RESEARCH ARTICLE

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Prevalence of Swimmer's Shoulder Among Competitive Swimmers: A Cross-Sectional Study

Gulam Raish and Siddesh Ganesan*

College of Physiotherapy, School of Health Sciences, Dayananda Sagar University, Kanakapura Road, Ramanagara District, Bengaluru – 562112, Karnataka, India; siddesh4544@gmail.com

Abstract

Background and Objective: Competitive swimming is a physically demanding sport that places significant stress on the shoulder joint, leading to a common overuse injury known as "swimmer's shoulder". This study aimed to determine the prevalence of swimmer's shoulder and identify the associated risk factors among competitive swimmers. **Methods:** Cross-sectional study of 126 swimmers (age 18-25; mean 20.4 ± 2.3 years). Participants completed the American Shoulder and Elbow Surgeons (ASES) score questionnaire and underwent standardised shoulder assessment (training history, ROM, strength, palpation, special tests). Key analyses: prevalence with 95% CI, One-way ANOVA for continuous between-group comparisons, paired t-tests for right-left Range of Motion (ROM), likelihood-ratio tests for categorical associations, and correlation analysis for pain and functional scores. Significance set at $p < 0.05$. **Results**: The prevalence of swimmer's shoulder was high, with 53.2% of participants exhibiting poor shoulder function (ASES score < 70; 95% CI: 44.5-61.7%). Swimmers with poor function trained more frequently (mean 6.5 sessions/week), with significant differences across ASES categories ($p < 0.05$). Significant right-left asymmetries were observed in the shoulder range of motion (flexion, extension, abduction, adduction, and external rotation; $p < 0.05$). Likelihood-ratio testing found no association with gender ($p = 0.464$) or primary stroke ($p = 0.140$), but a significant association with competition level (LR = 26.24; $p = 0.002$). Strong correlations were found between pain and function, with ASES pain positively associated with Activities of Daily Living (ADL) and total ASES scores ($r = 0.925$ and $r = 0.985$), and pain intensity negatively correlated with both ($r = -0.936$ and $r = -0.987$; $p < 0.001$). **Conclusion:** The high prevalence of swimmer's shoulder highlights the need for preventive strategies focusing on training optimisation, correction of asymmetries, and multidisciplinary management.

Major Findings: 1. High Prevalence of Swimmer's Shoulder: The prevalence of swimmer's shoulder was 53.2% (95% CI: 44.5-61.7%), indicating a considerable burden of shoulder-related functional impairment among competitive swimmers. **2. Training and Exposure-Related Associations:** Swimmers with poorer shoulder function reported higher training frequency (mean 6.5 sessions/week). Significant differences were observed across levels of competition (LR = 26.24; $p = 0.002$), whereas primary stroke ($p = 0.140$) showed no significant association. **3. Biomechanical and Functional Deficits:** Affected swimmers demonstrated significant right-left ROM asymmetries (flexion, extension, abduction, adduction, and external rotation; all $p < 0.05$), dominant-side strength deficits, and higher pain intensity. ASES pain scores showed strong positive correlations with ADL ($r = 0.925$) and total ASES ($r = 0.985$), while pain intensity displayed strong negative correlations with ADL ($r = -0.936$) and total ASES ($r = -0.987$), underscoring the substantial impact of pain on functional performance.

Keywords: Competitive Swimming, Prevalence, Risk Factors, Swimmer's Shoulder, Young Adult Swimmer

**Author for correspondence*

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1. Introduction

Competitive swimming is a physically demanding sport known for its emphasis on repetitive overhead motions. These motions propel swimmers through the water but can also lead to a common overuse injury known as swimmer's shoulder. This painful condition significantly impacts a swimmer's performance and well-being, causing inflammation, strain, or tears in shoulder structures like tendons, muscles, and ligaments. Commonly affected areas include the rotator cuff tendons (especially supraspinatus, subscapularis, infraspinatus, and teres minor) and surrounding muscles. The biceps tendon and the labrum (cartilage ring around the shoulder socket) can also be involved in some cases[1].

The prevalence of swimmer's shoulder among competitive swimmers varies widely, with studies reporting a range of 10% to a staggering 91%[2,3]. This highlights the need for further investigation, particularly within young adult competitive swimmers (aged 18-25). This age group is crucial as they enter peak performance years and may be more susceptible to overuse injuries due to training intensity[4].

Higher training volume and insufficient recovery periods increase the risk of swimmer's shoulder[4,5]. Faulty stroke mechanics may further contribute to shoulder overload[6,7]. Certain strokes, particularly butterfly and freestyle, may place greater mechanical stress on shoulder structures due to repetitive overhead motion compared to backstroke or breaststroke[8]. Pre-existing structural variations in the shoulder may further increase susceptibility to injury[9]. Technique-related factors, including faulty stroke mechanics, have also been implicated in overuse injuries, emphasising the importance of biomechanical efficiency in injury prevention[6,10,11].

