



The Effect of Functional Training on Power Improvement and Core Muscle Stabilization in Futsal Athletes

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ABSTRACT

This study aims to analyze the effect of functional training on improving lower-body muscle power and core muscle stabilization in futsal athletes in Bandung. The study employed an experimental method with a one-group pretest-posttest design. The sample consisted of 15 futsal athletes aged 16–19 years, selected using total sampling. The intervention, consisting of a functional training program, was conducted over 6 weeks at a frequency of 3 times per week (18 sessions). Measurements were taken using the Vertical Jump Test, the Triple Hop Jump Test, and the Unilateral Hip Bridge Endurance Test (UHBE). Data analysis included the Shapiro-Wilk normality test and a paired-sample t-test. The results showed an average increase in the Vertical Jump from 43.27 cm to 49.73 cm (14.20%), the Triple Hop Jump from 6.84 m to 7.05 m (2.92%), and the UHBE from 51.73 seconds to 60.93 seconds (17.78%). The paired-sample t-test revealed significant differences in all variables ($p < 0.05$). These results indicate that functional training effectively enhances lower-body muscle power and core muscle stabilization in futsal athletes. Thus, functional training can be recommended as a training method to improve physical performance while supporting injury prevention in futsal athletes.

Keywords: Functional Training, Power, Core Muscle Stabilization, Futsal



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INTRODUCTION

Futsal is a highly intense team sport. With a 40 x 20 meter court, a ball that moves freely, and constant defensive and offensive demands, players engage in high-intensity activities such as sprinting, accelerating, decelerating, and changing direction (Perwira Yustika et al., 2019). In futsal, basic techniques refer to a player's ability to perform effective moves to achieve specific goals. These basic techniques include passing, ball control, dribbling, heading, shooting, and chipping (Naser & Ali, 2016). The components of futsal include physical aspects such as endurance, speed, strength, flexibility, agility, and explosiveness. These physical attributes are crucial,

especially for futsal, which relies heavily on the players' physical condition (Asmara et al., 2023).

Competitive sports are a form of physical activity aimed at achieving excellence through competition. Essentially, sports are also practiced to meet various needs, such as improving health, providing entertainment or enjoyment, and developing physical abilities (Febrianty, 2020). Physiological factors play a significant role in physical training to support athletes' performance. The increasing intensity of competition in the world of sports demands the implementation of more optimal training programs to meet athletes' performance needs (Sidik et al., 2020).

Based on the researchers' observations on the futsal field, a lack of power and core muscle stability causes athletes to fall easily and lose their balance when performing explosive movements such as running, kicking, or sudden changes in direction, which can lead to injuries. Consistent with previous research, athletes with poor lower-body muscle strength particularly in the hip, knee, and ankle joints may experience reduced dynamic balance in their lower limbs. This condition makes it more difficult for the body to maintain stability during movement (Wang et al., 2025). Good dynamic balance plays a crucial role in improving overall physical performance. Suboptimal core stability can cause athletes to lose their balance easily, and injuries are also more likely to occur due to muscle weakness, muscle imbalances, and overuse of muscles or ligaments resulting from poor core stabilization (Purwatama & Wahyuni, 2023).

In previous research, power in futsal allows players to outmaneuver opponents in the battle for the ball and create scoring opportunities because it helps them transition quickly from defense to offense. Power is crucial to a futsal player's shooting ability (Latuhu, 2024). Core stabilization is essential for improving performance and reducing injuries in futsal athletes. Core muscle stabilization also helps improve body balance, allowing players to perform movements with greater stability and control (Jebavy et al., 2020).

There is one training method that can increase the power and stability of core muscles. Functional training is a form of exercise that focuses more on movement than simply building muscle. This emphasis on movement helps maintain balance between pushing and pulling motions (Warthadi et al., 2022). Movements that

involve multiple joints and are performed across a wide range of motion are the key characteristics of functional training; these exercises mimic real-world activities in sports. The focus includes improving core stability, mobility, strength, power, speed, balance, and coordination so that individuals can perform movements more effectively, efficiently, and with a lower risk of injury (Cao et al., 2024).

