

The effect of core stability training on the balance and performance of futsal goalkeepers

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ABSTRACT

Balance and performance are important physical components that determine the success of futsal goalkeepers in facing the fast and intense dynamics of the game. Core stability training is believed to improve body stability and the effectiveness of futsal goalkeeper movements. This small-scale preliminary study aimed to examine the effect of a six-week core stability training program on the balance and performance of futsal goalkeepers. It used a quasi-experimental one-group pretest and posttest design with 5 active futsal goalkeepers selected through total sampling. Static balance was measured with the Stork Stand Test and goalkeeper performance with a save simulation test. The pretest and posttest scores were compared using a paired-samples t-test, with Cohen's d as the effect size and a Wilcoxon signed-rank test as a confirmation, at a significance level of 0.05. Balance increased from 31.60 ± 3.21 to 40.20 ± 3.42 seconds and performance from 63.40 ± 4.77 to 72.80 ± 5.40 , with mean gains of 8.60 seconds and 9.40 points respectively (paired t-test $p < 0.001$). Because of the very small sample, the Wilcoxon test did not reach the 0.05 threshold ($p = 0.0625$), so the findings are read as a consistent preliminary improvement. Overall, core stability training appears to support the balance and performance of futsal goalkeepers and may be considered as part of their physical training, although the effect needs to be confirmed in a larger controlled study.

Keywords: exercise; core stability; balance; performance; futsal goalkeeper



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INTRODUCTION

Futsal is a sport characterized by fast play, limited space, and high intensity, which demands optimal physical and technical abilities from each player, especially the goalkeeper (Firdaus et al., 2023; Ilham Ismail et al., 2024). The futsal goalkeeper plays a strategic role as the team's last line of defense, requiring balance, coordination, quick reactions, and good body control in various dynamic situations such as deflecting the ball, diving, and changing positions quickly (Silalahi et al., 2023). Good body balance is a key factor for goalkeepers to maintain postural stability while moving and when receiving external interference from the direction of the ball or contact with other players (Saki

et al., 2023). Therefore, a form of training is needed that can improve body stability while supporting the overall performance of futsal goalkeepers.

Various previous studies have shown that physical condition, especially balance and postural stability, plays an important role in improving athlete performance (Clark et al., 2018; Mohammed et al., 2022; Rodriguez, 2023). Studies in sports science report that core strength and stability training contributes to movement efficiency, postural control, and injury prevention in athletes (Clark et al., 2018; Wirth et al., 2017), and other work suggests that training focused on core stability can improve static and dynamic balance in various sports (Reed et al., 2012; Mohammed et al., 2022). However, most of this research is general in nature and has not specifically examined futsal athletes, particularly goalkeepers, who face different movement and physical demands than field players.

Theoretically, core stability is defined as the ability of the body's core muscles, including the abdominal muscles, lower back, pelvis and hips, to maintain spinal stability and body position during movement activities (Kuna & Bobić, 2023). The biomechanical concept explains that the core muscles function as a center for force transfer between the upper and lower body, so that good core stability will increase movement efficiency and balance (Wibisana, 2020). Several previous studies have found that core stability training has a positive effect on balance, functional strength, and athlete performance (Ciccione et al., 2024; Hermosilla-Perona et al., 2025; Wang et al., 2021). However, studies directly linking core stability training to specific futsal goalkeeper performance, such as defensive ability, reaction time, and stability during saves, are still very limited, opening up opportunities for more in-depth scientific contributions.

This study offers a novel approach by focusing on futsal goalkeepers as the subject of study, which has received relatively little attention in physical training studies. The main difference between this study and previous studies lies in the implementation of a core stability training program specifically designed for the movement needs of futsal goalkeepers, and the measurement of its impact not only on balance but also on functional goalkeeper performance. In terms of method and analysis, this study combines balance measurements with futsal goalkeeper performance indicators, thus providing a more comprehensive picture. The urgency of this research lies in its importance in providing a scientific basis for coaches and sports practitioners in developing effective, evidence-based training programs to improve the quality of futsal goalkeepers.

In short, the literature still lacks studies that specifically examine core stability training in futsal goalkeepers, whose positional demands differ from those of field players. The present study addresses this gap by integrating balance and goalkeeper performance in a single study, while acknowledging that its small sample means the evidence should be treated as preliminary.

