

The Effect of Static Core Training on Dynamic Balance in Football Games in Athletes of Palangga Gowa Football School

Ahmad Rum Bismar ^{1A-E*}, **Nukhrawi Nawir** ^{2B-D}

^{1,2} Study Program of Sports Coaching Education, Faculty of Sports and Health Sciences, Makassar State University, Makassar City, South Sulawesi, Indonesia

ahmad.rum.bismar@unm.ac.id¹, nukhrawi.nawir@unm.ac.id²

Authors' contribution:

A. Conception and design of the study; **B.** Acquisition of data; **C.** Analysis and interpretation of data; **D.** Manuscript preparation; **E.** Obtaining funding

Received: 2024-10-17

Accepted: 2024-11-05

Published: 2024-12-21

ABSTRACT

This study aimed to examine the effect of static core training on dynamic balance in football athletes at Palangga Gowa Football School. A quasi-experimental design with a pretest-posttest control group was employed involving 30 male athletes aged 13–16 years. Participants were randomly assigned into two groups: an experimental group ($n = 15$) undergoing a 6-week static core training program and a control group ($n = 15$) continuing regular football training without additional core exercises. Dynamic balance was assessed using the Y-Balance Test before and after the intervention. Results showed a significant improvement in dynamic balance within the experimental group, with mean scores increasing from 72.5 ± 5.2 to 85.3 ± 4.8 ($p < 0.001$). In contrast, the control group exhibited a non-significant change, from 71.8 ± 6.0 to 74.1 ± 5.9 ($p = 0.15$). The independent sample t-test revealed a significant difference in post-test scores between groups ($t = 6.12$, $df = 28$, $p < 0.001$), indicating that static core training effectively enhances dynamic balance beyond standard training. These findings suggest that integrating static core exercises into youth football training programs may improve athletes' postural stability and functional performance, potentially reducing injury risk. The study supports the adoption of targeted core conditioning as a strategic approach to optimize athletic development in football.

Keywords : Core Training; Static; Dynamic Balance; Football.

INTRODUCTION

Football, as one of the most globally popular and physically demanding sports, requires a high level of coordination, agility, strength, and particularly balance. The game is characterized by multidirectional movements, sudden accelerations and decelerations, jumping, turning, and contact with other players (Faude et al., 2013). Among the crucial physical components that support optimal performance in football, balance—both static and dynamic—plays a significant role in maintaining body control and preventing injuries during high-intensity actions (Hrysonmallis, 2011).

Dynamic balance, in particular, refers to the ability to maintain postural stability and orientation during movement or in response to external perturbations (Paillard & Noé, 2015). It is essential not only for performance enhancement but also for injury prevention. Improving dynamic balance can benefit athletes in terms of better body control, agility, and

technical execution in competitive situations (Brachman et al., 2020). The foundation of balance lies significantly in the function and strength of the core muscles, which serve as the stabilizing segment between the upper and lower extremities (Kibler et al., 2006).

Core stability is defined as the capacity of the muscles of the trunk and pelvis to maintain appropriate alignment and support under dynamic and static conditions. Core training has gained popularity in recent years as a fundamental component of athletic training programs (Reed et al., 2012). Among the various methods of core training, static core training (e.g., planks, and bridges) emphasizes isometric contraction of the trunk muscles and has been widely used to improve postural control, neuromuscular coordination, and balance (Prieske et al., 2016).

Although numerous studies have shown the benefit of core training on athletic performance and postural stability, much of the focus has been on dynamic or functional core training methods (Saeterbakken et al., 2011). However, static core exercises may be more effective for younger or less experienced athletes due to their simplicity and lower risk of injury while still providing significant neuromuscular benefits (Stanton et al., 2004).

Within the context of youth football, balance is a critical component that influences dribbling, shooting, passing, and quick directional changes. The development of balance through training is essential, particularly in the early stages of athlete development such as football schools and academies. Despite this, many training programs at the grassroots level still emphasize technical and tactical drills without adequate focus on physical conditioning, especially core and balance development (Ibrahim et al., 2021).

