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A Narrative Review of Occupational Stress and Musculoskeletal Disorders: Risk Factors, Mediators, and Prevention

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ABSTRACT

Aims: Occupational stress is one of the contributing factors to Musculoskeletal Disorders (MSDs), affecting worker health and productivity. This study evaluates evidence on risk factors, mediators, and preventive strategies for musculoskeletal disorders in high-stress work environments.

Method and Materials: The literature review utilized PubMed, Scopus, Web of Science, and Google Scholar, focusing on studies published between 2019 and 2024. Relevant keywords and Boolean operators refined the search, and selected articles were screened based on inclusion and exclusion criteria. The final studies were analyzed and synthesized for a comprehensive review.

Findings: Occupational stress significantly contributes to musculoskeletal disorders, while psychological mediators like burnout and sleep disturbances exacerbate symptoms. Key stressors include excessive workloads, poor ergonomics, and long hours, which are particularly prevalent among women and older workers, who are at a higher risk of adverse health effects. Effective interventions, such as ergonomic training, physical activity, and leadership support, can mitigate these risks. Occupational stress significantly contributes to musculoskeletal disorders, requiring integrated interventions. Targeted strategies can reduce Musculoskeletal disorders, enhance well-being, and improve productivity.

Conclusion: Effective interventions, including ergonomic training, physical activity, and leadership support, can help mitigate these risks. Occupational stress significantly contributes to musculoskeletal disorders, requiring integrated interventions. Targeted strategies can reduce Musculoskeletal disorders, enhance well-being, and improve productivity.

Keywords: Occupational Stress, Musculoskeletal Disorders, Prevention

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Introduction

Occupational stress is a significant workplace health concern that affects employees across various industries, contributing to both physical and psychological health issues. Among these, Musculoskeletal Disorders (MSDs) are particularly prevalent, representing one of the leading causes of work-related disability and reduced productivity worldwide[1]. These disorders encompass a range of conditions affecting the muscles, joints, and tendons, often resulting from prolonged physical strain, repetitive movements, or poor ergonomic conditions[2]. Musculoskeletal disorders significantly impact workplace performance and employee well-being by reducing productivity, increasing absenteeism, and leading to long-term disability, which manifests as decreased efficiency, the need for replacement workers, increased healthcare costs, and career changes [3]. Research highlights a strong link between occupational stress and MSDs, in which high stress levels, heavy workload, low social support, and job dissatisfaction increase its prevalence across various industries[4]. Numerous studies have shown a strong link between job stress and MSDs, particularly in healthcare, midwifery, and office work, where high psychological demand and ergonomic risks contribute to its prevalence[5,6]. Stress exacerbates musculoskeletal pain through increased muscle tension, poor posture, burnout, sleep, and psychological

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disturbances factors, highlighting the need for effective to stress management to reduce its impact [7].

Moreover, prolonged exposure to stress is associated with increased inflammation, heightened pain sensitivity, and impaired recovery from physical exertion [8]. On a psychological level, stress-induced burnout, sleep disturbances, and anxiety contribute to maladaptive coping behaviors such as poor posture and lack of physical activity that further aggravate MSD symptoms[9].

Cybersecurity threats are particularly prevalent in industries such as healthcare, remote work, and construction, where reliance on digital technologies increases vulnerability to data breaches, ransomware, and insider threats. To mitigate these risks, organizations must implement robust security measures and maintain continuous monitoring to safeguard sensitive information and ensure operational integrity [10]. Despite the findings, the exact mechanisms and contributing factors behind these phenomena remain complex and multifaceted. This complexity arises from the interplay of various biological, environmental, and psychological elements, which can vary significantly across different contexts and populations.

A comprehensive synthesis of literature integrates findings from multiple studies, providing a cohesive understanding of trends, gaps, and methodological advancements within a field. This process not only enhances knowledge but also informs practice, policy decisions, and future research directions[11]. While previous research has extensively examined occupational stress and MSDS separately, the interplay between them remains underexplored. Recent studies have begun to address this gap, but further research is needed to fully understand the complex interactions and their impact on worker health and productivity [12,13].

