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Changes in Footwork Speed Following Shuttle Run Training among Badminton Extracurricular Students

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Abstract

Footwork is an important component of badminton because efficient movement enables players to change position and direction and return to the ready position. Previous studies have reported beneficial changes following shuttle run training in badminton athletes and students. However, evidence concerning changes in a specifically defined footwork performance outcome following a short school-based extracurricular training program remains limited. This study aims to determine the effect of shuttle run training on the footwork speed of extracurricular badminton students of Citepus Islamic Junior High School in 2026. The study used a quantitative, one-group pretest–posttest design involving seven students. Participants completed a footwork speed test before and after a 12-session shuttle run training program, with no control group included. Footwork speed was assessed using the footwork speed test used in the study, with the same measurement procedure at pretest and posttest. Data were analyzed using descriptive statistics and a paired-samples t-test. The mean footwork speed score increased from 6.57 (SD = 0.79) at pretest to 14.71 (SD = 1.11) at posttest, with a mean difference of 8.14 points. The results of the paired-samples t-test showed a significance value of 0.000 < 0.05, so there was a significant difference between the pretest and the posttest. This shuttle run training has a significant effect on increasing the footwork speed of extracurricular badminton students at Citepus Islamic Junior High School in 2026. This study provides preliminary evidence of short-term pretest–posttest change in footwork speed among badminton extracurricular students in a school-based setting and may inform training practices in comparable extracurricular contexts.

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INTRODUCTION

Footwork requires players to repeatedly move from the ready position toward different areas of the court and return to an appropriate position for the next movement. These actions depend on efficient footwork, particularly the ability to move rapidly and change direction while maintaining movement control(Atmoko, 2021). Therefore, the development of *footwork* is an important part of fostering the ability to play badminton, including in students who participate in extracurricular activities at school.(Salahuddin, 2021)

In school-based badminton extracurricular activities, the development of sport-specific movement competence is important not only for performance but also for the quality of students' participation and learning. Students who have difficulty changing position or direction may experience difficulty reaching the shuttlecock and maintaining an effective ready position.

Therefore, training activities that provide repeated movement stimuli relevant to badminton may be useful within extracurricular coaching.

Shuttle run training is a form of exercise that can be used to develop footwork skills because it involves moving quickly, changing direction, and moving back to the starting position. These movement characteristics are relevant to badminton footwork, which requires efficient movement between court positions. Previous studies have examined shuttle run training in relation to badminton footwork and related movement outcomes. Prasetyo et al. (2025) reported that shuttle run training was associated with changes in footwork agility among badminton athletes aged 10–15 years at BC Pusri Palembang following a six-week training program. Galugu (2024) reported that a shuttle run training model improved badminton footwork learning outcomes among Grade VIII students of SMP Negeri 13 Palopo. Denatara et al. (2023) also examined shadow and shuttle run training in relation to footwork among badminton players aged 13–15 years at PB Jaya Raya Metland. Mirfan et al. (2020) further reported that shuttle run and zig-zag run contributed to the footwork ability of badminton athletes.

Although these studies provide support for the relevance of shuttle run training to badminton-related movement, an important issue remains unresolved. Previous studies have used different populations, intervention durations, and outcome definitions (Salahuddin, 2021). In particular, footwork performance, footwork speed, and agility should not be treated as interchangeable constructs. Agility may include perceptual and decision-making components, whereas a planned shuttle run or footwork test may primarily capture performance on a predetermined movement task. Therefore, evidence of improvement in agility in another population does not automatically demonstrate improvement in a specific footwork test among school-based extracurricular students.

This condition is consistent with the practical challenges observed in badminton extracurricular activities at Citepus Islamic Junior High School. Preliminary observations during badminton extracurricular sessions indicated that some students had difficulty performing rapid positional movements and directional changes during footwork activities. These observations were informal and were used to identify the practical training problem rather than to quantitatively assess footwork speed, agility, coordination, or balance. The observed difficulties may reduce students' ability to reach the shuttlecock efficiently during play. However, the existing training activities were generally oriented toward badminton practice and had not been specifically structured around repeated shuttle-run movements to provide a targeted stimulus for footwork speed.

A training approach that reflects the movement demands of badminton may therefore be relevant to the development of footwork performance. Shuttle run training involves repeated acceleration, deceleration, directional changes, and movement between predetermined positions. From the perspective of training specificity, repeated exposure to these movement demands may provide a stimulus relevant to rapid and coordinated footwork. Repeated acceleration and deceleration may also place demands on neuromuscular control during changes of direction. Nevertheless, the similarity between shuttle-run movements and badminton footwork does not by itself establish that the training will improve footwork speed.

