

The effect of four weeks of plyometric single-leg hurdle hops with backward run on shooting speed in student futsal players

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ABSTRACT

In the sport of futsal, enhancing shooting speed is crucial for performance, yet there is a lack of targeted training methods that effectively improve this skill among student players. This study aimed to analyze the effect of plyometric single-leg hurdle hops combined with backward run training on shooting speed in student futsal players. A quasi-experimental design with a one-group pretest–posttest approach was employed. The population consisted of 25 student futsal players, and the sample included 15 players with a mean age of 14.67 ± 0.49 years, height of 160.73 ± 4.46 cm, weight of 50.20 ± 5.93 kg, and BMI of 19.42 ± 2.02 , selected using purposive sampling. Shooting speed was measured using a camera, and the recordings were analyzed with the Kinovea application. The results showed a significant increase ($p < 0.05$) in shooting speed following the training program. The mean shooting speed improved from 28.3 ± 2.02 m/s in the pretest to 30.4 ± 2.20 m/s in the posttest, with a mean difference of 2.04 ± 1.98 m/s and a 2-tailed significance value of 0.001 (< 0.05). In conclusion, plyometric single-leg hurdle hops combined with backward run training significantly improved shooting speed in student futsal players.

KEYWORDS

Futsal; Plyometric; Single Leg Hurdle Hops; Backward Run; Shooting Speed

1. INTRODUCTION

Good shooting speed is a crucial factor in achieving success in futsal (Naser et al., 2017; Naser & Ali, 2016; Ramos-Campo et al., 2016). It is essential for players to have the ability to kick quickly and accurately to create goals and beat the opponent's goalkeeper (Mohammed et al., 2014; Nicolai Ré et al., 2016; Sekulic et al., 2021). Therefore, it is essential to develop specific training methods to increase shooting speed (Villareal et al., 2015). One interesting training method developed to increase shooting speed is plyometric single-leg hurdle hops with backward run (Drouzas et al., 2020; Galeko et al., 2022; Nicolai Ré et al., 2016). Plyometrics has emerged as a reference training method that is effective, efficient and easy to do to improve various components of physical condition, which of course, can support player performance (Kons et al., 2023; Markovic & Mikulic, 2010; Wang & Zhang, 2016; Zhang et al., 2023). This exercise focuses on developing lower extremity muscles (Grgic et al., 2021; Moran et al., 2023; Spyrou et al., 2020). In the game of futsal, the lower extremity muscles have an essential role in supporting various skills such as shooting, passing, receiving and others (Palucci Vieira et al., 2021). Plyometric single-leg hurdle hops with backward runs require players to move quickly and explosively by jumping over a series of obstacles at a certain height using one leg, followed by running backward. This exercise aims to develop the strength, speed and muscle coordination needed for high-speed shooting.

In the backward run movement, the muscles perform flexion and extension movements corresponding to kicking a football. Backwards running training can increase quadriceps muscle strength (Uthoff et al., 2020). In this exercise, dominant quadriceps muscle contraction increases strength and stability when performing shooting movements. In addition, the mechanics of the backward run movement affect the player's coordination and understanding of body position and changes in momentum, which can be applied in shooting movements to increase shooting speed, power and accuracy (Uthoff et al., 2021). So, adding backwards running training can support student futsal players' ability to carry out shooting movements.

Although plyometric training is often used in strength and speed training, there has been no previous research that combines plyometric single-leg hurdle hop training with backward running training to increase the shooting speed of futsal players. Therefore, conducting this research to analyze the effect of plyometric single-leg hurdle hops with backward run training on shooting speed in student futsal players is interesting. In the context of this research, this exercise is considered novelty or innovative because it has yet to be explored much in previous research. However, it is necessary to

carry out scientific testing regarding the effect of this training on the shooting speed of the futsal players being studied.

By focusing on the effect of plyometric single leg hurdle hops with backward run on ball speed in futsal players' shots, the information obtained can provide a better understanding of the benefits of this exercise in increasing the speed and accuracy of shots by futsal players, especially students. This research can also provide a valuable contribution for coaches in developing more effective and efficient training programs to increase futsal players' shooting speed and improve players' performance in playing futsal.

2. METHODS

2.1. Design and Participants

The method used in this research was a quasi-experimental design with a one-group pretest–posttest setup, where the plyometric single-leg hurdle hops combined with backward run training served as the independent variable, and shooting speed was the dependent variable. The shooting speed measurement instrument uses Kinovea software.

