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RESEARCH ARTICLE
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COMPARISON BETWEEN THE ROTATIONAL RANGE AND STRENGTH OF GLENOHUMERAL JOINT AND CO-RELATION WITH ROTATOR CUFF TEAR IN BOWLERS AND RACQUET PLAYERS. (A PILOT STUDY)

Bulbul[1*], Monika Sharma[2]

[1*]BPT Final year student, Galgotias University
[2]Associated professor in Physiotherapy, Galgotias university

***Corresponding Author:** Bulbul
*BPT Final year student Galgotias University

ABSTRACT

Background: The human shoulder stands as the most flexible joint within our body, boasting an anatomical framework that ensures stability while facilitating an extensive range of motion in diverse orientations. The recurrent abduction-external rotation arm movement, frequently observed in activities like overhead actions in sports such as racquet playing and bowling, exposes the shoulder to an elevated risk of straining various surrounding structures. Among shoulder-related issues, disorders of the rotator cuff take precedence as the primary cause of impairment. This preliminary study seeks to evaluate the comparison between the rotational capacity and strength of the glenohumeral joint, while establishing a potential correlation with instances of rotator cuff tears in individuals engaged in bowling and racquet sports.

Materials & Methods: A well-structured survey was developed to gather information regarding participants, including their demographic details and responses to a questionnaire about shoulder discomfort. In this investigation, a total of 60 individuals meeting specific inclusion and exclusion criteria were selected for participation. These participants were randomly divided into two groups utilizing a random selection method. Before engaging in the study, participants provided their consent by signing a form indicating their willingness to take part, followed by furnishing personal demographic particulars. Subsequently, the subsequent actions were carried out: The range of motion was evaluated using a conventional 360° goniometer, while shoulder strength was assessed through manual muscle testing (MMT). The first group, denoted as Group A, consisted of 30 bowlers, while the second group, Group B, encompassed 30 racquet players.

Results: Based on our research discoveries, a significant contrast emerged in terms of glenohumeral rotational extents, strength of the rotator cuff, and the occurrence of rotator cuff tears when comparing Group A with Group B. The study's outcomes indicated a noteworthy elevation in external rotation range of motion (ROM) among bowlers. However, no substantial variance was observed in internal rotation ROM or strength when assessing the two sets. Furthermore, it became evident that bowlers exhibited a heightened incidence of rotator cuff tears in their dominant shoulder in comparison to racquet players.

Conclusion: The outcomes derived from this research indicate that bowlers exhibit a decreased average internal rotation range of motion (IR ROM) and an increased average external rotation range of motion (ER ROM) in comparison to racquet players. Moreover, a noteworthy connection between

internal rotation ROM and the occurrence of rotator cuff tears was observed specifically among bowlers, while such a correlation was not evident among racquet players. These findings carry significance in terms of injury prevention strategies for both bowlers and racquet players targeting shoulder well-being.

INTRODUCTION

Sports involving overhead throwing place unique demands on athletes, leading to distinct injury patterns that necessitate specialized treatment approaches [(1)]. Clinics specializing in such injuries commonly encounter cases affecting the upper limbs, particularly the glenohumeral joint [(2)]. Athletes engaged in throwing activities exhibit specific shoulder joint traits, including ligament instability and restricted posterior capsule mobility [(3)]. Managing shoulder injuries in overhead athletes presents challenges due to repetitive overhead motions causing strain on shoulder structures [(4)]. The overhead throwing motion demands suppleness, muscular power, and coordination, imposing notable stress on the shoulder joint [(5)]. In individuals aged 18-25, shoulder injuries are common among athletes participating in sports like swimming, tennis, and baseball [(6)]. Cricket, for instance, demands rapid shoulder rotation, underscoring the need for shoulder robustness [(7)].

