



Using Small-Sided Games or Their Combination with Speed Endurance Training: Which Is More Effective for Improving Aerobic Capacity in Young Amateur League Soccer Players?

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Abstract

Objectives. This study aimed to analyze the differences in the effects of Small-Sided Games (SSG) and a combination of Small-Sided Games with Speed Endurance Training (SSG+SET) on the aerobic capacity of young amateur league soccer players, as measured by total distance coverage and VO_{2max} .

Materials and methods. A total of 36 young amateur league soccer players were selected as samples and divided into two groups using the matching-group technique. The average sample characteristics were 20.08 ± 0.97 years of age, 170.47 ± 4.77 cm in height, 62.98 ± 5.89 kg in weight, and a body mass index of 20.08 ± 0.97 kg/m². Both groups underwent 12 training sessions over four weeks, with a frequency of three sessions per week. Aerobic capacity was measured using the Yo-Yo Intermittent Recovery Test Level 1 to evaluate total distance coverage and VO_{2max} before and after the intervention.

Results. Both training methods had a positive impact on improving aerobic capacity. However, the group undergoing the SSG+SET combination showed significantly greater improvements compared to the SSG-only group ($p < 0.05$). The SSG+SET group demonstrated a larger increase in total distance coverage and higher VO_{2max} values, reflecting physiological adaptations such as improved oxygen utilization efficiency and cardiovascular function.

Conclusions. The findings indicate that the combination of Small-Sided Games and Speed Endurance Training is more effective in enhancing the aerobic capacity of young amateur league soccer players, particularly in terms of total distance coverage and VO_{2max} . This method offers a comprehensive approach to improving physical fitness while simultaneously supporting the development of technical and tactical skills through specific game simulations.

Keywords: small-sided games, speed endurance training, total distance coverage, VO_{2max} , young amateur soccer players.

Introduction

Soccer is a complex sport involving various essential physical components such as aerobic endurance, anaerobic endurance, strength, power, speed, and agility (Akyildiz et al., 2022; Komarudin et al., 2022). Among these, aerobic endurance forms the foundation, as it is critical to sustaining performance during a match that lasts 90 minutes or more (Harrison et al., 2015). Players are required to maintain

physical intensity throughout the match, including running, fast walking, and sustaining optimal performance levels (Bangsbo et al., 2006; Ouertatani et al., 2022; Scott et al., 2014). Overall physical fitness significantly impacts game performance, as players with better physical conditions are more capable of maintaining consistent performance and handling pressure from opponents in dynamic game situations (Gonçalves et al., 2016; Mujika et al., 2018).

In modern soccer, achieving an optimal combination of technical and physical abilities is crucial. Therefore, a systematic and well-planned training program, including periodization, is necessary to attain high levels of strength and endurance (Turner & Stewart, 2014; Williams et al., 2017). An ideal training program must be holistic to better

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reflect the realities of gameplay (Esposito et al., 2024; Larsen et al., 2014). The success of training depends significantly on this holistic approach, as partial or unrealistic training models may hinder players' development (Ribeiro et al., 2022).

A holistic approach to soccer training integrates physical, technical, and tactical aspects relevant to game demands (Kusuma, Kusnanik, Lumintuarso, & Phanpheng, 2024). This approach enables players to enhance physical fitness while improving skills and game understanding. In addition to creating training conditions that simulate real-match scenarios, it helps maximize players' potential, reduce injury risk, and improve adaptation to the ever-changing dynamics of the game. Thus, the holistic approach is a fundamental necessity for improving players' overall performance.

Small-sided games (SSG) have become a highly popular training model among soccer coaches. This training method has proven effective in improving player performance, both in terms of physical fitness and technical abilities. However, with the increasing intensity demands of modern soccer, SSG alone is often insufficient to prepare players optimally for high-intensity matches. Therefore, combining SSG with other training methods, such as Speed Endurance Training (SET), is needed to comprehensively meet players' physical needs.

A popular holistic training method in soccer is the combination of Speed Endurance Training (SET) and Small-Sided Games (SSG) (Kusuma, Kusnanik, Lumintuarso, Setijono, et al., 2024). This combination provides a comprehensive solution for creating training scenarios that closely resemble real-match conditions. SET improves players' physical performance, while SSG, involving small-field games with short durations, not only contributes to aerobic fitness improvement but also incorporates technical-tactical aspects and players' actual movements (Clemente & Sarmiento, 2021; Iaia & Bangsbo, 2010). Previous studies have shown that the combination of SSG and high-intensity running-based training offers significant benefits for players' aerobic capacity (Rabbani et al., 2019).

This approach is expected to address the issue of separating physical and technical training while preparing players comprehensively to face various game challenges. This study aims to demonstrate the effectiveness of combining SSG and SET in improving soccer players' performance and compare the impact of the SSG+SET combination with SSG-only training. Thus, this research seeks to provide in-depth insights into the significant benefits of this approach in enhancing players' physical and technical qualities.

This study hypothesizes that the combination of Speed Endurance Training (SET) and Small-Sided Games (SSG) has a significant effect on improving soccer players' aerobic capacity. Additionally, this holistic approach is expected to simultaneously enhance players' technical-tactical abilities, offering advantages in more realistic and competitive gameplay contexts.