Fifteen male futsal players from a population of twenty-five participated in this study. Samples were taken using random sampling techniques. The age of the study participants was 14.67 ± 0.49 years, with a height of 160.73 ± 4.46 cm, a weight of 50.20 ± 5.93 kg, and a BMI of 19.42 ± 2.02 . Next, 15 players were given plyometric training, one-legged hurdle jumping with backward running.

2.2. Procedure

Fifteen futsal players were given a pretest to measure shooting speed. Then, the players were given plyometric single-leg hurdle hop treatment with backwards running training for four weeks (3 times a week) (Maciejczyk et al., 2021; Neves Da Silva et al., 2017), and ended with a posttest. The provided training program is shown in the Table 1.

Table 1. Training program in 4 weeks

Week	Sets	Repetitions per Set	Description
1	8	10	The exercise starts with an obstacle height of 23 cm. One repetition consists of jumping over the obstacle using one leg, returning with the same leg, and then performing backward running. Rest is taken based on a 1:3 ratio after crossing the finish line.
2	8	11	Same as week 1, but with one additional repetition per set.
3	8	12	Same as week 2, but with one additional repetition per set.
4	8	13	Same as week 3, but with one additional repetition per set.

The treatment procedure involved the participant standing on one leg facing an obstacle, with the other leg bent backward. The participant then jumped forward on the same leg, using arm swings to help maintain balance. The push is done with force using one leg, with a landing position with the knees slightly bent, jumping over the obstacles one by one from the first obstacle to the last obstacle, then returning with the same movement using the other leg after completing the last obstacle then continue with a backward running movement in the circuit that has been prepared. Backwards running is done by running backwards with the body, leaning slightly backwards and then swinging the arms to balance the body. After arriving at the finish line, the sample takes a break with a duration calculated from a ratio of 1:3. This exercise is done in 8 sets with ten repetitions per set. One repetition is added each week to increase the training load gradually. The height of the obstacle used in this treatment is 23 cm.

2.3. Statistical Analysis

Several data analysis techniques are used in this research, including normality testing using Shapiro-Wilk and hypothesis testing using Paired Sample T-Test. Paired Sample T-Test was used to analyze the differences between the pretest and posttest. The significance level (Sig) used in decision-making is as follows: If the value (Sig) <0.05, then H0 is rejected, and Ha is accepted. If the value (Sig) is >0.05, then H0 is accepted, and Ha is rejected. Statistical analysis was carried out using IBM SPSS statistics 29.0.

3. RESULTS

This research was conducted for one month, with 14 days of practice, with details of one pre-test, 12 treatments, and one post-test. The number of participants is 15 players. The shooting speed calculation results were obtained using video analysis via the Kinovea application with the following data (Table 2).

Table 2. Shooting speed before and after training

Variable	N	Mean±SD	Min	Max	Mean±SD Post
Shooting Speed	Pre-test	15	28.3±2.02	24.3	32.2
	Post-test	15	30.4±2.20	25.8	34.4

Note. The data are presented by means ± SD.

Table 2 above describes the data from increased shooting speed in this study. The results show an increase in shooting speed after the training intervention. The mean pretest shooting speed was 28.3

± 2.02 m/s, while the posttest mean was 30.4 ± 2.20 m/s, indicating an average improvement of 2.04 ± 1.98 m/s.

Table 3 presents the results of the Shapiro–Wilk normality test for the shooting speed data in the pretest and posttest measurements.

Table 3. Normality test results

Variable	Shapiro-Wilk				
		Statistic	Df	p value	Result
Shooting	Pretest	0.95	15	0.53	Normal
Speed	Posttest	0.93	15	0.31	Normal

Note. The data are presented by means \pm SD and sig. Value: In the Shapiro-Wilk test, the data is normally if the sig. ≥ 0.05 .

Based on the results in Table 3, the Shapiro–Wilk normality test showed that the pretest ($p = 0.53$) and posttest ($p = 0.31$) values were both greater than 0.05. This indicates that all the data were normally distributed, allowing the hypothesis to be tested using the parametric paired-sample t-test. In the following, Table 4 shows the results of the paired-sample t-test comparing shooting speed before and after the training intervention.

