Effect of light reaction agility training (LRAT) on agility performance of young male badminton players

Efecto del entrenamiento de agilidad de reacción ligera (LRAT) en el rendimiento de agilidad de jóvenes jugadores masculinos de bádminton

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Abstract

Introduction: The application of technology in sports is increasingly growing, including in badminton.
Objectives: This study aims to determine the effects of technology-based training called light reaction agility training (LRAT) in improving the physical performance of badminton players' agility.
Methodology: A quasi-experiment was employed in this study. The study involved 30 participants with the following criteria: active male undergraduate studies, aged 17-20 years, 9-12 years of training experience, normal body mass index, not injured, and voluntarily participated. To collect data, participants were divided into experimental (LRAT) and conventional groups, where each group underwent a training intervention for 6 weeks, 3 times a week. Then, an agility t-test was used to measure participants' agility. Additionally, Wilcoxon and Mann-Whitney tests were performed using the SPSS version 26.
Result: The Wilcoxon test results showed that both LRAT (Δ = -0.43 ± 0.17 sec) and conventional (Δ = -0.22 ± 0.12) groups were able to improve the agility of badminton players ($p<0.05$). However, the Mann-Whitney results showed that the LRAT group was significantly better than the conventional group ($p<0.05$).
Conclusions: It can be concluded that light reaction agility training (LRAT) can be used to improve the agility of badminton players.

Keywords

Badminton; light reaction agility training; physical performance; sports technology.

Resumen

Introducción: La aplicación de la tecnología en el deporte es cada vez mayor, incluido el bádminton.
Objetivo: Este estudio pretende determinar los efectos del entrenamiento basado en la tecnología denominado entrenamiento de agilidad de reacción ligera (LRAT) en la mejora del rendimiento físico de la agilidad de los jugadores de bádminton.
Metodología: En este estudio se utilizó un cuasiexperimento. Hubo 30 participantes en la investigación con los criterios de estudios universitarios masculinos activos, con edades comprendidas entre 17 y 20 años, 9-12 años de experiencia en entrenamiento, índice de masa corporal normal, no lesionados, y que participaron voluntariamente en el estudio. Los participantes se dividieron en grupos experimental (LRAT) y convencional, donde cada grupo se sometió a la intervención durante 6 semanas, 3 veces por semana de entrenamiento. Se utilizó la prueba T de agilidad como instrumento para medir la agilidad. Se utilizaron las pruebas de Wilcoxon y Mann-Whitney con la ayuda de SPSS versión 26.
Resultados: Los resultados del test de Wilcoxon mostraron que tanto el grupo LRAT (Δ = -0,43 ± 0,17 seg) como el convencional (Δ = -0,22 ± 0,12) fueron capaces de mejorar la agilidad de los jugadores de bádminton ($p<0,05$). Sin embargo, los resultados de Mann-Whitney mostraron que el grupo LRAT fue significativamente mejor que el grupo convencional ($p<0,05$).
Conclusiones: Se puede concluir que el entrenamiento de agilidad de reacción ligera (LRAT) se puede utilizar para mejorar la agilidad de los jugadores de bádminton.

Palabras clave

Bádminton; entrenamiento de agilidad de reacción ligera; rendimiento físico; tecnología deportiva.

Introduction

Badminton is one of the most popular sports in the world (Labib Siena Ar Rasyid et al., 2023; Phomsoupha & Laffaye, 2020). In international tournaments, the recorded shuttlecock speeds reach 417 km/h in singles and 426 km/h in doubles matches (Kuo et al., 2022). This proves that badminton is an integrated, fast-paced sport where athletes must have agility and speed with the right strategy (Kuo et al., 2022). Fast movements are the basis for badminton players because players who can make fast movements tend to dominate in tournaments (Andrašić et al., 2021).

When playing badminton, the players should be able to maintain their positions in the middle in order to control the defensive area. With the right steps, lunges, and foot movements to receive the shuttlecock, the players must return it as soon as possible for each attack and defense. This characteristic is often referred to as agility, the ability to change body direction quickly and react to stimuli that were not previously planned (Binishi & Skenderi, 2024). According to Redwood-Brown et al. (2019), speed and agility enable athletes to receive and provide effective attacks as well as make a counterattack during the game. Meanwhile, Young et al. (2015) argued that agility makes it easier for athletes to change direction in attacking or defending.

