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Efficiency Of Respiratory Exercises In Treating Musculoskeletal Pain Disorders: A Literature Review

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ABSTRACT

Background & Objectives: *Musculoskeletal pain disorders (MSDs) are widespread conditions that impose significant physical, emotional, and socioeconomic burdens on affected individuals. This review aimed to evaluate the effectiveness of respiratory exercises in reducing pain and improving mobility among patients with MSDs.*

Methods: *A literature review was conducted using nine high-quality studies involving a total of 1,096 patients. The studies assessed the impact of diaphragmatic and pursed-lip breathing techniques on conditions such as chronic low back pain, neck pain, adhesive capsulitis, and other MSDs.*

Results: *Findings revealed that respiratory exercises significantly reduced pain severity and enhanced respiratory efficiency. Improvements in core stability and overall functional mobility were also observed. The evidence suggests that these breathing techniques offer a non-invasive, low-cost intervention for managing MSD symptoms.*

Interpretation & conclusion: *Respiratory exercises are effective in managing pain and improving function in individuals with MSDs. The review highlights the need for developing condition-specific respiratory protocols. Future research should explore the long-term benefits, compare targeted and generalized breathing approaches, and examine the integration of respiratory training with broader physiotherapeutic strategies.*

Keywords: *Breathing exercises, global health, musculoskeletal pain disorders, respiratory exercises.*

INTRODUCTION

Musculoskeletal pain refers to pain that affects the muscles, bones, ligaments, tendons, and nerves. It can be acute or chronic and localized or widespread. Its etiologies are multifactorial, such as injury, overuse, disease, or normal wear and tear. Musculoskeletal pain can result in significant functional disability, inability to work, loss of independence, anxiety, depression, and concern for the future.[1] Consequently, persistent musculoskeletal pain significantly impacts social and emotional well-being.

Musculoskeletal pain disorders (MSDs) are highly prevalent worldwide and encompass a wide range of conditions impacting the muscles, bones, joints, tendons, and other connective tissues, leading to pain, reduced mobility, and disability.

Low back pain typically occurs between the lower rib margins and the buttock creases. It is commonly accompanied by pain in one or both legs, and anatomically, it extends from the 12th rib to the ilium. It has now become a major cause of disability worldwide, affecting approximately 540 million people globally.[1,2] Anderson and Bliven found that breathing exercises can be particularly effective for chronic, nonspecific lower back pain.[3]

Neck pain is another prevalent condition, affecting roughly 30–50% of adults each year. The Global Burden of Disease 2019 report ranked neck pain among the top five musculoskeletal diseases, affecting

