Physical Education Theory and Methodology
Теорія та методика фізичного виховання

ISSN 1993-7989 (print)
ISSN 1993-7997 (online)
ISSN-L 1993-7989

Original Scientific Article

The Effects of an Eight-Week Small-Sided Game-Based High-Intensity Interval Training Intervention and Traditional High-Intensity Interval Training Intervention on Physical Fitness in Youth Female Soccer Players

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Accepted for Publication: August 25, 2025
Published: September 30, 2025

DOI: 10.17309/tmfv.2025.5.09

Abstract

Objectives. The study aimed to compare the outcomes of an eight-week Small-Sided Game-based High-Intensity Interval Training (SSG-HIIT) and Traditional High-Intensity Interval Training (THIIT) on parameters of physical fitness in youth female soccer players. Specifically, it assessed changes in anaerobic power, explosive strength, sprint speed, agility, and flexibility.

Materials and Methods. Twenty-seven female soccer players aged 14 to 17 years playing at a competitive level (>2 years) were randomly assigned to three conditions: SSG-HIIT (n = 9), THIIT (n = 9) and Active Control Group (ACG, n = 9). The intervention took a period of eight weeks, with three sessions per week on the experimental groups. SSG-HIIT sessions included 3v3 to 5v5 soccer games with progressive intensity, while THIIT involved structured sprint intervals. Pre- and post-intervention assessments comprised the Running-Based Anaerobic Sprint Test (RAST), standing broad jump, 50-m sprint, Illinois agility test, and sit-and-reach flexibility test.

Results. There was a huge improvement in all variables in both SSG-HIIT and THIIT groups ($p < 0.05$), whereas ACG showed negligible changes. SSG-HIIT led to superior gains in explosive power (8.69 %), flexibility (11.3 %), anaerobic power (RAST: -8.58 %), sprint speed (-3.97 %), and agility (-4.37 %) compared to THIIT. Post hoc analysis confirmed significantly greater improvements in explosive power and flexibility in the SSG-HIIT group ($p < 0.05$), though sprint and agility gains were statistically similar between the two interventions.

Conclusions. According to the findings, SSG-HIIT proved more effective than THIIT in enhancing multiple physical fitness parameters, especially explosive power and flexibility. Incorporating game-based training within high-intensity protocols offers a practical and sport-specific approach to conditioning youth female soccer players.

Keywords: small-sided games, high-intensity interval training, youth soccer, anaerobic power, physical fitness.

Introduction

The most popular sport in the world, soccer, is an intense competitive activity with significant physical and physiological requirements on players, requiring optimal development of multiple fitness components including aerobic capacity, explosive power, speed, agility, and flexibility (Datson et al., 2014). The contemporary sport has become more competitive and quicker than ever, and as a result, highly advanced training strategies are required in order to maximize performance outcomes and minimize injury potential. High-intensity interval training (HIIT) has become an important component of modern soccer conditioning program, which has shown to greatly enhance

aerobic and anaerobic performance measures (Buchheit & Laursen, 2013). The traditional protocols in HIIT are developed around alternating blocks of intense activity and recovery or a lower level of effort (Kumar et al., 2023), and have been well-validated in improving cardiovascular health, power and metabolism in soccer players (Helgerud et al., 2001). However, the integration of soccer-specific movements and decision-making processes within training has led to the development of small-sided games (SSGs) as an alternative training modality. SSGs combine the physiological benefits of HIIT with technical and tactical skill development, offering a more holistic approach to soccer conditioning (Hill-Haas et al., 2011).

