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The Effect of Agility Ladder Exercise Using the Lateral Run Method on Agility of 13-Year-Old Soccer Athletes

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Abstract

This study aimed to determine the effect of Agility Ladder Exercise using the lateral run method on the agility of 13-year-old soccer athletes at Narmada Football Academy (NFA). The study employed a pre-experimental method with a one-group pretest-posttest design. Fifteen male soccer athletes aged 13 years were selected using purposive sampling. The intervention consisted of agility ladder exercises using the lateral run method conducted during the training program period. Agility performance was measured using an agility running test administered before and after the intervention. Data were analyzed using descriptive statistics, normality testing, and paired sample t-test with the assistance of SPSS version 20.

The results showed a significant improvement in athletes' agility after the intervention. The paired sample t-test indicated a significant difference between pretest and posttest scores ($t = 11.391$, $p < 0.001$). The mean difference between pretest and posttest scores was 2.298, with a 95% confidence interval ranging from 1.865 to 2.731. These findings indicate that Agility Ladder Exercise using the lateral run method effectively improves running agility in young soccer athletes.

In conclusion, agility ladder exercise with the lateral run method can be used as an effective training strategy to enhance agility performance in youth soccer players. Future studies are recommended to involve larger samples and control groups to strengthen the generalizability of the findings.

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INTRODUCTION

Soccer is one of the most popular sports in the world and requires players to possess excellent physical, technical, tactical, and mental abilities to achieve optimal performance. According to Pratama (2020), soccer is played by two teams consisting of 11 players each, with the objective of scoring goals while defending their own goal area. In addition, Fetri (2019) explained that soccer performance is influenced by several important components, including physical condition, technical skills, tactical understanding, and mental readiness. Among these components, physical condition plays a fundamental role in supporting players' performance during training and competition.

One of the most important physical components in soccer is agility. Agility refers to the ability to change direction quickly and efficiently while maintaining balance and body control. According to Tri-Mahardi (2021), agility is essential for soccer players because it supports rapid movement, dribbling, defensive transitions, and the ability to avoid opponents during matches. Players with poor agility often experience difficulties in maintaining movement efficiency, especially during high-intensity situations. Based on preliminary observations conducted at Narmada Football Academy (NFA), several junior players showed limitations in movement speed and directional changes during matches. The players tended to lose balance and experienced decreased movement effectiveness when performing quick running transitions. These conditions indicate the need for an appropriate training method to improve agility performance in youth soccer athletes.

Various training methods have been developed to improve agility in soccer players, such as shuttle run, zig-zag run, obstacle course, and ladder drill training. Hadi (2016) stated that agility training can be modified using different movement patterns and training media to improve players' movement coordination and reaction time. One training method that has recently attracted attention is Agility Ladder Exercise. According to Asshiddiqi (2020), agility ladder training helps improve coordination, balance, reaction time, and neuromuscular adaptation through structured foot movement patterns. In addition, the lateral run method is considered effective because it emphasizes side-to-side movement patterns that are highly relevant to soccer movement characteristics (Apriyadi, 2014).

Previous studies have reported positive effects of agility ladder training on agility performance. Mulya (2019) found that ladder drill exercises significantly improved agility in soccer players. Similarly, Rasyono (2018) reported that ladder drill training enhanced agility among youth soccer athletes. International studies conducted by Zoran Milanović et al. (2013) and Mathisen & Pettersen (2015) also demonstrated that agility-focused training programs contributed positively to sprint and agility performance in young soccer players. However, other studies have shown inconsistent findings. Padrón-Cabo et al. (2020) reported that agility ladder training did not always produce significantly superior improvements compared to other agility training methods. These inconsistent findings indicate that the effectiveness of agility ladder exercise may depend on the training method, intensity, movement variation, and athlete characteristics.

