



The Effect of Single Leg Hop Training on Shooting Accuracy in Futsal Games

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ABSTRACT

Shooting accuracy is a decisive skill in futsal, where players often have limited time and space to create scoring opportunities. Single-leg hop training may support this skill by developing unilateral lower-limb power and body control, but its association with shooting accuracy among university futsal players warrants direct examination. This study aimed to assess changes in shooting accuracy following single-leg hop training among students of the Physical Education, Coaching, and Health Faculty (PKO FIKK), Universitas Negeri Makassar (UNM). The study used a pre-experimental, one-group pretest–posttest design. Participants were 15 PKO FIKK UNM students who completed shooting-accuracy assessments before and after the training intervention. Data were analyzed descriptively and with a paired-samples t-test. The mean shooting-accuracy score increased from 8.13 (SD = 1.88) at pretest to 13.33 (SD = 1.23) at posttest, a mean gain of 5.20 points. The difference was statistically significant, $t(14) = 13.239$, $p < .001$. These results indicate that participants achieved higher shooting-accuracy scores after the intervention. The findings suggest that single-leg hop training may be a useful component of futsal preparation when combined with regular, task-specific shooting practice. However, because the study involved a small sample and did not include a control group, the improvement cannot be attributed exclusively to the intervention. The results should therefore be interpreted as evidence of a significant pretest–posttest change in this participant group. Controlled studies with larger samples and clearly reported training protocols are needed to test whether the observed improvement is caused by the intervention and can be generalized to other futsal players.

INTRODUCTION

Futsal is a fast, intermittent team sport in which players must perform technical actions under substantial spatial and temporal pressure. Shooting is especially consequential because it converts possession into a direct scoring opportunity. Effective shooting depends on more than the force applied to the ball: players must coordinate the support leg, trunk, and kicking limb while controlling the direction and point of contact. Research on futsal performance has examined the physical and technical characteristics associated with playing level, as well as the validity of futsal-specific skill tests (Naser & Ali, 2016). Biomechanical research likewise indicates that kicking outcomes are shaped by the interaction between approach movement and the support limb (Palucci Vieira et al., 2019).



For PKO FIKK UNM students, shooting accuracy is a practical performance concern as well as a technical learning outcome. A player who can strike the ball powerfully but cannot direct it consistently may fail to make the most of a scoring opportunity. Training that develops lower-limb function may therefore complement repeated technical practice. However, training interventions need to be assessed against shooting accuracy itself; improvements in jump height, strength, or general athletic performance do not automatically demonstrate improvement in shot placement. Single-leg hop training is a unilateral plyometric exercise involving rapid eccentric loading followed by a forceful concentric action. Its repeated take-off and landing demands may develop lower-limb explosive capacity and dynamic control. These qualities could be relevant to the shooting action, particularly because the support leg must stabilize the body while the kicking leg accelerates toward the ball. Yet this proposed transfer is a rationale for investigation, not an established effect. Plyometric exercises vary in movement direction, intensity, landing demands, and training volume, so findings for one exercise or population cannot be assumed to apply directly to single-leg hops or to university futsal players.

