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COMPARATIVE ANALYSIS OF ISOMETRIC STRENGTH AND RANGE OF MOTION OF SHOULDER, BEFORE AND AFTER A SINGLE BADMINTON MATCH IN YOUNG ELITE BADMINTON PLAYERS

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ABSTRACT

Background: This study investigates the impact of a single badminton match on shoulder ranges of motion (ROM) and isometric strength in young elite badminton players from Rawalpindi/Islamabad. Shoulder function is crucial in badminton, yet the acute effects of match play remains under explored**.**

Objective: The primary objective is to assess changes in shoulder adduction ROM, ROM across various movement planes, and isometric strength before and after a single badminton match. The study aims to contribute valuable insights into the dynamic aspects of shoulder function in response to acute sport-specific demands.

Methodology: A comparative cross-sectional study was conducted at Islamabad Sports Complex consisting of 56 participants meeting the inclusion criteria Participants include young elite badminton players, and assessments encompassed shoulder adduction ROM, ROM in flexion, extension, abduction, internal rotation (IR), and external rotation (ER), and isometric strength of specific muscle groups before and after a single badminton match. Statistical analyses employed paired t-tests, Wilcoxon Signed Rank Tests, and descriptive statistics using SPSS 23.

Results: While shoulder adduction ROM and isometric strength did not exhibit significant changes post-match, significant decreases were observed in flexion ($p = 0.04^*$) and abduction ($p = 0.04^*$) ROM. Conversely, extension, IR, and ER did not show significant differences ($p = 0.11$, 0.78, and 0.09, respectively).

Conclusion: It was concluded that a single badminton match may selectively impact certain shoulder ranges of motion, emphasizing the importance of assessing different movement planes. However, shoulder adduction ROM and isometric strength remained relatively stable.

Keywords: Shoulder joint, range of motion, isometric strength, single badminton match, elite Players.

INTRODUCTION

Badminton is a worldwide popular racquet sport, which has been commercialized and made more accessible for athletic tournaments and leisurely physical activities.(1) In badminton, the player uses a variety of multidirectional movement patterns quickly in succession to execute defensive/counterattacking retrievals or construct offensive plays.(2)Although badminton is considered a relatively safe sport, shoulder injuries are very common among both recreational and competitive players.(3)

Badminton injuries are around 1–5% of all sports injuries. They ranked six after soccer, basketball, volleyball, long-, distance running, and cycling.(4)To meet the functional requirements of their particular activity, overhead athletes need to maintain a careful balance of shoulder mobility and stability. (5)It has been noted that overhead athletes have altered shoulder mobility, which is assumed to arise from adaptive structural alterations to the joint brought on by the high physiological demands of overhead activity.(6)

The scapulothoracic articulation and the glenohumeral joint make up the shoulder complex, which divides the range of motion and increases it.(7)This composition places the glenoid beneath the humeral head to support some of the arm's weight, allowing the implicated muscles to perform in the most productive portion of their length-tension curve.(8)

In the scientific literature, studies on injuries and trauma related to badminton predominate however, some authors report that there are few scientific studies on the relationship between non-serious injuries such as overuse injuries and the history of SP.(9)Shoulder pain is a very common musculoskeletal complaint in recreational, national, and international competitive players.(10)

Shoulder instability encompasses a spectrum of diseases ranging from subluxation to frank dislocation. While a lot of instability occurrences happen after trauma, instability can also result through recurrent attenuation of the capsuloligamentous structures near the shoulder. Due to repeated microtrauma, overhead athletes are more likely to have subluxation-type occurrences.