Based on the previous studies, several research gaps can still be identified. First, most previous studies focused generally on ladder drill training without specifically examining the lateral run method as the primary training model. Second, studies involving 13-year-old soccer athletes in local football academies are still limited. Third, previous research has rarely discussed the practical implementation of lateral run movement patterns that closely resemble movement demands in soccer games. Therefore, this study offers novelty by specifically investigating the effect of Agility Ladder Exercise using the lateral run method on the agility of 13-year-old soccer athletes at Narmada Football Academy.

This study is important because agility

is a crucial component in modern soccer performance, especially for youth athlete development. An effective agility training model is expected to help coaches improve players' movement efficiency, reaction speed, and directional change ability during matches. Therefore, the purpose of this study was to determine whether Agility Ladder Exercise using the lateral run method significantly affects the agility of 13-year-old soccer athletes at Narmada Football Academy (NFA).

METHOD

Research Design

This study employed a quantitative approach using a pre-experimental design with a one-group pretest-posttest design. According to Sugiyono, a pre-experimental design is used when the researcher cannot fully control external variables that may influence the dependent variable. Therefore, the outcomes of the experiment are not solely affected by the independent variable because the study does not involve a control group or randomization procedures.

The one-group pretest-posttest design was selected because it allows the researcher to compare participants' performance before and after treatment within the same group. In this study, athletes were assessed through a pretest before the intervention and a posttest after the intervention to determine the effect of short and long serve performance on rally effectiveness and point acquisition during badminton matches. The research design can be illustrated as follows:

$$\mathbf{O_1 - X - O_2}$$

Where:

O_1 = Pretest

X = Treatment/Observation of service performance during matches

O_2 = Posttest

Participants

The participants in this study consisted of 14 male beginner singles badminton athletes (TPA-UTAMA category) who participated in the 2025 Semarang Regency Championship organized by PBSI Semarang Regency. A total sampling technique was employed because all athletes who met the inclusion criteria were involved in the study.

The inclusion criteria were as follows:

1. Registered as active athletes in the tournament,
2. Participated in the full match observation process,
3. Physically fit during the competition, and
4. Completed all match sessions observed by the researchers.

Although the sample size was relatively small, the study focused specifically on regional-level athletes participating in an official championship setting. Therefore, the findings should be interpreted within the context of developmental badminton performance analysis and may not be generalized to elite or international athletes.

Operational Definition of Variables

Short Serve

A short serve was operationally defined as a serve directed toward the front service area with a low shuttle trajectory close to the net, aiming to limit the opponent's attacking opportunities.

Long Serve

A long serve was defined as a serve directed toward the rear court area with a high and deep trajectory intended to push the opponent backward and alter rally tempo.

Rally Effectiveness

Rally effectiveness referred to the athlete's success in maintaining and controlling rallies after performing a serve, which resulted in tactical advantage or successful rally continuation. Rally effectiveness indicators included:

1. Successful rally continuation after serve,
2. Opponent difficulty in returning the shuttlecock,
3. Ability to maintain rally control, and
4. Contribution of the serve to rally success.

Point Acquisition

Point acquisition referred to the total points earned by athletes directly or indirectly following short or long serve execution during match play.

Instruments and Materials

Data were collected using systematic observation sheets and video recordings of official matches. Match videos were analyzed repeatedly to ensure observational accuracy and minimize recording bias. The observation instrument was developed based on badminton performance analysis indicators adapted from previous studies on serve and rally performance.

Validity and Reliability

To improve methodological rigor, the observation instrument underwent content validation by two badminton coaching experts and one sports performance analysis expert. The validation process focused on the relevance, clarity, and suitability of the observation indicators with the research objectives.

Instrument reliability was examined using inter-rater reliability procedures. Two independent observers analyzed the same match recordings, and the level of agreement between observers was assessed using Cohen's Kappa coefficient. The reliability coefficient obtained was above 0.80, indicating strong agreement and acceptable observational consistency.

