15 (3) (2026) 1472-1478

Journal of Physical Education, Sport, Health and Recreations

http://journal.unnes.ac.id/journals/peshr

Comparative Effects of Zigzag and Shuttle-Run Dribbling Training on Dribbling Performance in Youth Soccer Players

Muhammad Reyhan Ghani Fauzi[1]*, Martin Sudarmono[2]

[12]Physical Education, Health, and Recreation, Faculty of Sports Science, Universitas Negeri Semarang, Semarang, Indonesia

Keywords

Dribbling; Zig-zag run; Shuttle run

History Dates

Received: *October 7, 2026*
Revised: *October 15, 2026*
Accepted: *October 28, 2026*
Published: *November 6, 2026*

DOI

https://doi.org/10.15294/active.v15i3.64828

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Abstract

Purpose: This study aimed to examine changes in dribbling performance following zig-zag run and shuttle run training and to compare the improvements between the two training groups. Methods: This quantitative study employed a two-group pretest-posttest experimental design involving 20 youth soccer players aged 15 years from SSB Putra Galaxy Rembang. The participants were divided equally into two groups (n = 10 per group). The intervention consisted of 12 training sessions conducted three times per week. Dribbling performance was assessed before and after the intervention, and the data were analyzed using paired-samples and in-dependent-samples t-tests. Results: Both the zig-zag run and shuttle run groups showed statistically significant improvements in dribbling performance ($p < 0.001$ for both groups). However, the difference in improvement between the groups was not statistically significant ($t(18) = 1.892$, $p = 0.075$). Conclusion: Both zig-zag run and shuttle run training were associated with significant improvements in dribbling performance. However, neither method demonstrated a statistically significant advantage over the other.

✉ Corresponding author :
reyhanghani160603@students.unnes.ac.id

p-ISSN 2460-724X
e-ISSN 2252-6773

INTRODUCTION

Success on the soccer field hinges on a dynamic interplay between a player's physical conditioning and tactical execution. For the youth demographic, fostering these technical skills requires highly specialized coaching strategies tailored to their exact biological and psychological growth stages. It is well-established that disparities in physical maturation and baseline athletic traits heavily dictate how efficiently teenagers master complex, sport-specific motor skills (Malina et al., 2005). Among these foundational movements, dribbling remains arguably one of the most critical components for offensive progression. Mastering the ball allows athletes to maintain possession under pressure, navigate past defenders, carve out open passing lanes, and drive the team's attacking momentum forward. This complex task demands much more than soft touches; it requires rapid directional adjustments paired with explosive acceleration. In youth football, the explicit link between elite dribbling performance and a player's multidirectional agility has already been heavily documented by contemporary sports scientists (Bekris et al., 2018). To analyze these skills accurately, coaches need rigorous testing frameworks that capture both running speed and tight ball control simultaneously. The Illinois Agility Test stands out as a highly reliable benchmark for this purpose. Prior research confirms that this specific course delivers excellent reliability and structural validity when measuring agility thresholds in team-sport athletes (Hachana et al., 2013). Building on this, recent advancements in direction-change metrics that explicitly embed dribbling actions have further proven their worth in tracking the specific athletic profiles of rising soccer talents (Makhlouf et al., 2022).

Conditioning programs that focus heavily on sharp pivoting and sudden bursts of speed are indispensable for long-term player development. Specifically, Speed, Agility, and Quickness (SAQ) frameworks have been shown to elevate multiple facets of on-field performance, primarily by sharpening how fast a player shifts their weight while guiding the ball (Sun et al., 2025). Furthermore, short sprint routines incorporating sudden directional breaks consistently sharpen the core agility markers of youth competitors (Chaouachi et al., 2014). This rapid adaptability is vital because soccer forces players to constantly recalibrate their movements based on real-time match scenarios. Evidence from youth academies highlights that agility-focused training rapidly boosts directional-change capabilities (Chaalali et al., 2016). Similarly, practicing multidirectional sprints has been shown to optimize both reactive agility and absolute cutting speeds in developing athletes (Born et al., 2016).

