



The Difference in the Effects of Static and Dynamic Core Training Programs on Soccer Skills in Terms of Motor Performance (An Experimental Study on Male

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Abstract

This study aimed to determine: (1) the difference in the effects between static and dynamic core training programs on soccer skills, (2) the difference in soccer skills between athletes with high and low motor performance, and (3) the interaction between training programs and motor performance on soccer skills. This study employed an experimental method with a 2 × 2 factorial design. The population consisted of 27 male players from SSB Watuska Surakarta, with a sample of 24 players selected using purposive sampling and grouped based on the extreme groups design principle. The research instruments included motor performance tests and soccer skill tests, which were standardized using T-scores. Data analysis was conducted using a two-way ANOVA test with a significance level of $\alpha = 0.05$, followed by pairwise comparison tests. The results showed that: (1) there was no significant difference in the effect between static and dynamic core training programs on soccer skills ($p = 0.627 > 0.05$), with a small effect size ($\eta^2 = 0.012$); (2) there was a significant difference between players with high and low motor performance ($p = 0.023 < 0.05$), with a large effect size ($\eta^2 = 0.234$), where the low motor performance group demonstrated substantially greater improvement in soccer skills compared to the high motor performance group; and (3) there was no significant interaction between training program and motor performance level on soccer skills ($p = 0.706 > 0.05$). The conclusion of this study indicates that the effectiveness of core training is more influenced by the individual's initial motor performance capacity rather than the type of training method. Core training is highly effective for players with stability deficits (low motor performance), but it must be applied carefully in players with high motor performance to avoid overload, which may lead to increased muscle stiffness and reduced movement elasticity.

Keywords: Core Training; Motor Performance; Soccer Skills

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Soccer is one of the most popular sports worldwide and requires optimal mastery of fundamental technical skills to achieve competitive performance. (Aulia & M., 2020; Larsen et al., 2023; Zimba & Gasparyan, 2021) emphasized that technical, physical, and psychological components are key determinants that differentiate performance levels among soccer players. Similarly, (Vaz et al., 2019; Wea, 2020; J. Zhang et al., 2025)) identified technical skill proficiency as a primary discriminating factor in elite talent identification. Fundamental technical abilities such as ball control,

passing, and shooting are not merely aesthetic components but represent essential functional skills necessary to maintain ball possession, execute tactical strategies, and achieve competitive success. To perform these technical actions effectively, players must possess adequate physical capacity, as soccer involves high-intensity, explosive, and multidirectional movements. Muscular strength is considered a critical factor influencing athletic performance, as movement efficiency with or without the ball depends on the optimal interaction between muscular strength, speed, and neuromuscular coordination (Forthomme et al., 2005; Jurić et al., 2023; Lahoz et al., 2025; Song et al., 2024)

In recent years, core training has become an essential component of athletic conditioning programs due to its central role in the biological motor chain. The core musculature functions as a kinetic link that facilitates force transmission between the upper and lower extremities, enhances movement efficiency, and minimizes energy loss during dynamic movements (Carsamer, 2016; Chen & Zhang, 2025; Malwanage et al., 2022). Adequate core stability enables athletes to maintain postural control, improve balance, and enhance movement precision during sport-specific actions (Borzucka et al., 2020; Morris et al., 2021; Zahno, 2024). Furthermore, systematic reviews have demonstrated that core training improves athletic performance variables, including balance, coordination, agility, and sport-specific skill performance (Aidar et al., 2022; Kellmann, 2010; Kidokoro et al., 2023).

Core training can generally be classified into two primary categories: static core training and dynamic core training. Static core training, such as plank exercises, involves isometric contractions that improve muscular endurance and postural stability, whereas dynamic core training, such as crunches and mountain climbers, involves concentric and eccentric contractions that enhance functional strength and neuromuscular coordination (Bank et al., 2022; Plotkin et al., 2022; Sánchez Pastor et al., 2023). Previous studies have reported that both static and dynamic core training improve motor performance and balance. However, several studies suggest that dynamic core training may produce greater improvements in sport-specific skills because it more closely resembles functional movement patterns encountered in sports (Bunnell & Stratton, 2024; Majewska et al., 2022; Zhao et al., 2026). Despite these findings, the comparative effectiveness of static and dynamic core training in improving soccer-specific technical skills remains inconclusive, particularly when individual motor performance differences are considered.

In addition to training programs, athletic performance is strongly influenced by individual motor performance capacity, including strength, speed, endurance, agility, and coordination. Motor performance has been widely recognized as a key determinant of soccer performance and talent identification (Latorre Román et al., 2025; Romero-Martínez et al., 2025; Smits-Engelsman et al., 2025; Unger et al., 2024). Players with superior motor performance tend to demonstrate better technical execution, decision-making ability, and tactical efficiency during matches (Doe-Asinyo & Smits-Engelsman, 2021; Hohmann et al., 2025; Patti et al., 2025; Yang et al., 2025). Motor performance enhances neuromuscular efficiency, allowing athletes to execute technical skills with greater precision and consistency. Moreover, neuromuscular adaptation theory suggests that athletes with lower initial physical capacity may experience greater relative improvements following training interventions due to greater adaptive potential (Aslam et al., 2025; Melin et al., 2019; Sánchez Pastor et al., 2023; Xu et al., 2025).

Although previous studies have demonstrated the benefits of core training, most research has focused on its general effects on performance without considering motor

performance level as a moderating factor. Consequently, there remains a significant research gap regarding how individual motor performance capacity influences the effectiveness of different core training methods in improving soccer skills. Understanding this relationship is essential for optimizing training programs and ensuring that training interventions are tailored to individual athlete characteristics.

Therefore, this study aims to examine the differences in the effects of static and dynamic core training programs on soccer skills based on motor performance level. Specifically, this study investigates (1) the difference in effectiveness between static and dynamic core training programs, (2) the differences in soccer skills between athletes with high and low motor performance, and (3) the interaction effect between training program type and motor performance level on soccer skill development. The findings of this study are expected to provide important theoretical and practical contributions to sports training science, particularly in developing individualized training programs to optimize soccer performance.

METHOD

Research Design

This study employed an experimental method using a 2×2 factorial design to examine the effects of the training program (static vs. dynamic core training) and motor performance level (high vs. low) on soccer skills. This design allows simultaneous investigation of the main effects and interaction effects between the independent variables and the dependent variable (Sudjana, 2014).

Participants

The sample consisted of 24 male youth soccer players from SSB Watuska Surakarta (mean age: 14.63 ± 0.71 years; body weight: 48.33 ± 10.77 kg; height: 1.62 ± 0.08 m), selected using purposive sampling. Participants were classified into high and low motor performance groups using the extreme groups design method (Kelley, 1939), excluding three middle-ranked participants to maximize group contrast. Each group consisted of 12 participants, with balanced allocation into four experimental cells ($n = 6$ per group) to ensure statistical robustness (Miller, 2010). Group assignment was conducted using ordinal pairing to ensure comparable baseline ability across groups.

Procedure

The study was conducted over eight weeks, with training sessions performed three times per week (24 sessions total). Prior to the intervention, participants completed motor performance assessments and a soccer skill pre-test. The training program consisted of core exercises performed at 40–60% repetition maximum, with 15–30 repetitions, 3–5 sets, and 60 seconds of rest between sets (Kerksick et al., 2018).

The static core training group performed isometric exercises, including ball twists, prone plank, side plank, and V-leg raise (Terol-Sanchis et al., 2021). The dynamic core training group performed concentric and eccentric exercises, including crunches, squats, push-up plank, and mountain climbers (James et al., 2021). Following the intervention, participants completed a post-test to measure improvement in soccer skills.