During subluxation, the humeral head translates beyond normal physiological limits, but maintains contact with the glenoid, often resulting in translation to, but not beyond the glenoid rim. While subluxation is often overlooked, it can be problematic, especially in overhead athletes.(11)

Shoulder girdle motion is complex and involves synchronous movement of the scapula, clavicle, and humerus.Two-dimensional (2D and more recently three-dimensional (3D) measurement techniques have been used to describe this motion. As the arm is raised, the generally accepted pattern of motion at the shoulder is as follows; the scapula upwardly rotates, posteriorly tilts, and externally rotates; the clavicle elevates and retracts; and the humerus elevates and externally rotates. This coordinated motion, which is reliant on capsulo-ligamentous structures and neuromuscular control, is crucial for the shoulder girdle's correct operation.(12)

Xiao Zhou, Kazuhiro Imai, Xiao-Xuan Liu et.all in 2021, Abrams GD, Renstrom PA, Safran MR. Epidemiology of musculoskeletal injury in the tennis player. British journal of sports medicine.(10)There are currently insufficient research on the causes of shoulder pain in badminton players, as far as we could find in our search. Increased age, shorter height, hard training intensity, and more training hours per week, were found to be risk factors for shoulder pain in studies on other overhead motion sports, such as baseball.(13)

Many studies have shown that shoulder ROM is changed as an adaptive response to throwing. M. Fahlström,K. Söderman in 2007 described the prevalence and consequences of painful conditions in the shoulder region in recreational badminton players and found considerable decrease in range of motion and isometric strength showed slight variation.(14)

C. Couppé,K horborg,M. Hansen et.all, in 2021, noted profile shoulder passive range of motion (ROM) and isometric strength for external (ER) and internal (IR) rotation as part of the preseason and there was significant reduction in both profiles.(15)

Alejandro Lopez-Valenciano et.all, according to their findings demonstrated that playing two matches back-to-back on the same day with little time between them caused significant declines in shoulder strength and range of motion.(16)

There is very limited research purely investigating the short-term effect of overhead play such as single badminton matches. Hence, this study aims to analyze the effects of a single badminton match on young elite players of Rawalpindi and how it affects day-to-day shoulder movement in players.

MATERIALS AND METHODS

A cross-sectional comparative study design was used to observe the shoulder ranges of motion and isometric strength in the young elite badminton players of Rawalpindi and Islamabad. A sample of 56 was taken from the participants who fulfilled our inclusion and exclusion criteria. The sample size was calculated using the OpenEpi sample size calculator. Data was collected from Islamabad Sports Sports Complex. Only elite badminton players, both male and female gender between the age of 16-30 years and no prior history of shoulder injury or immobility are included. Players having any nerve injury or brachial plexus injury and Individuals who have systemic joint disease are excluded.

Self-structured questionnaire was used to obtain demographics and to assess the range of motion and isometric strength. Ranges of motion were assessed through goniometer. isometric strength of the selected muscles was measured through manual muscle testing. All the movements of the shoulder joint were measured i.e. Flexion, Extension, Abduction, Adduction, Internal Rotation and External Rotation. Ethical considerations were meticulously addressed to safeguard the rights and well-being of the participants. Informed consent was obtained from all individuals involved, ensuring a comprehensive understanding of the study's objectives and

potential implications. Confidentiality measures were implemented to protect participants' identities, and voluntary participation was emphasized, allowing individuals to withdraw without consequence. Data was analyzed using SPSS version 23. The normality of the data was initially assessed using the Kolmogorov-Smirnov test. The paired t-test and Wilcoxon signed-rank test were applied to identify any statistically significant differences in shoulder adduction and ranges of motion, respectively, before and after the badminton match.

RESULTS

The total 56 number of participants were analyzed. The mean of age was 22.5 ± 3.4. Regarding shoulder adduction ROM, participants displayed a mean of 9.1 degrees (±4.3 degrees) pre-match, which slightly decreased to 8.7 degrees (±4.9 degrees) post-match. The paired t-test revealed a non-significant p-value of 0.327, indicating that the alteration in shoulder adduction ROM was not statistically significant. The assessment of shoulder ROM across different planes using the Wilcoxon Signed Rank Test revealed distinctive outcomes. Notably, flexion and abduction demonstrated statistically significant decreases from pre-match mean values of 25.1 degrees and 28.0 degrees to post-match values of 23.4 degrees ($p = 0.04^*$) and 26.5 degrees ($p = 0.04^*$), respectively (Table 1). Conversely, extension, internal rotation (IR), and external rotation (ER) did not exhibit statistically significant differences.