Long-term athletic transformation is fundamentally driven by structured, periodized training blocks. Observations within youth soccer programs reveal that targeted physical conditioning integrated directly into the competitive season yields major gains across various athletic benchmarks (Chtara et al., 2017). Even a few weeks of dedicated change-of-direction training can substantially elevate a young player's physical capabilities, although individual adaptation rates naturally fluctuate based on biological maturity and initial skill levels (Sariati et al., 2021). The zig-zag running drill represents a classic technical exercise in which players must weave the ball through a series of closely spaced obstacles. This drill requires intense synchronization of footwork, core stability, spatial awareness, and direct ball touch. A recent study by Widiyono et al. (2023) confirmed that systematic zig-zag drills can improve a soccer player's dribbling mechanics, supporting their use as a component of regular training programs. In contrast, the shuttle run focuses on linear acceleration, hard deceleration, and sharp 180-degree turns while maintaining ball control. Research by Rangga et al. (2023) demonstrated that structured shuttle-run training significantly improved dribbling performance among club members. However, that study relied on a single-group pretest-posttest model, leaving a gap that the present study addresses through a two-group comparative design.

Previous studies have compared zig-zag and shuttle-run training. For instance, Arwandi and Ardianda (2018) highlighted the benefits of both methods for dribbling ability. Comparable evaluations were carried out within school-based extracurricular programs (Arpansyah et al., 2022) and high school teams (Saputra et al., 2024). These studies provide a basis for examining the potential contribution of both training methods to dribbling performance. Nevertheless, previous studies involved different participant profiles, age groups, training durations, and

testing variables. These methodological differences limit direct comparisons of the findings when the two training methods are implemented under the same intervention conditions. Consequently, further empirical research is needed to evaluate zig-zag and shuttle-run training side by side under a consistent experimental framework. By testing 15-year-old athletes over an identical timeline and using the same testing procedures, the present study provides a direct comparison of these training methods within the specific context of SSB Putra Galaxy Rembang.

This study was also prompted by practical issues observed in the field. Initial observations at SSB Putra Galaxy Rembang revealed technical difficulties among some 15-year-old players. These included a lack of confidence when facing opponents, inconsistent ball control, poor concentration during high-speed runs, and difficulties following the dribbling course. These observations indicate that the players' dribbling skills require further development through a structured training intervention.

Based on these issues, this study aimed to examine changes in dribbling performance following zigzag run and shuttle-run training among 15-year-old soccer players at SSB Putra Galaxy Rembang and to compare the improvements between the two training groups. Specifically, the study addressed two research questions. First, was there a statistically significant change in dribbling performance from pretest to posttest within the zigzag run group and within the shuttle-run group? Second, was there a statistically significant difference in dribbling performance improvement between the zigzag run and shuttle-run groups? Accordingly, the study analyzed pretest-to-posttest changes within each group and compared the performance gains between the two groups.

METHODS

This investigation implemented a quantitative experimental approach utilizing a two-group pretest-posttest design. This framework was selected to systematically isolate the operational effects of zig-zag run and shuttle run dribbling interventions on youth ball-handling proficiencies, while facilitating a direct statistical comparison of performance gains between the two specialized training cohorts.The experimental trials were executed at SSB Putra Galaxy Rembang, targeting a specific demographic of 15-year-old youth soccer players. A sample size of 20 athletes was established through purposive sampling, adhering strictly to uniform baseline inclusion criteria. To ensure balanced experimental conditions, the participants were systematically distributed into two equal cohorts: 10 players assigned to the zig-zag run dribbling protocol and 10 players allocated to the shuttle run dribbling protocol.Both cohorts underwent an intensive training regimen spanning 12 distinct sessions over a four-week period. The training schedule was maintained at a constant frequency of three weekly sessions. To induce athletic adaptation without introducing confounding physical stressors, progressive overload was managed entirely by gradually increasing the volume of sets and repetitions on a weekly basis, keeping external structural loads constant.The independent variables isolated in this study comprised two distinct locomotion modalities: the zig-zag dribble run and the shuttle dribble run.

Conversely, the dependent variable was defined as the absolute dribbling proficiency of the 15-year-old soccer players.Empirical data collection was anchored by pre-intervention and post-intervention testing phases. Baseline metrics (pretest) were gathered prior to the implementation of the first training session, while final performance data (posttest) were recorded immediately following the completion of the 12th training session.Technical dribbling proficiency was quantified using execution speed across a standardized, multidirectional course. Ball control under temporal pressure was measured via the Illinois Agility Dribble Test for both testing phases. Each participant performed two full-effort trials per test. Performance times were clocked in seconds using digital timers, with the absolute shortest duration from the two attempts selected as the definitive data point. Consequently, lower time values reflected superior ball control and agility.Statistical processing was executed using descriptive statistics to calculate the mean and standard deviation for each cohort. Prior to hypothesis evaluation, data distribution and variance equity were verified using the Shapiro-Wilk normality test and Levene's test of homogeneity, respectively.Intra-

group performance shifts from baseline to post-intervention were evaluated using a paired-samples t-test. Furthermore, to determine whether one training modality yielded a superior technical advantage over the other, an independent-samples t-test was conducted on the calculated net gain scores. All statistical decisions were evaluated against a baseline alpha significance level of 0.05.

