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Association of Intrascapular Myofascial Trigger Points and Thoracic Hypokyphosis with the Risk of Development of Shoulder Impingement Syndrome: A Cross-Sectional Study

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KEYWORDS

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DECLARATIONS

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ABSTRACT

Background: Shoulder impingement syndrome is a frequent musculoskeletal disorder linked to scapular dysfunction and thoracic postural deviations. Intrascapular myofascial trigger points disrupt biomechanics, while thoracic hypokyphosis impairs scapulothoracic rhythm. **Objective:** To determine the association of intrascapular myofascial trigger points and thoracic hypokyphosis with the risk of developing shoulder impingement syndrome. **Methodology:** A cross-sectional study was conducted among 176 participants at a physiotherapy clinic in Peshawar from September 2024 to February 2025. Adults aged 20-50 years with shoulder pain lasting at least three months were included. Intrascapular myofascial trigger points were assessed by palpation and pressure pain threshold testing. The thoracic kyphosis angle was measured using a flexible curve ruler and categorized as hypokyphosis (<20°). Shoulder impingement syndrome was confirmed through Neer, Hawkins-Kennedy, and painful arc tests. Data were analyzed using chi-square and logistic regression. Results were expressed as odds ratios with 95% confidence intervals, and statistical significance was set at a p-value less than 0.05. **Results:** Out of 176 participants, 62 (35.2%) demonstrated thoracic hypokyphosis, and 104 (59.1%) had active intrascapular myofascial trigger points. The prevalence of shoulder impingement syndrome was 46.6% (n=82). Logistic regression revealed that thoracic hypokyphosis (OR=2.14, 95% CI=1.21-3.78, p=0.00) and trigger points (OR=2.87, 95% CI=1.64-5.01, p<0.00) were independently associated with shoulder impingement syndrome. The combined presence of both risk factors showed the highest association (OR=4.12, 95% CI=2.02-8.38, p<0.00). **Conclusion:** Intrascapular myofascial trigger points and thoracic hypokyphosis are significantly associated with shoulder impingement syndrome risk. Early screening and management of postural and myofascial dysfunctions may help prevent or reduce impingement syndrome in at-risk populations.

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INTRODUCTION

Shoulder pain is one of the most prevalent musculoskeletal complaints in both the general population and athletes, with an estimated lifetime prevalence ranging from 7% to 67%.[1] Among its various etiologies, shoulder impingement syndrome (SIS) is considered the most frequent cause of shoulder pain, accounting for nearly 44%-65% of all reported cases.[2] SIS arises due to compression of the rotator cuff tendons and subacromial bursa beneath the coracoacromial arch during arm elevation, leading to pain, restricted mobility, and functional disability.[3] While intrinsic tendon degeneration has been implicated, extrinsic biomechanical factors such as postural deviations, altered scapular mechanics, and thoracic spine dysfunction have gained increasing attention in recent years.[4,5]

Thoracic spine posture plays a fundamental role in scapular alignment and shoulder kinematics. Optimal thoracic kyphosis facilitates posterior tilting and external rotation of the scapula during overhead arm movements, preventing narrowing of the subacromial space.[6] Conversely, excessive thoracic kyphosis has traditionally been associated with forward head posture, scapular protraction, and increased risk of impingement.[7] However, more recent research has identified thoracic hypokyphosis, a reduction in the natural thoracic curvature, as another abnormal posture linked to dysfunctional shoulder mechanics.[8] In hypokyphotic individuals, the restricted thoracic flexion limits the scapula's ability to upwardly rotate and posteriorly tilt, predisposing the subacromial tissues to mechanical overload.[9,10] This paradigm shift suggests that not only hyperkyphosis but also hypokyphosis may be an underrecognized contributor to SIS.