Table 4. Effect of training on shooting speed: paired-sample t-test results

Variable	Paired Difference				t	df	p value
	Mean \pm SD	Std. Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
Pre-Post Shooting Speed	-2.04 ± 1.98	0.51	-3.13	-0.94	-3.98	14	0.001

Note. The data are presented by means \pm SD; *statistically significant difference, mean scores at point comparisons from baseline: sig (2-tailed) value of ≤ 0.05 .

Based on the results in Table 4, the paired-sample t-test showed a 2-tailed significance value of 0.001 (< 0.05), indicating a significant increase in shooting speed following plyometric single-leg hurdle hops combined with backward run training.

4. DISCUSSION

This study investigates the effect of plyometric single-leg hurdle hops with backward run training on increasing shooting ball speed in student futsal teams. Training is held three times a week for four weeks, paying attention to training principles and increasing the load weekly (Maciejczyk et al., 2021; Neves Da Silva et al., 2017). The results showed that plyometric single-leg hurdle hops with backward run training was proven to have a positive influence on increasing ball shooting speed.

Body adaptation is essential in implementing the plyometric single-leg hurdle hops with backward run exercise. This exercise requires players to make explosive movements at high speed. This exercise involves jumping and stomping movements that rely on leg muscle strength to produce explosive power. This exercise also helps increase flexibility, agility and body strength, especially in the lower extremities, because it involves hops and backward runs (Chen et al., 2023; Markovic & Mikulic, 2010). Good muscle and joint flexibility is essential in efficient movement sequences and can minimize the risk of injury during training and matches.

Short-term training progressions applied over four weeks also optimally increase dexterity and various types of specific work (Slimani et al., 2016; Váczi et al., 2013). Proper training periodization will stimulate the muscles well by gradually increasing the intensity of training (Edoya et al., 2015; Hartmann et al., 2015). At the beginning of the workout, the intensity is low to moderate to allow the body to adapt to the new movement. Next, the intensity is increased to moderate to high by increasing the number of repetitions or exercise duration per set (Davies et al., 2015). In the final stage, training is carried out at high intensity with additional training loads such as obstacles or extra weights. Gradual overloading can stimulate muscle growth more effectively (Plotkin et al., 2022).

The plyometric exercise single leg hurdle hops with backward run also has characteristics that match the kicking movements in futsal. Plyometric training is synonymous with a fast and efficient stretch-shortening cycle (Clark et al., 2018; Davies et al., 2015; Malisoux et al., 2006; van Roie et al., 2020). When the legs make a hopping movement, the leg muscles stretch when landing (eccentric contraction) before contracting to push the body up (concentric contraction). This rapid stretching and contraction process increases the strength and explosive power of the leg muscles needed to kick the ball at high speed. Backwards running, emphasizing quadriceps muscle contraction, aims to increase the strength and explosive power of the front thigh muscles. The quadriceps muscles are the main muscles that work when kicking the ball. With this exercise, futsal players can strengthen their quadriceps muscles and improve their ability to kick with maximum speed and accuracy. The backward running movement forces the quadriceps muscles to work harder and follow the contraction requirements when kicking. As a result, players can produce a more vital impulse when kicking the ball. In addition, this exercise involves single-leg hurdle hops, which hone the balance and strength of one leg at a time, similar to kicking a ball with one leg. Plyometric movements, such as jumping and stomping, also increase muscle strength and explosive power, which are essential in kicking the ball at high speed.

The novelty of the current study lies in its focus on the combination of plyometric single-leg hurdle hops with backward running as a training method specifically aimed at enhancing ball shooting speed in futsal players. Unlike previous research that typically examines plyometric exercises or backward running in isolation, this study integrates both components into a comprehensive training regimen. This novel approach has demonstrated a significant improvement in shooting speed, which highlights its potential effectiveness for futsal players. However, this study has limitations that should be considered. The sample size was relatively small and homogeneous, which may affect the generalizability of the results to a broader population. Additionally, the study did not assess long-term effects or potential impacts on other aspects of performance and injury risk. Future research should address these limitations by incorporating larger, more diverse samples and examining the long-term benefits and potential risks associated with this training method.

5. CONCLUSIONS

Based on the results of research and discussion of plyometric single leg hurdle hops with backward run training on increasing shooting speed, it can be concluded that through the plyometric single leg hurdle hops with backward run training method. The findings indicate that regular implementation of this exercise enhances lower-limb power and coordination, contributing to better performance in shooting tasks.

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