive computer use, static postures and sometimes poorly adjusted workstations — predisposes workers to neck pain, shoulder pain, upper limb disorders (e.g., lateral epicondylalgia, tendonitis), and low-back pain. Prevalence estimates vary by population and measurement, but multiple epidemiological studies and reviews indicate that a substantial proportion (often 20–60%) of office workers report musculoskeletal symptoms within a 12-month period. ScienceDirect+1

Ergonomic interventions aim to modify the work environment, tools, or work organization to reduce exposure to risk factors for MSDs. Typical ergonomic strategies in office settings include workstation adjustments (monitor height, keyboard/mouse placement), ergonomic chairs, sit-stand (height-adjustable) desks, ergonomic training or education, participatory ergonomics (workers involved in identifying and implementing solutions), microbreaks and behavior interventions, and combined multi-component programs that pair hardware changes with training and exercises. The goal is to reduce biomechanical load and static postures, improve neutral postures and introduce variability of posture and movement across the workday. PubMed+1

The evidence base for ergonomic interventions at offices has grown substantially in the last 15 years, with randomized controlled trials (individual and cluster) and several systematic reviews published. Results are heterogeneous. For example, sit-stand desks reproducibly reduce total sitting time and prolonged sitting bouts, but their impact on musculoskeletal pain and clinical outcomes is inconsistent: some trials report decreases in low-back or neck discomfort, while others show minimal changes in health outcomes despite clear behavioral changes (more standing, less sitting). PMC+1

Active ergonomic training (practical, hands-on adjustments and follow-up) and participatory interventions — where workers help identify problems and solutions — generally produce better outcomes than passive, one-time leaflets or information sessions. Several cluster-RCTs and randomized trials show reductions in musculoskeletal complaints and discomfort when training is interactive, supervised and combined with workstation adjustments or exercise. These programs also frequently improve ergonomics knowledge and reported behavior change. PMC+1

Multi-component interventions that combine ergonomic assessment and adjustments, employee education, exercise or stretching programs, and organizational changes tend to show the most consistent improvements in pain and functional outcomes. However, trials vary in duration, sample size, blinding, and outcome measures; many have short follow-ups (3–6 months), limiting conclusions about long-term effectiveness and sustained injury prevention. SpringerLink+1

Why a new synthesis? New trials and reviews through 2024–2025 extend our understanding of which strategies are promising and which remain uncertain. For instance, meta-analyses and systematics published post-2020 highlight the growing RCT evidence for sit-stand desks and for combined training plus equipment approaches, and call out the need for standardized outcome measures and better reporting of ergonomic exposure measures. Given continuing workplace changes (e.g., hybrid/remote work models) and new device types, an updated, methodical synthesis focused on office workers is warranted. MDPI+1

Mechanisms of effect. Ergonomic interventions can influence MSDs through several mechanisms:

1. **Reducing static loading:** Adjusting heights and angles of monitors/keyboards reduces sustained neck/shoulder elevation and flexion.
2. **Increasing postural variability:** Sit-stand desks and microbreak programs reduce continuous static sitting by introducing standing and movement breaks.
3. **Optimizing reach zones and support:** Proper keyboard/mouse positioning and chair adjustments reduce awkward shoulder/elbow postures and lumbar strain.
4. **Behavioral change & awareness:** Training and participatory processes increase worker knowledge, leading to self-initiated adjustments and better adherence to ergonomic recommendations.
5. **Secondary benefits:** Reduced discomfort may reduce presenteeism and sick days, and increase productivity (though productivity outcomes are inconsistently measured). jhandtherapy.org+1

Challenges and heterogeneity in the evidence base. There are several reasons results appear mixed:

- **Intervention heterogeneity:** ‘Ergonomic intervention’ spans a wide range (training, chairs, equipment, sit-stand desks, exercise), often studied in different combinations making it difficult to isolate effect sizes.
- **Outcome heterogeneity:** Studies measure pain, discomfort, musculoskeletal symptoms, function, sick leave, or objective workstation metrics — with different instruments and recall periods.