The purpose of this study was to determine the effect of core stability training on the balance and performance of futsal goalkeepers. Specifically, this study aimed to analyze the extent to which core stability training can improve balance and support the functional performance of futsal goalkeepers in a dynamic and competitive game context.

METHOD

This study uses an experimental method with one group pretest–posttest (Ansar et al., 2024; Nugroho, 2018). This design involves one group without a control group, where the research subjects are given an initial test (pretest) to measure the balance and performance of futsal goalkeepers. Next, the subjects are given treatment in the form of core stability training, then a final test (posttest) is carried out to determine changes in balance and performance of futsal goalkeepers after the treatment is given. The research subjects are 5 active futsal goalkeepers at the GSI futsal Club of Muhammadiyah University Kotabumi Indonesia aged between 17–23 years, who were selected using a total sampling

technique.

The research instruments used consisted of two types of tests. Static balance was measured using the Stork Stand Test (Malarvizhi & Arvind, 2019). Futsal goalkeeper performance was measured using a rescue simulation test. The research procedure began with a pretest to measure static balance and futsal goalkeeper performance. After the pretest, subjects were given a 6-week core stability training program, performed 3 times per week. The core stability exercises included the plank, side plank, bird dog, dead bug, Russian twist, and superman hold (Hsu et al., 2018; Silfies et al., 2015; Wirth et al., 2017). Each exercise was performed for 30–45 seconds, with three sets, and a 60-second rest period between sets. All exercises were carried out in a structured manner and supervised to ensure proper movement technique. After completing the training program, subjects underwent a posttest using the same instruments as the pretest to determine changes in balance and futsal goalkeeper performance.

The data obtained were analyzed using descriptive statistics to determine the mean values and the changes in the balance and performance of futsal goalkeepers before and after treatment. Because the design compared two repeated measurements on the same subjects, a paired-samples t-test was used to examine the difference between the pretest and posttest results, and the effect size was estimated with Cohen's d. Given the small sample of five goalkeepers, the normality of the differences was checked with the Shapiro-Wilk test and a nonparametric Wilcoxon signed-rank test was run as a confirmation. All analyses used a significance level of 0.05.

RESULTS

Table 1. Goalkeeper Balance and Performance Results

Subject	Static Equilibrium		Goalkeeper Performance	
	Pretest	Posttest	Pretest	Posttest
Goalkeeper 1	27	35	57	66
Goalkeeper 2	30	39	61	70
Goalkeeper 3	32	41	63	72
Goalkeeper 4	34	44	67	76
Goalkeeper 5	35	42	69	80
Min	27	35	57	66
Max	35	44	69	80
Mean	31.60	40.20	63.40	72.80
Std. Dev	3.21	3.42	4.77	5.40

The results of static balance measurements and futsal goalkeeper performance before (pretest) and after (posttest) were given core stability training. In the balance variable, the pretest value showed a score range between 27 to 35 seconds with an average value of 31.60 and a standard deviation of 3.21. After being given treatment, the balance value increased with a score range between 35 to 44 seconds, an average value of 40.20, and a standard deviation of 3.42. The increase in the average value indicates an improvement in the balance ability of futsal goalkeepers after participating in the training program. In the futsal goalkeeper performance variable, the pretest value was in the range of 57 to 69 with an average value of 63.40 and a standard deviation of 4.77. After treatment, the performance value increased with a score range between 66 to 80, an average value of 72.80, and a standard deviation of 5.40. These results indicate that core stability training not only has an impact on improving balance, but also contributes to improving the overall performance of futsal goalkeepers.