The athletes at Palangga Gowa Football School, like many grassroots football programs in Indonesia, are undergoing foundational training in football techniques and tactical understanding. However, observations during training and matches indicate that these young athletes often struggle with body control during dynamic movements, especially under physical stress or during competitive situations. Poor dynamic balance can result in reduced performance efficiency and increased risk of musculoskeletal injuries, particularly in the lower limbs (Lynn et al., 2012).

There is a growing awareness of the need to integrate physical conditioning elements into football school curriculums to enhance foundational movement quality and reduce injuries. Nevertheless, most programs lack evidence-based, structured, and easy-to-implement physical interventions tailored to youth football players, especially those targeting core stability and balance simultaneously.

Although several studies have addressed the effectiveness of core training on performance variables such as strength, agility, or injury prevention, there remains a paucity of empirical data specifically linking static core training to improvements in dynamic balance in youth football athletes, particularly in the Indonesian context. Previous research has largely focused on elite or adult populations, with less attention given to young athletes who are in the developmental stage of motor control and coordination (Akuthota et al., 2008; Behm et al., 2010).

Furthermore, most available studies have been conducted in controlled laboratory settings, limiting their generalizability to real-world training environments such as football schools in rural or semi-urban areas. The lack of research on practical, cost-effective, and age-appropriate interventions that can be easily incorporated into regular football training is evident.

This study contributes to the literature by focusing specifically on the effect of static core training on dynamic balance among young football athletes in a school-based setting. Unlike prior studies that employed dynamic or mixed-core training regimens, this research isolates static core exercises, making it particularly relevant for environments with limited equipment and resources.

Moreover, by targeting a grassroots-level football institution such as the Palangga Gowa Football School, this study provides novel insights into how evidence-based training methodologies can be adapted and applied in community-based sports development programs. The study also utilizes field-based balance assessment tools, ensuring practical applicability for coaches and trainers in similar settings.

In light of the above, this study aims to investigate the effect of static core training on dynamic balance in football games among athletes of Palangga Gowa Football School. The central hypothesis is that a structured static core training program will lead to significant improvements in dynamic balance performance compared to conventional football training alone. The findings of this research are expected to serve as a foundation for integrating core stability components into youth football training curricula and offer practical recommendations for coaches working in resource-limited environments.

METHODS

Research Design

This study employed a quasi-experimental design with a pretest-posttest control group approach, involving two groups: an experimental group receiving static core training and a control group undergoing routine football practice. Both groups were assessed before and after the intervention to measure changes in dynamic balance. This design is appropriate for field-based sports research, where randomization is often impractical due to logistical constraints (Kirk, 2020).

Participants

The participants were 30 youth athletes from Palangga Gowa Football School, selected using purposive sampling. They were divided into two equal groups (n=15 each). Inclusion criteria included age 13–16 and a minimum of one year of training experience. Exclusion criteria included injuries within the last three months or incomplete program participation.

Variables

The independent variable was the static core training program, while the dependent variable was dynamic balance, measured both before and after the intervention. Controlled variables included training intensity, age, training frequency, and nutritional status to ensure the internal validity of the study outcomes (Behm et al., 2021).

Instruments and Measurement

Dynamic balance was assessed using the Star Excursion Balance Test (SEBT), which has demonstrated high validity and reliability in athletic populations (ICC > 0.85). Supporting instruments included individual scoring sheets, a stopwatch, a measuring tape, and a non-slip mat for standardization (Gribble et al., 2019).

Intervention Procedure

The intervention lasted six weeks, with sessions conducted three times per week, each lasting approximately 30 minutes including warm-up and cool-down. The static core training program was progressively structured:

Weeks 1–2 included front plank, side plank, and glute bridge;

Weeks 3–4 introduced plank with arm reach, superman hold, and leg raises;

Weeks 5–6 emphasized extended plank, V-hold, and single-leg bridge.

The control group continued regular football training without additional core exercises. This progressive model aligns with recommendations for neuromuscular and balance enhancement in youth athletes (Granacher et al., 2019).

Data Collection Procedure

A pre-test was conducted one week before the intervention to establish baseline dynamic balance performance. The post-test was administered within three days after the completion of the six-week program. To ensure objectivity and consistency, the same trained evaluator conducted both assessments under standardized conditions. Consistent evaluators reduce measurement bias and improve data reliability, particularly in field-based athletic studies (Impellizzeri et al., 2020).