Furthermore, the investigation delved into isometric strength changes in specific

shoulder muscle groups. Pre-match mean isometric strength values for the Latissimus Dorsi, Teres Major, Pectoralis Major, and Deltoid were observed. Post-match, strength increases were noted across all muscle groups, with post-match values of 16.5, 17.2, 16.4, and16.4, respectively. (Fig 1). However, none of these changes reached statistical significance, as evidenced by p-values of 0.28, 0.32, 0.75, and 0.75, respectively.

Table 1. Shoulder Range of Motion Before and After a Single Badminton Match Using the Wilcoxon Signed Rank Test

Variable	Pre Match Mean Rank	Post Match Mean Rank	P value

Flexion	**25.1**	**23.4**	**0.04***
Extension	**25.7**	**26.9**	**0.11**
Abduction	**28.0**	**26.5**	**0.04***
IR	**25.6**	**26.4**	**0.78**
ER	**25.6**	**28.1**	**0.09**

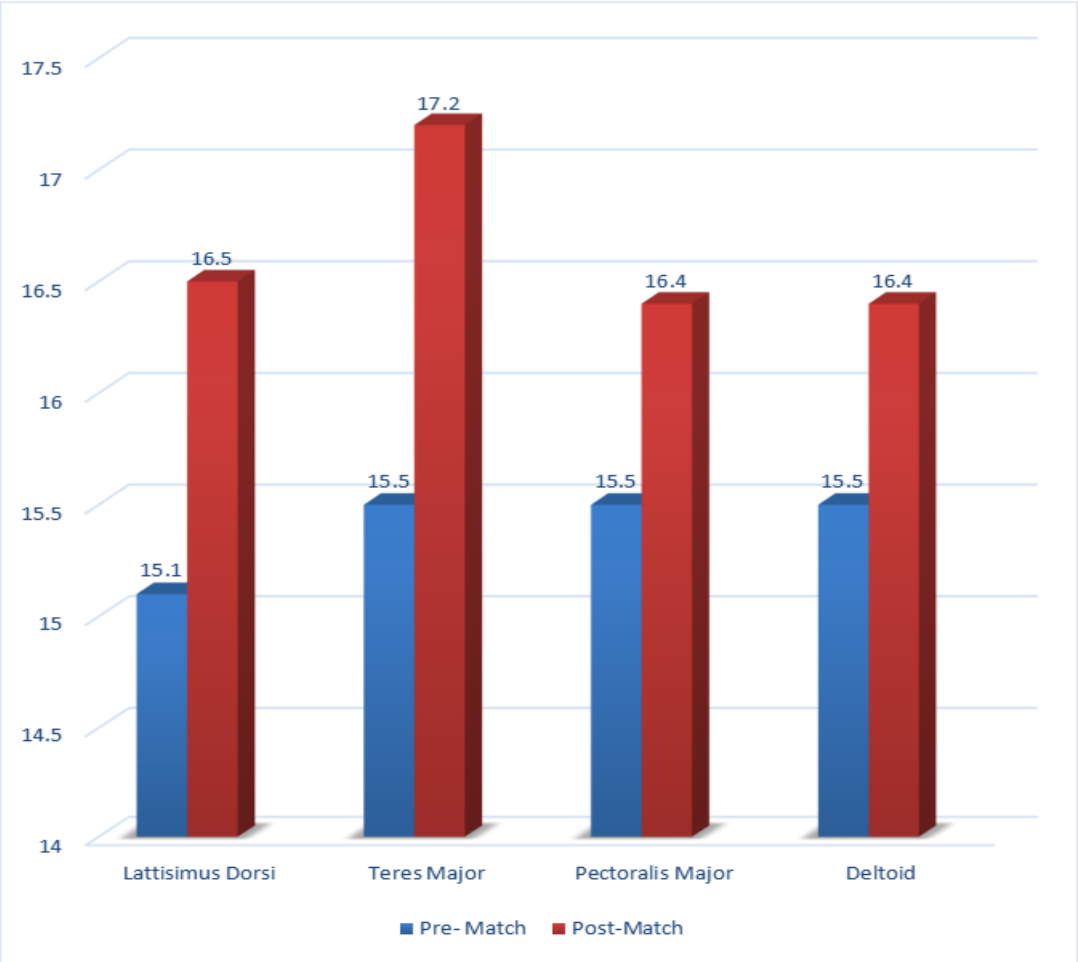

Figure 1. Shoulder Isometric Strength Before and After a Single BadmintonMatch Using the Wilcoxon Signed Rank Test

DISCUSSION

The purpose of the current study was to inspect and compare the effects of shoulder ranges of motion and isometric strength before and after a single badminton match. The present study data indicates that no significant changes were measured.

Jaime Fernandez-Fernandez et. all analyzed the influence of playing 2 consecutive prolonged badminton matches on the shoulder strength and range of motion (ROM) of young players.

After the matches, firstly it was noted that ER and IR were reduced. Secondly, the shoulder total ROM was also reduced.(16) Valentine Zimermann Vargas et al. in 2021 conducted a cross-sectional study in which 237 players participated and investigated in their study that there were no significant changes in shoulder ranges of motion and isometric strength in overhead athletes.(17) In contrast to recent study showed no significant difference in both isometric strength and ranges of motion of the shoulder. As contrary to the results of recent study, Henri Guermont conducted a prospective cohort study which included a total of nineteen elite badminton players with greater ratio of men as compared to women, they concluded that there was a significant bilateral decrease in the strength of shoulder muscles.(18) Another cross-sectional study was conducted in March2020, Youngwook Kim et al. analyzed the effects of shoulder ranges of motion and strength in overhead athletes. The results were the same as in the present study as there were no significant changes in both the profiles i.e. shoulder ranges of motion and isometric strength.(19)

