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Improving static balance in mini-football players by a specific training program using intelligent technologies

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Abstract

Background. Minifootball is a fast-paced sport that requires advanced motor skills and well-developed balance to maximize technical performance. Balance-specific exercises play a crucial role in stabilizing movements and optimizing players' technical levels.

Aims. The study aimed to optimize the static balance of minifootball players through a 12-week training program using Blazepod technology.

Methods. 20 senior minifootball players participated in an experimental program with proprioceptive exercises focused on balance. These exercises were integrated into the team's training sessions thrice weekly. To evaluate balance optimization in multiple movement directions, our study used the Star Excursion Balance Test, and the data were statistically analyzed using SPSS 24.

Results. The results indicated statistically significant improvements in balance across all tests. The greatest progress was observed in the lateral and medial directions on the left foot, 12.50 cm, and in the posterior and medial directions on the right foot, 12.25 cm. The effect size values ranged from 0.904 to 2.743, indicating a large to very large effect.

Conclusions. The results suggest that balance training using the modern Blazepod technology can significantly improve the performance of minifootball players, contributing to better balance, improved coordination, and enhanced technical execution.

Keywords: static balance, minifootball, proprioception, performance enhancement, Blazepod technology, sport training.

Introduction

Mini-football is derived from the sport of football and is a multifaceted game that is gaining increasing popularity worldwide. Mini-football is a complex sport that requires both motor and physical skills, such as sprints, jumps, changes of direction, decelerations, and performing actions specific to the mini-football game, including dribbling, dispossession, and shots on goal, which are carried out with maximum intensity in most cases. Since the actions in mini-football, such as passes, dribbling, takeovers, ball control, and shooting on goal, are performed on one leg, we consider that balance is essential for their performance (Alpaslan et al., 2017; Karakaya, 2015).

Balance is a fundamental component of human motor skills, being essential for performing technical gestures with precision and efficiency. In mini-football, characterized by small spaces, high intensity, and frequent contact situations, maintaining and restoring balance becomes crucial for developing players' technical skills (Artikov & Xasanov, 2022; Grigoroiu et al., 2019). Balance can be defined as the ability of the neuromuscular system to maintain the projection of the center of gravity within the support base, both at rest and in motion (static and dynamic) (Chicomban, 2020; Alecu, 2023; Nechita, 2020)). It is determined by the complex interaction between the vestibular, proprioceptive, and visual systems (Han et al., 2016; Hrysomallis et al., 2011). A good balance is a prerequisite for success in almost all sports; it also enhances sports performance and plays a role in preventing sports-related injuries. A high capacity to maintain postural balance, namely maintaining the vertical projection of the center of gravity within the base of support, is essential in sports (Dello Iacono et al., 2016; Badau, 2006).

Proprioception significantly affects an individual's ability to excel in sports, a crucial aspect of sports performance (Ene-Voiculescu & Ene-Voiculescu, 2018; Alecu & Ionescu-Bondoc, 2024). Proprioceptive training is a type of exercise that focuses on enhancing proprioception, which is the body's ability to sense and interpret stimuli related to position, movement, and balance (Yılmaz et al., 2024; Ljubojevic et al., 2020). Balance, along with agility, coordination, and reaction speed, is a component

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of proprioception. Effects of proprioceptive training on balance, speed, essential mobility, motor functions, and knee joint function (Apriliyasari, 2022; Nechita, 2018; Gioftsidou et al., 2006). Proprioceptive training can also improve physical performance and reduce the risk of sports injuries.

In mini-football, technical executions – such as receiving, passing, dribbling, or shooting – require advanced postural control. Players with optimal balance can execute precise technical gestures even under conditions of induced imbalance, such as opponent pressure, limited space, or fatigue. Mini-football players must develop a high level of athleticism, which must be accompanied by a set of other factors, such as technical, tactical, and mental skills, in order to perform effectively. Cardiorespiratory capacity, muscle strength, speed, agility, coordination, and balance assume an increasingly decisive role in the sports performance of players (Stoica & Blejan, 2013; Gidu et al., 2023; Ergen & Ulkar, 2008). Balance is not just a physical quality, but a key factor that enhances technicality in mini-football. In a sport with limited spaces and intense demands, body control is the key difference between a technically proficient player and a technically efficient one (Gidu et al., 2023; Ergen & Ulkar, 2008). Developing balance should be a strategic objective in the training of mini-football players. This study aims to optimize the balance of mini-football players through a 12-week experimental program that utilizes modern Blazepod technology.

