

Effect of an eight-week core training program on Y-Balance performance in professional female wrestlers: a controlled quasi-experimental study

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Abstract

Background and Study Aim Dynamic balance is a component of athletic performance. It is required in sports involving rapid postural adjustments, single-leg stabilization, and trunk control. Wrestling involves frequent changes in body position and rotational movements, which demand high levels of neuromuscular coordination and trunk stability. Despite the application of core training to improve postural control, its effectiveness in enhancing dynamic balance in elite female wrestlers remains a matter of practical interest. Therefore, the aim of this study was to investigate the effects of an eight-week core training program on Y-Balance performance in professional female wrestlers.

Material and Methods Fifteen elite female wrestlers participated in this study. A single-group pretest–posttest quasi-experimental design was used. Dynamic balance was assessed using the Y-Balance Test for the Lower Quarter in the anterior (ANT), posteromedial (PM), and posterolateral (PL) directions. Participants completed an eight-week core training program in addition to their regular wrestling training. Reach distances were normalized to leg length. Data were analyzed using a two-way repeated measures ANOVA, and statistical significance was set at $p < 0.05$.

Results Significant improvements were observed in Y-Balance performance following the intervention. For the dominant limb, a significant effect of time was found ($p < .001$). For the non-dominant limb, dynamic balance also improved significantly ($p = .005$). Composite Y-Balance scores increased significantly for both the dominant ($p < .001$) and non-dominant limbs ($p = .026$).

Conclusions Dynamic balance performance improved following the eight-week training intervention in elite female wrestlers. These findings suggest that integrating structured core exercises into wrestling training programs may support improvements in trunk stability and functional balance capacity.

Keywords: core training, dynamic balance, Y-Balance Test, wrestling; trunk stability, neuromuscular control

Introduction

Balance control is a fundamental aspect of movement performance in sports that involve complex and rapidly changing motor tasks. In disciplines such as wrestling, athletes are required to maintain stability under conditions of continuous body displacement, external perturbations, and rotational actions. These demands are associated with coordinated neuromuscular activity and effective control of trunk positioning during dynamic movements. The ability to sustain balance under such conditions is influenced by multiple interacting factors, including strength, coordination, and sensorimotor integration.

Dynamic balance allows control of the body's center of mass relative to the base of support during movement. This control is achieved through the integration of visual, vestibular, and somatosensory systems and is required for maintaining postural stability [1]. In sports performance, dynamic balance is considered a determinant, particularly

in movements such as single-leg loading, rapid acceleration, and changes of direction. Deficits in postural control mechanisms can lead to decreased movement efficiency and an increased risk of lower extremity injuries [2]. The Star Excursion Balance Test (SEBT), recognized as one of the standard methods for assessing dynamic stability and lower extremity injury risk, is widely used to measure postural control [3]. The Y-Balance Test (YBT), an instrumented and standardized version of the three most reliable reach directions of the SEBT, is a practical tool for evaluating lower extremity neuromuscular control and single-leg stability. In this test, athletes perform reaching tasks in the anterior, posteromedial, and posterolateral directions while maintaining balance on a single leg. These multidirectional reaching movements allow assessment of dynamic postural control and sensorimotor coordination [4].

In recent years, core stability has become a component of training programs aimed at enhancing athletic performance and reducing

injury risk. The core region is defined as a kinetic link system consisting of the pelvis, lumbar spine, and surrounding trunk musculature, which facilitates the transfer of force between the upper and lower extremities [5]. Adequate stabilization by the muscles in this region contributes to control of the body's center of mass during movement and maintenance of inter-limb coordination. Therefore, the development of core stability is used as a training approach for improving performance components such as balance, agility, and force production [6]. Experimental studies demonstrate that core training yields improvements in physical performance and postural stability.