The research gap in the present study therefore does not concern the novelty of shuttle run training as an exercise method. Rather, it concerns the limited evidence regarding short-term changes in a specifically defined footwork speed outcome following a structured shuttle run program in school-based badminton extracurricular activities. Examining this outcome can provide preliminary information about whether a targeted shuttle run program is associated with measurable pretest-to-posttest changes in footwork speed among junior secondary students. This focus also distinguishes footwork speed from broader constructs such as agility and from general badminton footwork learning outcomes examined in previous studies.

Accordingly, this study aimed to examine pretest-to-posttest changes in footwork speed following a 12-session shuttle run training program among badminton extracurricular students at Citepus Islamic Junior High School in 2026. Given the one-group pretest–posttest design without a control group, the study was intended to describe within-group change rather than establish a causal effect of shuttle run training. The findings are expected to provide preliminary pedagogical evidence that may inform the development of more targeted footwork training activities in comparable school-based badminton extracurricular settings.

METHODS

This study used a quantitative approach with a one-group pretest–posttest design. The design was chosen for feasibility reasons within a single school extracurricular program and allows estimation of within-participant change in footwork performance from pretest to posttest. It cannot isolate the contribution of the shuttle-run training from maturation, repeated testing, concurrent badminton practice, motivation, or other time-related factors. Consequently, the study is best interpreted as a preliminary examination of within-group change rather than a confirmatory causal experiment. No control or comparison group was available; this limitation is acknowledged and restricts causal claims.

The study was conducted during the badminton extracurricular program at SMP Islam Citepus (Jeruklegi, Cilacap) in 2026. Participants were junior-secondary students (grades 7 and 8) who regularly attended the extracurricular sessions held twice weekly (Wednesday and Thursday, 15:00–17:00). From a total of 15 students registered in the program, 10 met basic eligibility (active participation). Seven of these 10 were selected by purposive sampling on the basis of consistent attendance, willingness to complete the full protocol, and availability for both testing sessions. The three eligible students who were not included were excluded primarily because of incomplete availability or irregular attendance; exact reasons for each exclusion were not formally logged, introducing a possible selection bias. No a priori power calculation was performed; the sample of seven was determined by feasibility within the existing extracurricular group and is therefore treated as a small, preliminary sample. Estimates of significance, effect size, and normality are consequently unstable and should be interpreted with caution.

Institutional permission, parental/guardian consent, student assent, confidentiality procedures, and formal safety monitoring were not described in the available documentation. Because the participants were school-aged minors performing a physical training intervention, these omissions constitute a material limitation. Future reports should supply the relevant institutional review details and describe how exercise-related risks were managed.

The primary outcome was a footwork-speed test administered once before (22 May 2026) and once after (22 June 2026) the training period. The precise protocol (course layout, number of trials, timing or scoring method, unit of measurement, and whether higher scores indicate better or worse performance) is not fully specified in the source material. The test was intended to capture speed of positional change relevant to badminton footwork. No independent evidence of content validity, test–retest reliability, inter-rater reliability, or measurement error for this instrument in junior-secondary badminton players is provided; the conclusions therefore rest on an incompletely validated single measure. This is a central limitation.

The intervention consisted of shuttle-run training delivered across 12 sessions between the pretest and posttest dates (approximately one month). Sessions were integrated into the regular extracurricular schedule. Each session typically began with an 8–10 minute warm-up of light jogging, dynamic stretching, and shadow footwork. The main training consisted of shuttle-run drills emphasizing rapid positional shifts, direction changes, and return to the central ready position. The distance between points was 4–6 metres. Training volume generally comprised 4–6 sets of 6–8 repetitions, with 15–20 seconds rest between repetitions and 60–90 seconds rest between sets, performed at maximal intensity. Sessions ended with a 5–7 minute cool-down.

Progression was applied across the 12 sessions: the first four sessions used lower volume with emphasis on technique, the middle four sessions increased volume, and the final four sessions increased training density by reducing rest intervals while maintaining maximal effort. Attendance, the exact individual dose received, missed-session management, and any additional unstructured badminton practice were not systematically recorded. Whether any training movements directly rehearsed the footwork test sequence is also unclear; if substantial overlap existed, part of the observed improvement may reflect task familiarization rather than broader transfer to badminton footwork.

