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Comparison of Whole Body Reaction Time Between Singles and Doubles Badminton Players Aged 14–17 Years

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Abstract

Whole Body Reaction Time (WBRT) is a key biomotor ability in badminton, essential for responding to rapid and unpredictable game situations. This study compared WBRT between male singles and doubles badminton athletes aged 14–17 years. Using a quantitative comparative design with purposive sampling, 37 athletes met the inclusion criteria, consisting of 18 singles and 19 doubles players. Data collection on May 3–4, 2025 included anthropometric assessment (Omron Karada Scan HBF-375), height (OneMed HT701), and WBRT (Takei TKK-5408). The Shapiro–Wilk test confirmed normal data distribution ($p > 0.05$). The mean WBRT of singles players was 0.286 ± 0.024 s, while doubles players showed 0.260 ± 0.021 s. An independent t-test indicated a significant difference between groups ($p = 0.002$), with doubles players exhibiting faster reaction times. This difference likely reflects the higher tempo and complex perceptual demands of doubles play, requiring quicker neuromuscular responses to multiple stimuli. The findings suggest that player specialization influences reaction performance. Coaches are advised to incorporate position-specific perceptual-motor drills to enhance WBRT. This study contributes to the understanding of biomotor differences in youth badminton and supports tailored training for optimal performance development.

Keywords: *badminton, reaction time, whole body reaction, singles and doubles events*

INTRODUCTION

Badminton is one of the most popular racket sports in the world. This sport involves high intensity, speed, and rapid directional changes, as well as requiring a high level of technical skills and strategy (Phomsoupha & Laffaye, 2015). Based on research conducted by Perez and Turpin (2020), badminton is one of the fastest racket sports in the world as the shuttlecock can reach speeds of up to 260 km/h or

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72 m/s. Badminton players who possess high power have an advantage in performing movements such as jumps and quick reactions, such as smashes or rapid footwork to end a rally. The game is intermittent, consisting of short intense rallies followed by brief rest intervals, with the average rally duration around 7 seconds and rest time around 15 seconds (Laffaye, Phomsoupha, & Dor, 2015).

From a physiological aspect, badminton demands approximately 60–70% aerobic system contribution, with the rest coming from the anaerobic system, particularly the alactic anaerobic system due to the dominance of short explosive efforts (Phomsoupha & Laffaye, 2015). Heart rate during play often exceeds 90% of maximal heart rate, indicating a very high game intensity (Faude et al., 2007). A study by Green, West, and Willems (2023) also showed that in simulated singles games among junior male athletes, the average heart rate reached 151 ± 12 bpm (82 ± 10% HRmax), with oxygen consumption of 39.2 ± 3.9 $mL \cdot kg^{-1} \cdot min^{-1}$ (62 ± 7% VO_2max), and post-match blood lactate levels of 3.33 ± 0.83 $mmol \cdot L^{-1}$, indicating that although lower than adult players, the metabolic demands remain relatively high.

The characteristics of singles and doubles play are also different. Singles players cover the entire court, thus requiring endurance, full-court movement, and well-structured tactical planning. In contrast, doubles players tend to focus on fast-paced play with more explosive reactions and coordination with a partner (Hughes & Bartlett, 2002). These differences result in distinct physical and psychological demands. Furthermore, Liddle et al. (1996) found that singles players exhibited higher heart rate responses compared to doubles players, emphasizing the greater physical workload involved in full-court coverage

Badminton is a sport that demands a complex combination of technical skills, speed, strength, and cognitive abilities. One important aspect in badminton athlete performance is the whole body reaction time (WBRT), which refers to the time required by the entire body to respond to a stimulus. WBRT reflects the integration between visual perception, information processing, and motor response, all of which are crucial in fast-paced and dynamic game situations.