This research aimed to investigate the prevalence of swimmer's shoulder among young adult competitive swimmers (aged 18-25) and explore potential links to various influencing factors. Ultimately, the goal is to utilise these findings to develop targeted preventive strategies and training programs specifically designed to reduce the risk of swimmer's shoulder and enhance the well-being of young adult competitive swimmers. These strategies may involve optimising training programs to minimise stress on the shoulder while maximising performance benefits.

Additionally, implementing strength and flexibility training programs specifically designed for the shoulder joint can improve stability and range of motion, reducing the risk of injury. Furthermore, collaboration between swim coaches and sports therapists can provide swimmers with personalised feedback and guidance to refine their technique and minimise stress on the shoulder joint. Early identification of swimmer's shoulder symptoms is crucial for implementing effective treatment plans and preventing further injury.

2. Materials and Methods

2.1 Study Design

A cross-sectional study.

2.2 Study Setting

Swimming clubs, academies, and organisations in Bengaluru.

2.3 Target Population

Competitive swimmers within the age range of 18 to 25 years.

2.4 Sampling Technique

Convenience sampling.

2.5 Procedure

A cross-sectional study was conducted with 126 competitive swimmers to investigate the prevalence of swimmer's shoulder. Before starting the study, ethical clearance was obtained from the college for conducting the research. Informed consent was obtained from all participants before their inclusion in the study. The inclusion criteria for the study included individuals aged 18 to 25 years with a minimum of 3 years of competitive swimming experience at various levels, such as national, state, university, or club level. Both male and female swimmers actively participating in competitive swimming events were eligible. Exclusion criteria comprised athletes with pre-existing shoulder injuries within the past year, diagnosed musculoskeletal conditions affecting shoulder function, undergoing current shoulder treatment, participating in other sports placing significant stress on the shoulders, and having recent injuries or surgeries impacting swimming performance within the past 3 months. Shoulder function was assessed using the ASES score (range 0-100;

higher scores indicate better shoulder function). The ASES comprises a 50-point pain subscale and a 50-point ADL subscale. For categorical analyses, we used: poor < 70, fair 70-79, good 80-89 and excellent ≥ 90[12]. Pain intensity was measured using the Numeric Pain Rating Scale (NPRS) from 0 (no pain) to 10 (worst imaginable pain). All participants also underwent a comprehensive clinical shoulder assessment. This assessment included clinical history, training history and physical examination (ROM, strength testing, palpation, special tests). Shoulder ROM was assessed using a standard goniometer. Muscle strength was assessed using Manual Muscle Testing (MMT) based on the Medical Research Council (MRC) grading scale (0–5).

2.6 Statistical Analysis

The collected data were summarised using Descriptive Statistics: frequency, percentage, mean and Standard Deviation (SD). The Paired "t" test was used to compare the ROM between the right and left sides. The one-way ANOVA was used to compare the number of training sessions per week according to the prevalence of shoulder injury. To find the relation between the ASES pain subscale score, pain intensity, ADL Score, ASES score, and ROM, the Pearson correlation coefficient ("r") was used. The Likelihood ratio test was used to find the association between gender, strokes, swimmer's level and the prevalence of shoulder injury. The p-value < 0.05 was considered significant. Data were analysed by using the SPSS software (SPSS Inc., Chicago, IL) version 29.0.10.

3. Results

3.1 Descriptive Statistics for Age, ASES Pain Subscale, Intensity of Pain, ADL and ASES Score

Table 1 presents the descriptive statistics for participant characteristics, including age, ASES pain subscale score, Intensity of pain, ADL and ASES score. The statistics include the range, mean, and standard deviation based on data from 126 participants.

3.2 Prevalence of Swimmer's Shoulder

Table 2 presents the prevalence of Swimmer's Shoulder. The prevalence of poor shoulder function (ASES < 70) was 53.2% (95% CI 44.5 - 61.7%). Other categories were: fair 5.6% (95% CI 2.7 - 11.0%), good 9.5% (95% CI 5.5 - 15.9%), and excellent 31.7% (95% CI 24.3 - 40.3%).

3.3 Training in Competitive Swimming

Table 3 outlines the competitive swimming experience of participants, including details on training frequency, duration, and the number of training sessions per week. It provides insights into the training patterns of swimmers in relation to shoulder injury prevalence.

3.4 Range of Motion

Table 4 compares the ROM measurements for different shoulder movements between the right and left sides. There are significant differences ($p < 0.05$) in shoulder flexion, extension, abduction, adduction and external rotation between the right and left sides. Internal rotation shows no significant differences.

Table 1. Descriptive statistics for age, ASES pain subscale, intensity of pain, ADL and ASES Score

(n = 126)	Range	Mean	S.D.
Age(Years)	18 to 25	20.4	2.3
ASES Pain Subscale Score	0 to 50	30.3	15.3
Intensity of Pain (NPRS)	0 to 10	3.96	3.07
ADL Score	13 to 50	36.1	12.2
ASES Score	22 to 100	66.4	27.1

Note: ASES pain (0-50, higher = less pain); ADL (0-50, higher = better function); ASES total (0–100, higher = better); NPRS (0–10, higher = more pain)