Recent studies have established that SSG and HIIT effectively improved aerobic performance, and both types were significantly better than the control groups (Arslan et al., 2020). Moreover, both SSG and HIIT have been shown to enhance vertical and horizontal jump performance, agility or change-of-direction ability, as well as aerobic fitness as assessed through progressive and intermittent multistage testing in youth soccer players (Andersson et al., 2010; Arslan et al., 2020). The physiological responses to SSG-based training have been shown to elicit similar cardiovascular adaptations to traditional HIIT (THIIT) while providing additional benefits related to sport-specific skill development (F. M. Clemente et al., 2020). Comparative studies have revealed that SSG training creates substantial improvements in 20-meter sprint performance, agility, and anaerobic power in youth soccer players as measured by Running-based Anaerobic Sprint Test (RAST) (Hammami et al., 2018). RAST has become a standard assessment tool for evaluating anaerobic power and fatigue index in soccer players, providing valuable insights into explosive power capabilities and repeated sprint performance (Zacharogiannis et al., 2004). In recent years, RAST has shown high reliability and validity in measuring the anaerobic performance of young soccer players, with significant correlations between RAST parameters and traditional anaerobic testing methods (Jastrzębska, 2023; Köklü et al., 2011). Complementary fitness components including sprint speed, agility, and flexibility are equally crucial for optimal soccer performance, as they directly influence players' ability to execute technical skills under pressure and adapt to the dynamic nature of match play (Stølen et al., 2005). Training focused on speed, agility, and quickness (SAQ) has demonstrated notable enhancements in sprinting ability and directional change performance among youth soccer athletes (Jovanovic et al., 2011; Milanović et al., 2013).

The development of female soccer has experienced unprecedented growth globally, with increasing participation rates and elevated competitive standards demanding evidence-based training approaches specifically tailored to female athletes (Datson et al., 2014). Over the past decade, there has been a notable increase in female soccer participation, accompanied by greater financial investment from governing organizations. This growth places a growing responsibility on researchers and sports medicine professionals to deepen their understanding of the physical profiles, performance demands, and health requirements specific to female soccer players. The young female soccer players encounter physiological and biomechanical particularities that make them different not only with their male peers, but also with adult female players. Biological factors unique to female athletes can influence both game tempo and overall work capacity, highlighting the need for tailored training interventions that consider these physiological distinctions (Datson et al., 2014). Adolescence is a pivotal stage in athletic development, during which well-designed training programs can optimize performance improvements and reduce the likelihood of injury (Lloyd & Oliver, 2012). Research has shown that 15-year-old female soccer players demonstrate significant improvements in sprint performance (10m and 20m) and agility when exposed to structured training interventions, with pre-post improvements of 0.08 seconds in 10m sprint and 0.11 seconds in 20m sprint performance (Milanović et al., 2013). In female soccer players, strength training is chiefly associated with improvements in physical fitness components such as muscular strength, power, and speed, as well as increased bone mineral density. However, evidence regarding its role in injury prevention among female athletes remains comparatively limited (Darragi et al., 2024). Establishing structured and consistent training programs during the developmental years is especially important for female athletes, as studies have shown notable increases in body weight and fat percentage from the end of preseason through the postseason and into the transition phase, underscoring the necessity for ongoing, well-regulated training interventions (Parpa et al., 2024). The specificity of training adaptations in female soccer players is further emphasized by the distinct physical demands of women's soccer. The physical demands encountered by female soccer players during competition are influenced by the level of play, with match intensity and workload varying accordingly. These demands necessitate training programs that address the multifaceted nature of soccer performance while considering the unique physiological characteristics of female athletes.

Despite the growing body of research on HIIT and SSG interventions in soccer, several limitations persist in the current literature, including the predominant focus on male soccer players creating a substantial knowledge gap regarding female athlete responses (Mujika et al., 2009), limited intervention durations (typically 4-8 weeks) that may not adequately capture full training adaptations in youth athletes, challenges in standardizing SSG protocols due to numerous variables affecting training outcomes (Halouani et al., 2014), methodological difficulties in assessing training load during SSG sessions, seasonal variations in performance, and psychological differences between training modalities where HIIT produces mood disturbance while SSG ensures mood balance. Therefore, the primary objective of this study was to compare the effects of an eight-week SSG based HIIT (SSG-HIIT) intervention versus THIIT on physical fitness parameters in youth female soccer players, specifically evaluating the comparative effects on anaerobic power and fatigue index as measured by RAST, assessing differential impacts on explosive power development, determining relative effectiveness in enhancing sprint speed performance, comparing effects on agility and change-of-direction capabilities, examining influence on flexibility parameters, and providing evidence-based recommendations for optimal training prescription in youth female soccer players. The findings will contribute

to the limited body of research on female soccer training methodologies and provide practical insights for coaches, strength and conditioning professionals, and sports scientists working with this underrepresented population in sports science literature.