Data analysis proceeded as follows. Descriptive statistics (mean, standard deviation) summarized pretest and posttest scores. Normality of the paired difference scores (the relevant assumption for a paired-samples t-test) was examined with the Shapiro–Wilk test; with only seven observations, the test has low power and the result is sensitive to outliers. The paired-samples t-test was used to evaluate mean within-participant change; given the small sample, the result should be regarded as exploratory and checked for robustness (e.g., nonparametric or exact alternatives). Percentage change was calculated relative to the pretest mean.

Normalized Gain (N-Gain) was calculated according to:

$$\text{N-Gain} = \frac{\bar{X}_{\text{post}} - \bar{X}_{\text{pre}}}{\text{Ideal Maximum Score} - \bar{X}_{\text{pre}}}$$

The obtained N-Gain value was 0.61 (moderate category). This value implies an ideal maximum score of approximately 20; if the actual maximum score of the footwork test differs, the formula remains the same, and only the maximum score needs to be adjusted.

Effect size was calculated using Cohen's d for paired samples:

$$d = \frac{\bar{X}_{\text{post}} - \bar{X}_{\text{pre}}}{SD_{\text{difference}}}$$

where $SD_{\text{difference}}$ is the standard deviation of the individual difference scores (posttest − pretest). The effect size was $d = 11.80$ (very large). All inferential statements are limited to within-group change and do not support strong causal attribution of that change solely to the shuttle-run training.

In summary, the design and sample size permit only a preliminary description of pretest-to-posttest change in the measured footwork score. Stronger causal language, unsupported claims of instrument validity, and incomplete intervention reporting have been removed or qualified. Future work would benefit from a control or comparison condition, transparent participant flow, fully operationalized and validated outcome measures, detailed intervention protocols, attendance tracking, formal ethics documentation, and appropriately powered analyses with complete reporting of effect-size formulas.

RESULTS AND DISCUSSION

The results showed an increase in the measured footwork score after the shuttle-run training period. The mean pretest score of 6.57 increased to 14.71 at posttest, a mean difference of 8.14 points. These values represent scores on the footwork test used in this study, where higher scores indicate better performance. The exact unit of measurement, complete scale range, and detailed scoring procedure are not fully documented; therefore, the practical meaning of the numerical change must be interpreted with caution. The percentage increase calculated from the pretest mean reached 123.91%. Because the pretest mean is relatively low and the measurement scale is incompletely defined, this percentage may exaggerate the practical magnitude of the observed change. With a sample of only seven students, the improvement is best framed as a within-group pattern rather than as robust evidence of general effectiveness.

Informal observations during the training sessions suggested that students appeared to shift positions more quickly and showed better coordination when changing direction. These observations were not collected systematically with a predefined protocol, observation sheet, or independent raters. They are therefore treated only as informal impressions and cannot be regarded as empirical corroboration of the quantitative findings.

Table 1. Descriptive Statistics of Footwork Scores

Test	N	Mean	Standard Deviation
Pretest	7	6.57	0.79
Posttest	7	14.71	1.11

Source: Research data (2026).

The observed score change is consistent with the possibility that repeated rapid direction-change movements can improve performance on a similar footwork task. Shuttle-run training involves acceleration, deceleration, rapid changes of direction, and return to a central position—movements that share certain mechanical demands with badminton footwork, such as recovering to the base position, covering the court laterally, and moving forward and backward. However, the study did not measure these components separately, nor did it assess transfer to actual match play. Consequently, the data demonstrate only an improvement on the selected test. Part of the gain may also reflect familiarization with test-like movement patterns.

Evidence from badminton-specific studies provides the most direct support for the present findings. Limbong (2021) reported improvements in footwork and footwork-related agility among badminton participants following shuttle-run or similar training. Similar improvements in badminton footwork were also reported by Denatara et al. (2023) and Prasetyo et al. (2025) following shuttle-run-based training interventions.

The present findings are also supported by Musawwir et al. (2023), who found that shuttle-run training improved footwork agility among badminton athletes aged 13–16 years. This finding is particularly relevant to the present study because the participants were within a similar developmental age range and both studies examined badminton-specific footwork following shuttle-run training. The improvement may be attributed to the repeated acceleration, deceleration, and changes in direction required during shuttle-run exercises, which are also important movement components in badminton footwork. Supporting evidence was also reported by Suwardi et al. (2024), who found that shuttle-run training improved agility among badminton athletes. Although their study assessed general agility using the Illinois Agility Run Test rather than badminton-specific footwork, the findings provide additional support for the role of shuttle-run training in developing movement speed and the ability to change direction efficiently.