Table 2. Prevalence of swimmer's shoulder

		Frequency	Percentage %	95% CI
Prevalence of swimmer's shoulder	Poor (< 70)	67	53.2	44.5% - 61.7%
	Fair (70-79)	7	5.6	2.7% - 11.0%
	Good (80-89)	12	9.5	5.5% - 15.9%
	Excellent (90-100)	40	31.7	24.3% - 40.3%

Table 3. Training in competitive swimming

	Range	Mean	S.D.
Competitive Swimming Experience (Years)	3 to 13	5.46	2.16
Training Frequency (Times per week)	4 to 10	5.87	1.46
Training Duration (Average hours per day)	2 to 5	3.39	0.73

Table 4. Range of motion (shoulder)

Range of Motion		Mean	S.D.	"t"	p value
Shoulder Flexion	Right	164.6	20.1	-2.84	0.005*
	Left	172.3	16.8		
Shoulder Extension	Right	51.9	12.2	-2.97	0.004*
	Left	56.4	9.2		
Shoulder Abduction	Right	153.6	30.3	-2.91	0.004*
	Left	163.3	24.8		
Shoulder Adduction	Right	41.3	5.7	-3.34	0.001*
	Left	43.6	3.8		
Shoulder Internal Rotation	Right	66.6	7.3	-1.60	0.111
	Left	68.1	6.7		
Shoulder External Rotation	Right	76.2	19.5	-2.63	0.010*
	Left	82.9	15.6		

3.5 Strength Testing (MMT)

Figure 1 shows the MMT results for strength, where most participants demonstrated grade 5 strength (the highest) across various muscles. Specifically, 57.1% of participants have grade 5 strength in the supraspinatus on the right side, while 79.4% have the same level of strength on the left. Similar patterns were observed for the infraspinatus, teres minor, teres major, subscapularis, deltoid, biceps, and serratus anterior muscles.

3.6 Palpation

Palpation results (Table 5) indicate that 77.8% of participants have no swelling or tenderness in the acromioclavicular joint, while 16.7% have tenderness without swelling, and 5.6% have both swelling and tenderness. For the bicipital groove, 58.7% have no swelling or tenderness, 16.7% have tenderness without swelling, and 24.6% have both. In the deltoid muscle, 66.7% have no swelling or tenderness, 19.8% have tenderness without swelling, and 13.5% have both.

Table 5. Palpation

Palpation		Frequency	%
Acromio clavicular Joint	Swelling - Absent, Tenderness - Absent	98	77.8
	Swelling - Absent, Tenderness - Present	21	16.7
	Swelling - Present, Tenderness - Present	7	5.6
Bicipital Groove	Swelling - Absent, Tenderness - Absent	74	58.7
	Swelling - Absent, Tenderness - Present	21	16.7
	Swelling - Present, Tenderness - Present	31	24.6
Deltoid Muscle	Swelling - Absent, Tenderness - Absent	84	66.7
	Swelling - Absent, Tenderness - Present	25	19.8
	Swelling - Present, Tenderness - Present	17	13.5

3.7 Diagnosis

Figure 2 shows the distribution of clinical diagnosis among participants. The diagnosis among participants included patients with Acromioclavicular (AC) joint injury (1.6%), biceps tendinitis (4%), glenohumeral instability (2.4%), labral tear (2.4%), muscle sprains and strains (4%), rotator cuff tear (2.4%), rotator cuff tendinitis (16.7%), scapular dyskinesis (7.1%), subacromial bursitis (9.5%), subacromial impingement syndrome (13.5%). 36.5% of the participants were normal.

3.8 Correlation Analysis

Table 6 shows the correlation between age, ASES pain subscale, pain intensity, ADL score, and total ASES score. The ASES pain subscale was strongly and negatively correlated with pain intensity ($r = -0.995$, $p < 0.001$) and strongly and positively correlated with both ADL score ($r = 0.925$, $p < 0.001$) and total ASES score ($r = 0.985$, $p < 0.001$). Similarly, pain intensity demonstrated strong negative correlations with ADL ($r = -0.936$, $p < 0.001$) and total ASES ($r = -0.987$, $p < 0.001$), indicating that participants reporting higher pain intensity had poorer shoulder function. A strong positive correlation was also observed between ADL and total ASES scores ($r = 0.977$, $p < 0.001$), confirming that better daily functional ability aligned closely with overall shoulder status.