Instruments

Motor performance was assessed using standardized tests, including the Multi-stage Fitness Test (endurance), Running-based Anaerobic Sprint Test (RAST) (anaerobic capacity), 30-meter sprint test (speed), T-test (agility), and squat test (strength) (Sibbick et al., 2024). Soccer skills were evaluated using eight standardized skill tests developed by Rosch et al. (2000), including juggling, passing, dribbling, heading, and shooting.

Data Analysis

Raw data were converted into standardized scores (Z-scores and T-scores) to ensure comparability across different measurement units (Miller, 2010). Data analysis was conducted using SPSS version 25.0. Preliminary analyses included Shapiro–Wilk normality tests and Levene’s homogeneity tests, which confirmed that all data met parametric assumptions ($p > 0.05$).

Hypothesis testing was performed using Two-Way ANOVA on gain scores to examine the main and interaction effects of the independent variables. When significant differences were found, Bonferroni-adjusted pairwise comparisons were conducted to identify specific group differences. Effect size was calculated using Partial Eta Squared (η^2) and interpreted according to Cohen’s (1988) criteria: small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$).

RESULT AND DISCUSSION

Description Data

Table 1. Descriptive Statistics of Soccer Skills Based on Training Program and Motor Performance Level

Training Program	Motor Performance Level	Pre-Test Score (Mean ± SD)	Post-Test Score (Mean ± SD)	Gain Score (Mean ± SD)
Static Core Training	High Motor Performance	495.31 ± 19.32	472.57 ± 54.30	-22.74 ± 49.83
	Low Motor Performance	358.58 ± 22.62	372.61 ± 36.08	14.03 ± 36.37
Dynamic Core Training	High Motor Performance	438.66 ± 11.76	417.89 ± 30.81	-20.76 ± 29.06
	Low Motor Performance	307.46 ± 22.64	336.92 ± 40.16	29.47 ± 52.89

Based on the data presented in Table 4.1, subjects with high motor performance levels showed a decreasing trend in performance following the core training intervention. In the static core training group, the mean score decreased from 495.3 to 472.6. Similarly, in the dynamic core training group, the mean score declined from 438.5 to 417.8. This condition is reflected in the negative gain score values, indicating that the additional core training load in athletes with already well-developed motor performance may have had an unfavorable effect on the movement mechanics underlying their soccer skills.

In contrast, subjects with low motor performance levels responded positively to the core training program. In the static core training group, the mean score increased from 358.6 to 372.6. The dynamic core training group demonstrated the most substantial improvement, with mean scores increasing from 307.5 to 336.9. These findings indicate that athletes with low motor performance responded more favorably to core training interventions. The greatest improvement observed in the dynamic training group suggests that dynamic core training may be more effective than static training in enhancing soccer skills among athletes with lower motor performance or developmental-level players. To provide a clearer visual representation of the magnitude of improvement and decline in soccer skill scores across each treatment group, the mean gain score data are presented in the form of a histogram in Figure 1.

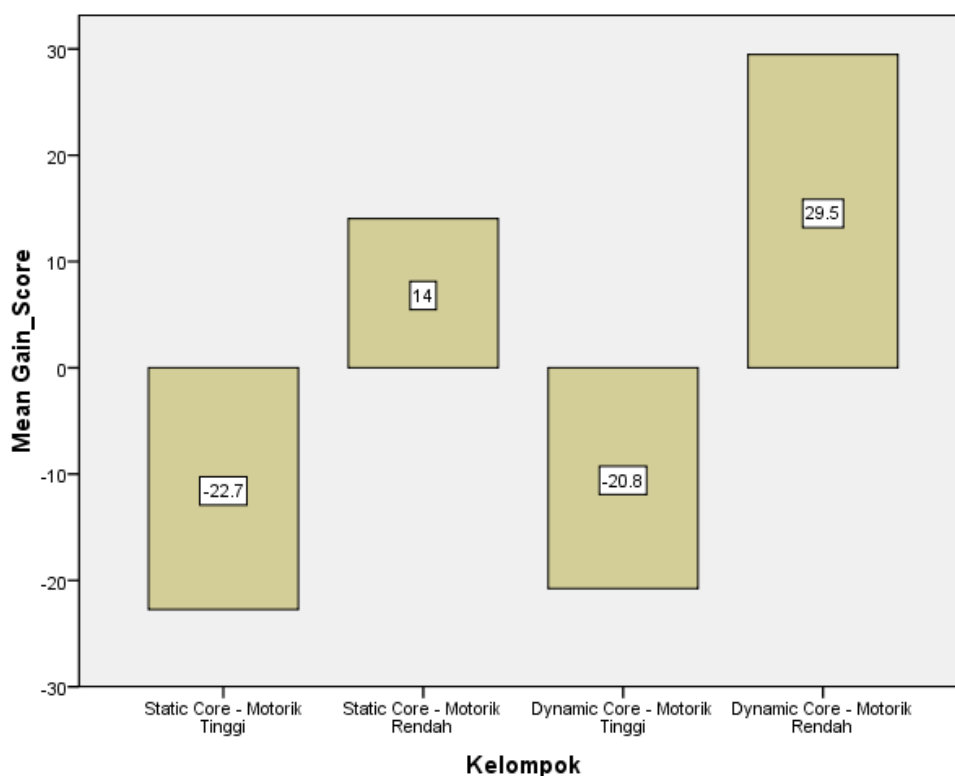


Figure 1. Histogram of Mean Gain Scores of Soccer Skills Across Treatment Groups

Figure 1 further illustrates the differences in treatment effectiveness across groups. Visually, the gain score bars for both high motor performance groups show a downward (negative) trend, indicating a decline in performance. The static core training group showed an average decrease of -22.7 , while the dynamic core training group experienced a decrease of -20.8 . These findings suggest that for subjects with high motor performance capacity, the implementation of core training programs may have negatively affected their soccer skill performance. In contrast, the gain score bars for both low motor performance groups show an upward (positive) trend, with the dynamic core training group demonstrating the highest increase among all groups. The static core training group showed an average improvement of 14.0 , whereas the dynamic core training group demonstrated the greatest improvement, with a mean increase of 29.5 . These results indicate that core training, particularly dynamic core training, is highly effective in improving soccer skills among players with low motor performance capacity.

Although the visualization in Figure 1 provides a clear representation of treatment effects, the substantial improvement observed in the dynamic core training-low motor performance group suggests a strong synergy between dynamic stability training and neuromuscular coordination adaptation in developing athletes. Conversely, the negative trend observed in the high motor performance groups may be attributed to muscle fatigue or a performance ceiling effect. Additional core training load in athletes with already developed motor performance may interfere with sport-specific movement mechanics, thereby reducing movement efficiency and technical precision.

Two-Way ANOVA Test

Table 2. Summary of Two-Way ANOVA Results

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Training_Program	454.730	1	454.730	0.244	0.627	0.012
Performance_Motorik	11353.668	1	11353.668	6.099	0.023	0.234
Training_Program * Performance_Motorik	271.903	1	271.903	0.146	0.706	0.007

Based on Table 2, the results can be interpreted as follows.