Previous research has suggested that core stability training may contribute to improvements in dynamic balance performance. For example, Kahle and Gribble reported that a six-week core stability training program was associated with improvements in Star Excursion Balance Test performance in healthy young adults [7]. Similarly, Filipa et al. reported that neuromuscular training focusing on core stability and lower extremity strength improved SEBT performance and reduced injury risk in young female athletes [8]. Prieske et al. reported that trunk muscle strength is a factor in athletic performance and is associated with movements requiring postural control [9]. These findings indicate that strengthening the core musculature contributes to the ability to maintain postural stability during dynamic movements [10, 11].

Analysis of research findings has shown that core stability is associated with postural control and dynamic balance performance in athletes. Researchers emphasize that coordinated trunk function and neuromuscular control contribute to the maintenance of balance during complex wrestling movements. At the same time, the interaction between core training interventions and dynamic balance performance remains a subject of practical relevance under conditions of wrestling-specific load. This aspect continues to limit the clear evaluation of how targeted core training may influence balance performance in wrestlers.

However, most studies investigating the effects of core training on balance performance have been conducted in team sport athletes. Data on athletes requiring a high level of postural control, including professional female wrestlers, remain limited. Wrestling involves rapid postural changes, rotational actions, isometric positions, and movements requiring single-leg stabilization. Control of the center of mass is required during situations such as defending a double-leg takedown or maintaining a bridging position. In this context, the Y-Balance Test provides an approach for assessing sensorimotor control and single-leg stability through multidirectional reaching tasks. However, experimental data on the effects of a structured core

training program integrated into routine wrestling training on Y-Balance performance in professional female wrestlers remain scarce.

Therefore, the purpose of this study was to investigate the effects of an 8-week core training program on Y-Balance performance in professional female wrestlers. It was hypothesized that, after the 8-week intervention, anterior, posteromedial, and posterolateral reach distances would increase compared to pre-test values.

Materials and Methods

Participants

A total of 15 professional female wrestlers actively competing at the elite level voluntarily participated in this study. The participants had been engaged in regular training for at least three years and were competing at the professional level. The dominant lower extremity was defined as the leg that participants reported as more stable when performing functional tasks requiring single-leg balance and directional control. Based on this criterion, the right leg was identified as the dominant limb for all participants.

The required sample size was determined using G*Power software [12]. A power analysis was conducted based on a statistical power of 0.80, an effect size of 0.70, and a significance level of $\alpha = 0.05$. According to these parameters, a minimum sample size of 15 participants was considered sufficient for the study. The inclusion criteria were defined as follows: (i) being a professional wrestler, (ii) having no history of serious musculoskeletal injury affecting the lower or upper extremities within the previous six months, and (iii) regular participation in the training program throughout the study period. The exclusion criteria included: (i) the presence of any neurological, vestibular, or orthopedic condition that could affect the measurement or training process, (ii) failure to attend training sessions regularly during the study, and (iii) any injury occurring during the measurement protocol.

The descriptive characteristics of the participants are presented in Table 1.

Table 1. Descriptive information of the study group.

Variables	N	Mean \pm SD	Min	Max
Age (years)	15	20.20 \pm 1.52	18	23
Body weight (kg)	15	63.40 \pm 6.79	53.00	76.00
Body height (cm)	15	165.93 \pm 6.15	155.00	177.00
Body mass index (BMI)	15	23.01 \pm 2.03	20.20	28.13

All participants completed the training intervention and post-test assessments. No participants were excluded from the final analysis.

All participants were fully informed about the purpose, procedures, and potential risks of the

study. Written informed consent was obtained prior to participation. The study protocol was approved by the Non-Interventional Clinical Research Ethics Committee of Yalova University Faculty of Health Sciences (Approval No: 2025/322, Date: 25 June 2025). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Research Design

The present study employed a single-group pretest–posttest quasi-experimental design to examine the effects of an eight-week core training program on lower-extremity dynamic balance performance in professional female wrestlers. A control group was not included due to ethical and practical constraints associated with modifying the training routines of professional athletes

during the competitive season. Therefore, the effectiveness of the intervention was evaluated by examining changes between pre-test and post-test measurements within the same participants.