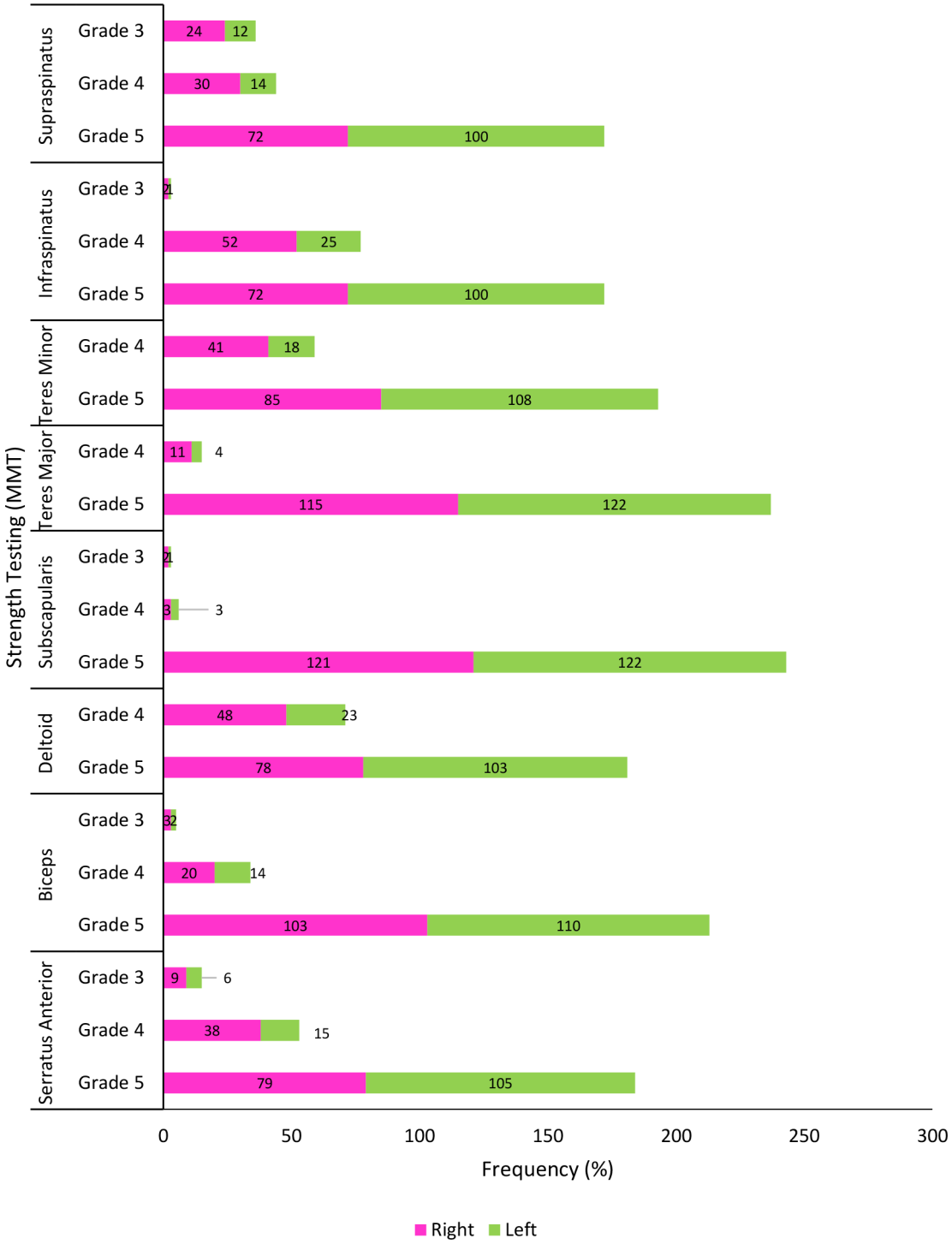


Figure 1. Strength testing (MMT).

Table 7 shows the relationship between shoulder range of motion (ROM) and both ADL and total ASES scores. No significant correlations were observed for any movement on either side ($p > 0.05$), indicating that variations in shoulder ROM were not directly associated with participants reported daily activity levels or overall shoulder function.

Table 8 shows the correlation between shoulder range of motion and participants age, ASES pain subscale, and pain intensity. Significant correlations were observed only

