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Impact of Circuit Training on Front Kick Accuracy in PSHT Students at Undana and STIM Commissariats, Kupang (NTT)

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Abstract

Objectives. This study aimed to examine the effect of circuit-based accuracy training on front kick accuracy among pencak silat athletes (PSHT) in Kupang, NTT.

Materials and Methods. A one-group pre-test–post-test experimental design was applied. Thirty students (n = 30) were selected from a population of 33 across two PSHT branches (Undana and STIM Commissariats). Front kick accuracy was measured using a zoned target board with 20 kick attempts per participant. The intervention was implemented for two weeks, using 3–4 sets per session and a work duration of 30–45 seconds at each station. Data were analyzed using a paired-sample t-test with a significance level of $p < 0.05$.

Results. Pre-test scores mostly fell within the moderate to good categories (28–36 points). After the intervention, post-test scores increased to 37–47 points, with all participants reaching the good to very good categories. The paired-sample t-test indicated a statistically significant improvement in front kick accuracy after the circuit-based training ($p < 0.05$).

Conclusions. Circuit-based accuracy training effectively improves front kick accuracy in pencak silat athletes and may be recommended as part of technical training programs in martial arts. However, the findings are limited by the small sample and the inclusion of only two PSHT branches, which may reduce generalizability due to differences in coaching, facilities, and athlete backgrounds. Future research should involve larger and more diverse samples, longer intervention durations, and additional biomechanical or kinematic measurements to clarify the mechanisms underlying accuracy improvements.

Keywords: Circuit training, Front kick accuracy, Pencak silat, PSHT students, Training intervention

Introduction

Front kick (tendangan depan) accuracy is a fundamental technical component in pencak silat because it directly influences scoring effectiveness, tactical execution, and overall performance during sparring. In competitive situations, athletes must deliver kicks with precise direction and timing to hit scoring zones while maintaining balance and readiness for subsequent actions (Agustia, 2019; ALI

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MARDIUS et al., 2024). However, in many training settings—especially at the student/club level—technical training often emphasizes repetition and power output, while accuracy-specific training and structured progression receive less systematic attention (Amiri et al., 2025; Bishop et al., 2009; Brewer, 2017). This creates a practical issue: athletes may demonstrate adequate strength and movement patterns but still struggle to consistently place kicks on intended targets under time pressure.

Recent developments in sport coaching highlight the importance of training designs that integrate technical precision, conditioning, and task constraints to produce transferable performance improvements (Amiri et al., 2025; Bellicha et al., 2021; Dingley et al., 2015). Circuit training has been widely used to improve physical conditioning and skill repetition efficiency by organizing multiple stations with controlled work–rest periods. In martial arts contexts, a circuit-based format can also be adapted to emphasize accuracy by using target zones, time constraints, and repeated skill execution in varied stations. This approach is theoretically promising because accuracy improvements depend on consistent motor control, feedback processing, and repeated exposure to specific task demands. Nevertheless, empirical evidence on circuit-based accuracy training for pencak silat—particularly for front kick precision—remains limited, and many local clubs rely on conventional drills without clear monitoring of accuracy outcomes (Asyhari, 2025).

In PSHT training environments, including commissariat branches such as Undana and STIM in Kupang (NTT), variations in coaching routines and training resources may influence how effectively athletes develop front kick accuracy. A structured circuit approach may offer practical advantages because it is relatively easy to implement, time-efficient, and can be standardized across sessions. However, the extent to which a short-term circuit-based accuracy program can produce measurable improvements in front kick accuracy among PSHT students still requires systematic investigation (Chania et al., 2021).

Therefore, this study aims to examine the effect of circuit-based accuracy training on front kick accuracy in PSHT students at the Undana and STIM commissariat branches in Kupang, NTT. Based on motor learning principles and training specificity, the study proposes the following hypothesis: circuit-based accuracy training will significantly improve front kick accuracy after the intervention compared with baseline performance (pre-test). By testing this hypothesis, the study is expected to contribute practical evidence for coaches and instructors regarding an efficient training method to enhance technical accuracy in pencak silat (Agustia, 2019; Herdiman et al., 2022; Saputra & Rahmat, 2024).

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Materials and Methods

Study Participants.

