Ergonomic and Occupational Factors Associated with Work-Related Musculoskeletal Issues: A Systematic Review

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Abstract: *Work-related musculoskeletal disorders (WMSDs) remain a major occupational health concern, affecting workers' physical function, well-being, productivity, absenteeism, and healthcare utilization. This systematic review aimed to identify ergonomic, occupational, and psychosocial factors associated with WMSDs across diverse occupational sectors. Following PRISMA guidelines, electronic searches were conducted in PubMed/MEDLINE, Scopus, Web of Science, CINAHL, Embase, ScienceDirect, and Google Scholar. Eligible studies examined ergonomic, occupational, work-organization, or psychosocial factors related to musculoskeletal pain, symptoms, discomfort, injuries, or disorders. Owing to heterogeneity in study designs, populations, exposure measures, and outcome definitions, findings were synthesized narratively. Twenty-four studies were included, covering healthcare workers, physiotherapists, office and computer users, bank workers, teleworkers, manufacturing workers, language professionals, and industrial settings. Common ergonomic factors included awkward or sustained postures, repetitive movements, manual handling, forceful exertion, prolonged static work, and inadequate workstation design. Occupational and psychosocial factors included workload, work intensity, long hours, insufficient recovery, job tenure, stress, low job control, and limited organizational support. Neck, shoulder, lower-back, wrist, hand, and elbow symptoms predominated across studies. WMSD prevention should therefore integrate ergonomic design, worker training, workload management, task variation, rest breaks, psychosocial risk reduction, and organizational support.*

Keywords: work-related musculoskeletal disorders; ergonomics; occupational health; workplace risk factors; psychosocial factors; systematic review; musculoskeletal pain.

1. Introduction

Musculoskeletal disorders (MSDs) refer to conditions affecting the muscles, tendons, ligaments, joints, nerves, cartilage, and spinal structures. When these conditions are caused or aggravated by occupational exposures, they are commonly described as work-related musculoskeletal disorders (WMSDs). WMSDs occur across healthcare, office-based, manufacturing, financial-services, teleworking, and other employment settings because work tasks differ in posture, force, repetition, duration, recovery time, and work organization (Greggi et al., 2024; Demissie et al., 2024; Jacquier-Bret & Gorce, 2023). The prevalence and consequences of WMSDs demonstrate their importance for occupational health. In a recent systematic review and meta-analysis, degenerative diseases of the lumbar spine were estimated at 21% among physicians and dentists, while osteoarthritis of the hand

was estimated at 37% among dentists (Greggi et al., 2024). WMSDs can reduce physical function, increase absenteeism, lower productivity, and raise healthcare, disability, and compensation costs for workers and employers (Radhakrishnan et al., 2025; Santos et al., 2025).

Office, banking, and computer-based tasks create a specific ergonomic profile. Prolonged sitting, sustained neck flexion, repeated keyboard and mouse use, poor screen position, and non-adjustable seating are commonly associated with symptoms of the neck, shoulders, back, wrists, and hands (Demissie et al., 2024; Goldsmith, 2024; Marzban et al., 2024). In teleworking and home-working contexts, inadequate home workstations, sedentary work, and blurred work-rest boundaries were also linked with musculoskeletal symptoms (Fadel et al., 2023; Moretti et al., 2020; Oakman et al., 2022). In healthcare and physiotherapy settings, patient handling, lifting, transferring, sustained bending, manual therapy, and repeated care-related movements expose workers to lower-back, neck, shoulder, wrist, and hand symptoms (Gorce & Jacquier-Bret, 2024; Jacquier-Bret & Gorce, 2023; Teixeira et al., 2024). Biomechanical exposures do not operate in isolation. Workload, work intensity, time pressure, long working hours, insufficient recovery, low decision latitude, limited social support, job insecurity, and low job satisfaction may interact with physical exposure and contribute to WMSDs (Bezzina et al., 2023; Oakman et al., 2025).

Manual and manufacturing work adds further risk through lifting, carrying, pushing, pulling, tool use, vibration, constrained postures, forceful exertion, and repetitive production demands. These exposures are particularly relevant to upper-limb and spinal symptoms when they occur with limited recovery or high work pace (Ding et al., 2023; Lorenzini et al., 2022; Rapicault et al., 2023). Management of WMSDs requires integrated prevention rather than isolated ergonomic adjustment. Reported strategies include workstation redesign, task variation, recovery breaks, manual-handling support, worker training, and psychosocial risk reduction (Santos et al., 2025; Teixeira et al., 2024). Technology-supported ergonomic assessment and human-robot work redesign were also reported as emerging risk-management approaches in high-risk industrial settings (Cippelletti et al., 2023; Lorenzini et al., 2022; Merlo et al., 2023).

However, previous evidence remains fragmented across particular sectors, body regions, and exposure types. Healthcare and physiotherapy studies emphasize patient handling and manual therapy; office, banking, and telework studies emphasize workstation design and prolonged sitting; and manufacturing studies emphasize repetition, force, and production demands. This fragmentation limits understanding of how ergonomic, occupational, and psychosocial factors interact across different work environments. Accordingly, this systematic review aimed to synthesize evidence on ergonomic, occupational, and psychosocial factors associated with WMSDs across different occupational sectors. The review also aimed to identify the main affected body regions and summarize prevention strategies relevant to the identified risk profile.