1. Effect of Static and Dynamic Core Training Programs on Soccer Skills

The Training Program row examines whether there is a significant difference in effectiveness between static and dynamic core training programs, regardless of motor performance level. The Type III Sum of Squares value of 454.730 represents the amount of variance in soccer skill scores attributable to differences between the training programs. The Mean Square value of 454.730 reflects the average variance per degree of freedom (df = 1). The F-value of 0.244 indicates a very small ratio between the variance explained by the training program and the error variance, suggesting minimal differences between the two training methods. Furthermore, the significance value of 0.627 ($p > 0.05$) indicates that there is no statistically significant difference between static and dynamic core training programs in improving soccer skills. The Partial Eta Squared value of 0.012 indicates that the training program accounts for only 1.2% of the variance in soccer skill improvement, which is classified as a small effect size. This finding suggests that both static and dynamic core training methods produce comparable effects on soccer skill performance.

2. Effect of Motor Performance Level on Soccer Skills

The Motor Performance row examines whether there is a significant difference in soccer skill improvement between players with high and low motor performance levels, regardless of the training program. The Type III Sum of Squares value of 11,353.668 indicates a substantial proportion of variance in soccer skill scores explained by differences in motor performance level. The Mean Square value of 11,353.668 reflects the average variance attributed to motor performance. The F-value of 6.099 indicates a meaningful difference between the two motor performance groups. The significance value of 0.023 ($p < 0.05$) confirms that motor performance level has a statistically significant effect on soccer skill improvement. The Partial Eta Squared value of 0.234 indicates that motor performance level accounts for 23.4% of the variance in skill improvement, which represents a large effect size. This finding demonstrates that motor performance level is a major determinant of training effectiveness.

3. Interaction Effect Between Training Program and Motor Performance

The interaction row (Training Program \times Motor Performance) examines whether the effectiveness of the training program depends on the athlete's motor performance level. The Type III Sum of Squares value of 271.903 represents the variance explained by the interaction between training program and motor performance level. The Mean Square value of 271.903 reflects the average variance attributed to this interaction effect. The F-value of 0.146 indicates a very weak interaction effect. The significance value of 0.706 ($p > 0.05$) confirms that there is no statistically significant interaction between training program type and motor

performance level in influencing soccer skills. The Partial Eta Squared value of 0.007 indicates that the interaction accounts for only 0.7% of the total variance, which is considered a negligible effect size.

Although the histogram in Figure 1 visually suggests different trends between high motor performance groups (declining performance) and low motor performance groups (improving performance), the statistical analysis confirms that motor performance level (23.4%) is a substantially more influential factor than the type of training program. The absence of a significant interaction effect is further illustrated in the profile plot shown in Figure 2, which demonstrates that the effectiveness of core training does not significantly depend on motor performance level, but rather reflects a consistent pattern across groups.

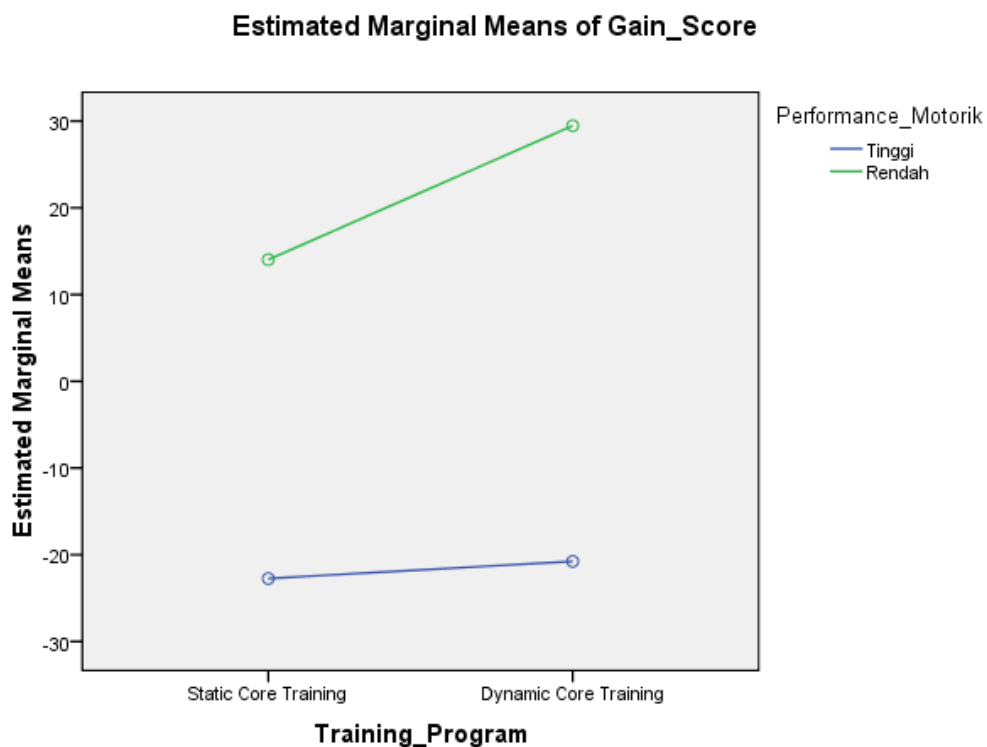


Figure 2. Profile Plot of the Interaction Between Training Program and Motor Performance

Figure 2 illustrates parallel lines between the high motor performance group (blue line) and the low motor performance group (green line). Statistically, the absence of line intersection confirms that there is no significant interaction between the training program and motor performance level. The green line (low motor performance group) is positioned above the zero line, indicating an improvement in soccer skill scores, whereas the blue line (high motor performance group) lies below the zero line, indicating a decline in performance. These findings suggest that motor performance capacity exerts a more consistent and dominant influence on gain score outcomes than the type of training program. Both lines exhibit nearly identical slopes when transitioning from static to dynamic core training. This pattern indicates that dynamic core training tends to produce marginally better outcomes at both motor performance levels. However, these differences are not substantial enough to generate a statistically significant interaction effect.

Pairwise Comparison Test

Following the Two-Way ANOVA analysis, further analysis was conducted using pairwise comparisons to examine the main effects and interaction effects between variables in greater detail. The results of this analysis are presented in the following table.

Table 3. Comparison of the Main Effects of Training Program

(I) Training_Program	(J) Training_Program	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Static Training	Core Dynamic Training	Core -8.706	17.615	.627	-45.449	28.038
Dynamic Training	Core Static Training	Core 8.706	17.615	.627	-28.038	45.449

Based on Table 3, which compares the training programs, the significance value was 0.627 ($p > 0.05$). This result indicates that there is no statistically significant difference between static core training and dynamic core training in improving soccer skills. Both training methods produced relatively comparable effects when considered independently. The standard error value of 17.615 reflects the variability in estimating the mean difference between the two training programs. This consistent value, which is also observed in the motor performance analysis, indicates the stability and reliability of the statistical model. The 95% confidence interval provides a range within which the true mean difference is expected to lie. The confidence interval for the difference between static and dynamic core training ranges from -45.449 (lower bound) to 28.038 (upper bound). Since this interval includes zero, it confirms that there is no statistically significant difference between the two training methods. The presence of zero within the confidence interval suggests that the observed mean difference of 8.706 is likely due to sampling variability rather than a true effect of one training method being superior to the other. Therefore, both static and dynamic core training methods can be considered equally effective in improving soccer skills.

Table 4. Comparison of the Main Effects of Motor Performance Level

(I) Performance_Motorik	(J) Performance_Motorik	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Tinggi	Rendah	-43.500*	17.615	.023	-80.244	-6.757
Rendah	Tinggi	43.500*	17.615	.023	6.757	80.244

Based on Table 4, the pairwise comparison results showed a mean difference of 43.500 with a significance value of 0.023 ($p < 0.05$). This finding indicates a statistically significant difference between players with high motor performance and those with low motor performance in their response to core training. The standard error value of 17.615 represents the variability in estimating the mean difference between the two groups. This consistent value reflects the stability and reliability of the data distribution within the statistical model. The 95% confidence interval provides the range within which the true mean gain score difference is expected to lie. The

comparison between the low motor performance group and the high motor performance group showed a confidence interval ranging from 6.757 (lower bound) to 80.244 (upper bound).

