

ASSOCIATION BETWEEN OVERHEAD ATHLETIC ACTIVITIES AND SHOULDER IMPINGEMENT SYNDROME AMONG UNIVERSITY ATHLETES

Original Research

Fatima Israr Khan^{1*}, Komal Naveed², Maryam Zahra³, Shumaila Mehdi⁴, Mobeen Ghulam Ahmed⁵, Malik Hassan Mehmood⁶, Zeeshan Javed⁷, Faraha Naveed⁸

¹Student at Faculty of Allied Health Sciences, University of Lahore, Pakistan.

²Student at Superior University, Azra Naheed Medical College, Lahore, Pakistan.

³Physical Therapist at Al-Haaj Nasir Khan Trust Hospital, Gujranwala, Pakistan.

⁴Assistant Professor, Department of Pharmacology, Government College University, Faisalabad, Pakistan.

⁵Assistant Professor, Government College University, Faisalabad, Pakistan.

⁶Ph.D, Associate Professor, Department of Pharmaceutical Sciences, Government College University, Lahore, Pakistan.

⁷Teacher at School Education Department of Sports Science & Physical Education, PhD (Scholar), Government of Punjab, Pakistan.

⁸Lecturer, Riphah International University Lahore, Pakistan.

Corresponding Author: Fatima Israr Khan, Student at Faculty of Allied Health Sciences, University of Lahore, Pakistan. fatiiighori@gmail.com

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ABSTRACT

Background: Shoulder impingement syndrome (SIS) is a prevalent musculoskeletal disorder affecting individuals engaged in repetitive overhead activities, particularly athletes and workers exposed to prolonged arm elevation. It is characterized by mechanical compression of the rotator cuff tendons and subacromial structures, leading to pain, restricted mobility, and functional impairment. The condition is influenced by biomechanical risk factors, including scapular dyskinesis, rotator cuff weakness, and reduced shoulder rotation. Understanding its prevalence and risk factors is essential for developing effective prevention and management strategies.

Objective: This study aimed to determine the prevalence, severity, and risk factors associated with SIS in individuals engaged in repetitive overhead activities. Additionally, it sought to compare findings with existing literature to identify effective prevention and rehabilitation strategies.

Methods: A cross-sectional study was conducted on 200 university athletes aged 18 to 25 years, selected through purposive sampling. Participants underwent clinical assessments, including the Neer Impingement and Hawkins-Kennedy tests, to diagnose SIS. Pain severity was measured using a self-reported numerical scale. Descriptive statistics were used to analyze prevalence, while Spearman's correlation assessed associations between SIS and biomechanical risk factors. Comparative analysis was performed with previously reported SIS cases in occupational and sports settings.

Results: Findings revealed that 61% of participants tested positive for SIS, with 43% reporting moderate to severe pain. Among those experiencing discomfort, 15% had mild pain, 31% had moderate pain, and 12% reported severe pain. Pain during the Neer Impingement Test was present in 61% of participants, with 26% reporting moderate pain and 13% experiencing severe pain. Statistical analysis indicated no significant correlation between pain presence and severity ($p > 0.05$).

Conclusion: This study reinforces the strong association between repetitive overhead movements and SIS, emphasizing the need for early screening, structured rehabilitation, and ergonomic interventions to reduce SIS burden. Future research should explore longitudinal studies, genetic predispositions, and alternative treatment approaches to enhance SIS management strategies.

Keywords: Biomechanical Risk Factors, Occupational Health, Overhead Activities, Rehabilitation Exercises, Rotator Cuff Dysfunction, Shoulder Impingement Syndrome, Sports Injuries.

