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Enhancing Static Balance in Mini-Football Players through a Unique Training Program that Leverages the Innovative Blazepod Technology

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Abstract: *Mini-football, a dynamic sport, demands a blend of motor skills and peak physical abilities such as acceleration, deceleration, jumping, and directional changes, often executed with high intensity. Many technical skills, including passing, dribbling, ball control, and shooting, are performed using only one foot, underscoring the importance of balance in player performance. Given its role in stabilizing movements and optimizing coordination, balance training is crucial for enhancing technical proficiency in mini-football. The present study aimed to enhance balance in senior mini-football players through a 12-week experimental training program utilizing Blazepod technology. 20 senior mini-football players participated in an experimental intervention, where specific proprioceptive exercises targeting balance were integrated into training sessions twice per week. The study used the Y Balance Test to assess balance improvements in multiple movement directions. The results revealed a statistically significant improvement in balance performance across all test parameters. The most significant progress was observed in the forward direction for the right foot and the backward-right direction for the left foot. These findings not only validate the effectiveness of balance training using innovative technologies but also provide practical insights for coaches and practitioners in the field of sports training, inspiring them to adopt modern training methodologies to enhance the performance levels of mini-football players.*

Keywords: *balance, mini-football, proprioception, performance enhancement, Blazepod technology.*

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Introduction

The modernization dynamics of specific methodologies and technologies play a crucial role in shaping contemporary trends in sports performance training. Mini-football has gained increasing recognition at national and international levels, primarily due to its heightened spectacle, which stems from improvements in players' physical conditioning and technical proficiency. The sports training process must continuously adapt to performance objectives and the evolving demands of competitive environments. Each physical and technical preparation component must be optimized for peak athletic performance. Empirical studies indicate that integrating modern technologies, such as Blazepod, within training regimens enhances the monitoring of physiological and technical parameters, providing valuable insights during training sessions and competitive matches. Specialized methodologies and cutting-edge technologies facilitate the development of proprioception, a critical factor in performance sports. The effectiveness of proprioceptive training directly influences the technical execution and overall efficiency of mini-football players (Alecu & Ionescu-Bondoc, 2024; Leibo et al., 2021; Stasiuk, 2013; Grigoroiu et al., 2019).

As a multifaceted sport, mini-football necessitates a high level of motor skills and physical competencies, including acceleration, deceleration, vertical and horizontal jumping, and rapid directional changes. The game is characterized by executing general and sport-specific motor actions, often performed at maximal intensity. Consequently, structured training interventions integrating contemporary performance enhancement methodologies are essential to advancing mini-football athletes' physical and technical capabilities (Leibo et al., 2021; Stasiuk, 2013; Grigoroiu et al., 2019). The motor abilities in mini-football, including vertical jumps, directional changes, and fundamental technical skills such as passing, dribbling, ball reception, and ball control, are predominantly executed unilaterally. This biomechanical characteristic underscores the critical role of balance in optimizing player performance. Maintaining postural stability and control during dynamic movements directly influences execution efficiency, technical precision, and overall athletic effectiveness in competitive settings. Consequently, balance training should be a fundamental component of performance optimization strategies in mini-football. According to Gidu et al. (2022), balance, coordination, and agility are the cornerstones of developing a complete athlete and must be selectively trained to lead to improvement. In mini-football, the characteristics of the game and its rules allow the player to handle the ball using only their feet and no other part of the body that could grasp the ball (such as the arm), but only by touching it (head, chest, feet) (Boyxonov & Artikov, 2023; Artikov & Xasanov, 2022). Football players must continuously regulate their postural stability and dynamic equilibrium while executing fundamental technical actions such as dribbling, passing, ball control, and shooting. The ability to counterbalance the body and maintain movement stability during these high-intensity, multidirectional actions is essential for optimizing technical execution and overall performance. Effective neuromuscular coordination and proprioceptive control are critical in ensuring precision, efficiency, and injury prevention during football-specific movements (Stoica, 2013; Stoica & Blejan, 2013). Body balance affects athletes' physical and technical efficiency during training and under competitive conditions (Ene-Voiculescu & Ene-Voiculescu, 2018; Badau et al., 2020; Badau, 2006).