The research protocol consisted of three sequential stages: pre-test, training intervention, and post-test (Figure 1). At the beginning of the study, all participants underwent baseline assessments of dynamic balance performance according to the predetermined measurement protocol. After the pre-test measurements, participants completed an eight-week core training program designed to improve trunk stability and neuromuscular control.

After the training period, the same measurement protocol used during the pre-test was applied for the post-test. The same testing sequence, identical environmental conditions, and the

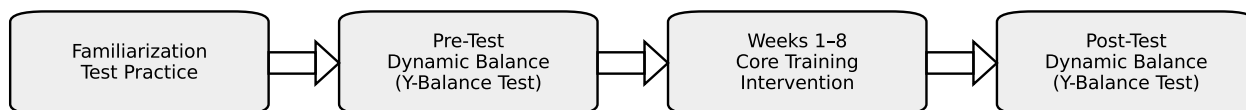


Figure 1. Experimental design of the study.

Table 2. Training program.

Weeks 1–2 (Adaptation Period)				
Exercise	Training Objective	Sets	Time / Repetitions	Rest
Front plank	Anti-extension	3	20 s	30 s
Side plank (right/left)	Lateral stabilization	2	20 s	30 s
Dead bug	Anti-extension / control	3	8	30 s
Bird dog	Anti-rotation	3	8	30 s
Glute bridge	Posterior chain	3	10	30 s
Weeks 3–4 (Stability and Control)				
Front plank + shoulder tap	Anti-rotation	3	25 s	30 s
Side plank with hip abduction	Lateral stabilization	3	20 s	30 s
Dead bug (with limb extension)	Anti-extension	3	10	30 s
Bird dog (tempo controlled)	Anti-rotation	3	10	30 s
Single-leg glute bridge	Unilateral stability	3	8	30 s
Weeks 5–6 (Dynamic Stabilization)				
Plank + alternating arm/leg lift	Dynamic control	3	30 s	30 s
Side plank with rotation	Anti-rotation	3	25 s	30 s
Dead bug (isometric hold)	Anti-extension	3	10	30 s
Bird dog row (resistance band)	Force transfer	3	8	30 s
Single-leg Romanian deadlift (bodyweight)	Core-lower extremity integration	3	8	30 s
Weeks 7–8 (Functional and Sport-Specific Transfer)				
Plank on unstable surface	Postural control	3	30 s	30 s
Side plank + reach	Lateral stability	3	30 s	30 s
Pallof press (band)	Anti-rotation	3	10	30 s
Dynamic bird dog	Dynamic balance	3	10	30 s
Single-leg squat + trunk control	Functional stability	3	8	30 s

same measurement instruments were used. This procedure ensured that performance changes associated with the training intervention were evaluated in a consistent manner.

All measurements were integrated into the athletes' regular training schedules and planned to minimize external factors that could influence performance outcomes. During testing sessions, participants were instructed to perform each test with maximal effort. Adequate recovery periods were provided between trials. All assessments were conducted by the same evaluator, in the same testing environment, and at similar times of the day throughout the study to enhance measurement consistency and reduce sources of measurement error. Pre-test and post-test assessments were conducted at the same time of day (± 1 hour) under standardized environmental conditions.

Training Program Design

In addition to their regular wrestling training routines, participants completed a structured core training program for a period of eight weeks. The core training sessions were performed three times per week, with each session lasting approximately 20–30 minutes. The program was designed to support athletic performance by improving trunk stability, force transmission, and dynamic postural control. Accordingly, the training protocol targeted not only isolated force production of the core musculature but also its role in transferring force between the upper and lower extremities. The program consisted of exercises focusing on (i) anti-extension, (ii) anti-rotation, (iii) lateral stabilization, and (iv) dynamic trunk control. This approach is consistent with previous studies examining the effects of core training on sport performance and balance [9, 13].

