



The Effect of Ladder Drill and Zigzag Run Training on the Agility of Taekwondo Athletes Aged 8- 12 Years

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ABSTRACTS

Purpose	The study aims to determine the effect of Ladder drill and Zigzag run training on the agility of taekwondo in aged 8-12 years White Tiger Club Mojokerto and to compare the effectiveness of the two methods.
Materials and Methods	The study uses a two-group pre-test post-test design with an experimental approach, conducted at the White Tiger Club Mojokerto for 18 meetings. The research subject was all 10 Taekwondo in aged 8-12 years (total sampling), divided using the matched subject ordinal pairing technique into group A: Ladder drill (n=5) and group B: Zigzag run (n=5). The data collection instrument used the Agility T-test. Data analysis included the Shapiro-Wilk normality test, Levene's Test homogeneity test, Paired Sample T-test, Paired Sample Effect Size (Cohen's d), and Independent Sample T-test.
Result	The results showed that Zigzag run training had a significant effect on increasing agility ($p=0,049$; Cohen's $d=1,254$). Ladder drill training showed positive changes but was not statistically significant ($p=0,069$; Cohen's $d=1,102$). There was no significant difference between the two groups in the post-test ($p=0,326$).
Conclusion	It was concluded that Zig-zag run was more effective in improving the agility of taekwondo in aged 8-12 years because of its relevance to the kyorugi movement pattern.
Keywords	Ladder drill; Zigzag run; Agility; Taekwondo.

INTRODUCTION

In the sport of Taekwondo, athletes are required to move quickly, turn nimbly, and kick with precision, so speed is fundamental to performance. Agility is important because it helps athletes respond to their opponents' attacks and restructure their body position effectively. Agility is strongly correlated with kicking and reaction performance in Taekwondo (Ali & Pahlawi, 2025). In Taekwondo competitions, which require rapid changes of direction and instant responses to opponent attacks, certain physical abilities are crucial for athletes to quickly adjust their body position while maintaining stability when kicking or dodging. Improving agility helps athletes minimize movement delays and accelerate decision-making during a duel. The effectiveness of this

ability is reinforced by research (Malasari, 2019) showing that shuttle run and zigzag run training can significantly improve the agility of Taekwondo athletes.

Given the importance of agility in Taekwondo performance, this ability does not emerge spontaneously but is influenced by coordination, flexibility, balance, and training patterns that require rapid changes of direction. Ladder drill training is a coordinative method designed to train foot speed, body control, and the ability to change direction quickly, so it is conceptually closely related to improving agility. This is in line with the research results, which state that ladder drill training combined with plyometrics can improve change of direction performance (Bassa et al., 2024). Agility and plyometric training can improve athletes' neuromuscular reaction (Zouhal et al., 2019). According to Gunawan and Hidayah (2025) research, it shows that use of ladder drill variations can improve the agility of taekwondo athletes' steps, confirming its relevance to competitive needs. Thus, ladder drill has a direct contribution to improving the physical components required in taekwondo. According to Arifin et al. (2020) research, the zig-zag run training method can improve agility because it provides a dominant stimulus for the ability to change direction, short acceleration, and body control during fast movements, thus playing a crucial role in improving agility. This exercise requires athletes to respond to sharp turns continuously, which results in increased acceleration capacity and explosive movement efficiency.

Despite the growing body of literature on agility training in sport science, there remains limited comparative evidence specifically examining the differential effects of ladder drill and zigzag run training within youth taekwondo populations. Most existing studies have investigated these training methods either in isolation, in adult athletes, or across general sport settings that do not reflect the technical and physical demands unique to taekwondo competition. Furthermore, research focusing on the 8-12 age group, a critical window for fundamental motor skill development, is particularly scarce, leaving practitioners without sufficient empirical guidance to determine which training approach yields superior agility gains for young taekwondo practitioners. This gap in the literature underscores the need for a direct comparative study that evaluates both methods under consistent conditions, using a taekwondo-specific population, to produce findings that are practically applicable to youth coaching programs.