Since the entire confidence interval lies above zero, this result provides strong statistical evidence that the low motor performance group experienced significantly greater improvement in soccer skills compared to the high motor performance group. The positive mean difference observed in the low motor performance group indicates a substantial benefit from the core training intervention, whereas the high motor performance group demonstrated relatively limited improvement or even a decline in performance.

Table 5. Estimated Marginal Means and Confidence Intervals for the Interaction Between Training Program and Motor Performance

Training_Program	Performance_Motorik	Mean	Std. Error	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
Static Core Training	Tinggi	-22.737	17.615	-59.481	14.006
	Rendah	14.031	17.615	-22.712	50.775
Dynamic Core Training	Tinggi	20.763	17.615	-57.507	15.980
	Rendah	29.469	17.615	-7.275	66.212

Table 5 presents the estimated marginal means for each combination of treatment group and motor performance level. Based on the table, the dynamic core training–low motor performance group demonstrated the highest estimated mean gain score of 29.469. In contrast, the static core training–high motor performance group showed the lowest estimated mean gain score of -22.737. The consistent standard error value of 17.615 across all groups indicates a comparable level of precision in the statistical model estimates. Regarding the 95% confidence interval, the dynamic core training–low motor performance group showed a range between -7.275 and 66.212. Although this interval includes zero, the predominance of positive values in both the mean and upper bound suggests that dynamic core training provides the most favorable improvement in soccer skills among players with low motor performance. These findings visually support the profile plot presented in Figure 2, which illustrates a clear acceleration in performance improvement among players with low motor performance, particularly those who underwent dynamic core training.

DISCUSSION

This study aimed to examine the effects of static and dynamic core training programs on soccer skills based on motor performance level. Three major findings emerged. First, there was no significant difference between static and dynamic core training programs in improving soccer skills. Second, motor performance level was found to be a significant determinant of training effectiveness, with players possessing low motor performance showing greater improvement compared to players with high motor performance. Third, no significant interaction was found between training program type and motor performance level, indicating that training effectiveness was primarily influenced by individual motor performance capacity rather than training method.

1. Effect of Static and Dynamic Core Training on Soccer Skills

The results showed no significant difference between static and dynamic core training programs in improving soccer skills. This finding suggests that both training methods provide comparable benefits in enhancing trunk stability and neuromuscular control, which are essential for technical skill execution in soccer. Core muscles serve as a central link in the kinetic chain, facilitating efficient force transfer between the upper and lower extremities and improving movement efficiency (Almansoof et al., 2023; Bustos Carvajal & Arias Coronel, 2025a; Jha et al., 2022; Tsartsapakis et al., 2025). This finding is consistent with previous studies reporting that both static and dynamic core training improve athletic performance, balance, and stability. For example, (Mitrousis et al., 2023; Schedler et al., 2020; D. Zhang et al., 2024; Zhong et al., 2025) found that both training methods significantly improved balance and motor performance, although differences between methods were not statistically significant. Similarly, (Bustos Carvajal & Arias Coronel, 2025a; Guo et al., 2025; Rodríguez et al., 2025; Tsartsapakis et al., 2025) reported that core training enhances stability and neuromuscular efficiency regardless of exercise type.

However, some studies have suggested that dynamic core training may provide greater sport-specific benefits because it involves concentric and eccentric contractions and functional movement patterns that resemble actual sport activities (Amato et al., 2025; Bustos Carvajal & Arias Coronel, 2025b; Dong et al., 2023; Hernandez-Martinez et al., 2024). The lack of significant difference in the present study may be explained by several factors. First, both training methods target the same core muscle groups and improve trunk stability. Second, the participants were adolescent players whose neuromuscular systems were still developing, which may have resulted in similar adaptation responses. Third, soccer skill performance is influenced by multiple factors beyond core strength, including coordination, perception, and technical training (Behm et al., 2025; Huang et al., 2025; Rodríguez-Perea et al., 2023). Therefore, these findings suggest that both static and dynamic core training methods are equally effective in improving general soccer skill performance, particularly in youth athletes.

2. Effect of Motor Performance Level on Soccer Skills

The results demonstrated that motor performance level had a significant and large effect on soccer skill improvement. Players with low motor performance showed significantly greater improvement compared to players with high motor performance. This finding supports previous studies demonstrating that motor performance is a key determinant of technical skill development in soccer players (Michael J Duncan et al., 2023; M. J. Duncan et al., 2022; Kokstejn et al., 2019; Lola et al., 2026). This finding can be explained by neuromuscular adaptation theory, which suggests that individuals with lower initial physical capacity have greater adaptive potential (Aslam et al., 2025; Jenkins et al., 2017; Mănescu, 2025; Martikainen et al., 2025). Core training improves trunk stability, neuromuscular coordination, and postural control, which are essential for efficient technical skill execution. As a result, players with low motor performance experience greater relative improvement because they have more room for physiological and neuromuscular adaptation.

These findings are also consistent with (Hegedüs et al., 2025; Ispyrlidis et al., 2024; Modric et al., 2022; Searston et al., 2025), who reported that motor performance significantly influences technical and tactical performance in soccer. Similarly, (Abarghouejad et al., 2021; N & V, 2024) found that motor performance components such as strength, speed, and coordination are critical predictors of soccer performance. Interestingly, players with high motor performance showed a decline in gain scores. This finding may be explained by the ceiling effect and training overload principle

(Bompa, 2011). Athletes with high motor performance may have already reached near-optimal neuromuscular efficiency, and additional core training may have interfered with their movement efficiency. Excessive stability training may increase muscle stiffness and reduce movement fluidity, which can negatively affect skill performance (Bao et al., 2025; Esposito et al., 2025; Skopal et al., 2024; Yu et al., 2025). Fatigue may also explain this decline. (de Dios-Álvarez et al., 2025; Valdesalici et al., 2026) reported that excessive training load without adequate recovery can impair neuromuscular coordination and technical performance. Therefore, additional core training without individualized periodization may negatively affect athletes with already developed motor performance.

3. Interaction Effect Between Training Program and Motor Performance

Although no statistically significant interaction was found, descriptive results showed that dynamic core training produced the greatest improvement in players with low motor performance. This finding suggests that dynamic core training may provide more functional neuromuscular stimulation, particularly in developing athletes. Dynamic exercises involve full range of motion and stimulate proprioceptive and neuromuscular systems more effectively (George et al., 2025; Malek et al., 2024). These exercises resemble sport-specific movements and improve coordination and movement efficiency. (Cardalda et al., 2021; Kilit et al., 2019; Plotkin et al., 2022) also reported that combining core training with dynamic exercises improves agility and motor performance in soccer players. However, the absence of significant interaction confirms the individualization principle in sports training (Bompa & Haff, 2009). Training effectiveness depends more on individual characteristics than on training method alone.

This study provides several important novel contributions to sports science literature. First, this study integrates core training methods and motor performance level in a factorial experimental design, which has rarely been applied in previous research. Most previous studies examined core training effects without considering motor performance as a moderating variable. Second, this study demonstrates that motor performance level is a more influential factor than training method in determining skill improvement. Third, this study identifies a potential negative effect of core training in athletes with high motor performance due to overload and neuromuscular interference. These findings contribute to training science by providing new evidence that training effectiveness is highly dependent on individual motor performance capacity.