Therefore, players need to react quickly and be able to make decisions in a short period of time (Willegems et al., 2018). There are two ways to measure reaction time: through visual and auditory stimuli (Willegems et al., 2018). Visual reaction time refers to the duration required for an individual to respond to a visual stimulus (Saber & Kashef, 2008). In general, reaction time is one of the essential components in the game of badminton. Dane and Pratt (2009) stated that every sports activity is associated with visual reaction time. Thus, the reaction time component may play an important role in improving the performance of badminton athletes. Reaction time is defined as the interval between the presentation of a stimulus and the initiation of movement (Bańkosz, Winiarski, & Malagoli Lanzoni, 2020). This process involves the reception of stimuli by receptors, the transmission of information through nerves to the brain, and from the brain to the muscles to produce movement (Seth et al., 2018).

In the context of singles and doubles play, there are characteristic differences that may affect WBRT. Singles players are responsible for the entire court area, thus requiring broader movement and more structured strategies. In contrast, doubles players operate in coordination with a partner, focusing on rapid reactions to net play and hard drives from opponents. These differences raise the question of whether there is a significant difference in WBRT between singles and doubles players, particularly in the adolescent age group of 14–17 years who are undergoing rapid physical and cognitive development.

Previous studies have shown that visual and motor training can improve athletes’ reaction time. For example, a study by Sukmooncharen et al. (2022) showed that visual training can significantly improve body and hand reaction time in badminton players. Additionally, Yüksel (2018) found that national-level badminton players under the age of 15 demonstrated excellent visual and auditory reaction times, even surpassing the average of youth athletes from other sports.

However, although many studies have discussed reaction time in the context of sports, studies specifically comparing WBRT between singles and doubles players in the adolescent age group are still very limited. Yet, this information is essential for coaches to develop more specific training approaches tailored to the roles of players.

Based on this background, this study aims to compare the whole body reaction time between singles and doubles badminton players aged 14–17 years.

The results of this study are expected to contribute to the development of more targeted training programs based on playing positions, and to enrich the scientific literature in the field of sports science.

METHODS

Research Design

This study used a quantitative approach with a comparative design to compare whole body reaction time (WBRT) between singles and doubles badminton players aged 14–17 years. The study was conducted using a cross-sectional method, with data collection carried out in a single measurement session. The research was conducted on May 3–4, 2025, at Taqi Arena Badminton Academy, located in Ngamprah, West Bandung Regency. The location was chosen based on the availability of representative training facilities and the presence of active athletes in the targeted age group.

Population and Sample

The population in this study consisted of all active badminton athletes aged 14–17 years who train at Taqi Arena Badminton Academy, totaling 60 athletes. The subjects used in this study amounted to 37 athletes, consisting of 19 doubles players and 18 singles players. The sampling technique used was purposive sampling, with the following inclusion criteria: (1) aged 14–17 years, (2) not experiencing injury in the past month, (3) actively participating in training for at least the last 3 months, and (4) willing to participate in all measurement procedures.

Instruments and Data Collection Procedure

Prior to the WBRT test, anthropometric measurements including body weight, body fat percentage, and muscle mass, were recorded using the Omron Karada Scan HBF-375 to obtain body composition data that might influence reaction performance. Whole Body Reaction Time was measured using the Whole Body Reaction Measuring Equipment TKK-5408 (Takei, Japan). Athletes were asked to stand on a sensory mat in a ready position, and when the light stimulus appeared, they had to jump off the mat as quickly as possible. The device recorded the time between the stimulus and the foot leaving the mat as the whole body reaction time. Each athlete was given one trial for familiarization with the device and procedure. After familiarization, testing was conducted three times to ensure result consistency, and the average value of the three trials was used as the final result. Testing was conducted indoors with stable lighting and room temperature to minimize external variables that might affect the results, such as fatigue or environmental distractions. All participants were asked to refrain from heavy physical activity for at least 24 hours before the measurement session.

Data Analysis

The collected data were analyzed using an Independent Samples t-Test to compare the WBRT between singles and doubles players. Significance testing was conducted at a 95% confidence level ($p < 0.05$), using SPSS version 26 software.

RESULTS

This study involved 37 male badminton athletes consisting of 18 singles players and 19 doubles players. The characteristics of the research subjects are presented in Table 1.