This research is very important to provide an objective picture of physical condition, particularly related to agility. The results are expected to help coaches develop more targeted interventions tailored to field needs. This research serves as a starting point for continuous improvement of the coaching system. Therefore, this study provides strong support for improving the performance of Taekwondo athletes aged 8-12 years. Ladder drill can improve body coordination precisely (Singha et al., 2024). Athletes with good agility can maximize performance (Pramono et al., 2023). Ladder drill and zigzag run training programs can train athletes' motoric skills when performing rapid movements. This form of training can improve athletes' physical abilities, especially in the 8-12 age group. This is currently in the development and formation stage of technical principles. The use of evidence-based training models such as the ladder drill and zigzag run needs to be tested locally to provide coaches with appropriate guidance in improving the quality of coaching (Zulkarnain et al., 2021). This study aims to analyze the effect of ladder drill and zigzag run training on the agility of 8-12 year old taekwondo athletes from the White Tiger Club, so that it can provide an effective training program for the development of athletes in the future.

METHODS

Study Participants

The sampling technique used in this study is total sampling, which is sampling by taking all members of the population as research samples. The criteria are 10 Taekwondo athletes, then using the MSOP (Matched Subject Ordinal Pairing) technique so that 5 people are in Group A (Ladder drill) and 5 people are in Group B (Zigzag run). Matching was performed by considering the athletes' initial agility levels to ensure that each group had relatively equivalent characteristics before treatment was administered. After the matching process was completed, subjects were randomly assigned to the ladder drill group and the zigzag run group, so that each athlete had an equal chance of being placed in either treatment group. This procedure was implemented to minimize research bias, maintain group homogeneity, and increase the internal validity of the study. The inclusion criteria in this study were taekwondo in aged 8-12 years, actively participate Training Center at the White Tiger Club Mojokerto, willing to follow the entire series of training programs and agility measurement tests during the research, and not currently experiencing any physical injury or medical condition that could hinder the implementation of the exercise at the time the study began. The exclusion criteria for this study were taekwondo practitioners who experience injuries or health problems during the intervention period so that they cannot continue the training program, taekwondo practitioners who are absent without a justifiable reason, and taekwondo practitioners who are not willing to follow the pre-test procedure and the post-test that has been determined.

Study Organization

The research design used in this study is a Two-Group Pre-test Post-test Design, namely an experiment involving two groups to be treated with different training methods to compare two training methods (ladder drill and zig-zag run) (Kohan et al., 2024). The variables were selected based on the research objectives and the characteristics of the physical abilities to be improved. The independent variables, namely ladder drill and zigzag run, were chosen because both training methods emphasize foot speed, body coordination, balance, and rapid changes of direction, which are directly related to improving athlete agility. Meanwhile, the dependent variable, namely athlete agility, is one of the main components of physical fitness required in various sports. The suitability of these variables is based on the theoretical relationship between training methods and the resulting improvement in agility performance. The research procedures used were, firstly, conducting a pre-test with an agility T-test; secondly, using the MSOP technique; thirdly, group A trained using the ladder drill method and group B trained using a zigzag run; and finally, conducting a post-test using an agility T-test.

Statistical Analysis

This study uses data analysis in stages starting from Descriptive Statistical Test are used to summarize data sets in a clear and understandable manner, Normality Test is conducted to ensure that the data obtained come from a normally distributed population, to meet the necessary assumptions required in parametric statistical analysis (Mishra et al., 2019), Homogeneity Test are often used to ensure that the samples being tested have a uniform composition, which underlies the analysis of precision and accuracy (Revilla-León et al., 2026), Paired Sample T-test is a parametric statistical analysis technique used to determine the average of two measurements that are related before and after (Xu et al., 2017), Paired Sample Effect Size (Cohen's d) is used to determine the

magnitude of effect which indicates how much change or difference occurs (Brydges, 2019), Independent Sample T-test is a statistical test that aims to compare the average of two unpaired groups and related or can be interpreted as two different sample subjects (Xu et al., 2017).

