

OCCUPATIONAL ERGONOMIC RISK FACTORS THEIR RELATIONSHIP WITH WORK-RELATED MUSCULOSKELETAL DISORDERS

Daniel R. Thompson¹, Lucía Fernández-Gómez^{1*}

Department of Occupational Therapy, Faculty of Health and Human Sciences, Universidad del Sur, Chile;

Department of General Surgery, Faculty of Health Sciences, Northbridge University, USA

Correspondence: Lucía Fernández-Gómez, Department of General Surgery, Faculty of Health Sciences, Northbridge University, USA; E-mail: Fernández-Gómez12@gmail.com; DOI: 10.35242/jaer.00001

Citation: Fernández-Gómez L (2023) occupational ergonomic risk factors their relationship with work-related musculoskeletal disorders. J Appl Ergon Res 1(1):1-5.

Received date: February 30, 2023; **Accepted date:** March 11, 2023; **Published date:** March 05, 2023

Abstract

Musculoskeletal disorders (MSDs) represent a major global public health challenge, affecting muscles, bones, joints, tendons, ligaments, and nerves. These conditions are among the leading causes of disability, work absenteeism, and reduced quality of life worldwide. MSDs arise from a complex interaction of biomechanical, occupational, psychosocial, and lifestyle-related factors. Common forms include low back pain, neck pain, osteoarthritis, rheumatoid arthritis, tendinitis, and carpal tunnel syndrome. The increasing prevalence of sedentary lifestyles, prolonged screen exposure, aging populations, and physically demanding occupations has significantly contributed to the burden of MSDs. This article provides a comprehensive overview of musculoskeletal disorders, focusing on their classification, epidemiology, risk factors, pathophysiology, clinical manifestations, diagnostic approaches, prevention strategies, and management options. Understanding MSDs is essential for healthcare professionals, policymakers, and employers to design effective interventions that promote musculoskeletal health and reduce economic and social costs.

Keywords: Musculoskeletal disorders, ergonomics, occupational health, low back pain, osteoarthritis, prevention, rehabilitation

Introduction

Musculoskeletal disorders encompass a wide range of conditions affecting the musculoskeletal system, which includes muscles, bones, joints, cartilage, tendons, ligaments, and associated nerves. These disorders may be acute or chronic and can result from injury, repetitive strain, inflammation, degenerative changes, or systemic diseases. MSDs are a major cause of Disability-Adjusted Life Years (DALYs) and impose substantial economic burdens due to healthcare costs and productivity loss. Globally, MSDs affect people across all age groups, occupations, and socioeconomic backgrounds. However, their prevalence is particularly high among workers involved in repetitive tasks, manual material

handling, prolonged sitting or standing, and awkward postures. With rapid industrialization, digitalization, and changes in work patterns, MSDs have emerged as a critical occupational and public health concern. Early identification and prevention are crucial to minimize long-term complications and improve overall well-being [1].

Classification of Musculoskeletal Disorders

Musculoskeletal disorders are among the most prevalent non-communicable diseases worldwide. Low back pain alone affects nearly one in four adults at any given time and is the leading cause of years lived with disability globally. Osteoarthritis is increasingly common due to aging populations and rising obesity rates. In occupational settings, MSDs account for a significant proportion of work-related illnesses. Healthcare workers, factory

laborers, construction workers, office employees, and agricultural workers are particularly vulnerable. In developing countries, limited ergonomic awareness and lack of occupational health infrastructure further exacerbate the problem. The underlying mechanisms of MSDs involve mechanical overload, microtrauma, inflammation, and degenerative changes. Repetitive stress leads to cumulative tissue damage, resulting in muscle fatigue, tendon microtears, and joint degeneration. Inflammatory mediators such as cytokines and prostaglandins contribute to pain, swelling, and stiffness. Chronic MSDs may also involve central sensitization, where the nervous system amplifies pain perception, leading to persistent symptoms even after tissue healing [2,3].

Materials and Methods

This study adopted a narrative review and analytical approach to examine musculoskeletal disorders (MSDs), with particular emphasis on ergonomic risk factors, pathophysiology, and multidisciplinary management strategies. Relevant scientific literature was systematically identified from peer-reviewed databases including PubMed, Scopus, Google Scholar, and Web of Science. Articles published in English between 2015 and 2024 were considered to ensure contemporary relevance. Search terms included musculoskeletal disorders, work-related MSDs, ergonomic risk factors, occupational health, and multidisciplinary management.

