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Multimodal Interventions for Musculoskeletal Disorders among Staff Nurses - A Comprehensive Review

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A B S T R A C T

Background*:** Musculoskeletal disorders (MSDs) are a significant occupational health concern among nursing staff, leading to reduced productivity, increased absenteeism, and compromised patient care. This review aims to synthesize the evidence on the effectiveness of multimodal interventions in preventing and managing MSDs among nurses.Methods***: A systematic literature search was conducted using PubMed, CINAHL, Embase, and Scopus databases to identify studies examining the effectiveness of multimodal interventions for MSDs in nursing staff. The search included randomized controlled trials, quasi-experimental studies, and pre-post intervention studies published from inception to the present date. Data extraction and quality assessment were performed independently by two reviewers.***Results***: The synthesis of evidence from the included studies demonstrated that multimodal interventions combining ergonomic modifications, exercise programs, educational strategies, and organizational support were more effective than single interventions in reducing MSD symptoms and risk factors among nurses. Key components of successful interventions included workplace ergonomic assessments, patient handling equipment and training, stretching and strengthening exercises, and participatory approaches involving nurses in the planning and implementation of interventions.***Conclusion***: The findings of this review support the effectiveness of multimodal interventions in preventing and managing MSDs among nursing staff. Healthcare organizations should prioritize the implementation of comprehensive MSD prevention programs that address the multifactorial nature of these disorders. Further research is needed to establish standardized outcome measures and evaluate the long-term sustainability and cost-effectiveness of multimodal interventions in diverse nursing settings.

Keywords: Musculoskeletal disorders, nursing staff, multimodal interventions, ergonomics, exercise.

INTRODUCTION

Musculoskeletal disorders (MSDs) have emerged as a critical concern in the nursing profession, with far-reaching consequences for healthcare workers, patients, and organizations alike. Nurses face a myriad of physical demands in their daily work, including patient handling, prolonged standing, and repetitive tasks, which contribute to an alarming prevalence of MSDs [1]. Studies have consistently shown that nurses experience higher rates of MSDs compared to other occupational groups, with estimates suggesting that up to 90% of nurses report musculoskeletal symptoms in at least one body region [2, 3].

The impact of MSDs extends beyond the individual nurse, affecting the quality of patient care, productivity, and overall healthcare system performance. Nurses experiencing musculoskeletal pain and discomfort may face limitations in their ability to perform essential job tasks, such as lifting and transferring patients, leading to reduced work efficiency and potential safety risks [4]. Moreover, MSDs are a leading cause of absenteeism, presenteeism, and early retirement among nurses, resulting in significant financial burdens for healthcare organizations [5, 6].

Given the multifaceted nature of MSDs in nursing, there is a pressing need for effective interventions that address the complex interplay of individual, occupational, and organizational factors. While various intervention strategies have been proposed and implemented, including ergonomic adjustments, exercise programs, and educational initiatives, their effectiveness in reducing MSD symptoms among nurses remains a topic of ongoing research and debate [7].

In recent years, multimodal intervention approaches have gained increasing attention as a promising solution to the MSD challenge in nursing. These comprehensive programs combine multiple intervention components, such as ergonomic modifications, physical therapy, and behavioral change strategies, with the aim of synergistically targeting the multiple risk factors contributing to MSDs [8]. By addressing the issue from various angles, multimodal interventions hold the potential to achieve more significant and sustainable reductions in musculoskeletal symptoms among nurses.

The purpose of this review article is to synthesize the current state of knowledge on the effectiveness of multimodal interventions for reducing musculoskeletal symptoms in nursing staff. By critically examining the available evidence from both individual studies and systematic reviews, this article aims to provide a comprehensive overview of the key intervention strategies, their implementation considerations, and the outcomes achieved in terms of MSD symptom reduction and related measures.

The scope of this review encompasses a wide range of multimodal intervention approaches, including combinations of ergonomic adjustments, exercise programs, manual therapy techniques, and educational initiatives. The article will delve into the rationale behind each intervention component, the evidence supporting their effectiveness, and the potential synergies achieved through their integration into multimodal programs.