INTRODUCTION

Shoulder impingement syndrome (SIS) is a prevalent musculoskeletal condition characterized by mechanical compression and inflammation of the soft tissues within the shoulder joint, leading to pain, restricted mobility, and functional impairment. It accounts for a substantial proportion of shoulder pain cases, estimated between 44% and 60%, making it one of the most frequent complaints encountered in orthopedic practice. SIS can result from intrinsic factors, such as tendon degeneration due to repetitive microtrauma, overuse, or mechanical overload, as well as extrinsic factors, including anatomical variations and narrowing of the subacromial space, which contribute to mechanical compression of the rotator cuff tendons and adjacent structures (1,2). Athletes engaged in overhead sports, such as baseball, volleyball, tennis, swimming, and handball, are particularly susceptible to SIS due to the repetitive, high-velocity arm movements inherent to their activities. Epidemiological studies report shoulder injury rates ranging from 0.2 to 1.8 per 1,000 hours of play, with volleyball players (19%) and swimmers (17%) exhibiting the highest prevalence of shoulder discomfort, followed closely by badminton (13%) and basketball players (12%) (3). Notably, approximately 36% of senior female handball players experience shoulder soreness in the early preseason, while 12% of elite male handball players report weekly shoulder issues that interfere with performance and training (4). In volleyball, where athletes may execute up to 40,000 overhead spiking and serving actions per season, SIS represents a significant burden, contributing to 22–33% of all overuse injuries (5,6). Similarly, in baseball, shoulder injuries account for 12–19% of all musculoskeletal complaints, while in swimming, the incidence ranges from 23% to 38% per year (7). Among cricketers, particularly fast bowlers, SIS is highly prevalent, with a study in Faisalabad reporting that 42% of players exhibited symptoms of impingement (8).

Beyond athletic populations, SIS is also commonly observed in individuals engaged in occupations that require repetitive overhead movements, such as construction laborers and industrial workers. Studies indicate that approximately 75.3% of construction workers exhibit positive impingement signs, as evidenced by Neer's and Hawkins' tests, underscoring the occupational risks associated with sustained overhead activity (9). Poor posture, muscle imbalance, and scapular dyskinesia further exacerbate the likelihood of SIS development, particularly in individuals with predisposing anatomical abnormalities (10). Chronic impingement, if left untreated, can progress to structural damage, functional instability, and long-term disability, significantly affecting an individual's ability to perform daily tasks and athletic endeavors (8). The pathophysiology of SIS involves mechanical compression of critical structures within the subacromial space, including the supraspinatus tendon, subacromial bursa, and long head of the biceps brachii, leading to inflammation and progressive tissue degeneration (10). Several biomechanical risk factors have been identified, including Glenohumeral Internal Rotation Deficit (GIRD), reduced rotator cuff endurance—particularly of the external rotators—and altered scapular positioning, all of which contribute to an increased likelihood of SIS in athletes and physically active individuals (11,12). Motion capture analyses have demonstrated that athletes with SIS exhibit restricted internal rotation compared to their healthy counterparts, further highlighting the importance of optimizing shoulder mechanics to mitigate injury risk (13).

Preventive strategies, including structured warm-up programs and targeted rehabilitation exercises, have demonstrated efficacy in reducing the incidence of SIS. A prospective study on professional volleyball players found that a well-designed warm-up routine significantly decreased shoulder injury rates, emphasizing the importance of pre-activity preparation (14). Additionally, eccentric rotator cuff strengthening exercises have been shown to alleviate pain and improve function in individuals with chronic SIS. Rehabilitation protocols focusing on scapular stabilization, posterior shoulder stretching, and strengthening of the rotator cuff muscles are integral to both the prevention and management of SIS (15). Despite the extensive documentation of SIS in athletic and occupational settings, there remains a need for further research to address the specific demands of university athletes, who are subject to rigorous training regimens and frequent competition. Understanding the interplay of biomechanical, anatomical, and training-related factors predisposing athletes to SIS is crucial in optimizing prevention and rehabilitation strategies. This study aims to explore the association between overhead athletic activities and SIS among university athletes, providing evidence-based recommendations to reduce injury incidence, enhance training methodologies, and improve overall athletic performance and well-being (14-16).