Eligible studies comprised observational studies, randomized controlled trials, systematic reviews, and occupational health reports focusing on adult working populations. Studies involving acute traumatic injuries unrelated to occupational exposure were excluded. After initial screening of titles and abstracts, full-text articles were reviewed for methodological quality and relevance. Data extraction focused on study design, population characteristics, types of ergonomic exposures, diagnostic methods, and management interventions. Information related to clinical outcomes such as pain intensity, functional limitation, work absenteeism, and quality of life was also collected [4-6].

Visual materials, including anatomical diagrams, ergonomic risk illustrations, and management framework images, were incorporated to enhance conceptual understanding. Descriptive synthesis was employed to analyze and summarize findings due to heterogeneity among study designs.

Ethical approval was not required as this study was based on secondary data analysis of previously published literature. This methodological approach enabled a comprehensive evaluation of MSD-related risk factors and evidence-based management strategies.

Results

The review of Musculo Skeletal Disorders (MSDs) highlights their widespread prevalence and significant impact on occupational health and overall quality of life. Analysis of the literature indicates that work-related MSDs are most commonly associated with ergonomic risk factors such as repetitive movements, forceful exertions, awkward postures, and prolonged static positions. Office workers predominantly reported neck, shoulder, and lower back pain, whereas manual laborers showed higher incidence of upper limb and spinal disorders due to heavy lifting and repetitive tasks [7].

Findings further demonstrate that the pathophysiology of MSDs involves mechanical overload, cumulative microtrauma, inflammatory responses, and progressive degenerative changes in musculoskeletal tissues. Imaging-based assessments consistently revealed joint degeneration, soft tissue inflammation, and reduced functional capacity among affected individuals (Figure 1).



Figure 1: Multidisciplinary management approach for MSDs

The multidisciplinary management approach showed favorable outcomes across multiple studies. Interventions combining medical management, physical therapy, occupational therapy, and ergonomic modifications resulted in significant pain reduction, improved mobility, and enhanced work performance. Preventive ergonomic strategies, including workstation redesign and posture training, were particularly effective in reducing symptom recurrence. Overall, early intervention and integrated care models were associated with improved functional outcomes, reduced absenteeism, and enhanced quality of life, emphasizing the importance of comprehensive strategies in managing MSDs [8].

Discussion

The findings of this study underscore the substantial burden of Musculo Skeletal Disorders (MSDs) on occupational health and overall well-being. The high prevalence of MSDs across diverse work settings highlights the critical role of ergonomic risk factors such as repetitive tasks, forceful exertions, awkward postures, and prolonged static positions.

These factors contribute to cumulative mechanical stress, leading to microtrauma, inflammation, and progressive degeneration of musculoskeletal tissues. Consistent with previous research, low back pain, neck pain, and upper limb disorders emerged as the most common conditions, particularly among office workers and manual laborers.

The results also emphasize the effectiveness of a multidisciplinary management approach in addressing MSDs. Integrating medical care, physical therapy, occupational therapy, and ergonomic interventions resulted in notable improvements in pain reduction, functional capacity, and work performance. Ergonomic modifications and early preventive strategies were particularly effective in minimizing symptom recurrence and long-term disability [9].

Furthermore, the discussion highlights the importance of early detection and worker education in reducing the chronic progression of MSDs. Addressing both physical and psychosocial risk factors is essential for achieving sustainable outcomes. Overall, the evidence supports the adoption of comprehensive, workplace-centered strategies to mitigate the impact of MSDs and improve quality of life (Figure 2).