The exercises were primarily selected from bodyweight-based movements characterized by closed and semi-closed kinetic chain actions. Throughout the progression of the program, exercise difficulty was gradually increased by narrowing the base of support, incorporating unilateral exercise variations, increasing movement amplitude, and extending isometric hold durations. This progressive structure was implemented to promote neuromuscular adaptation. Rest intervals were standardized as 30 seconds between sets and 1 minute between exercises. The exercise content, types of exercises, set–repetition or time structures, and week-by-week progression of the training program are presented in Table 2. All training sessions were conducted under the supervision of an experienced coach. Particular attention was paid to ensuring that all exercises were performed with proper technique. This structured approach aligns with the current study emphasizing the role of core musculature in balance, stability, and extremity function. The program was designed considering the demands for isometric and dynamic trunk control in wrestling [5, 14].

Data Collection Tools

Body height was measured using a wall-mounted Holtain (England) stadiometer with 1 mm accuracy, and body weight was measured using a Tanita BC480 (Japan) digital scale. Body mass index (BMI) was calculated by dividing body weight in kilograms by the square of height in meters (kg/m^2), according to the formula established by the World Health Organization (WHO).

Assessment of Lower-Extremity Dynamic Balance

Lower-extremity dynamic balance performance was assessed using the Y-Balance Test for the Lower Quarter (YBT-LQ). The Y-Balance Test is a valid and reliable assessment tool designed to evaluate an individual's ability to maintain postural stability on the stance limb while performing controlled reaching movements in multiple directions (Plisky et al., 2009; Picot et al., 2021). The test was performed using a standardized measurement apparatus consisting of a central platform with three reach directions: anterior, posteromedial, and posterolateral.

All measurements were conducted in accordance with the standardized testing protocols described by [15]. Participants performed the test barefoot on a flat, non-slip surface. Before testing, the procedure was explained in detail, and each participant was allowed 2–3 familiarization trials for each lower extremity.

During the test, participants stood on one leg at the center of the Y-Balance testing platform and reached as far as possible with the non-stance limb in the three designated directions (Figure 2). Each attempt was performed in a controlled manner. A trial was considered invalid if the stance foot moved from its original position, balance was lost, the heel lifted from the platform, or the reaching foot made uncontrolled contact with the floor. Particular attention was paid to preventing compensatory movements, such as excessive rotation of the hip, knee, or trunk, which could influence the test results.

For both the dominant and non-dominant lower extremities, three valid trials were recorded in each direction. Reach distances were measured with millimeter precision, and the best performance for each direction was included in the analysis. To minimize measurement error, invalid trials were repeated. Only technically correct attempts were considered for analysis.

The raw reach distances were normalized to account for anthropometric differences among participants. Accordingly, reach distances were expressed relative to leg length, defined as the distance from the anterior superior iliac spine to the medial malleolus. Normalized reach scores were calculated as percentages using the following formula [3]: Normalized score (%) = [reach distance (cm) / limb length (cm)] \times 100. For each lower extremity, a composite score was calculated as the mean of the

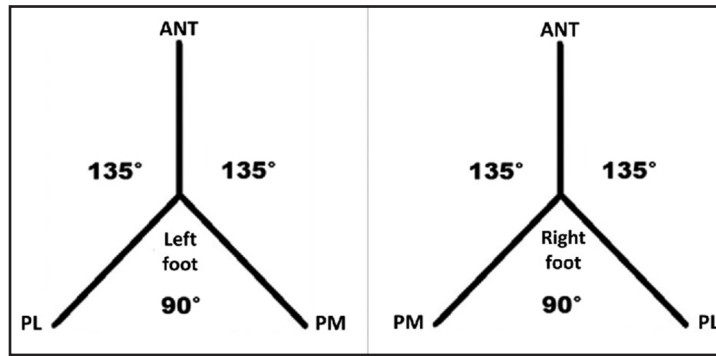


Figure 2. Standardized Y-Balance test apparatus [16].

normalized reach distances obtained in the anterior, posteromedial, and posterolateral directions.