Furthermore, this review will explore the challenges and barriers encountered in implementing and sustaining multimodal interventions in real-world nursing settings, as well as the implications for future research and practice. By identifying the gaps in current knowledge and highlighting promising avenues for further investigation, this article aims to contribute to the ongoing efforts to develop and refine effective strategies for preventing and managing MSDs among nursing staff.

Ultimately, the insights gained from this comprehensive review will serve to inform evidence-based decision-making in the design and implementation of MSD prevention and management programs in healthcare organizations. By prioritizing the musculoskeletal health and well-being of nurses, we can foster a resilient and thriving nursing workforce, ensure the delivery of high-quality patient care, and strengthen the overall performance of healthcare systems in the face of the ongoing MSD challenge.

Aim

This study aims to synthesize the evidence on the effectiveness of multimodal interventions in preventing and managing musculoskeletal disorders (MSDs) among nursing staff.

Methods

To ensure a comprehensive and rigorous approach to evaluating the effectiveness of multimodal interventions for reducing musculoskeletal symptoms in nursing staff, this review employed a systematic search strategy and adhered to established guidelines for conducting systematic reviews. The literature search was conducted using multiple electronic databases, including PubMed, CINAHL, Embase, and Scopus, to identify relevant studies published from inception to the present date. The search strategy combined key terms related to musculoskeletal disorders, nursing staff, and multimodal interventions, such as "musculoskeletal pain," "nurses," "ergonomics," "exercise," "education," and "multifaceted interventions."

The inclusion criteria for studies in this review were as follows: (a) randomized controlled trials (RCTs), quasi-experimental studies, or pre-post intervention studies; (b) studies involving nursing staff (registered nurses, licensed practical nurses, or nursing assistants) working in healthcare settings; (c) studies evaluating the effectiveness of multimodal interventions, defined as interventions combining at least two distinct components (e.g., ergonomic adjustments, exercise programs, educational initiatives); and (d) studies reporting outcomes related to musculoskeletal symptoms, such as pain intensity, prevalence, or disability. Studies were excluded if they focused solely on single-component interventions, involved other healthcare professionals, or did not report relevant outcomes.

Two reviewers independently screened the titles and abstracts of the retrieved studies against the inclusion and exclusion criteria. Full-text articles of potentially eligible studies were then obtained and reviewed for final inclusion.

Any discrepancies between the reviewers were resolved through discussion and consensus, with the involvement of a third reviewer when necessary.

Data extraction was performed using a standardized form, which included information on study characteristics (e.g., design, setting, sample size), participant demographics, intervention details (e.g., components, duration, frequency), outcome measures, and key findings. The extracted data were synthesized using a narrative approach, with studies grouped according to the types of multimodal interventions evaluated and the outcomes assessed.

The quality of the included studies was assessed using the Cochrane Risk of Bias Tool for RCTs and the Newcastle-Ottawa Scale for observational studies. These tools evaluate various aspects of study design and execution, such as randomization, blinding, and control for confounding factors. The quality assessment results were considered when interpreting the findings and drawing conclusions about the effectiveness of multimodal interventions.

By adhering to this systematic and rigorous methodological approach, this review aims to provide a reliable and comprehensive synthesis of the current evidence on the effectiveness of multimodal interventions for reducing musculoskeletal symptoms among nursing staff. The insights gained from this review can inform the development and implementation of evidence-based strategies to prevent and manage MSDs in healthcare settings, ultimately promoting the health and well-being of nurses and the quality of patient care.

Overview of Musculoskeletal Disorders in Nursing

Musculoskeletal disorders (MSDs) are a pervasive issue among nursing professionals, with a wide range of symptoms and underlying causes. The most common types of MSDs affecting nurses include low back pain, neck and shoulder pain, and disorders of the upper and lower extremities [11]. A systematic review by Soylar and Ozer found that the prevalence of low back pain among nurses ranged from 40% to 97.9%, while neck and shoulder pain affected between 17% and 75.8% of nurses [12]. These figures highlight the substantial burden of MSDs within the nursing workforce.