Procedures

The study began with preliminary observations and preparation of match analysis instruments. During the championship, all matches involving the selected athletes were recorded using video documentation. Researchers then conducted systematic observations of short serves, long serves, rally effectiveness, and point acquisition.

The observation process was conducted repeatedly to ensure data consistency and reduce subjectivity. Data coding was performed after all match recordings had been reviewed and verified by the observers.

Data Analysis

Data analysis was conducted using SPSS version 26. Descriptive statistics, including mean, standard deviation, minimum, and maximum scores, were used to describe the characteristics of the variables. Prior to hypothesis testing, assumption tests consisting of normality and homogeneity tests were performed.

The Shapiro–Wilk test was used to assess data normality because the sample size was relatively small ($n < 50$). Although the homogeneity test indicated unequal variances, the paired sample t-test was still applied because the analysis compared two related measurements obtained from the same participants. Furthermore, the paired t-test is considered robust for normally distributed paired data despite variance inequality in small samples.

To strengthen the statistical interpretation, effect size analysis using Cohen's d was also calculated to determine the practical significance of the findings. Additionally, 95% confidence intervals were reported to provide a clearer interpretation of the magnitude and precision of the observed effects.

RESULTS

Descriptive Statistics and Comparative Analysis

Table 1 presents the descriptive statistics of short serves, long serves, rally effectiveness, and point acquisition among beginner badminton athletes during the 2025 Semarang Regency Championship.

Table 1. Desctiptive Statistics of Research Variables

Variable	Min	Max	Mean	SD
Short Serve	18.42	83.33	51.63	20.60
Long Serve	16.67	81.58	48.36	20.60
Rally Effectiveness	36.00	66.30	53.06	8.49
Point Acquisition	36.00	66.30	53.06	8.49

The descriptive analysis indicates that short serves demonstrated a slightly higher average value (51.63±20.60) compared to long serves (48.36±20.60). However, the relatively

large standard deviation in both variables suggests substantial variability in serving performance among athletes. This finding reflects differences in technical consistency and tactical execution at the regional developmental level.

From a practical perspective, the higher average score of short serves suggests that athletes tended to use short serves more effectively to initiate rally control and reduce opponents' attacking opportunities. Nevertheless, the relatively similar average values between short and long serves indicate that both serve types remain strategically relevant during competitive play.

Meanwhile, rally effectiveness and point acquisition showed identical average values (53.06±8.49), indicating a direct relationship between successful rally management and scoring opportunities. This finding suggests that rally stability and tactical consistency may contribute more substantially to point acquisition than serve variation alone.

Normality Test

Table 2. Sharpio-Wilk Normality Test

Variable	Statistic	df	Sig,
Short Serve	.965	14	.811
Long Serve	.965	14	.811
Rally Effectiveness	.976	14	.942
Point Acquisition	.976	14	.942

The Shapiro–Wilk test results showed significance values greater than 0.05 for all variables, indicating that the data were normally distributed. The use of the Shapiro–Wilk test was considered appropriate due to the relatively small sample size ($n < 50$). These findings supported the use of parametric statistical analysis in the subsequent hypothesis testing.

Homogenity Test

Table 3. Sharpio-Wilk Normality Test

Levene Statistic	df1	df2	Sig.
13.466	3	52	.000

The homogeneity test revealed a significance value below 0.05 ($p = .000$), indicating unequal variances among variables. Although the assumption of homogeneity was violated, the paired sample t-test was still applied because the analysis involved paired observations from the same participants. Previous statistical literature suggests that the paired t-test remains sufficiently robust when normality assumptions are satisfied.

Paired Sample t-Test and Effect Size Analysis

Table 4. Paired Sample t-Test of Short and Long Serve Effectiveness

Comparison	Mean Difference	SD	t	df	Sig. (2-tailed)	Cohen's d
Short Serve - Long	3.96	20.79	.713	13	.488	0.19

The paired sample t-test revealed no statistically significant difference between the effectiveness of short serves and long serves on rally outcomes and point acquisition ($p = .488 > .05$). Although short serves showed a slightly higher mean value, the difference was relatively small and statistically insignificant.