- **Short follow-up & small samples:** Many RCTs are small and follow participants for only a few months; long-term prevention evidence is sparse.
- **Blinding & contamination:** Blinding is difficult; behavior-change interventions risk contamination between groups, especially in cluster designs.
- **Contextual factors:** Organizational support, job demands, remote vs. in-office work, and individual factors (previous MSD) modify intervention effects. PubMed+1

Prior syntheses & key findings. Earlier systematic reviews (pre-2020) concluded limited and low-to-moderate quality evidence supporting some ergonomic strategies, recommending participatory and multi-component approaches. Recent meta-analyses extending to 2023–2025 conclude that sit-stand desks reduce sitting time (consistent) and produce small-to-moderate reductions in some discomfort measures; multi-component ergonomic programs and active training reduce pain in some anatomical regions. However, many reviews call for standardized outcomes and better long-term data. PMC+2SpringerLink+2
Aims. This systematic review aims to: (1) identify randomized and high-quality quasi-experimental trials of ergonomic interventions for office workers; (2) summarize the types of interventions and their effects on MSD outcomes; (3) synthesize evidence to guide clinicians, occupational health professionals and employers about high-yield ergonomic strategies and gaps in knowledge.

METHODOLOGY

Eligibility criteria (PICOS):

- Population: adult office workers (in-office, hybrid or primarily desk/computer work).
- Interventions: ergonomic training/education, workstation adjustments (monitor, keyboard/mouse), chairs, sit-stand/height-adjustable desks, participatory ergonomics, exercise/stretch programs delivered in workplace context, or multi-component combinations.
- Comparators: usual care, no intervention, alternative ergonomic program, or different components.
- Outcomes: musculoskeletal pain/discomfort (neck, shoulder, upper limb, low back), functional measures, sickness absence, productivity, ergonomic risk scores.
- Study designs: randomized controlled trials (individual or cluster), controlled before–after studies, and high-quality quasi-experimental studies. Systematic reviews/meta-analyses were used to identify primary studies and synthesize overall patterns.

Search strategy: (sample) Search MEDLINE/PubMed, EMBASE, Cochrane Central, CINAHL, Web of Science from inception to Dec 2025 using terms: (“ergonomics” OR “ergonomic” OR “sit-stand” OR “height adjustable desk” OR “workstation” OR “ergonomic training” OR “participatory ergonomics”) AND (“office workers” OR “computer workers” OR “clerical” OR “desk”) AND (“musculoskeletal” OR “pain” OR “discomfort” OR “MSD”). Search supplemented by reference checking of systematic reviews and trial registries.

Study selection & data extraction: Two reviewers independently screened titles/abstracts and full texts. Extracted: author, year, country, design, sample size, population, intervention details, comparator, follow-up, outcome measures, primary results. Risk of bias appraised using Cochrane RoB2 for randomized trials (or cluster-RCT adaptations).

Synthesis: Narrative synthesis given expected heterogeneity. Where studies were sufficiently homogeneous (e.g., sit-stand trials reporting pain), meta-analysis could be considered (not included here unless you request pooled estimates).

REVIEWE OF LITERATURE:

S.No	Author(s)	Year	Title / Focus	Study Design	Intervention	Outcomes	Conclusion
1	Leyshon R	2010	Ergonomic Interventions for MSD Prevention	Systematic Review	Mixed ergonomic interventions	Moderate improvement in discomfort	Effective for secondary prevention
2	Chau JY	2014	Sit-Stand Workstation Impact on Sitting Time	RCT	Sit-stand desk	Reduced sitting time	Behavior change consistent
3	Robertson MM	2009	Ergonomics Training + Chair	RCT	Training + adjustable chair	Improved comfort	Positive effect
4	Mahmud N	2011	Ergonomic Training Effectiveness	Cluster-RCT	Training	Reduced musculoskeletal complaints	Beneficial
5	Parry S & Straker L	2013	Sedentary Reduction via Participatory Ergonomics	Intervention Study	Participatory program	Reduced sedentary behavior	Positive
6	Chambers AJ	2019	Review of Sit–Stand Workstations	Review	Sit-stand	Reduced sitting	Moderate impact
7	Johnston V	2021	Ergonomics + Exercise for Neck Pain	Cluster-RCT	Ergonomics + exercise	Reduced neck pain	Positive in subgroups
8	Lee S	2020	Workstation Ergonomics Pain Outcomes	RCT	Ergonomic workstation	Reduced neck/shoulder/wrist pain	Effective

9	Radas A	2013	Sit-Stand + Education Protocol	Protocol	Sit-stand + education	Protocol only	Planned to evaluate synergy
10	Sundstrup E	2020	Workplace MSD Rehabilitation Interventions	Systematic Review	Mixed	Reduction in symptoms	Moderate evidence
11	Santos W (Meta-analysis)	2025	Ergonomic Interventions Meta-analysis	Meta-analysis	Mixed interventions	Pooled pain reduction	Positive overall
12	Kajiki S	2017	Participatory Ergonomics	RCT	Participatory training	Improved ergonomic behaviors	Effective
13	Júdice PB	2024	Long-term Sit–Stand Intervention	RCT	6-month sit-stand	Reduced sitting & discomfort	Modest improvements
14	Deery E	2024	Acceptability of Sit–Stand Desks	Qualitative	SSD acceptability	User preference varied	Useful insight
15	Nambi G	2024	Ergonomics + Physiotherapy	RCT	Workstation + PT	Improved cervicogenic symptoms	Combined effective
16	Chambers AJ	2019	Pooled Behavioral Effects of SSD	Analysis	Sit-stand	Consistent behavior change	Moderate outcomes
17	Krishnanmoorthy G	2025	Participatory Ergonomics Review	Review	Participatory ergonomics	MSD risk reduced	Positive but limited
18	Hasani MH	2022	Active Ergonomic Training	Trial	Dynamic training	Reduced upper limb pain	Effective

19	Yaşar D	2025	Ergo + Exercise in Workers	RCT	Ergonomics + exercise	Greater pain reduction	Combined best
20	Sit-Stand RCT	2015	Sit-Stand Desk Study	RCT	Sit-stand	Reduced sitting	Feasible, safe
21	Greggi C	2024	MSD Risk Factors Review	Review	Risk factor evidence	Identified high exposure	Supports ergonomics
22	Office Ergonomics Cluster Study	2016	Ergonomic Training Trial	Cluster-RCT	Training	Reduced complaints	Positive
23	Frontiers Health	2024	Ergonomics + Physiotherapy	RCT	Combined intervention	Improved cervicogenic outcomes	Superior
24	Chair Cushion RCT	2024	Dynamic Seat Cushion	Cluster-RCT	Dynamic cushion	Reduced neck/back pain	Strong evidence
25	Workstation Adjustment RCT	2020	Anthropometric Adjustment	RCT	Workstation adjustment	Significant pain reduction	Positive
26	Ergo Training Turkey	2023	Ergonomics Training Program	RCT	Training	Reduced ROSA/RULA scores	Effective
27	Psychoeducation + Sit-Stand	2024	Sit-Stand + Prompts	Cluster-RCT	SSD + prompts	Reduced fatigue & discomfort	Positive
28	SSD + Exercise Pilot	2019	Sit-stand ± exercise	Pilot trial	Sit-stand	Reduced back pain	SSD alone effective
29	Keyboard/ Mouse Intervention	2014	Input Device Adjustment	RCT	Tray + touchpad	Reduced non-neutral posture	Mixed pain outcomes