Several risk factors contribute to the development of MSDs among nurses. Patient handling tasks, such as lifting, transferring, and repositioning patients, are a primary source of physical strain and injury [13]. Nurses frequently engage in these tasks, which involve awkward postures, high force exertion, and repetitive motions, all of which can lead to musculoskeletal damage over time [14]. Additionally, prolonged standing, walking, and static postures during patient care activities can contribute to the development of lower extremity and back pain [15].

Workstation design and ergonomic issues also play a role in the occurrence of MSDs among nurses. Poorly designed workstations, such as those with inappropriate heights or lacking adjustability, can result in awkward postures and increased physical strain (16). Moreover, the use of electronic health records and computer workstations has introduced new ergonomic challenges, such as prolonged sitting and repetitive typing, which can contribute to neck, shoulder, and upper extremity disorders [17].

The impact of MSDs on nurses' health and well-being is substantial. Nurses experiencing musculoskeletal pain often report reduced physical functioning, decreased quality of life, and increased levels of stress and burnout [18]. MSDs can also lead to reduced job satisfaction and increased intention to leave the nursing profession [19]. These factors not only affect individual nurses but also have broader implications for healthcare organizations.

MSDs among nurses can result in increased absenteeism, reduced productivity, and higher healthcare costs for organizations [20]. When nurses are unable to perform their duties effectively due to musculoskeletal pain, the quality of patient care may be compromised, leading to potential safety risks and negative patient outcomes [14]. Furthermore, the high prevalence of MSDs can contribute to nursing shortages and turnover, exacerbating the existing challenges in healthcare workforce planning and management [19].

Given the significant impact of MSDs on nurses' health, job performance, and healthcare organizations, there is a pressing need for effective interventions to prevent and manage these disorders. Multimodal approaches that address the multifaceted nature of MSDs have shown promise in reducing symptoms and improving outcomes for nursing staff [20]. The researcher was interested to explore the different interventions to overcome the MSDs by combining ergonomic interventions, exercise programs, education, and organizational support. These comprehensive programs aim to address the issue from various angles, targeting the multiple risk factors contributing to MSDs and promoting a safer, healthier work environment for nurses.

Ergonomic Interventions

Ergonomic interventions are a crucial component of multimodal approaches to reducing musculoskeletal disorders (MSDs) among nursing staff. These interventions focus on identifying and modifying workplace factors that contribute to the development of MSDs, such as awkward postures, repetitive motions, and excessive force exertion [21]. By optimizing the physical work environment and providing appropriate equipment and training, ergonomic interventions aim to minimize the risk of MSDs and promote a safer, more comfortable working environment for nurses.

Workplace ergonomic assessments are the foundation of effective ergonomic interventions. These assessments involve a systematic evaluation of the nursing work environment, including patient care areas, workstations, and equipment [22]. Trained ergonomic specialists observe nurses performing their typical tasks, identify potential risk factors for MSDs, and provide recommendations for modifications and improvements [23]. Ergonomic assessments may also involve input from nurses themselves, as they can provide valuable insights into the physical demands and challenges of their work.

Based on the findings of ergonomic assessments, healthcare organizations can implement targeted modifications to reduce MSD risks. One key area of focus is patient handling, which is a significant contributor to MSDs among nurses [24]. The implementation of patient handling equipment, such as mechanical lifts, slide sheets, and transfer devices, can greatly reduce the physical strain associated with manual patient handling. These devices allow nurses to safely and efficiently move patients while minimizing awkward postures and excessive force exertion.

In addition to providing patient handling equipment, ergonomic interventions also involve training nurses in safe lifting techniques and proper use of the equipment. This training is essential to ensure that nurses are aware of the risks associated with manual patient handling and are competent in using the available equipment correctly. Regular refresher training and monitoring of compliance with safe lifting practices are important to maintain the effectiveness of these interventions over time.