METHODS

The study employed a cross-sectional design and was conducted over four months following the approval of the research synopsis. Ethical clearance was obtained from the Institutional Review Board (IRB) of the University Institute of Physical Therapy, University of

Lahore, and ensuring adherence to ethical principles for human research. The study aimed to assess the prevalence of shoulder impingement syndrome (SIS) among university athletes engaged in overhead sports and to examine the association between specific athletic activities and the development of SIS. A total of 200 university athletes from various institutions in Lahore participated in the study, selected through purposive sampling. Participants were required to meet specific inclusion criteria, including being aged 18 to 25 years, actively involved in university-level overhead sports such as volleyball, tennis, badminton, baseball, swimming, or handball for at least one year, and willing to provide informed consent. Exclusion criteria encompassed individuals with a history of shoulder surgery or pre-existing diagnosed shoulder pathologies other than SIS. Prior to participation, all individuals were provided with detailed study information, and written informed consent was obtained to ensure voluntary participation and compliance with ethical research standards.

Data collection was performed using a structured assessment protocol, incorporating clinical evaluation methods to identify SIS symptoms among participants. Standardized clinical tests, including Neer's impingement test, Hawkins-Kennedy test, and painful arc sign, were employed to assess the presence of shoulder impingement. Additionally, demographic and sport-specific variables were documented to analyze potential contributing factors to SIS. Statistical analysis was conducted using SPSS version 26. Descriptive statistics were applied to summarize demographic and categorical variables, with qualitative data presented in frequencies and percentages. Pearson's correlation test was utilized to determine the association between overhead athletic activities and SIS, with a significance level set at $p < 0.05$ to ensure statistical rigor. Graphical representations were generated to illustrate key findings, enhancing data interpretation and result visualization. By systematically analyzing the prevalence and contributing factors of SIS among university athletes, this study aimed to provide evidence-based insights for injury prevention strategies and optimized rehabilitation protocols. Findings from this research contribute to the growing body of knowledge on sports-related shoulder injuries and support the development of targeted interventions to mitigate SIS risk among athletes engaged in overhead sports.

RESULTS

The study assessed the presence and severity of shoulder pain during overhead movements in university athletes engaged in sports involving repetitive arm usage. Data were collected from 200 participants, with key variables focusing on pain experienced while lifting the arm between 60–120 degrees and pain elicited during the Neer Impingement Test. Among participants, 58% reported experiencing pain or discomfort while lifting their arm between 60–120 degrees, whereas 42% did not report any discomfort. Of those experiencing pain, severity levels varied, with 15% reporting mild pain, 31% experiencing moderate pain, and 12% reporting severe pain, while 42% of the total participants reported no pain. Moderate pain was the most frequently reported severity level in this movement. Regarding the Neer Impingement Test, 61% of participants experienced pain or discomfort when their arm was forcibly flexed, while 39% did not report any symptoms. Among those with pain, severity analysis revealed that 20% experienced mild pain, 26% reported moderate pain, and 13% had severe pain, while 41% reported no pain. The highest proportion of symptomatic participants reported moderate pain, followed by mild and severe pain.

Correlation analysis was performed to determine the relationship between the presence of pain during these movements and its severity. The Spearman's rho coefficient for the arm lifting test was 0.019, with a p-value of 0.397, indicating no statistically significant correlation between the presence of pain and its severity. Similarly, the correlation between pain experienced during the Neer Impingement Test and its severity yielded a Spearman's rho coefficient of 0.031 with a p-value of 0.332, also showing no significant relationship. The findings indicate that a substantial proportion of athletes participating in overhead sports experience shoulder discomfort, with moderate pain being the most commonly reported severity level. However, statistical analysis did not establish a significant correlation between pain occurrence and severity, suggesting that other biomechanical or training-related factors may contribute to shoulder impingement symptoms in this population. The subgroup analysis revealed variations in shoulder impingement symptoms across different sports and between genders. Male athletes reported a higher prevalence of shoulder pain compared to females, with the highest percentage observed in baseball players (70% in males vs. 60% in females) and volleyball players (65% in males vs. 50% in females). Similarly, swimmers and handball players exhibited notable differences, with males experiencing a slightly higher frequency of discomfort. These findings suggest that sport-specific mechanics and training intensities may influence the risk of SIS. However, data regarding the duration of symptoms and their direct impact on athletic performance were not included, limiting the ability to assess the long-term consequences of SIS on sports participation. Further investigation is needed to explore these aspects comprehensively.