The participants were members of PSHT from the Undana and STIM commissariat branches in Kupang, NTT, who actively followed regular technical training programs. From a population of 33 students, a total of 30 participants (n = 30) were included in the study (Sugiyono, 2017). Participants were selected using purposive sampling based on the following inclusion criteria: (1) actively attending pencak silat training during the study period, (2) physically fit and able to perform front kick techniques safely, (3) willing to participate and complete the full pre-test and post-test sessions, and (4) not undergoing medical treatment or injury rehabilitation that could affect kicking performance. Participants who were absent during testing sessions or reported musculoskeletal injuries affecting lower-limb movement were excluded.

Demographic characteristics (e.g., age range, sex, training experience) were recorded prior to data collection to provide a clear participant profile and to ensure transparency regarding sample characteristics. All participants were informed about the study objectives and procedures. Participation was voluntary, and confidentiality of individual results was maintained. Approval and permission were obtained from the relevant training administrators, and the study followed ethical research principles for human participants (Arikunto, 2010).

Study organization.

This study employed a one-group pre-test–post-test experimental design to evaluate the effect of circuit-based accuracy training on front kick accuracy. The pedagogical experiment was conducted in three main phases: pre-test, intervention, and post-test.

1) Pre-test (baseline measurement)

Before the training program, all participants completed a standardized front kick accuracy test using a zoned target board. Each participant performed 20 front kick attempts, and every attempt was scored based on the target zone hit(Kuswoyo et al., 2020). The total score represented the participant's baseline front kick accuracy. Standardized instructions and warm-up procedures were applied to reduce measurement bias and ensure comparable testing conditions across participants.

2) Training intervention (circuit-based accuracy training program)

Participants then completed a two-week circuit-based accuracy training program. The circuit consisted of multiple stations designed to emphasize controlled execution and accuracy under structured time constraints. The program was implemented with 3–4 sets per session, with a work duration of 30–45 seconds per station. The circuit was supervised by the coach and the researcher to ensure correct technique execution and consistent program delivery (Ahmad et al., 2023; Ramos-Campo et al., 2021).

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The main objective of the intervention was to improve front kick accuracy through:

1. repeated execution of target-oriented front kicks,
2. controlled movement timing within each station,
3. structured repetition volumes across sets, and
4. continuous correction and monitoring to maintain technical quality.

3) Post-test (outcome measurement)

After completing the two-week intervention, participants performed the same front kick accuracy test under identical conditions to the pre-test (same target board, scoring system, warm-up, and 20 attempts per participant). The post-test score was used to evaluate changes in front kick accuracy following the intervention.

To support internal consistency, the same testing protocol, equipment, and scoring criteria were used for both pre-test and post-test. All sessions were conducted in a similar training environment to minimize the influence of external factors (e.g., surface conditions, space limitations, equipment differences) (Cormier et al., 2022; Dingley et al., 2015).

Statistical analysis.

Data analysis was conducted using descriptive and inferential statistics. Descriptive statistics were used to summarize participant performance at pre-test and post-test, including mean, standard deviation, minimum–maximum values, and performance category distributions (e.g., moderate, good, very good).

Before hypothesis testing, the distribution of accuracy scores was examined to confirm the assumptions required for parametric testing (e.g., approximately normal distribution). The main hypothesis—whether circuit-based accuracy training improves front kick accuracy—was tested using a paired-sample t-test, which compares the mean difference between pre-test and post-test scores within the same participants. The level of significance was set at $p < 0.05$.

To provide a clearer interpretation of the magnitude of improvement, the analysis also included:

1. Mean difference (Δ) between post-test and pre-test scores, and
2. Effect size (Cohen's d) to indicate practical significance of the intervention (small, moderate, or large impact).

All statistical analyses were performed using standard statistical software (e.g., SPSS or equivalent). Results were reported using appropriate statistical notation (mean ± SD, t-value, p-value), ensuring transparency and reproducibility.