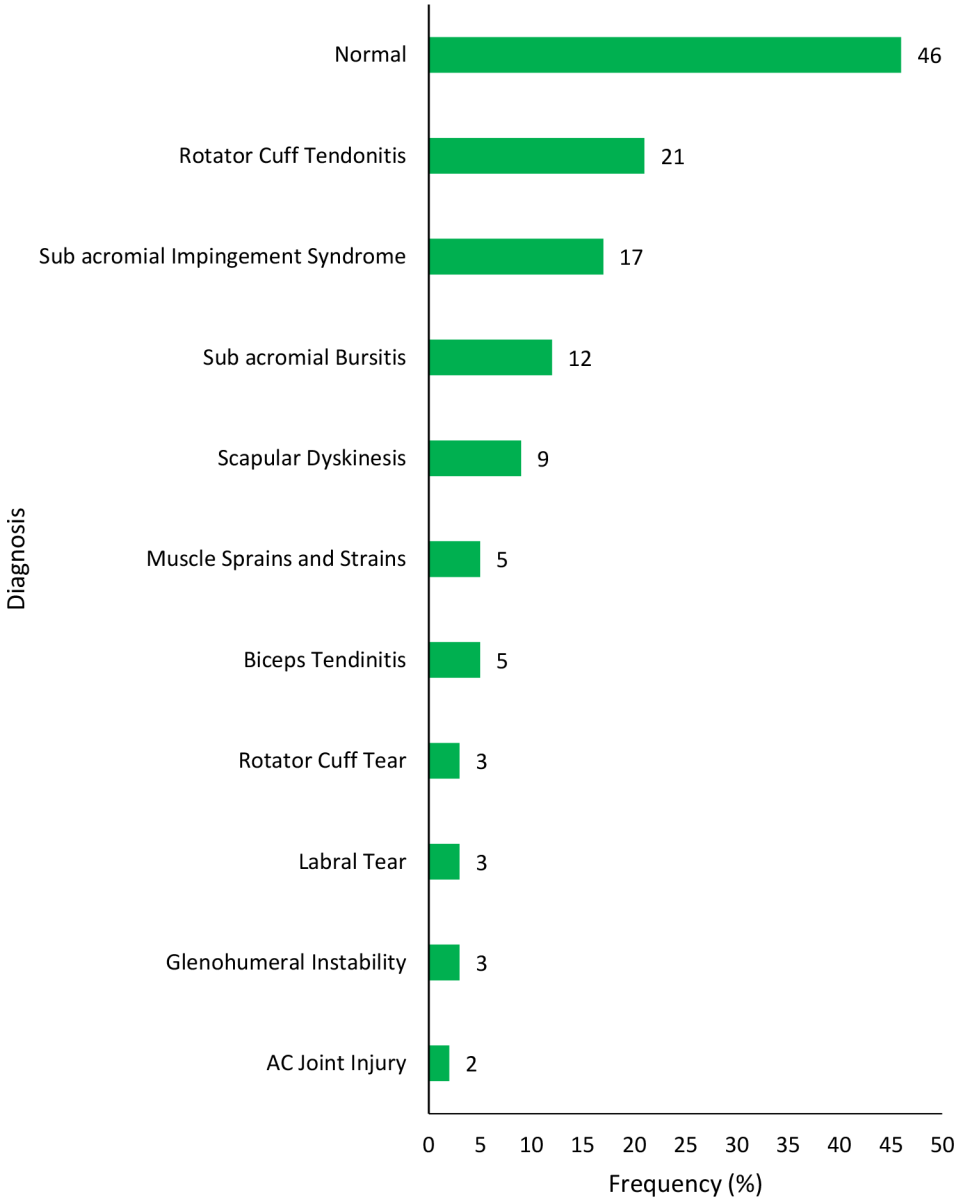


Figure 2. Diagnosis.

Table 6. Relation between age, ASES pain subscale, intensity of pain, ADL score, and ASES score

		Age (Years)	ASES Pain Subscale	Intensity of Pain	ADL Score	ASES Score
Age (Years)	"r"	1	0.042	-0.021	0.050	0.046
	p value	--	0.641	0.813	0.583	0.608
ASES pain subscale	"r"		1	-0.995	0.925	0.985
	p value		--	< 0.001*	< 0.001*	< 0.001*
Intensity of pain	"r"			1	-0.936	-0.987
	p value			--	< 0.001*	< 0.001*
ADL Score	"r"				1	0.977
	p value				--	< 0.001*
ASES Score	"r"					1
	p value					--

for left internal rotation (r = 0.176, p = 0.050) and right external rotation (r = -0.188, p = 0.036), suggesting that age and pain variables may influence these specific shoulder movements. No other ranges of motion demonstrated significant associations.

The correlation analysis (Figure 3) showed that the ASES pain subscale was strongly and negatively correlated with pain intensity (NPRS) (r = -0.995, p < 0.001) and strongly and positively correlated with both ADL score (r = 0.925, p < 0.001) and total ASES score (r = 0.985, p < 0.001). Similarly, pain intensity demonstrated strong negative correlations with ADL (r = -0.936, p < 0.001) and total ASES (r = -0.987, p < 0.001), indicating that participants reporting higher pain intensity had poorer shoulder function. A strong positive correlation was also observed between ADL and total ASES scores (r = 0.977, p < 0.001), confirming that better daily functional ability aligned closely with overall shoulder status.

Table 7. The relation between the range of motion and the ADL score, and the ASES score.

Range of Motion "r"		ADL Score		ASES Score	
		p value	"r"	p value	
Shoulder Flexion	Right	-0.104	0.247	-0.089	0.323
	Left	0.108	0.230	0.118	0.188
Shoulder Extension	Right	-0.051	0.567	-0.044	0.621
	Left	0.116	0.195	0.123	0.171
Shoulder Abduction	Right	-0.056	0.535	-0.042	0.643
	Left	0.101	0.261	0.120	0.182
Shoulder Adduction	Right	-0.063	0.483	-0.066	0.466
	Left	0.083	0.358	0.101	0.260
Shoulder Internal Rotation	Right	-0.081	0.368	-0.070	0.436
	Left	0.065	0.473	0.091	0.313
Shoulder External Rotation	Right	-0.068	0.447	-0.052	0.564
	Left	0.132	0.141	0.134	0.134

3.9 Number of Training Sessions Per Week According to the Prevalence of Shoulder Injury

Figure 4 illustrates training frequency across different levels of shoulder injury using One-way ANOVA. A significant difference was observed, with swimmers having poor shoulder function training most frequently (6.5 sessions/week). This indicates a potential link between higher training frequency and increased risk of shoulder injury.