2. Methods

2.1 Design and Reporting Guidelines

This systematic review was designed and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement, which provides a transparent structure for identifying, screening, selecting, and reporting evidence in systematic reviews (Page et al., 2021). An integrative occupational health approach was used because the review question required synthesis across ergonomic, occupational, work-organization, and psychosocial domains rather than restriction to a single occupation, exposure, or body region.

2.2 Eligibility Criteria

Eligibility criteria were structured using the PICOS framework: Population, Exposure, Comparator, Outcome, and Study design. This ensured that study selection was aligned with the review question: What ergonomic, occupational, work-organization, and psychosocial factors are associated with WMSDs among adult workers across different occupations? The population comprised working adults in any occupational sector, including healthcare, office and computer work, banking, manufacturing, teleworking, physiotherapy, industrial work, and service work. Eligible participants had to be assessed in relation to work tasks, occupational roles, workplace exposures, or employment conditions. Eligible study designs included empirical research reports such as cross-sectional, cohort, case-control, longitudinal, and non-randomized intervention studies that reported exposure-outcome data relevant to WMSDs. Studies without a formal comparator were retained only when they provided usable occupational exposure and musculoskeletal outcome data.

Studies were excluded if they focused on non-work-related traumatic injuries, retired or student populations without occupational exposure, clinical populations without workplace data, editorials, commentaries, opinion papers, conference abstracts with insufficient detail, or papers that did not provide relevant exposure-outcome data. Evidence syntheses were screened separately; only records that directly summarized occupational exposure-outcome evidence were retained in the evidence matrix, while narrative/background papers were not treated as primary empirical evidence. The exposure domain included ergonomic, occupational, biomechanical, psychosocial, and work-organization factors. Ergonomic exposures included workstation, equipment, tool, material, and work-aid design; posture; repetition; force; manual handling; prolonged sitting or standing; and vibration. Occupational and organizational exposures included workload, work intensity, long working hours, shift work, task demands, rest breaks, job control, psychosocial stress, safety culture, training, and teleworking or home-based work.

2.3 Search Strategy

A comprehensive literature search was performed to identify studies examining the association between ergonomic or occupational exposures and WMSDs. The databases searched were PubMed/MEDLINE, Scopus, Web of Science, CINAHL, Embase, ScienceDirect, and Google Scholar because they cover occupational health, ergonomics, public health, medicine, rehabilitation, nursing, engineering, and workplace safety. Three core concepts guided the search strategy: musculoskeletal outcomes, ergonomic or occupational exposures, and workplace populations. Controlled vocabulary and free-text terms were combined where possible. The primary search string was: ("work-related musculoskeletal disorders" OR "musculoskeletal symptoms" OR "musculoskeletal pain" OR "musculoskeletal discomfort" OR "musculoskeletal injuries" OR "WMSDs") AND (ergonomic OR posture OR "awkward posture" OR "repetitive work" OR repetition OR "manual handling" OR lifting OR "forceful exertion" OR "workstation design" OR "prolonged sitting" OR "prolonged standing" OR vibration OR "physical workload") AND (occupational OR workplace OR worker OR employee OR job OR employment OR "work organization" OR workload OR "job demands" OR "psychosocial factors").

Additional occupational keywords were combined with the main search string to capture healthcare workers, computer users, office workers, bank workers, manufacturing workers, teleworkers, physiotherapists, industrial workers, and home-office workers. Search results were imported into reference-management software, and duplicates were removed before screening. Title and abstract screening was followed by full-text assessment of potentially eligible studies. The selection process was summarized using a PRISMA flow diagram, and reasons for full-text exclusion were documented.

2.4 Study Selection

Study selection followed PRISMA 2020 procedures (Page et al., 2021). After duplicate removal, titles and abstracts were screened against the eligibility criteria. Records were excluded at this stage when they were not related to occupational musculoskeletal outcomes, did not involve adult workers or occupational groups, or did not examine ergonomic, biomechanical, psychosocial, occupational, or work-organization exposures. Potentially eligible full texts were then assessed against the population, exposure, comparator, outcome, and study-design criteria. Studies were excluded if they addressed non-occupational musculoskeletal problems, traumatic or sports-related injuries, general-population outcomes without workplace exposure, or insufficient exposure-outcome data. The final inclusion stage retained studies that met all eligibility criteria and provided data suitable for synthesis. The PRISMA flow diagram reported the number of records identified, duplicates removed, records screened, full texts assessed, exclusion reasons, and studies included. Two reviewers independently screened records and full texts. Disagreements were resolved through discussion, and a third reviewer was consulted when consensus could not be reached.