Materials and Methods

Study Design

In the study, a three-arm, parallel group randomized, and controlled trial was planned to study the effects of SSG-HIIT and THIIT on different physical fitness parameters in adolescent female soccer players. The study was ethically approved by DSS Academy, Ormanjhi, Ranchi, India (Ref. No.: DSSA/2025/007) and was undertaken in accordance with the principles in the Declaration of Helsinki (World Medical Association, 2013). All the participants and their legal guardians provided written informed consent before participation.

Participants

The participants of the study were adolescent soccer-playing females aged between 14 and 17 years. Eligibility requirements were two years playing experience at competitive level and the active involvement in organized soccer trainings not less than three times a week. The participants had to give medical clearance of being able to perform high-intensity exercise and had never had musculoskeletal injuries within the three months prior to the study. Individuals were excluded if they had a known history of cardiovascular, respiratory, or metabolic conditions; were currently using performance-enhancing substances or medications influencing physical performance; were involved in additional structured training programs outside of their regular soccer regimen; or were unable to complete baseline fitness assessments due to illness or injury. The study took place at DSS Academy, Ormanjhi, Ranchi, India, over an eight-week period from April 14 to June 9, 2025. Sample size estimation was performed using G*Power software (version 3.1.9.7), referencing effect sizes reported in prior studies on HIIT among youth athletes (Saha et al., 2025). Given alpha = 0.05, a statistical power of 0.80, and an estimated effect size of 0.25 on the primary outcome (anaerobic power), a minimum needed sample size of eight subjects per group was estimated to be achieved. In anticipation of 20% dropout rate, nine participants per group were recruited, and the final sample size became 27 athletes. Participants were randomly assigned to one of three intervention arms using a computer-generated randomization sequence: (1) SSG-HIIT (n = 9), (2) THHT group (n = 9), or (3) Active Control group (ACG, n = 9). The processing of randomization was stratified by age and baseline fitness scores to ensure balanced distribution. The allocation concealment was assured by using sequentially numbered opaque and sealed envelopes.

Table 1. Demographic Values for Participants

Variables	SSG-HIIT	THIIT	ACG
Age	15.44 ± 1.01	15.11 ± .92	15.77 ± .97
Experience	2.55 ± .52	2.77 ± .66	2.88 ± .60
Height	148.77 ± 4.46	146.77 ± 3.19	148.11 ± 2.42
Weight	49.66 ± 2.59	48.44 ± 3.35	48.22 ± 1.92
BMI	22.53 ± 2.30	22.55 ± 2.29	21.98 ± .90

Intervention Protocol

The Table 2 SSG-HIIT protocol was implemented over eight weeks with progressive adjustments in session duration, intensity, and tactical complexity. Participants trained three