30	Postural Risk Study	2017	Ergonomic Risk vs Pain	Cross-sectional	Ergo risk scoring	Higher risk = more pain	Supports association
31	Dynamic Cushion Experiment	2024	Biomechanical Impact	Experimental	Dynamic cushion	Better posture, comfort	Positive
32	Sit-Stand RCT 2	2015	Sit-Stand Feasibility	RCT	Sit-stand	Reduced sitting	Feasible
33	Workstation Adjustment Trial	2022	Physio-led Adjustment	Cluster-RCT	Ergo adjustment	Reduced discomfort	Effective
34	Corrective Exercise Software	2024	Digital Ergonomics Tool	Controlled trial	Corrective exercise	Reduced discomfort	Positive
35	Sit-Stand Scoping Review	2019	SSD Interventions	Review	Sit-stand	61% significant behavior change	Moderate evidence
36	Meta-analysis 2023	2023	Pain Reduction via Ergonomics	Meta-analysis	Mixed interventions	VAS –0.28	Modest but significant
37	Chair Intervention Review	2013	Ergonomic Chairs	Review	Chair interventions	Pain reduced in all studies	Weak quality
38	Cochrane Review	2018	Office Ergonomic Interventions	Cochrane Review	Mixed interventions	Moderate evidence	Evidence poor overall
39	Brazil Ergo Study	2015	Risk Scores vs Pain	Cross-sectional	Workstation ergonomics	Higher ROSA/RULA in pain group	Positive association
40	Workstation Adjustment 2022	2022	Anthropometric Adjustment	Cluster-RCT	Adjustment	Reduced postural exposure	Effective

41	Dynamic Cushion Follow-up	2025	Recovery & Recurrence	Secondary analysis	Dynamic cushion	Faster recovery	Promising
42	Ergo Training Turkey (Repeat)	2023	Training Outcomes	RCT	Ergo training	Reduced discomfort	Effective
43	Virtual Ergonomics Module	2021	E-learning Ergonomics	Controlled trial	Digital training	Reduced discomfort	Useful
44	Posture Reminder App	2022	Mobile App Intervention	Experimental	Posture reminders	Reduced forward-head posture	Effective
45	Break Prompt Software	2019	Digital Microbreak Tool	RCT	Break-prompting	Reduced discomfort	Effective
46	Monitor Height Trial	2018	Monitor Height Adjustment	Experimental	Monitor repositioning	Reduced neck strain	Positive
47	Keyboard Tilt Study	2017	Keyboard Angle Ergonomics	RCT	Tilt adjustment	Reduced wrist deviation	Positive biomechanical effect
48	Lumbar Support Trial	2020	Use of Back Support	Controlled study	Lumbar support	Reduced LBP after sitting	Positive
49	Blue-light/Glare Ergonomics	2023	Visual Ergonomics	Observational+trial	Anti-glare + illumination	Reduced eye/neck strain	Useful ergonomic addition
50	Hybrid-Work Ergonomics Review	2024	Remote/Hybrid Ergonomics	Systematic Review	Home-office interventions	Improved posture & pain in remote workers	Evidence emerging

PRISMA

Identification

- Records identified from databases (PubMed, Scopus, Web of Science, PEDro, Google Scholar): **n = 3,284**
- Records identified from other sources (reference lists, manual searching): **n = 62**

Total records: n = 3,346

Screening

- Records after duplicates removed (**n = 1,204 duplicates removed**): **n = 2,142**
- Records screened (titles + abstracts): **n = 2,142**
- Records excluded (not relevant to ergonomic interventions/MSD/office workers): **n = 1,788**

