Correlation Between Hand Eye Coordination, Agility and Upper Limb Explosive Power in Recreational Badminton Players: A Pilot Study

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Abstract: Badminton is a dynamic racket sport that demands high levels of hand–eye coordination, agility, and upper limb explosive power for effective performance. These components are essential for rapid shuttle tracking, multidirectional movement, stroke execution, and efficient court coverage. The study's objective was to ascertain the relationship between recreational badminton players' hand-eye coordination, agility, and upper limb explosive power. A pilot survey of recreational badminton players was carried out in Southern Karnataka. Recreational badminton players Convenience sampling was used to recruit people between the ages of 18 and 35. Hand–eye coordination, agility, and upper limb explosive power were assessed using the Alternate Hand Wall Toss Test, Agility T-Test, and Seated Medicine Ball Throw Test, respectively. Correlation was performed using Karl-Pearson's correlation method. Statistical significance was set at $P < 0.05$. Correlation analysis revealed a significant moderate negative correlation between hand–eye coordination and agility ($r = -0.591$, $p = 0.043$). Hand–eye coordination also demonstrated a moderate positive correlation with upper limb explosive power ($r = 0.545$), although the association was not statistically significant ($p = 0.067$).

Keywords: Alternate Hand Wall Toss Test, Agility, Hand–Eye Coordination

INTRODUCTION

One of the world's quickest racquet sports is badminton, requiring rapid decision-making, high levels of neuromuscular coordination, and precise execution of complex motor skills. The sport is characterized by intermittent high-intensity rallies, quick directional changes, and explosive movements, placing significant demands on both aerobic and anaerobic systems[1]. Recreational badminton players constitute a substantial proportion of the badminton-playing population and participate primarily for health, fitness, and leisure rather than competitive excellence. Unlike elite athletes, they generally lack structured coaching, systematic conditioning, and sport-specific training, which may influence the development of essential performance components such as coordination, agility, and muscular power. Consequently, recreational players may exhibit variations in neuromuscular performance compared with professionally trained athletes[2,3].

The capacity to receive visual information and transfer it into exact motor actions is known as hand-eye coordination. This talent is especially important in sports like badminton, where accurate stroke execution and fast reflexes are crucial[4]. Hand-eye coordination is very important, namely when we see the ball soar, the hands start to square off hitting the shuttlecock quickly and sharply toward the target on the field and this is also the need for a reaction from each player[5].

In badminton, players are required to react instantly to unpredictable shuttlecock trajectories while maintaining balance and postural control. Effective footwork, quick directional changes, and movement efficiency enable players to cover the court efficiently and respond successfully to offensive and defensive situations. However, recreational badminton players often emphasize technical play rather than structured physical conditioning, which may limit the development of agility and other fundamental physical capacities[6,7,8].

Upper limb explosive power is defined as the muscles capacity to provide maximum force in the shortest amount of time and is a critical component of racket sport performance. In badminton, explosive upper limb power directly influences the execution of high-speed strokes such as smashes, clears, and drives. The production of these powerful movements depends on rapid neuromuscular activation and efficient force transfer through the lower limbs' kinetic chain, trunk, and upper extremities. Greater upper limb explosive power has been associated with higher shuttlecock velocity, improved stroke effectiveness, and enhanced overall playing performance [9,10].

Although badminton performance has been extensively investigated, the association among hand–eye coordination, agility, and upper limb explosive power in recreational players remains insufficiently explored. Existing research has predominantly focused on elite athletes, while recreational players, who may have limited access to systematic training, have received less attention. Hence, this study aimed to examine the relationship between hand–eye coordination, agility, and upper limb explosive power in recreational badminton players. The findings may provide useful insights for coaches and physiotherapists in designing appropriate training and rehabilitation strategies to enhance performance and minimize injury risk.

RESEARCH METHODOLOGY

A pilot correlational study was undertaken to evaluate the interrelationship among hand eye coordination, agility and upper limb explosive power in recreational badminton players.

Participants

Recreational badminton players between the ages of 18 and 35 participated in this cross-sectional pilot study. Convenience sampling was used to select participants based on predetermined inclusion and exclusion criteria. The study comprised recreational badminton players who fulfilled the qualifying requirements, played the game for at least three hours a week, and provided written, informed permission.

Outcome Measure

- **Hand eye coordination:** Assessed using Alternate hand wall toss test
- **Agility**: Assessed using Agility T- test
- **Upper limb explosive power:** Assessed using Seated medicine ball throw test

Statistical Analysis

SPSS version 29.0 (IBM SPSS Statistics for Windows, Version 29.0; IBM Corp., Armonk, NY) was used for statistical analysis. The mean and standard deviation were used to summarize continuous variables. Karl-Pearson's correlation method was used to perform the correlation. Statistical significance was defined as a p value of less than 0.05.