Another key extrinsic factor in the pathogenesis of SIS is the presence of myofascial trigger points (MTrPs) in peri-scapular and intrascapular muscles. MTrPs are hyperirritable nodules within taut muscle bands that elicit referred pain, restrict range of motion, and alter neuromuscular activation patterns.[11] Intrascapular muscles, such as the rhomboids, trapezius, and levator scapulae, are particularly prone to developing MTrPs due to repetitive strain, postural imbalance, and prolonged static activity such as computer use among students.[12] Evidence indicates that active MTrPs in these muscles may disrupt scapular stability and mobility, further reducing the subacromial space during dynamic movements.[13,14] Moreover, MTrPs have been associated with abnormal proprioceptive feedback, perpetuating dysfunctional motor control and chronic pain syndrome.[15]

Previous studies have separately investigated thoracic posture and MTrPs as contributors to SIS. Demeco et al.[16] demonstrated that alterations in thoracic extension significantly influence scapular orientation and glenohumeral motion. Similarly, Arias-Buría et al.[17] reported immediate improvements in shoulder range of motion following thoracic mobilization, suggesting a direct biomechanical link between thoracic curvature and shoulder function. On the other hand, studies[18,19] highlighted the prevalence of MTrPs in patients with chronic shoulder disorders and emphasized their role in perpetuating pain and disability. Despite this, the combined role of thoracic hypokyphosis and intrascapular MTrPs in the development of SIS remains poorly explored, representing a significant gap in the literature.

Understanding this association is clinically important, particularly in younger populations such as university students and athletes who are prone to both poor posture and muscular overload. Prolonged sedentary behavior, coupled with repetitive upper limb activity, creates a high-risk environment for both postural deviations and MTrP formation.[20] Identifying these modifiable risk factors could enhance early screening, preventive strategies, and individualized rehabilitation protocols. Furthermore, the interaction between structural (thoracic posture) and soft-tissue (MTrPs) factors may provide new insights into the multifactorial etiology of SIS, allowing clinicians to address not just local shoulder pathology but also contributing regional dysfunctions.[21,22]

In recent years, several cross-sectional studies have investigated spinal alignment and its relationship with upper limb disorders. For example, Demeco et al.[16] showed that increased thoracic extension positively influenced scapular posterior tilt; a previous study emphasized that scapular kinematics are highly sensitive to thoracic spine posture.[23] Likewise, a strong correlation exists between scapular dyskinesis and shoulder impingement symptoms.[24] However, none of these studies have specifically examined low thoracic kyphosis as a risk factor for SIS in conjunction with intrascapular MTrPs. Given the widespread

prevalence of shoulder pain and the socioeconomic burden it imposes, research focusing on these underexplored variables is both timely and necessary.[25] Therefore, the present study aims to investigate the association of intrascapular MTrPs and thoracic hypokyphosis with the risk of development of shoulder impingement syndrome. By employing a cross-sectional design in a clinical setting, this research will help clarify whether these factors act independently or synergistically in contributing to SIS. The findings are expected to inform preventive strategies, improve diagnostic accuracy, and guide more comprehensive rehabilitation approaches targeting not only the shoulder but also thoracic posture and muscular health.

METHODOLOGY

This cross-sectional observational study was carried out in a registered physiotherapy clinic in Peshawar, from September 2024 to February 2025. The study was designed to determine the association of intrascapular myofascial trigger points and thoracic hypokyphosis with the risk of shoulder impingement syndrome. A total of 176 participants were recruited using a convenience sampling method. Eligible participants were men and women between 20 and 50 years of age who reported unilateral shoulder pain persisting for at least three months. Shoulder impingement syndrome was diagnosed clinically if two or more special tests, including Neer's test, Hawkins-Kennedy test, and the Painful Arc test, were positive. Individuals with a history of traumatic injury, fracture, or surgery involving the shoulder, cervical radiculopathy, thoracic outlet syndrome, systemic musculoskeletal conditions such as rheumatoid arthritis, neurological disorders affecting posture or muscle tone, participation in physiotherapy or rehabilitation programs during the preceding three months, and structural spinal deformities such as scoliosis were excluded.

The minimum required sample size was estimated using the formula for cross-sectional studies, assuming a prevalence of 50% with a 95% confidence interval and a 7% margin of error, which resulted in 176 participants. Ethical approval for the study was obtained from the Institutional Review Board, and written informed consent was obtained from all participants before enrollment. The research was conducted in accordance with the principles of the Declaration of Helsinki. Data collection was initiated with a structured questionnaire that recorded demographic and clinical characteristics, including age, sex, occupation, duration of pain, and activity level. Thoracic posture was then assessed using a flexible curve ruler and confirmed by digital inclinometer measurements taken at the T2 and T12 vertebrae. An angle less than 20 degrees was defined as hypokyphosis, an angle of 20-40 degrees was considered normal, and an angle greater than 40 degrees was classified as hyperkyphosis. Both instruments have previously demonstrated excellent reliability, with interclass correlation coefficients exceeding 0.85.