This study has important practical implications for coaches and practitioners. Core training is particularly beneficial for athletes with low motor performance and can significantly improve technical skill performance. However, for athletes with high motor performance, core training should be carefully periodized and integrated with flexibility and technical training to avoid performance decline. These findings support individualized training approaches and highlight the importance of assessing motor performance before designing training programs.

This study has several limitations. First, the sample size was relatively small and limited to youth soccer players. Second, the intervention period was limited to eight weeks, which may not fully capture long-term training effects. Third, physiological variables such as muscle activation and biomechanics were not directly measured. Future studies should include larger and more diverse samples, longer intervention periods, and elite athletes. Future research should also incorporate biomechanical and neuromuscular measurements to better understand the mechanisms underlying

training adaptations. Longitudinal studies are also recommended to examine long-term effects of core training on soccer performance.

CONCLUSION

This study concludes that there was no significant difference between static core training and dynamic core training programs in improving soccer skills. Both training methods demonstrated comparable effectiveness in enhancing trunk stability and neuromuscular control, which are essential for executing fundamental soccer techniques. However, motor performance level was identified as a critical determinant of training effectiveness. Players with low motor performance showed significantly greater improvement in soccer skills following core training, whereas players with high motor performance exhibited limited improvement or even a decline in performance, likely due to overload and neuromuscular interference. Furthermore, no significant interaction was found between training program type and motor performance level, indicating that training effectiveness is influenced more by individual motor performance capacity than by the specific training method. These findings contribute to the existing body of knowledge by providing empirical evidence that motor performance level plays a more dominant role than training method in determining skill improvement, highlighting the importance of individualized training approaches in youth soccer development.

Based on these findings, coaches and practitioners are encouraged to consider athletes' motor performance levels when designing core training programs. Core training is particularly beneficial for players with low motor performance, as it enhances neuromuscular coordination and technical skill execution. However, for players with high motor performance, core training should be carefully periodized and integrated with sport-specific and flexibility training to prevent performance decline. Future research is recommended to involve larger sample sizes, longer intervention periods, and elite-level athletes to enhance the generalizability of the findings. Additionally, future studies should incorporate biomechanical and physiological measurements to further understand the mechanisms underlying core training adaptations and optimize training program effectiveness.

REFERENCES

- Abarghoueinejad, M., Baxter-Jones, A. D. G., Gomes, T. N., Barreira, D., & Maia, J. (2021). Motor Performance in Male Youth Soccer Players: A Systematic Review of Longitudinal Studies. *Sports (Basel, Switzerland)*, 9(4). <https://doi.org/10.3390/sports9040053>
- Aidar, F. J., Cataldi, S., Badicu, G., Silva, A. F., Clemente, F. M., Latino, F., Greco, G., & Fischetti, F. (2022). Paralympic Powerlifting as a Sustainable Way to Improve Strength in Athletes with Spinal Cord Injury and Other Disabilities. *Sustainability (Switzerland)*, 14(4), 1-11. <https://doi.org/10.3390/su14042017>
- Almansoof, H. S., Nuhmani, S., & Muaidi, Q. (2023). Role of kinetic chain in sports performance and injury risk: a narrative review. *Journal of Medicine and Life*, 16(11), 1591-1596. <https://doi.org/10.25122/jml-2023-0087>
- Amato, A., Cortis, C., Tropea, M., Politi, M., Fusco, A., & Musumeci, G. (2025). Comparison of the Core Training and Mobility Training Effects on Basketball Athletic Performance in Young Players: A Comparative Experimental Study. In *Sports* (Vol. 13, Issue 11, p. 398). <https://doi.org/10.3390/sports13110398>
- Aslam, S., Habyarimana, J. D. D., & Bin, S. Y. (2025). Neuromuscular adaptations to resistance training in elite versus recreational athletes. *Frontiers in Physiology*,

<https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2025.1598149>

- Aulia, P., & M., P. R. (2020). Pengaruh Latihan Mental Terhadap Kepercayaan Diri Atlet Sepakbola Akademi Persekat Padang Pariaman. *Jurnal Psikologi, Universitas Negeri Padang*, 4(2017), 44-45. <https://jptam.org/index.php/jptam/article/download/863/779/1702>
- Bank, N., Hecht, C., Karimi, A., El-Abtah, M., Huang, L., & Mistovich, R. J. (2022). Raising the Young Athlete: Training and Injury Prevention Strategies. *Journal of the Pediatric Orthopaedic Society of North America*, 4(2), 462. <https://doi.org/https://doi.org/10.55275/JPOSNA-2022-0037>
- Bao, Z., Wang, S., & Li, Z. (2025). Effects of unstable training on muscle activation: a systematic review and meta-analysis of electromyographic studies. *PeerJ*, 13, e19751. <https://doi.org/10.7717/peerj.19751>
- Behm, D. G., Konrad, A., Nakamura, M., Alizadeh, S., Culleton, R., Hadjizadeh Anvar, S., Pearson, L. T., Ramirez-Campillo, R., & Sale, D. G. (2025). A narrative review of velocity-based training best practice: the importance of contraction intent versus movement speed. *Applied Physiology Nutrition and Metabolism*, 50, 1-9. <https://doi.org/https://doi.org/10.1139/apnm-2024-0136>
- Bompa. (2011). *Theory And Of Training The Key Perpomance*,. Hunt Publishing Company.
- Bompa, T. O., & Haff, G. G. (2009). Periodization: Theory and Methodology of Training. In *Champaign, Ill. : Human Kinetics*;
- Borzucka, D., Kręcis, K., Rektor, Z., & Kuczyński, M. (2020). Postural control in top-level female volleyball players. *BMC Sports Science, Medicine & Rehabilitation*, 12, 65. <https://doi.org/10.1186/s13102-020-00213-9>
- Bunnell, E., & Stratton, M. T. (2024). The Impact of Functional Training on Balance and Vestibular Function: A Narrative Review. In *Journal of Functional Morphology and Kinesiology* (Vol. 9, Issue 4, p. 251). <https://doi.org/10.3390/jfmk9040251>
- Bustos Carvajal, J. S., & Arias Coronel, F. (2025a). Exploring the role of the core in sports performance: a systematic review of the effects of core muscle training. *Frontiers in Sports and Active Living*, 7(September), 1-11. <https://doi.org/10.3389/fspor.2025.1630584>
- Bustos Carvajal, J. S., & Arias Coronel, F. (2025b). Exploring the role of the core in sports performance: a systematic review of the effects of core muscle training. *Frontiers in Sports and Active Living*, Volume 7-2025. <https://www.frontiersin.org/journals/sports-and-active-living/articles/10.3389/fspor.2025.1630584>
- Cardalda, I. M., Pereira Pedro, K. P., Rodríguez, A. L., & Cancela Carral, J. M. (2021). Application of a physical exercise coordinating program by MOTomed® system in older adults diagnosed with moderate-severe Parkinson's disease. Case Reports. *Retos*, 2041(39), 13-17. <https://doi.org/10.47197/retos.v0i39.78385>
- Carsamer, E. (2016). Volatility transmission in African foreign exchange markets. *African Journal of Economic and Management Studies*, 7(2), 205-224. <https://doi.org/https://doi.org/10.1108/AJEMS-05-2015-0056>
- Chen, Z., & Zhang, T. (2025). Evaluation of basic sports actions for students based on DTW posture matching algorithm. *Systems and Soft Computing*, 7, 200196. <https://doi.org/https://doi.org/10.1016/j.sasc.2025.200196>
- de Dios-Álvarez, V., Rey, E., Padrón-Cabo, A., & Castellano, J. (2025). Impact of Weekly Eccentric Overload Training on Locomotor and Mechanical Performance in Youth Soccer Players. *Journal of Sports Science and Medicine*, 24(2), 351-362.