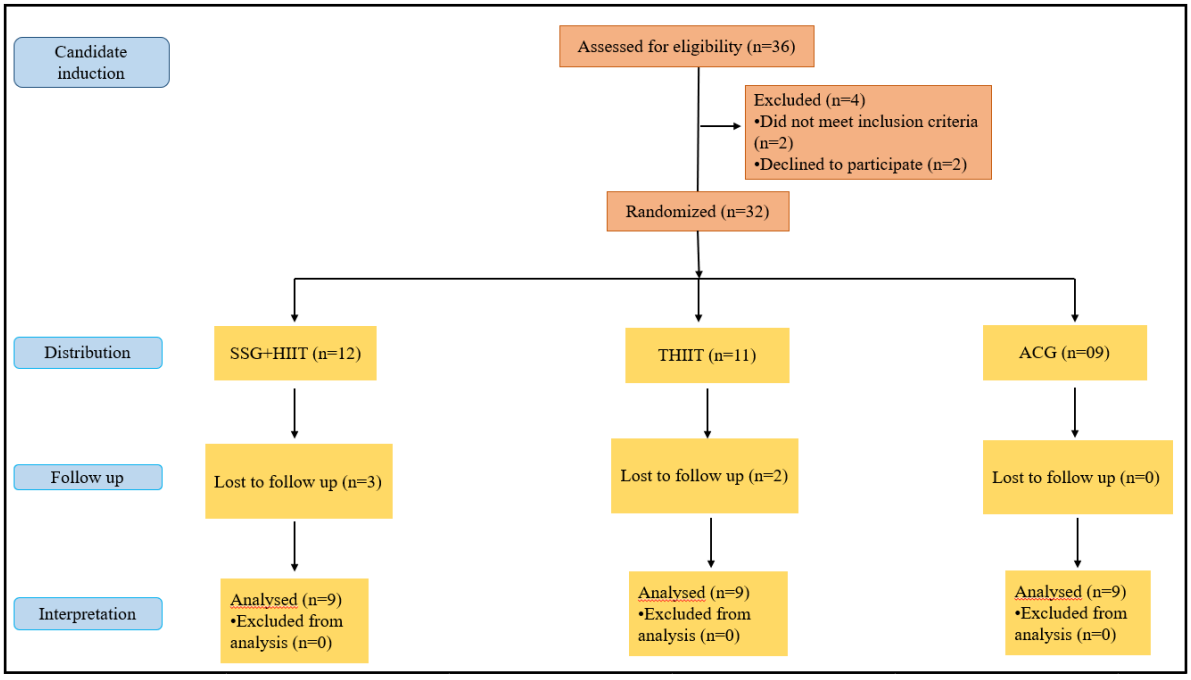

Fig. 1. CONSORT-Compliant Flow Diagram Illustrating the Process of Participant Enrollment, Group Allocation, Follow-Up, and Data Analysis

Table 2. SSG-HIIT Protocol Over an 8-Week Period

Week	Sessions/Week	Duration/Session	Intensity	Work-to-Rest Ratio	Training Content
1-2	3	30-35 min	85-90% HRmax / RPE 7-8	2:1 (2-min game: 1-min rest)	3v3 or 4v4 SSGs on 30x20m pitch, focusing on attacking/defensive transitions
3-4	3	35-40 min	88-92% HRmax / RPE 8-9	2:1	4v4 SSGs with limited touches, mini-goals, or directional play
5-6	3	40-45 min	90-93% HRmax / RPE 8-9	3:1	5v5 games with tactical constraints, such as possession or overloads
7-8	3	45-50 min	90-95% HRmax / RPE 9	3:1	Mixed format SSGs: 4v4 + 2 neutral players, focused on high tempo and decision-making

Table 3. THIIT Protocol (Running-Based) Across an 8-Week Period

Week	Sessions/Week	Duration/Session	Intensity	Work-to-Rest Ratio	Training Content
1-2	3	25-30 min	85-90% HRmax / RPE 7-8	1:1 (30s run: 30s rest)	10-12 reps of 100m shuttle runs or 15s sprint intervals
3-4	3	30-35 min	88-92% HRmax / RPE 8	2:1	6 x 200m intervals 90% effort with 60-90s passive recovery
5-6	3	35-40 min	90-93% HRmax / RPE 8-9	3:1	8 x 30s sprint runs with 15s recovery (tabata-style format introduced)
7-8	3	40-45 min	90-95% HRmax / RPE 9	3:1	10-12 x 20s maximal effort sprints with 10s jog/walk recovery

times per week, starting with 30-35-minute sessions at 85-90% HRmax using 3v3 or 4v4 formats focused on transitions. Intensity and volume increased gradually across the weeks, with sessions extending to 45-50 minutes at 90-95% HRmax by Weeks 7-8. Training formats evolved from limited-touch 4v4 games with directional play to 5v5 games involving tactical constraints (e.g., possession, overloads), culminating in mixed-format 4v4+2 games emphasizing tempo and decision-making. The work-to-rest ratio progressed from 2:1 to 3:1, maintaining high physiological load while targeting game-specific skills.

The THIIT protocol in Table 3 was carried out over eight weeks with three sessions per week, progressively increasing in duration, intensity, and complexity. Training began with 25-30-minute sessions at 85-90% HRmax, using 1:1 work-rest ratios (e.g., 100m shuttle runs or 15s sprints). From Weeks 3-4, intensity rose to 88-92% HRmax with 200m intervals at a 2:1 work-rest ratio. In Weeks 5-6, Tabata-style sprints (8 x 30s with 15s recovery) were introduced, increasing intensity to 90-93% HRmax and a 3:1 ratio. The final phase (Weeks 7-8) featured 10-12 bouts of 20s maximal sprints with 10s jog/walk recovery, pushing intensity to 90-95% HRmax. This progressive format ensured overload while targeting speed, endurance, and anaerobic capacity.