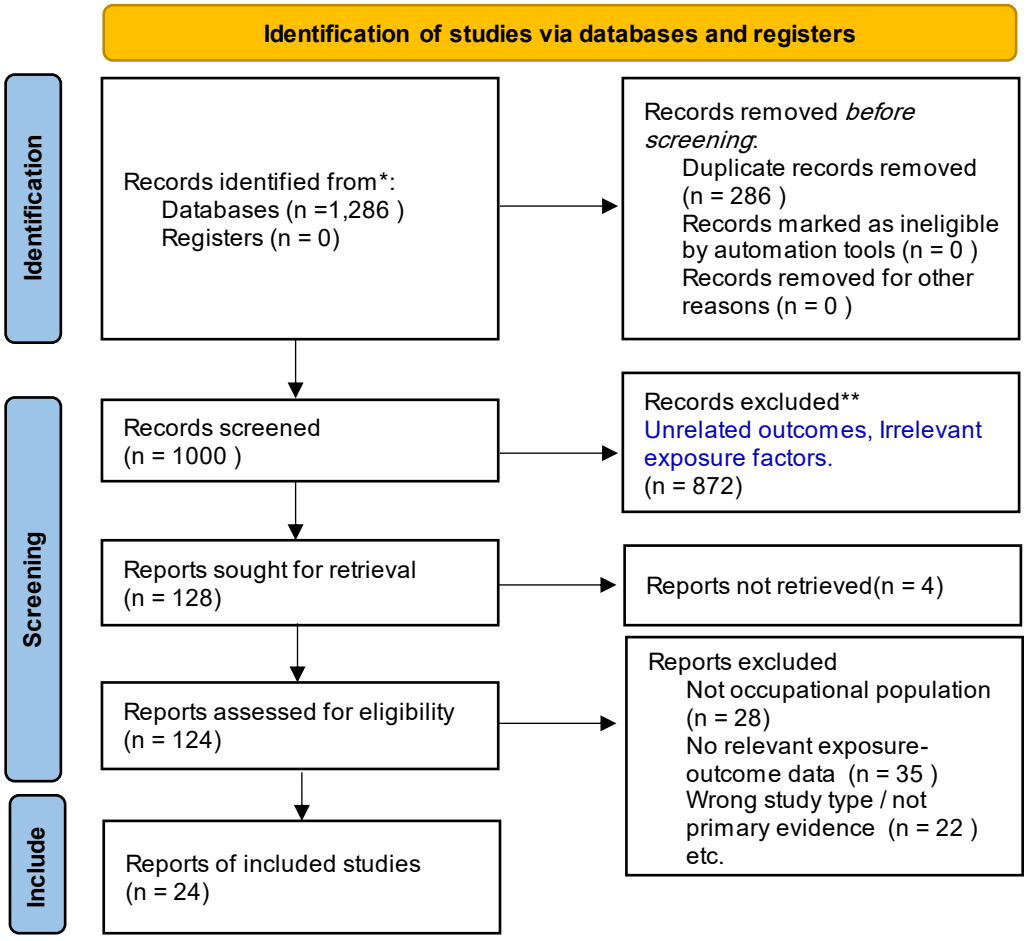

Figure 1. PRISMA flow diagram of study identification, screening, eligibility assessment, and inclusion.

2.5 Data Extraction

Data were extracted using a standardized evidence-extraction form developed for this review. The form was refined to support transparent coding of study characteristics, assessment methods, exposure domains, and risk-factor categories before narrative synthesis. For each included study, the extracted

fields included author and year, country or geographical setting, study design, sample size, population and participant characteristics, occupational sector, exposure-assessment method, musculoskeletal outcome definition, affected body region, quality-assessment tool, and main exposure-outcome findings. The extraction form used two main coding domains. The first domain was ergonomic determinants, including awkward or constrained posture, sustained static posture, prolonged sitting or standing, repetitive movement, manual handling, lifting, carrying, pushing, pulling, patient transfer, manual therapy, forceful exertion, vibration, tool or equipment exposure, and workstation or equipment-design limitations. Office and computer-work items were coded from computer-user and bank-worker evidence (Demissie et al., 2024; Marzban et al., 2024). Healthcare and physiotherapy items were coded from healthcare/physiotherapy evidence (Gorce & Jacquier-Bret, 2024; Jacquier-Bret & Gorce, 2023). Manufacturing and upper-extremity risk items were coded from production and upper-limb exposure evidence (Chiarotto et al., 2023; Ding et al., 2023; Rapicault et al., 2023).

The second domain was occupational and work-organization determinants, including workload, work intensity, long working hours, insufficient recovery or rest breaks, job demands, job control, psychosocial stress, organizational support, employment setting, telework or home-based work, and intervention-related workplace arrangements. Workload, work intensity, psychosocial stress, job control, and organizational support were coded from psychosocial and work-organization evidence (Bezzina et al., 2023; Oakman et al., 2025). Telework and home-based work items were coded from evidence on home-working arrangements and work-rest boundaries (Fadel et al., 2023; Oakman et al., 2020; Oakman et al., 2022). Preventive and organizational evidence was also coded when studies reported ergonomic training, aerobic or physical-activity interventions, technology-supported ergonomic assessment, task redesign, workplace redesign, or worker-support strategies. Ergonomic intervention and workplace-redesign items were supported by intervention evidence (Santos et al., 2025; Teixeira et al., 2024). Technology-supported assessment and dynamic task-design items were supported by industrial ergonomics evidence (Lorenzini et al., 2022; Merlo et al., 2023).

To support synthesis across heterogeneous evidence, each study was classified by occupational context: healthcare or physiotherapy, computer, office, banking, or language-professional work, telework or home work, manufacturing or industrial work, and broader occupational populations. When a study reported more than one exposure or sector, it was coded in all relevant categories rather than forced into a single group. Unclear classifications were rechecked against the eligibility criteria and retained only when the study provided explicit occupational exposure-outcome relevance. The completed extraction matrix informed Table 1 and the thematic synthesis of ergonomic determinants, occupational determinants, affected body regions, and sector-specific work environments.

