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The Effect of Ladder Drill Training on Speed and Agility Improvement in Junior Badminton Athletes Aged 11-14 Years

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ABSTRACT (English)

Background: This study aims to determine the effect of ladder drill training on improving speed and agility in badminton athletes aged 11-14 years. This age is considered the golden period of motor development, so training intervention at this age is expected to provide optimal results. **Research Objectives**: To determine the effect of ladder drill training on improving speed and agility in badminton athletes aged 11-14 years. **Methods**: The research method used was a quasi-experiment with a pre-test and post-test control design. The sample consisted of 30 junior athletes (12 males, 18 females) with an average age of 12.6 ± 1.1 years from a badminton club. Participants were randomly divided into an Experimental Group (LDT, n=15) who received 20 minutes of ladder drill training, 3 times a week for 8 weeks, and a Control Group (CG, n=15) who only underwent regular training. Speed was measured using a 20-meter sprint test, while agility was measured using a T-test. Data analysis used Paired t-tests and Independent t-tests with a significance level of $p < 0.05$. **Result**: The Experimental Group experienced a significant increase in speed with an average time reduction of 0.28 seconds (p=0.001) and agility with an average time reduction of 0.72 seconds (p=0.000). The Control Group did not show significant changes ($p > 0.05$). **Conclusion**: Ladder drills are very effective in improving speed and agility in badminton players aged 11-14 years.

Keywords: Ladder Drill, Speed, Agility, Badminton, Junior Athletes

ABSTRAK (Bahasa Indonesia)

Latar Belakang: Penelitian ini bertujuan untuk mengetahui pengaruh latihan ladder drill terhadap peningkatan kecepatan dan kelincahan pada atlet bulutangkis usia 11-14 tahun. Usia tersebut merupakan periode emas perkembangan motorik, sehingga intervensi latihan pada usia ini diharapkan dapat memberikan hasil optimal. **Tujuan Penelitian**: Mengetahui pengaruh latihan ladder drill pada peningkatan kecepatan dan kelincahan atlet bulutangkis usia 11-14 tahun. **Metode**: Metode penelitian yang digunakan adalah quasi-eksperimen dengan desain pre-test dan post-test kontrol. Sampel terdiri dari 30 atlet junior (12 laki-laki, 18 perempuan) dengan rata-rata usia 12,6 ± 1,1 tahun dari sebuah klub bulutangkis. Peserta dibagi secara acak menjadi Kelompok Eksperimen (LDT, n=15) yang menerima latihan ladder drill 20 menit, 3 kali seminggu selama 8 minggu, dan Kelompok Kontrol (KK, n=15) yang hanya menjalani latihan reguler.

Kecepatan diukur menggunakan tes sprint 20 meter, sedangkan kelincahan diukur dengan T-Test. Analisis data menggunakan Paired t-test dan Independent t-test dengan tingkat signifikansi $p < 0,05$. **Hasil**: Kelompok Eksperimen mengalami peningkatan signifikan pada kecepatan dengan penurunan waktu rata-rata 0,28 detik (p=0,001) dan kelincahan dengan penurunan waktu rata-rata 0,72 detik (p=0,000). Kelompok Kontrol tidak menunjukkan perubahan signifikan ($p > 0,05$). **Kesimpulan**: Latihan ladder drill sangat efektif dalam meningkatkan kecepatan dan kelincahan pada atlet bulutangkis usia 11-14 tahun.

Kata kunci: *Ladder Drill*, Kecepatan, Kelincahan, Bulutangkis, Atlet Junior.

INTRODUCTION

Badminton has evolved into a very fast and dynamic sport (Phomsoupha & Laffaye, 2015). To achieve peak performance, athletes need not only technical and tactical skills, but also a strong physical foundation (Sampayo-Cordero et al., 2020). The two most dominant physical components in badminton are speed and agility (Liu & He, 2025). Speed is needed to accelerate quickly to chase the shuttlecock at the net or run backwards for a smash. Agility is defined as the ability to change body direction quickly and efficiently (Sekulic et al., 2017), which is crucial when transitioning from a defensive to an offensive position or vice versa.