A study was conducted to notice the shoulder instability and variation in upper limb muscular strength. A total of 116 athletes were included in the study with the greater ratio of female, the results concluded that there was significant increase in the muscular strength of upper limb in the overhead athlete playing sports majorly as basketball, volleyball and badminton. The results compared to recent study were not same as in our study as there was no significant difference in the isometric strength of shoulder after playing the single badminton match.(20)

Another randomized control trial was conducted in 2021 by S Sharma et.al, in which changes in isometric strength in overhead athletes with the history of shoulder impingement syndrome were observed. A total of 38 overhead athletes were included in the study including basketball, badminton and volleyball with an equal ratio of both male and female athletes. Unlike the results of our study there was a significant decrease in the shoulder isometric strength in the overhead athletes.(21)

M. Ahmed et.al conducted a study in 2020, the main objective of this study was to elucidate the muscle activity and its involvement in the upper extremity during Badminton strokes. Biomechanical aspects by examining kinematic disparities in the wrist, elbow, and shoulder joints during various badminton forehand overhead shots, including the precise shot, smash, and drop were noticed. The results were similar as compared to our study as there was no significant changes noted.(22)

CONCLUSION:

In conclusion, this research provides insights into the effects of a single badminton match on shoulder ROM and isometric strength in young elite players from Rawalpindi/Islamabad. While shoulder adduction ROM and isometric strength did not significantly change, specific movement planes showed notable alterations. Further investigations into the dynamic and multifactorial aspects of shoulder function in badminton players are warranted to better understand the implications for training and injury prevention**.**

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