Plyometric training has been studied as a way to improve neuromuscular performance in soccer and other team sports. A systematic review and meta-analysis reported a positive pooled effect of plyometric training on soccer kicking performance, while also drawing on studies that used different interventions and kicking outcomes (Ramírez-Campillo et al., 2023). This synthesis supports the general plausibility of a training effect but does not establish that every plyometric protocol improves accuracy, or that the effect is specific to futsal shooting. The evidence also cautions against treating shooting as a simple proxy for physical power. In professional futsal players, simulated match-related fatigue reduced running and neuromuscular measures, yet did not significantly change finishing-kick speed or accuracy (Miloni et al., 2016). In a different line of research, futsal kicking accuracy improved following a dynamic coordination program relative to static coordination training (Priyambada et al., 2024). These findings suggest that technical precision can reflect coordinated movement and task-specific control, as well as physical capacity. They also support measuring accuracy directly rather than inferring it from strength or jumping outcomes. Studies of plyometric and related training have examined several forms of transfer to kicking and shooting. Examples include plyometric training effects on soccer kicking performance (Ramírez-Campillo et al., 2023), plyometric work combined with sprint training in adolescent soccer players (Sáez de Villarreal et al., 2015), and training interventions involving hurdle hops or jump-to-box exercises in futsal and soccer contexts (Musamus *Journal of Physical Education and Sport*, 2025; *ACTIVE: Journal of Physical Education, Sport, Health and Recreation*, 2023). Indonesian journal studies have also considered rope-skipping and plyometric training in relation to futsal or football shooting (Nuryadin et al., 2023; *COMPETITOR*, 2026). Together, this work makes a case for examining how specific training exercises relate to sport skills, while leaving open which exercise best supports accuracy in the present population.

The available evidence does not yet provide a clear, directly applicable answer to whether single-leg hop training improves futsal shooting accuracy among PKO FIKK UNM students. Much of the related work concerns soccer rather than futsal, evaluates broader plyometric programs rather than a clearly defined single-leg hop intervention, or measures outcomes such as kick speed, general kicking ability, or physical fitness. Even evidence from futsal studies using other plyometric exercises cannot establish the effect of single-leg hops, because exercise demands and adaptation may differ. A further issue is that shooting accuracy should be distinguished from shot velocity and overall kicking performance. These outcomes may relate to one another, but they are not interchangeable. Consequently, a focused study should test shooting accuracy as its primary outcome and describe the single-leg hop program sufficiently for coaches to interpret and reproduce it. This study addresses that specific question in a university-level futsal context.

This study aims to examine the effect of single-leg hop training on shooting accuracy in futsal among students of the Physical Education, Coaching, and Health Faculty (PKO FIKK), Universitas Negeri Makassar (UNM). Its novelty lies in isolating a unilateral plyometric exercise and evaluating its relationship with a specific technical outcome shooting accuracy in the target population. By bringing together a clearly specified training focus, a futsal skill measure, and university students as participants, the study is intended to provide locally relevant evidence for coaches and practitioners. The findings may help inform training choices, while conclusions should remain bounded by the study's design, participants, and intervention characteristics.

METHODS

This study employed a pre-experimental, one-group pretest–posttest design to examine changes in futsal shooting accuracy following single-leg hop training. The study was conducted at the Faculty of Sport Science and Health, Universitas Negeri Makassar (FIKK UNM), from November to December 2024. The design consisted of a baseline test (O_1), the training intervention (X), and a post-intervention test (O_2): $O_1 \rightarrow X \rightarrow O_2$. A pretest–posttest comparison is appropriate for documenting change within the same participants; however, because the study had no control group, changes cannot be attributed to the intervention with the same confidence as in a controlled experiment (Knapp, 2016).

The study population comprised PKO FIKK UNM students. The sample consisted of 15 students who received the single-leg hop intervention. The original study record should specify how participants were selected and whether any eligibility criteria were applied; these details should not be inferred. The intervention was delivered during the study period. For reproducibility, the final manuscript should report its frequency, number of sessions, sets, repetitions, rest intervals, progression, supervision, and any concurrent futsal training. These details matter because plyometric responses depend on the training dose and program structure. Meta-analytic evidence supports the potential of plyometric training to improve kicking performance, but the available evidence primarily concerns soccer kicking speed and distance, rather than futsal shooting accuracy specifically (Zhang et al., 2023; Ramírez-Campillo et al., 2023).