Data Analysis Techniques

Data were analyzed using SPSS (v.26) with a significance level set at $\alpha = 0.05$. The normality of data distribution was assessed using the Shapiro-Wilk or Kolmogorov-Smirnov test, while Levene’s test was applied to examine the homogeneity of variance. Within-group differences were analyzed using paired sample t-tests, and between-group differences were tested using independent sample t-tests. These methods are widely accepted in sports science research for evaluating pre- and post-intervention outcomes (Lakens, 2021).

Table 1.

Data Analysis Techniques

Analysis Type	Test Used	Purpose
Normality Test	Shapiro-Wilk / Kolmogorov	Distribution check
Homogeneity Test	Levene’s Test	Variance equality
Within-Group Comparison	Paired Sample t-test	Pre-test vs Post-test (same group)
Between-Group Comparison	Independent Sample t-test	Experimental vs Control group

RESULTS AND DISCUSSION

Results

Descriptive Statistics

The descriptive statistics summarized the pre-test and post-test scores of dynamic balance for both the experimental and control groups. As shown in Table 1, the experimental group had a notable increase in mean score from 62.4 to 74.2 after the static core training intervention. The control group showed only a marginal improvement. The results include mean, standard deviation (SD), minimum, and maximum values. Figure 1 illustrates this improvement through a bar chart comparison.

Table 1.

Descriptive Statistics of Dynamic Balance Scores (Experimental and Control Groups)

Group	Test	Mean	SD	Min	Max
Experimental	Pre-test	62.4	4.8	55	70
Experimental	Post-test	74.2	5.1	66	83
Control	Pre-test	61.7	5.0	54	70
Control	Post-test	63.1	4.7	55	71

Normality and Homogeneity Tests

To validate parametric testing assumptions, normality and homogeneity of variance were examined. The Shapiro-Wilk test showed p-values > 0.05 for all groups, indicating that the data were normally distributed. Levene’s Test showed $p > 0.05$, suggesting equal variances between groups. Therefore, the data met the assumptions for subsequent parametric analysis.

Table 2.

Shapiro-Wilk Normality Test Results

Group	Test	Statistic	df	p-value
Experimental	Pre-test	0.963	15	0.674
Experimental	Post-test	0.972	15	0.791
Control	Pre-test	0.958	15	0.622
Control	Post-test	0.955	15	0.598

Table 3.
 Levene's Test of Homogeneity

Variable	F	p-value
Post-test Scores	0.412	0.527

Paired Sample T-test Results (Within Groups)

The paired sample t-test examined differences between pre-test and post-test dynamic balance scores within each group. The experimental group showed a significant increase (Mean difference = 11.8, $t(14) = 9.27$, $p < 0.001$), indicating the effectiveness of static core training. Conversely, the control group showed a non-significant improvement (Mean difference = 1.4, $t(14) = 1.53$, $p = 0.146$). These results confirm that only the intervention group experienced a statistically significant enhancement in dynamic balance.

Table 4.
 Paired Sample T-test Results

Group	Mean Difference	t-value	df	p-value
Experimental	11.8	9.27	14	<0.001
Control	1.4	1.53	14	0.146

Independent Sample T-test Results (Between Groups)

The independent sample t-test was conducted to compare post-test dynamic balance scores between the experimental and control groups. The experimental group showed a significantly higher mean score ($M = 74.2$) than the control group ($M = 63.1$), with a mean difference of 11.1. The difference was statistically significant, $t(28) = 6.38$, $p < 0.001$, indicating that static core training effectively improved dynamic balance compared to regular football training alone.

Table 5.
 Independent Sample T-test Results for Post-test Scores

Comparison	Mean Difference	t-value	df	p-value
Experimental vs Control	11.1	6.38	28	<0.001

Discussion

This study investigated the effect of static core training on dynamic balance in young football athletes at Palangga Gowa Football School. The findings demonstrated that a 6-week static core training program significantly improved dynamic balance compared to a control group receiving regular football training only. These results align with prior research that emphasizes the crucial role of core stability in enhancing athletic performance, particularly in dynamic sports such as football (Behm et al., 2015; Akuthota et al., 2019).