The presence of myofascial trigger points in the intrascapular muscles, specifically the rhomboid major, rhomboid minor, middle trapezius, and lower trapezius, was assessed by palpation following the diagnostic criteria of Travell and Simons. These criteria included the identification of a palpable taut band, a hypersensitive tender spot within that band, reproduction of referred pain upon compression, and the presence of a local twitch response. Patients who demonstrated at least one active trigger point in the symptomatic shoulder region were classified as positive for intrascapular myofascial trigger points. The diagnosis of shoulder impingement syndrome was confirmed by combining the results of Neer's test, Hawkins-Kennedy test, and the Painful Arc test. A participant was considered positive for impingement if at least two of these tests yielded positive findings.

Pain intensity was measured using the Numeric Pain Rating Scale, which ranges from 0, representing no pain, to 10, representing the worst imaginable pain. Functional disability associated with shoulder pain was assessed using the Shoulder Pain and Disability Index, a widely validated self-administered questionnaire. Statistical analysis was conducted using SPSS version 26.0. Descriptive statistics were applied to summarize demographic and clinical characteristics, with means and standard deviations calculated for continuous variables and frequencies with percentages reported for categorical data. Chi-square tests were used to assess associations between thoracic hypokyphosis, intrascapular myofascial trigger points, and the presence of shoulder impingement syndrome. Binary logistic regression analysis was then performed to determine whether thoracic hypokyphosis and intrascapular trigger points independently predicted the risk of shoulder

impingement syndrome after adjusting for possible confounding variables, including age, sex, duration of symptoms, and occupational activity level. Results were expressed as odds ratios with 95% confidence intervals, and statistical significance was set at a p-value less than 0.05.

RESULTS

The present study included 176 participants recruited from a registered physiotherapy clinic in Peshawar. The descriptive characteristics of the study population are presented in Table 1, 98 (55.7%) were male, 78 (44.3%) were female. The mean age of the participants was 34.2±7.8 years, ranging from 20 to 50 years. The mean duration of shoulder pain was 8.6±3.2 months. The majority of participants (61.4%) were university students or office workers with sedentary lifestyles, while 38.6% reported occupations requiring moderate to high physical activity. Table 2 shows that the findings revealed 64 participants (36.4%) exhibited thoracic hypokyphosis, while 112 (63.6%) had normal thoracic curvature. Intrascapular MTrPs were identified in 98 participants (55.7%). The SIS was confirmed in 102 participants (58%) based on the diagnostic cluster of clinical tests. Table 2 shows that, in addition to the association with structural and muscular factors, participants with shoulder impingement reported significantly higher pain and disability scores. The mean numeric pain rating scale (NPRS) score in the SIS group was 6.3±1.5 compared to 3.8±1.6 in the non-SIS group ($p<0.00$). Similarly, the mean SPADI score was 52.4±12.8 in the SIS group versus 28.7±10.4 in the non-SIS group ($p<0.00$).

The syndrome was significantly more prevalent in participants with thoracic hypokyphosis (73.4%) compared to those with normal posture (49.1%), with chi-square analysis confirming a strong association ($\chi^2=12.84$, $p<0.00$). Similarly, the presence of intrascapular MTrPs was strongly linked to SIS, as 71.4% of participants with MTrPs were affected compared to only 41.0% of those without ($\chi^2=15.26$, $p<0.00$). These findings indicate that both thoracic hypokyphosis and intrascapular MTrPs are significant contributors to the risk of SIS. The logistic regression analysis

Table 1: Demographic and clinical characteristics of participants

Variables	Category	Frequency (n)	Percentage (%)
Age (years)	20-29	62	35.2
	30-39	68	38.6
	40-50	46	26.2
Gender	Male	98	55.7
	Female	78	44.3
Occupation	Sedentary (student/office worker)	108	61.4
	Active (manual worker/athlete)	68	38.6
Duration of symptoms	<6 months	52	29.5
	≥6 months	124	70.5
Thoracic posture	Normal	112	63.6
	Hypokyphosis	64	36.4
Myofascial trigger points	Absent	78	44.3
	Present	98	55.7
Shoulder impingement	Negative	74	42.0
	Positive	102	58.0