- <https://doi.org/10.52082/jssm.2025.351>
- Doe-Asinyo, R. X., & Smits-Engelsman, B. C. M. (2021). Ecological validity of the PERF-FIT: correlates of active play, motor performance and motor skill-related physical fitness. *Heliyon*, 7(8), e07901. <https://doi.org/https://doi.org/10.1016/j.heliyon.2021.e07901>
- Dong, K., Yu, T., & Chun, B. (2023). Effects of Core Training on Sport-Specific Performance of Athletes: A Meta-Analysis of Randomized Controlled Trials. *Behavioral Sciences (Basel, Switzerland)*, 13(2). <https://doi.org/10.3390/bs13020148>
- Duncan, Michael J, Eyre, Emma L J, Clarke, Neil, Hamid, Abdul, & Jing, Yanguo. (2023). Importance of fundamental movement skills to predict technical skills in youth grassroots soccer: A machine learning approach. *International Journal of Sports Science & Coaching*, 19(3), 1042–1049. <https://doi.org/10.1177/17479541231202015>
- Duncan, M. J., Eyre, E. L. J., Noon, M. R., Morris, R., Thake, C. D., Clarke, N. D., & Cunningham, A. J. (2022). Actual and perceived motor competence mediate the relationship between physical fitness and technical skill performance in young soccer players. *European Journal of Sport Science*, 22(8), 1196–1203. <https://doi.org/10.1080/17461391.2021.1948616>
- Esposito, G., Ceruso, R., Invernizzi, P. L., Manzi, V., & Raiola, G. (2025). Effects of Stretching and Resistance Training on Psychophysical Awareness: A Pilot Study. In *Applied Sciences* (Vol. 15, Issue 15, p. 8259). <https://doi.org/10.3390/app15158259>
- Forthomme, B., Croisier, J. L., Ciccarone, G., Crielaard, J. M., & Cloes, M. (2005). Factors correlated with volleyball spike velocity. *American Journal of Sports Medicine*, 33(10), 1513–1519. <https://doi.org/10.1177/0363546505274935>
- George, J., Maqsood, M., Ahmed, H. S., Muhammad, A. S., Abdelrehim, Z. M., Ezzi, J., Rehman, A., & Abdeldayem, T. S. (2025). The Efficacy of Proprioceptive Neuromuscular Facilitation Techniques in Improving Range of Motion and Strength: A Systematic Review. *South Eastern European Journal of Public Health*, XXVI, 996–1006. <https://doi.org/10.70135/seejph.vi.3801>
- Guo, X. Bin, Lan, Q., Ding, J., Tang, L., & Yang, M. (2025). Effects of different types of core training on pain and functional status in patients with chronic nonspecific low back pain: a systematic review and meta-analysis. *Frontiers in Physiology*, 16, 1672010. <https://doi.org/10.3389/fphys.2025.1672010>
- Hegedüs, P., Csala, D., Tóth, J., & Tóth, J. (2025). Age-Related Effects of Physical Performance on Technical and Tactical Outcomes in Youth Soccer. In *Sports* (Vol. 13, Issue 6, p. 162). <https://doi.org/10.3390/sports13060162>
- Hernandez-Martinez, J., Cid-Calfucura, I., Chiguay, C., Weinberger, M., Delgado-Floody, P., Muñoz-Vásquez, C., Aristegui-Mondaca, J., Levín-Catrilao, Á., Herrera-Valenzuela, T., Branco, B. H. M., & Valdés-Badilla, P. (2024). Effects of elastic band training on body composition and physical performance in older people: A systematic review with meta-analysis. *Experimental Gerontology*, 196, 112553. <https://doi.org/https://doi.org/10.1016/j.exger.2024.112553>
- Hohmann, A., Schmid, J., & Charbonnet, B. (2025). Toward a Differentiated Model of Athlete Performance Development (DMAPD): Preliminary version and testing based on a German sample representing six sports. *Psychology of Sport and Exercise*, 80, 102896. <https://doi.org/https://doi.org/10.1016/j.psychsport.2025.102896>
- Huang, D., Song, W., Liu, Y., Ke, X., & Wu, Z. (2025). Isokinetic eccentric vs. concentric training for functional ankle instability: a randomized controlled trial. *Journal of Orthopaedic Surgery and Research*, 20(1), 775. <https://doi.org/10.1186/s13018-025->

- Ispyrilidis, I.,ourgoulis, V., Mitrotasios, M., & Mantzouranis, N. (2024). Physical performance and technical-tactical aspects in 4 vs. 4 small-sided games across various field formats among professional soccer players. *Journal of Physical Education and Sport*, 24(2), 482–487. <https://doi.org/10.7752/jpes.2024.02059>
- James, R., Griffin, J. G. L., Senior, C., & Love, R. (2021). The role of the Radiographer in osteoporosis and fracture prevention services – a narrative review. *Radiography*, 27, S34–S38. <https://doi.org/10.1016/j.radi.2021.07.020>
- Jenkins, N. D. M., Miramonti, A. A., Hill, E. C., Smith, C. M., Cochrane-Snyman, K. C., Housh, T. J., & Cramer, J. T. (2017). Greater Neural Adaptations following High- vs. Low-Load Resistance Training. *Frontiers in Physiology*, 8, 331. <https://doi.org/10.3389/fphys.2017.00331>
- Jha, P., Nuhmani, S., Kapoor, G., Al Muslem, W. H., Joseph, R., Kachanathu, S. J., & Alsaadi, S. M. (2022). Efficacy of core stability training on upper extremity performance in collegiate athletes. *Journal of Musculoskeletal & Neuronal Interactions*, 22(4), 498–503.
- Jurić, P., Dudley, D. A., & Petocz, P. (2023). Does incorporating high intensity interval training in physical education classes improve fitness outcomes of students? A cluster randomized controlled trial. *Preventive Medicine Reports*, 32, 102127. <https://doi.org/10.1016/j.pmedr.2023.102127>
- Kellmann, M. (2010). Preventing overtraining in athletes in high-intensity sports and stress/recovery monitoring. *Scandinavian Journal of Medicine & Science in Sports*, 20 Suppl 2, 95–102. <https://doi.org/10.1111/j.1600-0838.2010.01192.x>
- Kerksick, C. M., Wilborn, C. D., Roberts, M. D., Smith-Ryan, A., Kleiner, S. M., Jäger, R., Collins, R., Cooke, M., Davis, J. N., Galvan, E., Greenwood, M., Lowery, L. M., Wildman, R., Antonio, J., & Kreider, R. B. (2018). ISSN exercise & sports nutrition review update: research & recommendations. *Journal of the International Society of Sports Nutrition*, 15(1), 38. <https://doi.org/10.1186/s12970-018-0242-y>
- Kidokoro, T., Tomkinson, G. R., Lang, J. J., & Suzuki, K. (2023). Physical fitness before and during the COVID-19 pandemic: Results of annual national physical fitness surveillance among 16,647,699 Japanese children and adolescents between 2013 and 2021. *Journal of Sport and Health Science*, 12(2), 246–254. <https://doi.org/10.1016/j.jshs.2022.11.002>
- Kilit, B., Arslan, E., & Soylu, Y. (2019). Effects of different stretching methods on speed and agility performance in young tennis players. *Science & Sports*, 34(5), 313–320. <https://doi.org/10.1016/J.SCISPO.2018.10.016>
- Kokstajn, J., Musalek, M., Wolanski, P., Murawska-Cialowicz, E., & Stastny, P. (2019). Fundamental Motor Skills Mediate the Relationship Between Physical Fitness and Soccer-Specific Motor Skills in Young Soccer Players. *Frontiers in Physiology*, Volume 10-2019. <https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2019.00596>
- Lahoz, C., Pérez-Rey, J., González, D., Gallart, J., Bayod, J., & Luesma, M. J. (2025). The relationship between lower limb alignment and physical fitness in children aged 10–12: A sex-specific analysis using the ALPHA-fitness test battery. *Brazilian Journal of Physical Therapy*, 29(5), 101242. <https://doi.org/10.1016/j.bjpt.2025.101242>
- Larsen, M. N., Terracciano, A., Møller, T. K., Aggestrup, C. S., Buono, P., Krstrup, P., & Castagna, C. (2023). An 11-week school-based “health education through football” programme improves musculoskeletal variables in 10–12-year-old Danish