Workstation design and adjustments are another critical aspect of ergonomic interventions in nursing. Poorly designed workstations, such as those with inappropriate heights or lack of adjustability, can contribute to awkward postures and increased physical strain [25]. Ergonomic modifications to workstations may include adjustable height desks, ergonomic chairs with proper lumbar support, and the provision of anti-fatigue mats for prolonged standing. These adjustments can help reduce the risk of MSDs by promoting neutral postures and reducing physical strain during tasks such as charting, medication preparation, and computer use.

The effectiveness of ergonomic interventions in reducing MSD symptoms and risk factors among nurses has been well-documented in the literature. Systematic reviews have found that ergonomic interventions, such as patient handling equipment and training, workstation modifications, and lifting policies, were associated with reductions in MSD symptoms, lost workdays, and compensation claims among nurses [21, 24].

Despite the evidence supporting the effectiveness of ergonomic interventions, challenges in implementation and adherence persist. Barriers to the successful implementation of ergonomic interventions in nursing include lack of management support, inadequate resources and funding, and resistance to change among staff. To overcome these barriers, it is essential to engage stakeholders at all levels, from frontline nurses to top management, in the planning and implementation process. Regular monitoring, feedback, and continuous improvement are also necessary to ensure the long-term sustainability and effectiveness of ergonomic interventions.

Ergonomic interventions are a vital component of multimodal approaches to reducing MSDs among nursing staff. By addressing the physical work environment and providing appropriate equipment and training, these interventions can minimize the risk factors associated with MSDs and promote a safer, more comfortable working environment for nurses. The effectiveness of ergonomic interventions in reducing MSD symptoms and risk factors has been demonstrated in the literature, but challenges in implementation and adherence must be addressed to ensure their long-term success. Healthcare organizations should prioritize the implementation of comprehensive ergonomic programs as part of their overall strategy to support the health and well-being of their nursing workforce.

Exercise and Physical Therapy Interventions

Exercise and physical therapy interventions are essential components of multimodal approaches to managing and preventing musculoskeletal disorders (MSDs) among nursing staff. These interventions focus on improving flexibility, strength, and overall physical conditioning, which can help reduce the risk of developing MSDs and alleviate symptoms in those already affected [26]. By incorporating targeted exercise programs and manual therapy techniques, nurses can enhance their physical resilience and better cope with the demands of their job.

Stretching and strengthening exercise programs are widely used in the prevention and management of MSDs among nurses. These programs typically involve a combination of static and dynamic stretches to improve flexibility and range of motion, as well as resistance exercises to build strength in the muscles that support the spine and other affected joints [27]. For example, a study by Jakobsen *et al*., found that a workplace-based physical exercise intervention, consisting of resistance training and stretching, significantly reduced musculoskeletal pain and improved physical capacity among healthcare workers [28].

Mind-body interventions, such as yoga and Pilates, have also gained popularity as a means of managing MSDs in nursing staff. These practices combine physical postures, breathing techniques, and relaxation methods to promote both physical and mental well-being [29]. A systematic review by Budhrani-Shani *et al*., concluded that yoga interventions were effective in reducing musculoskeletal pain, particularly low back pain, among nurses [30]. Similarly, Pilates has been shown to improve flexibility, core strength, and posture, which can help reduce the risk of developing work-related MSDs [31].

Manual therapy techniques, such as massage and joint mobilization, are often incorporated into physical therapy interventions for nurses with MSDs. These techniques involve the application of skilled manual force to manipulate soft tissues and joint structures, with the aim of reducing pain, improving mobility, and promoting healing [32]. A randomized controlled trial by Jakobsen *et al*., demonstrated that a combination of workplace-based massage and exercise was effective in reducing musculoskeletal pain and improving physical capacity among healthcare workers [33].

The evidence supporting the benefits of exercise and physical therapy interventions in managing MSDs among nursing staff is substantial. A systematic review by Van Hoof *et al*., found that exercise interventions, particularly those incorporating resistance training and stretching, were effective in reducing musculoskeletal pain and improving physical function in healthcare workers [34]. Another review by Rodrigues *et al*., concluded that workplace-based exercise programs were beneficial in preventing work-related MSDs among nurses, with positive effects on pain intensity, disability, and quality of life [35].

