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PREVALENCE OF GLENO-HUMERAL INTERNAL ROTATION (GIRD) DEFICIT IN SEMI-PROFESSIONAL CRICKET FAST BOWLERS

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Abstract *:*

Background & Objective: Repetitive high-velocity fast bowling creates posterior capsular contracture, causing Glenohumeral Internal Rotation Deficit (GIRD). Semi-professional bowlers undergo professional-level stress but lack regular medical screening or preventative physiotherapy. This study determines the prevalence of GIRD in semi-professional fast bowlers.

Methods: This cross-sectional study evaluated 165 male semi-professional cricket fast bowlers (aged 18–35 years) using purposive sampling across professional clubs. Bilateral passive internal rotation range of motion (IRRM) was measured in supine position at 90° abduction using a universal goniometer, with GIRD defined as a deficit exceeding 20° compared to the non-dominant arm. Functional reach asymmetry was evaluated using the Apley's Scratch Test, where a reach deficit greater than 5 cm indicated restriction.

Results: The mean internal rotation was significantly lower in the throwing (dominant) shoulder than the non-throwing (non-dominant) shoulder (72.15° vs. 80.36°), showing an average deficit of 10.18°.

GIRD Prevalence: Goniometry identified clinically significant prevalence of GIRD in 12% of participants (19/165).

Functional Restriction: The Apley's Scratch Test revealed functional posterior reach restriction in 15% of the sample (25/165).

Demographics: The highest concentration of deficits occurred in players aged 25–30 years and those with 3–5 years of playing experience.

Conclusion: Repetitive fast bowling induces significant shoulder internal rotation deficits among 12% and 15% with goniomentric assessment and apleys scratch respectively of semi-professional players, peak-loading in their mid-to-late twenties. Regular goniometric screening and early targeted posterior capsule stretching protocols are strongly recommended within club training to prevent long-term shoulder morbidity.

***IndexTerms* -** Fast bowlers, GIRD, Goniometry, Apley's Scratch Test, Overuse injury

INTRODUCTION

Cricket is one of the oldest organised sports and the world's second most popular sport, played worldwide in many countries.[1] Cricket is a global team sport that involves the repetitive overhead activities of bowling and throwing.[2]

In the sport of cricket, bowlers can be divided into fast bowlers and spin bowlers. All bowlers throw a 156g cricket ball towards a batsman or his wickets.[3] The bowlers start bowling with a smooth and rhythmical runup to create linear momentum, which is transferred from the lower extremities to the upper body over the front leg during the delivery stride. Hand acceleration is produced by a proximal-to-distal sequence of joint rotations, which is then generated by sequential proximal-to-distal muscle contraction. The most commonly used 'bowling deliveries' by fast bowlers are 'Bouncers' and 'Yorkers'. [1] A Bouncer delivery is a bowl that is targeted at the chest level of the batsman by dropping it in the middle of the cricket pitch, whereas a Yorker is a ball aimed at the toes of the batsman.[1]

The overhead throwing motion has been reported as the fastest athletic movement performed in sports. The very high velocity achieved by overhead throwers puts the shoulder under extreme forces, resulting in both adaptive changes and pathologic findings that can be detected during imaging.[4] The shoulder, especially the glenohumeral joint (GHJ), which mainly depends on soft tissues for stability, is naturally prone to injury.[2] Upper extremity injuries are common among overhead and throwing athletes.[5] Fast bowling has been shown to cause non-contact shoulder and wrist injuries in fast bowlers.[1] Biomechanically, fast bowling can be analysed as an action in which the internal shoulder rotator muscles contract concentrically during the acceleration phase of the throwing (phases of overhead throws are classified as wind up, cock-up, acceleration, deceleration and follow through), and this is counterbalanced by eccentric contraction of the external rotators during the deceleration phase.[1]