3.10 Association Between Gender and the Prevalence of Shoulder Injury

Table 9 shows the Likelihood Ratio Test evaluating the association between gender and shoulder injury prevalence. The results indicate no significant relationship (p = 0.464), as both males and females displayed similar injury patterns

Table 8. Relation between the range of motion and the age, the ASES pain subscale, and the intensity of pain

Range of Motion "r"		Age (Years)		ASES Pain Subscale		Intensity of Pain	
		p value	"r"	p value	"r"	p value	
Shoulder Flexion	Right	-0.099	0.273	-0.074	0.413	0.065	0.469
	Left	0.143	0.111	0.122	0.173	-0.119	0.184
Shoulder Extension	Right	-0.036	0.690	-0.037	0.677	0.042	0.644
	Left	0.085	0.347	0.124	0.166	-0.121	0.175
Shoulder Abduction	Right	-0.138	0.124	-0.029	0.748	0.026	0.776
	Left	0.071	0.430	0.131	0.144	-0.126	0.158
Shoulder Adduction	Right	0.026	0.772	-0.065	0.468	0.069	0.441
	Left	0.120	0.184	0.112	0.210	-0.110	0.220
Shoulder Internal Rotation	Right	-0.110	0.223	-0.059	0.512	0.062	0.491
	Left	0.176	0.050*	0.108	0.227	-0.106	0.236
Shoulder External Rotation	Right	-0.188	0.036*	-0.037	0.681	0.032	0.720
	Left	0.096	0.285	0.132	0.141	-0.129	0.151

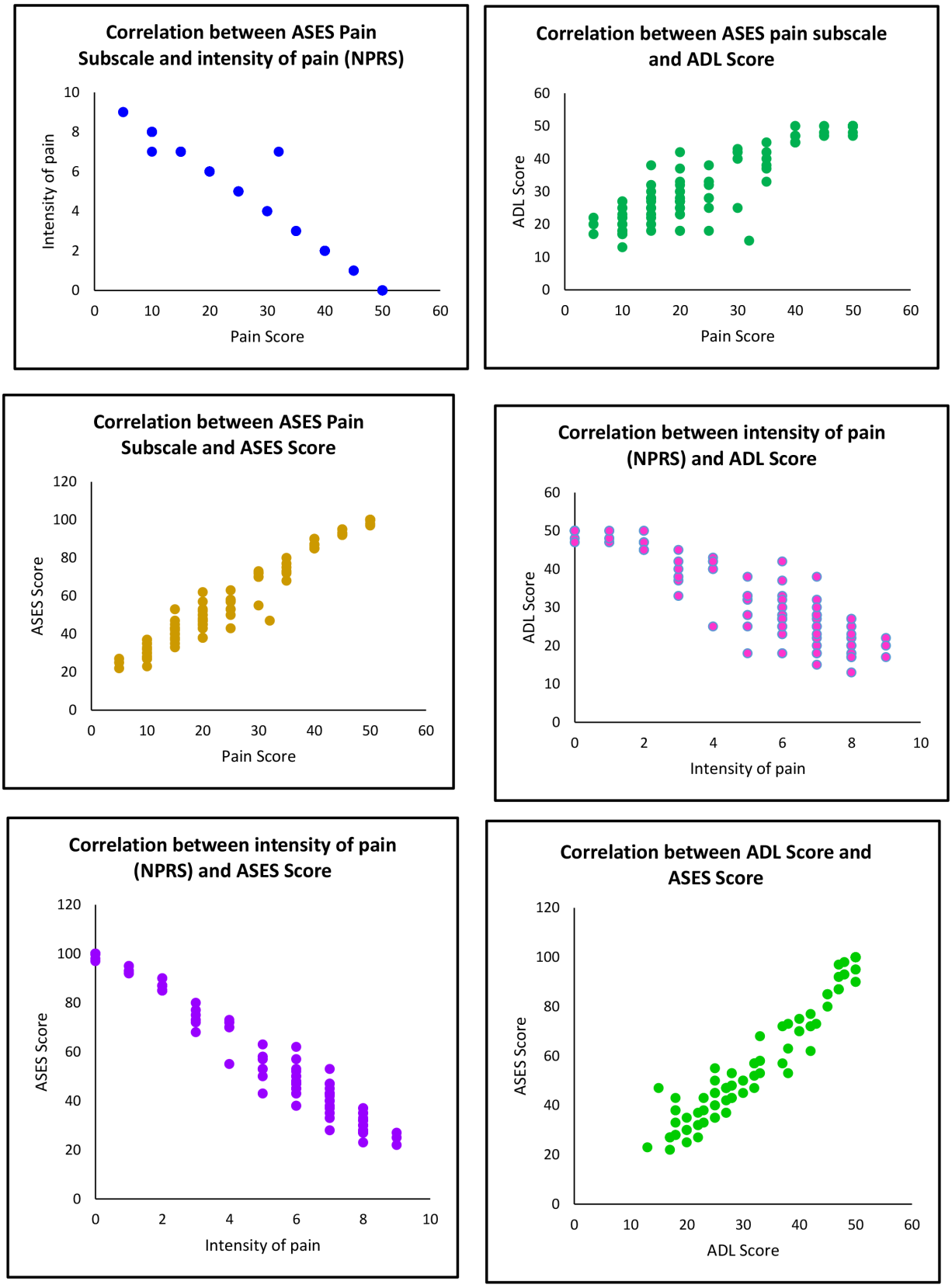


Figure 3. Correlation between ASES pain subscale, pain intensity (NPRS), ADL score, and total ASES score.