Shooting accuracy was assessed before and after the intervention using the same futsal shooting test and testing conditions. Participants completed the pretest individually; scores were recorded using the scoring procedure specified by the test protocol. After completing the training program, they performed the posttest under comparable conditions, and the results were recorded in the same manner. The manuscript should state the test's source, target-zone layout, shooting distance, number of attempts, scoring rules, warm-up, rest between attempts, and whether shots were taken with the dominant foot, non-dominant foot, or both. These specifications are necessary because futsal shooting tests differ in their protocols; published work has examined the reliability and validity of futsal-specific shooting assessments (Naser & Ali, 2016; Farhani et al., 2019).

Data were summarized using means and standard deviations for pretest and posttest scores. The distribution of paired difference scores was assessed using the Shapiro–Wilk test. Because the design compares two measurements from the same participants, the primary inferential analysis was a paired-samples t-test if the difference scores met the normality assumption. If that assumption was not met, the Wilcoxon signed-rank test was used. The analysis should report the test statistic, degrees of freedom where applicable, exact p value, mean change, and a confidence interval; an effect-size estimate should also be included to convey the magnitude of change. A homogeneity-of-variance test is not required for this paired design. Findings should be interpreted as a pre–post change in this sample, recognizing that practice effects, maturation, or other events during the study could also contribute to observed differences (Knapp, 2016).

RESULTS AND DISCUSSION

Results

Descriptive Statistics

The shooting-accuracy scores of the 15 PKO FIKK UNM students were tabulated before analysis. Descriptive statistics were used to summarize performance before and after the single-leg hop intervention. The mean score increased from 8.13 at pretest to 13.33 at posttest, a mean increase of 5.20 points.

Table 1. Descriptive statistics for futsal shooting accuracy

Test	<i>N</i>	Minimum	Maximum	Range	Sum	Mean	SD
Pretest	15	5	11	6	122	8.13	1.88
Posttest	15	11	15	4	200	13.33	1.23

The posttest mean was 5.20 points higher than the pretest mean. The posttest scores also showed lower variability ($SD = 1.23$) than the pretest scores ($SD = 1.88$). These descriptive results indicate improved average

shooting-accuracy scores after the intervention; the inferential analysis below evaluates whether the observed pretest–posttest difference was statistically significant.

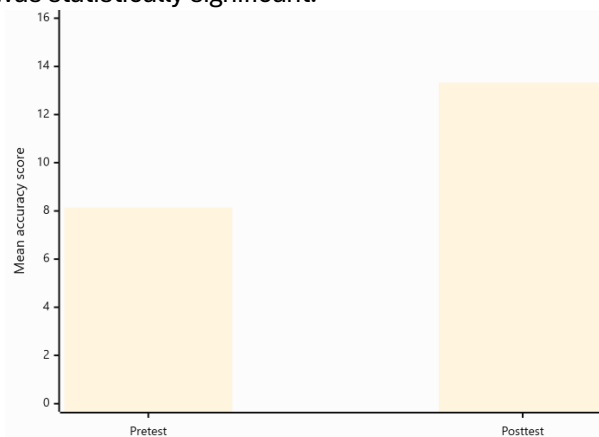


Figure 1. Mean shooting-accuracy scores before and after the intervention

Assumption Check

The supplied Kolmogorov–Smirnov results indicated no statistically significant departure from normality for either assessment: pretest, $D = 0.211$, $p = 0.072$; posttest, $D = 0.172$, $p \geq 0.200$. Both p values exceed .05.

Table 2. Kolmogorov–Smirnov normality results

Assessment	<i>D</i>	<i>p</i>	Decision at $\alpha = .05$
Pretest	0.211	0.072	No significant departure from normality
Posttest	0.172	≥ 0.200	No significant departure from normality

The study used the same 15 students for both assessments. Therefore, the appropriate assumption for a paired-samples t -test is normality of the **paired difference scores**. The reported results test pretest and posttest distributions separately; if available, normality of the difference scores should also be checked. A homogeneity-of-variance test is not required for this one-group paired design.

Hypothesis Test

The study hypothesis was that single-leg hop training would be associated with a difference in shooting-accuracy scores between pretest and posttest. A two-tailed paired-samples t -test was used to compare the two assessments.