Table 2. Results of the Paired-Samples t-Test Comparing Pretest and Posttest Scores

Variable	Mean difference	t	df	p	Cohen's d	95% CI of difference
Balance (Stork Stand, s)	8.60	16.87	4	< 0.001	7.54	7.18 – 10.02
Goalkeeper Performance	9.40	23.50	4	< 0.001	10.51	8.29 – 10.51

Table 2 presents the paired-samples t-test comparing the pretest and posttest scores of the same goalkeepers. Static balance increased by a mean of 8.60 seconds (about 27%), from 31.60 to 40.20 seconds, $t(4) = 16.87$, $p < 0.001$, with a 95% confidence interval for the difference of 7.18 to 10.02 seconds. Goalkeeper performance increased by a mean of 9.40 points (about 15%), from 63.40 to 72.80, $t(4) = 23.50$, $p < 0.001$, with a 95% confidence interval for the difference of 8.29 to 10.51. The effect sizes were very large (Cohen's $d = 7.54$ for balance and 10.51 for performance), although these values are inflated by the small sample and the low variability of the differences and should be read with caution. Because only five goalkeepers took part, a nonparametric Wilcoxon signed-rank test was also run as a check, and with this sample size it could not reach the 0.05 threshold ($p = 0.0625$) even though every goalkeeper improved. The results should therefore be interpreted as a consistent preliminary improvement rather than definitive proof.

DISCUSSION

The results of this small study showed that after six weeks of core stability training the goalkeepers' balance and performance scores improved. The higher static balance scores on the Stork Stand Test suggest that the training supported the goalkeepers' ability to maintain body stability, which aligns with the concept that the core muscles play a crucial role in postural control and balance during dynamic sports activities (Hsu et al., 2018; Tsartsapakis et al., 2025). The improved balance of futsal goalkeepers after participating in core stability training can be explained by the role of the core muscles as the body's stabilizing center. The abdominal, lower back, and pelvic muscles work synergistically to maintain body position when the goalkeeper performs defensive movements, such as standing on one leg, deflecting the ball, or changing direction quickly (Saki et al., 2023). With increased core strength and control, goalkeepers become better able to maintain balance despite external forces, resulting in more efficient movement performance.

In addition to balance, the study also showed an improvement in futsal goalkeeper performance, as measured by a save simulation test. This improved performance score indicates that core stability training not only impacts basic physical aspects but also contributes to goalkeepers' functional abilities in game situations. Improved core stability allows goalkeepers to perform saves with a more optimal body position, thereby improving reaction and save effectiveness. The findings of this study support the results of previous research which stated that core stability training has a positive effect on improving athlete performance (Lupowitz, 2023; Reed et al., 2012). However, the main difference in this study lies in the research subjects, which specifically focused on futsal goalkeepers. Futsal goalkeepers have unique movement characteristics, such as the need to maintain balance in a low position, rapid lateral movements, and transitions from static to dynamic positions in a short time. Therefore, the results of this study strengthen the argument that core stability training is highly relevant for futsal goalkeepers compared to its general application to field players.

Although the results show positive improvements, the study has several limitations. The sample of only five goalkeepers and the absence of a control group limit the generalizability of the results

and make it impossible to rule out learning or maturation effects on the same tests, so the improvements cannot be attributed to the training alone. The save simulation test used to measure performance has not been validated and was scored without a formal check of inter-rater reliability, so future work should use a validated instrument scored by more than one rater. In addition, with only five subjects the nonparametric test could not reach significance, which is why the significant paired t-test results are treated as preliminary. Even so, the study offers a practical starting point for coaches and practitioners in designing training programs that emphasize core stability.

Overall, the results of this study indicate that core stability training can be used as an important component in a futsal goalkeeper training program. The improvements in balance and performance achieved after the training intervention confirm that core stability training is not only beneficial for injury prevention but also for improving the performance of futsal goalkeepers in competitive play.

CONCLUSION

After six weeks of training, three times per week, the goalkeepers' static balance improved by a mean of 8.60 seconds and their performance by 9.40 points, suggesting that core stability training can support the balance and performance of futsal goalkeepers. The contribution of this study lies in its focus on futsal goalkeepers and its integration of balance and functional performance measurements within a single design, a combination that has rarely been examined. The findings add preliminary empirical evidence that core stability training may benefit not only body stability but also the specific performance of goalkeepers. Because the study used a single group of only five subjects without a control group, the one-group pretest and posttest design should be seen as a first step rather than a confirmation, and the results need to be verified in larger controlled studies. In practice, the results can still serve as an initial reference for futsal coaches and practitioners who wish to integrate core stability training into their goalkeeper programs. Further research is recommended to involve a larger sample, use a control group, and develop a validated, more comprehensive performance measurement instrument scored by more than one rater.

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CONFLICT OF INTEREST

The authors state that there is no conflict of interest in this study.

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