2.6 Quality Assessment

Methodological quality and risk of bias were evaluated using design-appropriate tools. Analytical cross-sectional studies were appraised using the Joanna Briggs Institute checklist for analytical cross-sectional studies or the Appraisal Tool for Cross-Sectional Studies (Downes et al., 2016; Joanna Briggs Institute, 2020). Cohort and case-control studies were appraised using the Newcastle-Ottawa Scale (Wells et al., 2014). Non-randomized intervention or ergonomic technology studies were appraised using ROBINS-I (Sterne et al., 2016). Evidence syntheses were judged at review level based on the transparency of search strategy, eligibility criteria, synthesis method, and appraisal reporting. The appraisal focused on clarity of objectives, sampling, exposure measurement, outcome measurement, identification and management of confounding, appropriateness of statistical analysis, and completeness of reporting. Particular attention was given to recall bias, reporting bias, common-method bias, and exposure misclassification because many occupational musculoskeletal studies rely on self-reported exposure and symptom data. Two reviewers independently completed quality assessment. Disagreements were resolved by discussion, with third-reviewer consultation when

needed. Quality ratings were not used as automatic exclusion criteria; instead, they were used to guide the strength and caution of interpretation during synthesis.

2.7 Data Synthesis

Because the review question covered multiple sectors and exposure domains, findings were synthesized narratively rather than statistically pooled. The synthesis was structured thematically. First, ergonomic factors were summarized, including awkward or sustained posture, repetition, manual handling, forceful exertion, static work, workstation design, tool use, and equipment exposure. Second, occupational and work-organization factors were summarized, including workload, work intensity, stress, job control, working hours, shift work, job tenure, organizational support, rest breaks, and work arrangements. Third, findings were grouped by affected body region. Finally, sector-specific patterns were compared across healthcare, physiotherapy, office-based work, banking, manufacturing, teleworking, and other sectors. Prevalence estimates, odds ratios, relative risks, and comparable measures of association were summarized when reported by the included studies. Where quantitative measures were not comparable, findings were synthesized narratively.

3. Results

3.1 Study Selection and Characteristics

The systematic search yielded 1,286 records from electronic databases and no additional records from registers. After removal of 286 duplicates, 1,000 titles and abstracts were screened. A total of 872 records were excluded because they were unrelated to occupational musculoskeletal outcomes, did not involve worker populations, or did not examine ergonomic, occupational, psychosocial, or work-organization factors. Of the 128 reports sought for retrieval, 4 were unavailable. The remaining 124 full-text reports were assessed for eligibility, and 100 were excluded: 28 focused on general populations, 35 lacked relevant exposure-outcome data, 22 were ineligible study types or lacked relevant evidence, and 15 had insufficient methodological detail or unclear work-related musculoskeletal outcomes. Finally, 24 studies met the eligibility criteria and were included in the synthesis. The included evidence base covered work-related musculoskeletal issues across multiple occupational contexts, including healthcare and physiotherapy, computer and office work, banking, manufacturing, telework, language-related work, and technologically mediated work systems.

Healthcare and physiotherapy evidence focused on patient handling, manual therapy, injury prevention, and technology-supported prevention (Gorce & Jacquier-Bret, 2024; Jacquier-Bret & Gorce, 2023; Teixeira et al., 2024). Computer, office, banking, and language-professional evidence addressed workstation design, prolonged sitting, screen exposure, and upper-body symptoms (Demissie et al., 2024; Goldsmith, 2024; Marzban et al., 2024). Telework evidence focused on home workstation conditions, reduced movement, and work-home boundary issues (Fadel et al., 2023; Moretti et al., 2020; Oakman et al., 2022). Manufacturing and industrial evidence addressed repetitive work, physical demand, production pace, ergonomic assessment systems, and human-robot collaboration (Ding et al., 2023; Lorenzini et al., 2022; Merlo et al., 2023).

The evidence represented several countries and international datasets, including China, France, Italy, Ghana, Nigeria, the United States, and multi-country evidence syntheses (Ding et al., 2023; Greggi et al., 2024; Santos et al., 2025). The included publications were concentrated between 2020 and 2025, reflecting increased attention to telework, digitalization, ergonomic technology, and changing workplace organization. The most frequently reported outcomes were musculoskeletal pain, symptoms, discomfort, and disorders in multiple body regions. In healthcare and physiotherapy, the most commonly reported symptoms involved the lower back, neck, shoulders, wrists, and hands

(Gorce & Jacquier-Bret, 2024; Jacquier-Bret & Gorce, 2023; Teixeira et al., 2024). Computer-based, banking, and language-professional contexts mainly reported neck, shoulder, back, wrist, and hand symptoms (Demissie et al., 2024; Goldsmith, 2024; Marzban et al., 2024). Teleworking and home-working contexts reported similar neck, shoulder, back, wrist, and hand symptoms (Fadel et al., 2023; Moretti et al., 2020; Oakman et al., 2022). In manufacturing and industrial contexts, repetitive work, forceful exertion, constrained posture, and production demands were associated with back and upper-extremity symptoms (Ding et al., 2023; Lorenzini et al., 2022; Rapicault et al., 2023).