Agility combines physical qualities and cognitive skills. Physically, individuals' speed and agility depend on muscle strength, explosiveness, and core muscle strength (Kuntze et al., 2010). Cognitively, an athlete must be able to make quick decisions and have time to react. Agility's significance in badminton highlights the constant need for athletes to refine their performance. In this context, technological advancements have emerged as valuable tools to enhance training methods and optimize athletic capabilities.

Advancements in technology have increasingly influenced sports training, including badminton. Innovations, such as automatic tracking sensors, video analysis, and smart bands, are effectively used to encourage people to exercise regularly, and this is an integration of sports technology (Amir as'ari et al., 2020; Polo-Peña et al., 2020). Further, previous research combined technology with exercise programs, and the discovery created an application connected to a cellphone (Chiu et al., 2020). This proves that technology-based sports training is applicable among athletes (Anand et al., 2017). Recent research revealed that China was the country that contributed 17 discoveries related to sports technology, and England was the most influential country, with 474 citations (Simbolon et al., 2023).

Specific to badminton, technology has been used to improve agility and train footwork. For example, Kusuma and Aminullah (2019) have used a remote control to monitor the athlete's agility in the intended direction without planning it. Meanwhile, Fang and Sun (2021) used video to accurately and robustly extract human movements in badminton players. Similarly, smart sensors and badminton have been employed to recognize changes in emotions while a person is playing badminton (Chang et al., 2022). Several researchers found out about the application of technology-based training in badminton (González-Peño et al., 2024; Han & Wang, 2024; Rusdiawan et al., 2023). A blibliometric literature study exploring research trends over the past three decades in badminton indicates that the use of technologu in the sport has become increasingly prevalent, both in training processes and in the analysis of athletes' gameplay (Ardha et al., 2024). Many studies have used light sensors to help the shadow training process to improve badminton footwork. However, recent tools, like the Light Reaction Agility Time (LRAT), have introduced innovative features, such as automatic and manual menus. It has training interval/speed settings according to the athlete's movement ability. Additionally, there are training duration settings, eight directions of shadow points, and power batteries. Therefore, this study aims to determine the impact of this tool, LART, on badminton performance among male college athletes.

Method

Participants

This study used a quasi-experimental design under the lens of a quantitative approach. The participants were male college athletes who were still active in badminton. They were selected using a purposive sampling technique with the following criteria: men actively pursuing undergraduate studies, 17-20

years old, 9 – 12 years of training experience, normal body mass index, no injuries, and voluntarily participating in the research. A total of 30 male collegiate badminton athletes were recruited and participated in this study. These participants were randomly divided into two groups, with 15 men in the conventional group (C) and the rest in the LRAT group. The process of dividing research participants into two different groups was carried out by simple randomization.

This research was approved by the Sport & Exercise Research Center (SERC) of Surabaya State University with letter number 129197/UN38.III.3/TU.00.00/2024.

Procedure

In the first week, participants carried out a pre-test using a T-Test. This test aimed to collect data before treatment so that we could make a comparison before and after. When the program ended, a pre-test was carried out. In this study, both the LRAT and the Conventional groups conducted the test. Every two weeks, 1 set of increases was achieved. This exercise is done 3 times a week on Monday, Wednesday, and Friday.

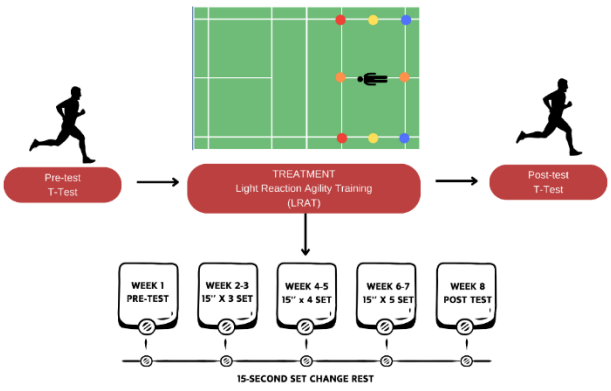
In the second and third weeks, participants carried out an exercise program using automatic mode with repetitions of 15 seconds, followed by recovery for 1 minute. In the second week, the first meeting started with 3 sets. In the fourth and fifth weeks, the sets increased to 4, but the duration remained 15 seconds. Weeks six to seven continued to increase to 5 sets to improve a person's ability to respond and adapt quickly to changes in situations or orders with a gradual training program.