Hypothesis

By implementing an experimental program with specific exercises that utilize Blazepod technology, we aim to contribute to improving static balance in mini-football players.

Material and methods

Research protocol

a) Period and place of the research

This research was conducted over 14 weeks, structured as follows: the first week involved initial testing, 12 weeks were dedicated to implementing the experimental program, and final testing was performed in the last week. In this study, we performed initial and final testing. We performed an experimental program during the two tests that included specific exercises necessary to optimize static and dynamic balance. In these exercises, we integrated the modern Blazepod technology. The mini-football players who participated in this research attended the experimental program three times a week, at the beginning of training, after the warm-up, for 30 minutes. Two exercises were performed at each training session to optimize proprioception, emphasizing the proprioception component, specifically balance.

b) Subjects and groups

This study included 20 mini-football players aged between 24 and 38 years. To be included in the study, players had to be active athletes, in good health, have at least one year of competitive experience, and undergo both the initial and final tests. Additionally, participation in the entire experimental program is mandatory for this study. The identity of the group in this study: age is 29.55 ± 4.045 years; height 178.9 ± 3.477 cm, weight 77.05 ± 4.946.

c) Applied tests

In this study, we used the Star Excursion Balance Test, which was performed on both legs in eight execution directions for each leg. The Star Excursion Balance Test parameters that we evaluated were:

- Right / left leg test and leading the left / right leg in the anterior position
- Right / left leg test and leading the left / right leg in the posterior position
- Right / left leg test and leading the left / right leg in the lateral position
- Right / left leg test and leading the left / right leg in the medial position
- Right / left leg test and leading the left / right leg in the anterolateral position
- Right / left leg test and leading the left / right leg in the anteromedial position
- Right / left leg test and leading the left / right leg in the posterolateral position
- Right / left leg test and leading the left / right leg in the posteromedial position

Balance is maintained on one leg, and everything is performed regularly and in a controlled manner. The maximum point on the ground that the athlete can reach with their foot from a balanced position, in each of the eight directions, without losing their balance, is measured. The star test is frequently used during sports training for functional diagnosis, particularly to prevent injuries. The length chosen for each side of this star test is 150 cm, with results being measured in cm.

d) Statistical processing

The data processing for the results of this study were performed with the SPSS 24 software, calculating the following parameters: arithmetic mean (X), the progress achieved by the difference in arithmetic means between the two tests, initial and final (ΔX), standard deviation (SD), coefficient of variation (CV), 95% confidence interval (CI), Cohen's effect size. As an interpretation of the effect size, we have: 0-0.3, small; 0.3-0.5, medium; 0.5-0.8, large; and over 0.8, very large. The significance threshold was set at $p<0.05$.

Results

The lowest value of the average from the final test was recorded in the star test for both the left and right legs in the lateral position, at 73.947 cm, and the highest value was recorded in the star test for both the left and right legs in the posteromedial position, at 95 cm. The data obtained from the two tests shows us varied performances among the mini-football players. The fact that we have a significant increase in the average score from the final test compared to the initial test indicates an improvement in their performance. This test's coefficient of variability (CV%) ranges from 5.475% to 17.56% (Table I). Following data collection, we observe that the coefficient of variability decreased for almost all parameters of the star test in the final testing, indicating that the homogeneity of the group is very good. This suggests that the experimentally implemented program contributed to optimizing the balance of the mini-football players in this study.

Table I
Descriptive statistics of Star Excursion Balance Test results.