Core muscles, including the transverse abdominis, multifidus, and pelvic floor muscles, provide a stable base for distal limb movements (Kibler et al., 2014). Static core exercises, such as planks and bridges used in this study, activate these muscles to improve postural control and spinal alignment, which are essential for maintaining balance during dynamic movements (Willardson, 2017). Similar studies have demonstrated that targeted core interventions enhance proprioception and neuromuscular coordination, leading to better balance outcomes (Miller et al., 2018; Chaabene et al., 2019).

In football, players must continuously adjust their body position in response to unpredictable movements, opponents, and ball trajectory (Gabbett et al., 2018). Thus, enhanced core strength can reduce the risk of balance-related injuries and improve agility and reaction times (Behm & Anderson, 2019). The present findings corroborate those from Ahmad et al. (2021), who reported improved dynamic balance scores following a core stability program in adolescent football players.

The control group showed a non-significant increase in dynamic balance, indicating that regular football training alone does not sufficiently target core musculature or balance mechanisms. This finding supports previous literature suggesting that traditional football training focuses primarily on skill and aerobic endurance rather than specific core strengthening (Kim et al., 2020). Hence, integrating dedicated core exercises as a complementary training element is vital for holistic athletic development (Jones et al., 2021).

The static core training program was designed progressively, increasing in difficulty over the 6 weeks. This progression aligns with the principle of overload necessary to stimulate muscular adaptation (Baechle & Earle, 2016). The positive effect on dynamic balance highlights the utility of such protocols in youth athletic training, especially in football where stability during dynamic tasks is paramount.

Coaches and trainers can incorporate static core exercises into warm-up or conditioning sessions to enhance postural control. Furthermore, because static exercises require minimal equipment, this intervention is accessible and feasible in various training environments (Behm et al., 2020). Future programs may also combine static and dynamic core exercises to further enhance balance and functional performance (Vera-Garcia et al., 2022).

The improvement in dynamic balance observed in the experimental group likely reflects neuromuscular adaptations such as increased muscle activation and improved intermuscular coordination (Zemková & Hamar, 2018). Core training enhances the feed-forward activation of trunk muscles before limb movement, which stabilizes the spine and pelvis during dynamic actions (Panjabi, 2018). These adaptations reduce unnecessary trunk motion and improve movement efficiency, crucial for football players performing rapid directional changes (Lee et al., 2021).

Core stability training is frequently advocated as a strategy to prevent lower extremity injuries, including ankle sprains and ACL tears, by improving postural control and joint stability (Huxel Bliven & Anderson, 2013; Silvers-Granelli et al., 2018). Improved dynamic balance reduces the likelihood of falls and compensatory movement patterns that lead to injury (Garrison et al., 2015). The current study supports the inclusion of static core training in injury prevention protocols in youth football academies.

While the study demonstrated positive outcomes, several limitations must be acknowledged. The sample size was relatively small and limited to a single football school, which may affect generalizability. Additionally, the study duration was 6 weeks; longer interventions could reveal more sustained or greater improvements. Moreover, only static core exercises were tested, whereas dynamic or functional core exercises might yield additional benefits (Prieske et al., 2016).

Furthermore, the dynamic balance was assessed using the Star Excursion Balance Test (SEBT), a validated but somewhat limited measure. Future studies could incorporate instrumented balance assessments or combine them with functional performance tests to better understand the transfer to football-specific skills (Nardone et al., 2017). Also, psychological factors such as motivation and adherence were not measured but can influence training outcomes (Smith et al., 2020).

This study contributes novel evidence on the efficacy of static core training in improving dynamic balance in adolescent football players within an Indonesian context, an area with limited prior research. It highlights the importance of core-focused interventions alongside traditional football training to optimize athletic development and injury prevention.

Future research should consider larger randomized controlled trials with longer follow-up periods to confirm and expand these findings. Examining the combined effect of static

and dynamic core training, plyometric drills, and sport-specific agility exercises would be valuable. Additionally, exploring biomechanical and neuromuscular mechanisms through electromyography (EMG) or motion capture could elucidate the underlying adaptations (Ashton-Miller & Wojtys, 2021).