Table 3. Paired-samples t -test for shooting accuracy

Mean difference (posttest – pretest)	<i>t</i>	<i>df</i>	<i>p</i>	Decision
5.20	13.239	14	$< .001$	Statistically significant

The paired-samples test showed a statistically significant difference between pretest and posttest scores, $t(14) = 13.239$, $p < .001$. The posttest mean was higher by 5.20 points. The null hypothesis of no pretest–posttest difference was rejected. Based on the reported results, shooting-accuracy scores improved following the single-leg hop intervention among the participants.

Interpretive note: The supplied t statistic, sample size, and mean difference imply an estimated paired standardized effect (d_{z}) of approximately 3.42. This is a derived estimate, not a directly supplied SPSS result. Because the design had no control group, the findings establish a significant change over time in this sample; other factors, such as repeated-test practice or concurrent training, cannot be ruled out as contributors.

Discussion

This study found a statistically significant difference in futsal shooting-accuracy scores after the single-leg hop intervention. Among the 15 PKO FIKK UNM students, the mean increased from 8.13 (SD = 1.88) at pretest to 13.33 (SD = 1.23) at posttest, a gain of 5.20 points. The paired-samples test confirmed that the difference was statistically significant, $t(14) = 13.239$, $p < .001$. This result supports the study hypothesis that

scores improved between the two assessments. The estimated paired effect size, $d_{z} \approx 3.42$, is large; however, it is calculated from the reported test statistic and sample size and should be interpreted with caution, particularly given the small sample and one-group design.

Plyometric training provides a plausible framework for interpreting this improvement. Single-leg hopping requires rapid force production and repeated take-off and landing on one limb. Such tasks involve the stretch-shortening cycle, in which the muscle-tendon unit undergoes a rapid lengthening action followed by shortening. Reviews describe how plyometric exercise can develop the neuromuscular qualities used in fast, reactive movements (Cormie et al., 2011; Markovic & Mikulic, 2010; Ramirez-Campillo et al., 2023). In this study, however, strength, balance, muscle activation, and movement mechanics were not measured. They therefore remain potential explanations for the observed score change, rather than demonstrated mediators of it.

The proposed connection to shooting is also biomechanically credible. A futsal shot relies on coordinated action by the kicking limb and the support limb, together with an approach step and control of body position. In a study of futsal players, support-limb and approach-run mechanics differed between dominant- and non-dominant-side kicks, and less efficient support-limb motion was associated with poorer performance outputs (Palucci Vieira et al., 2019). Single-leg hopping may provide a training stimulus relevant to unilateral force production and landing control. Yet the present study did not measure support-leg stability or kicking mechanics, so it cannot show that either changed or caused the improvement in accuracy.

Prior evidence is broadly consistent with the possibility of transfer from plyometric training to kicking performance. A systematic review and meta-analysis found a positive overall effect of plyometric training on soccer kicking performance, particularly outcomes such as kicking speed and distance (Zhang et al., 2023). Research with futsal players has also reported gains in explosive-strength measures following structured strength and plyometric programs, although the protocols and outcomes vary between studies (Guzmán et al., 2024). These findings support the general rationale for using plyometric methods in futsal training, but they are not direct replications of this single-leg hop intervention: soccer kicking speed, jump performance, and futsal shooting accuracy are related yet distinct outcomes. A futsal-specific study of coordination training further suggests that movement coordination can be relevant to kick accuracy (Priyambada et al., 2024).

The increase in the posttest mean and the lower posttest standard deviation suggest that participants scored higher and that their scores were less dispersed at the end of the study. Nevertheless, the available summary statistics do not reveal whether every student improved or whether the change was concentrated among a few participants. Individual paired scores, confidence intervals, and a fully described shooting test would make the result easier to interpret. Shooting-test protocols differ in distance, number of attempts, target zones, and scoring systems; futsal-specific performance tests have therefore emphasized the importance of clear procedures and measurement properties (Naser & Ali, 2016; Farhani et al., 2019).