Training Program

Ladder drills can hone footwork efficiency, balance, stability, and mobility (Prakash et al., 2021). Zig-zag runs are designed to train the body's ability to accelerate, decelerate, and transition efficiently (Arifin et al., 2020). The following is a training program designed to improve the agility of Taekwondo athletes aged 8-12 years at the White Tiger Club Mojokerto.

Table 1. Ladder Drill Training Program

Week	Meeting	Exercise Items	Exercise Dosage
1-2	1-3		6 reps x 3 sets on one exercise item rest between sets 2 minutes intensity: moderate-high
	4-6		8 reps x 3 sets on one exercise item rest between sets 2 minutes intensity: moderate-high
3-4	7-9	1. Single step 2. Lateral shuffle	8 reps x 4 sets on one exercise item rest between sets 2 minutes intensity: moderate-high
	10-12	3. Icky shuffle 4. Single step backwards 5. Ladder T-drill	12 reps x 2 sets on one exercise item rest between sets 2 minutes intensity: moderate-high
5-6	13-15		10 reps x 3 sets on one exercise item rest between sets 2 minutes intensity: moderate-high
	16-18		12 reps x 3 sets on one exercise item rest between sets 2 minutes intensity : moderate-high

Table 2. Zig-zag run Training Program

Week	Meeting	Exercise Items	Exercise Dosage
1-2	1-3		Set: 2-3 Work time: 15-20 seconds Interval: 15-20 seconds Recovery: 2 minutes Intensity: moderate-high
	4-6	1. Zig-zag run shuffle 2. Zig-zag run forward-backward 3. Zig-zag run pivot 4. Zig-zag run fighting stance	Set: 3-4 Work time: 15-20 seconds Interval: 15-20 seconds Recovery: 2 minutes Intensity: moderate-high
3-4	7-9	5. Y zigzag	Set: 4-5 Work time: 15-20 seconds Interval: 15-20 seconds Recovery: 2 minutes Intensity: moderate-high
	10-12		Set: 2-3 Work time: 10-15 seconds
5-6	13-15		

Week	Meeting	Exercise Items	Exercise Dosage
			Interval: 15-20 seconds Recovery: 2 minutes Intensity: moderate-high
	16-18		Set: 3-4 Work time: 10-15 seconds Interval: 15-20 seconds Recovery: 2 minutes Intensity: moderate-high

RESULT

The results of pre-test and post-test experiments of ladder and zigzag running exercises on the agility of taekwondo in aged 8-12 years at the Mojokerto White Tiger Club. This study involved 10 taekwondo athletes (10 males). The average age of the sample was 9.9 years with an average body weight of 31.75 kg.

Table 3. Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Pre-test ladder drill	5	3.12	11.04	14.16	12.5920	1.11493
Post-test ladder drill	5	2.63	9.61	12.24	11.3920	1.07816
Pre-test zigzag run	5	6.80	11.01	17.81	13.6700	2.58547
Post-test zigzag run	5	6.50	10.00	16.50	12.7340	2.65548
Valid N(listwise)	5					

Based on the table above, both groups have the same sample size, namely 5 respondents each (N = 5). In the initial measurement (pre-test) of the ladder drill variable, the average (mean) value of 12.5920. This decrease in the mean of 1.20 seconds indicates an increase in the subject's performance after receiving treatment, if lower times reflect better abilities. The percentage improvement for the ladder drill group was 9.53%. In the pre-test for the zigzag run variable, the average value of 13.6700 was higher than the ladder drill pre-test. In the final measurement (post-test) for the zigzag run variable, the average value decreased to 12.7340 from 13.6700 in the pre-test. This decrease of 0.936 indicates an increase in the subjects' agility abilities after the intervention, reflecting a percentage improvement of 6.85%.