Badminton athlete training should ideally begin at an early age. The 11-14 age group (early adolescence) is considered a "window of opportunity" or sensitive period for the development of motor skills and coordination (Lloyd & Oliver, 2012). Physical training interventions at this age can provide optimal neuromuscular adaptation, which will form the foundation for future physical development (Guven et al., 2017). However, physical training for this age group must be carefully designed, focusing on coordination, movement technique, and injury prevention, rather than just pure strength (Faigenbaum et al., 2016).

One popular training method for improving footwork, coordination, and movement speed is the ladder drill (Batool et al., 2022). Ladder drills are a form of low-intensity plyometric training that emphasizes fast, rhythmic, and precise stepping patterns (Lee et al., 2024). This exercise can theoretically improve neuromuscular efficiency, shorten ground contact time, and increase step frequency, all of which are important predictors of speed and agility (Young et al., 2015).

Empirical research testing its effectiveness in novice badminton players is still limited, especially that focusing on the 11–14 age group who are in the peak height velocity (PHV) phase, where their neural adaptation characteristics to agility training differ fundamentally from those of the adult population (Ozmen & Aydogmus, 2017). Many studies focus on other sports such as soccer or basketball (Phomsoupha & Laffaye, 2015), or on adult badminton athletes. Therefore, this study aims to fill this gap by experimentally testing the effect of an 8-week ladder drill training program on speed and agility in badminton athletes aged 11-14 years.

METHOD

Design

This study used a quasi-experimental design with a pre-test post-test control group. This design was chosen to compare the effectiveness of the intervention in two equivalent groups.

Participants

The research population consisted of all athletes in the "PB Trisula Surabaya Badminton School" badminton club in the U-15 age group. Using purposive sampling, the sample was selected based on the following criteria: aged 11-14 years, having practiced badminton for at least 2 years, being physically and mentally healthy, and willing to participate in the research program for 8 weeks. A total of 30 athletes (12 males and 18 females) met these criteria. The sample was then randomly divided into two groups: the Experimental Group (LDT) with 15 athletes (mean age 12.5 ± 1.2 years) and the Control Group (CG) with 15 athletes (mean age 12.7 ± 1.0 years).

Instruments and data measurements

Speed was measured using a 20-meter sprint test, where athletes sprinted from a standing position to the 20-meter finish line at maximum effort. The times were recorded using timing gates (SmartSpeed, Fusion Sport) with accuracy to the nearest thousandth of a second. Agility was assessed using the T-Test, which evaluates the athlete's ability to move forward, sideways (right-left), and backward following a "T" pattern. Timing was recorded with a stopwatch by two testers, demonstrating high inter-tester reliability (r = 0.98).

Intervention Procedure

The study was conducted over 8 weeks with a frequency of 3 times per week. The Experimental Group (LDT) participated in regular badminton training consisting of techniques and tactics for 90 minutes, plus a 20-minute ladder drill program before the main training session. The ladder drill program included variations such as single-leg hops, icky shuffle, lateral in-out, and Ali shuffle, with an increase in intensity and complexity every 2 weeks. Regarding load increase, this study applied continuous stair climbing for 20 minutes per session, 3 times a week for 8 weeks. Every 2 weeks, the intensity and complexity of the stair climbing variations were increased. This article did not mention adjustments to rest periods or the use of a metronome to increase step frequency, but focused on increasing the complexity of the exercise. Meanwhile, the Control Group (CG) only participated in regular badminton training for 90 minutes, accompanied by a standard dynamic warm-up for 20 minutes without ladder drills. All athletes from both groups underwent a pre-test in week 0 and a post-test after week 8 using a 20-meter sprint test and T-Test.