A literature review matrix was developed to categorize evidence by ergonomic factors, occupational/work-organization factors, psychosocial factors, technology-related interventions, occupational sector, study design, quality-assessment tool, and preliminary risk-of-bias judgment. As shown in Table 1, the most common factors were posture or static work, workload or work intensity, repetition, workstation or equipment design, manual handling or forceful exertion, and psychosocial stress.

3.2 Evidence Matrix, Quality Assessment, and Risk-Factor Classification

Table 1 : Evidence matrix and preliminary quality assessment.

No.	Author(s) & year	Study design	Sector/context	Main factors/body regions	Quality/risk of bias
1	Greggi et al. (2024)	Systematic review/meta-analysis	Healthcare, farming, industrial, computer sectors	Posture, manual handling, sector-specific WMSD prevalence; lumbar spine and hand outcomes	Review-level appraisal; low to moderate
2	Bezzina et al. (2023)	Systematic review of longitudinal studies	Multiple occupational sectors	Psychosocial factors, job demands, support, and MSD risk	Review-level appraisal; low to moderate
3	Demissie et al. (2024)	Systematic review	Computer users	Prolonged sitting, workstation design, repetition; neck, shoulder, back, wrist/hand symptoms	Review-level appraisal; moderate
4	Fadel et al. (2023)	Systematic review	Telework/home work	Home workstation limitations, sedentary work, blurred work-rest boundaries	Review-level appraisal; moderate
5	Jacquier-Bret & Gorce (2023)	Systematic review	Healthcare professionals	Patient handling, sustained posture, lifting; lower back, neck, shoulder, wrist/hand symptoms	Review-level appraisal; moderate
6	Chiarotto et al. (2023)	Systematic review	Upper-extremity occupational exposure	Physical and psychosocial exposures; elbow and upper-extremity disorders	Review-level appraisal; moderate
7	Marzban et al. (2024)	Systematic review/meta-analysis	Bank workers	Office workstation design, prolonged sitting, computer use; neck, back, shoulder, wrist/hand symptoms	Review-level appraisal; low to moderate

No.	Author(s) & year	Study design	Sector/context	Main factors/body regions	Quality/risk of bias
8	Goldsmith (2024)	Cross-sectional study	Language professionals	Computer/screen exposure; upper-body pain and eye strain	AXIS/JBI; moderate
9	Oakman et al. (2020)	Rapid review	Working from home	Physical and mental health effects of home-based work	Review-level appraisal; moderate
10	Moretti et al. (2020)	Cross-sectional study	Home workers during COVID-19	Home workstation, sedentary behavior, reduced movement	AXIS/JBI; moderate
11	Afolabi et al. (2025)	Cross-sectional study	University population with work-like exposures	Prevalence and associated risk factors for MSDs	AXIS/JBI; moderate
12	Yarfi (2021)	Cross-sectional study	Ghanaian physiotherapists	Career prevalence, coping mechanisms, body-region symptoms	AXIS/JBI; moderate
13	Ding et al. (2023)	Cross-sectional study	Emerging manufacturing workers	Repetition, posture, workload, production demand; back and upper-extremity symptoms	AXIS/JBI; moderate
14	Oloruntoba et al. (2024)	Cross-sectional study	US healthcare workers	Musculoskeletal pain and depressive symptoms	AXIS/JBI; moderate
15	Gorce & Jacquier-Bret (2024)	Systematic review	Physical therapists/physiotherapists	Manual therapy, sustained posture, patient handling; lower back, neck, shoulder, wrist/hand symptoms	Review-level appraisal; moderate
16	Santos et al. (2025)	Systematic review/meta-analysis	Ergonomic interventions	Effectiveness of ergonomic interventions for work-related musculoskeletal pain	Review-level appraisal; low to moderate
17	Teixeira et al. (2024)	Scoping review	Healthcare professionals	Technology for preventing work-related musculoskeletal injuries	Review-level appraisal; moderate
18	Lorenzini et al. (2022)	Ergonomic assessment/observational technology study	Industrial workplace ergonomics	Online multi-index ergonomic assessment, posture and workload monitoring	ROBINS-I; moderate
19	Merlo et al. (2023)	Ergonomic framework/technology study	Human-robot collaboration	Ergonomic role allocation and dynamic task design	ROBINS-I; moderate
20	Cippelletti et al. (2023)	Case/observational workplace study	Cobot introduction/industrial setting	Psychosocial aspects and subjective employee experience before cobot introduction	ROBINS-I; moderate
21	Rapicault et al. (2023)	Risk-score development/validation study	French working population	Upper-extremity MSD risk score, physical and occupational exposures	ROBINS-I/NOS; moderate

No.	Author(s) & year	Study design	Sector/context	Main factors/body regions	Quality/risk of bias
22	Radhakrishnan et al. (2025)	Narrative review	Occupational health broadly	Epidemiology, risk factors, socioeconomic impact, and prevention	Not eligible for primary appraisal; not rated
23	Oakman et al. (2025)	Systematic review/meta-analysis	Multiple occupational sectors	Psychosocial versus biomechanical hazards and MSD risk	Review-level appraisal; low to moderate
24	Oakman et al. (2022)	Longitudinal cohort study	Employees working from home	Musculoskeletal pain trajectories during home work	NOS; low to moderate

The evidence was also organized into a risk-factor classification table to mirror the extracted domains and to separate ergonomic, occupational/work-organization, telework, and intervention-related determinants before the narrative results.