Table 1. Anthropometric Data

	Singles	**Doubles**
n	18	19
Age (year)	15,1 ± 1,09 SD	15,26 ± 1,14 SD
Height (cm)	165,1 ± 4,87 SD	163,5 ± 7,5 SD
Body Mass (kg)	54,18 ± 6,44 SD	56,9 ± 8,8
% Body Fat	11,69 ± 1,57 SD	12,4 ± 2,9
% Muscle Mass	38,9 ± 0,6	38,9 ± 0,9

* *n : number of subject, SD = Standard deviation*

The normality test on subject characteristics, which includes age, height, weight, body fat percentage, and skeletal muscle mass, was conducted separately in each group (singles and doubles) using the Shapiro-Wilk test. This test aimed to ensure that the data were normally distributed so that the analysis could be performed fairly and not influenced by baseline differences between groups. The results are shown in the following table.

Table 2. Normality Test For Subject Characteristic

		Shapiro-Wilk			
	Category	**Statistic**	**df**	**Sig.**	**Results**
Age	Singles	0,848	18	0,008	Normal
	Doubles	0,845	19	0,006	Normal
Body height	Singles	0,959	18	0,575	Normal
	Doubles	0,974	19	0,857	Normal
Body weight	Singles	0,987	18	0,993	Normal
	Doubles	0,956	19	0,498	Normal
Body fat	Singles	0,932	18	0,212	Normal
	Doubles	0,971	19	0,802	Normal
Skeletal muscle mass	Singles	0,978	18	0,922	Normal
	Doubles	0,911	19	0,077	Normal

After confirming that the subject characteristics were normally distributed and balanced between groups, the normality test was continued on the main variable, namely whole body reaction time (WBRT).

The normality test was conducted separately for the singles and doubles groups using the Shapiro-Wilk test. The results are shown in the table below:

Table 3. Normality Test for WBRT

Variable	**Group**	**n**	**Mean ± SD**	**Shapiro Wik**		
				Statistic	**df**	**Sig.**
WBRT	Singles	18	0,286 ± 0,024	0,957	18	0,549
	Doubles	19	0,260 ± 0,021	0,923	19	0,131

** WBRT = whole body reaction time, df = degree of freedom*

The results of the normality test in both groups showed that the data were normally distributed ($p > 0.05$). Therefore, the analysis of the difference in WBRT between the singles and doubles groups was conducted using the Independent Samples T-Test, a suitable parametric statistical method. The test results are shown below:

Table 4. Independent Samples t-Test

	Levene’s test Sig.		**t-test for Equality of Means**		
	f	Sig	t	df	Sig. (2 tailed)
Equal variance assumed	0,751	0,392	3,368	35	0,002
Equal variance not assumed			3,356	33,920	0,002

** f = levene’s test statistic, t = t-test statistic, df = degree of freedom*

Based on the Independent Samples T-Test, the significance value obtained was 0.002 ($p < 0.05$), indicating a significant difference in WBRT between singles and doubles athletes. The statistics show that doubles players had better whole body reaction ability (WBRT) compared to singles players, with an average of 0.260 seconds.

DISCUSSION

The present study revealed a significant difference in whole body reaction time (WBRT) between singles and doubles badminton players aged 14–17 years. Doubles players demonstrated faster reaction times (0.260 ± 0.021 seconds) compared to singles players (0.286 ± 0.024 seconds), with an average difference of 0.026 seconds. These results suggest that the type of match event significantly influences an athlete’s reactive ability, likely due to distinct tactical demands and movement patterns associated with each discipline.

This difference can be attributed to the dynamic nature of doubles play, which typically involves shorter rallies, faster exchanges, and a higher need for synchronization with a partner. Cabello-Manrique and González-Badillo (2003) emphasized that doubles matches demand greater reaction speed due to the rapid rhythm of play. Supporting this, Singh and Bisht (2024) found that doubles players outperformed singles players in various reaction time measures, possibly due to the heightened frequency of fast-response scenarios in modern doubles games.