The primary outcome of the study was defined as the composite Y-Balance Test score, as it represents an overall indicator of dynamic balance performance. Direction-specific reach distances were analyzed as secondary outcomes. Multiple outcome measures were analyzed, including direction-specific reach distances and composite Y-Balance Test scores. Given the exploratory nature of the directional analyses and the primary focus on the composite score as the main outcome, no formal adjustment for multiple comparisons was applied. Therefore, the results related to secondary outcomes were interpreted with caution.

Statistical Analysis

All statistical analyses were performed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics were reported as mean (\bar{x}) and standard deviation (SD). To examine changes in lower-extremity dynamic balance performance across time (pre-test vs. post-test) and reach directions (anterior [ANT], posteromedial [PM], and posterolateral [PL]), a two-way repeated-measures analysis of variance (ANOVA) was conducted separately for the right and left limbs. In this analysis, time (two levels: pre-test and post-test) and direction (three levels: ANT, PM, PL) were treated as within-subject factors. The sphericity assumption for repeated-measures ANOVA was assessed using Mauchly's test. The normality of the data distribution was assessed using the Shapiro-Wilk test prior to conducting parametric analyses. When this assumption was violated, the Greenhouse-Geisser correction was applied. Statistical significance was set at $p < 0.05$. Effect sizes were reported using partial eta squared (η^2p). In addition, pre-test to post-test changes in composite Y-Balance Test scores for the dominant (right) and non-dominant (left) limbs were analyzed using a paired-samples t-test. For these comparisons, effect sizes were calculated using Cohen's d. The required sample size was determined a priori using G*Power software [12]. Based on a two-tailed paired-samples t-test, the significance level was set at $\alpha = 0.05$,

with statistical power set at $1 - \beta = 0.80$. Assuming a moderate-to-large effect size ($d = 0.70$) based on previous literature, the analysis indicated that a minimum of 15 participants was required.

Results

Descriptive statistics for dominant leg Y-Balance Test performance are presented in Table 3. Mean reach distances increased from pre-test to post-test in all directions (ANT, PM, and PL). The largest absolute improvement was observed in the posterolateral direction. A 2 (Time: pre-post) \times 3 (Direction: ANT, PM, PL) repeated-measures ANOVA revealed a significant main effect of time, indicating an overall improvement in dynamic balance performance following the intervention ($F(1,14) = 29.21, p < .001, \eta^2p = .676$). A significant main effect of direction was also observed ($F(1.45, 20.31) = 90.98, p < .001, \eta^2p = .867$), demonstrating differences in reach performance across directions. The Time \times Direction interaction did not reach statistical significance after Greenhouse-Geisser correction ($F(1.03, 14.41) = 4.05, p = .062, \eta^2p = .224$). This indicates that the magnitude of improvement over time was generally consistent across directions. The effect size indicates a difference in changes across directions, particularly in the posterolateral reach.

Table 3. Repeated measures ANOVA results for dominant-leg (right) Y-Balance Test performance across time (pre-post) and direction.

Direction	Test	Mean	SD
ANT	Pre-test	67.36	6.30
ANT	Post-test	69.46	5.96
PM	Pre-test	84.60	8.27
PM	Post-test	86.50	7.09
PL	Pre-test	81.86	9.11
PL	Post-test	87.00	7.09

Note: Greenhouse-Geisser corrections were applied when the sphericity assumption was violated. Time: $F(1,14) = 29.21, p < .001, \eta^2p = .676$; Direction: $F(1.45, 20.30) = 90.98, p < .001, \eta^2p = .867$; Time \times Direction: $F(1.02, 14.40) = 4.04, p = .062, \eta^2p = .224$

Table 4. Repeated measures ANOVA results for non-dominant-leg (left) Y-Balance Test performance across time (pre–post) and direction.

