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Original Research Article

Effect of pre and post badminton match on shoulder rotators strength and range of motion in recreational badminton players

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ABSTRACT

Background: Badminton is recognized as the fastest racquet sport, with shuttle speeds during match play ranging from 50–75 m/s and post-smash velocities exceeding 100 m/s. Singles competition demands high levels of fitness, while doubles require sustained aggression and rapid reflexes. Players rely on aerobic endurance, agility, strength, speed, and precision. The biomechanics of badminton involve six rapid motion phases, with acceleration lasting just 0.05 seconds being the most injury-prone. Identifying early signs of shoulder dysfunction is essential to prevent long-term damage. This study aims to evaluate the effect of a single badminton match on shoulder rotator strength and range of motion (ROM) in recreational male players.

Methods: A total of 44 recreational male badminton players participated in the study. Shoulder rotator strength and ROM were assessed both before and after match play. Strength was measured using a handheld dynamometer, and ROM was evaluated using a goniometer. A p value of <0.01 was considered statistically significant.

Results: Post-match analysis revealed a significant decrease in internal rotator ROM and strength, alongside an increase in external rotator ROM. External rotator strength also showed a notable reduction. These changes were statistically significant ($p<0.001$), indicating acute biomechanical alterations following match play.

Unpaired t-test analysis revealed statistically significant differences in shoulder internal and external rotation ROM ($p<0.001$), internal rotator strength ($p<0.001$) and external rotator strength ($p<0.05$) between pre- and post-match assessments.

Conclusion: Post-match findings indicated a decrease in shoulder internal rotation ROM and external rotator strength, alongside an increase in external rotation ROM and internal rotator strength. These changes highlight the acute impact of match play on shoulder function and underscore the need for targeted conditioning and recovery strategies.

Keywords: Glenohumeral joint, Range of motion, Strength, Junior players, Overhead throwing athletes

INTRODUCTION

Badminton is a biomechanically intensive sport characterized by rapid bursts of high-intensity movement with minimal recovery time.[1] During match play, shuttle speeds typically range from 50 to 75 meters per second, with post-smash velocities often exceeding 100 meters per second.[2] These explosive actions, combined with repetitive overhead strokes, place substantial rotational stress on the upper extremities particularly the shoulder joint.[1] Globally, over 200 million individuals engage in badminton, most at a recreational level. Among this population, shoulder pain is a prevalent musculoskeletal issue, affecting 9–12% of individuals aged 16–44. Recreational players experience more overuse injuries than elite athletes due to inadequate conditioning, with 58–76% of injuries affecting the lower extremities, 19–32% the upper extremities, and 11–16% the back.[3]

The glenohumeral joint, inherently unstable due to its anatomical configuration, relies heavily on ligamentous and musculotendinous structures particularly the rotator cuff for dynamic stability. In overhead sports like badminton, precise coordination of these muscles is essential to maintain joint integrity and prevent injury.[4] Hutchinson highlights that repetitive and forceful shoulder actions can lead to imbalances between agonist and antagonist muscle groups, increasing the risk of damage.[5]

Throwing involves one of the fastest human movements, with humeral internal rotation reaching speeds over 6000°/s during acceleration. To control these forces, scapular retractors and shoulder external rotators absorb high eccentric loads during deceleration, which can lead to muscle weakening, inflammation, and connective tissue damage.[6]

While previous research has examined shoulder strength and range of motion (ROM) in elite players following multiple matches, limited data exists for recreational athletes. Given their higher injury risk, this study aims to assess changes in shoulder rotator strength and ROM before and after a single badminton match in recreational players. The findings will help inform targeted training and recovery strategies to enhance performance and reduce injury incidence.

METHODS

Study design and setting

This observational study was carried out in Mangalore, Karnataka, over a twelve months period from August 2022 to August 2023.