In a previous study conducted by (Usgu et al., 2020) It is stated that functional training has an impact on performance and various related physical components in basketball players, as well as an improvement in their basketball movement skills. Another study also found that functional training significantly improves movement quality and tennis technique performance compared to conventional training. The study involved male athletes aged 12–16 who were non-professionals. (Xiao et al., 2025).

Previous research has shown that functional training is effective in improving various components of physical fitness, athletic performance, and sports skills. However, most studies have been conducted in sports other than futsal, such as basketball and tennis, and have involved athlete populations with different characteristics. Furthermore, previous studies have generally focused on only one aspect of performance or one component of physical fitness; consequently, there has been limited research examining the effects of functional training on improving lower-body muscle power and core muscle stabilization, particularly among regional level athletes in Indonesia.

Therefore, this study was conducted to address this gap by analyzing the effects of functional training on simultaneously improving lower body muscle power and core muscle stabilization in futsal athletes in Bandung, with the hope that it will help improve power and core stability in futsal athletes and reduce the risk of injuries to the back, hips, knees, and ankles.

RESEARCH METHODOLOGY

The research method to be used is experimental research. According to Sugiyono, “Experimental research with a one-group pretest-posttest design is a type of experimental design that uses a single sample group and involves taking measurements before and after the treatment is administered to the sample.” (Sugiyono, 2017).

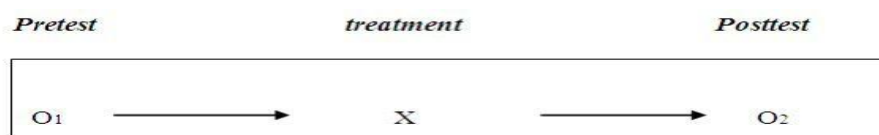


Figure 1. One Group Pretest-Posttest Research Design

Source: (Sugiyono, 2017).

Description:

- O1 = Start with a pretest consisting of the Vertical Jump, Triple Hop Jump, and Unilateral Hip Bridge Endurance
- X = Treatment following the pretest consists of functional training
- O2 = Posttest following treatment involving the Vertical Jump, Triple Hop Jump, and Unilateral Hip Bridge Endurance

The population for this study consisted of 15 futsal athletes from Bandung. The study employed total sampling, with the 15 futsal athletes from Bandung serving as the study sample. These athletes were aged 16–19 years and were nonprofessional athletes competing in regional-level championships.

The instruments used for both the initial pretest and final posttest measurements were the Vertical Jump Test, the Triple Hop Jump Test, and the Unilateral Hip Bridge Endurance Test (UHBE).

The Vertical Jump Test is designed to determine the increase in power a person can generate in a single repetition using proper technique, without external assistance. Lower-body power is measured by correlating the results of the vertical jump test which has high validity ($r = 0.61$) and reliability ($r = 0.97$) with the jump height (Haryono et al., 2021).

The Triple Hop Jump Test is a unilateral horizontal jump test performed by jumping forward three times in a row using the same leg to assess an athlete's ability to generate forward propulsion and determine lower-body explosive power. The Triple Hop Jump has a strong correlation with quadriceps and hamstring strength, with correlation coefficients ranging from ($r = 0.70$ to 0.77), and exhibits excellent reliability, with a coefficient of ($r = 0.80$) (Stolberg et al., 2016).

The Unilateral Hip Bridge Endurance Test (UHBE) is a test conducted to assess improvements in the strength of the core muscles (including the abdominal, lower back, pelvic, and diaphragmatic muscles) in maintaining spinal and pelvic

stability during both static and dynamic activities. The Unilateral Hip Bridge Endurance Test is performed with the subject lying on their back with arms crossed over the chest, knees bent, and feet flat on the floor. The subject performs a two-legged hip bridge, and once a neutral spine and pelvic position is achieved, the subject is instructed to straighten one knee so that the leg is straight and the thighs are parallel to each other, maintaining this position for as long as possible. The score used is the best time from the two trials, with fairly high validity ($r = 0.61$) and reliability ($r = 0.69$) values (Worst, 2026).