The practical implication should be kept proportionate to the evidence. Coaches may consider single-leg hopping as one component of a program that also includes technical shooting practice, but the current findings do not establish an optimal dose or demonstrate that hop training alone improves match scoring. Nor did this study measure injury incidence or risk factors. Although landing-training research addresses lower-limb injury risk, conclusions about injury prevention require specific injury or biomechanical outcomes (Mollinger et al., 2023). The reference to the Golgi tendon organ should likewise not be treated as a measured explanation: this study included no assessment of tendon-organ activity, reflex responses, or muscle-tendon properties.

The study's main limitation is its one-group pretest-posttest design. Without a control group, the observed change cannot be attributed exclusively to single-leg hop training. Familiarity with the shooting test, concurrent training, motivation, or other events during the intervention period could also have contributed. Methodological analyses of one-group pretest-posttest designs specifically caution against strong causal claims from this design (Knapp, 2016). Future studies should use a control or comparison group, report the intervention dose in full, provide individual or change-score data, and assess both shooting accuracy and relevant biomechanical or physical variables. In conclusion, the students' shooting-accuracy scores were significantly higher at posttest, and the result is consistent with the potential value of plyometric training. It should be presented as a promising pre-post finding in this sample, rather than definitive proof that single-leg hops alone caused the improvement.

CONCLUSION

This study examined whether single-leg hop training was associated with improved futsal shooting accuracy among 15 students of the Physical Education, Coaching, and Health Faculty, Universitas Negeri Makassar (PKO FIKK UNM). The mean shooting-accuracy score increased from 8.13 (SD = 1.88) at pretest to 13.33 (SD = 1.23) at posttest, representing a mean improvement of 5.20 points. A paired-samples t-test indicated that this pre–post difference was statistically significant, $t(14) = 13.239$, $p < .001$. Thus, the participants achieved higher shooting-accuracy scores after completing the intervention.

Conceptually, single-leg hopping may support futsal shooting by challenging unilateral force production and lower-limb control, qualities that could contribute to maintaining body position during the shooting action. This interpretation is consistent with the demands of futsal kicking, in which the support limb and approach movement play a role in shot execution. However, this study measured shooting accuracy only; it did not directly assess balance, strength, coordination, muscle activation, or kicking mechanics. These factors should therefore be understood as possible explanations, not confirmed mechanisms.

The findings suggest that single-leg hop training may be considered as one element of a futsal training program alongside regular, task-specific shooting practice. They should be interpreted within the limits of the study: the sample was small and the one-group pretest–posttest design did not include a control group. Consequently, the results demonstrate a significant improvement over time in this sample, but do not establish that single-leg hop training alone caused the change. Future studies should use a controlled design, report the training protocol in detail, and assess whether the improvement is maintained and transfers to match performance.