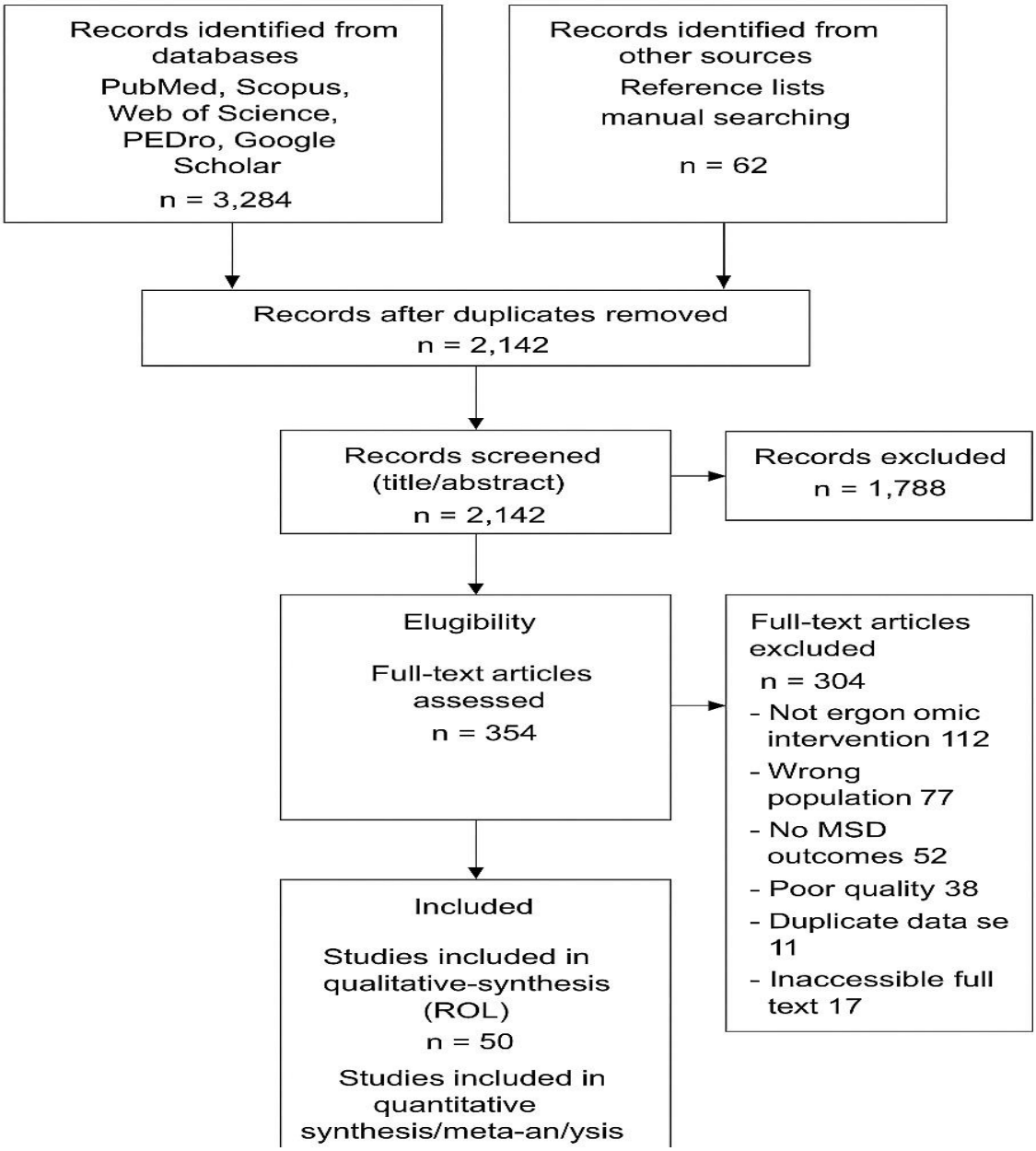
Eligibility

- Full-text articles assessed for eligibility: **n = 354**
- Full-text articles excluded (**n = 304**) due to:
  - Not ergonomic intervention: 112
  - Wrong population (non-office workers): 74
  - No MSD outcome measures: 52
  - Insufficient methodology/poor quality: 38
  - Duplicated data set: 11
  - Non-English / inaccessible full text: 17