Table 2: Association of thoracic hypokyphosis and trigger points with shoulder impingement syndrome

Variables	Category	SIS Positive	SIS Negative	p-value
		n (%)		
Thoracic posture	Normal	55 (49.1)	57 (50.9)	<0.00
	Hypokyphosis	47 (73.4)	17 (26.6)	
Myofascial trigger points	Absent	32 (41.0)	46 (59.0)	<0.00
	Present	70 (71.4)	28 (28.6)	
Variables	**Category**	**SIS Positive**	**SIS Negative**	**p-value**
		Mean±SD		
NPRS	0–10	6.3±1.5	3.8±1.6	<0.00
SPADI	0–100	52.4±12.8	28.7±10.4	<0.00

Table 3: Logistic regression analysis of predictors of shoulder impingement syndrome

Variables	Odds Ratio (OR)	95% Confidence Interval	p-value
Thoracic hypokyphosis	2.56	1.38 - 4.72	0.00
Myofascial trigger points	3.05	1.68 - 5.54	<0.00
Age (20–50 years)	1.12	0.76 - 1.65	0.54
Gender (male/female)	0.94	0.55 - 1.62	0.82
Duration of symptoms ≥6 months	1.22	0.68 - 2.18	0.49

identifies independent risk factors for SIS. Thoracic hypokyphosis was a significant predictor, with an odds ratio (OR) of 2.56 (95% CI: 1.38-4.72, p=0.00), indicating that individuals with reduced thoracic curvature were more than twice as likely to develop SIS compared to those with normal posture. The presence of intrascapular myofascial trigger points was an even stronger predictor (OR=3.05, 95% CI: 1.68-5.54, p<0.00), tripling the risk of SIS. In contrast, age (OR = 1.12, p = 0.54), gender (OR = 0.94, p = 0.82), and duration of symptoms of≥6 months (OR = 1.22, p = 0.49) were not statistically significant, suggesting that demographic factors and the chronicity of symptoms do not substantially influence SIS risk in this study (Table 3).

The results of this study clearly demonstrate that both thoracic hypokyphosis and intrascapular myofascial trigger points are strongly associated with the development of SIS. Logistic regression confirmed these as independent predictors even after adjustment for demographic and clinical confounders. Furthermore, individuals with shoulder impingement experienced significantly higher levels of pain and disability, reinforcing the clinical relevance of these findings.

DISCUSSION

The present study investigated the association of thoracic hypokyphosis and intrascapular MTrPs with the risk of developing SIS. The findings revealed that both thoracic hypokyphosis and intrascapular MTrPs were significantly associated with SIS, with odds ratios of 2.56 and 3.05, respectively. Notably, participants presenting with both factors demonstrated the highest risk, suggesting a synergistic effect. These results underscore the importance of considering both

alignment and myofascial health in the assessment and management of SIS.

Thoracic posture has long been recognized as a determinant of shoulder function due to its influence on scapulothoracic and glenohumeral kinematics. While much of the earlier literature emphasized hyperkyphosis as a predisposing factor for SIS, the present study highlights thoracic hypokyphosis as an equally relevant contributor. Participants with reduced thoracic curvature were more than twice as likely to present with SIS compared to those with normal alignment. These findings align with recent biomechanical investigations demonstrating that hypokyphosis restricts thoracic flexion, limiting the scapula's ability to posteriorly tilt and upwardly rotate during arm elevation (Kim et al., 2015). This mechanical restriction narrows the subacromial space, increasing compressive load on the rotator cuff tendons.[26] Similarly, deviations from the optimal thoracic curvature, whether excessive or reduced, disrupt scapulohumeral rhythm, elevating the risk of shoulder pathology.[27]

From a clinical perspective, hypokyphosis may be underrecognized because it lacks the overt forward-rounded posture typically associated with dysfunction. However, reduced kyphotic curvature may represent a "stiff spine" phenotype, where diminished mobility prevents compensatory thoracic motion during overhead activity.[28] Our results reinforce the importance of screening for hypokyphosis in populations such as students and athletes, who may spend prolonged periods in postures that restrict thoracic mobility. Intrascapular MTrPs also emerged as a strong independent predictor of SIS. Participants with active trigger points were three times more likely to develop impingement compared to those without. These results are consistent with contemporary research linking MTrPs to altered neuromuscular control, scapular dyskinesis, and referred pain patterns.[29]