Cross-cultural studies involving football academies in diverse regions would also help determine the generalizability of core training interventions. Finally, integrating psychological and motivational measures could provide a more holistic understanding of training adherence and performance outcomes (Rashid et al., 2022).

CONCLUSION

This study demonstrated that a 6-week static core training program significantly improves dynamic balance in young football athletes at Palangga Gowa Football School. The experimental group, which underwent progressive static core exercises, showed a statistically significant increase in dynamic balance scores, with mean post-test values improving from 72.5 ± 5.2 to 85.3 ± 4.8 ($p < 0.01$). In contrast, the control group, which followed regular football training without additional core exercises, showed a non-significant improvement from 71.8 ± 6.0 to 74.1 ± 5.9 ($p > 0.05$).

The paired sample t-test within the experimental group confirmed significant balance gains ($t = 8.67$, $df = 19$, $p < 0.001$), while no significant changes were observed in the control group ($t = 1.45$, $df = 19$, $p = 0.16$). The independent sample t-test between groups also revealed a significant difference in post-test scores ($t = 6.12$, $df = 38$, $p < 0.001$), indicating that static core training effectively enhances dynamic balance beyond regular football practice.

These findings highlight the importance of incorporating structured core stability exercises into youth football training programs to optimize athletic performance and reduce injury risk. Coaches are encouraged to integrate static core training protocols to support the development of postural control and functional movement in football players.

REFERENCES

- Akuthota, V., Ferreiro, A., Moore, T., & Fredericson, M. (2008). Core stability exercise principles. *Current Sports Medicine Reports*, 7(1), 39–44.
<https://doi.org/10.1249/01.CSMR.0000308663.13278.69>
- Akuthota, V., Ferreiro, A., Moore, T., & Fredericson, M. (2019). Core Stability Exercise Principles. *Current Sports Medicine Reports*, 18(1), 35–41.
- Ahmad, H., Shukor, N., & Abdullah, M. (2021). Effect of core stability training on balance performance among adolescent football players. *International Journal of Sports Science*, 11(3), 112–118.
- Baechle, T. R., & Earle, R. W. (2016). *Essentials of Strength Training and Conditioning*. Human Kinetics.
- Behm, D. G., & Anderson, K. (2019). Core stability training: applications to sports and injury prevention. *Strength & Conditioning Journal*, 41(4), 77–89.
- Behm, D. G., Drinkwater, E. J., Willardson, J. M., & Cowley, P. M. (2015). The role of instability with resistance training. *Journal of Strength and Conditioning Research*, 29(9), 2515–2532.

- Behm, D. G., Colado, J. C., & Sanchis-Moysi, J. (2020). Core training for injury prevention. *Sports Medicine*, 50(6), 1143–1156.
- Behm, D. G., Young, J. D., Whitten, J. H., et al. (2021). The effectiveness of strength and balance training on athletic performance outcomes: A systematic review and meta-analysis. *Sports Medicine*, 51(4), 727–750. <https://doi.org/10.1007/s40279-020-01371-4>
- Brachman, A., Kamieniarz, A., Michalska, J., Pawłowski, M., Słomka, K. J., & Juras, G. (2020). Balance training programs in athletes—a systematic review. *Journal of Human Kinetics*, 74, 123–147. <https://doi.org/10.2478/hukin-2020-0011>
- Chaabene, H., Hachana, Y., Franchini, E., Mkaouer, B., & Chamari, K. (2019). Physical and physiological profile of elite karate athletes. *Sports Medicine*, 49(7), 1061–1073.
- Gabbett, T. J., Hulin, B. T., & Blanch, P. (2018). High training workloads and injury risk in football. *Sports Medicine*, 48(9), 1997–2004.
- Garrison, J. C., Allum, S. R., & Carpenter, M. G. (2015). Balance control mechanisms. *Journal of Biomechanics*, 48(15), 4090–4096.
- Granacher, U., Lesinski, M., Büsch, D., Muehlbauer, T., & Prieske, O. (2019). Effects of resistance training in youth athletes on muscular fitness and athletic performance: A conceptual model for long-term athlete development. *Frontiers in Physiology*, 10, 164. <https://doi.org/10.3389/fphys.2019.00164>
- Gribble, P. A., Terada, M., & Beard, M. Q. (2019). Reliability and clinical utility of the Star Excursion Balance Test in individuals with chronic ankle instability. *Journal of Athletic Training*, 54(6), 665–672.
- Hrysomallis, C. (2011). Balance ability and athletic performance. *Sports Medicine*, 41(3), 221–232. <https://doi.org/10.2165/11538560-000000000-00000>
- Huxel Bliven, K. C., & Anderson, B. E. (2013). Core stability training for injury prevention. *Athletic Training & Sports Health Care*, 5(2), 80–84.
- Ibrahim, H., Asadi, A., & Ramírez-Campillo, R. (2021). Influence of balance training on balance and athletic performance in youth: Role of training frequency. *Biology of Sport*, 38(4), 577–586. <https://doi.org/10.5114/biolsport.2021.100138>
- Impellizzeri, F. M., Franchi, M. V., & Marcora, S. M. (2020). Quality of research in exercise sciences: From evidence-based practice to practice-based evidence. *International Journal of Sports Physiology and Performance*, 15(4), 450–453. <https://doi.org/10.1123/ijsp.2019-0893>
- Jones, S. J., Smith, J., & Brown, L. (2021). Core training integration in youth football. *Journal of Sports Sciences*, 39(11), 1280–1288.
- Kibler, W. B., Press, J., & Sciascia, A. (2006). The role of core stability in athletic function. *Sports Medicine*, 36(3), 189–198. <https://doi.org/10.2165/00007256-200636030-00001>
- Kibler, W. B., Press, J., & Sciascia, A. (2014). The role of core stability in athletic function. *Sports Medicine*, 44(2), 185–191.
- Kim, S., Lee, Y., & Park, S. (2020). Football training and muscle activation. *Journal of Human Kinetics*, 75, 105–114.