223 million individuals globally, with 22 million enduring long-term disability. The prevalence of neck discomfort among the working population is notable, with 60–80% experiencing recurrent symptoms within one year.[4] Bradley and Esformes (2014)[5] demonstrated that breathing pattern disorders often accompany functional movement impairments in these populations. Breathing exercises have been beneficial in managing neck pain by improving respiratory function and reducing pain and disability.[6]
Osteoarthritis affects over 500 million people globally and is one of the primary causes of joint pain and disability, particularly in older adults.[7] Furthermore, physical injuries impact overall health, causing prolonged recovery and absenteeism. This affects mental, social, and emotional well-being and can lead to socioeconomic issues like job loss, illness-related absenteeism, healthcare costs, and, in some instances, hospitalization among employees.[8]
Management of these conditions traditionally includes physical therapy, medication, and lifestyle modifications. Respiratory exercises, such as diaphragmatic breathing and respiratory resistance training, show promise in enhancing respiratory muscle function and postural stability and reducing compensatory muscle recruitment, which can contribute to pain relief.[9] Furthermore, breathing exercises are also employed for various MSDs to enhance posture and core stability while reducing muscle tension. These exercises contribute to restoring normal breathing mechanics, alleviating pain, decreasing stress, and improving mobility by addressing dysfunctional breathing patterns that may exacerbate musculoskeletal pain, particularly in the neck, back, shoulders, and chest.[10]
Physiotherapy is an integral part of MSD management.[11] Physiotherapy addresses pain management, functional rehabilitation, and, most importantly, respiratory exercises. Respiratory exercises condition respiratory muscles, improve chest mobility, and improve oxygenation. Respiratory exercises involve diaphragmatic breathing, thoracic expansion, inspiratory muscle training, and synchronised breathing. These are combined with manual therapy, education, and electrotherapy. Respiratory aspects also address posture correction, pain relief through breathing retraining, endurance training, and coordination of breathing with core stability to improve respiratory and musculoskeletal function.[12]
Mehling et al. (2005)[13] noted that breath therapy can be an effective alternative treatment for patients with chronic low back pain, yielding both physical and psychological benefits. A systematic review and meta-analysis found that respiratory exercises significantly reduced low back pain and improved functional outcomes, particularly when performed three to five times a week for >4 weeks.[14] These exercises can also aid in muscle fatigue recovery and improve musculoskeletal health by enhancing proprioception and muscle firing patterns.[15] Janssens et al. (2015)[16] further established that inspiratory muscle training significantly affects proprioceptive use and can reduce low back pain intensity.[16]
Bordoni et al. (2018)[17] highlighted the profound effects of breathing on the central nervous system, suggesting possible neurophysiological mechanisms through which breathing exercises may reduce pain. Although several studies and reviews have explored the efficacy of breathing exercises in alleviating pain, their effectiveness in improving posture, enhancing mobility, and promoting relaxation has yet to be systematically reviewed.
This study aims to review the existing literature on various breathing exercises used in the management of different musculoskeletal disorders (MSDs) and to provide insights into how respiratory exercises can be integrated into comprehensive pain management strategies.

METHODS

A thorough search was performed in PubMed, ProQuest, Google Scholar, Science Direct, Scopus, and Web of Science databases from 2009 to 2024. The following keywords were utilized for the literature search: "breathing exercise" OR "respiratory exercise" OR "inspiratory training" OR "expiratory training" OR "diaphragmatic breathing" OR "respiratory resistance training" AND "chronic neck pain" OR "low back pain" OR "musculoskeletal pain" OR "knee pain" AND ("musculoskeletal disorders" OR "MSDs") AND ("pain relief" OR "mobility improvement" OR "function restoration").
The inclusion criteria for the studies were as follows: (i) studies directly addressing the role of breathing exercises in managing MSDs, irrespective of study type; (ii) English-language articles; (iii) relevant outcome measures must be clearly defined and reported, such as pain levels, mobility, and functional improvement; and (iv) high and good quality studies, as determined by established assessment tools like the

Physiotherapy Evidence Database Scale (PEDro). The PEDro scale is a tool for evaluating randomized controlled trials, categorizing them as “poor” (scores 0–4), “fair” (4–5), “good” (6–8), and “excellent” (9–10). Articles exhibiting low levels of evidence were excluded from this review.

A Google spreadsheet was utilized for data extraction from all shortlisted articles. Screening of these articles was conducted using the Johns Hopkins Evidence-Based Practice Model for Nursing and Healthcare Professionals, with the decision made to include only high-quality studies for review purposes. Information extracted from all articles included the publication year, author's name, journal of publication, study location, population involved, intervention utilized, type of breathing exercise employed, outcome measures assessed, study design, sample size, and conclusion. Upon preparation by the principal investigator, the spreadsheet was submitted to additional investigators for review and consensus.

Every individual study underwent uniform critical appraisal screening methods. Additionally, the PEDro served as the assessment tool for all clinical trials included in this review.

RESULTS

The search conducted according to the established selection criteria identified eleven articles, as illustrated in the flowchart in Figure 1. Following the initial shortlist of fifteen articles, three were removed for lack of relevance, and one was excluded for being an unpublished clinical case study. The remaining eleven articles proceeded to quality testing and critical appraisal.[18–29]

A data chart for the eleven selected articles was created by the primary investigator in a Google spreadsheet, which was later circulated among the other investigators for quality assessment. After consensus was reached among the investigators, two articles were excluded due to insufficient evidence as per the Johns Hopkins Evidence-Based Practice Model, resulting in nine research articles being finalized for review.