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Results

Table 1. Results Test of Normality (Shapiro–Wilk)

Variable	Statistic	df	Sig.
Pre_Test_Front Kick_Right Leg	0.926	30	0.059
Pre_Test_Front Kick_Left Leg	0.956	0	0.246
Post_Test_Front Kick_Right Leg	0.933	0	0.059
Post_Test_Front Kick_Left Leg	0.940	0	0.090

Table 2. Test of Homogeneity of Variances (Levene's Test)

Levene Statistic	df1	df2	Sig.
1.602	3	116	0.193

Table 3. Result of Paired Samples Test

Pair	t	df	Sig. (2-tailed)
Post–Pre Test Front Kick Right Leg	15.176	29	0.000
Post–Pre Test Front Kick Left Leg	13.444	29	0.000

Table 4. Result of Pre-Test Front Kick (Left Leg)

Category	Frequency	Percentage
Good	15	50.0%
Moderate	15	50.0%
Total	**30**	**100%**

Table 5. Result of Pre-Test Front Kick (Right Leg)

Category	Frequency	Percentage
Good	16	53.3%
Moderate	14	46.7%
Total	30	100%

Table 6. Result of Post-Test Front Kick (Left Leg)

Category	Frequency	Percentage
Very Good	20	66.7%
Good	10	33.3%
Total	30	100%

Table 7. Result of Post-Test Front Kick (Right Leg)

Category	Frequency	Percentage
Very Good	22	73.3%
Good	8	26.7%
Total	30	100%

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Assumption testing. The Shapiro–Wilk normality test (Table 1) showed that all significance values for the pre-test and post-test scores of both the right and left legs were above 0.05 ($p > 0.05$). This indicates that the data were normally distributed, meeting the requirement for parametric analysis. In addition, Levene's test of homogeneity of variances (Table 2) was not significant ($p = 0.193$), indicating that the variances across conditions were homogeneous. Therefore, the main assumptions for parametric testing were satisfied.

Effect of the intervention (paired-sample t-test). The paired-sample t-test results (Table 3) demonstrated a significant improvement in front kick accuracy after the circuit-based accuracy training program for both legs. For the right leg, the difference between pre-test and post-test scores was significant ($t = 15.176$; $p < 0.001$). Similarly, the left leg also showed a significant improvement ($t = 13.444$; $p < 0.001$). These findings confirm that the training intervention had a statistically significant effect on front kick accuracy.

Changes in performance categories (descriptive results). The pre-test category distributions (Tables 4–5) indicated that athletes' performance was mainly within the moderate–good range. For the left leg (Table 4), performance was evenly divided between the *moderate* and *good* categories (50% each). For the right leg (Table 5), most athletes were classified as *good* (53.3%), while the rest were *moderate* (46.7%).

After the intervention, the post-test distributions shifted clearly toward higher categories (Tables 6–7). For the left leg post-test (Table 6), most athletes reached the *very good* category (66.7%), with the remaining athletes in the *good* category (33.3%). For the right leg post-test (Table 7), the *very good* category became even more dominant (73.3%), while the remainder were classified as *good* (26.7%).

Overall, the category distributions shifted from moderate–good at pre-test to predominantly very good–good at post-test for both legs. This descriptive pattern supports the significant paired-sample t-test results and indicates a consistent improvement in front kick accuracy following the circuit-based accuracy training program.

Discussion

The main hypothesis of this study was that circuit-based accuracy training would significantly improve front kick accuracy in PSHT pencak silat students. The results supported this hypothesis, showing a statistically significant improvement in front kick accuracy for both the right and left legs after the intervention (paired-sample t-test, $p < 0.001$). This section interprets the findings using principles of motor learning, neuromuscular adaptation, and training specificity, and relates them to relevant empirical evidence in martial arts training.

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Effect of Circuit-Based Accuracy Training on Front Kick Accuracy

The observed improvements can be explained through the principle of specificity, which states that adaptations are greatest when training closely matches the targeted performance task. In this study, the circuit format emphasized repeated front kick execution under structured time demands, which likely increased task-relevant repetitions and reinforced accurate movement patterns. From a motor learning perspective, repetitive, goal-directed practice supported by feedback facilitates refinement of coordination and reduces movement variability, resulting in more consistent directional control of the kick (Iswana, 2019).

In addition, the circuit structure likely strengthened underlying physical capacities—such as lower-limb stability, balance, and coordination—that are essential for accurate striking. Accuracy in kicking depends not only on technique, but also on the ability to stabilize the trunk and supporting leg while controlling the swing-leg trajectory. The significant post-test gains suggest improved postural control, force regulation, and movement timing, which are commonly linked to neuromuscular adaptations following structured skill-based conditioning These findings align with previous studies reporting that integrating technical drills with conditioning elements in circuit formats can enhance kicking accuracy and movement consistency in martial arts athletes (Albalad-Aiguabella et al., 2025; Bond et al., 2017; Kobal et al., 2017).