The overhand throwing or serving motion produces large loads and forces on the joint tissues because of the high velocities and large range of motions. A high degree of arthrokinematic precision is needed to perform this task efficiently for maximum performance and minimal risk of injury. One of the key factors in G-H arthrokinematics is allowing optimal G-H rotation, which includes both internal rotation (IR) and external rotation (ER). The proper balance of IR and ER helps the humeral head stay centered in the glenoid fossa and maximizes concavity compression. Optimal ER also helps in achieving maximum hand and ball velocity and reduces the valgus loads at the elbow. [6] The amount of developed IR and ER is dynamic and keeps adapting continuously to the high G-H forces and loads. Many studies have shown that in the dominant arm, compared to the non-dominant arm, the amount of glenohumeral internal rotation (GIR) is decreased and the amount of glenohumeral external rotation is increased in most throwing athletes.[6]

Repeated pitching at high velocities over time leads to long-term changes in the soft and bony tissues that make up the GHJ. These structural changes likely cause differences in range of motion (ROM) when both shoulders are compared and when overhead-throwing athletes are compared with non-overhead-throwing athletes.[3] During pitching, biomechanical studies have shown that shoulder ER can go beyond 160°, IR acceleration can go beyond 6,000°/second, and IR torque can go beyond 60 N/m. [7]

As acute injury investigation was performed at the Center for Musculoskeletal injuries, injuries only contribute to a small part of all shoulder-related problems, while overuse pathologies remain the most common reasons for medical treatment. Some of these overuse conditions are linked to sport-specific structural adaptations, such as thickening of tendons, muscles, and connective tissue caused by repetitive movements and minor injuries. One of these adaptations, called "Glenohumeral Internal Rotation Deficit Syndrome (GIRD)," has been identified as a specific risk factor in the development of many shoulder injuries and overuse pathologies.[8] Previously, GIRD was defined as the difference in internal rotation range of motion (IRRM) between the dominant and non-dominant limbs of an athlete.[8] Two types of GIRD have been described: anatomical and pathological. Anatomical GIRD is described as a loss of less than 18–20° of glenohumeral internal rotation (IR), with symmetrical total rotational motion (for example, sum of ER + sum of IR) of the uninvolved shoulder within 5°. Pathological GIRD is identified as a loss of glenohumeral internal rotation greater than 18–20°, along with a corresponding loss of total rotation greater than 5°, seen in the throwing shoulder compared to the non-throwing shoulder.[9]

The excessive tightness of the posterior capsule, caused by repeated functional positions of 90° shoulder abduction and ER ≥ 90°, makes the humeral head shift antero-superiorly compared to a normal shoulder during throwing movements.[9] These adaptations can change muscle stiffness (posterior deltoid, subscapularis, and teres minor), glenohumeral (GH) joint flexibility, posterior capsular stiffness, the rotator cuff ER:IR strength ratio, and joint position sense in the dominant shoulder.[9] GIRD is primarily associated with stiffness of the posterior capsule in the glenohumeral joint. When the posterior capsule of the glenohumeral joint tightens, it causes translation in the opposite direction. Thus, tightness in the postero-inferior capsule results in postero-superior translation, whereas tightening of the posterior capsule leads to antero-superior translation[5] The cuff becomes more and more affected due to internal shear stresses and failure of undersurface fibers, which are made worse by a tight posterior capsule, anterior instability, and internal impingement.[5] Tightening of the posterior capsule and rotator cuff happens because of scar tissue formation from repetitive movements, leading to capsular injury and later involvement of neighboring structures in the affected arm.[5] Repetitive overuse leads to many pathological conditions, including posterior labral tears, partial articular-sided posterosuperior rotator cuff tears, and superior labral anterior-to-posterior (SLAP) tears.[7]

A cross-sectional study evaluating 127 collegiate overhead athletes determined that the prevalence of Glenohumeral Internal Rotation Deficit (GIRD) in this population is 29.1%. Despite this notable prevalence—which is consistent with rates seen in elite athletes—the study found no statistically significant association between GIRD and either scapular dyskinesia ($p=0.237$) or altered external-to-internal rotator cuff strength ratios ($p=0.411$) [14]

Maximum passive ER and IR are assessed in the throwing shoulder and compared to the contralateral extremity, and the differences can be measured using a goniometer.[7] In addition to goniometric measurement of shoulder range of motion, the Apley's Scratch Test will be used as a clinical assessment tool to evaluate functional mobility of the shoulder joint. This test helps assess the combined movements of shoulder abduction, external rotation, adduction, and internal rotation by asking the participant to reach behind the head and back to touch the opposite scapula. The test provides a simple and effective method to compare the functional range of motion between the dominant and non-dominant shoulders. It also assists in identifying limitations in shoulder mobility that may be associated with glenohumeral internal rotation deficit in overhead athletes such as cricket fast bowlers.[12]