This review focuses on three key aspects of the relationship between occupational stress and musculoskeletal disorders (MSDs). First, it examines the primary risk factors contributing to both job-related stress and musculoskeletal disorders (MSDs), including excessive workloads, long working hours, and poor ergonomic conditions. Second, it explores the psychological and physiological mediators that link occupational stress to MSDs development, such as burnout, sleep disturbances, and work-family conflict. Ultimately, the review assesses workplace interventions designed to mitigate these risks, including ergonomic training, leadership support, and strategies for promoting mental well-being. By synthesizing findings from various studies, this review aims to provide valuable insights that can inform workplace policies and guide future research in occupational health, ultimately contributing to the development of more effective prevention strategies for musculoskeletal disorders (MSDs) in high-stress environments.

Method and Materials

The present study explores the relationship between occupational stress and MSDs, focusing on risk factors, psychological and physiological mediators, and prevention strategies. To gather relevant literature, databases such as PubMed, Scopus, Web of Science, and Google Scholar were examined. The target studies were considered from the last five years (2019–2024) to ensure the inclusion of recent research. Additionally, references from the identified articles were reviewed to access further relevant studies.

The search was conducted using a combination of keywords and Medical Subject Headings (MeSH) terms, including "occupational stress," "work-related stress," "musculoskeletal disorders (MSDs)," "risk factors," "psychological mediators," "ergonomic risks," and "workplace interventions." Boolean operators (AND, OR) were applied to refine the search results, ensuring a broad yet focused collection of relevant studies.

According to this strategy, an initial search yielded a broad collection of articles, from which those relevant to the study's objectives were selected. The inclusion of articles was based on specific criteria: studies that investigated the association between occupational stress and musculoskeletal disorders (MSDs), as well as those discussing

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risk factors, mediating mechanisms, or workplace interventions. Articles were included if their keywords appeared in the title or abstract and were published in peer-reviewed journals.

Exclusion criteria included studies that focused solely on ergonomic risks without considering stress, non-peer-reviewed sources, duplicate publications, and articles for which full-text access was unavailable. After reviewing and evaluating the selected studies based on the mentioned criteria, a final set of relevant articles was included in the review. These selected articles were thoroughly analyzed and synthesized to develop a comprehensive discussion on occupational stress and musculoskeletal disorders (MSDs).

Findings

Regarding the direct relationship between job stress and MSDs, numerous studies confirm a strong positive association between occupational stress and MSDs, indicating that high-stress work environments contribute to the onset and severity of physical ailments. Among firefighters, occupational stress was significantly linked to work-related MSDs, with emotional exhaustion and burnout playing a significant role in amplifying these symptoms [14]. Similarly, midwives experiencing high levels of job stress due to heavy physical workloads and emotional demands reported a significantly higher prevalence of MSDs, particularly affecting their lower extremities [15]. In the construction sector, workers facing occupational stress were also more likely to suffer from MSDs, notably lower back pain, highlighting how physically demanding professions are more susceptible to the combined burden of stress and musculoskeletal strain [16].

According to psychological and physiological mediators between stress and MSDs, it has been argued that psychological factors play a crucial role in linking occupational stress to MSDs, with depression, burnout, and sleep disturbances acting as key mediators. Firefighters suffering from occupational stress were found to develop MSDs through pathways of emotional exhaustion and depersonalization, with Post-Traumatic Stress Disorder (PTSD) further exacerbating musculoskeletal symptoms [14]. In healthcare workers, sleep quality was identified as a major mediator between stress, burnout, and MSDs, with poor sleepers experiencing significantly higher risks of chronic musculoskeletal pain compared to those with better sleep patterns [17]. Additionally, Work-Family Conflict (WFC) was found to mediate the relationship between occupational stress and MSDs, with employees experiencing work-related stress spilling into their personal lives being at a higher risk of musculoskeletal pain than those whose stress originated from family-related obligations [18]. These findings suggest that addressing mental health concerns and improving sleep quality can be effective strategies for mitigating MSDs in high-stress occupations.