Alcock and Cable (2009) also highlighted the higher pace and attacking transitions in doubles matches, which require players to maintain continuous readiness. Over time, this may contribute to greater neuromuscular efficiency, as players adapt to the tempo and reactive demands of the game. From a physiological standpoint, these findings align with the theory of training specificity proposed by

Behm et al. (2010), which asserts that neuromuscular adaptations are shaped by the particular demands imposed during sport-specific training.

Importantly, reaction time in badminton is not merely a product of muscular output but heavily relies on perceptual and cognitive processing. Visual reaction time, in particular, plays a central role in responding to shuttlecock trajectory, opponent movement, and situational cues. Several studies have reported sport-specific perceptual-motor adaptations among badminton athletes. Dane, Hazar, and Tan (2008) suggested that participation in badminton training is associated with superior eye–hand visual reaction time and enhanced visuospatial intelligence. Similarly, Dube, Mungal, and Kulkarni (2015) found that badminton players have significantly shorter visual reaction times than sedentary individuals. These improvements highlight the role of repeated exposure to high-speed visual stimuli in sharpening visuomotor coordination. Neuroimaging research by Di et al. (2012) further supports this, demonstrating that professional badminton players exhibit neuroplastic changes in both brain structure and function, including increased gray matter density and altered resting-state connectivity in regions responsible for sensorimotor coordination, such as the cerebellum and motor cortex. These neurological adaptations may partially explain the superior WBRT observed in doubles players in this study.

Technological interventions also appear promising. Lu et al. (2022) showed that the use of a Visual Reaction Training System (VRTS) significantly improved athletes' footwork speed and visual response accuracy over a 6-week period. Their findings suggest that visual-motor coordination training, particularly using light-based stimuli, can enhance the cognitive-motor integration that underlies WBRT in badminton contexts (Kuo et al., 2022). Incorporating such training modalities into athlete development programs may offer targeted improvements in reaction ability—especially for doubles players who operate under higher perceptual and coordination demands.

Taken together, the results of this study emphasize the importance of designing training programs that consider the specific match demands of singles and doubles disciplines. Enhancing whole body reaction time should involve not only physical and technical drills but also perceptual-cognitive and neuromuscular training to support rapid visual processing, decision-making, and motor execution. Future research could further explore the neural mechanisms underpinning reaction time development in youth athletes and the efficacy of visual and neuromotor interventions across training cycles.

RESEARCH LIMITATION

This study has several limitations that should be acknowledged. First, the research sample was limited to athletes from a single badminton academy, which may restrict the generalizability of the findings to broader populations, such as national-level or regional athletes with different training environments and competitive exposures. Second, the study did not account for individual factors such as hand dominance or laterality, which could influence reaction performance. In addition, due to the cross-sectional design, the findings only describe the observed differences between singles and doubles players and cannot establish causal relationships. Future studies are recommended to include a more diverse sample, incorporate additional perceptual-motor variables, and adopt a longitudinal approach to better understand how training specialization influences reaction time development in badminton athletes.

CONCLUSION

This study concludes that there is a significant difference in whole body reaction time (WBRT) between singles and doubles badminton players aged 14–17 years. Doubles players demonstrated faster reaction times compared to singles players. This finding indicates that the type of match event influences athletes' overall reaction ability, which is likely due to the specific demands of doubles play that require quick responses to stimuli from both opponents and partners.

The results highlight that the tempo of doubles matches, characterized by faster rallies and the need for constant coordination, plays a key role in developing faster reaction times. In contrast, singles players focus more on court coverage and tactical planning, which may not demand the same level of reactive speed. These differences support the principle of specificity of training, which states that athletes' neuromuscular adaptations depend on the unique demands of their sport and training environment.

Therefore, this study emphasizes the importance of designing training programs that are tailored to the characteristics of each match event. Coaches should consider implementing more reaction-based training, particularly for doubles players, to optimize their performance.). This research also contributes to the growing body of knowledge in sports science and can serve as a reference for future studies exploring reaction ability in youth athletes.

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