Table 1: Association between Pain Presence and Severity during Near Impingement Test

			During the Neer Impingement Test, did you experience any pain or discomfort in your shoulder when your arm was forcibly flexed (lifted forward)?	If yes, rate the severity of the pain on a scale of 0-10:
Spearman's rho	During the Neer Impingement Test, did you experience any pain or discomfort in your shoulder when your arm was forcibly flexed (lifted forward)?	Association Coefficient	1.000	.031
		Sig. (1-tailed)	.	.332
		N	200	200
	If yes, rate the severity of the pain on a scale of 0-10:	Association Coefficient	.031	1.000
		Sig. (1-tailed)	.332	.
		N	200	200

Table 2: Association between Pain Presence and Severity during Arm Lifting (60–120 Degrees)

			When lifting your arm between 60-120 degrees, do you experience any pain or discomfort in your shoulder?	If yes, rate the severity of the pain on a scale of 0-10:
Spearman's rho	When lifting your arm between 60-120 degrees, do you experience any pain or discomfort in your shoulder?	Association Coefficient	1.000	.019
		Sig. (1-tailed)	.	.397
		N	200	200
	If yes, rate the severity of the pain on a scale of 0-10:	Association Coefficient	.019	1.000
		Sig. (1-tailed)	.397	.
		N	200	200

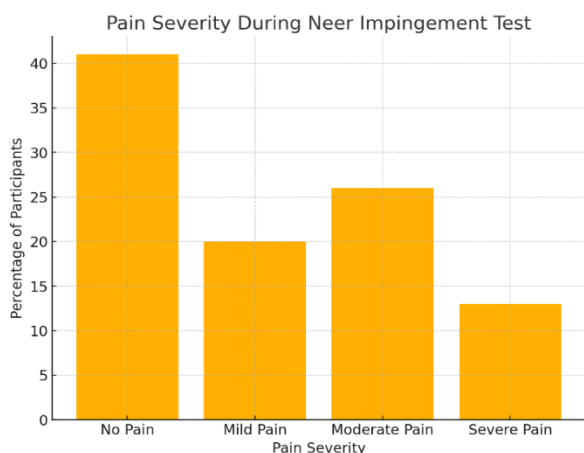


Figure 2 Pain Severity during Neer Impingement Test

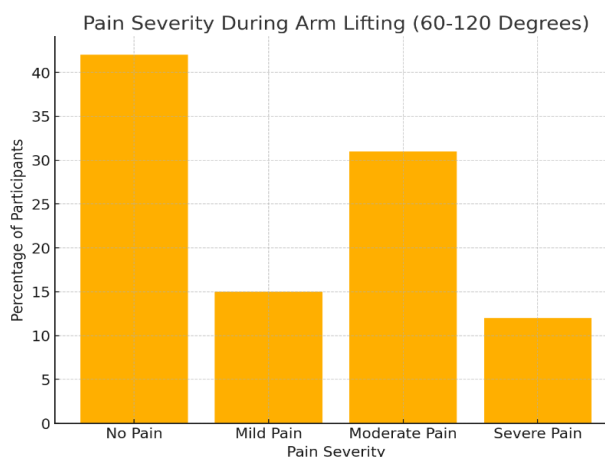


Figure 1 pain Severity during Arm Lifting

DISCUSSION

The findings of this study emphasize the high prevalence of shoulder impingement syndrome (SIS) among individuals engaged in repetitive overhead activities, with 61% of participants testing positive for SIS using the Neer Impingement Test and 43% experiencing moderate to severe pain during shoulder movements. These results align with existing literature, reinforcing the well-established association between overhead tasks and SIS. Previous studies have reported varying prevalence rates across different populations, influenced by factors such as sample size, occupational exposure, training intensity, and biomechanical demands. The prevalence observed in this study was consistent with research on athletes and occupational workers performing frequent overhead movements, supporting the role of repetitive strain and muscular imbalances in SIS development (17). The significant proportion of athletes experiencing moderate to severe pain highlights the functional limitations imposed by SIS. The impact of the condition extends beyond pain, as it affects performance, endurance, and training capacity. Non-surgical interventions, particularly structured rehabilitation programs, have demonstrated efficacy in reducing pain and disability in SIS patients, reinforcing the importance of early intervention. Exercise-based management strategies, including rotator cuff strengthening and scapular stabilization exercises, have been widely recommended for improving shoulder function and minimizing the risk of chronic progression. The effectiveness of such conservative treatments is well-documented, with studies suggesting that targeted rehabilitation can significantly reduce the need for surgical intervention in SIS cases (18).

