



Breathing Dysfunction And Its Association With Shoulder Pain: A Cross-Sectional Study

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Abstract: Breathing dysfunction has been implicated in musculoskeletal disorders, but its association with shoulder pain remains underexplored. This study aimed to investigate the relationship between breathing dysfunction and shoulder pain severity, thoracic mobility, and shoulder-related disability. A cross-sectional study was conducted on 80 individuals with chronic shoulder pain (≥ 3 months). Participants underwent assessments for pain intensity using the Visual Analog Scale (VAS) and shoulder disability using the Shoulder Pain and Disability Index (SPADI). Breathing dysfunction was evaluated using the Breathing Pattern Assessment Tool (BPAT), the Manual Assessment of Respiratory Motion (MARM), and chest expansion measurements at the xiphoid level. Pearson's correlation and multiple regression analyses were performed to determine the association between breathing parameters and shoulder pain outcomes. A significant negative correlation was observed between chest expansion and VAS scores ($r = -0.52$, $p < 0.001$), indicating that reduced thoracic mobility was associated with higher pain levels. BPAT scores were positively correlated with SPADI scores ($r = 0.48$, $p < 0.001$), suggesting greater shoulder disability in individuals with dysfunctional breathing patterns. MARM scores were negatively correlated with SPADI scores ($r = -0.41$, $p = 0.002$). Multiple regression analysis revealed that breathing dysfunction variables significantly predicted shoulder pain and disability ($R^2 = 0.37$, $p < 0.001$). Breathing dysfunction is significantly associated with increased shoulder pain and disability. Integrating breathing assessments and interventions into shoulder rehabilitation programs may provide a more comprehensive approach to pain management. Future studies should explore the effectiveness of breathing re-education in improving musculoskeletal outcomes.

Index Terms - Shoulder pain, breathing dysfunction, thoracic mobility, diaphragmatic movement, musculoskeletal pain.

I. INTRODUCTION

Shoulder pain is a prevalent musculoskeletal condition that affects individuals across various age groups and occupational backgrounds. It is a major contributor to functional impairment and reduced quality of life, with etiologies ranging from mechanical dysfunctions and postural imbalances to neuromuscular impairments and systemic conditions. While the biomechanical and pathological aspects of shoulder pain have been extensively studied, the potential role of breathing dysfunction in its development and persistence remains an area of emerging interest.

Breathing dysfunction encompasses a range of abnormalities in respiratory mechanics, including altered diaphragm function, dysfunctional breathing patterns, and impaired thoraco-abdominal coordination. Research suggests that faulty breathing mechanics can influence postural stability, scapular kinematics, and neuromuscular control of the shoulder girdle. The diaphragm, being a core stabilizer, has anatomical and

functional connections with the thoracic spine and shoulder complex. Dysfunction in this system may lead to compensatory patterns, altered muscle recruitment, and increased load on the shoulder musculature, potentially exacerbating pain and dysfunction.¹

Previous studies have highlighted the association between respiratory dysfunction and musculoskeletal disorders, particularly in the cervical and thoracic regions. However, limited evidence exists regarding the specific relationship between breathing dysfunction and shoulder pain. Identifying this association may provide valuable insights into alternative therapeutic approaches, including breathing re-education and diaphragm-focused interventions, for managing shoulder pain.²

This cross-sectional study aims to investigate the association between breathing dysfunction and shoulder pain, evaluating respiratory patterns, diaphragmatic function, and their potential impact on shoulder biomechanics. Understanding this relationship could contribute to a more integrated approach in musculoskeletal rehabilitation, emphasizing the role of breathing mechanics in the management of shoulder pain.

II. RESEARCH METHODOLOGY

This study was designed as a cross-sectional observational study to assess the association between breathing dysfunction and shoulder pain. Written informed consent was obtained from all participants before enrollment. A total of 80 participants with shoulder pain were recruited from physiotherapy outpatient clinics. Participants were selected based on predefined inclusion and exclusion criteria.

Inclusion Criteria

1. Adults aged 20–60 years.
2. Individuals with unilateral or bilateral shoulder pain persisting for more than three months.
3. Participants with a **Visual Analogue Scale (VAS)** score of 3 or higher.
4. Presence of restricted shoulder range of motion (ROM) or muscular tightness.
5. Individuals willing to participate and provide informed consent.

Exclusion Criteria

1. History of recent (within the last six months) shoulder surgery or fracture.
2. Diagnosed respiratory conditions such as chronic obstructive pulmonary disease (COPD), asthma, or interstitial lung disease.
3. Neurological conditions affecting posture or respiration (e.g., stroke, Parkinson's disease).
4. Severe spinal deformities (e.g., scoliosis >40° curvature).
5. Current participation in a structured breathing rehabilitation program.
6. Pregnant individuals due to physiological changes affecting respiration.

Assessment Tools and Outcome Measures

Each participant underwent a detailed assessment to evaluate shoulder pain, functional disability, respiratory function, and postural mechanics.

1. **Pain Assessment**

- **Visual Analogue Scale (VAS):** Used to quantify shoulder pain intensity. Participants were asked to mark their pain level on a 10 cm horizontal line, with 0 representing "no pain" and 10 representing "worst pain imaginable."