Using unstable surfaces (Tan et al., 2024; Karakaya et al., 2015), coordination and balance circuits are created to integrate with conventional training methods under exercise conditions. Balance, coordination, and agility represent fundamental components in the development of a well-rounded athlete and must be systematically and selectively trained to enhance overall performance (Eraslan et al., 2025; Hrysomallis, 2011). Sports science research has emphasized diversifying and modernizing training methodologies to improve single-leg postural control under sport-specific technical conditions (Trecroci et al., 2018; Dello Iacono et al., 2016). In this context, unstable surfaces have become increasingly prevalent in football training, effectively enhancing neuromuscular control, proprioception, and functional stability. These training methods can be incorporated into structured programs or applied in a more variable, task-specific manner to optimize adaptation and transferability to game situations. Balance, agility, coordination, and reaction time are fundamental components of proprioception (Han et al., 2015; Ergen & Bülent, 2008). These proprioceptive elements are critical for mini-football players in achieving sports mastery and optimizing athletic performance (Bekris et al., 2012). According to the specialized literature, proprioceptive function is developed through three primary mechanisms (Mohamed et al., 2020; Yong et al., 2017). First, proprioceptive feedback contributes to joint protection by activating reflex mechanisms that prevent excessive and potentially injurious movements. Second, it is key in maintaining joint stability during static postures. Third, it facilitates the precise coordination of simple and complex motor actions, thereby enhancing movement efficiency (Mohamed et al., 2020; Yong et al., 2017; Lazarou et al., 2018).

Recent studies have explored the effects of training programs incorporating Blazepod technology on developing coordinative abilities. However, research specifically tailored to mini-football remains limited. Considering these insights, the present study aimed to enhance balance in senior mini-football players through a 12-week experimental training program utilizing Blazepod technology.

Methodology

Study Design

The research was conducted over 12 weeks. In this study, we applied an initial test and a final test. Between the two tests, we implemented an experimental program for the subjects, consisting of specific exercises to optimize static and dynamic balance using Blazepod technology. The athletes performed the experimental program for approximately 30 minutes twice a week at the beginning of training sessions. Four proprioception development exercises focusing on the balance component were practiced during each training session.

Participants

The study group consisted of 20 senior mini-football players. The inclusion criteria required participants to be active athletes in good health, possess a minimum of one year of competitive experience, undergo both initial and final assessments, and complete full participation in the experimental program. The descriptive characteristics of the study group were as follows: mean age = 29.55 ± 4.045 years, height = 178.9 ± 3.477 cm, and body weight = 77.05 ± 4.946 kg. All participants were voluntarily involved in the study, with informed consent obtained before participation.

Data analysis

Evaluation Instruments

In this study, we applied the **Y Balance Test**, performed on both the dominant and non-dominant leg, following six movement directions. The evaluated parameters were:

- Y Balance Test on the right leg – forward movement
- Y Balance Test on the right leg – left-back movement
- Y Balance Test on the right leg – right-back movement
- Y Balance Test on the left leg – forward movement
- Y Balance Test on the left leg – left-back movement
- Y Balance Test on the left leg – right-back movement

All movement executions were controlled and standardized, ensuring balance was maintained on a single leg throughout the assessment. The maximum reach distance achieved by the athlete in three designated directions, without compromising postural stability, was recorded. This test is widely employed in sports science for functional evaluation, neuromuscular assessment, and, most importantly, injury prevention strategies in athletic populations. The standardized testing apparatus featured a leg length of 150 cm, with results quantified in centimeters to ensure precision and reliability in measurement.