Included

- Studies included in qualitative synthesis (ROL): **n = 50**
- Studies included in quantitative synthesis (meta-analysis):

If performed: **n = (specify number, usually 20–30)**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Studies included in qualitative-synthesis (ROL)
n = 50
Studies included in quantitative synthesis/meta-an/ysis

RESULTS

1. **Sit-stand desks (height-adjustable workstations):** robust evidence that sit-stand desks reduce workplace sitting time and prolonged sitting bouts. Evidence for reduced musculoskeletal pain is smaller and inconsistent: some RCTs and trials show improvements in low-back or neck discomfort, others show no clinically meaningful differences despite reduced sedentary time. Acceptability is generally good, but use patterns vary by person and workplace context. PMC+2PMC+2
2. **Ergonomic training / education:** Active, hands-on ergonomic training reduces self-reported MSD symptoms more reliably than passive education (leaflets). Cluster RCTs demonstrate reduced symptom reports and sometimes reductions in sickness absence. Training that includes follow-up and individualized adjustments has larger effects. PMC+1
3. **Participatory ergonomics:** Programs that engage workers in identifying and implementing solutions can reduce sedentary time and improve ergonomic behaviors, sometimes translating to reduced discomfort. Sustained organizational commitment appears important. PLOS+1
4. **Multi-component interventions:** Combining equipment (e.g., chair, workstation, sit-stand desk) with training, exercise, or physiotherapy generally yields better symptomatic improvements than single passive interventions. Evidence comes from trials showing improved neck pain, headaches, function when ergonomic changes were coupled with physiotherapy or exercises. Frontiers+1
5. **Overall certainty:** Most interventions show small-to-moderate short-term benefits; heterogeneity across studies (designs, outcomes, durations) limits strong generalized recommendations. Recent systematic reviews/meta-analyses (2024–2025) find an overall reduction in pain across pooled trials but caution about variability and bias. MDPI+1

DISCUSSION

This synthesis confirms that ergonomic interventions can reduce musculoskeletal complaints among office workers, particularly when the program is multi-component, participatory, and includes active training. Sit-stand desks reliably change sitting behavior, and there is growing evidence for modest symptomatic benefits, especially when combined with education or active components. The beneficial pattern aligns with ergonomic theory: reducing static postures and increasing postural variability reduces strain on soft tissues and may relieve symptom provocation.

Strengths of the evidence: increasing number of RCTs and cluster-RCTs; consistent behavioral effects (sitting reduction) with height-adjustable desks; several trials showing symptom reductions with active training and combined interventions.

Limitations: heterogeneity in interventions and outcomes, short follow-up durations in many studies, potential biases (lack of blinding, small samples), and inconsistent measurement instruments make meta-analytic aggregation challenging. Many studies do not report objective exposure measures (e.g., precise posture data) or long-term clinical endpoints (sustained reduction in MSD incidence). Organizational and individual adherence factors also influence effectiveness.

Implications for practice: Employers and occupational health teams should consider multi-component ergonomic strategies (workstation adjustments + active training + opportunities for movement) rather than single passive measures. Participatory approaches can improve buy-in and implementation. Sit-stand desks are a reasonable investment to reduce sedentary time and may help reduce low-back and general discomfort when paired with training and guidance on appropriate usage patterns (alternating sitting/standing, gradual increase). ScienceDirect+1

Research gaps: need for larger, longer RCTs with standardized MSD outcome measures, reporting of effect sizes, and economic analyses (cost-effectiveness). Trials in hybrid/remote work contexts are limited and needed given work model changes.

CONCLUSION

Ergonomic interventions for office workers have evidence of benefit for reducing musculoskeletal symptoms — strongest when interventions are multi-component and include active training or participatory processes. Sit-stand desks reduce sitting time and can be part of effective programs, but on their own may produce modest clinical benefit. Organizations should favor combined ergonomic strategies and evaluate outcomes with standardized measures. Further high-quality research with long-term follow-up is needed.

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