RESULTS

Table 1: Descriptive Statistics of Age and Gender of Recreational Badminton Players

		Frequency	Percent
Age	20-24 years	7	58.3
	25-29 years	5	41.7
Gender	Female	6	50.0

	Male	6	50.0

The descriptive analysis showed that among the 12 recreational badminton players, the majority belonged to the 20–24 years' age group, accounting for 58.3% (n=7), while 41.7% (n=5) were in the 25–29 years' age group. The participants had a mean age of 24.250±2.832 years. With regard to gender, an equal distribution was observed, with 50.0% (n=6) being female and 50.0% (n=6) being male.

Table 2: Descriptive Statistics of Hand Eye Coordination, Agility and Upper Limb Explosive Power among Recreational Badminton Players

	Minimum	Maximum	Mean	Std. Deviation
Hand eye coordination	21.00	35.00	28.000	4.748
Agility	9.70	11.50	10.483	0.586
Upper limb explosive power	3.50	5.30	4.483	0.583

The descriptive analysis revealed that the recreational badminton players had a mean hand eye coordination score of 28.000±4.748, with scores ranging from 21.00 to 35.00.

The mean agility score was 10.483±0.586, with a minimum value of 9.70 and a maximum value of 11.50.

Similarly, the mean upper limb explosive power was 4.483±0.583, with values ranging from 3.50 to 5.30.

Table 3: Correlation between Hand Eye Coordination and Agility among Recreational Badminton Players

		Agility
Hand eye coordination	r value	-.591*
	p value	.043
	N	12

The correlation analysis revealed that hand eye coordination had a moderate negative correlation with agility (r = -.591, p = .043) among the recreational badminton players. Since the p value (.043) was less than 0.05, the association was statistically significant. This indicated that as the hand eye coordination score increased, the agility score tended to decrease among the study participants.

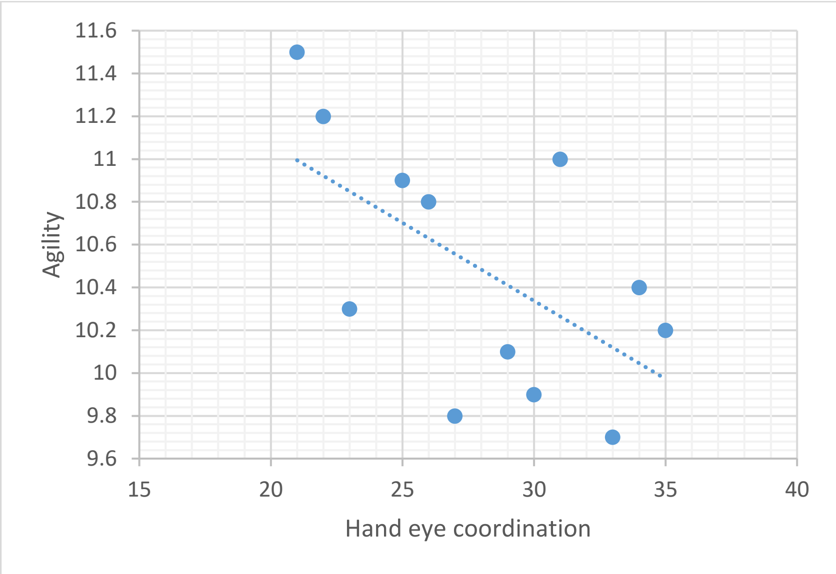

Figure 1: Representing the Correlation between Hand Eye Coordination and Agility among Recreational Badminton Players

Table 4: Correlation between Hand Eye Coordination and Upper Limb Explosive Power among Recreational Badminton Players

		Upper limb explosive power
Hand eye coordination	r value	.545
	p value	.067
	N	12

The correlation analysis revealed that hand eye coordination had a moderate positive correlation with upper limb explosive power (r = .545, p = .067) among the recreational badminton players. However, since the p value (.067) was greater than 0.05, the association was not statistically significant. This indicated that although hand eye coordination tended to increase with upper limb explosive power, there was no statistically significant correlation among the study participants.

DISCUSSION

The present pilot study investigated the relationship between hand–eye coordination, agility, and upper limb explosive power among recreational badminton players. The main discovery was a moderately negative connection that was statistically significant between hand–eye coordination and agility ($r = -0.591$, $p = 0.043$), demonstrating that individuals have superior hand–eye coordination completed the Agility T-test in less time and therefore demonstrated superior agility performance. In contrast, although hand–eye coordination showed a moderate positive correlation with upper limb explosive power ($r = 0.545$), the association did not reach statistical significance ($p = 0.067$). These results imply that visuomotor coordination is more closely associated with multidirectional movement performance than with upper limb power production in recreational badminton players.