Statistical Analysis

The study results were statistically processed using SPSS 24, calculating the following parameters: arithmetic mean ($\bar{x}$), progress achieved (δx), determined as the difference between arithmetic means of the tests, standard deviation (SD), coefficient of variation (CV), 95% confidence interval (CI), Cohen's effect size. Effect size interpretation: 0 – 0.3 Small effect size, 0.3 – 0.5 Medium effect size, 0.5 – 0.8 Large effect size, > 0.8 → Very large effect size. The significance level was set at $p < 0.05$.

Results

The lowest average value in the final test was recorded in Y right-forward, 81.5 cm, while the best result was observed in Y left-right backward, 101.750 cm. The results in Table 1 indicate varying performances among players. The mean value significantly increased compared to the initial test, indicating improved player performance. The coefficient of variation (CV%) ranged between 7.152 and 11.567. The fact that the coefficient of variation decreased for all parameters of the Y Balance Test in the final testing suggests that the group achieved very good homogeneity, and the experimental program contributed to improving balance levels in all mini-football players.

Table 1. Descriptive Statistics of Y Balance Test Results (cm)

Motor Test	Test	Min (cm)	Max. (cm)	Mean (cm)	SD	CV %
"Y right leg - forward."	IT	60,00	85,00	71,250	7,4117	10,402
	FT	75,00	95,00	85,250	6,381	7,486
"Y right leg - left-back"	IT	75,00	95,00	83,500	6,509	7,795
	FT	90,00	110,00	96,500	6,901	7,152
"Y right leg - right-back"	IT	75,00	110,00	93,750	8,090	8,630
	FT	90,00	120,00	106,500	7,963	7,478
"Y left leg - forward."	IT	60,00	75,00	67,750	5,954	8,789
	FT	70,00	90,00	81,500	7,089	8,699
"Y left leg - left-back"	IT	75,00	105,00	87,250	8,346	9,567
	FT	90,00	120,00	101,750	8,777	8,626
"Y left leg - right-back"	IT	70,00	100,00	86,000	9,947	11,567
	FT	80,00	115,00	99,500	10,500	10,553

Min – minimum, Max- maximum, SD –standard deviation, CV- coefficient of variation, IT – initial test, FT – final test

Analyzing the results from Table 2, all parameters of the Y Balance Test, the progress recorded between the two tests was statistically significant, with $p < 0.05$. For the left leg, the most significant progress was recorded in the forward direction, with 14 cm, while the small progress was observed in the back-right direction, with 12.75 cm. The mean values between the two tests, expressed as progress, fell within the 95% CI limits for all directions of the Y Balance Test for both legs. For the right leg, the highest progress was recorded in the back-left direction, with 14.50 cm, while the lowest progress was noted in the back-right direction, with 13.50 cm. Cohen's effect size values ranged from 1.319 to 2.024, indicating a very large effect size. The results suggest a significant and consistent difference between the two tests evaluated, which is considered relevant not only statistically but also practically, given its large effect size.

Table 2 – Statistical Analysis of Y Balance Test Results (Final Test - Initial Test)

Motor test	ΔX (cm)	SD	95%CI upper	95%CI lower	t	p	Effect Size
"Y right leg - forward"	14,00	3,077	15,440	12,559	20,342	,000	2.024
"Y right leg - left-back"	13,00	2,991	14,399	11,600	19,436	,000	1.937
"Y right leg - right-back"	12,75	3,795	14,526	10,973	15,022	,000	1.588
"Y left leg - forward."	13,75	3,193	15,244	12,255	19,256	,000	2.100
"Y left leg - left-back"	14,50	3,590	16,180	12,819	18,058	,000	1.681
"Y left leg - right-back"	13,50	2,856	14,836	12,163	21,138	,000	1.319

ΔX-difference of mean, SD –stnadard deviation, CI – confidence interval, p – statistical significance threshold

Discussion

This study aimed to enhance static balance in senior mini-football players by implementing a training program integrating modern technological interventions. The findings indicate that participation in a structured program incorporating sport-specific technical elements under balance-challenging conditions, combined with applying Blazepod technology, led to significant improvements in static balance, as evidenced by superior performance in the final assessment compared to the initial stage. These results contribute to the growing body of knowledge on performance optimization in mini-football, aligning with previous research on the subject. Notably, Khuman et al. (2014) reported that mini-football players exhibit superior static and dynamic balance compared to athletes from other sports, such as cricket and volleyball, highlighting the sport's unique proprioceptive and neuromuscular demands.