Table 1. Exercise Program

Weeks	Types of Ladder Movements	Set x Repetitions	Work:Rest Ratio
1-2	*1-In, 2-In, Lateral Shuffle*	3 x 3 rep	1 : 3
3-4	*Icky Shuffle, In-Out, Hop Scotch*	4 x 4 rep	1 : 3
5-6	*Carioca, Snake Jump, icky Shuffle Backwards*	4 x 5 rep	1 : 2
7-8	*Kombinasi semua gerakan + Sprint out 5m*	5 x 5 rep	1 : 2

The ladder drill program (8 weeks, 3 times a week, 20 minutes per session) is designed progressively. It starts with low volume (3 sets x 3 repetitions) and a long rest ratio (1:3) in Weeks 1–2 to master the technique. Gradual intensity increases are implemented by raising the volume to 4x4 and 4x5 repetitions in Weeks 3–6, while reducing the rest ratio to 1:2 (Weeks 5–8). The peak phase (Weeks 7–8) uses the highest volume (5 sets x 5 repetitions) and combines all the movements learned, ending with a 5m Sprint out to train complexity and reaction.

Data analysis

The data were analyzed using SPSS version 26. Descriptive statistics in the form of means and standard deviations were used to describe the data. Normality (Shapiro-Wilk) and homogeneity (Levene's Test) tests were also performed. To test the hypothesis, a Paired t-test was used to compare the differences in pre-test and post-test scores in each group (LDT and CG), and an Independent t-test was used to compare the improvement scores (the difference between the post-test and pre-test) between LDT and CG. The significance level was set at $p < 0.05$.

RESULTS

The Levene test results show that the pre-test data variance for both groups is homogeneous (Speed: p=0.812; Agility: p=0.755). The results of the independent t-test on the pre-test data also showed no significant initial differences between LDT and CG (Speed: p=0.904; Agility: p=0.941), indicating that the two groups were equivalent before the intervention.

Table 2. Descriptive Data of Pre-Test and Post-Test Results for Speed and Agility

Variabels	Groups	N	Test	Mean	SD	Min	Max
Speed (s)	Experimental	15	Pre-Test	3.48	0.16	3.21	3.75
			Post-Test	3.21	0.14	2.98	3.45
	Control	15	Pre-Test	3.49	0.17	3.24	3.77
			Post-Test	3.47	0.16	3.22	3.74
Agility (s)	Experimental	15	Pre-Test	11.54	0.33	11.05	12.01
			Post-Test	10.78	0.29	10.30	11.25
	Control	15	Pre-Test	11.56	0.35	11.01	12.04
			Post Test	11.51	0.34	10.98	11.99

Note: A decrease in 'Mean' (time) indicates an improvement in performance.

The results of descriptive statistical analysis (Table 2) show that the Experimental Group (LDT) experienced a clear decrease in average travel time on the post-test for both variables. The average speed of the LDT improved (decreased) by 0.27 seconds, and agility improved by 0.76 seconds. In contrast, the Control Group (CG) showed only minimal changes (an improvement of 0.02 seconds for speed and 0.05 seconds for agility).

Table 3. Paired t-test Results Hypothesis Test

Analysis	Variables	Groups	Mean ± SD (Pre)	Mean ± SD (Post)	p-value (Paired)
In Groups	Speed (s)	LDT(n=15)	3,48 ± 0,16	3,21 ± 0,14	**< 0.001***
		CG(n=15)	3,49 ± 0,17	3,47 ± 0,16	0,188
	Agility (s)	LDT(n=15)	11,54 ± 0,33	10,78 ± 0,29	**< 0.001***
		CG(n=15)	11,56 ± 0,35	11,51 ± 0,34	0,094

**Significant at p < 0.05*

The results of the paired t-test (Table 3, Upper section) confirm that the changes in LDT are highly significant ($p < 0.001$) for speed and agility. The changes in CG are not statistically significant ($p > 0.05$).