The included studies were of the following types: randomized controlled trials [RCTs], n=6; systematic review with meta-analysis, n=1; cross-sectional study, n=1; and prospective study, n=1. The total sample size was 1,096 participants (398 from the six RCTs and 698 from the systematic review) (Figure 1).

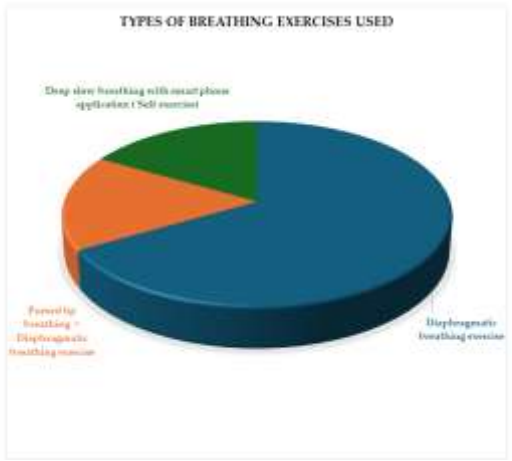
(Figure 1)

All included studies concluded that breathing exercises are effective in alleviating musculoskeletal pain associated with disorders such as low back pain, neck pain, and adhesive capsulitis. Details of the findings of the included studies can be found in Table I.

Table – I:

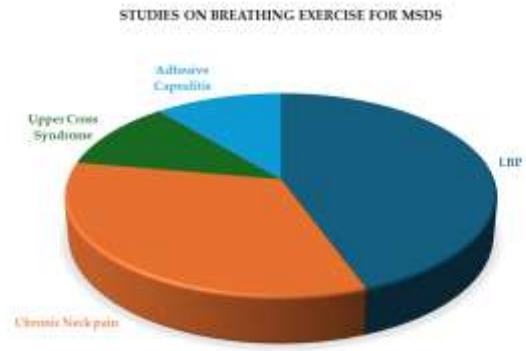
The systematic review and meta-analysis conducted by Zhai et al. (2024)[18] on fourteen randomized controlled trials (total N = 698; ages 60–80 years) demonstrated that resisted breathing exercise programs lasting >4 weeks represent the most effective intervention for low back pain.[18]

Four out of six RCTs implemented diaphragmatic breathing exercises, while one RCT integrated both diaphragmatic and pursed-lip breathing exercises. Additionally, one prior study utilized a smartphone application to guide participants in self-directed deep, slow breathing exercises (Figure 2).



(Figure 2)

Various included studies analysed the efficacies of breathing exercises for various MSDs: low back pain (4/9 studies), chronic neck pain (3/9 studies), upper cross syndrome (1/9 studies), and adhesive capsulitis (1/9 studies) (Figure 3).



(Figure 3)

All RCTs underwent assessment using the PEDro scale. The results indicated that only two trials received excellent ratings, one trial received a good rating, and three trials were rated as fair. The average PEDro score across all six RCTs was 6.83, indicative of a good rating (Table II, Figure 4).

Table – II:

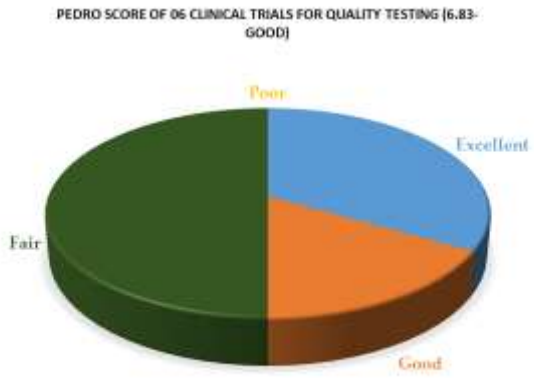


Figure 4
Evaluations of non-randomized controlled trials employing the Johns Hopkins Evidence-Based Practice Model demonstrated positive outcomes. The overall results indicated "good" results in quality testing.