Study participants and sampling

This study was conducted among recreational badminton players in southern India using a purposive sampling technique. Participants who expressed willingness to join were screened based on predefined inclusion and exclusion criteria, and those eligible were recruited following written informed consent. A total of 44 subjects were selected, as determined by sample size calculation. Ethical approval was obtained from the Institutional Ethics Committee of AJ Institute of Medical Sciences, Mangalore.

Data collection tool and technique

Prior to participation, all subjects were provided with a detailed patient information sheet outlining the study objectives and procedures. Written informed consent was obtained from each participant. An initial screening was conducted to collect demographic data, including name, age, gender, hand dominance, and duration of badminton practice. Shoulder rotator strength and range of motion (ROM) were assessed both before and after a single badminton match. Strength of the shoulder rotators was measured using a handheld dynamometer, while ROM was evaluated using a goniometer.

The study aimed to examine the impact of pre- and post-match activity on shoulder rotator strength and ROM in recreational badminton players. Inclusion criteria consisted of male recreational players aged 20 to 30 years, practicing at least 6 to 8 hours per week, with no history of shoulder injury or current shoulder pain, and who voluntarily agreed to participate. Exclusion criteria included individuals with a history of upper extremity surgery, any deformity in the upper limb, neurological or systemic illness, or complaints of neck pain.

Outcome measures

Shoulder rotators strength was assessed using a hand-held dynamometer (HHD). Tests for external rotation (ER) and internal rotation (IR) were performed with participants in a supine position, the arm positioned at 90° abduction and 0° rotation in the scapular plane, and the elbow flexed at 90°. The examiner stabilized the humerus by applying downward pressure toward the examination table. For the ER test, participants externally rotated the shoulder against the HHD, which was placed just proximal to the ulnar styloid process. Similarly, for the IR test, participants internally rotated the shoulder against the HHD positioned at the same anatomical landmark.[7,8]

Strength measurements were recorded in kilograms, Newtons, or pounds and compared against the unaffected side or age-matched normative values. Only muscles capable of moving against gravity were tested. Two testing protocols were used: the “Make Test,” where participants held an isometric contraction for 3–5 seconds, and the “Break Test,” where the examiner applied force to overcome the participant’s strength, inducing an eccentric contraction. The myometer was held perpendicular to the muscle being tested at a standardized distance from the joint. Each participant performed 2–3 maximal voluntary isometric or eccentric contractions, and the scores were summed for analysis.

Shoulder range of motion (ROM) was evaluated using a goniometer. Participants were positioned supine on a bench with the shoulder abducted to 90° and the elbow flexed at 90°, maintaining the forearm perpendicular to the bench surface. To ensure accurate measurement and minimize compensatory movement, the examiner stabilized the clavicle and scapula. Passive rotation of the humerus within the glenohumeral joint was performed to assess maximum external rotation (ER) and internal rotation (IR). Two measurements were recorded for each movement, and the mean values were used to calculate the total arc of motion (TAM).[9]

Statistical analysis

Statistical analysis was performed using SPSS version 21.0 with a total sample size of 44 participants. The

normality of the data distribution was assessed using the Shapiro-Wilk test. Descriptive statistics were used to summarize the data, with measurable variables expressed as mean and standard deviation (SD). To evaluate the effect of a single badminton match on shoulder rotator strength and range of motion (ROM) in recreational players, a paired t-test was employed to determine the significance of differences between pre- and post-match values. A p value of less than 0.05 was considered statistically significant.

RESULTS

A total of 44 male participants, aged between 20 to 30 years were enrolled in the study. Table 1 presents the descriptive statistics for the variable Age revealing a moderately concentrated distribution around the early twenties. To evaluate the assumption of normality, the Shapiro-Wilk test was applied. The results confirmed that the age data followed a normal distribution.

Table 1: Age wise distribution of the study participants.

	N	Minimum	Maximum	Mean	Standard deviation
Age (in years)	44	20.0	27.0	23.318	2.0434

Table 2: Comparison of the shoulder rotator strength pre- and post-match.