In conclusion, the repetitive overhead actions involved in fast bowling place significant biomechanical stress on the glenohumeral joint, leading to adaptive changes in shoulder range of motion. One of the most notable adaptations observed in overhead throwing athletes is Glenohumeral Internal Rotation Deficit (GIRD), which results from posterior capsular tightness and repetitive high-velocity movements. While certain adaptations may enhance performance, pathological changes in shoulder rotation can increase the risk of various overuse injuries affecting the rotator cuff, labrum, and surrounding structures. Therefore, aim of this study was assessing glenohumeral internal rotation using reliable clinical tool for identifying deficits and preventing potential shoulder injuries in cricket fast bowlers.

NEED OF THE STUDY.

Cricket involves repetitive high-velocity overhead bowling that places extreme stress on the glenohumeral joint. This leads to adaptive changes in the dominant shoulder, commonly resulting in Glenohumeral Internal Rotation Deficit (GIRD). GIRD, especially the pathological type (>18–20° loss of internal rotation with total rotational range of motion asymmetry), is a well-established risk factor for shoulder injuries including posterior capsule tightness, internal impingement, rotator cuff tears, and labral injuries in overhead athletes.

While studies show a prevalence of 29.1% in collegiate overhead athletes and up to 37% in recreational bowlers, there is very limited data specifically on semi-professional cricket players. These players train and compete at near-professional intensity but usually lack adequate medical support, workload monitoring, and preventive care.

This study is therefore essential to determine the occurence of GIRD in semi-professional cricketers, identify high-risk individuals at an early stage, and provide baseline data for effective screening and injury prevention programs. Early detection can help reduce shoulder morbidity and support longer, healthier playing careers in this important talent pool.

RESEARCH METHODOLOGY

Study Type: Observational study
Study Design: Cross-sectional study
Type of Sampling: Purposive sampling
Study Population: semi-professional cricket fast bowlers training in professional cricket clubs.
Age group: 18-35 years.
Source of samples: Professional cricket clubs.
Sample size: 165

$$n = \frac{Z^2 P\,(1-P)}{d^2}$$

n – Number of samples, Z-1.96, P- Prevalence is %, i.e, 0.3, d- margin of error, i.e, 0.07

Thus,

$n = (1.96)^2 \times 0.3 \times 0.7 / (0.07)^2 = 3.8416 \times 0.21 / 0.0049 \approx 164.64$, Sample Size= 165

INCLUSION CRITERIA

- Male semi-professional cricket fast bowlers aged 18-35 years actively training in professional clubs [4]
- Players with at least 3 years of regular fast bowling experience at a competitive level [10]
- Ability to perform overhead bowling actions without acute injury during assessment [8]

EXCLUSION CRITERIA

- History of shoulder surgery or major trauma (e.g., fractures, dislocations) in the dominant shoulder.[8]
- Diagnosed shoulder conditions other than GIRD (e.g., rotator cuff tears, labral injuries).[9]
- Players with systemic conditions affecting joints (e.g., rheumatoid arthritis).[9]
- Fast bowlers were inactive for more than 3 months before the study due to injury or other reasons.[8]
- Use pain medication or physiotherapy for shoulder issues within 4 weeks before assessment.[9]

OUTCOME MEASURE

1. GONIOMETRIC ASSESSMENT

The universal goniometer is a reliable and valid tool for measuring shoulder ranges of motion, with intratester intraclass correlation coefficients (ICCs) ranging from 0.87 to 0.99 for motions like internal and external rotation, ensuring high consistency when used by the same assessor [15]. Its validity is confirmed by accurate measurement of standardized angles (0°–180°), making it suitable for clinical assessments like GIRD in cricket fast bowlers [15].