The ACG continued working on their routine soccer activities with no further interventions. Training logs were maintained to monitor habitual activity levels throughout the study period.

Outcome Assessments

RAST: Used to evaluate anaerobic endurance, and has demonstrated strong validity (r = 0.897) and high test-retest reliability (r = 0.919) in previous research (Saha et al., 2025).

Explosive Power: Standing broad jump distance was measured using a standardized protocol as described by Castro-Piñero et al. (2010). Participants performed three maximal efforts with 2-minute recovery between attempts. The best performance was recorded to the nearest centimetre.

Sprint Speed: 50-meter sprint performance was assessed using electronic timing gates following the protocol established by Haugen & Buchheit (2016). Participants performed two maximal sprints with 5-minute recovery, and the best time was recorded to the nearest 0.01 seconds.

Agility: The Illinois Agility Test was conducted following standardized procedures as described by Liu et al. (2025). Participants completed two trials with 5-minute recovery, and the best time was recorded to the nearest 0.01 seconds.

Flexibility: Sit-and-reach test was performed using a standardized sit-and-reach box according to the protocol described by Khati et al. (2025). Three attempts were made with 30-second intervals, and the best score was recorded to the nearest 0.1 cm.

Data Collection Procedures

All performance assessments were carried out at two time points: baseline (week 0) and immediately following the intervention period (week 9). Testing was conducted in a controlled laboratory environment at a consistent time of day (±2 hours) to minimize the influence of circadian variations. Participants were advised to refrain from engaging in intense physical activity for at least 48 hours prior to testing and were instructed to maintain stable hydration and nutritional routines. The sequence of assessments was standardized for all participants to ensure consistency:

(1) anthropometric measurements, (2) flexibility evaluation, (3) assessment of explosive power, (4) sprint speed testing, (5) agility testing, and (6) anaerobic power evaluation using the RAST. A minimum rest period of five minutes was provided between each test to facilitate adequate recovery. All testing procedures were conducted indoors under controlled environmental conditions (temperature: 20-22°C; humidity: 50-60%) on a standardized natural grass surface to simulate soccer-specific settings. To minimize assessment bias, outcome evaluators were blinded to participants' group assignments, and participants were instructed not to disclose their training group to the assessors throughout the study duration.

Statistical Analysis.

The analysis of all data was performed with the help of IBM SPSS Statistics software. Descriptive data were expressed as mean values and respective standard deviations (mean ± SD). The assessment of the outcomes of the interventions was performed using the mixed-model analysis of variance (ANOVA) with two within-level time points (pre- and post-intervention) and three-between-level groups (SSG-HIIT, THIIT, and ACG). The Bonferonni-adjusted post hoc pairwise comparison was also used to figure out fundamental group x time interaction effects. Effect sizes for the ANOVA were determined using partial eta-squared (η^2p), with thresholds defined as small (<0.06), moderate (≥0.06–0.13), and large (≥0.14), as suggested by Saha et al. (2025). A statistical level of significance was set at $p < 0.05$.

Results

Table 4 presents the pre- and post-test statistical analysis of physical fitness outcomes across three groups: SSG-HIIT, THIIT, and the ACG. Significant improvements were observed in all variables for the experimental groups, with the SSG-HIIT group demonstrating the greatest percentage changes. In the RAST, SSG-HIIT showed an 8.58% improvement, while THIIT and ACG improved by 4.64% and 1.89%, respectively ($p = 0.000$, $\eta^2p = .52$). Explosive power increased most notably in the SSG-HIIT group (8.69%), followed by THIIT (6.37%) and minimally in ACG (0.39%), with a large effect size ($p = 0.000$, $\eta^2p = .93$). Sprint speed and agility also improved significantly in both experimental groups, with SSG-HIIT again showing the highest gains (3.97% and 4.37%, respectively), supported by significant F-values and medium to large effect sizes ($p < 0.005$, $\eta^2p = .35$ and .46). Flexibility improvements followed a similar trend, with SSG-HIIT leading at 11.30% improvement, THIIT at 6.50%, and negligible change in ACG ($p = 0.000$, $\eta^2p = .58$). Overall, both interventions enhanced physical fitness, with SSG-HIIT consistently producing superior outcomes.