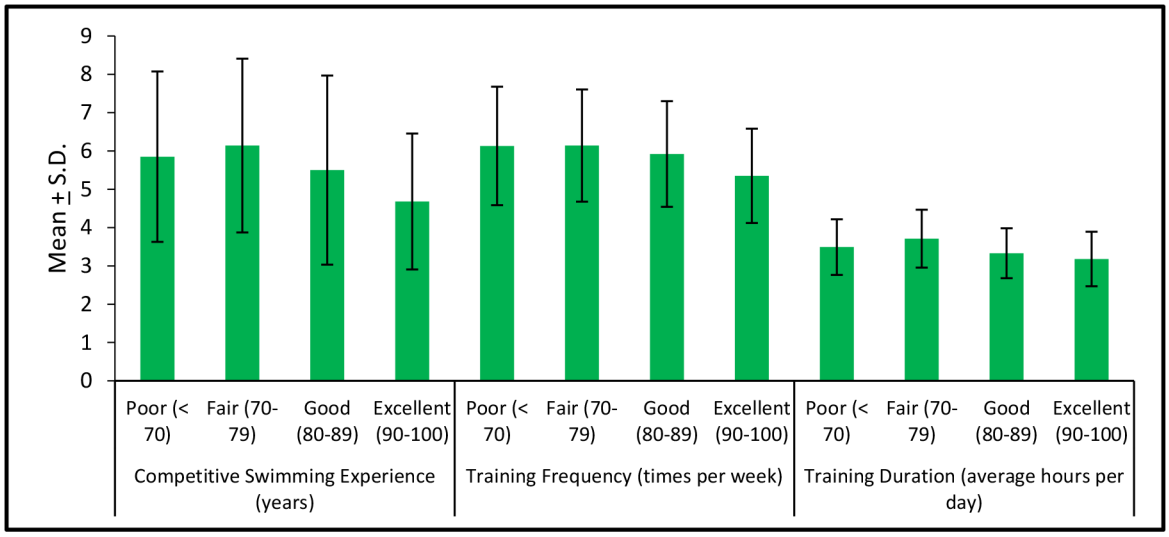


Figure 4. Number of training sessions per week according to the prevalence of shoulder injury.

Table 9. Association between gender and the prevalence of shoulder injury

		Prevalence of swimmer's shoulder								Likelihood ratio	p value
		Poor (< 70)		Fair (70-79)		Good (80-89)		Excellent (90-100)			
		N	%	n	%	N	%	n	%		
Gender	Male	38	56.7	4	57.1	5	41.7	17	42.5	2.56	0.464
	Female	29	43.3	3	42.9	7	58.3	23	57.5		

Table 10. Association between stroke(s) and the prevalence of shoulder injury

Primary Stroke(s) Practiced	Prevalence of Swimmer's Shoulder								Likelihood ratio	p value
	Poor (< 70)		Fair (70-79)		Good (80-89)		Excellent (90-100)			
	N	%	N	%	N	%	n	%		
Backstroke	3	4.5	1	14.3	3	25.0	8	20	24.47	0.140
Backstroke, Breaststroke	13	19.4	0	0	2	16.7	3	7.5		
Breaststroke	6	9.0	0	0	1	8.3	3	7.5		
Butterfly	4	6.0	1	14.3	1	8.3	3	7.5		
Freestyle	10	14.9	3	42.9	2	16.7	7	17.5		
Freestyle, Butterfly	20	29.9	2	28.6	3	25.0	7	17.5		
Freestyle, Butterfly, Backstroke, Breaststroke	11	16.4	0	0	0	0	9	22.5		

across categories. Thus, gender does not appear to influence shoulder injury occurrence among swimmers.

3.11 Association Between Stroke(S) and the Prevalence of Shoulder Injury

Table 10 presents the Likelihood Ratio Test assessing the association between primary swimming stroke and shoulder injury prevalence. The results show no significant relationship ($p = 0.140$), indicating that the type of stroke practised (backstroke, breaststroke, butterfly, freestyle) does not significantly influence the likelihood of shoulder injuries.

3.12 Association Between Swimmers Level and the Prevalence of Shoulder Injury

Table 11 shows the association between swimmers competitive level and the prevalence of shoulder injury. A

Table 11. Association between swimmers level and the prevalence of shoulder injury

Swimmer's Level	Prevalence of swimmer's shoulder								Likelihood ratio	p value
	Poor (< 70)		Fair (70-79)		Good (80-89)		Excellent (90-100)			
	n	%	n	%	n	%	n	%		
Club (Train and compete with a swimming club)	9	13.4	1	14.3	1	8.3	9	22.5	26.24	0.002*
National (Qualify for Senior National Aquatic Championships)	16	23.9	2	28.6	3	25.0	3	7.5		
State (Compete at State Championship Level)	26	38.8	3	42.9	1	8.3	5	12.5		
University (Compete at University Level – e.g., Khelo India University Games)	16	23.9	1	14.3	7	58.3	23	57.5		

statistically significant association was observed between competition level and shoulder function (LR = 26.24; p = 0.002). University-level swimmers demonstrated the highest proportion of athletes in the good and excellent categories (58.3% and 57.5%, respectively), indicating comparatively better shoulder function. In contrast, national-level swimmers showed a lower proportion in the excellent category (7.5%) and relatively higher proportions in poor and fair categories, suggesting greater functional impairment at higher competitive exposure.