Biomechanical factors play a critical role in the pathogenesis of SIS, with restricted internal shoulder rotation, scapular dyskinesis, and rotator cuff weakness being identified as primary contributors. The findings of this study further support the correlation between these factors and SIS symptoms, reinforcing the importance of addressing movement impairments through biomechanical assessments and corrective training. Workplace ergonomics have also been recognized as a key factor in reducing SIS risk, particularly in occupational settings requiring sustained overhead activity. The implementation of ergonomic modifications, task rotation strategies, and strength-based training programs has been advocated as an effective approach to minimizing impingement-related injuries in high-risk populations (19). The diagnostic approach utilized in this study, incorporating the Neer Impingement and Hawkins-Kennedy tests, remains a widely accepted screening method for SIS. However, imaging techniques such as MRI and ultrasound provide greater diagnostic accuracy by identifying structural abnormalities and inflammatory changes within the subacromial space. The inclusion of imaging in future research would enhance diagnostic precision and facilitate a deeper understanding of SIS pathophysiology. Additionally, improper scapular movement and muscle imbalances are recognized as primary causes of SIS, further supporting the need for comprehensive biomechanical assessments in clinical practice (20-24).

The strengths of this study include its focus on a specific athletic population, providing valuable insights into the prevalence and severity of SIS among university athletes. The sample size of 200 participants ensured a robust analysis of SIS occurrence, while the use of standardized clinical tests enhanced the reliability of findings. However, the study was limited by its cross-sectional design, preventing the establishment of causality between overhead activities and SIS development. The lack of longitudinal follow-up data restricts the ability to assess the long-term progression of SIS symptoms and the effectiveness of intervention strategies. Furthermore, subgroup analyses exploring variations in SIS prevalence across different sports and gender-based differences were not extensively examined, which could provide a more comprehensive understanding of specific risk factors. Future research should adopt a longitudinal approach to evaluate the progression of SIS over time, incorporating biomechanical assessments, sport-specific injury surveillance, and rehabilitation effectiveness. The inclusion of genetic predisposition factors and advanced imaging modalities would further contribute to the understanding of SIS etiology and optimal management strategies. Additionally, implementing regular screening programs for athletes and occupational workers at high risk of SIS could facilitate early detection and intervention, ultimately reducing the burden of this condition on performance and overall well-being (26-30). The integration of preventative exercise programs, structured warm-ups, and workplace ergonomic policies remains crucial in minimizing SIS occurrence and promoting shoulder health in at-risk populations.

CONCLUSION

This study underscores the significant prevalence and impact of shoulder impingement syndrome (SIS) among individuals engaged in repetitive overhead activities, highlighting its association with biomechanical factors such as restricted shoulder rotation and muscular imbalances. The findings reinforce the need for early intervention, structured rehabilitation, and targeted prevention strategies to mitigate the functional limitations caused by SIS. Emphasizing the role of neuromuscular training, ergonomic adjustments, and regular screening, the study advocates for proactive measures to reduce the burden of SIS in both athletic and occupational settings. By strengthening existing rehabilitation frameworks and exploring long-term treatment approaches, future research can contribute to more effective management strategies, ultimately improving performance and overall musculoskeletal health in at-risk populations.

AUTHOR CONTRIBUTIONS

Author	Contribution
Fatima Israr Khan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Komal Naveed	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Maryam Zahra	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Shumaila Mehdi	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Mobeen Ghulam	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Malik Hassan Mehmood	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Zeeshan Javed	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Faraha Naveed	Writing - Review & Editing, Assistance with Data Curation

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