2. **Shoulder Function and Disability Evaluation**

- **Shoulder Pain and Disability Index (SPADI):** This tool assesses both pain and functional limitations associated with shoulder dysfunction. It consists of 13 items divided into two subscales: pain (5 items) and disability (8 items), with higher scores indicating greater impairment.

3. Respiratory Function Assessment

- **Breathing Pattern Assessment Tool (BPAT):** A structured observational tool used to identify dysfunctional breathing patterns, including paradoxical breathing, upper chest dominance, and irregular respiratory rhythm.³
- **Manual Assessment of Respiratory Motion (MARM):** Used to evaluate diaphragmatic movement and thoraco-abdominal coordination. The examiner palpates the thorax and abdomen to assess symmetrical expansion and diaphragmatic activation.⁴
- **Chest Expansion Measurement:** A tape measure was used to assess thoracic mobility at three levels: axillary (upper chest), mid-sternal (mid-thorax), and xiphoid (lower thorax). Measurements were taken during full inspiration and expiration, with reduced expansion indicating respiratory dysfunction.

4. Postural and Biomechanical Assessment

- **Scapular Dyskinesis Test:** Participants performed dynamic arm movements while scapular motion was observed for abnormalities such as winging or asymmetry.
- **Forward Head Posture Measurement:** A lateral view assessment was conducted using a plumb line to measure the craniovertebral angle, with smaller angles indicating increased forward head posture.⁵

Statistical Analysis

Descriptive statistics were used to summarize demographic and clinical characteristics. Pearson's correlation was employed to examine the relationship between breathing dysfunction and shoulder pain severity. Multiple regression analysis was performed to determine whether breathing dysfunction parameters independently contributed to shoulder pain intensity and disability. A significance level of $p < 0.05$ was considered statistically significant.

III. RESULTS

Demographic and Clinical Characteristics

A total of 80 participants (mean age: 42.6 ± 8.5 years, 40 males and 40 females) were included in the study. The mean duration of shoulder pain was 8.4 ± 3.2 months. The mean **VAS score** was 6.5 ± 1.3 , while the mean SPADI score was 58.7 ± 12.1 . The mean chest expansion measured at the xiphoid level was 3.2 ± 0.8 cm. Table 1 presents the demographic and clinical characteristics of the participants.

Table 1. Demographic and Clinical Characteristics of Participants

Variables	Mean $\pm$ SD / n (%)
Age (years)	42.6 ± 8.5
Gender (Male/Female)	40 (50%) / 40 (50%)
Duration of Shoulder Pain (months)	8.4 ± 3.2
Dominant Hand (Right/Left)	60 (75%) / 20 (25%)
VAS Score	6.5 ± 1.3
SPADI Score (%)	58.7 ± 12.1
Chest Expansion (cm)	3.2 ± 0.8

Correlation between Breathing Dysfunction and Shoulder Pain

Pearson's correlation analysis was conducted to examine the association between breathing dysfunction and shoulder pain severity. A significant negative correlation was observed between chest expansion and VAS scores ($r = -0.52$, $p < 0.001$), indicating that reduced thoracic mobility was associated with higher pain levels. Additionally, a significant positive correlation was found between BPAT scores and SPADI scores ($r = 0.48$, $p < 0.001$), suggesting that individuals with more pronounced dysfunctional breathing patterns exhibited greater shoulder-related disability. The MARM score also showed a significant negative correlation with SPADI scores ($r = -0.41$, $p = 0.002$), indicating that reduced diaphragmatic movement was associated with increased shoulder dysfunction. These findings are summarized in Table 2.

Table 2. Correlation Between Breathing Parameters and Shoulder Pain Outcomes

Variable Comparison	Pearson's r	p-value
Chest Expansion vs. VAS	-0.52	<0.001**
BPAT Score vs. SPADI	0.48	<0.001**
MARM Score vs. SPADI	-0.41	0.002**

* $p < 0.05$, * $p < 0.001$ (statistically significant)

Predictors of Shoulder Pain and Disability

To further investigate the contribution of breathing dysfunction to shoulder pain and disability, a multiple regression analysis was performed, with VAS and SPADI scores as dependent variables and chest expansion, BPAT score, and MARM score as independent variables. The regression model was statistically significant ($F(3,76) = 15.28$, $p < 0.001$, $R^2 = 0.37$), indicating that breathing dysfunction explained 37% of the variance in shoulder pain and disability.

Among the predictors, chest expansion ($\beta = -0.38$, $p < 0.001$) emerged as the strongest predictor of pain intensity, suggesting that restricted thoracic mobility contributes significantly to shoulder pain severity. Additionally, BPAT scores ($\beta = 0.32$, $p = 0.004$) were significantly associated with SPADI scores, indicating that dysfunctional breathing patterns were linked to greater shoulder disability. The MARM score ($\beta = -0.27$, $p = 0.009$) also showed a significant negative association with SPADI scores, suggesting that impaired diaphragmatic movement may contribute to shoulder dysfunction.

