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Effects of a Specific Six-Week Intensive Training Program on the Biomechanical Parameters of Futsal Players

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Abstract

Futsal is a high-intensity sport characterized by significant physical, technical, and tactical demands. Performance is influenced by various biomechanical and physiological factors, including speed, strength, and movement efficiency. Injury prevention has become a key component in maximizing performance and ensuring athlete longevity. This study aimed to evaluate the effects of a six-week, sport-specific training program on the biomechanical and motor performance parameters of futsal players, with an emphasis on injury prevention and performance enhancement. A total of 40 futsal players were divided into an experimental group (n=21) and a control group (n=19). The experimental group underwent a targeted training intervention consisting of exercises to develop strength, speed, agility, coordination, balance, and specific motor skills. The control group continued their standard training routine. Motor and functional tests were conducted pre- and post-intervention. Following the six-week intervention, the experimental group demonstrated statistically significant improvements in 12 out of 13 measured parameters compared to the control group. Notable enhancements were observed in aerobic capacity, vertical jump, sprint performance, agility, step frequency, and step length. The findings underscore the effectiveness of targeted conditioning programs in futsal, particularly those integrating strength, plyometrics, agility, balance, and dynamic stretching. Such interventions contribute to improved athletic performance and play a crucial role in injury prevention. These results highlight the need for evidence-based, sport-specific conditioning protocols in futsal training.

Keywords: *biomechanics, futsal, conditioning, injury prevention, performance enhancement*

Introduction

In recent years, the physical demands of sports have significantly increased, requiring athletes to perform more explosive movements, cover greater distances at higher speeds, and execute frequent changes in direction and intensity (Bradley et al., 2009). Futsal, as a high-intensity, fast-paced sport, differs substantially from traditional football—not only in terms of pitch dimensions and rules, but also in match dynamics. One of the most distinctive features is that the match clock stops during interruptions, extending the actual playing time by approximately 75–85% beyond the scheduled 40 minutes (Barbero et al., 2008).

During a typical match, futsal players cover 3–5 kilometers with alternating intensities, maintaining a work-to-rest ratio of about 1:1. Nearly half of the work phase consists of high-intensity efforts, including over 700 directional changes, frequent sprints, and jumps (Akenhead et al., 2013). These high-demand phases often occur during critical game moments, such as transitions, ball recoveries, and scoring opportunities (Di Salvo et al., 2009). Performance in futsal

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is influenced by a variety of factors, including linear speed, running technique, muscle strength, and leg power (Saryono et al., 2018).

In this context, understanding the principles of heterochrony and training periodization is crucial for optimizing athlete development and minimizing injury risk (Kiely, 2012; Molnar et al., 2007). Previous studies have highlighted that inadequate physical preparation, muscle imbalances, anatomical anomalies, and insufficient motor control may contribute to higher injury incidence, especially in younger players (Junge et al., 2010; Stanić et al., 2013). Notably, Jeffreys (2002) demonstrated that stability-focused exercises not only reduce injury risk but also enhance overall match performance throughout the season.

Based on the principle of training specificity, futsal coaches continuously seek effective training models to improve both performance and injury prevention (Sarmento et al., 2016). Sprint training with external load has shown benefits in improving change-of-direction speed in young athletes (Carlos-Vivas et al., 2020). Additionally, research into goal-scoring sequences in elite-level futsal confirms the importance of sport-specific conditioning for enhancing both physical and technical capabilities (Sarmento et al., 2016).

Recent studies have demonstrated that structured plyometric and high-intensity interval training (HIIT) programs significantly enhance key motor abilities in futsal players. For example, a six-week plyometric training intervention in sub-elite adult male futsal athletes produced substantial improvements in 20 m sprint performance ($\Delta\approx$-12.7%, d=2.08), moderate enhancements in agility ($\Delta\approx$-6.5%, d=0.85), and small to moderate gains in countermovement jump (CMJ) height (d=0.38) (Ishak & Abdul Halim, 2024; Silva et al., 2022). Similarly, combined high-load resistance and HIIT protocols over an 11-week period yielded significant improvements in Yo-Yo Intermittent Recovery Level 2 (IR2) test results and match performance indicators (Melo et al., 2023). While related conditioning programs in soccer have also proven effective in enhancing both aerobic and anaerobic capacity (Belegišanin, 2017), there is currently a lack of empirical evidence on the effects of such interventions in professional futsal players in Serbia.