Furthermore, the effect size analysis produced a Cohen's d value of 0.19, indicating a small practical effect. This finding suggests that the difference between short and long serves had minimal practical influence on rally effectiveness during match play.

From a tactical perspective, these findings imply that rally success at the regional athlete level is influenced more by overall playing consistency, rally management ability, and technical stability rather than by serve type alone. Both short and long serves appear to provide relatively balanced tactical contributions in competitive situations.

In addition, the findings indicate that beginner-level athletes may not yet possess highly specialized serving strategies, unlike

elite badminton players who typically demonstrate more structured tactical serve patterns. Therefore, coaches should emphasize comprehensive rally development, decision-making ability, and consistency during training sessions rather than focusing excessively on a single serve variation.

Visual Comparison of Short Serve and Long Serve Mean Scores

(Insert bar chart comparing the mean values of short serve and long serve effectiveness here)

The visual comparison demonstrates that short serves produced marginally higher effectiveness scores than long serves. However, the overlapping performance tendencies between both serve types further support the statistical findings indicating no significant practical difference between the two serving strategies.

DISCUSSION

The findings of this study demonstrated that there was no statistically significant difference between short serves and long serves in terms of rally effectiveness and point acquisition among beginner male badminton athletes participating in the 2025 Semarang Regency Championship. Although short serves showed a slightly higher mean score than long serves, the difference remained statistically insignificant with a small effect size. These findings indicate that, at the regional developmental level, serve type alone does not play a dominant role in determining rally success or point acquisition. Instead, rally outcomes appear to be influenced by a more complex interaction of technical consistency, tactical adaptation, decision-making ability, and athlete readiness during competitive play.

From a performance analysis perspective, badminton rallies are multidimensional and cannot be explained solely through isolated technical variables such as serve type. According to Gomez M. A. et al. (2020), rally success in badminton is influenced by the continuity of technical execution, tactical organization, and the ability to maintain rally control under competitive pressure. This supports the present findings, where both short and long serves contributed relatively equally because rally effectiveness depended more on subsequent rally management than on the initial serve itself. In modern badminton, the serve functions primarily as a tactical entry point rather than a direct scoring mechanism, particularly at the developmental athlete level where technical consistency is still evolving.

The absence of significant differences may also be explained through tactical play theory and game strategy adaptation. Short serves are generally associated with front-court control and limiting offensive returns, whereas long serves are intended to push opponents toward the rear court and alter rally tempo (Iino et al., 2026; Pangaestu et al., 2025). However, beginner athletes often lack tactical specialization and adaptive decision-making during match situations. Consequently, both serve types may produce relatively similar outcomes because athletes have not yet developed stable tactical patterns or strategic serve variation. This interpretation aligns with the findings of Zhou C. and Jie (2021), who reported that elite badminton players demonstrate highly structured service patterns based on tactical identity and match strategy. In contrast, regional-level athletes tend to use serves more situationally and inconsistently due to limited competitive experience and tactical maturity.

The findings can also be interpreted through the lens of motor learning theory. According to motor learning principles, athletes in the developmental stage are still refining movement coordination, technical automation, and perceptual decision-making. As a result, technical execution tends to fluctuate under competitive pressure. This condition may explain the relatively large standard deviations observed in both short and long serve performances. Research conducted by Taufik E. et al. (2024) similarly found substantial variation in short and long serve mastery among adolescent badminton athletes, primarily influenced by tech-

nical proficiency, training exposure, and tactical understanding. Therefore, the lack of significant differences in the present study likely reflects the developmental characteristics of regional athletes who are still transitioning from fundamental technical acquisition toward tactical performance stabilization.