Table 4. Normality Test Shapiro-Wilk

Category		Shapiro-Wilk		
		Statistic	df	Sig.
Result	Pre-test ladder drill	.956	5	.778
	Post-test ladder drill	.827	5	.131
	Pre-test zigzag run	.904	5	.453
	Post-test zigzag run	.947	5	.713

In the Ladder Drill Pre-test group, the results of the Shapiro-Wilk tests showed a significance value > 0.05 , which indicates that the data is normally distributed. Similarly, in the Ladder Drill Post-test group, the Shapiro-Wilk test produced a significance value of 0.131, which means > 0.05 , so it can be concluded that the data in this group is also normally distributed. Similar results were also found in the Zigzag Run Pre-test and Zigzag Run Post-test groups. Both groups showed a

significance value greater than 0.05, namely 0.713 in the Shapiro-Wilk test, which confirmed that the data in both groups were normally distributed.

Table 5. Homogeneity Test

		Levene statistic	df1	df2	Sig.
Post-test	Based on Mean	4.439	1	8	.068
	Based on Median	2.596	1	8	.146
	Based on Median and with adjust df	2.596	1	6.693	.153
	Based on trimmed mean	4.232	1	8	.074

In the Based on Mean method, the Levene Statistic value obtained is 4.439 with degrees of freedom (df1 = 1, df2 = 8) and a significance value of 0.068. A significance value of $0.068 > 0.05$ indicates that there is no significant difference between groups, so the assumption of homogeneity is met.

Table 6. Paired Sample T-test Ladder drill

		Mean	Std. deviation	Std. error mean	95% Confidence Interval of the difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pre-test dan posttest ladder drill	1.20000	1.08890	.48697	-.15205	2.55205	2.464	4	.069

The results of the Paired Sample T-test in the Ladder Drill group showed a decrease in the average time from 12.592 to 11.392, indicating an increase in Agility in the sample. However, statistically, the results were not yet significant because the p-value of 0.069 was greater than 0.05. This means that the Ladder Drill exercise has provided changes for the better, but the effect is not yet strong enough to be declared statistically significant.

Table 7. Paired Sample T-test Zigzag run

		Mean	Std. deviation	Std. error mean	95% Confidence Interval of the difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pre-test dan posttest zigzag run	.93600	.74624	.33373	.00942	1.86258	2.805	4	.049

The results of the Paired Sample T-test in the Zigzag Run group showed a decrease in the average time from 13.670 to 12.734, indicating an increase in agility. Statistically, this result is significant because the p-value of 0.049 is smaller than 0.05. This indicates that Zigzag Run training has a significant effect on increasing agility in taekwondo athletes aged 8–12 years.

Table 8. Paired Sample Effect Size Ladder drill

			Standardizer	Point estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Pre-test post-test ladder drill	Cohen's d	1.08890	1.102	-.078	2.211
		Hedge's correction	1.36473	.879	-.062	1.746

Cohen's $d = 1.102$ indicates that the difference between the pre-test and post-test has a large effect. Conceptually, this value indicates that the change in performance after the Ladder Drill treatment is quite robust in a practical context. Referring to Cohen's general criteria ($0.2 = \text{small}$, $0.5 = \text{medium}$, $0.8 = \text{large}$), a value above 0.8 represents a large effect. However, interpretation should be made considering the 95% Confidence Interval, which is -0.078 to 2.211 . This range includes the value of zero, meaning that there is still a statistical possibility that the true effect could be very small or even non-existent. This implies significant uncertainty in the effect size estimate, likely due to the relatively small sample size.