Internal Rotation Range of Motion (IRRM):

The IRRM measures the maximum internal rotation angle of the dominant and non-dominant shoulders in degrees, using a standard goniometer. Participants are positioned supine with the shoulder at 90° abduction and elbow at 90° flexion. The goniometer's fulcrum is aligned over the olecranon, with the stationary arm along the torso and the moving arm along the ulna. The participant rotates the forearm inward to the maximum point without discomfort. Three trials per shoulder are recorded, and the average is calculated to enhance reliability. This measure identifies restricted internal rotation, a primary indicator of GIRD, essential for determining its prevalence [9].

Internal Rotation Difference (IRD):

The IRD is calculated as the difference between the non-dominant and dominant shoulder IRRM (IRD = non dominant IRRM – dominant IRRM), expressed in degrees. An IRD exceeding 20° is defined as GIRD, IRD is derived from IRRM measurement post assessment. This measure quantifies shoulder asymmetry, enabling calculation of GIRD prevalence (percentage of participants with IRD > 20°) and the extent of deficit, directly addressing this study's objective [9]

2. APLEYS TEST

The Apley scratch test is a valid, quick, and reliable clinical tool for assessing complexshoulder range of motion (ROM)—specifically combining abduction/external rotation and adduction/internal rotation—with reported reliability (ICC) of 0.89–0.99. It is commonly used to identify restricted motion.[14]
The internal rotation component of the Apley's Scratch Test was used to assess functional shoulder mobility. The participant was asked to stand in an upright position with arms relaxed by the side. The subject was then instructed to move the hand of the test arm behind the back and attempt to reach upward towards inferior. This movement assesses shoulder adduction and internal rotation. The difference of more than 5cm reached by the middle finger was noted by the examiner. The same procedure was repeated for the opposite shoulder to allow comparison between the dominant and non-dominant sides. The findings were recorded to identify any limitation in internal rotation of the shoulder joint.[14]

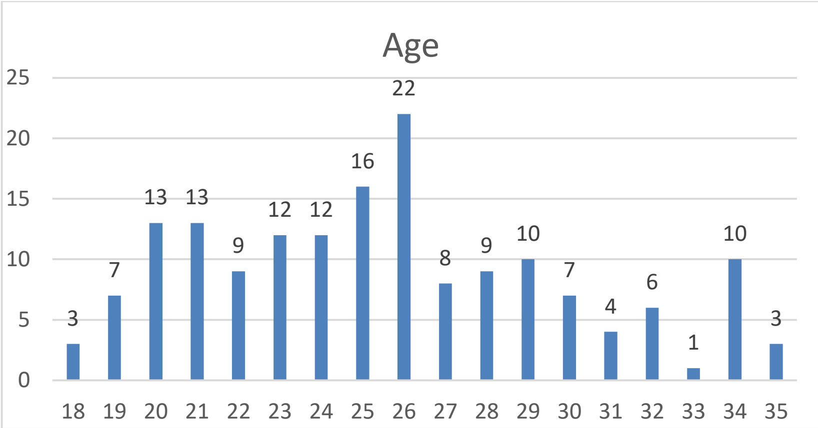
PROCEDURE

After approval from ethical committee, data collection began ss per the inclusion and exclusion criteria mentioned above. A standardized shoulder range of motion assessment was conducted to measure GIRD, focusing on internal and external rotation ranges. Participants filled a questionnaire capturing demographics (age, experience) and injury history to confirm eligibility. A 5-minute upper-body warm-up (arm swings, stretches) was given prior to measurements to reduce joint stiffness [9]. Three trials per shoulder (dominant, non-dominant) were averaged, randomized to avoid order bias, with 30-second rests between trials [12]. Data (IRRM, ERRM, TRM, IRD) was recorded then using outcome measures mentioned above. Collected data was analyzed using appropriate statistical methods to determine GIRD prevalence and degree, detailed in the statistical analysis section.

STATISTICAL ANALYSIS AND RESULT

The SPSS IBM version 20 (Statistical Package for Social Sciences) software was used to analyze the data. Data was analyzed for normal distribution.