Despite the increasing global popularity of futsal, it remains underrepresented in the scientific literature. Existing research primarily focuses on match analysis and physiological demands, leaving a notable gap in studies related to performance development, biomechanics, and the effects of specific training interventions (Naser et al., 2017). Given this context, comparative and longitudinal studies evaluating the outcomes of structured conditioning programs are essential to establish evidence-based training guidelines for coaches and practitioners.

The primary aim of this study is to examine the effects of a six-week high-intensity training program on motor and functional performance in professional futsal players. The intervention is designed to improve strength, speed, agility, coordination, balance, flexibility, and futsal-specific motor skills. Additionally, the program incorporates preventive strategies to reduce injury risk—an integral aspect of sustaining high-level athletic performance. This research addresses a significant gap in the current literature and offers practical insights for conditioning practices in futsal, particularly within the Serbian professional context.

Method

Participants

The participants in this study were 40 elite futsal players with an average sports experience of 7.68±3.12 years in the sport. The experimental group consisted of 21 senior elite futsal players from the first league (age 27.04±5.03 years, height 179.82±5.32 cm, weight 81.70±11.44 kg) who followed a specific six-week intensive training program during the preparation period, while the control group consisted of 19 senior futsal players from the second league (age 26.63±4.64 years, height 180.40±6.27 cm, weight 83.10±9.80 kg) who followed a standard pre-season training routine.

All participants were informed about the study procedures and provided written informed consent prior to participation. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Faculty of Sport and Physical Education, University of Novi Sad (Approval No. 49-0204/2023-1).

Procedure

All participants were informed about the complete testing procedure prior to the start of the research. The testing was conducted between January and March 2024 in the small hall of the Sports and Business Center Vojvodina (SPENS), located in Novi Sad, Serbia. All assessments took place in the evening hours on a futsal court with a parquet surface.

Before the testing sessions, athletes performed a standardized warm-up protocol lasting approximately 15 minutes. The warm-up included both general and specific components. It began with 5 minutes of low-intensity jogging aimed at raising core body temperature, followed by dynamic stretching exercises. The specific part of the warm-up consisted of progressive running, changes of direction, sudden stops, and plyometric drills to ensure optimal readiness for testing.

Testing conditions were consistent across all sessions, with an indoor temperature maintained at approximately 20–22°C and relative humidity between 40–50%. All measurements were conducted by certified strength and conditioning professionals, while the experimental training program was implemented and supervised by licensed coaches with experience in working with elite futsal players.

Tests

Vertical Jump test - Kistler force plate (Kistler, Winterthur, Switzerland) was used to assess lower limb explosive power with these tests: squat jump, counter-movement jump, single leg jump, and counter-movement jump with arm swing.

5, 10 and 20m Sprint Test - Assessment of speed ability was performed with a 20-meter maximal sprint test (high start) which is measured with a wireless photocell system (Witty-Gate, Microgate, Bolzano, Italy) Within this test, variables like movement speed and starting acceleration were monitored, i.e. the time required to run the first 5 and 10 meters as well as the time required to run the second 10 meters. The system of photocells was placed at approximately hip height for all participants to assure that the gates were passed through with only one part of the body (Yeadon et al., 1999). Participants assumed a standing starting position 50 cm from the starting line and were instructed to cross the finish line as fast as possible.

Balsom Agility Test is an agility test designed for football players, which requires from participants to run around a series of cones, making several changes of direction and two sharp

180-degree turns. The test was developed by (Balsom, 1994).

RAT test (Reactive Agility Test), in addition to the ability to quickly change of direction, also includes the motor-cognitive domain of sports with visual signals during running. The reactive agility test (RAT) was performed according to the protocol described previously by Trecroci et al. (2019). Running time was recorded using photocell gates (Microgate Witty – Gate).

30-15 IFT test (Intermittent Fitness Test) - is an endurance test with a progressive gradual increase in the intensity of intermittent running. The mentioned test was used to evaluate the aerobic capacity as well as to program training for the development of endurance, which was conceived through medium and high-intensity sprint training. The test was performed according to the (Buchheit, 2008) protocol.

Sit and Reach test - test to assess mobility and flexibility of the hamstrings and lower back muscles on a specially designed bench.

Biomechanical analysis included kinematic parameters such as acceleration, maximum speed, step frequency, and step length. Data were recorded using a stationary high-speed digital camera (Sony HDR-CX405, Sony Corporation, Tokyo, Japan) positioned laterally to the sprinting lane. The recorded footage was analyzed using motion analysis software (Kinovea, version 0.9.5, Kinovea Open Source Project, Bordeaux, France).