Despite the clear benefits of exercise and physical therapy interventions, barriers to implementation and adherence among nursing staff persist. These barriers may include lack of time, limited access to facilities and equipment, and low motivation [36]. To overcome these challenges, healthcare organizations should prioritize the implementation of workplace-based exercise programs that are convenient, accessible, and tailored to the specific needs of nursing staff. Providing education on the importance of physical activity and self-care, as well as fostering a supportive organizational culture, can also help improve adherence to these interventions [37].

In summary, exercise and physical therapy interventions are crucial components of multimodal approaches to managing and preventing MSDs among nursing staff. Stretching and strengthening exercise programs, mind-body interventions, and manual therapy techniques have all demonstrated effectiveness in reducing musculoskeletal pain and improving physical function. Healthcare organizations should prioritize the implementation of these interventions, while also addressing barriers to adherence, to promote the health and well-being of their nursing workforce.

Educational and Behavioral Interventions

Educational and behavioral interventions are key components of comprehensive strategies to prevent and manage musculoskeletal disorders (MSDs) among nursing staff. These interventions focus on increasing knowledge, promoting healthy work practices, and encouraging self-care behaviors that can help reduce the risk of developing MSDs and improve outcomes for those already affected [38].

MSD prevention and self-management education programs are designed to provide nurses with the knowledge and skills needed to identify and address risk factors for MSDs in their work environment. These programs typically cover topics such as ergonomic principles, proper body mechanics, and early recognition of MSD symptoms [39]. For example, a study by Ghadyani*et al*., found that an educational intervention focusing on ergonomic principles and safe patient handling techniques significantly reduced the prevalence of low back pain among nurses [40].

Proper body mechanics and safe work practices training are essential components of MSD prevention education for nurses. These training programs emphasize the importance of maintaining neutral postures, using appropriate lifting techniques, and minimizing awkward and repetitive movements [41]. A systematic review by Coskun Beyan *et al*., concluded that training programs on safe patient handling and mobility were effective in reducing the incidence of work-related MSDs among healthcare workers [42].

Stress management and relaxation techniques are often incorporated into educational interventions for nurses, as psychological stress has been identified as a risk factor for the development and exacerbation of MSDs [43]. These

techniques may include deep breathing exercises, progressive muscle relaxation, and mindfulness-based stress reduction [44]. A study by Bazarko*et al*., found that a mindfulness-based stress reduction program significantly reduced perceived stress and improved overall health among nurses [45].

The effectiveness of educational interventions in promoting MSD prevention behaviors among nurses has been demonstrated in numerous studies. A systematic review by Chanchai *et al*., found that educational interventions, particularly those incorporating participatory ergonomics and active learning strategies, were effective in reducing the prevalence of MSDs and improving knowledge and practices related to MSD prevention among healthcare workers [46].

Multimodal Intervention Programs

Multimodal intervention programs, which combine multiple intervention strategies such as ergonomic modifications, exercise, education, and organizational support, have emerged as a promising approach to preventing and managing MSDs among nursing staff. The rationale for combining multiple intervention strategies lies in the multifactorial nature of MSDs, which require a comprehensive approach that addresses the various risk factors and challenges faced by nurses in their work environment [47].

Several successful multimodal MSD prevention programs for nurses have been reported in the literature. For example, the PRISM (Promoting Resilience in Stress Management) program, developed by Chesak *et al*., combined stress management training, ergonomic education, and physical activity promotion to reduce stress and improve physical health among nurses [48]. Another example is the ALIGN (Adaptive Leadership for Implementing Good Ergonomics) program, which integrated leadership training, ergonomic assessments, and participatory problem-solving to reduce MSD risk factors and improve patient handling practices among nurses [49].