The observed relationship is supported by contemporary evidence demonstrating that agility is not solely dependent on muscular speed but also relies heavily on perceptual–cognitive abilities and visuomotor integration. Young and Farrow reported that agility performance is strongly influenced by visual scanning, anticipation, and decision-making, which all help to rapid movement responses during sport-specific tasks. Similarly, Nimphius and colleagues emphasized that efficient change-of-direction performance depends on the interaction between neuromuscular capacity and perceptual processing rather than physical speed alone. These findings support the present results, suggesting that enhanced visual information processing enables badminton players to execute faster and more coordinated movements during agility tasks. [11,12]

The present study demonstrated a moderate positive correlation between hand–eye coordination and upper limb explosive power ($r = 0.545$); Nevertheless, there was no statistically significant correlation ($p = 0.067$). Although participants with better hand–eye coordination tended to exhibit greater upper limb explosive power, the findings suggest that improvements in visuomotor coordination do not always result in higher upper limb force production among recreational badminton players. This observation highlights that these performance components, while functionally related during badminton play, are influenced by distinct physiological and neuromuscular mechanisms.

Hand–eye coordination primarily depends on the efficient integration of visual input, sensorimotor processing, reaction time, and movement accuracy, whereas upper limb explosive power is determined predominantly by muscle strength, rate of force development, neuromuscular activation, and the efficiency of the kinetic chain. Although both qualities contribute to badminton performance, they may develop independently in recreational players because of differences in training exposure and physical conditioning. Recreational players commonly participate in badminton for leisure and fitness rather than structured performance enhancement and therefore may not receive sufficient resistance or plyometric training to develop maximal upper limb power. Consequently, improvements in coordination may occur through repeated sport participation without proportional gains in muscular power.

The small sample size could possibly account for the lack of statistical significance of this pilot study. With only twelve participants, the study had reduced statistical power to detect moderate associations. Small samples increase the probability of Type II error, in which a true relationship may not reach statistical significance despite a meaningful correlation coefficient. The observed correlation ($r = 0.545$) suggests a moderate association that may become statistically significant in studies involving larger and more heterogeneous samples. Consequently, the current results should be interpreted cautiously and considered preliminary rather than conclusive.

Previous investigations have similarly reported that upper limb explosive performance is influenced by multiple physical attributes beyond visuomotor coordination. Studies evaluating badminton-specific training have shown that resistance training, plyometric exercises, shoulder muscle strength, trunk stability, and efficient lower-limb force transfer contribute substantially to shuttlecock velocity and stroke effectiveness. In contrast, visuomotor coordination primarily enhances stroke timing, racquet positioning, and movement precision rather than maximal force generation. These observations support the present findings by indicating that although coordination facilitates technical execution, muscular power remains dependent on specific neuromuscular adaptations achieved through targeted strength and power training. [3,13,14]

The results of this investigation have important implications for sports physiotherapists, coaches, and recreational badminton players. The significant association between hand–eye coordination and agility suggests that visuomotor training should be incorporated into badminton-specific conditioning programmes to enhance on-court movement efficiency. Exercises such as reaction-ball drills, alternate hand wall toss exercises, shuttle-response training, and sport-specific multidirectional agility drills may improve visual processing, movement initiation, and change-of-direction ability. Since badminton performance depends on the rapid integration of perception and movement, training interventions that simultaneously target perceptual–cognitive skills and physical performance are likely to produce greater functional improvements than isolated conditioning programmes. Recent evidence has shown that perceptual–motor training enhances decision-making speed, reaction time, and movement efficiency, all of which are essential for successful badminton performance. [15,16]

Although hand–eye coordination demonstrated a positive relationship with upper limb explosive power, the absence of statistical significance implies that enhancing visuomotor coordination might not be enough to enhance muscular power. Development of upper limb explosive performance requires specific neuromuscular adaptations achieved through progressive resistance training, plyometric exercises, and sport-specific power training. Therefore, recreational badminton players should follow integrated conditioning programmes that combine coordination training with structured strength and power development to optimise overall performance.[17,18]

CONCLUSION

This study demonstrated that hand–eye coordination is significantly associated with agility in recreational badminton players, reinforcing its importance as a key determinant of sport-specific performance. While a positive trend was observed between hand–eye coordination and upper limb explosive power, the relationship failed to achieve statistical significance. The findings support the integration of visuomotor coordination training into recreational badminton conditioning programmes to enhance movement efficiency and on-court performance. Future research involving larger and more diverse samples is needed to further elucidate these relationships and strengthen the evidence base for performance-oriented training strategies.

DECLARATIONS

Study Limitations

the study included a relatively small sample of recreational badminton players, which may have reduced the statistical capability to identify important associations, particularly for upper limb explosive power. Second, participants were recruited using convenience sampling from a limited geographical region, which may restrict the generalisability of the findings to other recreational badminton populations. Third, factors such as playing experience, weekly training volume, technical proficiency, previous injury history, and physical activity levels were not controlled and may have influenced the observed relationships.

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Nil

Competing Interests

There are no financial or charitable organization to carry out this research

Ethical Approval

The study was approved by the Institutional Ethics Committee, A. J. Institute of Medical Sciences & Research Centre, Mangaluru, Karnataka, India. Ethical approval was granted under Reference No. AJEC/REV/207/2025 on 24 June 2025. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Informed Consent

All subjects give consent prior to the study.

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