The present findings are directionally consistent with these earlier reports. However, direct comparison of the magnitude or practical importance of the findings remains limited because the studies differed in sample characteristics, training context, intervention duration, measurement instruments, and outcome definitions. Some previous studies involved club athletes or more structured training environments, whereas the present participants were junior-secondary extracurricular students with limited prior specialized training. Therefore, the present study should be interpreted as a preliminary contribution to school-based badminton development rather than as a direct replication of findings obtained with more experienced athletes.

Evidence from other sports provides additional but indirect support for the present findings. Malasari (2019) reported improvements in general agility following shuttle-run exercises, while Durahim et al. (2023) also found improvements in agility following similar training. Nevertheless, these findings should be interpreted cautiously because differences in

sport-specific movement demands and participant characteristics limit their direct comparability with badminton footwork.

Table 2. *Paired Sample t-Test*

Comparison	Mean difference	Sig. (2-tailed)	Decision
Pretest–Posttest	8.14	< 0.001	Significant

Source: Research data (2026).

The paired-samples t-test indicated a statistically significant mean difference (reported p = 0.000, conventionally understood as $p < 0.001$). With only seven participants and no control group, this result indicates a change after the intervention period but does not establish that shuttle-run training was the sole cause of the improvement. Possible alternative influences include repeated testing, regular badminton practice within the extracurricular programme, motivation, maturation, and increasing familiarity with the test itself.

Previous studies have reported statistically significant pretest–posttest improvements in agility or footwork outcomes following shuttle-run training among young badminton players (Limbong, 2021). Similar findings were also reported by Prasetyo et al. (2025). However, direct comparison of the magnitude or practical importance of these findings with the present results remains limited because the studies used different sample sizes, training doses, measurement instruments, and outcome definitions. In addition, earlier studies primarily assessed agility, which may involve perceptual and decision-making components, whereas the present study measured a preplanned change-of-direction footwork score (Chen et al., 2025). Therefore, treating these outcomes as equivalent could overstate the comparability of the studies. The present findings are directionally consistent with earlier reports but do not necessarily demonstrate the same magnitude of effect.

The results of the next study are in line with the finding that Utomo et al. (2023) *shuttle run training* for six weeks has an effect on the footwork agility of badminton athletes aged 10–15 years. Any connection drawn to research on balance training is indirect. The current intervention did not include balance exercises and did not measure balance independently. Suggestions that the shuttle-run programme simultaneously improved speed, balance, coordination, and body control remain hypotheses informed by previous literature rather than findings supported by the present data.

The results of the study are also related to research showing that balance exercises can improve the footwork performance of badminton players (Utomo et al., 2023). That earlier work suggests footwork ability is not only related to speed but also requires balance and body control. In the present study, the shuttle-run movement that involves rapid movement and changing direction may provide a stimulus to these components simultaneously. However, because the current intervention did not include specific balance exercises and did not measure balance independently, this connection remains a hypothesis informed by previous literature rather than a finding directly supported by the present data.

Although the results showed a statistically significant change, the study has important limitations that must shape the interpretation of all findings. The sample consisted of only seven students, and the design was a one-group pretest–posttest without a control group. This design cannot separate the contribution of the shuttle-run training from maturation, repeated testing, concurrent badminton practice, regression to the mean, expectancy effects, or simple familiarization with the test. Because participants completed the same footwork test twice and the training movements may have overlapped with the test, part of the observed score increase could reflect test familiarity rather than a broader change in badminton footwork. Consequently, the findings provide only preliminary evidence of improvement within a specific school-based extracurricular context. The small sample also limits the statistical stability of the estimates, and

the absence of a control group prevents strong causal inference. The results therefore cannot be generalized widely.

Future research should address the specific weaknesses of the present study. In addition to using larger samples and including a control or comparison group, subsequent studies should compare different types of footwork-specific interventions (for example, shuttle-run versus shadow footwork or reaction training), examine retention of any gains after the training period ends, and incorporate more precise performance indicators such as reaction speed, movement accuracy, balance control, and court-coverage efficiency. Such designs would allow clearer evaluation of both the effectiveness and the transferability of shuttle-run training in school settings.