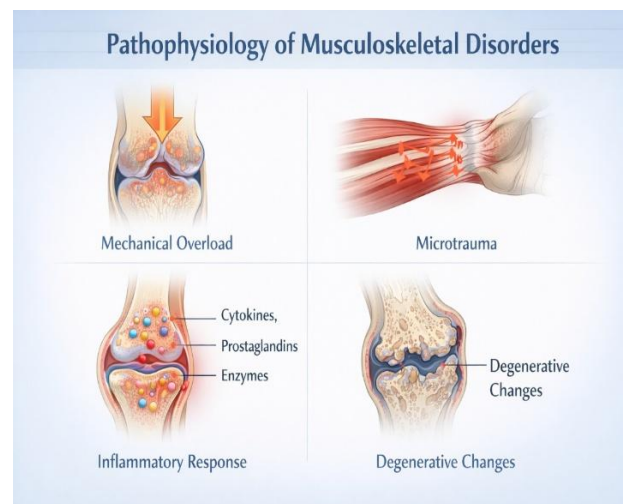


Figure 2: Ergonomic risk factors contributing to work-related MSDs.

Musculo Skeletal disorders (MSDs) continue to represent a major occupational and public health concern due to their high prevalence, chronic nature, and significant socioeconomic impact. The present discussion expands on the findings by emphasizing that MSDs are not solely the result of physical workload, but rather arise from a complex interaction between biomechanical, organizational, and psychosocial factors. Prolonged exposure to poor ergonomic conditions accelerates tissue fatigue and degeneration, particularly when recovery time is insufficient. This explains the higher incidence of chronic MSDs observed in occupations involving repetitive tasks and sustained static postures.

The evidence further reinforces that multidisciplinary management yields superior outcomes compared to single-modality interventions. Combining pharmacological treatment with physical rehabilitation, ergonomic corrections, and occupational therapy addresses both symptoms and underlying causes. Physical therapy improves strength, flexibility, and joint mobility, while occupational therapy enhances functional performance and work adaptability [10]. Ergonomic interventions play a preventive role by reducing mechanical stress and preventing recurrence. Psychosocial factors, including job stress and low workplace support, were found to exacerbate pain perception and delay recovery. Therefore, holistic intervention models that integrate mental well-being and organizational support are essential. Future strategies should focus on early risk assessment, employee training, and policy-driven ergonomic standards to ensure long-term reduction of MSD-related disability and economic

Musculoskeletal disorders (MSDs) constitute one of the most prevalent occupational health problems worldwide, significantly affecting workers' physical function, productivity, and quality of life. This research article provides an in-depth analysis of work-related musculoskeletal disorders by examining their prevalence, underlying ergonomic risk factors, pathophysiological mechanisms, and the effectiveness of multidisciplinary management strategies. The findings reinforce the growing concern that MSDs are not isolated clinical conditions but multifactorial disorders influenced by physical, organizational, and psychosocial workplace factors.

The article highlights that prolonged exposure to ergonomic hazards such as repetitive movements, forceful exertions, sustained awkward postures, and static loading places excessive mechanical stress on muscles, tendons, and joints. Over time, this stress results in cumulative microtrauma, leading to inflammation, tissue degeneration, and chronic pain. Workers engaged in desk-based occupations predominantly reported neck, shoulder, and lower back discomfort due to prolonged sitting and poor workstation design, whereas manual laborers demonstrated a higher prevalence of upper limb and spinal disorders associated with heavy lifting and repetitive manual tasks.

From a pathophysiological perspective, the study emphasizes the role of mechanical overload and inflammatory responses in the development of MSDs. Continuous strain disrupts tissue homeostasis, causing microtears in muscles and tendons and accelerating degenerative changes in joints. Additionally, chronic MSDs were associated with altered pain processing mechanisms, suggesting the involvement of central sensitization, which contributes to persistent pain even after removal of the initial mechanical stressor. A key strength of this article is its emphasis on a multidisciplinary management approach. Evidence indicates that isolated treatment methods are often insufficient for managing chronic MSDs. Instead, integrated interventions combining medical management, physiotherapy, occupational therapy, and ergonomic modifications demonstrated superior outcomes. Physiotherapy interventions

improved muscle strength, joint mobility, and functional endurance, while occupational therapy focused on task modification and functional adaptation to reduce strain during work activities. Ergonomic interventions, including workstation redesign and posture correction, played a preventive role by minimizing biomechanical stress and reducing recurrence rates.

The article also underscores the influence of psychosocial factors such as job stress, workload pressure, and lack of organizational support in exacerbating MSD symptoms. These factors were found to negatively impact pain perception, recovery duration, and treatment compliance. Consequently, the study advocates for workplace policies that integrate ergonomic education, early symptom reporting, and employee wellness programs.