DISCUSSION

The main aim of this study was to review the existing literature concerning the role of breathing exercises in the management of various MSDs. It assessed their effectiveness in reducing pain, improving posture, enhancing mobility, and promoting relaxation. The outcomes obtained from the review indicate that certain breathing exercises, i.e., diaphragmatic breathing and pursed-lip breathing, have been identified to be beneficial in reducing pain in the case of diseases like chronic low back pain, cervical pain, and adhesive capsulitis. The review also indicated that these exercises can potentially increase respiratory efficiency, core stability, and overall rehabilitation.

Breathing exercises have a positive impact on various MSDs, with the potential for further enhancements to achieve superior outcomes in the future. Janssens et al. (2015)[16] proved that inspiratory muscle fatigue greatly affects postural stability, especially in patients suffering from chronic low back pain, and that this may be one mechanism by which respiratory exercises work. Jiang et al. (2024)[30] demonstrated that diaphragmatic breathing techniques significantly reduced pain intensity and improved functional capacity in patients with chronic lower back pain.[30] This is likely due to the relaxation response that diaphragmatic breathing elicits, which can decrease muscle tension and promote a sense of calm.

The notable decrease in the PEDro score may result from methodological deficiencies observed during the quality assessment of the RCTs using the PEDro scale, particularly as blinding was not practiced in the majority of studies during data collection.[31] In five out of six trials, therapists were not blinded, and four studies did not implement the blinding of subjects, therapists, or assessors. Random allocation was not concealed in three of the randomized controlled trials. The aforementioned findings provide a foundation for the implementation of advanced and corrective respiratory training techniques, which could yield significant results in the treatment of a range of MSDs with specificity.

While breathing exercises demonstrate advantageous effects on numerous MSDs, the potential for bias in study outcomes cannot be disregarded due to methodological limitations. Additionally, the breathing exercises employed were predominantly generic rather than specialized or condition-specific. O'Sullivan et al. (2002)[32] highlighted that patients with sacroiliac joint pain exhibit altered motor control strategies, indicating that targeted breathing interventions might be more efficacious than generic approaches.[32] Multiple systematic reviews, with or without meta-analysis, have analyzed the effectiveness of therapeutic exercise for the management of people with shoulder impingement syndrome, showing a decrease in pain and an increase in shoulder function.[33-35]

Breathing dysfunction is prevalent among individuals with musculoskeletal complaints, particularly affecting regions such as the back, neck, shoulders, and knees.[36] Dysfunctional breathing, characterized by shallow or rapid breaths, has been associated with increased muscle tension and decreased motor

control, particularly in the trunk and spine.[36] This dysfunction is often associated with imbalances in the autonomic nervous system, resulting in aberrant breathing patterns that exacerbate pain. Sizer proposed that the musculoskeletal system would gravitate toward predictable movement patterns in response to pain or the presence of muscle imbalance.[37] The prevalence of altered movement patterns in individuals exhibiting disordered breathing patterns has also been discussed by Hruska (1997).[38] Consequently, breathing mechanics are of paramount importance and intimately connected to musculoskeletal pain and disorders, influencing posture, movement, and pain perception. Bradley and Esformes (2014)[5] further emphasized that breathing pattern disorders can significantly impair functional movement capabilities, establishing a bidirectional relationship between respiratory and musculoskeletal functions.

Dysfunctional breathing patterns, frequently induced by poor posture, stress, or chronic pain, can contribute to musculoskeletal issues, predominantly in the spine, neck, shoulders, and core. This often results in observable postural deviations such as rounded shoulders and a shortened, compressed neck. In individuals characterized as upper chest breathers, rib expansion may appear limited, with shoulders and rib cage elevated to accommodate lung expansion. During normal breathing patterns, the lower ribs expand laterally to facilitate complete lung expansion. Thoracic breathing can acutely influence respiratory chemistry, particularly by reducing carbon dioxide (CO_2) levels in circulation. This reduction elevates blood pH, resulting in respiratory alkalosis. Respiratory alkalosis can instigate physiological, psychological, and neurological alterations within the body that may adversely affect health, performance, and the musculoskeletal system.[39,40]