Table 3. Multiple Regression Analysis for Predicting Shoulder Pain and Disability

Predictor Variable	Standardized β	p-value
Chest Expansion	-0.38	<0.001**
BPAT Score	0.32	0.004**
MARM Score	-0.27	0.009**

* $p < 0.05$, * $p < 0.001$ (statistically significant)

The results of this study demonstrate a significant association between breathing dysfunction and shoulder pain. Individuals with reduced chest expansion exhibited higher pain intensity, as indicated by a negative correlation with VAS scores. Similarly, dysfunctional breathing patterns were associated with greater shoulder disability, as evidenced by the positive correlation between BPAT and SPADI scores. Furthermore, the regression analysis suggests that breathing dysfunction explains a substantial proportion of the variance in shoulder pain and disability, emphasizing its potential role in musculoskeletal dysfunction.

These findings highlight the need for an integrated approach to shoulder pain management that includes assessment and intervention for breathing mechanics. Future studies should explore whether breathing re-education and diaphragmatic training can serve as effective therapeutic strategies for individuals with shoulder pain.

IV. DISCUSSION

The present study aimed to examine the association between breathing dysfunction and shoulder pain by analyzing thoracic mobility, dysfunctional breathing patterns, and diaphragmatic movement in individuals with chronic shoulder pain. The findings revealed a significant correlation between reduced chest expansion and increased pain severity, as well as a strong association between dysfunctional breathing and shoulder-related disability. These results highlight the potential role of respiratory dysfunction in musculoskeletal pain and functional impairment.

Association between Breathing Dysfunction and Shoulder Pain

A significant negative correlation was observed between chest expansion and VAS scores ($r = -0.52$, $p < 0.001$), indicating that individuals with restricted thoracic mobility reported higher pain intensity. This finding is consistent with previous studies suggesting that thoracic spine mobility plays a critical role in maintaining normal scapulothoracic kinematics, and its restriction may contribute to altered biomechanics,

muscle dysfunction, and pain in the shoulder region. Limited rib cage expansion may lead to compensatory overuse of the accessory muscles of respiration, particularly the sternocleidomastoid and upper trapezius, which have been implicated in chronic shoulder pain syndromes.

Similarly, a significant positive correlation was observed between BPAT scores and SPADI scores ($r = 0.48$, $p < 0.001$), suggesting that individuals with more pronounced dysfunctional breathing patterns exhibited greater shoulder-related disability. Dysfunctional breathing has been associated with altered neuromuscular control, postural instability, and increased mechanical loading on the shoulder girdle. The findings of this study support the hypothesis that altered breathing patterns contribute to musculoskeletal pain, potentially through increased muscle fatigue, impaired motor control, and excessive activation of accessory respiratory muscles.^{6,7}

Furthermore, the MARM score demonstrated a significant negative correlation with SPADI scores ($r = -0.41$, $p = 0.002$), indicating that impaired diaphragmatic movement was associated with greater shoulder disability. The diaphragm plays a crucial role in postural stabilization and movement efficiency, and its dysfunction may lead to compensatory motor patterns, including increased reliance on the pectoral and scalene muscles, which can exacerbate shoulder pain and dysfunction. These findings align with previous research indicating that compromised diaphragmatic function can alter lumbopelvic and thoracic stability, potentially affecting upper limb biomechanics.⁸

Predictive Value of Breathing Dysfunction in Shoulder Pain and Disability

The multiple regression analysis indicated that breathing dysfunction variables significantly contributed to the variance in shoulder pain and disability ($F(3,76) = 15.28$, $p < 0.001$, $R^2 = 0.37$). Among the predictors, chest expansion ($\beta = -0.38$, $p < 0.001$) emerged as the strongest determinant of pain intensity, reinforcing the role of thoracic mobility in shoulder mechanics. Restricted thoracic expansion may impair scapular movement and place additional strain on the glenohumeral joint, leading to increased pain and functional limitations.^{9,10}

Additionally, BPAT scores ($\beta = 0.32$, $p = 0.004$) were found to be significant predictors of SPADI scores, suggesting that dysfunctional breathing contributes to shoulder disability. Given that breathing dysfunction has been linked to altered postural control and inefficient stabilization strategies, these findings underscore the need to consider respiratory function in individuals with shoulder pain. The MARM score ($\beta = -0.27$, $p = 0.009$) also demonstrated a significant association with shoulder disability, further supporting the role of diaphragmatic dysfunction in musculoskeletal pain.¹¹

Several limitations should be acknowledged in the present study. First, the cross-sectional design precludes any causal inferences regarding the relationship between breathing dysfunction and shoulder pain. Future longitudinal studies are needed to determine whether addressing respiratory dysfunction can lead to significant improvements in pain and disability outcomes. Additionally, this study did not assess respiratory muscle strength, which may provide further insights into the mechanisms underlying the observed associations.

V. CONCLUSION

This study demonstrated a significant association between breathing dysfunction and shoulder pain, with reduced chest expansion correlating with higher pain intensity and dysfunctional breathing patterns predicting greater shoulder disability. The findings suggest that respiratory dysfunction may contribute to musculoskeletal impairments and should be considered in the assessment and management of shoulder pain.

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