Protocol

Before the tests, the players had a warm-up consisting of a general and a specific part, lasting about 15 minutes. The warm-up started with running at a lower intensity for 5 minutes, followed by dynamic stretching as well as a specific part in the form of progressive running, changing the direction of movement, micro-dosing of lending exercise and plyometrics.

The tests were conducted in the following order: body composition, vertical jump, speed test, agility test, 30-15 test, and flexibility assessment test.

Experimental treatment

During the preparation period for the season, players participated in a six-week experimental training program, conducted three to five times per week as part of regular team sessions. The experimental group followed a high-intensity, sport-specific program designed to develop muscular strength, speed, agility, coordination, mobility, balance, and futsal-specific motor skills. Special emphasis was placed on injury prevention through targeted neuromuscular and stabilization exercises. The structure and rationale of this training protocol are based on previous findings highlighting the effectiveness of integrated conditioning in team sports (Hammami et al., 2018; Silva et al., 2022; Slimani et al., 2016). The detailed training schedule and specific exercise descriptions are presented in the tables below.

Table 1. Detailed description and schedule of the specific six-week intensive program

‹	WEEK	WEEK	WEEK	WEEK	WEEK	WEEK
M O N	Initial testing: tests of speed, explosive strength, agility, IFT test.	Sprint (acceleration), 6x20m Extensive plyometrics, 6x20m Circuit strength training 3x6 exercises (W:R=40”:20”)	Anaerobic circuit polygon with a ball 4x 80m (8 obstacles) Core exercises, SMG exercises (Prevention) 3x6 exercises (8-12reps) PM - Te/ Ta - FUTSAL	DAY OFF	RSA 3 x 8 sprint , (W:R = 5”:10”) Te/ Ta - FUTSAL Strength exercises SMG (W:R=30”:15”)	Flying sprints (4x30m), R=1’ Plyometrics micro dose 2x(4x7m) Te/ Ta - FUTSAL
T U E	LSD running 2x4000m (65%-70% MAS) Mobility flow 2x4 exercise (W=30”)	Core stability exercises with resistance band (paired) 3x6 exercises (W:R=30”:15”) Te/ Ta - FUTSAL	Active recovery Walk, bike, pool, foot tennis (1h) PM- Te/ Ta - FUTSAL	Strength training (whole body) 3x6 exercises (2-4 reps) Te/ Ta - FUTSAL	Proprioception activation Strength power based training (whole body) 2x 6 exercise (3-6 reps (60-80% 1RM) Te/ Ta - FUTSAL	Strength training (power based) 2x6 exercises (2-4 reps,) Te/ Ta - FUTSAL
W E D	CNS activations Sprint micro doses 4 x 15m Strength training (whole body) 2 x 6 excersice (12- 15 rep) Te/ Ta - FUTSAL	LSD running 3x3000m (70% MAS) Mobility exercises (foot, ankle, pelvic, spine, shoulder) 2x6 exercises (W=30-45”)	Isolated sprint (prolonged accelerations) 4x (4x60m) W:R=1:3 Circuit strength training (lower body) 3x6 exercises, W:R=30”:15” PM - Te/ Ta - FUTSAL	"Lending skills" 4x8 repetitions Tempo running with COD 5 x 3 min (W:R = 2’:1’) Te/ Ta - FUTSAL Mobility exercises 2x4 exercises (W:R=45”:15”)	FUTSAL PRESEASON GAME Strength training (lower body) 2x 6 exercise	CNS activation, Explosive jumps 4x4 reps Sprint micro doses 4x10m Te/ Ta - FUTSAL Mobility exercises 2x3 exercises (W:R=30”:15”)

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Table 1. Detailed description and schedule of the specific six-week intensive program