Direction	Test	Mean	SD
ANT	Pre-test	65.83	5.49
	Post-test	68.06	5.82
PM	Pre-test	83.56	9.78
	Post-test	84.73	5.82
PL	Pre-test	82.33	7.03
	Post-test	84.30	6.66

Note: Greenhouse–Geisser corrections were applied when the sphericity assumption was violated. Time: $F(1, 14) = 10.76, p = .005, \eta^2p = .435$; Direction: $F(1.37, 19.22) = 95.74, p < .001, \eta^2p = .872$; Time \times Direction: $F(1.03, 14.44) = 0.26, p = .623, \eta^2p = .018$

Increases in reach distance from pre-test to post-test were observed in all directions, including anterior (ANT), posteromedial (PM), and posterolateral (PL). Results of the 2×3 repeated-measures ANOVA revealed a significant main effect of time, indicating an improvement in left-leg dynamic balance performance following the training intervention ($F(1, 14) = 10.77, p = .005, \eta^2p = .435$). A significant main effect of direction was also found ($F(1.37, 19.22) = 95.74, p < .001, \eta^2p = .872$), demonstrating that Y-Balance Test performance differed across directions for the left leg. The Time \times Direction interaction was not statistically

significant after Greenhouse–Geisser correction ($F(1.03, 14.44) = 0.26, p = .623, \eta^2p = .018$). This indicates that the magnitude of improvement over time was consistent across directions.

Pre- to post-test changes in composite Y-Balance Test scores for the dominant and non-dominant legs were analyzed using paired-samples t-tests (Table 5). For the dominant leg, composite scores increased from pre-test to post-test ($t(14) = 7.51, p < .001, d = 1.93$). For the non-dominant leg, composite scores increased from pre-test to post-test ($t(14) = 2.48, p = .026, d = 0.64$).

The changes in composite Y-Balance Test scores from pre-test to post-test for the dominant and non-dominant limbs are presented in Figure 3.

Discussion

The present study investigated the effects of an eight-week core training program on dynamic balance performance in elite female wrestlers using the Y-Balance Test. The findings showed improvements in dynamic balance performance. Reach distances increased from pre-test to post-test in both the dominant and non-dominant limbs. Differences were observed between reach directions, whereas the time \times direction interaction was not statistically significant. Composite Y-Balance Test scores increased in both limbs, with a larger effect size in the dominant leg. These results are consistent with the initial hypothesis that a

Table 5. Paired-samples t-test results for composite Y-Balance Test scores of the dominant leg (right) and non-dominant leg (left) from pre- to post-test.

Leg	Test	Mean	SD	Mean Difference	95% CI (Lower–Upper)	t	df	p	ES
Dominant	Pre-test	183.45	16.17	6.02	4.30–7.74	7.51	14	<.001	1.93
	Post-test	189.46	14.92						
Non-dominant	Pre-test	181.08	15.77	4.16	0.56–7.76	2.48	14	.026	0.64
	Post-test	185.24	13.53						

Note. ES indicates Cohen’s d for paired samples.