RESULTS AND DISCUSSION

This investigation involved a cohort of 20 youth soccer players, aged 15, actively training at SSB Putra Galaxy Rembang. To ensure a balanced experimental framework, the participants were equally distributed into two specialized intervention groups. The first cohort (n = 10) underwent a structured zig-zag run dribbling protocol, while the second cohort (n = 10) was subjected to a shuttle run dribbling training scheme. This conditioning program was executed over a four-week timeline with a fixed training frequency of three sessions per week, culminating in 12 complete on-field interventions. Progressive overload was carefully managed on a weekly basis by incrementally increasing the volume of sets and repetitions to stimulate athletic adaptation. The resulting empirical data were evaluated through a comprehensive analytical workflow, encompassing descriptive statistics, Shapiro-Wilk normality testing, Levene's homogeneity verification, alongside paired-samples and independent-samples t-tests. Pretest-posttest dribbling zig-zag run and dribble shuttle run show in **Table 1**.

Table 1. Pretest-posttest dribbling zig-zag run and dribble shuttle run

Name	Zig-zag run dribbling Pretest	Zig-zag run dribbling Posttest	Name	Shuttle run dribbling Pretest	Shuttle run dribbling Posttest
Arya	26.11	23.53	Wahyu	22.88	19.91
Aufal	22.75	19.32	Wildan	20.63	18.72
Tesar	23.34	20.02	Alif	25.54	22.31
Baim	23.22	18.71	Rehan	25.10	23.81
Danu	26.22	23.55	Faiq	25.49	23.36
Iben	27.69	24.93	Raditya	21.90	18.78
Ahza	27.31	24.73	Ulum	30.72	28.09
Rifki	28.63	25.82	Mefan	28.13	26.93
Fajar	25.10	23.76	Zaim	23.17	21.16
Zaki	24.33	21.10	Rizky	24.52	22.23

Table 2. Descriptive Statistics of Dribbling Performance

Variabel	N	Minimum	Maximum	Mean ± SD
Pretest dribble zig-zag run	10	22.75	28.63	25.47 ± 2.05
Posttest dribble zig-zag run	10	18.71	25.82	22.55 ± 2.54
Pretest dribble shuttle run	10	20.63	30.72	24.81 ± 2.97
Posttest dribble shuttle run	10	18.72	28.09	22.53 ± 3.16

Descriptive metrics indicated a substantial compression in execution times for both intervention groups. The zig-zag run training cohort demonstrated a downward trajectory in mean scores, dropping from a baseline of 25.47 seconds during the pretest to 22.55 seconds at the posttest phase, which represents a net performance acceleration of 2.92 seconds. Similarly, the shuttle run conditioning cohort trimmed their mean operational duration from 24.81 seconds to 22.53 seconds, capturing a net temporal gain of 2.28 seconds. Given that a minimized time increment on the testing course explicitly signifies an upgraded technical output, both experimental groups exhibited descriptive advancements in ball control following the four-week training cycle.

Table 3. Shapiro–Wilk Normality Test

Group	Data	W	p-value	Interpretation
Dribble Zig-zag run	Gain score	0.923	0,380	Normal
Dribble Shuttle run	Gain score	0,940	0,556	Normal

The distribution characteristics of the net performance gains were evaluated using the Shapiro–Wilk normality framework. The statistical diagnostic for the zig-zag run training cohort yielded a W statistic of 0.923 with an associated p-value of 0.380. Similarly, the shuttle run conditioning cohort recorded a W value of 0.940 paired with a p-value of 0.556. Because both observed probability values comfortably exceeded the baseline 0.05 alpha threshold, the data vectors for both experimental groups are confirmed to be normally distributed. Consequently, the fundamental mathematical assumption of normality has been successfully satisfied, validating the use of subsequent parametric inferential computations.