Shoulder rotator strength	Time point	Mean	N	Std. deviation	P value
Internal Rotator (kg)	Pre	7.298	44	1.0142	0
	Post	5.452	44	1.0015	
External Rotator (kg)	Pre	5.782	44	0.6865	0.029
	Post	5.341	44	0.9867	

Table 3: Comparison of the shoulder rotator range of motion pre and post-match.

Shoulder rotator range of motion	Time point	Mean	N	Std. Deviation	P value
Internal rotation	Pre	60.795	44	9.2097	0
	Post	51.523	44	10.9703	
External rotation	Pre	85.705	44	9.6221	0
	Post	95	44	10.273	

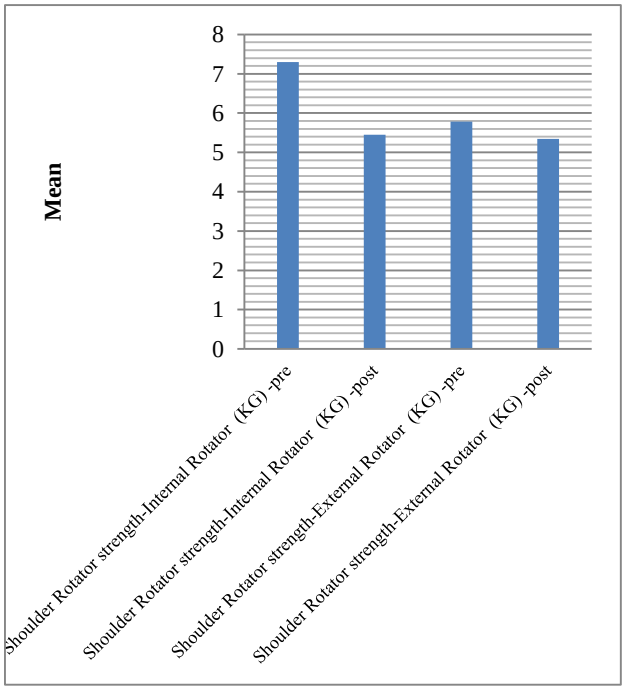

Figure 1: Comparison of the shoulder rotator strength pre and post-match.

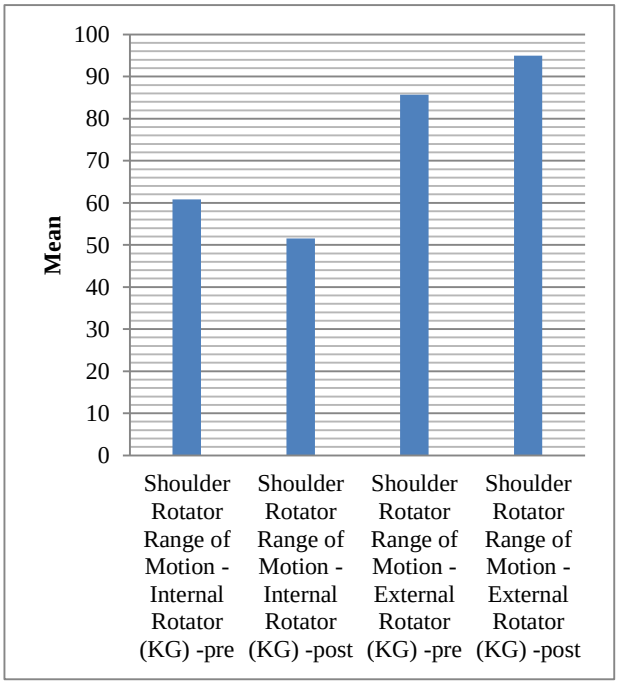

Figure 2: Comparison of the shoulder rotator range of motion pre- and post-match.