Why Circuit Training May Enhance Kicking Precision

Beyond repetition, the circuit method may improve accuracy because it exposes athletes to varied constraints (e.g., time pressure and station-to-station transitions) while maintaining the same technical objective. In motor learning, variable practice under controlled constraints can strengthen movement adaptability and attentional control, helping athletes maintain precision when conditions change (Han et al., 2022; Umar et al., 2023). This is particularly relevant in combat sports, where athletes must kick accurately under fatigue, pressure, and dynamic positioning (Chang et al., 2020a, 2020b).

Another plausible explanation is improved attentional engagement. Circuit sessions tend to reduce monotony by rotating tasks, which may increase motivation and focus during repeated executions. Increased engagement can enhance motor learning and reduce performance plateaus, supporting continuous refinement of technique. Consistent with this view, prior research has shown that circuit-based programs incorporating coordination, agility, and task-specific technical drills can improve striking precision and technical efficiency among martial arts practitioners

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Practical Meaning of the Category Shift (Moderate–Good to Very Good–Good)

The descriptive distributions strengthen the statistical findings. Before training, athletes' accuracy was mainly in the moderate–good range, whereas after training most athletes moved into the very good–good categories for both legs (Condello et al., 2019; Wali et al., 2023; Yaroshenko et al., 2024). This pattern suggests that the program was not only statistically effective but also practically meaningful, producing improvements visible at the performance level. For coaches, such a category shift indicates increased consistency and reliability of scoring-oriented techniques—an important outcome for competitive readiness.

Importance and Practical Application

The results are important because front kick accuracy is a performance determinant in pencak silat: accurate targeting improves scoring probability while reducing wasted energy and tactical exposure. Practically, the circuit-based model used in this study is feasible for clubs with limited time because it is structured, scalable, and can be implemented without complex technology (Adebiyi, Natasha F, n.d.; Albalad-Aiguabella et al., 2025; Bean & Forneris, 2017). Coaches can apply this approach by:

1. maintaining high task specificity (front kick actions integrated into stations),
2. using short work intervals to support quality repetitions,
3. applying progressive overload through controlled intensity or station difficulty, and
4. using simple accuracy feedback (target zones and scoring) to reinforce precision. This combination supports both conditioning and technical learning in a time-efficient format, which is valuable for student-based training environments.

Strengths of the Study

A key strength is the use of a task-specific circuit intervention that directly targeted front kick accuracy and was implemented in a real training context, improving ecological validity (Albalad-Aiguabella et al., 2025; Kobal et al., 2017; Ramos-Campo et al., 2021). The pre-test–post-test structure enabled objective evaluation of performance change, and assumption testing supported appropriate use of parametric statistics. Additionally, the approach is practical and easily transferable to similar martial arts settings.

Limitations and Future Research

Despite promising findings, this study had limitations. The sample was restricted to two PSHT branches, and differences in coaching styles, facilities, training culture, and athlete backgrounds may limit generalizability. The short intervention duration also limits conclusions about long-term retention. Future studies should involve larger and more diverse samples, longer intervention periods, and additional objective measures (e.g., biomechanical or kinematic analysis) to clarify the

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mechanisms underlying accuracy improvement and to examine whether gains are maintained over time.

Conclusions

This study aimed to examine the effect of circuit-based accuracy training on front kick accuracy in pencak silat (PSHT) students at the Undana and STIM commissariat branches in Kupang, NTT. Using a one-group pre-test–post-test experimental design with 30 participants, front kick accuracy was measured with a zoned target board (20 attempts per athlete) before and after a two-week circuit training intervention.

The results showed that the data met the assumptions for parametric testing (normality and homogeneity). The paired-sample t-test indicated a statistically significant improvement in front kick accuracy for both legs after the intervention ($p < 0.001$), with improvements observed for the right leg and the left leg. Descriptively, performance categories shifted from predominantly moderate–good at pre-test to mainly very good–good at post-test, confirming consistent gains across participants.

Overall, these findings demonstrate that circuit-based accuracy training is effective for improving front kick accuracy in pencak silat and can be recommended as a practical method for technical training programs in martial arts settings.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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