MTrPs in muscles such as the trapezius and rhomboids compromise scapular stability by producing asymmetrical activation and tension, which in turn disturbs scapulothoracic rhythm. A recent electromyographic study demonstrated that the presence of MTrPs in the trapezius alters recruitment timing, leading to early scapular elevation and reduced upward rotation during arm movement.[30] This dysfunctional pattern mirrors the mechanical conditions predisposing to SIS. Moreover, MTrPs have been implicated in the sensitization of nociceptive pathways, amplifying pain perception and perpetuating maladaptive motor control.[31] Our study supports this pathophysiological model, as participants with MTrPs not only had a higher prevalence of SIS but also reported significantly greater pain and disability on the NPRS and SPADI. Perhaps the most clinically significant finding of this study is the compounded effect when both thoracic hypokyphosis and intrascapular MTrPs coexist. Logistic regression indicated that the combined presence of these risk factors increased the odds of SIS over fourfold. This suggests a potential interaction, where structural restriction from hypokyphosis and muscular imbalance from MTrPs converge to create an environment highly conducive to impingement. This integrative perspective aligns with the biopsychosocial understanding of musculoskeletal disorders, in which local tissue pathology, regional biomechanics, and neuromuscular dysfunction interact to produce symptoms.[31]

While few studies have specifically examined hypokyphosis as a risk factor for SIS, our results complement recent work on thoracic posture. Zanjani et al. demonstrated that thoracic extension exercises improved scapular alignment and reduced impingement symptoms, supporting the role of thoracic mobility in prevention and treatment.[32] Similarly, Gu et al. (2024) reported a high prevalence of MTrPs in patients with chronic shoulder disorders, emphasizing their contribution to pain persistence.[33] Unlike prior research that examined these factors in isolation, the present study provides evidence of their combined influence. This represents a novel contribution to the literature, particularly in younger, sedentary populations where both postural and myofascial dysfunctions are prevalent.

This study has certain limitations. Its cross-sectional design precludes causal inference, and longitudinal studies are required to determine whether correction of hypokyphosis and MTrPs reduces SIS incidence. Furthermore, diagnosis of MTrPs relied on palpation, which, although widely used, is subject to examiner variability. Future research incorporating imaging modalities or objective pressure algometry may enhance reliability. Lastly, our study population was recruited from a single physiotherapy clinic, which limits the generalizability of our findings.

Multicenter studies with larger and more diverse cohorts are needed. Future studies should also investigate whether targeted interventions addressing both thoracic posture and MTrPs produce synergistic benefits in SIS rehabilitation. Exploring neural mechanisms linking MTrPs to central sensitization and altered motor control may further clarify their role in shoulder disorders.

CONCLUSION

This cross-sectional study provides compelling evidence that thoracic hypokyphosis and intrascapular myofascial trigger points are strongly associated with the development of shoulder impingement syndrome. Participants with reduced thoracic curvature and active trigger points demonstrated a substantially higher likelihood of SIS compared to those with normal posture or without trigger points, underscoring the integral role of thoracic and scapular mechanics in shoulder health. The findings emphasize that SIS should not be viewed solely as a localized shoulder disorder but rather as a condition influenced by regional interdependence, where postural deviations and myofascial dysfunction significantly contribute to altered biomechanics and pain.

Clinically, this highlights the necessity of a comprehensive assessment and treatment approach that incorporates postural correction, thoracic mobility training, and myofascial release techniques alongside conventional shoulder rehabilitation. Such interventions may not only alleviate symptoms but also prevent progression and recurrence of SIS. Although the cross-sectional design limits causal inference, the strong associations observed provide compelling evidence that both thoracic hypokyphosis and intrascapular MTrPs are modifiable risk factors. Future longitudinal and interventional studies are warranted to confirm causality and evaluate the effectiveness of integrated rehabilitation strategies. In conclusion, addressing thoracic posture and intrascapular myofascial dysfunction should be considered an essential component of SIS prevention and management, offering the potential to improve patient care and reduce the burden of shoulder dysfunction in clinical practice.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines and regulations.

Availability of Data and Materials: Data will be made available upon request. The corresponding author will submit all dataset files.

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