Table 4. Independent t-test Results Hypothesis Test

	Variables	Gain Score EC (Mean ± SD)	Gain Score CG (Mean ± SD)	p-value (Independent)
(Gain Score)	Speed (s)	-0,27 ± 0,09	-0,02 ± 0,07	**< 0.001***
	Agility (s)	-0,76 ± 0,15	-0,05 ± 0,11	**< 0.001***

**Significant at p < 0.05*

The results of the independent t-test on the gain score (Table 3, bottom section) show that the magnitude of the increase (decrease in time) in LDT is significantly greater than the minimal increase that occurred in CG ($p < 0.001$).

DISCUSSION

The results of this study clearly show that an 8-week ladder drill training program, administered 3 times a week, has a significant effect on improving speed and agility in badminton athletes aged 11-14 years.

Significant improvements in the Experimental Group (LDT) are consistent with findings in the SAQ (Speed, Agility, Quickness) literature. Ladder drills directly target improvements in neuromuscular efficiency (Ravi & Divya, 2024). The rapid and repetitive stepping patterns in ladder drills train the nervous system to increase the firing rate of motor units and improve the synchronization between muscles involved in movement (Afonso et al., 2020). This results in faster and more coordinated foot movements, which manifest as improvements in speed (20m sprint) and agility (T-Test) (Ga Rahman et al., 2023).

The improvement in agility (a reduction of 0.76 seconds) appears to be more substantial than that in speed (a reduction of 0.27 seconds). This can be explained by the fact that the T-Test involves lateral (sideways) changes of direction and transitions from running forward to backward (Ramdhani et al., 2023). The lateral shuffle and in-out patterns in the ladder drill specifically train the mechanisms of deceleration (braking) and re-acceleration in a new direction, which are at the core of agility (Lee et al., 2024). This is particularly relevant for badminton, which is dominated by multi-directional movements on the court (Phomsoupha & Laffaye, 2015).

The finding that the Control Group (CG) did not experience a significant improvement ($p > 0.05$) despite regular training is an important point (Septyani et al., 2024). This indicates that standard badminton technique training alone may not provide sufficient stimulus to maximize neuromuscular adaptation related to speed and agility in this age group (Gandala Putra et al., 2023). Incorporating structured ladder drills alongside traditional training could enhance the overall effectiveness of physical conditioning for junior badminton players (Gunawan & Hidayah, 2025). Incorporating these drills allows for targeted improvement in agility and speed, crucial for enhancing performance on the badminton court (Kusuma et al., 2025). Additional structured and specific physical training, such as ladder drills, is needed to complement technical training (Oktanansa et al., 2022).

These findings also support the importance of intervention in the 11-14 age group. According to the Youth Physical Development (YPD) model, this phase is a "window of opportunity" for the development of speed and agility because the nervous system is still highly plastic (Lloyd & Oliver, 2012).

This study has limitations. The sample size (N=30) is relatively small and only comes from one club, so the results need to be generalized with caution. In addition, this study does not control for the biological maturity status (e.g., Peak Height Velocity/PHV) of individuals, which can affect the response to training in this age range.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that ladder drill training has a significant effect on increasing speed, as measured by a 20m sprint, and increasing agility, as measured by a T-test, in badminton athletes aged 11-14 years. An 8-week training program with a frequency of 3 times a week and a duration of 20 minutes per session has been proven effective as a supplementary training method to improve the basic physical quality of junior athletes. Therefore, ladder drills are highly recommended for badminton coaches as part of a junior athlete physical training program to significantly improve their performance.

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CONFLICT OF INTEREST

Conflict of interest in this study states that the author or researcher has no conflicting interests that could influence the results of the study. In other words, there are no personal, financial, or other interests that could affect the objectivity and integrity of this study. This statement indicates that the study was conducted independently and without external pressure that could influence the results and interpretation of the data.

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