This study used functional training as the intervention for the experimental group, incorporating exercises based on functional movement patterns combined with core training. The intervention consisted of functional training conducted over 6 weeks at a frequency of 3 times per week, for a total of 18 training sessions (Zuo et al., 2022). The functional training program is designed to increase lower-body muscle power and core muscle stabilization. Power exercises are performed at 60% of one-repetition maximum (1RM), with 8 repetitions in 4 sets and a 4-minute rest period between sets. Strength-endurance exercises to improve core muscle stabilization are performed at 40% of 1RM, consisting of 12 repetitions in 2 sets with a 1.5-minute rest period between sets, while core exercises are performed isometrically with a contraction duration of 30–60 seconds and a 30 second rest period between sets.

The data were analyzed using the Shapiro-Wilk normality test. In sports research with a small sample size (fewer than 50 subjects), this test is used to determine whether the research data are normally distributed before conducting hypothesis testing. Hypothesis testing in this study used a paired-sample t-test to determine the effect of functional training on increases in lower-body and core muscle power. The paired-sample t-test was used under the assumption that the study data met the assumption of a normal distribution.

RESULTS AND DISCUSSION

RESULT

The research results consist of statistical data used to provide an overview of the research data before further analysis. The data used in this study include pretest and posttest scores obtained from 15 futsal athletes who underwent functional training for 6 weeks.

Table 1. Descriptive Statistics for the Pretest-Posttest Vertical Jump, Pretest-Posttest Triple Hop Jump, and Pretest-Posttest Unilateral Hip Bridge Endurance Tests

Variabel	N	Minimum	Maximum	Mean	Std Deviation
<i>PreTest VJ (cm)</i>	15	34	54	43,27	5,04
<i>Posttsest VJ (cm)</i>	15	43	60	49,73	5,36
<i>PreTest THJ (m)</i>	15	5,97	7,45	6,84	0,38
<i>PostTest THJ (m)</i>	15	6,28	7,65	7,05	0,38
<i>PreTest UHBE (scn)</i>	15	39	67	51,73	9,24
<i>PostTest UHBE (scn)</i>	15	47	78	60,93	9,99

Based on Table 1, the average pretest vertical jump was 43.27 cm, and the posttest result increased to 49.73 cm, representing a 14.20% increase. The average pretest triple hop jump was 6.84 m, and the posttest result increased to 7.05 m, representing a 2.92% increase. The average pretest unilateral hip bridge endurance was 51.73 seconds, and the posttest result increased to 60.93 seconds, representing a 17.78% increase. After a 6-week functional training intervention, there was an improvement in performance.

Table 2. Results of the Shapiro-Wilk Normality Test

Variabel	Statistic	df	Sig.	Desc
<i>PreTest VJ</i>	0,96	15	0,76	Normal
<i>Posttsest VJ</i>	0,92	15	0,20	Normal
<i>PreTest THJ</i>	0,95	15	0,63	Normal
<i>PostTest THJ</i>	0,97	15	0,88	Normal
<i>PreTest UHBE</i>	0,92	15	0,24	Normal
Variabel	Statistic	df	Sig.	Desc
<i>PostTest UHBE</i>	0,93	15	0,32	Normal

Based on Table 2, the Sig. values (0.76, 0.20, 0.63, 0.88, 0.24, 0.32) are all greater than 0.05. Therefore, H0 is accepted. It can thus be concluded that all of these data sets are normally distributed.

Table 3. Hypothesis Testing

	Variabel	Mean	Std. Devi Ation	Std. Error Mean	T	df	Sig. (2- tailed)
Pair 1	Pre test VJ – Post test VJ	-6,46	2,56	0,66	-9,78	14	0,00
Pair 2	Pre test THJ- Post test THJ	-0,20	0,09	0,02	-8,60	14	0,00
Pair 3	Pre test UHBE - Pos ttest UHBE	-9,20	1,56	0,40	- 22,73	14	0,00

Based on Table 3, the Sig. values (0.00, 0.00, 0.00) are all less than 0.05; therefore, H₀ is rejected. Thus, it can be concluded that functional training has a significant effect on improving power and core muscle stabilization in futsal athletes.