Due to this issue, occupational stressors could contribute to MSD development. Several occupational stressors have been identified as contributing to the development of MSDs, including long working hours, excessive workloads, and poor ergonomic conditions. It was demonstrated that workers who regularly worked more than 60 hours per week faced a significantly increased risk of cumulative fatigue, occupational stress, and musculoskeletal disorders (MSDs), in which overtime work amplified these risks even further [1]. Among computer-user bankers, repetitive wrist movements, prolonged work hours, and a lack of ergonomic training were significant contributors to the prevalence of Carpal Tunnel Syndrome (CTS), highlighting how prolonged and repetitive tasks can increase the likelihood of Musculoskeletal Disorders (MSDs). In remote work settings, frequent workplace interruptions and unclear job roles were significant sources of occupational stress, leading to increased musculoskeletal pain; however, strong leadership support mitigated these risks to some extent [19]. These findings underscore the importance of reducing excessive workloads, optimizing ergonomic work conditions, and providing clear job structures to minimize stress-induced musculoskeletal disorders (MSDs).

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Regarding gender and individual differences in the stress-MSDs relationship, the studies showed that the impact of job stress on MSDs is not uniform across different demographics, as factors such as gender and work experience influence susceptibility. Female employees were found to have a significantly higher risk of MSDs than their male counterparts. Women who are working in Information Technology (IT) occupations are 2.3 times more likely to develop musculoskeletal pain than men [1]. Similarly, female bankers reported a higher prevalence of CTS compared to male colleagues, suggesting that gender-related physiological and ergonomic factors may contribute to these disparities [20]. Age and work experience also played a role, with workers over 45 years old and those with more than five years of experience being at a significantly higher risk of developing MSDs, particularly in jobs involving repetitive tasks or heavy physical labor [20]. These findings highlight the need for gender-sensitive and age-appropriate workplace interventions to address MSD risks.

Regarding protective factors and workplace interventions, despite the strong association between occupational stress and musculoskeletal disorders (MSDs), several protective factors have been identified that can help mitigate these risks. Engaging in moderate physical activity has been shown to lower the risk of musculoskeletal disorders (MSDs), especially among IT workers who exercise at least 1–3 times per week, resulting in reduced cumulative fatigue and musculoskeletal pain [1]. Ergonomic training and postural awareness were also found to be effective preventive measures, particularly in industrial employees, where poor body posture was the strongest predictor of MSDs [21]. Additionally, workplace interventions that include clear job roles, leadership support, and improved working conditions were associated with lower levels of stress and MSDs, as observed in dental hygienists and remote workers [18,22]. These findings highlight the importance of a comprehensive approach to occupational health that includes both physical and psychological interventions to reduce MSD risk in high-stress environments. Table 1 presents the studies examined, highlighting the relationship between occupational stress and musculoskeletal disorders (MSDs).

Table 1) Summary of studies examining the relationship between job stress and musculoskeletal disorders