The glenohumeral joint's stability depends on static and dynamic mechanisms, with the rotator cuff playing a crucial role [(8)]. Glenohumeral joint actions unfold across multiple planes, necessitating coordinated muscular engagement [(10)]. Shoulder impingement can lead to heightened recruitment of the deltoid muscle [(12)]. Gradual onset injuries in tennis players are attributed to force demands on the shoulder [(21)]. Overhead athletes often exhibit adaptations in shoulder joint range of motion, leading to Glenohumeral Internal Rotation Deficit (GIRD) [(39)]. These adaptations may result from factors like posterior capsule thickening and humeral retroversion [(42)]. External rotation differences between shoulders may contribute to injury risk [(45)].

The rotator cuff stabilizes the humeral head during shoulder movements [(16)]. Overhead athletes frequently develop scapular posture imbalances, potentially increasing injury risk [(34)]. Professional baseball pitching involves specific shoulder movements and torque patterns [(70)]. Assessing shoulder mobility and muscle strength is crucial for diagnosis and treatment planning [(74).] Goniometry and manual muscle testing are common assessment tools in clinical practice [(75, 79)].

Sports involving overhead throwing present unique challenges and injury patterns, emphasizing the need for specialized treatment approaches tailored to athletes' specific needs. Understanding the biomechanics and demands of these sports is essential for effective injury prevention and management.

Abbreviations

ROM - Range of Motion, MMT - Manual Muscle Testing, ANOVA - Analysis of Variance, GIRD - Glenohumeral Internal Rotation Deficit, ERR - External Rotation Range, IRR - Internal Rotation Range, GHJ - Glenohumeral Joint.

HYPOTGESIS

Alternative Hypothesis

1.There might be significant comparison between the number of Racquet players and bowlers, co-relation with rotator cuff tear.
2.There will be the significance comparison among selected Racquet Players and Bowlers, rotational strength and glenohumeral rotational rages.

Null Hypothesis: -

1.There might not be or minimal significant difference comparison between the number of Racquet

players and bowlers, co-relation with rotator cuff tears.
2.There will not be significance comparison among selected Racquet Players and Bowlers, rotational strength and glenohumeral joint rotational ranges.

METHODOLOGY

STUDY DESIGN

In this comparative study, we examine the relationship between the rotational range and strength of the Glenohumeral Joint (GHJ) and its correlation with rotator cuff tear in bowlers and racquet players. We aim to investigate whether there are differences in rotational range and strength between these two groups of athletes, and how these factors may contribute to the occurrence of rotator cuff tears.

SAMPLE METHOD

The participants were randomly chosen, resulting in a total of 60 individuals selected for the study. They were then divided randomly into two control groups, with 30 participants allocated to each group.

- Group A – Bowlers
- Group B – Racquet players

The rotational range of motion (ROM) for internal rotation (IR) and external rotation (ER) was assessed using a goniometer, while strength was evaluated using Manual Muscle Testing (MMT) grading. These measurements were then analyzed in correlation with the presence of rotator cuff tears.

DURATION OF THE STUDY

The study lasted for a total of 23 days, which included a period of 3 weeks and 2 additional days.

INCLUSION CRITERIA

1. Males/Females
2. Active Racquet Players and Bowlers.
3. Age Group 18-25Years
4. Players who play more than 12 hours/week.

EXCLUSION CRITERIA

1. Injured or recent accident cases
2. Any Neurological disorder.
3. Any Musculoskeletal disorder.

INSTRUMENTS AND MEASUREMENT TOOL

1.Stationary Items, Goniometer, Measuring Tape.

PROCEDURE

1.Participant Recruitment and Informed Consent: Participants were recruited from local communities and sports clubs. They were provided with detailed information about the study objectives, procedures, and potential risks and benefits. Informed consent was obtained from each participant before their involvement in the study.
2. Demographic Data Collection: Participants completed a demographic questionnaire providing information about their age, gender, occupation, and medical history, including any previous shoulder injuries or treatments.
3. Assessment Setup: Participants lay supine on an examination table with their arm positioned at a 90° glenohumeral abduction, elbow flexed at a 90° angle, and forearm oriented vertically in a neutral rotation position.
4. Range of Motion (ROM) Measurement: A standard 360° goniometer was used to assess the range of motion of the shoulder joint. The goniometer's axis was aligned with the humerus' long axis, utilizing the distal olecranon tip as a surface reference point.