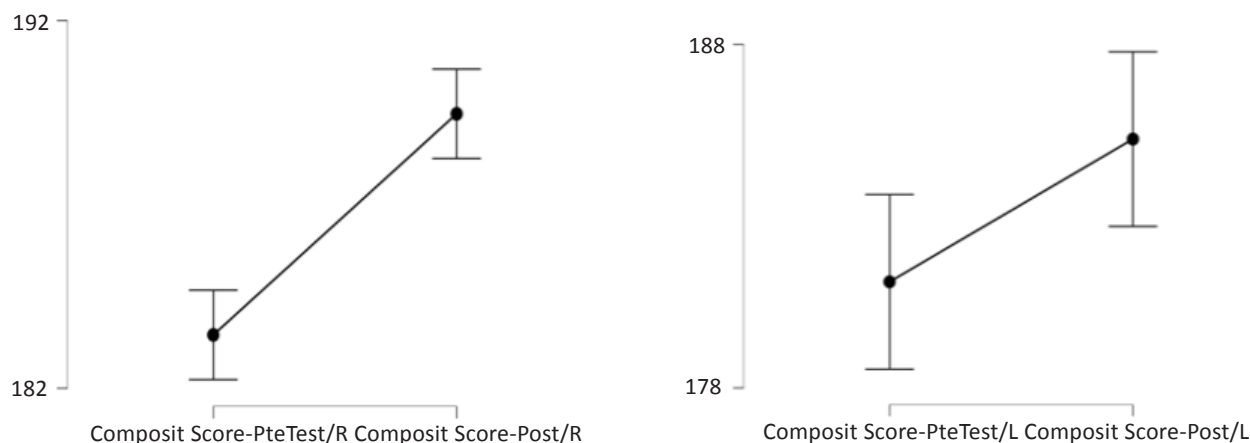


Figure 3. Changes in composite Y-Balance Test scores from pre-test to post-test for the dominant and non-dominant limbs.

structured core training program may enhance dynamic balance capacity in elite wrestlers. Due to the single-group pre–post design, the observed improvements should be interpreted as within-subject changes over time rather than causal effects of the intervention. One possible explanation for the observed improvements is related to the role of core musculature in maintaining trunk stability and facilitating force transfer between body segments.

The present findings are consistent with previous research on the role of core musculature in dynamic balance control. Several studies have shown that core training contributes to neuromuscular coordination and trunk stability, which are components of postural control during single-leg tasks such as the Y-Balance Test. Systematic reviews and meta-analyses have reported that core training interventions produce improvements in dynamic balance performance among athletes and physically active individuals. These improvements are attributed to trunk stabilization and force transfer between body segments during movement [17].

Previous meta-analytic evidence also suggests that core training may influence performance variables including balance, jumping ability, and sport-specific movement efficiency. Improvements in balance performance are reported among the outcomes in the literature [18]. More recent systematic reviews indicate that core training contributes to athletic performance through trunk muscle endurance, postural control, and balance capacity. These studies also report that the transfer of core training to sport-specific performance variables may vary depending on training duration, athlete level, and characteristics of the intervention [19].

The core region functions as a kinetic link that stabilizes the trunk and enables coordinated movement between the upper and lower extremities. Improved trunk stability may enhance the ability to control the center of mass during single-leg stance tasks, which are a component of the Y-Balance Test. Previous studies have suggested that lumbopelvic stability may contribute to neuromuscular coordination and postural control during tasks requiring unilateral support and multiplanar movement [20]. Considering the dynamic and contact-based nature of wrestling, where athletes perform rapid positional adjustments, rotational actions, and unilateral stabilization tasks, improvements in trunk control may contribute to balance regulation during sport-specific movements.

Dynamic balance assessments such as the Star Excursion Balance Test (SEBT) and its modified version, the Y-Balance Test, are used to evaluate lower extremity neuromuscular control and postural stability [2, 3]. These tests require athletes to maintain single-leg stability while reaching in multiple directions. This challenges the postural control system and requires coordinated activation of trunk and lower extremity musculature. Because

of these characteristics, SEBT-based assessments are used as functional tools for evaluating dynamic balance capacity and monitoring training adaptations in athletes [2].