Table 5. Post Hoc Statistical Profiling of Physical Fitness Transformations across Varied Training Groups

Variables	(I) Group	(J) Group	Mean Difference (I-J)	p
RAST	SSG-HIIT	HIIT	-.27	1.000
		ACG	.22	1.000
	THIIT	ACG	.50	0.940
Explosive Power	SSG-HIIT	HIIT	2.33	0.015*
		ACG	8.44	0.000*
	THIIT	ACG	6.11	0.000*
Sprint Speed	SSG-HIIT	HIIT	.02	1.000
		ACG	-.07	1.000
	THIIT	ACG	-.09	1.000
Agility	SSG-HIIT	HIIT	.12	1.000
		ACG	-.24	1.000
	THIIT	ACG	-.37	1.000
Flexibility	SSG-HIIT	HIIT	1.31	.019*
		ACG	1.35	.015*
	THIIT	ACG	.04	1.000

Table 4. Pre-Post Statistical Investigation of Physical Fitness Gains in Diverse Training Cohorts

Variables	Groups	Pre data	Post data	(%)	SS	F	p	η^2p
RAST	SSG-HIIT	36.22 ± 1.09	33.11 ± 1.16	-8.58	13.59	13.10	0.000*	.52
	THIIT	35.77 ± .66	34.11 ± 1.05	-4.64				
	ACG	34.77 ± 1.48	34.11 ± 1.26	-1.89				
Explosive Power	SSG-HIIT	171.22 ± 1.64	186.11 ± 1.83	8.69	484.14	171.43	0.000*	.93
	THIIT	170.88 ± 2.20	181.77 ± 1.71	6.37				
	ACG	169.88 ± 1.76	170.55 ± 1.66	0.39				
Sprint Speed	SSG-HIIT	8.30 ± .72	7.97 ± .59	-3.97	.21	6.70	0.005*	.35
	THIIT	8.21 ± .76	8.02 ± .75	-2.31				
	ACG	8.22 ± .56	8.20 ± .55	-0.24				
Agility	SSG-HIIT	17.35 ± 1.14	16.60 ± .77	-4.37	1.20	10.59	0.001*	.46
	THIIT	17.11 ± .89	16.59 ± .95	-3.03				
	ACG	17.24 ± 1.09	17.21 ± 1.06	-0.17				
Flexibility	SSG-HIIT	25.74 ± 1.12	28.65 ± .79	11.30	17.34	16.65	0.000*	.58
	THIIT	25.07 ± .69	26.70 ± 1.09	6.50				
	ACG	25.77 ± 1.19	25.91 ± 1.33	0.54				

Table 5 presents the post hoc analysis of physical fitness outcomes comparing the SSG-HIIT, THIIT, and ACG. Significant differences were observed primarily in explosive power and flexibility. The SSG-HIIT group showed significantly greater gains in explosive power compared to both THIIT (mean difference = 2.33, p = 0.015) and ACG (8.44, p = 0.000), while THIIT also outperformed ACG (6.11, p = 0.000). In terms of flexibility, SSG-HIIT demonstrated significantly greater improvements than both THIIT (1.31, p = 0.019) and ACG (1.35, p = 0.015). Nevertheless, there were no significant differences between the groups for RAST, sprint speed, or agility, as all p-values exceeded 0.940, indicating similar improvements or minimal differences among groups for these variables. These findings suggest that while both interventions were effective, SSG-HIIT had a more pronounced impact on explosive power and flexibility.

Discussion

The notable findings of this work are that SSG-HIIT and THIIT were crucial in enhancing different components of physical fitness in young women soccer players. Nonetheless, the SSG-HIIT protocol led to consistently greater enhancements across all assessed variables, with especially notable gains observed in explosive power and flexibility when compared to both the THIIT and ACG. The observed enhancements in anaerobic endurance, assessed through the RAST, are consistent with earlier studies supporting the efficacy of high-intensity training methods in improving anaerobic performance among youth soccer athletes (Sperlich et al., 2010). The superior gains observed in the SSG-HIIT group can be attributed to the combined physiological stress imposed by both game-specific movements and structured interval training. SSG naturally involve successive bouts of high-intensity activity interspersed with limited recovery, thereby replicating the physiological and metabolic demands encountered during actual match play (F. M. Clemente et al., 2020). This finding is consistent with recent work by Clemente & Sarmento (2020), who reported that combining different training modalities can produce synergistic effects on anaerobic capacity in youth athletes. The superior anaerobic performance observed in both intervention groups relative to the control aligns with the principle of training specificity, suggesting that repeated high-intensity exercise is necessary to elicit physiological adaptations within the phosphocreatine and glycolytic pathways (Buchheit & Laursen, 2013). The SSG-HIIT protocol likely provided additional neuromuscular recruitment patterns and metabolic stress through the varied movement demands inherent in SSG, contributing to the observed superior adaptations.