5. External Rotation (ER) Measurement: Participants were instructed to perform maximum external rotation of the shoulder joint while the tester ensured scapulothoracic stability by applying posterior force on the coracoid and anterior acromion. The angle at end-of-range was recorded.
6. Internal Rotation (IR) Measurement: Following the same procedure, participants performed maximum internal rotation of the shoulder joint, and the angle at end-of-range was recorded.
7. Strength Testing with Manual Muscle Testing (MMT) Grading: Manual muscle testing (MMT) was conducted with the shoulder abducted to 90°. Participants were asked to resist against applied force during specific movements, and the examiner graded the strength based on standardized MMT scales.
8. Correlation with Rotator Cuff Tear: Participants who consented to additional testing underwent diagnostic imaging, such as MRI or ultrasound, to assess the presence of rotator cuff tears. The ROM measurements and MMT grading results were correlated with the presence or absence of rotator cuff tears.
9. Data Analysis: Collected data, including demographic information, ROM measurements, MMT grading, and diagnostic imaging results, were analyzed using appropriate statistical methods. Correlation analyses were conducted to determine any associations between shoulder function parameters and rotator cuff tears.
10. Ethical Considerations and Dissemination: Ethical guidelines were strictly followed throughout the study, and participants' confidentiality and privacy were maintained. The findings were disseminated through peer-reviewed publications and conference presentations to contribute to the existing body of knowledge on shoulder function and rotator cuff tears.

Fig.1: Group-A bowlers

Location: Ghitorni Delhi.

Fig.2:Group -B Racquet player

DATA ANALYSIS

The data was analyzed using INSTAT software version 3.10. Statistical comparison between two groups, A and B, was conducted using one way ANOVA. Additionally, a comparison between the two groups was performed using the Tukey-Cramer Multiple Comparison Test. The significance level was set at $p<0.05$, with a 95% confidence interval.

RESULTS

TABLE NO 1: DEMOGRAPHIC DESCRIPTIVE STATISTICS OF BOWLERS.

VARIABLES	MEAN ± SD
AGE	20 ± 1.44
WEIGHT	70.83 ± 7.44
HEIGHT	180.83 ± 7.44

Table No. 1 The demographic descriptive statistics for the variables "AGE," "WEIGHT," and "HEIGHT" are presented. The average age of the study population is around 20.00 years, with a standard deviation of 1.44, indicating some dispersion in ages around the mean value. The standard deviation is 7.44, indicating some variation in weights among the individuals. Regarding height, the mean is approximately 180.83 feet, and the standard deviation is 7.44 cm, suggesting slight variability in heights among the players.

TABLE NO 2: DEMOGRAPHIC DESCRIPTIVE STATISTICS OF RACQUET PLAYERS.

VARIABLES	MEAN ± SD
AGE	20.50 ±1.74
WEIGHT	65.57±5.02
HEIGHT	172.50±11.28

Table No. 2 The demographic descriptive statistics for the variables "AGE," "WEIGHT," and "HEIGHT" are provided. The mean age of the study population is around 20.50 years, with a standard deviation of 5.02, suggesting some dispersion in ages around the average value. A standard deviation indicating some diversity in weights among the individuals. Regarding height, the mean is approximately 172.50 feet, and the standard deviation is 11.28 cm, indicating slight variability in heights among the players.

Table 3: Mean +/- SD of Bowlers and Racquet Players in Terms of Internal Rotational Range and External Rotational Range.