- school children. *Bone Reports*, 18, 101681. <https://doi.org/https://doi.org/10.1016/j.bonr.2023.101681>
- Latorre Román, P. Á., Huete, V. S., Atero Mata, E. M., Andrade-Lara, K. E., Párraga Montilla, J. A., Sánchez, J. H., Marín, A. M., Redondo, M. M., Pozas, D. M., Sánchez, J. S., Cabrera Linares, J. C., & Zurita, M. L. (2025). Development of an innovative approach to the assessment of eye-hand coordination in a dual-task context in prepubertal children. *Journal of Experimental Child Psychology*, 254, 106217. <https://doi.org/https://doi.org/10.1016/j.jecp.2025.106217>
- Lola, A., Bassa, E., Symeonidou, S., Stavropoulou, G., Papavasileiou, A., Fregidis, K., & Bismpos, M. (2026). Analysis of Motor and Perceptual-Cognitive Performance in Young Soccer Players: Insights into Training Experience and Biological Maturation. *Sports (Basel, Switzerland)*, 14(1). <https://doi.org/10.3390/sports14010022>
- Majewska, J., Kołodziej-Lackorzyńska, G., Cyran-Grzebyk, B., Szymczyk, D., Kołodziej, K., & Wądołkowski, P. (2022). Effects of Core Stability Training on Functional Movement Patterns in Tennis Players. *International Journal of Environmental Research and Public Health*, 19(23). <https://doi.org/10.3390/ijerph192316033>
- Malek, N. F. A., Nadzalan, A. M., Tan, K., Nor Azmi, A. M., Krishnan Vasanthi, R., Pavlović, R., Badau, D., & Badau, A. (2024). The Acute Effect of Dynamic vs. Proprioceptive Neuromuscular Facilitation Stretching on Sprint and Jump Performance. *Journal of Functional Morphology and Kinesiology*, 9(1). <https://doi.org/10.3390/jfmk9010042>
- Malwanage, K. T., Senadheera, V. V., & Dassanayake, T. L. (2022). Effect of balance training on footwork performance in badminton: An interventional study. *PloS One*, 17(11), e0277775. <https://doi.org/10.1371/journal.pone.0277775>
- Mănescu, D. C. (2025). Computational Analysis of Neuromuscular Adaptations to Strength and Plyometric Training: An Integrated Modeling Study. In *Sports* (Vol. 13, Issue 9, p. 298). <https://doi.org/10.3390/sports13090298>
- Martikainen, O., Niiranen, H., Rytkönen, T., Schoenfeld, B. J., Ahtiainen, J. P., & Hulmi, J. J. (2025). Influence of Varying Proximity-to-Failure on Muscular Adaptations and Repetitions-in-Reserve Estimation Accuracy in Resistance-Trained Individuals. *Journal of Science in Sport and Exercise*. <https://doi.org/10.1007/s42978-025-00338-8>
- Melin, A. K., Heikura, I. A., Tenforde, A., & Mountjoy, M. (2019). Energy Availability in Athletics: Health, Performance, and Physique. *International Journal of Sport Nutrition and Exercise Metabolism*, 29(2), 152–164. <https://doi.org/10.1123/ijsnem.2018-0201>
- Miller, D. K. (2010). *Measurement by the Physical Educator Why and How*.
- Mitrousis, I., Bourdas, D. I., Kounalakis, S., Bekris, E., Mitrotasios, M., Kostopoulos, N., Ktistakis, I. E., & Zacharakis, E. (2023). The Effect of a Balance Training Program on the Balance and Technical Skills of Adolescent Soccer Players. *Journal of Sports Science and Medicine*, 22(4), 645–657. <https://doi.org/10.52082/jssm.2023.645>
- Modric, T., Malone, J. J., Versic, S., Andrzejewski, M., Chmura, P., Konefał, M., Drid, P., & Sekulic, D. (2022). The influence of physical performance on technical and tactical outcomes in the UEFA Champions League. *BMC Sports Science, Medicine and Rehabilitation*, 14(1), 179. <https://doi.org/10.1186/s13102-022-00573-4>
- Morris, N. B., Piił, J. F., Morabito, M., Messeri, A., Levi, M., Ioannou, L. G., Ciuha, U., Pogačar, T., Kajfež Bogataj, L., Kingma, B., Casanueva, A., Kotlarski, S., Spirig, C., Foster, J., Havenith, G., Sotto Mayor, T., Flouris, A. D., & Nybo, L. (2021). The HEAT-SHIELD project – Perspectives from an inter-sectoral approach to