‹	WEEK	WEEK	WEEK	WEEK	WEEK	WEEK
THU	Isometric activation Extensive running 4x10min (70%-75% MAS)	Plyometrics 3x (6x4 rep) R=1' Isometric 2 x 4 exercises (W:R=1':30") Te/ Ta - FUTSAL	Tempo running with progression and CoD, 4x8 min (W:R=15":45", 130% MAS) Foam roller (self-massage), Mobility exercises 2x5 exercises, W:R=30":15" PM - Te/ Ta - FUTSAL	Curvilinear sprints 8x20m (R:1') Intensive plyometrics 6x4 reps (R:1') Te/ Ta - FUTSAL SMG (prevention) Cal Dietz 3x4 exercises (8 repetitions)	Boyle warm up „Lending skills"4x6 exercises Anaerobic circuit ball polygon 3x4 min (4 obstacles) Te/ Ta - FUTSAL	Isometric activation, Prevention core + SMG strength. 2x4 exercises (8 reps)
FRI	Hill sprint 2x (4x20m) W:R=1:4 Hill plyometrics 2x (4x10 repetitions) Prevention, SMG 3x4 exercises (8-12 reps)	Altitude preparation Active recovery (after the trip) Foot tennis+ Mobility 3x6 exercises (W:R=45":15")	Isometric activation, Core + proprioception exercises 2 x 6 exercises (8 reps) PM - Te/ Ta - FUTSAL	CNS activation 4x5m Landings exercise + COD 2x(4x10m) Te/ Ta - FUTSAL	RSA 4 x 6 sprint, (W:R = 5":10") FUTSAL Mobility prevention 2x4 exercises (W:R=30":15")	CNS activation, "Lending skills" 4x6 repetitions 2x (4x10m) SAQ, COD
SAT	Dynamic proprioception excersice 3 x 4 excersice (W:R = 30":30") Te/ Ta - FUTSAL	Aerobic tempo running 4 x 8 min (120% MAS) Strength exercises, Cal Dietz (prevention) 3x6 exercises (10/12 reps) PM - Te/ Ta - FUTSAL	Intensive plyometrics (microdoses) 4x5 repetitions Sprint with resistance 4x20m Strength training 3x 6 exercises (3-5 rep) PM - Te/ Ta - FUTSAL	PREPARARATION MATCH Strength training 3x 6 exercises (6-10 reps 60%-80% of 1RM)	PRESEASON GAME Strength training 2x 4 exercises (6-10 reps 60%-80% of 1RM)	FIRST ROUND GAME Tempo running after the game (who didn't play) 4x6 min (W:R=15":30", 130% of MAS)
SUN	DAY OFF	Extensive plyometrics 2x(4x20m) W:R=1:3 Sprint with load (band in pairs) 2x(4x20m) W:R=1:3 Circuit strength training 2x6 exercises (W:R=30":15")	Bilat running 30"-30" 3x7 min (100% of MAS) Mobility exercises 2x3 exercises (W:R=45":15") DEPARTURE FOR THE Novi Sad	DAY OFF	Intensive plyometrics 2x4 exercises (4 repetitions) SAQ + COD, 2x (4x10m) Extensive intervals (85-90% of MAS) 10x2min, W:R=2':1'	DAY OFF

Legend. W:R – Work: Rest; R – Rest; PM – Post meridiem; MAS – Maximal aerobic speed; Cal Dietz – strength exercises for pelvic muscles; LSD – long slow distance running; SMG – strengthening of small muscle groups; SAQ – Speed, Agility, Quickness training; Te/Ta – Technical/Tactical training.

Statistical Analyses

All statistical analyzes were performed using SPSS V. 20 (IBM Corporation; Armonk, NY, USA). Descriptive statistics were calculated for all the previously mentioned data. Paired sample T-test and Analysis of covariance were used for data analysis. Paired sample T-test showed differences between the initial and final testing in both groups and determined whether there was a statistically significant effect of the experimental treatment. After determining the conditions that there are no differences in the initial measurement between the groups and that there is no regression homogeneity, Analysis of Covariance (ANCOVA) was used where the initial measurement was taken as a covariate, the group variable was a fixed factor and the final measurement was taken as a dependent variable. The level of statistical significance was set at $p<0.05$.

Results

Table 2 shows the pre- and post-intervention comparisons within the experimental group, indicating statistically significant improvements across all measured variables, with the exception of the Reactive Agility Test (RAT), where the observed change did not reach statistical significance ($p=0.716$).

Table 2. Differences between the initial and final measurements of the experimental group