Leg	Test motric	Test	Min (cm)	Max (cm)	X (cm)	SD	CV %
Left leg	Star test right anterior	TI	70.00	90.00	82.105	6.732	8.199
	Star test right posterior	TF	80.00	100.00	94.210	7.502	7.963
	Star test right lateral	TI	60.00	75.00	68.421	3.746	5.475
	Star test right medial	TF	70.00	90.00	80.263	4.851	6.044
	Star test right anterolateral	TI	50.00	80.00	61.315	9.104	14.848
	Star test right anteromedial	TF	60.00	95.00	73.947	10.351	13.999
	Star test right posterolateral	TI	55.00	85.00	72.631	9.184	12.645
		TF	65.00	100.00	85.263	9.200	10.790
	Star test right anterior	TI	70.00	95.00	80.263	8.074	10.060
	Star test right posterior	TF	80.00	110.00	91.842	8.852	9.638
	Star test right lateral	TI	65.00	95.00	81.052	7.374	9.098
	Star test right medial	TF	80.00	110.00	93.157	7.304	7.841
	Star test right anterolateral	TI	70.00	90.00	81.315	5.228	6.430
	Star test right anteromedial	TF	85.00	100.00	93.157	5.325	5.716
	Star test right posterolateral	TI	70.00	95.00	82.631	7.143	8.644
		TF	80.00	110.00	95.000	7.817	8.228
Right leg	Star test left anterior	TI	70.00	90.00	81.000	6.805	8.401
	Star test left posterior	TF	80.00	100.00	92.000	7.677	8.345
	Star test left lateral	TI	70.00	90.00	80.500	5.826	7.237
	Star test left medial	TF	80.00	105.00	92.750	6.381	6.880
	Star test left anterolateral	TI	70.00	90.00	80.750	5.683	7.038
	Star test left anteromedial	TF	80.00	100.00	92.250	6.171	6.690
	Star test left posterolateral	TI	70.00	90.00	82.250	5.495	6.681
		TF	85.00	110.00	94.500	5.826	6.165
	Star test left anterior	TI	65.00	100.00	80.250	7.517	9.367
	Star test left posterior	TF	75.00	115.00	92.000	8.013	8.709
	Star test left lateral	TI	60.00	85.00	73.750	7.232	9.806
	Star test left medial	TF	70.00	100.00	85.250	7.859	9.219
	Star test left anterolateral	TI	50.00	85.00	63.250	12.276	19.41
	Star test left anteromedial	TF	60.00	100.00	74.750	13.126	17.56
	Star test left posterolateral	TI	60.00	90.00	78.500	8.287	10.557
		TF	70.00	100.00	90.250	8.955	9.922

Min – minimum, Max- maximum, SD –standard deviation, CV- coefficient of variation.

Table II
Statistical analysis of Star Excursion Balance Test results.

Parameters	ΔX (cm)	SD	95%CI		t	p	Cohen's d
			lower	lower			
Star test left anterior	12.25	2.552	13.444	11.055	21.466	.000	1.698
Star test left posterior	11.75	2.935	13.123	10.376	17.899	.000	2.732
Star test left lateral	12.50	2.564	13.700	11.299	21.794	.000	1.295
Star test left medial	12.50	2.564	13.70	11.299	21.794	.000	1.374
Star test left anterolateral	11.50	2.350	12.60	10.399	21.877	.000	1.366
Star test left anteromedial	12.00	2.513	13.176	10.823	21.354	.000	1.649
Star test left posterolateral	11.75	2.446	12.895	10.604	21.476	.000	2.243
Star test left posteromedial	12.25	2.552	13.444	11.055	21.466	.000	1.651
Star test right anterior	11.00	2.051	11.960	10.039	23.974	.000	1.516
Star test right posterior	12.25	2.552	13.444	11.055	21.466	.000	2.004
Star test right lateral	11.50	2.350	12.600	10.399	21.877	.000	1.938
Star test right medial	12.25	3.024	13.665	10.834	18.116	.000	2.163
Star test right anterolateral	11.75	2.446	12.895	10.604	21.476	.000	1.5123
Star test right anteromedial	11.50	2.350	12.600	10.399	21.877	.000	1.522
Star test right posterolateral	11.50	2.350	12.600	10.399	21.877	.000	0.904
Star test right posteromedial	11.75	2.446	12.895	10.604	21.476	.000	1.361

ΔX - mean difference, SD - standard deviation, CI - confidence coefficient, P - statistical significance threshold.