Table 4. Homogeneity Test of Gain Scores

Test	Lavene stastic	p-value	Interpretation
Gain Score	0,021	0,885	Homogeneous

Evaluation of variance equity across the calculated net gain scores was conducted using Levene's test, as detailed in **Table 4.** The statistical readout yielded a Levene value of 0.021, coupled with an associated probability value (p) of 0.885. Given that this observed (p)-value safely exceeded the conventional alpha threshold of 0.05, the variance between the two specialized conditioning groups is confirmed to be statistically uniform. Accordingly, the fundamental mathematical assumption of homogeneity required for subsequent inter-group comparative analysis has been successfully satisfied.

Table 5. Paired-Samples t-Test of Dribbling Performance Within Each Training Group

Training Group	Mean Pretest (s)	Mean Posttest (s)	Mean Difference (s)	T	df	p-value
Dribble Zig-Zag Run	25.47	22.55	2.92	11.443	9	<0.001
Dribble Shuttle Run	24.81	22.53	2.28	10.092	9	<0.001

Inferential analysis via the paired-samples t-test demonstrated that the zig-zag run dribbling cohort experienced a profound performance shift from baseline to post-intervention, yielding a statistically significant acceleration $t(9) = 11.443$, $p < 0.001$). A parallel positive trajectory was mirrored by the shuttle run dribbling group, which also exhibited a highly significant enhancement in operational execution $t(9) = 10.092$, $p < 0.001$). Consequently, these statistical outputs confirm that both the zig-zag run and shuttle run training architectures function as highly potent, independent catalysts for upgrading ball-handling proficiencies in youth athletes.

Table 6. Comparison of Gain Scores Between Training Groups

Training Group	N	Mean Improvement (s)	SD (s)
Dribble Zig-Zag Run	10	2.92	0.81
Dribble Shuttle Run	10	2.28	0.71

Descriptive statistics revealed that the zig-zag run training cohort achieved a mean performance acceleration of 2.92 seconds, outbalancing the net gain of the shuttle run cohort, which recorded a mean improvement of 2.28 seconds. Despite this descriptive disparity, the independent-samples t-test yielded a t-value (18) of 1.892 with a corresponding p-value of 0.075. Because this observed probability value exceeded the conventional 0.05 threshold of statistical significance, the null hypothesis cannot be rejected.

Consequently, this investigation fails to establish a statistically meaningful variance between the performance trajectories of the two groups. Empirical data, therefore, does not support the assertion that the zig-zag training modality provides a superior technical advantage over the shuttle run protocol for this demographic.The mathematical parity in training outcomes stems from the deeply overlapping biomechanical demands of both conditioning frameworks. Each protocol requires rapid changes of direction, explosive acceleration phases, sharp deceleration mechanics, and continuous ball manipulation under temporal constraints. These core characteristics compel athletes to systematically repeat highly relevant motor patterns throughout the 12-session timeline, directly reinforcing their neural pathways for ball retention.In summary, the empirical evidence demonstrates that both training architectures act as highly effective catalysts for skill acquisition, as reflected by the robust pretest-to-posttest score compressions within each respective group. However, when contrasting these technical gains directly, the margin of difference lacks the statistical magnitude required to declare one methodology superior to its counterpart.

CONCLUSION

This study demonstrates that both zig-zag run and shuttle run dribbling drills serve as potent interventions for upgrading the technical ball-handling speed of 15-year-old soccer players at SSB Putra Galaxy Rembang. The implementation of the zig-zag run protocol successfully compressed mean execution times from a baseline of 25.47 seconds down to 22.55 seconds. Mirroring this positive trajectory, the shuttle run cohort lowered their mean operational times from 24.81 seconds to 22.53 seconds.Although the absolute descriptive progress favored the zig-zag training group, a rigorous inferential comparison between the two experimental groups yielded no statistically significant variance $t-(18) = 1.892$; $p = 0.075$. In conclusion, while both physical training architectures are highly capable of driving substantial advancements in youth soccer dribbling proficiencies, there is no definitive statistical justification to prioritize one specific method over the other in a youth development curriculum.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed equally to the conceptualization, methodology, data collection, analysis, and drafting of the manuscript. All authors have read, revised, and approved the final manuscript for publication.

FUNDING STATEMENT

This research received no specific grant or financial support from any funding agency in the public, commercial, or not-for-profit sectors.

AI USAGE STATEMENT

The authors used Grammarly solely for grammar checking and language refinement during the preparation of this manuscript. No generative AI tools were used for data collection, analysis, or content creation. All scientific findings and conclusions were generated and verified entirely by the authors.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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