The substantial improvements in explosive power, particularly in the SSG-HIIT group, represent one of the most significant findings of this investigation. Explosive power is a critical performance determinant in soccer, directly influencing jumping, sprinting, and change of direction capabilities (Faude et al., 2012). The superior gains in the SSG-HIIT group can be explained by the multidirectional movement patterns, rapid acceleration and deceleration phases, and sport-specific power demands embedded within SSG (Dellal et al., 2008). Previous research has established that plyometric and power-based training interventions can enhance explosive power in youth soccer players (Ramírez-Campillo et al., 2016). The current findings extend this knowledge by demonstrating that integrating SSG with THIIT can produce even greater adaptations than HIIT alone. This suggests that the variable movement patterns, reactive strength demands, and sport-specific power applications within SSG provide additional neuromuscular stimuli that enhance explosive power development beyond what is achieved through linear running-based training alone.

Both experimental groups demonstrated meaningful improvements in sprint speed and agility performance, with the SSG-HIIT group showing marginally superior gains. These improvements are consistent with the established relationship between HIIT and neuromuscular adaptations that enhance speed and agility performance (Lockie et al., 2015). The absence of statistically significant differences between groups for these variables indicates that each training approach delivers a sufficient stimulus to enhance these physical attributes in adolescent female soccer players. The observed gains in agility across both intervention groups are consistent with earlier findings that highlight the efficacy of HIIT strategies in improving change-of-direction performance (Milanović et al., 2013). The SSG-HIIT protocol's incorporation of reactive and unpredictable movement patterns may have provided additional cognitive and neuromuscular challenges that contributed to the observed improvements, although the differences were not statistically significant compared to THIIT. The significant improvements in flexibility, with the SSG-HIIT group demonstrating superior gains, represent an interesting and practically important finding. Flexibility is crucial for injury prevention and optimal movement efficiency in soccer players (Witvrouw et al., 2004). The enhanced flexibility improvements in the SSG-HIIT group may be attributed to the varied movement patterns, dynamic stretching components, and multidirectional demands inherent in SSG. THIIT protocols typically involve linear movement patterns with limited range of motion demands, whereas SSG require players to execute a variety of movement patterns including cutting, turning, and reaching movements that may contribute to improved flexibility (Hill-Haas et al., 2011). This finding suggests that incorporating game-based training methods may provide additional benefits for maintaining or improving flexibility compared to traditional running-based training alone.

This study has significant implications to the youth soccer training program design. The superior adaptations observed in the SSG-HIIT group suggest that combining game-based training with traditional interval training methods can optimize training efficiency and effectiveness. This approach may be particularly beneficial for youth players as it maintains the specificity and enjoyment of soccer-related activities while still providing the physiological stimulus necessary for performance enhancement (Köklü et al., 2015). From a practical standpoint, the SSG-HIIT protocol offers several advantages over traditional training approaches. First, it provides sport-specific skill development opportunities while simultaneously improving physical fitness components. Second, it may enhance player motivation and engagement compared to repetitive running-based training protocols. Third, it allows for more efficient use of training

time by addressing multiple performance components simultaneously (Sanchez-Sanchez et al., 2017). Although this study offers meaningful contributions regarding the comparative impact of distinct training modalities, certain limitations should be considered. The duration of the intervention was relatively brief, potentially restricting the ability to capture long-term physiological adaptations that may arise from prolonged training exposure. Moreover, the participant pool consisted solely of adolescent female soccer players, which may constrain the applicability of the findings to male athletes or individuals from different age categories. To build on these findings, future studies should explore the sustained effects of integrated training protocols over extended periods, determine the most effective balance between SSG and THIIT components, and assess their effectiveness across varied age groups and competitive levels. Furthermore, examining the psychological and motivational dimensions of these training methods could yield important insights to inform the design of more holistic youth soccer development programs.