The eighth week was the final stage. This week, participants conducted a post-test using a fixed instrument, the T-Test. In this final stage, data will be produced to compare with previous results in the first stage or pre-test.

Table 1. LRAT Group Training Program

Meeting		Set	Duration	Rest/Set	Type of Activity
Week 1			Pre-Test (T-Test)		
Week 2	Monday	3	15 seconds work/15 seconds rest	1 minute	Auto Mode
	Wednesday	3			
	Friday	3			
Week 3	Monday	3			
	Wednesday	3			
	Friday	3			
Week 4	Monday	4			
	Wednesday	4			
	Friday	4			
Week 5	Monday	4			
	Wednesday	4			
	Friday	4			
Week 6	Monday	5			
	Wednesday	5			
	Friday	5			
Week 7	Monday	5			
	Wednesday	5			
	Friday	5			
Week 8			Post-Test (T-Test)		

Figure 1. Research Flow



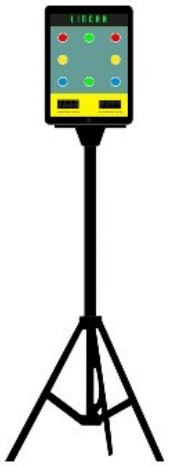
Research instrument

An agility T-Test instrument was employed to determine the physical components of badminton players' agility. The test was administered to the two groups, beginning with a pre-test before implementing the exercise intervention. After the pre-test, all participants were divided into two groups (LRAT and C) with equal numbers. Each group underwent exercise intervention with a frequency of 3 times a week for 6 weeks. After 6 weeks of training to implement the intervention, all participants took a post-test.

As mentioned earlier, participants in the LRAT group (experimental group) received an intervention during the training. They used the LINCAH application tool, a technology-based training program with the participant's starting position in the middle of the field. They have to move towards 8 points adjusted by the tool for 15 seconds. The LINCAH application has also been developed to monitor the heart rate monitor installed on the participant's arm.

The training tools used in this study have been validated by three experts (expert judgement), consisting of: 1) a badminton physical condition analysis expert; 2) a sports technology lecturer; and 3) a BWF Level 1 certified badminton coach with more than 10 years of training experience.

Figure 2. LINCAH tool used in the LRAT group



Data analysis

The data in this study was analyzed using descriptive statistical analysis (mean and standard deviation) and non-parametric statistical tests, including the Wilcoxon test and the Mann-Whitney test. Non-parametric statistical tests were used because the normality test showed that the research data was not normally distributed (p-value <0.05). The Microsoft Excel 2016 and SPSS version 25 applications were used by researchers to assist in the data analysis process. Because non-parametric statistics are used in this study, the effect size formula (r) will be used.

Results

The results of the descriptive statistical tests are presented, focusing on the characteristics of the 30 participants and the dependent variables.

Table 2. Research Descriptive Statistical Test Results

Variable	Mean ± SD	
	LRAT Group (n = 15)	Conventional Group (n = 15)
Participant Characteristics:		
Height (cm)	165.73 ± 3.94	167.8 ± 4.09
Body Weight (Kg)	58.53 ± 4.31	59.47 ± 5.74
Body Mass Index (Kg/m2)	21.30 ± 1.28	21.07 ± 1.21
Age (Years)	18.67 ± 1.11	18.73 ± 1.22
Length of Practice Badminton (Years)	10.53 ± 1.25	10.07 ± 1.22
Dependent variable:		
Pre-test agility (seconds)	11.0 ± 0.14	11.3 ± 0.17
Agility post-test (seconds)	10.6 ± 0.08	11.1 ± 0.11
Δ (post-pre) agility (seconds)	-0.43 ± 0.17	-0.22 ± 0.12

Note: SD = Standard deviation; Δ = post test – pre test.