- occupational heat stress. *Journal of Science and Medicine in Sport*, 24(8), 747–755.
<https://doi.org/https://doi.org/10.1016/j.jsams.2021.03.001>
- N, K., & V, K. (2024). Integrating Electroencephalography with Motophysic training: Assessing the shift in fitness and cognitive functions in elite youth soccer players. *Heliyon*, 10(14), e34342.
<https://doi.org/https://doi.org/10.1016/j.heliyon.2024.e34342>
- Patti, A., Salvatore Vicari, D. S., Giustino, V., Figlioli, F., Seidita, G. M., Montalto Monella, A. C., Oddo, A., Paoli, A., Drid, P., Thomas, E., & Bianco, A. (2025). The impact of sports experience on manual dexterity performances in school-age children. *Heliyon*, 11(1), e41421.
<https://doi.org/https://doi.org/10.1016/j.heliyon.2024.e41421>
- Plotkin, D., Coleman, M., Van Every, D., Maldonado, J., Oberlin, D., Israetel, M., Feather, J., Alto, A., Vigotsky, A. D., & Schoenfeld, B. J. (2022). Progressive overload without progressing load? The effects of load or repetition progression on muscular adaptations. *PeerJ*, 10, e14142. <https://doi.org/10.7717/peerj.14142>
- Rodríguez-Perea, Á., Reyes-Ferrada, W., Jerez-Mayorga, D., Chiroso Ríos, L., Van den Tillar, R., Chiroso Ríos, I., & Martínez-García, D. (2023). Core training and performance: a systematic review with meta-analysis. *Biology of Sport*, 40(4), 975–992. <https://doi.org/10.5114/biol sport.2023.123319>
- Rodríguez, S., Hernández-Álvarez, E. D., & León-Prieto, C. (2025). Effects of core stability training on physical performance in soccer players: Systematic review and meta-analysis. *Journal of Bodywork and Movement Therapies*, 45, 1082–1100. <https://doi.org/https://doi.org/10.1016/j.jbmt.2025.10.026>
- Romero-Martínez, J., Menescardi, C., Ortega-Benavent, N., Montalt-García, S., Barnett, L. M., García-Massó, X., & Estevan, I. (2025). Effects of a classroom-based intervention to promote physical literacy in children: the randomized and controlled ALPHYL Study. *Journal of Science and Medicine in Sport*. <https://doi.org/https://doi.org/10.1016/j.jsams.2025.05.006>
- Sánchez Pastor, A., García-Sánchez, C., Marquina Nieto, M., & de la Rubia, A. (2023). Influence of Strength Training Variables on Neuromuscular and Morphological Adaptations in Prepubertal Children: A Systematic Review. *International Journal of Environmental Research and Public Health*, 20(6). <https://doi.org/10.3390/ijerph20064833>
- Schedler, S., Tenelsen, F., Wich, L., & Muehlbauer, T. (2020). Effects of balance training on balance performance in youth: role of training difficulty. *BMC Sports Science, Medicine and Rehabilitation*, 12(1), 71. <https://doi.org/10.1186/s13102-020-00218-4>
- Searston, M., Joyce, C., & Lyons, M. (2025). Tactical performance in youth football: the influence of sex, age and playing position. *International Journal of Performance Analysis in Sport*, 1–15. <https://doi.org/10.1080/24748668.2025.2516391>
- Sibbick, E., Boat, R., Sarkar, M., Johnston, J. P., Groom, M., Williams, R. A., Dring, K. J., Sun, F.-H., & Cooper, S. B. (2024). Associations of physical activity and cardiorespiratory fitness with cognitive function, self-control, and resilience in young people with attention deficit hyperactivity disorder. *Advanced Exercise and Health Science*, 1(1), 51–58.
<https://doi.org/https://doi.org/10.1016/j.aehs.2024.01.003>
- Skopal, L. K., Drinkwater, E. J., & Behm, D. G. (2024). Application of mobility training methods in sporting populations: A systematic review of performance adaptations. *Journal of Sports Sciences*, 42(1), 46–60.
<https://doi.org/10.1080/02640414.2024.2321006>
- Smits-Engelsman, B., Denyssen, M., Lust, J., Coetzee, D., Valtr, L., Schoemaker, M., &

- Verbecque, E. (2025). Which outcomes are key to the pre-intervention assessment profile of a child with developmental coordination disorder? A systematic review and meta-analysis. *Biomedical Journal*, 48(2), 100768. <https://doi.org/https://doi.org/10.1016/j.bj.2024.100768>
- Song, H., Lau, P. W. C., Wang, J., Liu, Y., Song, Y., & Shi, L. (2024). 24-H movement behaviors and physical fitness in preschoolers: A compositional and isotemporal reallocation analysis. *Journal of Exercise Science & Fitness*, 22(3), 187-193. <https://doi.org/https://doi.org/10.1016/j.jesf.2024.03.002>
- Sudjana, N. (2014). *Penilaian Hasil Proses Belajar Mengajar*. Remaja Rosdakarya.
- Terol-Sanchis, M., Elvira-Aranda, C., Gomis-Gomis, M. J., & Pérez-Turpin, J. A. (2021). The Relationship between Speed and Strength in the Beach Volleyball Serve. *Journal of Human Kinetics*, 80, 39-47. <https://doi.org/10.2478/hukin-2021-0099>
- Tsartsapakis, I., Zafeiroudi, A., Trigonis, I., Lyrtzis, C., & Astrapellos, K. (2025). Development and Implementation of a Core Training Protocol: Effects on Muscle Activation, Hypertrophy, Balance, and Quality of Life in Recreationally Active Adults. In *Methods and Protocols* (Vol. 8, Issue 4, p. 77). <https://doi.org/10.3390/mps8040077>
- Unger, A., Reichel, W., Röttig, K., & Wilke, J. (2024). Secular trends of physical fitness in Austrian children attending sports schools: An analysis of repeated cross-sections from 2006 to 2023. *Preventive Medicine*, 189, 108149. <https://doi.org/https://doi.org/10.1016/j.ypmed.2024.108149>
- Valdesalici, A., Sella, E., Domenicucci, R., Ghisi, M., & Borella, E. (2026). Effects of non-functional overreaching and overtraining syndrome on psychological and cognitive functioning in elite athletes: A systematic review. *Psychology of Sport and Exercise*, 84, 103079. <https://doi.org/https://doi.org/10.1016/j.psychsport.2026.103079>
- Vaz, M. S., Ribeiro, Y. S., Pinheiro, E. S., & Del Vecchio, F. B. (2019). Psychophysiological profile and prediction equations for technical performance of football players. *Revista Brasileira de Ciências Do Esporte*, 41(2), 215-221. <https://doi.org/10.1016/j.rbce.2018.04.009>
- Wea, Y. M. (2020). Pengaruh latihan small sided games terhadap teknik dasar permainan sepakbola. *Jurnal Penjakora*, 7(1), 11-17.
- Xu, Z., Sun, J., Gu, J., & Yu, L. (2025). Effects of 8 weeks of combined strength and plyometric training on lower limb vertical stiffness and jump performance in elite long jump athletes. *Frontiers in Physiology*, Volume 16-2025. <https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2025.1692254>
- Yang, Q., Song, M. L., Chen, X., Li, M., & Wang, X. (2025). The influence of linear and nonlinear pedagogy on motor skill performance: the moderating role of adaptability. *Frontiers in Psychology*, 16(March), 1-11. <https://doi.org/10.3389/fpsyg.2025.1540821>
- Yu, T., Xu, Y., Zhang, Z., Sun, Y., Zhong, J., & Ding, C. (2025). The impact of core training on overall athletic performance in different sports: a comprehensive meta-analysis. *BMC Sports Science, Medicine and Rehabilitation*, 17(1), 112. <https://doi.org/10.1186/s13102-025-01159-6>
- Zahno, S. (2024). Creativity in sports: The crucial role of motor skills. *Journal of Creativity*, 34(3), 100091. <https://doi.org/https://doi.org/10.1016/j.yjoc.2024.100091>
- Zhang, D., Soh, K. G., Chan, Y. M., Feng, X., Bashir, M., & Xiao, W. (2024). Effect of functional training on fundamental motor skills among children: A systematic

- review. *Heliyon*, 10(23), e39531.
<https://doi.org/https://doi.org/10.1016/j.heliyon.2024.e39531>
- Zhang, J., Zhou, X., & Goh, Y. S. (2025). Unpacking AI-supported Chinese as a foreign language learning: How beginner-level learners' cognitive and motivational factors predict speaking proficiency. *Acta Psychologica*, 260, 105703. <https://doi.org/https://doi.org/10.1016/j.actpsy.2025.105703>
- Zhao, X., Ya, X., Zhou, H., Liu, G., Liu, Z., Luo, J., Liu, Y., & Bu, Y. (2026). The specificity of cluster training effects in sports: a systematic review and meta-analysis. *Frontiers in Physiology*, Volume 16-2025. <https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2025.1722401>
- Zhong, Y., Guo, W., Chen, P., & Wang, Y. (2025). Effects of core training on balance performance in older adults: a systematic review and meta-analysis. *Frontiers in Public Health*, 13, 1661460. <https://doi.org/10.3389/fpubh.2025.1661460>
- Zimba, O., & Gasparyan, A. Y. (2021). Plagiarism detection and prevention: A primer for researchers. *Reumatologia*, 59(3), 132–137. <https://doi.org/10.5114/reum.2021.105974>
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