Table 2 presents descriptive statistics for shoulder rotator strength, revealing a significant reduction in both internal and external rotator strength following the intervention. Internal rotator strength decreased from a mean of 7.29 kg (SD=1.01) to 5.45 kg (SD =1.00), while external rotator strength declined from 5.78 kg (SD=0.69) to 5.34 kg (SD=0.99). Paired t-tests confirmed that these reductions were statistically significant, with p values of <0.001 and 0.029, respectively.

Table 3 summarizes the shoulder rotator range of motion data for the same group of 44 participants. Measurements taken before and after the intervention showed a contrasting pattern. Internal rotator range of motion decreased from 60.80 kg (SD=9.21) to 51.52 kg (SD=10.97), whereas external rotator range of motion increased from 85.71 kg (SD=9.62) to 95.00 kg (SD=10.27). Paired sample t-tests revealed that both changes were statistically significant (p<0.001), indicating that the intervention produced opposing effects on internal and external rotator function.

DISCUSSION

The present study aimed to investigate the acute effects of a badminton match on shoulder rotator strength and ROM in recreational players. The findings revealed a post-match decrease in internal rotator ROM, an increase in external rotator ROM, and a reduction in both internal and external rotator strength. These results align with existing literature on shoulder biomechanics and match-induced musculoskeletal changes in badminton athletes. The observed reduction in internal rotator ROM post-match may be attributed to repetitive overhead strokes, particularly smashes and clears, which place high eccentric loads on the internal rotators. Silva et al reported similar post-match declines in shoulder ROM, suggesting fatigue-induced stiffness and microtrauma as contributing factors.[10] The increase in external rotator ROM could reflect compensatory laxity or muscle inhibition following fatigue. Guermont et al highlighted that shoulder muscle imbalance, especially dominance of internal rotators, may predispose players to excessive external rotation post-match, increasing injury risk.[11]

The decline in both internal and external rotator strength post-match is consistent with findings by Fernandez-Fernandez et al who demonstrated acute fatigue effects on shoulder musculature following simulated matches. This reduction may compromise joint stability and neuromuscular control, particularly in recreational players with less conditioning.[12]

Pardiwala et al emphasized the biomechanical demands of badminton, noting that elite players experience high shoulder loading during overhead strokes. Although recreational players may not reach elite intensity, the repetitive nature of play still induces fatigue and transient neuromuscular deficits.[13] Wang et al further demonstrated that shoulder flexibility training enhances smash mechanics, implying that limited ROM and strength could impair performance and elevate injury risk.[14] Unlike elite athletes, recreational players often lack structured warm-up, conditioning, and recovery protocols. The clinical study on shoulder laxity in competitive players underscores the importance of joint integrity and muscular balance, which may be compromised in recreational settings. The biomechanical review on badminton performance and muscle activation supports the need for targeted interventions to preserve shoulder health.

Incorporating dynamic warm-ups and rotator cuff activation exercises before a match can help mitigate the loss of range of motion and decline in shoulder strength. Following play, engaging in stretching and light resistance exercises supports recovery by restoring muscle balance and reducing the risk of long-term deficits. A consistent training focus on strengthening the external rotators and improving internal rotator flexibility is essential to prevent muscular imbalances and lower the risk of shoulder injuries in recreational badminton players.

Despite the valuable insights gained, this study has several limitations. First, the sample size was relatively small and limited to recreational badminton players, which may restrict the generalizability of the findings to competitive or elite populations. Second, the assessment was confined to immediate pre- and post-match measurements, without evaluating long-term adaptations or recovery patterns. Third, external factors such as individual playing style, match intensity, and prior training history were not controlled, which could have influenced shoulder performance outcomes.

CONCLUSION

This study explored the effect of pre and post badminton match on shoulder rotators strength and range of motion in recreational badminton players. The findings revealed that suggest even a single session of competitive play can acutely alter shoulder biomechanics, potentially contributing to muscular imbalances and increased injury risk. Such insights emphasize the need for tailored warm-up routines and post-match recovery strategies to preserve shoulder health in recreational badminton athletes.

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