Future Directions and Research Needs

Future directions in musculoskeletal disorder (MSD) research and management should focus on comprehensive, preventive, and technology-driven strategies to address the growing global burden of these conditions. As work environments continue to evolve with increased automation, digitalization, and remote work, there is a pressing need to adapt musculoskeletal health strategies to modern occupational demands. Long-term, prospective studies are essential to better understand the natural history of work-related MSDs and to identify early predictors of chronic disability. Such studies can help differentiate transient musculoskeletal discomfort from conditions that are likely to progress into long-term impairment.

One of the most promising future directions is the integration of advanced technologies into MSD prevention and management. Wearable devices and smart sensors can monitor posture, movement patterns, muscle activity, and workload in real time, providing immediate feedback to workers and employers. Artificial intelligence-based systems can analyze large datasets to identify ergonomic risk patterns and recommend personalized interventions. These tools have the potential to transform traditional ergonomic assessments from periodic evaluations into continuous, dynamic monitoring systems. A holistic approach that integrates technology, clinical care, ergonomics, and organizational support will be essential for achieving sustainable reductions in the burden of musculoskeletal disorders and improving long-term worker health and productivity.

Conclusion

Structured, Musculoskeletal disorders are a pervasive and growing health concern with significant individual, occupational, and societal consequences. Their multifactorial nature necessitates a holistic approach encompassing prevention, early diagnosis, and comprehensive management. Promoting ergonomic practices, healthy lifestyles, and timely medical intervention can substantially reduce the burden of MSDs. Collaborative efforts among healthcare providers, employers, policymakers, and individuals are essential to improve musculoskeletal health and enhance quality of life.

References

1. Bucki FM, Clay MB, Tobiczky H, Green BN. Scoping review of telehealth for musculoskeletal disorders: applications for the COVID-19 pandemic. *JMPT*. 2021;44(7):558-565. [Crossref] [Google Scholar]
2. Asadzadeh A, Samad-Soltani T, Salahzadeh Z, Rezaei-Hachesu P. Effectiveness of virtual reality-based exercise therapy in rehabilitation: A scoping review. *IMU*. 2021; 24:100562. [Crossref] [Google Scholar]
3. Molhemi F, Monjezi S, Mehravar M, Shaterzadeh-Yazdi MJ. Effects of virtual reality vs conventional balance training on balance and falls in people with multiple sclerosis: a randomized controlled trialV. *PMH*. 2021;102(2):290-299. [Crossref] [Google Scholar]
4. Luan L, El-Ansary D, Adams R, Wu S, Han J. Knee osteoarthritis pain and stretching exercises: a systematic review and meta-analysisV. *Physiotherapy*. 2022; 114:16-29. [Crossref] [GoogleScholar] [PubMed]
5. Gill TK, Mittinty MM, March LM, Steinmetz JD, Culbreth GT, Cross M, Kopec JA, Woolf AD. Global, regional, and national burden of other musculoskeletal disorders, 1990–2020, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. *The Lancet Rheumatology*. 2023;5(11):e670-82. [Google Scholar]
6. Global, regional, and national burden of musculoskeletal disorders, 1990–2021: an analysis of the global burden of disease study 2021 and forecast to 2035. *Front Public Health*. [Google Scholar]
7. Qiu K, Wang C, Mo X, Yang G, Pan Z. The global macroeconomic burden of musculoskeletal disorders. *IJS*. 2025;111(11):7857-66. [Crossref] [Google Scholar] [PubMed]
8. Cordero DM, Miclau TA, Paul AV, Morshed S, Miclau III T. The global burden of musculoskeletal injury in low and lower-middle income countries: a systematic literature review. *OTA International*. 2020;3(2):e062. [Crossref] [Google Scholar] [PubMed]
9. Hassan MF, Zulkifley MA, Hussain A. Squat exercise abnormality detection by analyzing joint angle for knee osteoarthritis rehabilitation. *Jurnal Teknologi*. 2015;77(7). [Google Scholar]
10. Minyoung Lee PT, Dongwon Suh MD, Jungjin Kim PT, Bum Chul Yoon PT. Patient perspectives on virtual reality-based rehabilitation after knee surgery: Importance of level of difficulty. *JRRD*. 2016;53(2):239. [Crossref] [Google Scholar] [PubMed]