Table 2 : Risk-factor classification based on extracted determinants.

Domain	Risk-factor category	Specific determinants coded	Main contexts and body regions	Representative evidence
Ergonomic determinants	Posture and static work	Awkward or constrained posture; sustained neck or trunk flexion; prolonged sitting or standing; static seated or standing work.	Office, banking, telework, healthcare, physiotherapy, and manufacturing contexts; mainly neck, shoulders, back, wrists, and hands.	Demissie et al. (2024); Jacquier-Bret & Gorce (2023); Marzban et al. (2024)
Ergonomic determinants	Repetition and upper-limb load	Repetitive keyboard or mouse use; repetitive production work; repeated clinical or manual-therapy movements; insufficient recovery.	Computer work, production work, physiotherapy, and healthcare; mainly shoulders, elbows, wrists, hands, forearms, and neck.	Chiarotto et al. (2023); Demissie et al. (2024); Rapicault et al. (2023)
Ergonomic determinants	Manual handling and forceful exertion	Patient transfer, repositioning, lifting, carrying, pushing, pulling, manual handling, tool use, and forceful tasks.	Healthcare, physiotherapy, manufacturing, and industrial settings; mainly lower back, shoulders, and upper limbs.	Ding et al. (2023); Jacquier-Bret & Gorce (2023); Teixeira et al. (2024)
Ergonomic determinants	Workstation and equipment design	Poorly supportive seating; limited adjustability; screen, desk, and input-device limitations; inadequate home-workstation setup.	Computer, office, banking, telework, and home-working settings; mainly neck, back, shoulders, wrists, and hands.	Demissie et al. (2024); Fadel et al. (2023); Moretti et al. (2020)
Occupational/work-organization determinants	Workload, work intensity, and recovery	High workload; work pressure; long working hours; insufficient rest breaks; high pace; job demands; limited recovery.	Multiple occupational sectors, including healthcare, office work, telework, and manufacturing; multi-region WMSD outcomes.	Bezzina et al. (2023); Ding et al. (2023); Oakman et al. (2025)

Domain	Risk-factor category	Specific determinants coded	Main contexts and body regions	Representative evidence
Occupational/work-organization determinants	Psychosocial and organizational factors	Psychosocial stress; low job control; limited support; low decision latitude; organizational support and safety-culture issues.	Multiple occupational sectors; musculoskeletal symptoms interacting with biomechanical exposure.	Bezzina et al. (2023); Oakman et al. (2025)
Work arrangement determinants	Telework and home-based work	Inadequate home workstation; reduced movement variability; blurred work-rest boundaries; prolonged sedentary work.	Teleworkers and home workers; neck, shoulders, back, wrists, and hands.	Fadel et al. (2023); Moretti et al. (2020); Oakman et al. (2022)
Prevention and intervention determinants	Ergonomic interventions and technology-supported prevention	Ergonomic training; physical-activity or aerobic interventions; task redesign; workplace redesign; technology-supported ergonomic assessment; dynamic task allocation.	Healthcare, industrial, and broader workplace prevention contexts; prevention of work-related musculoskeletal pain or injury.	Santos et al. (2025); Teixeira et al. (2024); Lorenzini et al. (2022); Merlo et al. (2023)

This classification table was used to guide the sequence of the following results sections: ergonomic determinants, occupational determinants, affected body regions, and sector-specific work environments.

3.3 Ergonomic Determinants

Across the included evidence, ergonomic factors were repeatedly associated with WMSDs in multiple sectors. The most frequently reported factors were awkward or sustained posture, repetitive movement, manual handling, forceful exertion, prolonged static work, and inadequate workstation or equipment design (Demissie et al., 2024; Ding et al., 2023; Greggi et al., 2024). In computer-based office and banking tasks, sustained sitting, neck flexion toward the workstation, and poorly designed seating or desk arrangements were associated with neck, shoulder, back, wrist, and hand symptoms (Demissie et al., 2024; Goldsmith, 2024; Marzban et al., 2024). In teleworking, non-adjustable chairs, inadequate monitor position, limited desk clearance, and poorly designed home workstations were associated with musculoskeletal symptoms (Fadel et al., 2023; Moretti et al., 2020; Oakman et al., 2022). Repetitive movement was reported across computer work, manual therapy, healthcare, and production contexts. In upper-extremity and production evidence, repetition combined with force, awkward posture, high pace, or insufficient recovery was particularly relevant to shoulders, elbows, wrists, hands, and forearms (Chiarotto et al., 2023; Ding et al., 2023; Rapicault et al., 2023). Computer-use and physiotherapy evidence similarly linked repeated upper-limb activity with wrist, hand, shoulder, and forearm symptoms (Demissie et al., 2024; Gorce & Jacquier-Bret, 2024).