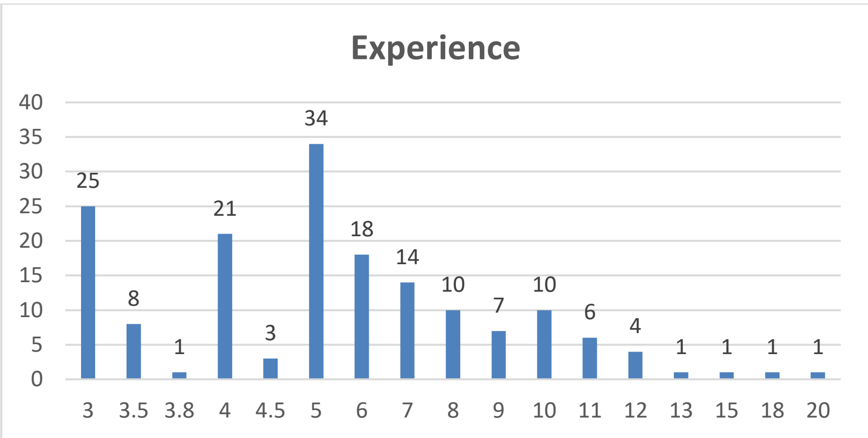
Graph 1 – Age distribution of the sample ranging from 18 to 35



Age in years

Interpretation: Players aged 22 years were maximum in the study.

Graph 2 – Experience of Players

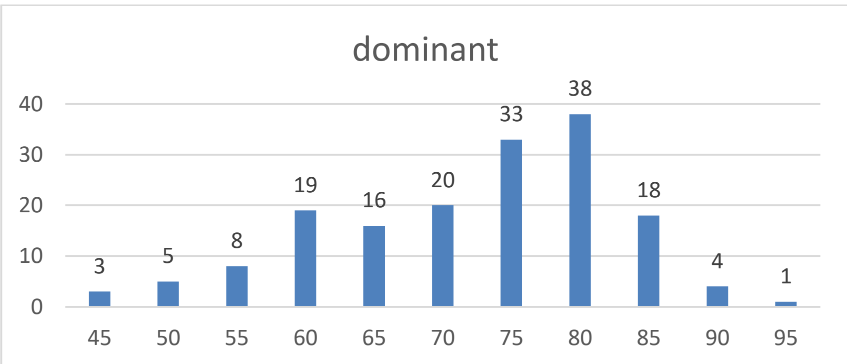


Experience in years

Interpretation – Majority players had experience of 3 to 5 years

Graph 3 – Internal Rotation Range of Motion of the dominant arm

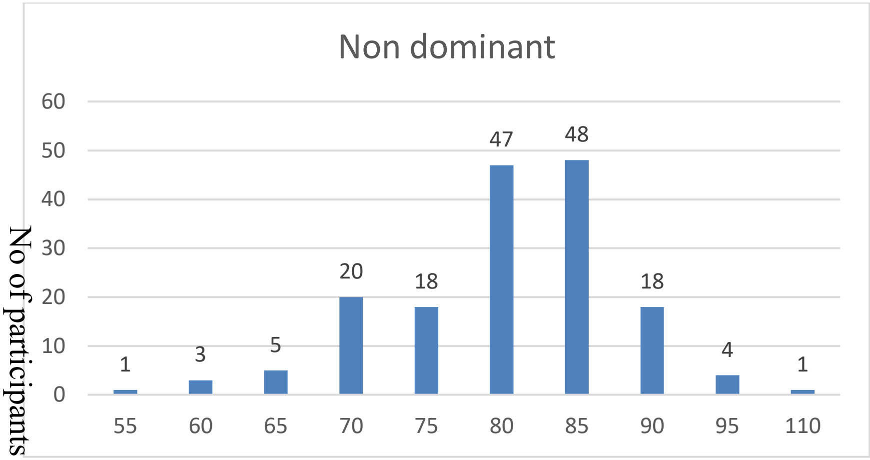
No of participants



Range of motion in degrees

Interpretation: Internal Rotation ROM of majority players was found to be 75 and 80 degrees in dominant arm