Overall, performance on the measured footwork test improved during the 12-session programme. Within this particular group of junior-secondary extracurricular students, shuttle-run training was associated with higher footwork scores. The findings suggest that shuttle-run training may be a feasible, low-equipment strategy for developing basic movement readiness in school badminton programmes. However, because the research design does not support strong causal generalization, any practical recommendation must remain cautious and limited to contexts similar to the one examined here.

Table 3. Improvement of Footwork Speed

Indicator	Result	Category
Mean *pretest*	6.57	–
Mean *posttest*	14.71	–
Mean difference	8.14	–
Improvement	123.91%	–
N-Gain	0.61	Moderate
Effect Size	11.80	Very large

Source: Research data (2026).

The N-Gain value of 0.61 falls in the moderate category according to conventional thresholds. This indicates that an improvement occurred on the measured footwork test. However, the interpretation of N-Gain depends on the assumption of an ideal maximum score of approximately 20. Without a clearly documented upper limit of the test scale, the figure is of limited value for judging programme effectiveness.

The effect-size estimate of 11.80 is extraordinarily large for a physical-performance outcome. It was calculated as Cohen's d for paired samples, yet such a magnitude raises questions about the standardizing denominator, the scoring scale, or possible calculation error. With only seven observations, the estimate is highly sensitive to outliers and should be treated with extreme caution. Because the sample is very small and the study lacks a comparison group, these indices should not be over-interpreted as definitive evidence of programme effectiveness.

Earlier research has shown that shuttle-run training can improve footwork ability among badminton participants (Mirfan et al., 2020). Similar positive effects on footwork agility have also been reported following structured shuttle-run programmes (Limbong, 2021). The present findings are directionally consistent with those reports, although differences in sample characteristics, training context, and measurement instruments limit direct comparison of effect magnitudes.

Suggestions that longer training duration, more consistent attendance, gradual load progression, or more game-specific variations would produce greater improvement remain hypotheses rather than conclusions supported by the present data (Budiwanto, 2018). The

principles of overload, progressive loading, and specificity provide a theoretical rationale for such adjustments (Harsono, 2017), yet these factors were not systematically examined in this study.

The paired-samples t-test indicated a statistically significant mean difference (reported as $p = 0.000$, conventionally understood as $p < 0.001$). With only seven participants and no control group, this result indicates a change after the intervention period but does not establish that shuttle-run training was the sole cause of the improvement. Possible alternative influences include repeated testing, regular badminton practice within the extracurricular programme, motivation, maturation, and increasing familiarity with the test itself. The statistical result should therefore be considered together with the limitations of the design, the incomplete documentation of the measurement scale, and the practical meaning of the observed score change.

Previous studies conducted in different populations have reported that shuttle-run exercises can enhance agility (Malasari, 2019). Similar findings were also reported by Durahim et al. 2023). While these findings offer directional support for the present results, differences in sport context and participant characteristics mean that they cannot eliminate the internal-validity limitations of the present one-group design

Overall, performance on the measured footwork test improved during the 12-session programme. Within this particular group of junior-secondary extracurricular students, shuttle-run training was associated with higher footwork scores. The findings suggest that shuttle-run training may be a feasible, low-equipment strategy for developing basic movement readiness in comparable school badminton programmes. However, because the research design does not support strong causal generalization and because improvement was observed only on the study test, any practical recommendation must remain cautious and limited.

CONCLUSION

Based on the results of the study, an increase in the measured footwork score was observed after the 12-session shuttle-run programme. The mean score rose from 6.57 at pretest to 14.71 at posttest, with a mean difference of 8.14 points and a percentage increase of 123.91%. The paired-samples t-test indicated a statistically significant difference ($p < 0.001$). The N-Gain value was 0.61 (moderate), and the reported effect size was 11.80.

These findings indicate a large within-group change on the selected footwork test. However, because the study used a one-group pretest–posttest design with only seven participants and without a control group, the improvement cannot be attributed solely to the shuttle-run training. Factors such as repeated testing, test familiarization, concurrent badminton practice, and maturation remain possible alternative explanations. In addition, the exact measurement scale of the footwork test is not fully documented, and the exceptionally large effect size requires further verification.

Within these limitations, shuttle-run training was associated with higher footwork scores among the junior-secondary extracurricular students who participated in this study. The programme may serve as a feasible, low-equipment option for developing basic movement readiness in similar school settings. Nevertheless, its comparative effectiveness and transfer to actual badminton performance have not been established and require further controlled research.

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