Study	Population	Key Findings	Study Design	Recommendations
Khoshakhlagh et al. (2024)	2,617 firefighters	Job stress positively correlates with MSDs. PTSD impacts MSDs via depersonalization.	Cross-sectional survey	Implement policies to manage occupational stress, depression, and burnout to reduce MSDs.
Zheng (2023)	1,363 IT workers in China	Long work hours, overtime, and cumulative fatigue increase MSD risk. Women have a 2.3x higher risk.	Cross-sectional study	Address high-risk groups (women, long-hour workers) with stress reduction and ergonomic programs.
Demissie et al. (2023)	422 computer-user bankers in Ethiopia	11.7% prevalence of Carpal Tunnel Syndrome (CTS). Risk factors: smoking, repetitive wrist movements, and>8-hour computer use.	Cross-sectional study	Ergonomic training, posture correction, and reduction of repetitive strain.
Vieira et al. (2023)	125 healthcare workers in Brazil	Burnout and stress are linked to multisite MSDs. Poor sleep quality mediates the stress-musculoskeletal Disorder (MSD) link.	Longitudinal study	Address mental health and sleep quality in workplace interventions.
Wei et al. (2024)	21 dental hygienists in China	High occupational stress, but no direct correlation with job satisfaction. MSDs significantly affected satisfaction.	Observational cross-sectional study	Enhance work flexibility, teamwork, and stress management to minimize

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				Musculoskeletal Disorders (MSDs).
Mohammadian (2023)	74 midwives in Iran	78.4% reported MSDs. High job stress contributed to increased pain and reduced efficiency.	Cross-sectional study	Provide ergonomic training and stress management programs.
Amirmahani et al. (2022)	91 midwives in Iran	96.7% reported MSDs: high stress levels but no direct correlation with work ability. MSDs negatively impact work ability.	Cross-sectional study	Improve workplace ergonomics and manage workload.
Oakman et al. (2023)	965 remote workers in Australia	High job demands and workplace interruptions increased stress and MSD risk. Leadership support reduced risks.	Longitudinal study	Improve job design, reduce workload, and enhance leadership support for remote workers.
Jeong & Lee (2024)	178 construction workers in South Korea	53.9% reported MSDs. High stress intensified the negative impact of MSDs on quality of life.	Cross-sectional study	Implement ergonomic interventions and stress reduction programs.
Arefian et al. (2023)	147 industrial employees in Iran	Work-related stress, poor posture, and mental health issues significantly predicted MSDs (neck, back, hand pain).	Cross-sectional study	Introduce ergonomic training, stress management, and mental health support programs.
Weale et al. (2023)	897 remote workers in Australia	Work-family conflict mediated the stress-MSD relationship. High job demands and workplace interruptions increased stress and pain.	Longitudinal study	Improve work-life balance policies and workplace risk management.

Discussion

This study revealed a strong association between occupational stress and musculoskeletal disorders, demonstrating that high-stress work environments contribute to both the onset and severity of these conditions. Psychological factors such as burnout, sleep disturbances, and work-family conflict play a crucial mediating role. At the same time, occupational stressors, including excessive workloads, long working hours, and poor ergonomic conditions, further exacerbate MSD risks. Additionally, demographic differences, particularly in gender and age, influence susceptibility to MSDs, underscoring the need for targeted workplace interventions.

Our review of the literature indicates a consistent association between job stress and MSDs across various occupational settings.

Job stress is strongly associated with these disorders across multiple professions, with psychological strain, workload, and physiological responses playing key roles [6,23]. High job demands and low control increase muscle tension and exacerbate MSD symptoms, while long working hours and cumulative fatigue further elevate risk. The hyperventilation theory suggests that stress-induced breathing changes contribute to sustained muscle tension, particularly in the neck and shoulder muscles [6]. Social support and job autonomy mitigate these effects, highlighting the importance of workplace interventions [23]. Addressing these risks through ergonomic improvements, workload management, and psychosocial support is essential, though further research is needed to refine intervention strategies.

Beyond the direct association between occupational stress and MSDs, several psychological and physiological mediators have been identified that further explain this relationship. One of the key mediators is burnout, which has been shown to exacerbate musculoskeletal MSDs, which are prevalent occupational health concerns, often interconnected due to the physical and

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psychological demands of various professions[24]. Studies indicate high rates of MSDs and burnout among coal miners, occupational therapists, firefighters, white-collar workers, nursing professionals, and healthcare students, influenced by factors such as workload, shift systems, and physical activity levels [24–27]. Key contributing elements include physically demanding tasks, stressful work environments, and psychological factors like emotional exhaustion and depersonalization.