DISCUSSION

The results of the study indicate that a 6-week functional training program had a significant effect on improving power and core muscle stabilization in futsal athletes in Bandung. Based on the results of the statistical test (Paired Sample t-Test), the results showed a significant value of Sig. $0.00 < 0.05$.

An increase in lean muscle mass can be achieved through functional training that engages the arm, core, and lower-body muscles. Engaging these various muscle groups helps improve explosive power, while the resulting physiological adaptations have a positive impact on athletes' performance (Rusdiana et al., 2025). Functional training can increase lower body muscle power in athletes. This increase results from muscle hypertrophy the growth in muscle fiber size caused by training with an overload. In addition to improving explosive power, this adaptation also strengthens the muscles, helping to maintain stability and reduce the risk of injury (Mahmudi et al., 2025).

Improvements in lower-body muscle strength, explosive power, movement quality, and dynamic balance can be achieved through functional training that involves multi-joint and multi-directional movements. Adaptations from such training enhance neuromuscular coordination, motor unit synchronization, and the recruitment of fast-twitch muscle fibers, enabling muscles to generate greater force

in a shorter amount of time. This makes movements more efficient, stable, and coordinated, thereby contributing to improved athletic performance while helping to reduce the risk of injury (Zhu et al., 2026). Increased eccentric muscle strength may contribute to an increase in vertical jump height because there is a close relationship between eccentric strength during knee extension and squatting movements and jumping ability. Therefore, the increase in lower-body muscle power following a functional training program is thought to result from neuromuscular adaptations that enhance the muscles' ability to generate force rapidly and efficiently during the push-off phase (Nishiumi et al., 2023). Horizontal jump distance can increase due to an increase in lower-body muscle power. A horizontal jump requires the muscles to generate a large amount of force in a short period of time in order to propel the body forward as far as possible. As lower-body muscle power increases, an athlete's ability to generate a powerful push-off also increases, resulting in a longer jump distance (Lin et al., 2023).

Increased power has a direct impact on improved athletic performance, such as the ability to jump higher, accelerate faster, and change direction more effectively. Physiologically, this occurs due to increased muscle activation and more optimal neuromuscular coordination (Oliveira et al., 2026). Good core muscle stability plays a crucial role in controlling the position of the trunk and pelvis during movement, especially when changing direction. With good core stability, the body is able to maintain a more stable position, resulting in more efficient force distribution. Optimal control of the trunk and pelvis also helps reduce the load on the knee joints during changes in direction, thereby lowering the risk of ACL injury (Duchene et al., 2018).

Improvements in physical components including strength, balance, and endurance as well as technical performance in specific sports can be achieved through functional training. A training approach designed to mimic the actual movement patterns of sports activities enables athletes to perform movements more effectively and efficiently during competition (Xiao et al., 2025). The findings of this study are consistent with the characteristics of futsal, which is dominated by explosive movements such as acceleration and deceleration during short sprints, passing, and shooting. Improving lower-body muscle power and core muscle

stabilization through functional training directly contributes to the performance of movements frequently performed during futsal matches.

Although this study showed a significant increase in lower-body muscle strength and core muscle stabilization following a functional training program, there are several limitations that should be noted. The sample size was relatively small only 15 athletes and the use of a one-group pretest-posttest design has limitations because it did not include a control group for comparison. Consequently, it cannot be fully confirmed that the improvements observed after the functional training program were solely due to the intervention, as there remains the possibility that they were influenced by other factors outside the scope of this study. Therefore, future research is recommended to use a larger sample size and include a control group so that the results will be more accurate and provide stronger evidence regarding the effects of functional training on improvements in lower-body muscle power and core muscle stabilization.

CONCLUSION

Based on the research findings, the researchers concluded that a 6-week functional training program, conducted three times per week, had a significant effect on improving lower-body muscle power and core muscle stabilization in futsal athletes in Bandung. Therefore, functional training can be recommended as an effective training method to improve the physical performance of futsal athletes while helping to reduce the risk of injury by enhancing core muscle stabilization.

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