	Experimental group (N=21)		t	p
	AM	SD		
5m sprint (s) 1	1.171	.195	2.310	.032
5m sprint (s) 2	1.128	.178		
10m sprint (s) 1	1.903	.187	6.400	.000
10m sprint (s) 2	1.795	.133		
20m sprint (s) 1	3.180	.256	2.435	.024
20m sprint (s) 2	3.068	.141		
SJ (cm) 1	45.416	5.438	-5.341	.000
SJ (cm) 2	48.504	5.235		
CMJ (cm) 1	49.585	5.032	-5.805	.000
CMJ (cm) 2	51.125	4.825		
VJ (cm) 1	55.213	6.316	-10.386	.000
VJ (cm) 2	58.430	5.948		
Balsom test (s) 1	11.873	.654	6.572	.000
Balsom test (s) 2	11.501	.583		
RAT (s) 1	2.429	.126	5.031	.716
RAT (s) 2	2.315	.092		
IFT 1	17.452	1.731	-11.649	.000
IFT 2	19.024	1.528		
Sit&Reach (cm) 1	30.642	4.604	-5.187	.000
Sit&Reach (cm) 2	32.690	5.211		
Step frequency (f) 1	5.515	0.958	-1.459	.038
Step frequency (f) 2	5.374	0.097		
Stride length (cm) 1	181.48	23.852	2.175	0.28
Stride length (cm) 2	186.02	21.567		

N – number of respondents; AM – arithmetic mean; SD – standard deviation; t - value; p – statistical significance; SJ – squat jump; CMJ - countermovement jump; VJ – vertical jump; RAT – reactive agility test; IFT – intermittent fitness test.

Table 3 presents the differences in the control group. No statistically significant differences were found between pre- and post-testing in most variables, except in the squat jump (SJ, p=0.001) and the reactive agility test (RAT, p=0.031), where modest improvements were observed. These findings suggest that the six-week specific high-intensity training program in the experimental group led to significant improvements in most performance variables, unlike the control group, which showed limited progress.

Table 4 presents the results of the differences in variables at

Table 3. Differences between initial and final measurements of the control group

	Control group (N=19)		t	p
	AM	SD		
5m sprint (s) 1	1.224	.107	1.837	.083
5m sprint (s) 2	1.206	.092		
10m sprint (s) 1	1.941	.152	.516	.612
10m sprint (s) 2	1.936	.148		
20m sprint (s) 1	3.262	.212	.152	.881
20m sprint (s) 2	3.260	.183		
SJ (cm) 1	47.486	4.953	-4.112	.001
SJ (cm) 2	46.940	4.760		
CMJ (cm) 1	49.933	6.046	.609	.551
CMJ (cm) 2	48.211	13.684		

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Table 3. Differences between initial and final measurements of the control group

	Control group (N=19)		t	p
	AM	SD		
VJ (cm) 1	55.733	5.645	1.216	.242
VJ (cm) 2	50.300	19.742		
Balsom test (s) 1	12.302	.493	-.801	.434
Balsom test (s) 2	12.329	.510		
RAT (s) 1	2.576	.253	2.333	.031
RAT (s) 2	2.354	.255		
IFT 1	16.55	4.14	-2.005	.060
IFT 2	18.36	.813		
Sit&Reach (cm) 1	32.578	7.832	1.372	.187
Sit&Reach (cm) 2	32.894	7.210		
Step frequency (f) 1	5.841	0.997	.872	.622
Step frequency (f) 2	5.720	0.112		
Stride length (cm) 1	171.41	19.184	1.457	.247
Stride length (cm) 2	174.81	17.462		

Legend. N – number of respondents; AM – arithmetic mean; SD – standard deviation; t - value; p – statistical significance; SJ – squat jump; CMJ –counter – movement jump; VJ – vertical jump; RAT – reactive agility test; IFT – intermittent fitness test.

the final test with the control of the initial test. Univariate analysis of covariance (ANCOVA) was used to test the existence of differences and determine the effects of the experimental program. Statistically significant differences were observed in all variables in favor of the subjects of the experimental group at the level of statistical significance $p<0.05$, only in the variable for reactive agility (RAT test) no statistically significant differences were observed.

Table 4. Significance of differences in variables at the final test with control of the results from the initial test (covariate)

	Experimental group N=21		Control group N=19		ANCOVA	p	Partial Eta Squared
	AM	SD	AM	SD	F		
5m sprint (s)	1.128	0.178	1.206	0.092	3.144	0.084	0.078
10m sprint (s)	1.795	0.133	1.936	0.148	51.979	0.000	0.583
20m sprint (s)	3.068	0.141	3.260	0.183	17.314	0.001	0.318
Sit & Reach (cm)	32.690	5.211	31.894	7.210	16.977	0.024	0.314
SJ (cm)	48.504	5.235	46.940	4.760	0.947	0.037	0.026
CMJ (cm)	51.125	4.825	48.211	13.684	1.614	0.022	0.044
VJ (cm)	58.430	5.948	50.300	19.742	4.526	0.040	0.114
RAT (s)	2.315	0.092	2.354	0.255	18.111	0.116	0.328
Balsom test (s)	11.501	0.583	12.329	0.510	42.837	0.000	0.536
IFT 30-15 (vift)	20.024	1.528	18.368	0.813	1.871	0.049	0.048
Step frequency (f)	5.374	0.097	5.720	0.112	28.712	0.003	0.274
Stride length (cm)	186.02	21.567	174.81	17.462	50.298	0.001	0.322

Legend. N – number of respondents; AM – arithmetic mean; SD – standard deviation; p – statistical significance; F - test value; ANCOVA - analysis of covariance; SJ – squat jump; CMJ –counter – movement jump; VJ – vertical jump; RAT – reactive agility test; IFT – intermittent fitness test.