Another vital mediator is WFC, where stress originating in the workplace spills over into personal life, leading to an increased risk of musculoskeletal pain. Research highlights a strong link between WFC and MSDs, with stress acting as a key mediator in this relationship [28,29]. While women face increased MSD risks due to family responsibilities like eldercare, men experience heightened vulnerability when balancing childcare with physically demanding jobs [30].

In addition to psychological mediators, specific occupational stressors have been identified as major contributors to MSD prevalence. Long working hours, excessive workloads, and poor ergonomic conditions significantly increase the risk of developing musculoskeletal disorders, including musculoskeletal pain. Long working hours, excessive workloads, and poor ergonomic conditions collectively contribute to a higher risk of musculoskeletal pain, as prolonged work periods lead to fatigue and hinder proper posture [31,32]. Excessive physical demands, such as repetitive movements and heavy lifting, further strain muscles and joints, increasing the likelihood of chronic pain[33]. Addressing these risks through ergonomic interventions, workload management, and balanced work schedules is essential to prevent long-term musculoskeletal disorders.

Despite the strong association between occupational stress and MSDs, several protective factors have been identified that can help mitigate these risks. Regular physical activity plays a crucial role in reducing MSDs, particularly among office workers, where higher activity levels are linked to lower risks of neck and shoulder pain [34]. However, barriers such as chronic pain and fatigue can limit physical activity in individuals with MSDs, highlighting the need for tailored interventions to maximize their benefits [35].

Furthermore, our reviewed workplace interventions, which include clear job roles, leadership support, and improved working conditions, were associated with lower levels of occupational stress and musculoskeletal disorders (MSDs). Clear job roles, leadership support, and improved working conditions play a crucial role in reducing job stress and MSDs by minimizing role ambiguity and helping employees manage workload more effectively [19]. Leadership support further mitigates stress by fostering a positive organizational culture and encouraging participation in workplace wellness initiatives. Additionally, better working conditions, including ergonomic improvements and balanced workloads, contribute to both physical and mental well-being, ultimately lowering the risk of MSDs and enhancing overall job satisfaction [2].

One of the strengths of this study is its comprehensive analysis of the relationship between occupational stress and musculoskeletal disorders (MSDs), highlighting key psychological and physiological mediators of this relationship. Additionally, the inclusion of diverse occupational groups provides a broad perspective on the issue. However, a key limitation is that only information from the last five years was reviewed, which may exclude relevant findings from earlier studies. Furthermore, as a narrative review, this study lacks a systematic methodology for study selection and data synthesis, which may introduce selection bias.

Future reviews should consider conducting systematic reviews or meta-analyses to provide a more quantitative assessment of the relationship between occupational stress and musculoskeletal disorders (MSDs). Additionally, expanding the review period beyond the last five years and including longitudinal studies could offer deeper insights into long-term effects. Investigating the role of occupational interventions and policy changes in mitigating MSD risks would

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also be valuable for developing evidence-based workplace strategies.

Conclusion

The strong association between occupational stress and MSDs underscores the need for comprehensive workplace interventions addressing both physical and psychological factors. Given the role of burnout, sleep disturbances, and ergonomic stressors in exacerbating MSDs, targeted strategies such as workload management, ergonomic improvements, and mental health support are essential. Additionally, demographic variations in MSD susceptibility highlight the importance of tailored interventions for at-risk groups, particularly women and older workers. Implementing holistic preventive measures can enhance employee well-being, reduce the prevalence of musculoskeletal disorders (MSDs), and improve overall workplace productivity.

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Authors' Contributions

ZSH conducted the literature search, collected relevant studies, and performed the review. MF provided academic supervision, reviewed, and edited the manuscript. Both authors read and approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

Ethical Approval

As this study is a narrative review and does not involve human subjects or interventions, all referenced studies have been accurately cited.

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