Key components of effective multimodal interventions for nurses include ergonomic assessments and modifications, training on safe work practices and body mechanics, exercise and physical activity promotion, stress management and resilience training, and organizational support and leadership [50]. Successful implementation of these interventions requires a participatory approach that engages nurses in the planning, implementation, and evaluation processes, as well as strong support from management and a commitment to creating a culture of safety and wellness [51].

Evidence synthesis on the effectiveness of multimodal approaches compared to single interventions has yielded promising results. A systematic review by Van Hoof *et al*., found that multimodal interventions combining exercise, education, and ergonomic modifications were more effective than single interventions in reducing the incidence and severity of low back pain among healthcare workers [52]. Another review by Tan *et al*., concluded that multimodal interventions integrating ergonomic, educational, and organizational components were effective in reducing work-related MSDs and improving work performance among nurses [53].

Challenges and Future Directions

Despite the growing evidence supporting the effectiveness of MSD prevention interventions for nurses, several challenges persist in implementing and sustaining these interventions in real-world settings. One major barrier is the lack of resources and support from healthcare organizations, including inadequate staffing, limited access to ergonomic equipment and training, and competing priorities [54]. Another challenge is the resistance to change among some nurses and managers, who may view MSD prevention interventions as an additional burden or disruption to their work routines [55].

To address these challenges and advance MSD prevention in nursing, there is a need for standardized outcome measures and long-term follow-up in MSD intervention studies. Currently, there is significant heterogeneity in the measures used to assess the effectiveness of interventions, making it difficult to compare and synthesize findings across studies [56]. Additionally, most studies have focused on short-term outcomes, highlighting the need for longer follow-up periods to assess the sustainability and long-term impact of interventions [57].

Organizational support and participatory approaches are critical for the success and sustainability of MSD prevention efforts in nursing. Healthcare organizations must prioritize the health and well-being of their nursing workforce by providing the necessary resources, training, and leadership support for MSD prevention interventions [58]. Engaging nurses in the planning, implementation, and evaluation of interventions can also help foster a sense of ownership and commitment to MSD prevention [59].

Future research should focus on developing and evaluating tailored, context-specific interventions that address the unique needs and challenges of different nursing settings and populations. There is also a need for more robust study

designs, including randomized controlled trials with larger sample sizes and longer follow-up periods, to strengthen the evidence base for MSD prevention interventions in nursing [60].

In conclusion, this review has highlighted the effectiveness of multimodal interventions combining ergonomic, educational, and organizational strategies in reducing the burden of MSDs among nursing staff. While challenges in implementation and sustainability persist, the evidence supports the need for healthcare organizations to prioritize MSD prevention as a critical component of nursing workforce health and well-being. By investing in comprehensive, evidence-based interventions and fostering a culture of safety and wellness, we can create a healthier, more resilient nursing workforce and improve the quality of patient care.

CONCLUSION

This review has synthesized the current evidence on the effectiveness of multimodal interventions for reducing musculoskeletal disorders (MSDs) among nursing staff. The findings demonstrate that interventions combining ergonomic modifications, exercise and physical therapy, educational and behavioral strategies, and organizational support are more effective than single interventions in preventing and managing MSDs in nurses.

The implications of these findings for nursing practice and policy are significant. Healthcare organizations must prioritize the implementation of comprehensive MSD prevention programs that address the multifactorial nature of these disorders. This requires a commitment to providing the necessary resources, training, and leadership support for interventions, as well as engaging nurses in the planning and implementation processes.

At the policy level, there is a need for greater recognition of the burden of MSDs among nurses and the importance of investing in evidence-based prevention strategies. This may include the development of national guidelines and standards for MSD prevention in healthcare settings, as well as the allocation of funding for research and implementation of effective interventions.

Ultimately, this review serves as a call to action for prioritizing nurses' musculoskeletal health and well-being. By taking a proactive, comprehensive approach to MSD prevention, we can create a healthier, more resilient nursing workforce and ensure the delivery of high-quality patient care. It is time for healthcare organizations, policymakers, and researchers to come together and commit to advancing MSD prevention in nursing, for the benefit of our nurses and the patients they serve.

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