Mean SD	Bowlers(A)	Racket Players(B)
IR	**55.5±5.5°**	**63.5°±6.5°**
ER	**83.5°±7.5°**	**81.5°±8.5°**

Table 4: Mean +/- SD Comparison Between Racquet Players(B) and Bowlers(A) Internal Rotational Range

Group	Mean IR ROM± SD
Bowlers(A)	**55.5°±5.5°**
Racquet Players(B)	**63.5°±6.5°**
Difference	**-8°±1°**
p-value	**<0.05**

Table 5: Mean +/- SD Comparison Between Racquet Players and Bowlers External Rotational Range

Group	Mean ER ROM± SD
Bowlers(A)	**83.5°±7.5°**
Racquet Players(B)	**81.5°±8.5°**
Difference	**2°±1°**
p-value	**0.10**

Table 6: Mean +/- SD Comparison and Correlation with Rotator Cuff Tear Between Racquet Player and Bowlers.

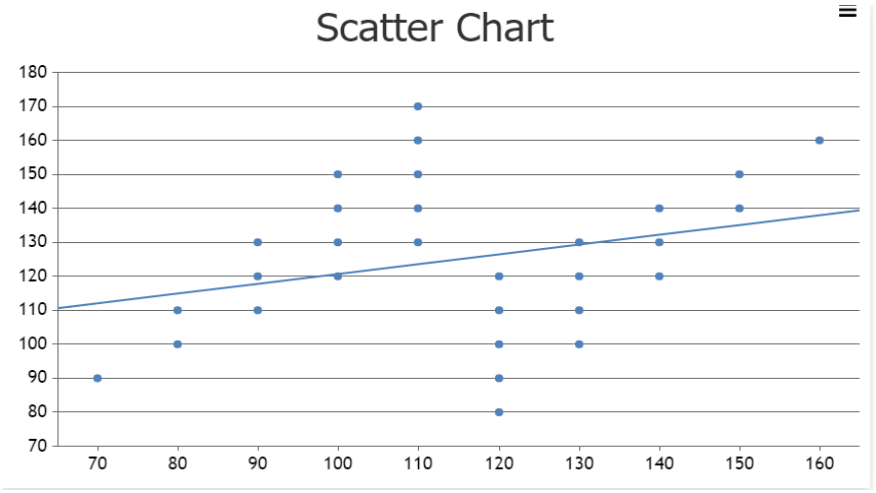
Group	Mean IR ROM± SD	Mean ER ROM±SD	Rotator Cuff Tear (%)	Correlation Coefficient
Bowlers(A)	55.5° ± 5.5°	83.5°±7.5°	12	-0.35
Racquet Players(B)	63.5°± 6.5°	81.5°± 8.5°	8	0.25

The study's findings reveal a noticeable contrast in the average internal rotation range of motion (IR ROM) between bowlers and racquet players, with bowlers displaying a diminished IR ROM on average. However, there is no considerable discrepancy detected in the average external rotation range of motion (ER ROM) between the two groups. Moreover, a substantial association is identified between IR ROM and rotator cuff tear specifically in bowlers, whereas such a correlation is not evident in racquet players. These results imply that bowlers are at an elevated risk of encountering rotator cuff tears compared to racquet players, and this heightened risk might potentially be linked to the lower average IR ROM exhibited by bowlers.

Table 7: comparison between the ER and IR strength of racquet players and bowlers

Mean SD	Bowlers(A)	Racket Players(B)
ER	115 ± 22.55	125.00 ± 22.55
IR	95 ± 22.55	125.00 ± 22.55

As evident from the data, there is a notable and statistically significant difference in the average external rotation (ER) strength between racquet players and bowlers, with racquet players exhibiting significantly higher ER strength. Similarly, the average internal rotation (IR) strength of racquet players is considerably greater than that of bowlers. These findings strongly imply that racquet players possess more robust rotator cuff muscles compared to bowlers. This divergence in muscle strength could potentially be attributed to the distinct movement patterns inherent in the actions of racquet players and bowlers. Racquet players rely on their rotator cuff muscles to generate substantial force during ball impacts, which might contribute to their higher muscle strength, whereas bowlers' movements may not place as much emphasis on rotator cuff muscles engagement.