Table 9. Paired Sample Effect Size Zigzag run

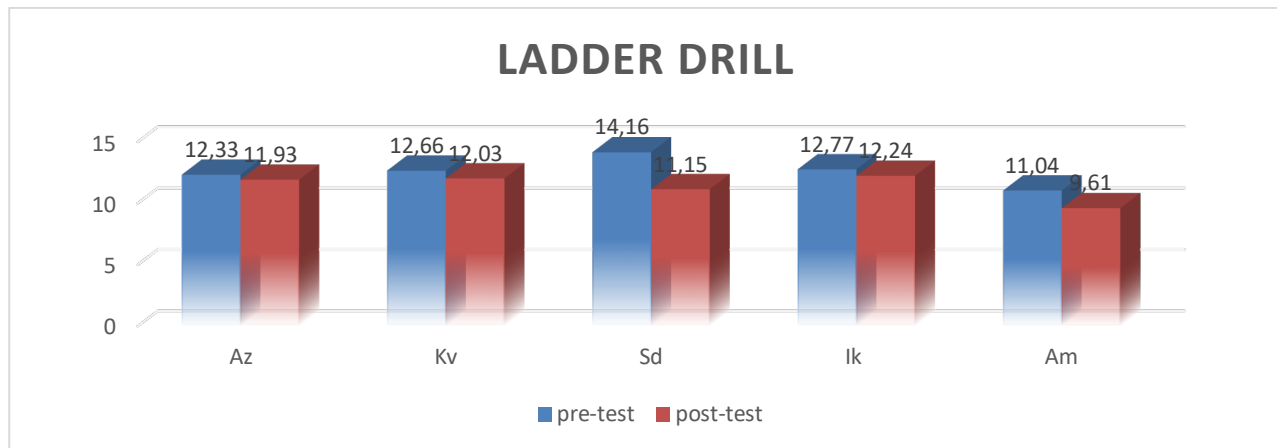
			Standardizer	Point estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Pre-test post-test zigzag run	Cohen's d	.74624	1.254	.007	2.431
		Hedge's correction	.93528	1.001	.006	1.940

Cohen's d value = 1.254 indicates that the difference between the pre-test and post-test measurements has a large effect. This value indicates that the intervention or treatment provided makes a strong contribution to performance changes. This interpretation is supported by the 95% Confidence Interval, which ranges from 0.007 to 2.431 . Because the interval range does not cross zero, it can be concluded that the treatment provided significantly improved Zig-zag Run ability from pre-test to post-test. This result is statistically stronger than the findings for the Ladder Drill variable, whose confidence interval still crossed zero.

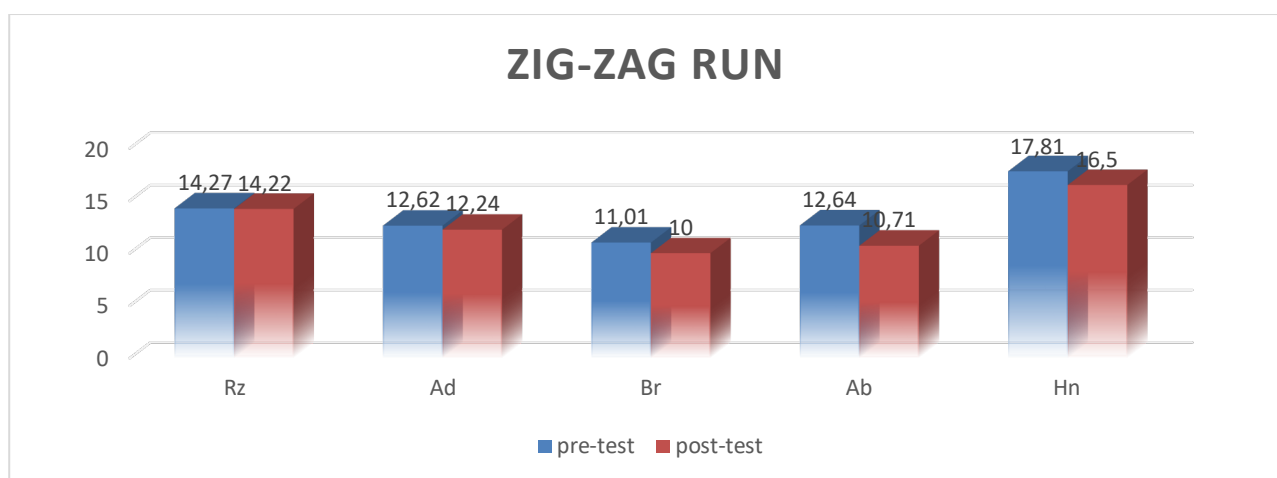
Table 10. Independent Sample T-test

		Levene's test for equality of variances		T-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence Interval of the difference	
									Lower	Upper
Results	Equal variance assumed	4.439	.068	-1.047	8	.326	-1.34200	1.28172	-4.29765	1.61365
	Equal variance not assumed			-1.047	5.284	.341	-1.34200	1.28172	-4.58422	1.90022