Discussion

The findings of this study indicate that the implemented six-week high-intensity training program significantly improved motor and functional abilities in professional futsal players. Improvements were observed in 12 out of 13 measured variables (Table 2), suggesting the efficacy of this multimodal training approach in enhancing physical preparedness and supporting injury prevention.

These results are consistent with previous studies emphasizing the unique physiological demands of futsal, characterized by repeated high-intensity efforts, accelerations, decelerations, and multidirectional changes (Castagna et al., 2009). Statistically significant gains were observed in aerobic capacity (VIFT 30-15, $p<0.049$), vertical jump ($p<0.040$), sprint speed (10 m: $p<0.000$; 20 m: $p<0.001$), agility ($p<0.000$), flexibility ($p<0.024$), step frequency ($p<0.003$), and step length ($p<0.001$).

These results align with findings from Loturco et al. (2015), who reported strong associations between vertical jump performance and sprint speed in elite athletes, highlighting the importance of neuromuscular power. Similarly, Torres-Torrelo et al. (2018) demonstrated that both resistance training alone and combined training programs positively influenced repeated sprint ability in futsal players. Although the current study employed a more comprehensive training model—including strength, agility, coordination, balance, and flexibility components—the similarities in performance gains suggest that multifactorial training programs may offer broader benefits across multiple physical domains in futsal athletes.

Mechanistically, the observed improvements likely stem from neuromuscular adaptations facilitated by plyometric and high-intensity interval training, including increased motor unit recruitment, enhanced intermuscular coordination, and greater eccentric strength (Markovic & Mikulic, 2010). In addition, improvements in aerobic capacity may result from peripheral and central cardiovascular adaptations induced by high-intensity efforts performed near 90–95% of individual VIFT, as noted by Buchheit et al. (2008). Such adaptations are further influenced by the interplay between training intensity, duration, and recovery strategies, as demonstrated in studies on football players (Dupont et al., 2004; Iaia et al., 2009; Impellizzeri et al., 2005).

Nonetheless, comparisons with earlier studies should be interpreted cautiously due to differences in methodology, training volume, and sample characteristics (Viana-Santasmarinas et al., 2018). Unlike previous designs that matched training volume between groups, this study included variability in workload, which may have affected adaptation responses.

A notable limitation of this study is the use of a generalized training program that incorporated multiple training elements simultaneously, without isolating specific training modalities (e.g., resistance vs. plyometric vs. HIIT). As a result, it is not possible to determine which component contributed most significantly to specific performance improvements. Future research should investigate the isolated effects of individual training types to identify the most efficient methods for targeting particular motor abilities in futsal players. Moreover, long-term monitoring of training load and injury rates would be valuable for evaluating the sustainability and safety of such interventions.

In conclusion, the integrated high-intensity training program implemented in this study led to significant improvements in multiple domains of physical performance in professional futsal players. These findings reinforce the value of multifaceted conditioning approaches and provide practical guidance for coaches aiming to enhance sport-specific fitness in futsal.

Conclusion

This study demonstrated that futsal players who participated in a six-week high-intensity training program focused on developing muscle strength, speed, agility, coordination, balance, and sport-specific motor skills, with a strong emphasis on injury prevention achieved significantly better results in the final testing compared to the control group. These players showed greater improvements in key physical performance indicators and, notably, reported no injuries or discomfort during the preparatory period that would have limited their participation. These results underscore the importance of evidence-based, sport-specific conditioning protocols in optimizing athletic performance and minimizing injury risk. In conclusion, the integrated high-intensity training program implemented in this study proved to be effective in enhancing multiple domains of physical performance in professional futsal players. These findings highlight the practical value of multifaceted conditioning approaches and may assist coaches and practitioners in designing more efficient and targeted training strategies tailored to the specific demands of futsal.

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Conflict of interest
The authors declare no conflict of interest.

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