REFERENCES

- Bathe, C., Fennen, L., Heering, T., Greif, A., & Dubbeldam, R. (2023). Training interventions to reduce the risk of injury to the lower extremity joints during landing movements in adult athletes: A systematic review and meta-analysis. *BMJ Open Sport & Exercise Medicine*, 9(2), e001508. <https://doi.org/10.1136/bmjsem-2022-001508>
- Cormie, P., McGuigan, M. R., & Newton, R. U. (2011). Developing maximal neuromuscular power: Part 1—Biological basis of maximal power production. *Sports Medicine*, 41, 17–38. <https://doi.org/10.2165/11537690-000000000-00000>
- Farhani, F., Rajabi, H., Negaresh, R., Ali, A., Shalamzari, S. A., & Baker, J. S. (2019). Reliability and validity of a novel futsal special performance test designed to measure skills and anaerobic performance. *International Journal of Sports Physiology and Performance*, 14(8), 1096–1102. <https://doi.org/10.1123/ijsp.2018-0850>
- Guzmán, A. B., Vidal-Espinoza, R., Urzua-Alul, L., Castelli Correia de Campos, L. F., Fuentes-López, J., Urra-Albornoz, C., Cossio-Bolaños, M., & Gomez-Campos, R. (2024). Prescription criteria and effects of explosive strength training in indoor soccer players: A systematic review. *European Journal of Translational Myology*, 34(4). <https://doi.org/10.4081/ejtm.2024.12888>
- Knapp, T. R. (2016). Why is the one-group pretest–posttest design still used? *Clinical Nursing Research*, 25(5), 467–472. <https://doi.org/10.1177/1054773816666280>
- Markovic, G., & Mikulic, P. (2010). Neuro-musculoskeletal and performance adaptations to lower-extremity plyometric training. *Sports Medicine*, 40, 859–895. <https://doi.org/10.2165/11318370-000000000-00000>
- Milioni, F., Vieira, L. H. P., Barbieri, R. A., Zagatto, A. M., Nordsborg, N. B., Barbieri, F. A., Dos-Santos, J. W., Santiago, P. R. P., & Papoti, M. (2016). Futsal match-related fatigue affects running performance and neuromuscular parameters but not finishing kick speed or accuracy. *Frontiers in Physiology*, 7, 518. <https://doi.org/10.3389/fphys.2016.00518>

- Musamus Journal of Physical Education and Sport. (2025). The effect of plyometric barrier hops and jump-to-box training on shooting accuracy in futsal among extracurricular students at SMA PGRI 2 Palembang. <https://ejournal.unmus.ac.id/index.php/physical/article/view/7126>
- Naser, N., & Ali, A. (2016). A descriptive-comparative study of performance characteristics in futsal players of different levels. *Journal of Sports Sciences*, 34(18), 1707–1715. <https://doi.org/10.1080/02640414.2015.1134806>
- Nuryadin, et al. (2023). The effect of rope skipping training on shooting ability to the goal of futsal game students UPT SPF SMPN 46 Makassar. *COMPETITOR: Jurnal Pendidikan Kepelatihan Olahraga*. <https://ojs.unm.ac.id/competitor/article/view/59549>
- Palucci Vieira, L. H., Cunha, S. A., Santiago, P. R. P., Dos Santos, P. C., Cardenas, G. C., Barbieri, R. A., Baptista, A. M., & Barbieri, F. A. (2019). Dominant/non-dominant support limb kinematics and approach run parameters in futsal kicking of stationary and rolling ball. *The Journal of Sports Medicine and Physical Fitness*, 59(11), 1852–1860. <https://doi.org/10.23736/S0022-4707.19.09654-3>
- Priyambada, G., Raharja, A. T., Julianur, J., Rismayanthi, C., & Ristiana, P. A. (2024). The influence of a coordination training model that uses various manipulative movements on futsal kick accuracy. *Jurnal Keolahragaan*, 12(2), 195–204. <https://doi.org/10.21831/jk.v12i2.70905>
- Ramirez-Campillo, R., et al. (2023). Effects of plyometric training on kicking performance in soccer players: A systematic review and meta-analysis. *Frontiers in Physiology*, 14, 1072798. <https://doi.org/10.3389/fphys.2023.1072798>
- Sáez de Villarreal, E., Suarez-Arrones, L., Requena, B., Haff, G. G., & Ferrete, C. (2015). Effects of plyometric and sprint training on physical and technical skill performance in adolescent soccer players. *Journal of Strength and Conditioning Research*, 29(7). <https://doi.org/10.1519/JSC.0000000000000838>
- Zhang, Y., Li, D., Gómez-Ruano, M.-Á., Memmert, D., Li, C., & Fu, M. (2023). Effects of plyometric training on kicking performance in soccer players: A systematic review and meta-analysis. *Frontiers in Physiology*, 14, Article 1072798. <https://doi.org/10.3389/fphys.2023.1072798>