Based on the homogeneous assumption (equal variances assumed), the calculated t value was obtained as -1.047 with degrees of freedom (df) = 8 and a significance value (2-tailed) of 0.326 . A significance value of $0.326 > 0.05$ indicates that H_0 is accepted, meaning there is no significant difference in the average between the Ladder Drill Post-test and Zigzag Run Post-test groups at the 95% confidence level. The negative t -value (-1.047) indicates that the average of the Ladder Drill Post-test group is lower than the Zigzag Run Post-test group. However, this difference is not large enough to be considered statistically significant. The mean difference is -1.34200 with a standard error of 1.28172 . The 95% Confidence Interval for the mean difference ranges from -4.29765 to 1.61365 . Since this confidence interval includes the value of zero (0), it confirms that the difference between the two groups is not significant. In other words, we cannot confidently conclude that there is a significant difference between the results of the Ladder Drill Post-test and the Zig-zag Run Post-test in the population.



Graph 1. Pre-test and Post-test Ladder Drill



Graph 2. Pre-test and Post-test Zigzag run

Both graphs show a decrease in time from pre-test to post-test in all subjects, both in ladder training and zigzag running, indicating an increase in agility ability after treatment. The substantially higher mean pre-test score of the Zigzag Run group (13.670 s) compared to the Ladder Drill group (12.592 s) confirms that the two groups were not equivalent at baseline, a difference of 1.078 seconds that must be explicitly considered when comparing post-test outcomes across groups. The specific principles of ladder drill are to train stride speed, neuromuscular coordination, and footwork control, while zigzag run trains the ability to change direction quickly, accelerate, and maintain balance. Both exercises have movement characteristics that align with agility components, so implementing specific training for the movement needs of the sport can optimally improve an athlete's agility abilities. Overall, both types of training were shown to have a positive effect in improving agility, as demonstrated by the increase in travel time performance in the final test.

DISCUSSION

Based on the results of the Paired Sample T-test, the Ladder Drill group showed a decrease in the average Agility T-test time from 12.592 seconds in the pre-test to 11.392 seconds in the post-test. This 1.2-second decrease substantially indicates an increase in agility after the intervention for 18 sessions. Although the statistical significance value obtained was $p = 0.069$, making it statistically insignificant, the effect size resulting from Cohen's d value of 1.102 is classified as a large effect. However, the statistical insignificance in this group can be explained through several critical perspectives. First, from a methodological perspective, the sample size of only five subjects in this

group was very limited and had low statistical power (Lavianti et al., 2025). This condition made the paired t-test less likely to detect practically meaningful differences. Second, from the perspective of motor development theory in children aged 8-12 years, this phase is a sensitive period for the development of coordination and basic motor skills, as well as neuromuscular adaptations that require a relatively longer time compared to adult athletes because children's nervous systems are still maturing. Improved coordination between the nervous system and muscles produces fast, precise, and efficient movements. Repeated training can increase the speed of motor unit activation, muscle coordination, and body response, allowing athletes to better change direction, maintain balance, and effectively control body movements during dynamic movements. To get maximum neuromuscular adaptation results also requires a specific program (Antoni et al., 2026). This is linked to previous research, which states that ladder training has a significant influence on Taekwondo Student Activity Unit of The State University of Surabaya (Fajar, 2022). The study used more mature athletes with different physical conditions. Therefore, the results of this study do not contradict previous research but rather clarify the contextual limitations of Ladder Drill's effectiveness based on the athlete's age and developmental level.