Analyzing the results in Table II, we find that for all parameters of the star test, the progress recorded between the two tests was statistically significant ($p < 0.05$). For the left leg, the greatest progress was recorded in the lateral and medial directions, with 12.50 cm, and the lowest progress in the anterolateral direction, with 11.50 cm. The mean values between the two tests, expressed in progress, fell within the 95% CI limits for all directions of the star test, for both legs of execution. For the right leg, the greatest progress was recorded in the posterior and medial directions, with 12.25 cm, and the lowest progress in the anterior direction, with 11 cm. Cohen's values fell between 0.904 and 2.743, which reflects a substantial increase in the effect. The results suggest a significant and consistent difference between the two tests evaluated, which we consider relevant from a practical point of view, given its large effect size.

Discussion

In this study, our goal was to develop an experimental program utilizing modern Blazepod technology, with the aim of optimizing the static balance of mini-football players. Our study found that the players achieved better results in the final testing than in the initial one, due to the specialized program assisted by Blazepod technology, which contained technical elements in balance conditions. This research contributes to the advancement of knowledge in the field of sports performance in mini-football, aligning with higher studies on the same topic.

Research in the field of sports games has highlighted the fact that balance is a crucial component in the performance of these players, particularly those with high levels of balance (Andreeva et al., 2021). The efficiency of technical skills in sports games is conditioned by the level of development of coordination capacities that are essential in this sport: kinesthetic differentiation, spatiotemporal orientation, reaction time, rhythm, ability to combine movements and balance (Kartal et al., 2020; Hadjicharalambous et al., 2020) Optimal balance during the handball game is an important factor for ensuring coordinated and efficient movements, and it has been shown that improving balance will have a positive impact on injury prevention (Daneshjoo et al., 2022; De Vasconcelos et al., 2021).

Qualities such as speed, balance, endurance, and strength are important in volleyball athletes. Anaerobic effort and balance skills are crucial in volleyball training and competition, particularly in fundamental movements such as jumping, attacking, and blocking. Balanced elements ensure stopping, changing direction, and maintaining body control (Bora & Dağlıoğlu, 2022; Bouteraa et al., 2020).

A series of studies have aimed to utilize modern technologies, such as Blazepod or Fitlight, in optimizing sports training (Potisaen & Potisaen, 2023; Steff et al., 2024). The studies have aimed at improving the physical or technical training components in sports games through the use of light stimuli that optimize balance capacity, reaction time, coordination, and spatial orientation in players of different age categories (Mahdi & Jaro, 2023; Grădinaru et al., 2023). The training process of sports players has been optimized through the use of intelligent technologies, which has also led to the improvement of the physical and technical potential of mini-football or futsal players (Ungur et al., 2024; Lisenchuk et al., 2023; Albeanu et al., 2022; Polevoy, 2017).

Previous studies have shown that static and dynamic balance in highly trained soccer or mini-football players is significantly better than in untrained ones (Baghbani et al., 2016; Bogalho et al., 2022). In contrast, Bressel and his collaborators demonstrated that in terms of static and dynamic balance, soccer or mini-football players outperform basketball players, but do not differ significantly from gymnasts. Maintaining an adequate balance appears to be effective in neuromuscular control, while also serving as a distinguishing factor for professional soccer or mini-football players (Zech et al., 2010). Studies have shown that physical training improves balance control, reducing body sway from static and dynamic positions (Guillou et al., 2007). Coaches should continually assess players' balance levels through specific tests and integrate postural development components into their training plans.

Study limitations

Our study was conducted over 12 weeks, involving only 20 senior players. The control group was not included in our study. We did not analyze the impact of the experimental program in low conditions, evaluate other components of proprioception, or evaluate the impact on the players' technique.

Conclusions

1. The data obtained when assessing static balance using the Star Test confirmed the experimental program's effectiveness, and modern Blazepod technology helped mini-football players develop their balance more effectively.

2. The implemented training program, which included proprioceptive exercises adapted to mini-football and utilized Blazepod technology, optimized static balance in mini-football players when executing on both feet. These results suggest that integrating modern training methods can contribute to improved performance and reduced risk of injury.

3. Maintaining body stability in dynamic conditions allows for precise and efficient technical execution. Therefore, modern training should systematically include methods for developing functional balance, integrated into real game contexts.

Conflict of interest

No conflict to declare.

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