Proper breathing mechanics, particularly diaphragmatic breathing, can enhance core stability, diminish muscle tension, and improve rehabilitation outcomes for individuals suffering from musculoskeletal conditions. Kocjan et al. (2018)[41] demonstrated the significant influence of diaphragm function parameters on balance maintenance, indicating an important role for respiratory training in enhancing postural stability. CBT approaches combined with breath training have shown promise in reducing the psychological aspects of pain.[42,43] This suggests that respiratory exercises may offer a dual benefit by not only enhancing physiological function but also addressing the cognitive and emotional dimensions of pain. The respiratory system is intricately linked to the autonomic nervous system, where controlled breathing can help balance sympathetic and parasympathetic responses.[44] This modulation can be particularly beneficial in managing stress, which is known to exacerbate pain perception.

Furthermore, advancements in technology have facilitated the incorporation of respiratory training into home-based rehabilitation programs. Mobile applications and wearable devices capable of monitoring breathing patterns have emerged as valuable tools in promoting adherence to respiratory exercises.[44] Such innovations enable personalized therapy that can adapt to the individual needs of patients in real time, potentially leading to better long-term outcomes.

This review has some limitations. First, only nine articles were reviewed. Such a small sample size may not be representative of the effectiveness of breathing exercises in various musculoskeletal disorders. To address this limitation, future studies must include a greater number of studies by widening the search and including other databases. Second, the review comprised RCTs, systematic reviews, and observational studies. This heterogeneity in study design can generate variability in the quality of evidence, and it becomes challenging to derive definitive results regarding the effectiveness of breathing exercises. Future studies could try to assess studies with similar study designs or conduct comparative studies specifically on breath intervention protocols to yield more reliable results. Lastly, the PEDro score could not be calculated from the RCTs included in the systematic review due to a lack of information. Future studies should try to use objective and standardized measures to evaluate the effects of breathing exercises on musculoskeletal pain and function and thereby improve the overall quality and validity of findings.

CONCLUSION

Breathing exercises, particularly diaphragmatic and pursed-lip techniques, demonstrate efficacy in managing MSD-related pain and mobility impairment and represent effective therapeutic interventions in the management of musculoskeletal disorders. These exercises improve respiratory function, enhance core stability, diminish muscle tension, and foster relaxation, which are essential for effective pain management and functional restoration. The literature supports the application of techniques such as

diaphragmatic breathing, pursed-lip breathing, and resisted breathing exercises in diverse musculoskeletal conditions, including chronic low back pain, neck pain, and adhesive capsulitis, while promoting relaxation. Despite the recognition of the necessity for breathing exercises in managing musculoskeletal pain disorders, the existing approaches remain largely generalized. A deficiency of literature persists regarding advanced and corrective breathing techniques, such as postural respiration techniques, which could specifically address musculoskeletal pain disorders.

Future Research Recommendations

It is essential to investigate the effectiveness of condition-specific breathing exercises compared to generic breathing techniques for different musculoskeletal disorders. This will provide valuable insights for clinical practice. Future studies could build upon pioneering work on breath therapy for chronic low back pain and examine specialized interventions tailored to specific conditions. Conducting longitudinal studies to evaluate the sustained benefits of respiratory exercises on musculoskeletal pain over extended durations (1–2 years) will contribute to establishing their role in chronic pain management. Further studies investigating the physiological mechanisms through which breathing exercises alleviate musculoskeletal pain are required, particularly exploring changes in muscle activation patterns, biomechanical adjustments, and neurophysiological responses. In addition, the study needs to explore how the breathing exercises are to be combined appropriately with other physiotherapeutic treatments and enable the establishment of combined treatment protocols. Furthermore, studies on how individual characteristics (e.g., sex, age, and comorbidities) influence responses to breathing exercises are needed. These will enable the interventions to be designed for specific patient subgroups.

Statement and declarations

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Consent to participate- Not applicable

Consent for publication- Not applicable

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Figure legends

Figure 1. Search strategies for screening articles
Figure 2. Types of breathing exercises used
Figure 3. Studies on breathing exercise for MSDS
Figure 4. PEDRO Score of 06 clinical trials for quality testing (6.83-good)