The results of the sample t-test displayed in the Zigzag Run group showed a decrease in average time, with a significance value of $p = 0.049$, which is below <0.05 . Statistically, Zig-zag Run training has a real effect in increasing the agility of Taekwondo athletes aged 8-12 years at the Mojokerto White Tiger Club, reinforced by Cohen's d value of 1.254, which is classified as a large effect category, accompanied by a 95% Confidence Interval of 0.007 to 2.431 which does not pass the zero value, so that the estimated effect size is statistically valid. The results of this study are consistent with the results of previous studies, which showed that Zig-zag Running training had an influence on increasing the agility of Taekwondo Dojang Saburai athletes (Malasari, 2019). Despite the different club contexts, the similarity of the intervention variable (Zigzag Run) and the dependent variable (Taekwondo athlete agility) provides strong external validity in this study. Research on soccer players of the Department of Sport Education and Health, ULM Banjar Baru also showed that zig-zag run can provide a positive influence on increasing agility (Arifin et al., 2020). The average post-test score of the Zigzag Run group is higher than the post-test of the Ladder Drill group, indicating that in absolute terms the Ladder Drill group has a faster Agility T-test time. However, this needs to be interpreted because the average pre-test score of the Zigzag Run group was also higher than that of the Ladder Drill group. This means that the initial conditions of the two groups were different. The Zigzag Run group had a lower initial agility score, so a direct comparison of post-test scores between groups is not entirely appropriate without considering the gain score or percentage increase.

The Independent Sample T-test results showed no significant difference between the Ladder Drill and Zigzag Run groups' post-tests. This finding indicates that neither method was statistically significantly superior to the other in improving agility in taekwondo in aged 8-12 years during the study period. Careful and critical interpretation of the results of this study is essential. First, the absence of a significant difference does not mean that both methods are identical in effectiveness but rather suggests that due to the limited sample size ($n = 5$ per group) and duration of the study, the study lacked sufficient statistical power to detect differences between the groups. In terms of comparing effect sizes, Zig-zag Run yielded a larger Cohen's d than Ladder Drill. This provides an empirical, though not conclusive, indication for the 8-12-year-old taekwondo population regarding the relevance of the Zigzag Run movement pattern. This is closer to the movement demands in Taekwondo kyorugi, namely rapid mobility in various directions with sudden changes in position. Theoretically, both Ladder Drill and Zig-zag Run have been proven to have strong theoretical

mechanisms for increasing Agility through neuromuscular system stimulation, and empirically both have shown changes towards improvement, although with varying levels of significance. The statistical significance achieved only by Zigzag Run in this study does not necessarily mean that Ladder drill is ineffective but rather reflects the limited statistical power due to the small sample size.

This study has several limitations that should be considered when interpreting the results. First, the small sample size ($n = 5$ per group) is a major limitation affecting the statistical power and generalizability of the findings. Second, the study duration of 18 sessions may not be sufficient to produce optimal neuromuscular adaptation, especially in children aged 8-12 years who require more time to internalize movement patterns. Third, this study only used one agility measurement instrument (the Agility T-test), thus not being able to capture changes in each agility indicator separately. Fourth, external factors such as physical activity outside of the study training sessions, sleep patterns, and nutritional status were not systematically controlled, potentially confounding variables. Therefore, the results of this study still require further testing through further research with a larger sample size, longer intervention duration, and a more rigorous design to control variables.

CONCLUSION

In conclusion, both the Ladder Drill and Zig-zag Run are effective intervention methods for enhancing agility in Taekwondo athletes aged 8–12 years. However, the Zig-zag Run demonstrated a clear practical advantage, making it the more impactful approach for this age group. This superior outcome is primarily attributed to the movement specificity of the Zigzag Run, which closely mimics the multi-directional footwork and rapid changes of direction inherent in kyorugi. Consequently, coaches and practitioners are encouraged to prioritize Zigzag Run drills when designing agility training programs for young Taekwondo athletes. Future research should consider larger sample sizes and longer intervention periods to further confirm these practical gains.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding this research.

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