Systematic reviews and meta-analyses have reported that core training interventions are associated with changes in dynamic balance performance and other performance variables in athletes and physically active individuals [17, 18, 19]. These findings indicate that trunk stabilization and force transfer between body segments are involved in balance control during movement. Experimental and applied studies have examined the effects of core and neuromuscular training on balance, agility, and postural control in different athletic populations [21, 22, 23, 24]. The results show that training programs targeting trunk and lower extremity function are associated with changes in dynamic balance and movement control. Research focusing on integrative neuromuscular training has also reported changes in balance performance and injury-related outcomes in youth and athletic populations [25, 26, 27]. These findings indicate that structured training approaches involving coordination and stability components are associated with balance performance adaptations.

For instance, Filipa et al. reported that an eight-week neuromuscular training program emphasizing core stability and lower extremity strength improved SEBT composite scores in young female soccer players [8]. Similarly, Kahle and Gribble reported that a six-week core stability training program increased normalized reach distances during SEBT performance, indicating that strengthening the lumbopelvic musculature may contribute to dynamic postural control [28]. Systematic reviews have suggested that core training alone may not always produce changes in performance measures, but may contribute to movement control, force transmission, and functional stability when integrated into training programs [6].

Another finding of the present study was the difference observed between reach directions in the Y-Balance Test. This finding is consistent with previous research showing that the biomechanical and neuromuscular demands of the test vary depending on reach direction [2, 3]. The posteromedial and posterolateral reach tasks require greater hip mobility, trunk stabilization, and multiplanar neuromuscular coordination compared with the anterior reach. During these movements, athletes maintain single-leg stance while controlling trunk position and lower extremity alignment. This increases task complexity. Therefore, the directional differences observed in the present study likely reflect the biomechanical demands of each reach direction rather than an effect of the training intervention.

The magnitude of improvement in composite Y-Balance Test scores was greater in the dominant

limb compared to the non-dominant limb. Limb dominance has been reported to influence dynamic balance performance due to differences in motor control strategies and movement familiarity [2]. In many sport-specific tasks, the dominant limb is involved in stabilization or force-production roles, which may lead to differences in neuromuscular coordination and motor control patterns. When exposed to a training stimulus targeting trunk stability and neuromuscular control, the dominant limb may show greater changes due to existing neuromuscular adaptations. Improvements were also observed in the non-dominant limb, indicating changes in bilateral dynamic balance capacity.

From a practical perspective, the improvements in dynamic balance observed in this study may have implications for wrestling performance. Wrestling requires athletes to maintain postural stability while executing movements such as pushing, pulling, rotational actions, and single-leg support positions. During these situations, athletes stabilize the trunk while generating force through the lower extremities. Improved lumbopelvic control may contribute to maintaining body alignment and balance during opponent interaction and transitional phases of movement. Improved dynamic balance may contribute to controlled execution of wrestling-specific techniques.

An additional aspect of the present study is its focus on elite female wrestlers. Most previous investigations examining the relationship between core training and balance performance have been conducted in team-sport athletes or recreational populations. Examination of adaptations to core training in a combat sport population provides information on how trunk-focused conditioning strategies may influence functional performance characteristics in elite wrestlers.

Limitations

Several limitations should be acknowledged.

First, the study was conducted using a single-group pre-post experimental design without a control group. This methodological choice was related to the characteristics of the study population, which consisted of elite female wrestlers competing at a professional level. In high-performance environments, it is not feasible to withdraw athletes from their regular training routines or to restrict participation in additional conditioning programs to establish a control group. Another limitation is the relatively small sample size, which may limit generalizability to broader athletic populations. The study evaluated the effects of the intervention within regular training conditions. Future studies using randomized controlled designs and larger sample sizes may provide evidence regarding the effects of core training on dynamic balance performance.

Conclusions

The findings of this study indicate that lumbopelvic stability is associated with neuromuscular coordination during unilateral balance tasks. The results indicate that incorporating structured core training into conditioning programs of wrestlers is associated with changes in dynamic balance performance. Dynamic balance performance improved following the structured core training period in elite wrestlers.

Consent to Participate

Written informed consent was obtained from all participants prior to data collection.

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Conflict of Interest

The authors declare no conflict of interest.

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