Psychological factors may also have contributed to the findings. Competitive anxiety, pressure during rallies, concentration stability, and confidence in service execution can substantially affect badminton performance. Official tournament environments often create psychological demands that influence technical execution consistency. As explained by Eval Edmizal et al. (2024), match-based observations provide more realistic representations of athlete performance because competition pressure directly affects tactical and technical behavior. In the current study, athletes may have experienced fluctuations in concentration and tactical confidence, thereby reducing the distinct effectiveness of each serve type during match play. This reinforces the understanding that technical performance in badminton cannot be separated from psychological readiness and situational decision-making.

Another important finding of this study is the strong relationship between rally effectiveness and point acquisition. The results indicate that successful point scoring was more closely associated with rally stability and the ability to maintain tactical control rather than with a specific serve variation. This finding supports the study by Prajongjai V. et al. (2021), which emphasized that rally outcomes are strongly determined by movement coordination, technical continuity, and consistency throughout rally sequences. Similarly, Li C.-H. et al. (2025) argued that successful rally construction depends on integrated technical and tactical execution rather than isolated actions at the beginning of play. Thus, the serve should be understood as part of a broader tactical system involving anticipation, positioning, shot selection, and rally transition management.

From a coaching and athlete development perspective, the present findings provide important practical implications. Coaches at the regional development level should avoid overemphasizing a single serve type during training programs. Instead, training should focus on comprehensive rally development, tactical adaptability, decision-making skills, and consistency under match pressure. Athlete development programs should integrate technical training with situational gameplay scenarios to improve tactical awareness and rally management ability. This approach is consistent with contemporary athlete development models emphasizing integrated skill acquisition rather than isolated technical repetition.

Furthermore, the findings contribute to the broader international literature on badminton performance analysis by providing empirical evidence from regional-level competition contexts, which remain underrepresented in previous studies. Most existing badminton performance research has focused predominantly on elite or international athletes (Carboch & Smocek, 2020; Zhou & Jie, 2021). Consequently, limited evidence is available regarding the tactical and technical characteristics of developmental athletes competing at regional levels. The current study helps address this gap by demonstrating that serve effectiveness among regional athletes may differ substantially from elite tactical patterns due to variations in technical maturity, competitive exposure, and psychological readiness. Therefore, this study contributes to the growing understanding that performance analysis in badminton should consider athlete development stages and contextual competitive environments.

Despite its contributions, this study has several limitations. The relatively small sample size limits the generalizability of the findings and reduces statistical power. Additionally, the study focused only on beginner male singles athletes within a single regional championship. Future studies are recommended to involve larger samples, multiple competition levels, and additional tactical variables such as rally duration, shot sequence patterns, and opponent re-

sponse analysis. Incorporating biomechanical and psychological performance indicators may also provide a more comprehensive understanding of badminton tactical effectiveness.

CONCLUSION

This study concluded that there was no statistically significant difference between short serves and long serves in influencing rally effectiveness and point acquisition among beginner male badminton athletes competing in the 2025 Semarang Regency Championship. Although short serves demonstrated slightly higher average scores, both serve types contributed relatively equally to rally formation and scoring opportunities. These findings indicate that rally success at the regional developmental level is influenced more by overall game consistency, tactical control, decision-making ability, and athlete readiness rather than by serve variation alone.

Nevertheless, this study has several limitations. The relatively small sample size reduced the statistical power and limited the generalizability of the findings. In addition, the study only involved beginner male singles athletes from one regional championship, which may not fully represent athletes from other competitive levels or categories.

Therefore, future research is recommended to involve larger and more diverse participant groups across multiple competition levels. Further studies should also incorporate additional tactical variables such as rally duration, shot sequence analysis, movement patterns, psychological readiness, and biomechanical indicators to provide a more comprehensive understanding of badminton performance. Longitudinal and mixed-method approaches may further strengthen the analysis of athlete development and tactical adaptation in competitive badminton.

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