Conclusions

According to the results of the study, both SSG-HIIT and THIIT can enhance numerous physical fitness qualities in adolescent female soccer players. Notably, the SSG-HIIT intervention yielded more pronounced improvements, especially in measures of explosive power and flexibility. These results highlight the value of integrating game-based elements within structured HIIT programs. From a practical standpoint, incorporating SSG into conditioning routines may offer coaches an efficient strategy to enhance physical performance while simultaneously reinforcing sport-specific skills.

Acknowledgment

The authors would like to show their utmost gratitude to all the interested volunteers whose valuable contribution added greatly to the success of this research.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Вплив восьмитижневої інтервенції з високоінтенсивного інтервального тренування на основі ігор неповними складами та традиційної інтервенції з високоінтенсивного інтервального тренування на фізичну підготовленість юних футболісток

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Реферат. Стаття: 10 с., 5 табл., 1 рис., 35 джерел.

Мета дослідження. Дослідження мало на меті порівняти результати восьмитижневого високоінтенсивного інтервального тренування на основі ігор неповними складами (ІНС-ВІІТ) та традиційного високоінтенсивного інтервального тренування (ТВІІТ) за параметрами фізичної підготовленості у юних футболісток. Зокрема, проведено оцінку змін в анаеробній потужності, вибуховій силі, швидкості спринту, спритності та гнучкості.

Матеріали та методи. Двадцять сім футболісток віком від 14 до 17 років, які грають на змагальному рівні (>2 роки), було розподілено за методом рандомізації на три групи, що виконували наступні програми: ІНС-ВІІТ (n = 9), ТВІІТ (n = 9) та активна контрольна група (АКГ, n = 9). Тривалість інтервенції становила вісім тижнів, з трьома сесіями на тиждень для експериментальних груп. Сесії ІНС-ВІІТ включали футбольні матчі 3v3 до 5v5 з прогресивною інтенсивністю, тоді як ТВІІТ передбачало структуровані спринтерські інтервали. Оцінювання результатів перед- та постінтервенційного етапів включало анаеробний спринт-тест на основі бігу (RAST), стрибок у довжину з місця, спринт на 50 м, Іллінойський тест на спритність та тест на вимірювання загальної гнучкості тіла при згинанні тулуба вперед, сидячи на підлозі з витягнутими вперед руками.

Результати. У групах ІНС-ВІІТ і ТВІІТ спостерігалося значне поліпшення всіх показників ($p<0.05$), тоді як у АКГ зміни були незначними. Застосування методики ІНС-ВІІТ призвело до суттєвого підвищення показників у вибуховій потужності (8.69 %), гнучкості (11.3 %), анаеробній потужності (RAST: -8.58 %), швидкості спринту (-3.97 %) та спритності (-4.37%) порівняно з ТВІІТ. Post hoc аналіз підтвердив значніші покращення вибухової потужності та гнучкості в групі ІНС-ВІІТ ($p < 0.05$), однак зростання показників спринту та спритності виявилося статистично подібним між двома інтервенціями.

Висновки. Згідно з результатами дослідження, методика ІНС-ВІІТ виявилася ефективнішою за ТВІІТ у покращенні багатьох показників фізичної підготовленості, особливо вибухової потужності та гнучкості. Впровадження тренувань на основі ігор в рамках високоінтенсивних протоколів пропонує практичний та специфічний для спорту підхід до підготовки юних футболісток.

Ключові слова: ігри неповними складами, високоінтенсивне інтервальне тренування, юнацький футбол, анаеробна потужність, фізична підготовленість.

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Cite this article as: Prasad, B., Saha, S., Das, S., Erianti, Singh, R. K., Dalpie, M. A., Obhrai, S., & Mondal, P. (2025). The Effects of an Eight-Week Small-Sided Game-Based High-Intensity Interval Training Intervention and Traditional High-Intensity Interval Training Intervention on Physical Fitness in Youth Female Soccer Players. *Physical Education Theory and Methodology, 25*(5), 1100-1109. https://doi.org/10.17309/tmfv.2025.5.09

Received: 21.07.2025. Accepted: 25.08.2025. Published: 30.09.2025