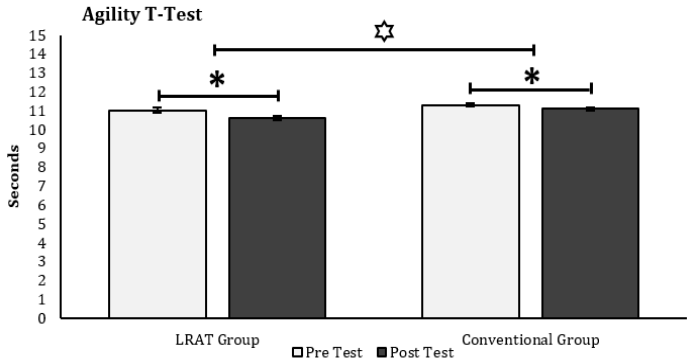
To analyze the results more comprehensively, the Wilcoxon test was conducted to evaluate the difference in mean values between the pre-test and post-test in each group. Additionally, the Mann-Whitney test was performed to see the differences in changes between the LRAT and Conventional groups. The results of both tests are presented in Table 3 and Figure 3.

Table 3. Wilcoxon and Mann-Whitney test results

Group	Wilcoxon		Mann-Whitney	
	p-value	ES	p-value	ES
LRAT	0.001*	0.625	0.002✡	0.553
Conventional	0.001*	0.605		

Note: *=p-value<0.05 means there is a significant difference between the pre-test and post-test, while ✡=p-value<0.05 means a significant difference between the LRAT and Conventional. ES=Effect Size (r).

Figure 3. Graph of Differences Between LRAT and Conventional Groups.



Note: *=p-value<0.05 means there is a significant difference between the pre-test and post-test; ✡=p-value<0.05 means a significant difference between the LRAT and Conventional.

Wilcoxon test results showed that there was a significant difference between the pre-test and post-test ($p<0.05$). Similarly, Mann-Whitney test results showed a significant difference between the LRAT and Conventional groups in increasing agility ($p<0.05$).

Discussion

This research aims to determine the effect of technology-based training called Light Reaction Agility Training in increasing the agility of badminton athletes. The results revealed that LRAT can improve the agility of badminton athletes ($p<0.05$) and is significantly better than the conventional group ($p<0.05$). Basically, this exercise movement is like shadowing but uses reaction light technology as a basis. Shadow is a famous badminton training technique that mimics real game movements without using a shuttlecock, thereby improving foot movement skills to make it easier for badminton players to hit the shuttlecock (Ishak et al., 2020; Rahman et al., 2020).

The results are in line with the research by Pratama et al. (2024). They found that shadow training with reaction lights could significantly improve the physical components of badminton players' agility compared to shadow training via manual guidance from a trainer. Other research also discovered similar findings, in which application-based shadow training is significantly superior in improving the agility of badminton players compared to conventional shadow groups (Ihsan et al., 2024). Shadow training, in general, has many benefits, including improving the physical performance of badminton players (Yüksel & Aydos, 2017).

This research supports the broader application of technology in sports training. Technological integration in the coaching process offers valuable tools for the training process to help both coaches and athletes (Budijono et al., 2024). Evidence from physical education (PE) research further enhances the benefit of integrating technology in badminton training. Studies demonstrated that the application of technology in PE in the form of technology-based learning (TBL) can improve specific badminton motor

skills, such as smash and clear technical skills (González-Peño et al., 2023; Lin et al., 2023). This highlights the potential of technology to improve both training and educational contexts within the sport.

However, this study has several limitations. First, the sample size was relatively small, limiting the generalizability of the findings. Additionally, agility was the only dependent variable measured, leaving out other critical physical components. This study also did not differentiate between single and double players. Therefore, future research should address these limitations by involving a larger number of participants of various ages and adding physical components other than agility as the dependent variable. Finally, future research is recommended to compare the results of the effects obtained from LRAT training between singles players and badminton doubles players.

Conclusions

It can be concluded that technology-based training called Light Reaction Agility Training can be used as a tool to improve the physical components of agility in badminton athletes. These findings can be used as recommendations for coaches to provide the latest variations that can be applied to badminton player training programs.

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