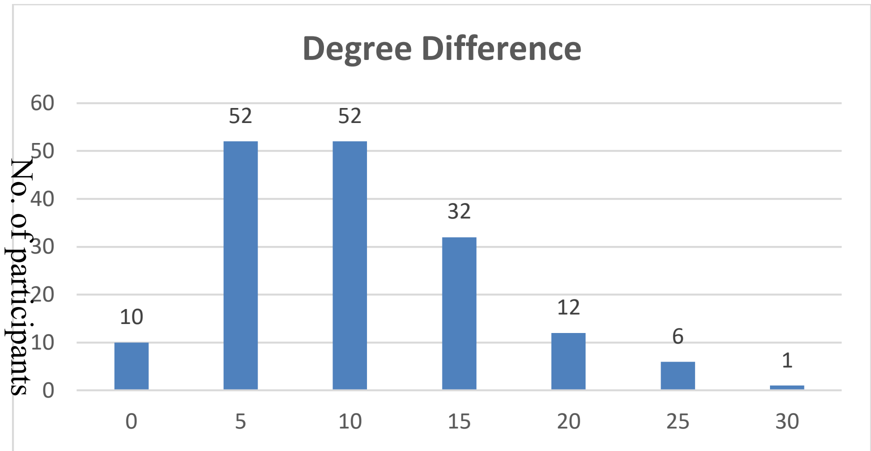
Graph 4 – Internal Rotation Range of Motion of the Non- dominant arm



Range of motion in degreec

Interpretation: Internal Rotation ROM of majority players was found to be 80 and 85 degrees in non-dominant arm

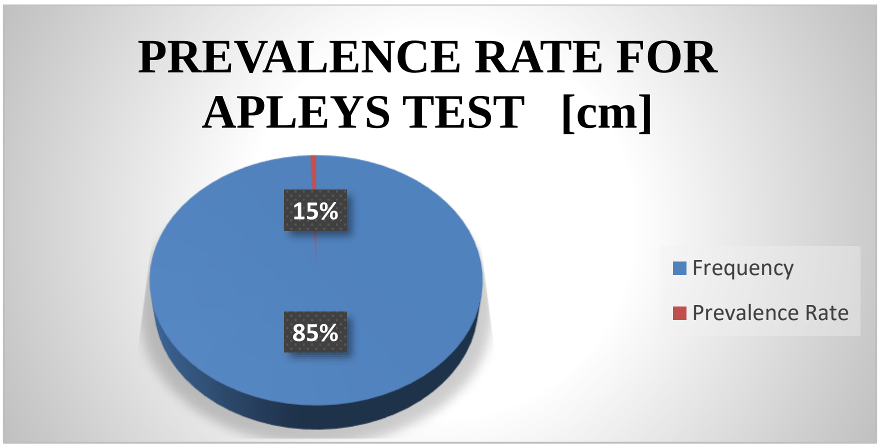
Graph 5 – Difference in degree of Internal rotation in Dominant arm and non-dominant arm



Range of motion in degrees

Interpretation- The difference in degree of Internal rotation range in dominant and non-dominant arm was found to be 10-15 degree in majority player

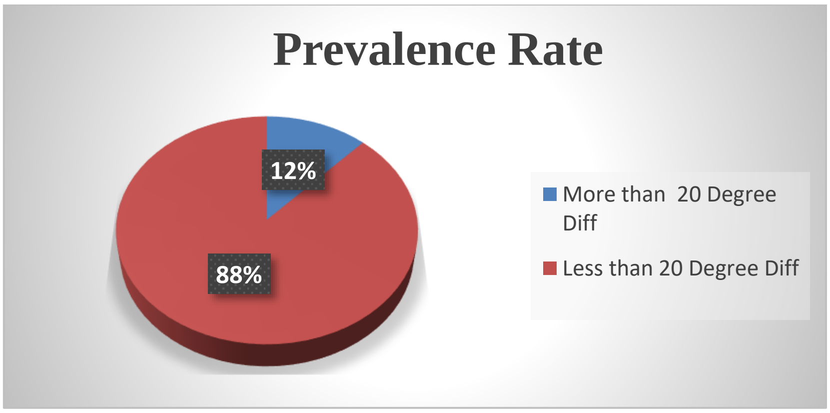
Graph 6 – Prevalence of GHIRD using Apleys test in dominant arm



Interpretation: Prevalence was found to be 15% in dominant arm

Graph 7 and Table 1- Prevalence rate of degree difference of Internal Rotation in Dominant and non-dominant arm assessed using goniometry