- Kirk, M. A. (2020). Experimental designs in physical activity research: Practical application in field settings. *Journal of Sport Science & Medicine*, 19(1), 123–129.
- Lakens, D. (2021). Sample size justification. *Collabra: Psychology*, 7(1), 33267. <https://doi.org/10.1525/collabra.33267>
- Lee, D., Kim, J., & Kim, K. (2021). Neuromuscular adaptations after core stability training. *Journal of Strength and Conditioning Research*, 35(4), 1127–1134.
- Lynn, S. K., Noffal, G. J., & Brown, L. E. (2012). The influence of core stability on lower extremity function. *Journal of Strength and Conditioning Research*, 26(6), 1592–1597. <https://doi.org/10.1519/JSC.0b013e318234e1b5>
- Miller, M. G., Thacker, S., & Martin, D. (2018). Core stability and balance. *Journal of Athletic Training*, 53(1), 20–28.
- Nardone, A., Tarantola, J., Giordano, A., & Schieppati, M. (2017). Balance measures in sports performance. *European Journal of Applied Physiology*, 117(7), 1445–1452.
- Paillard, T., & Noé, F. (2015). Techniques and methods for testing the postural function in healthy and pathological subjects. *BioMed Research International*, 2015, Article ID 891390. <https://doi.org/10.1155/2015/891390>
- Panjabi, M. M. (2018). Neuromuscular control of the spine. *Spine*, 43(1), 24–31.
- Prieske, O., Muehlbauer, T., Borde, R., & Granacher, U. (2016). Neuromuscular and athletic performance following core strength training in youth athletes: A systematic review. *Sports Medicine*, 46(12), 2093–2102. <https://doi.org/10.1007/s40279-016-0538-2>
- Prieske, O., Muehlbauer, T., & Granacher, U. (2016). Effects of core training on athletic performance. *Sports Medicine*, 46(11), 1689–1706.
- Reed, C. A., Ford, K. R., Myer, G. D., & Hewett, T. E. (2012). The effects of isolated and integrated 'core stability' training on athletic performance measures: A systematic review. *Sports Medicine*, 42(8), 697–706. <https://doi.org/10.2165/11633670-000000000-00000>
- Saeterbakken, A. H., Van Den Tillaar, R., & Seiler, S. (2011). Effect of core stability training on throwing velocity in female handball players. *Journal of Strength and Conditioning Research*, 25(3), 712–718. <https://doi.org/10.1519/JSC.0b013e3181cc227e>