Manual handling and forceful exertion were important in healthcare, physiotherapy, manufacturing, and other physically demanding occupations. Patient transfer and repositioning were associated with lower-back, shoulder, and upper-limb symptoms among healthcare workers, while repetitive tool use, pushing, pulling, carrying, and forceful tasks were relevant in manufacturing settings (Ding et al., 2023; Jacquier-Bret & Gorce, 2023; Teixeira et al., 2024). Suboptimal workstation and equipment design were also associated with WMSDs. Relevant factors included desk and screen dimensions, prolonged static use of screens or input devices, limited adjustability, and poorly supportive seating (Demissie et al., 2024; Fadel et al., 2023; Marzban et al., 2024).

3.4 Occupational Determinants

Occupational and work-organization factors included high workload, work intensity, long working hours, insufficient rest, psychosocial stress, low job control, and limited support (Bezzina et al., 2023; Ding et al., 2023; Oakman et al., 2025). Healthcare, physiotherapy, and manufacturing work showed higher physical workload through patient handling, manual therapy, repetitive tasks, and physically demanding production work. Office, banking, computer, and telework contexts showed risks related to long workdays, uninterrupted sitting, prolonged screen exposure, and insufficient breaks (Demissie et al., 2024; Fadel et al., 2023; Marzban et al., 2024). Work organization also influenced musculoskeletal risk. High job demands, work pressure, low support, and low control were linked with musculoskeletal symptoms (Bezzina et al., 2023; Oakman et al., 2025). Telework and home-based work introduced risks through inadequate home workstations, blurred work-rest boundaries, reduced movement variability, and limited occupational-health oversight (Fadel et al., 2023; Moretti et al., 2020; Oakman et al., 2022).

3.5 Affected Body Regions

Multiple body regions were affected by WMSDs, most commonly the neck, shoulders, lower back, upper back, wrists, hands, and elbows. Neck and shoulder symptoms were reported among computer users, bank employees, teleworkers, language professionals, healthcare workers, and physiotherapists. In office, banking, and language-professional work, these symptoms were linked with prolonged sitting, screen use, repetitive upper-limb movement, sustained posture, and poor workstation design (Demissie et al., 2024; Goldsmith, 2024; Marzban et al., 2024). In healthcare and physiotherapy, neck and shoulder symptoms were linked with sustained posture, patient handling, and manual therapy (Gorce & Jacquier-Bret, 2024; Jacquier-Bret & Gorce, 2023). Symptoms of the lower back were recorded in healthcare and physiotherapy occupations and in manufacturing, due to exposure to the manual handling of patients, transfer activities, lifting, carrying, and bending combined with prolonged awkward postures (Ding et al., 2023; Gorce & Jacquier-Bret, 2024; Teixeira et al., 2024).

Upper-extremity symptoms, including elbow, wrist, hand, and forearm symptoms, were associated with keyboard and mouse use, manual therapy, repetitive work, forceful exertion, and insufficient recovery (Chiarotto et al., 2023; Demissie et al., 2024; Gorce & Jacquier-Bret, 2024). Symptoms of elbow and upper-extremity disorders were associated with the combination of posture, repetitive work, force, and insufficient recovery (Chiarotto et al., 2023; Rapicault et al., 2023). Lower-extremity symptoms received less attention and were associated with prolonged standing, walking, kneeling, or physically demanding work, especially among healthcare and manufacturing workers (Ding et al., 2023; Jacquier-Bret & Gorce, 2023).

3.6 Work Environments Sector

Sector-specific findings indicated different risk patterns by task and work environment. In healthcare and physiotherapy, WMSDs were associated with patient handling, lifting, transferring, sustained bending, manual therapy, repetitive clinical tasks, and long working hours. The most commonly affected regions were the lower back, neck, shoulders, wrists, and hands (Gorce & Jacquier-Bret, 2024; Jacquier-Bret & Gorce, 2023; Teixeira et al., 2024). In office, computer-based, and banking sectors, prolonged static sitting, repeated keyboard or mouse use, screen exposure, and inadequate workstations were associated with symptoms of the neck, shoulders, back, wrists, and hands (Demissie et al., 2024; Goldsmith, 2024; Marzban et al., 2024). Teleworking contexts showed similar symptoms through inadequate home workstations, reduced movement variability, and blurred work-

rest boundaries (Fadel et al., 2023; Moretti et al., 2020; Oakman et al., 2022). In manufacturing and industrial contexts, repetitive work, forceful exertion, frequent tool handling, constrained postures, and production demands were linked with biomechanical risk, while emerging ergonomic technologies and human-robot collaboration systems were evaluated as potential risk-management approaches (Ding et al., 2023; Lorenzini et al., 2022; Merlo et al., 2023).

3.7 Quality Assessment

As summarized in Table 1, The preliminary quality assessment showed that evidence quality varied by study design. Systematic reviews and meta-analyses generally provided broader synthesis, whereas cross-sectional studies contributed sector-specific exposure-outcome information but were more vulnerable to recall bias, self-report bias, and exposure misclassification. Longitudinal evidence was stronger for temporal interpretation, while technology-focused and ergonomic-intervention studies were appraised with caution because of context specificity and limited generalizability. Overall, the most consistent evidence concerned awkward or sustained posture, repetitive work, manual handling or forceful exertion, prolonged sitting, workload, job demands, and psychosocial stress. Evidence was less consistent for newer contexts such as telework, technology-supported ergonomic assessment, and human-robot collaboration, where additional longitudinal and intervention-based studies are needed.