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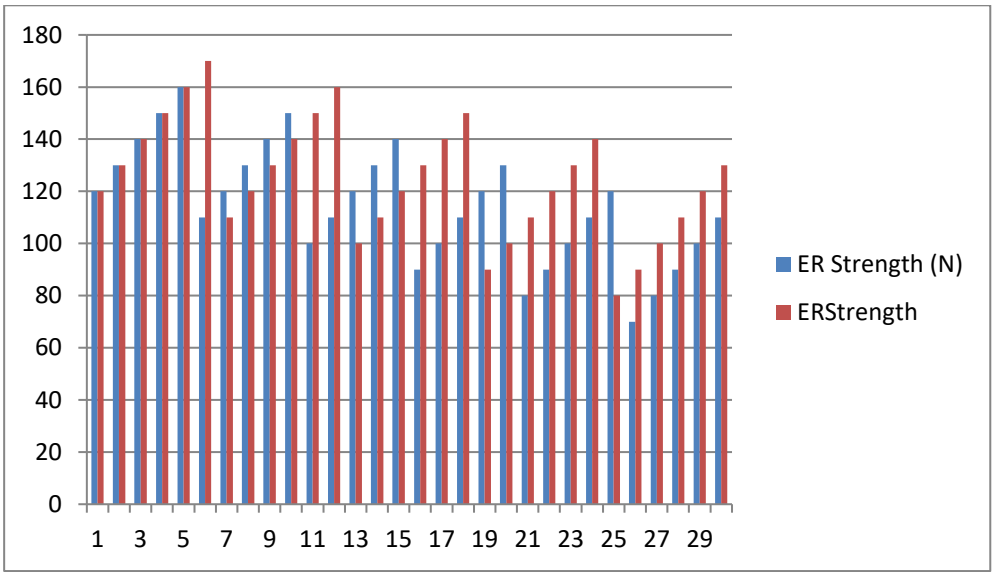