Degree Diff	Frequency	Prevalence Rate
More than 20 Degree Diff	19	12%
Less than 20 Degree Diff	146	88%
Total	165	100%



More than 20% of difference was found in 12% individuals.
Interpretation: Graph shows 12% players had a difference in Internal Rotation range

DISCUSSION

The present study examined 165 semi-professional overhead athletes that is cricket fast bowlers, aged between 18 and 35 years. The aim was to determine the prevalence of glenohumeral internal rotation deficit (GIRD) in them. These athletes undergo intense training involving high volumes of repetitive, high-velocity throwing, similar to elite professionals. However, unlike professional players, they often lack regular medical supervision, biomechanical screening, and preventive physiotherapy. This makes them a particularly vulnerable group for the silent development of shoulder adaptations such as GIRD.

This study was an observational cross-sectional study. Purposive sampling was used to select the participants. The study population included 165 semi-professional cricket fast bowlers aged between 18 and 35 years who were training in professional cricket clubs. Purposive sampling was chosen because it allowed the study to focus specifically on semi-professional fast bowlers who face high training loads and repetitive stress but usually do not receive regular medical monitoring.

Shoulder rotational range of motion was measured using a standard universal goniometer. Measurements were taken on both the dominant (throwing) and non-dominant sides at a standardised shoulder abduction angle. The results showed that the mean internal rotation on the dominant side was 72.15°, compared to 80.36° on the non-dominant side, resulting in an average deficit of 10.18° across the group.

A clinically significant GIRD was defined as a difference greater than 20° of dominant as compared to non-dominant. This condition was observed in 12% of the participants (19 out of 165). The majority of cases were found among athletes aged 25–30 years and those with 3–5 years of playing experience.

The loss of passive motion was closely mirrored by their functional abilities during the Apley's scratch test, where 15% of the athletes (25 individuals) demonstrated restricted posterior reach (readings of more than 5cm). When breaking down this affected group, the highest prevalence of these deficits occurred in players aged 25 to 30 years, who accounted for 47% of the rotational deficit cases and 44% of the restricted Apley's scores. Furthermore, athletes with a moderate background of 3 to 5 years of experience were the most affected, making up 58% of those with a >20-degree rotation difference and 48% of those with poor Apley's test results. Together, these findings indicate that functional shoulder tightness is a prominent issue, particularly for athletes in their mid-to-late twenties who are in their early-to-moderate years of competitive play.

A study identified a **bilateral form of Glenohumeral Internal Rotation Deficit (GIRD)** in elite gymnasts. In this study, Internal rotation decreased significantly with age in both shoulders (down to 10° in seniors), unlike classic unilateral GIRD.It was associated with posterior capsular thickening and mild humeral retrotorsion, without compensatory external rotation gain.[8]

GIRD is caused by repetitive overhead throwing motions that produce **posterior glenohumeral capsule contracture and tightness** (mainly posterior band of inferior glenohumeral ligament). This leads to >20° loss of internal rotation in the dominant shoulder, often with reduced total rotational range of motion. [10]

Repetitive overhead activities place considerable stress on the posterior structures of the shoulder during the deceleration phase of throwing. Over time, this leads to tightening of the posterior capsule and rotator cuff muscles, along with possible bony adaptations. The tight posterior capsule causes **antero-superior humeral head translation**, internal impingement, and scar-tissue formation in the capsule and rotator cuff. It may also involve increased humeral retrotorsion (osseous adaptation), especially when training begins before growth-plate closure [10]

If left unaddressed, these changes can alter normal shoulder mechanics and increase the risk of injuries such as SLAP tears, internal impingement, and rotator cuff problems

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CONCLUSION

The findings of this study indicate that repetitive overhead motions commonly result in shoulder rotational deficits among semi-professional athletes, with a 12% prevalence of GIRD found in dominant or the bowling shoulder with goniometric assessment of internal rotation deficit. Also, prevalence of 15% of GIRD was found with Apleys scratch test in the dominant or bowling shoulder. The study highlights the progressive nature of functional mobility loss over years of play. Therefore, regular goniometric screening for GIRD, along with early implementation of posterior capsule stretching exercises and appropriate training modifications, is strongly recommended to prevent long-term shoulder problems and support the athletic careers of these players

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