4. Discussion

4.1 Main Findings

This systematic review categorized work-related musculoskeletal disorders as multifactorial occupational health issues caused by the combination of the ergonomic, occupational, and psychosocial factors. The major ergonomic factors identified in the studies were awkward or sustained posture, repetitive movements, manual handling, exertion, prolonged static work, and poor workstation or equipment design. Such ergonomic factors were reported across healthcare and physiotherapy evidence (Greggi et al., 2024; Jacquier-Bret & Gorce, 2023) and across computer, banking, and manufacturing evidence (Demissie et al., 2024; Marzban et al., 2024; Ding et al., 2023). The review also found that occupational and work-organization factors contributed substantially to musculoskeletal risk. High workload, long working hours, insufficient rest, work intensity, job tenure, psychosocial stress, low job control, and inadequate organizational support were related to musculoskeletal symptoms across studies. The neck, shoulders, lower back, upper back, wrists, hands, and elbows were the most commonly affected regions. These findings suggest that work-related musculoskeletal problems are the result of complex conditions that include both physical exposure and organizational factors (Bezzina et al., 2023; Oakman et al., 2025).

4.2 Interpretation

These findings suggest that ergonomic issues contribute to musculoskeletal disorders through repetitive or sustained exposure to biomechanical demands. Awkward or sustained postures, repetitive actions, static work, and insufficient recovery may increase tissue loading and reduce recovery time. Telework and computer-based tasks were associated with symptoms of the neck, upper back, hands, and wrists (Demissie et al., 2024; Fadel et al., 2023). Healthcare, manufacturing, and physiotherapy settings carried higher risk through patient handling and physically demanding work (Ding et al., 2023; Gorce & Jacquier-Bret, 2024). Psychosocial and work-organization conditions also shape ergonomic risk because high work pressure, low autonomy, and inadequate support may increase muscle tension, fatigue, pain, and delayed recovery (Bezzina et al., 2023; Oakman et al.,

2025). Therefore, prevention should address workstation design, task design, workload, rest breaks, organizational support, and psychosocial risk together.

4.3 Practical Implications

These results have significant implications for workplace prevention and occupational health practice. Ergonomic risk assessment should be coupled with workplace redesign, appropriate equipment, manual-handling support, task rotation, rest breaks, and training. In office, banking, computer-based, and teleworking tasks, interventions should focus on adjustable workstations, optimal screen and seating arrangements, movement breaks, and reduced continuous sedentary work. In healthcare, physiotherapy, manufacturing, and manual work, interventions should focus on patient-handling aids, lifting assistance, workload distribution, suitable tools and equipment, and reduction of repetitive or excessive forceful tasks. The findings also indicate that interventions should address both organizational and ergonomic aspects. Psychosocial risk prevention, adequate staffing, workload management, supportive supervision, worker participation, and early symptom reporting may reduce the incidence and persistence of musculoskeletal symptoms. Telework requires particular attention because ergonomic risk can shift from formal workplaces to home environments where occupational-health oversight is limited. Remote and hybrid work should therefore include ergonomic provision, workload supervision, rest breaks, and psychosocial support.

4.4 Strengths and Limitations

One strength of this review is its broad occupational scope. Instead of examining a single worksite, body region, or exposure type, the review compared several work environments and considered ergonomic, occupational, and psychosocial factors together. This approach helped identify common factors such as posture, repetition, manual handling, workload, and psychosocial stress across healthcare, physiotherapy, telework, banking, manufacturing, and office-based work. Several limitations should be considered. The evidence varied in study design, population, exposure measurement, outcome definition, and body region. This heterogeneity limited quantitative synthesis. Many included studies were cross-sectional and relied on self-reported exposures or symptoms, which may increase reporting bias, recall bias, and exposure misclassification. Differences between occupational contexts also require caution when generalizing findings across sectors.

4.5 Future Research

Future research should prioritize longitudinal and intervention-based designs to clarify how occupational risk factors contribute to WMSDs over time. Validated exposure and outcome measures would strengthen evidence and improve comparability across studies. Future studies should also examine how psychosocial and biomechanical conditions interact in real workplace systems, especially in emerging contexts such as telework, hybrid work, ergonomic technologies, and human-robot collaboration. More sector-specific prevention studies are needed in healthcare, manufacturing, and remote-work environments.

5. Conclusion

This systematic review identified ergonomic, occupational, and psychosocial factors associated with work-related musculoskeletal disorders across a range of work environments. The most common ergonomic factors were awkward or sustained posture, repetitive movement, manual handling, forceful exertion, static work, and poor workstation setup. Occupational factors included long

working hours, heavy workload, insufficient recovery, high work demands, work-related stress, low control, and inadequate support. These factors varied across healthcare, physiotherapy, computer-based work, banking, teleworking, manufacturing, and industrial environments. The findings suggest that preventing WMSDs requires integrated workplace design and organizational support. Effective prevention should combine ergonomic workstation design, manual-handling aids, task variation, rest breaks, worker training, psychosocial risk reduction, and management engagement. In remote and hybrid work, prevention should also address the transfer of ergonomic risk from formal workplaces to home workstations. Future research should use longitudinal and sector-specific intervention designs to clarify how ergonomic and work-related factors interact and to guide effective prevention in contemporary workplaces.

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