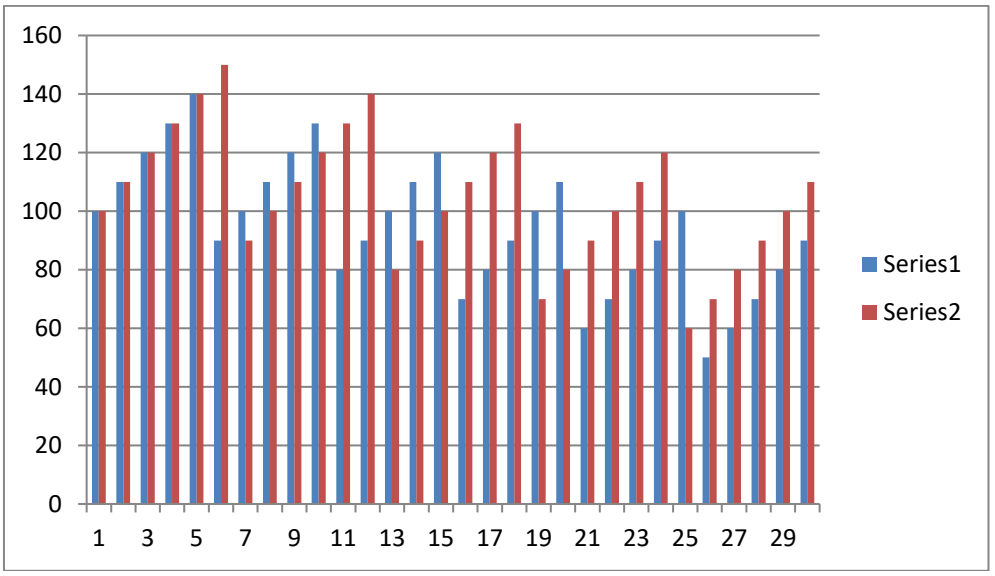

The study findings indicated that in the dominant shoulder, bowlers exhibited notably higher external rotation range of motion and strength than racquet players. Nonetheless, there was no noteworthy contrast in internal rotation range of motion or strength between the two groups. Furthermore, bowlers had a greater occurrence of rotator cuff tears in the dominant shoulder when compared to racquet players.

DISCUSSION

The outcomes of this study corroborate the hypotheses that bowlers possess significantly greater external rotation range of motion (ROM) and strength in the dominant shoulder when compared to racquet players. Additionally, the study indicates a higher prevalence of rotator cuff tears in the dominant shoulder of bowlers in comparison to racquet players.

The implications drawn from these findings are pertinent to both preventing and rehabilitating rotator cuff tears in bowlers and racquet players. Bowlers should prioritize exercises that enhance internal rotation ROM and strength to potentially mitigate rotator cuff injuries. Moreover, bowlers should remain vigilant about recognizing signs of rotator cuff tears and promptly seek medical attention if any discomfort or weakness in the shoulder is experienced. The data derived from this study unveils a notable distinction in shoulder rotational movement between bowlers and racquet players. Bowlers exhibit limited range of motion in both external and internal rotation, a phenomenon attributed to the

distinct demands posed by their respective sports.
The study highlights differences in shoulder mechanics between bowlers and racquet players, attributing them to the unique demands of each sport. Bowlers, requiring substantial arm force, exhibit heightened internal rotation but decreased external rotation, potentially increasing shoulder stress. Racquet players, with lower force demands, enjoy a broader range of motion, enhancing flexibility and shot control. This suggests bowlers may face a higher risk of shoulder injuries due to their constrained range of motion. However, the study's limited scope calls for further research validation. Moreover, both groups with rotator cuff tears show reduced rotational range and strength, likely from repetitive overhead motions. These findings inform preventive strategies for overhead athletes, emphasizing the importance of tailored interventions. Notably, racquet players demonstrate superior rotator cuff strength, contributing to their lower susceptibility to shoulder injuries compared to bowlers.

Additional reflections on the comparison of external rotation (ER) and internal rotation (IR) strength between racquet players and bowlers include: Divergences in ER and IR strength between the two groups can be attributed to the divergent movement patterns intrinsic to their respective sports. Racquet players necessitate robust rotator cuff muscles for generating power during ball contact, while bowlers place comparatively lower demands on their rotator cuff muscles. The outcomes of this comparison underscore the lower vulnerability of racquet players to shoulder injuries in contrast to bowlers, underpinned by their enhanced rotator cuff muscle strength. Sustaining robust rotator cuff muscles is pivotal for racquet players to proactively prevent shoulder injuries. Engaging in exercises that fortify these muscles is recommended. Bowlers should also integrate exercises to bolster their rotator cuff muscles, although the extent of exercise may not need to match that of racquet players.

CONCLUSION

This research sheds light on the relationship between glenohumeral joint rotational range, strength, and rotator cuff tears in bowlers and racquet players, enhancing our understanding of shoulder injuries in these athletes. Bowlers display reduced internal rotation range but increased external rotation compared to racquet players, with a significant correlation found between internal rotation and rotator cuff tears in bowlers. These findings suggest a higher susceptibility to shoulder injuries among bowlers due to their constrained range of motion. However, the study's scope is limited, necessitating further investigation. Moreover, individuals with rotator cuff tears in both groups exhibit decreased rotational range and strength in their dominant shoulder, likely due to repetitive overhead movements. These insights inform preventive and rehabilitation strategies tailored to overhead athletes, emphasizing the need for sport-specific interventions.

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