4. Discussion

A notably high prevalence of swimmer's shoulder was observed. 53.2% of swimmers (95% CI: 44.5–61.7 %) demonstrated swimmer's shoulder, indicating a substantial burden of shoulder-related functional impairment among competitive swimmers. Training frequency and cumulative competitive exposure were importantly associated with poorer shoulder function in our sample; swimmers with poor function trained most frequently (6.5 sessions/week), suggesting that repetitive overhead movements and greater exposure over time increase the risk of shoulder injury[13-15].

The study observed clear right-left asymmetries in range of motion: flexion, extension, abduction, adduction, external rotation and corresponding relative weakness on the right (dominant) in manual muscle testing. Such side-specific adaptations are commonly reported in overhead athletes and swimmers, where repetitive unilateral loading produces mechanical and neuromuscular changes (including altered scapular kinematics and rotational imbalances) that may act as either risk factors for, or consequences of, shoulder dysfunction[15,16].

The diagnostic pattern in the sample: predominantly rotator cuff tendinitis (16.7%), subacromial impingement (13.5%) and subacromial bursitis (9.5%) reflects the multifactorial overuse spectrum commonly described as swimmer's shoulder, where tendinous overload, subacromial crowding, and bursitis frequently coexist and contribute to pain and functional limitation[17,18].

ASES pain scores showed strong positive correlations with ADL (r = 0.925) and total ASES (r = 0.985), while pain intensity displayed strong negative correlations with ADL (r = –0.936) and total ASES (r = –0.987), underscoring the substantial impact of pain on functional performance. These findings reinforce that shoulder pain in competitive swimmers is not merely a symptom but a key determinant of activity limitation and functional decline. The strength of these correlations suggests that as pain increases, both daily functional capacity and overall shoulder status decline proportionately, highlighting the clinical necessity of early pain management and functional monitoring in this population[19,20]. Analysis of competition level revealed a significant association with shoulder-function distribution (p = 0.002). University swimmers had a relatively higher within-group proportion of excellent function and a lower within-group proportion of poor function compared with national and state swimmers.

Clinically, the results supported routine screening of competitive swimmers using valid self-report tools (such as the ASES) and periodic objective checks of ROM and strength to detect early dysfunction, particularly in swimmers with high weekly training loads. Prevention strategies should prioritise load management (monitoring session counts and progression), incorporation of rotator-cuff endurance and scapular-stability programs,

and technique-focused coaching to reduce repetitive deleterious mechanics. Studies suggest that structured preventive exercise programs can improve shoulder physical qualities and reduce symptom incidence when implemented consistently[21].

Collaboration between coaches and sports therapists can facilitate personalised training adjustments and technical improvements to alleviate shoulder stress. Additionally, educating swimmers on proper technique and body mechanics is essential for long-term injury prevention and performance enhancement[10,11].

This study has the following limitations: Firstly, this study used convenience sampling of competitive swimmers from clubs and academies in Bengaluru, which may limit the external validity of our findings to swimmers from other regions or training systems. The use of self-reported data, such as training history and pain levels, may be subject to recall bias, potentially affecting the accuracy of the information collected. Shoulder assessments and diagnostic labels were based on standardised clinical tests without confirmatory imaging (ultrasound/MRI). The inclusion of such diagnostic tools could have provided more objective data on the underlying shoulder pathologies.

Based on the findings and limitations of this study, several recommendations can be made for future research. Conducting a multi-centre study with a larger, more diverse sample of competitive swimmers across different geographic regions would enhance the generalisability of the results. Incorporating longitudinal study designs to track the progression of shoulder health and the long-term impact of swimmer's shoulder would provide valuable insights into the natural history of this condition. Additionally, future studies should consider the use of advanced imaging techniques, such as MRI and ultrasound, to obtain a more detailed assessment of the underlying shoulder pathologies and guide targeted treatment strategies. Expanding the evaluation to include a comprehensive analysis of swimming technique and training load, including biomechanical assessments, could help identify specific risk factors contributing to the development of swimmer's shoulder. Lastly, the development and evaluation of targeted prevention and rehabilitation programs, in collaboration with sports medicine professionals, coaches, and swimmers, would be crucial in addressing this prevalent issue and improving the overall shoulder health of competitive swimmers.

5. Conclusion

The study highlights the considerable impact of swimmer's shoulder among young adult competitive swimmers. These findings emphasise the need for a comprehensive approach to prevention and rehabilitation by improving training methods, incorporating targeted shoulder exercises, and encouraging cooperation between athletes, coaches, and healthcare professionals. By addressing risk factors and promoting early screening, the prevalence of swimmer's shoulder can be reduced, helping young swimmers reach peak performance while preserving shoulder health.

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