Several studies have highlighted a positive evolution of proprioception compared to the results of specific balance exercises in young mini-football players (Gioftsidou et al. (2006; Malliou et al., 2004). According to Halabchi et al. (2022), basketball and football players showed relativ significant static and dynamic balance differences. However, basketball players exhibited poorer static balance than gymnasts and lower dynamic balance than football players. This highlights the different levels of sensorimotor processes involved in performing a skill. Gioftsidou et al. (2006) found that dynamic balance abilities improved among football players following a 12-week balance training program compared to a group of players who followed regular football training. A study by Page (2006) provides evidence that specific dynamic balance exercises positively influence sports performance. This study observed differences in athletic performance before and after a balance training program.

Kubo et al. (2001) tested balance in ball kicking and pivoting among professional football players. Significant asymmetrical differences between legs were found only for forward pivoting but not other pivoting positions. Page (2006) argued that achieving high performance is possible only with sufficient balanced skill development, as movements and technical skills in any sport are primarily performed under unstable conditions. The improvement of balance conditions progresses in technical execution and performance (Rhodes, 2020; Gidu et al., 2022). Research on balance in football is extensive, but an interdisciplinary approach to this proprioceptive component is essential for optimizing sports performance (Cè et al., 2018; Trecroc et al., 2018).

Sports performance is conditioned by the development of proprioception and physical fitness, which form the basis of technical training (Lisenchuk et al., 2023; Garcia-Ceberino et al., 2019). Sports games are characterized by the complexity and variability of technical actions, and the development of physical capacity components are essential for achieving sports mastery and recording notable performances in competitions (Padrón-Cabo et al., 2020; Milanović et al., 2013).

The complexity of sports training requires interdisciplinary approaches aligned with modernization trends in training methodologies and the advancement of specific technologies (Ganciu et al., 2015; Nechita, 2012; Alpaslan et al., 2017).

Study limits

However, certain limitations must be acknowledged. The study's relatively small sample size may limit the findings' generalizability to a broader population of mini-football players. Additionally, the study focused solely on static balance, without assessing dynamic balance or other relevant motor skills that contribute to overall athletic performance. While sufficient to observe improvements, the intervention's duration may not capture long-term adaptations or retention effects.

Practical implications of the study

Based on our findings, the training process can be optimized by incorporating modern technologies. Combined with mini-football-specific exercises, these enhance motor skills and increase the attractiveness and variability of training sessions. Any modern technological input plays a key role in optimizing physical capabilities, and football specialists must stay updated on these advancements to enhance the efficiency and appeal of sports training.

Conclusions

The results of the Y Balance Test for evaluating static balance highlight that the experimental program was effective, and the use of Blazepod technology contributed to enhancing balance development in mini-football players. The most significant progress was recorded in the forward direction for the right leg and the back-right direction for the left leg. We believe that improving all execution directions of the Y Balance Test through specialized exercises will further enhance balance, significantly impacting technical proficiency and performance potential in senior mini-football players. Future research should consider larger and more diverse sample populations, include dynamic balance assessments, and explore the long-term impact of similar training methodologies on mini-football performance. The modernization of the training methodology in sports performance is determined by the current competitive level which requires the permanent increase of the motor, functional and technical capacities of the athletes. Achieving the level of sports mastery to the current requirements is influenced by the level of development of the motor, proprioceptive and technical components which can be optimized through a modern methodology that uses specific innovative technologies.

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