Materials and methods

Study participants

This study involved 36 randomly selected participants, consisting of young soccer players competing in amateur

leagues. The average sample characteristics included an age of 20.08 ± 0.97 years, a height of 170.47 ± 4.77 cm, a weight of 62.98 ± 5.89 kg, and a body mass index of 20.08 ± 0.97 kg/m². This population was chosen to represent young players at the amateur level, ensuring the study findings provide relevant insights to support the development of their physical performance.

Study Organization

The research employed an experimental method with a randomized parallel matched-group design, dividing the sample into two distinct groups. The 36 participants were split evenly, with 18 players assigned to the SSG Group and 18 players to the SSG+SET Group. Group allocation was conducted using a matched-group approach, beginning with an initial test using the Yo-Yo Intermittent Recovery Level 1 Test (YYIR1) for all participants. Test results were used to rank participants by score, from highest to lowest. Participants were paired sequentially, such as the top scorer with the second-highest scorer, and so on until all participants were paired. Each pair was then randomly assigned to one of the intervention groups.

Statistical Analysis

Mean (average) and standard deviation (SD) were used to describe the data. Normality and differences in means were analyzed using the Shapiro-Wilk test, while aerobic capacity (total distance, VO₂ max level) differences between the SSG and SSG+SET groups were examined using the Mann-Whitney U test. A p-value of < 0.05 was considered statistically significant.

Training Program

SSG+SET Training Program combines Small-Sided Games (SSG) and Sprint Endurance Training (SET) to improve players' physical fitness and skills. The field was divided into three areas: Area 1 (SSG 1) and Area 3 (SSG 2) were used for SSG sessions, each measuring 20×40 meters, while Area 2 served as a 20-meter sprint zone connecting Area 1 and Area 3. Three groups of six players each were formed: one group trained, while the other two engaged in active recovery by passing the ball on the sidelines. The training began with Group 1 performing a combination of SSG and sprints as follows: playing SSG for 18 seconds in Area 1, sprinting 20 meters to Area 2, playing SSG for 18 seconds in Area 3, and sprinting back to Area 2. This pattern was repeated 4 times per repetition, covering a total of 80 meters in sprints and 72 seconds of SSG play. In one session, Group 1 completed 8 repetitions, sprinting a total of 640 meters and playing SSG for 576 seconds. The work-to-rest ratio was 1:2, with 88 seconds of activity followed by 176 seconds of rest per repetition. The net training duration per session was 35 minutes and 12 seconds (264 seconds per repetition × 8 repetitions). After one repetition, the groups rotated to ensure all players had the opportunity to train and enough time for active recovery (Bharlaman et al., 2024).

The Small-Sided Games (SSG) training used a 6v6 + 6 neutral player format in a 20×20 meter area with a 2:1 ratio of work to rest (2 minutes work, 1-minute rest) over 10 repetitions. The session started with Team A vs. Team

B, while Team C acted as neutral players. After 1 minute, Team A rotated out to become neutral players, while Team B remained on the field to compete against Team C. This rotation continued, with each team alternating roles as active players and neutral players throughout the 10 repetitions. Each repetition included a 2-minute work phase followed by a 1-minute rest phase. Total activity time per repetition was 3 minutes, resulting in 30 minutes of training time for all 10 repetitions, including work and rest periods. This format provided players with role variations, maintained game intensity, and improved tactical skills and physical fitness.

Results

Based on Table 1 above, there was an increase in total distance and VO₂max in both the SSG and SSG+SET groups. The SSG group demonstrated moderate improvements in both variables, while the SSG+SET group recorded greater increases. For the total distance variable, the SSG+SET group achieved higher post-test results compared to the SSG group. Similarly, for VO₂max, the SSG+SET group showed a more significant improvement after the intervention compared to the SSG group.

Table 1. Descriptive Data for Total Distance and VO₂max

Variable	SSG	SSG+SET
Pretest Total Distance (m)	1377.78 ± 387.14	1371.11 ± 323.45
Posttest Total Distance (m)	1611.11 ± 405.79	1748.89 ± 368.35
Pretest VO ₂ max (ml/kg/min)	47.98 ± 3.26	47.92 ± 2.71
Posttest VO ₂ max (ml/kg/min)	49.94 ± 3.43	51.09 ± 3.11

Values are expressed as Mean ± SD

Table 2 presents the results of the normality test for the variables analyzed. Based on the normality test results, the pretest and post-test data in all groups, both for total distance and VO₂max, indicate that the data distribution does not meet the assumption of normality. This is evidenced

Table 2. Normality test result

Variable	Statistic	df	Sig.
Pretest-Posttest Distance Group SSG	.8676	18	.0163
Pretest-Posttest Distance Group SSG+SET	.8780	18	.0242
Pretest-Posttest VO ₂ max Group SSG	.8756	18	.0220
Pretest-Posttest VO ₂ max Group SSG+SET	.8949	18	.0468

by significance values smaller than the tolerance threshold of 0.05. Consequently, the non-parametric Mann-Whitney test was employed to ensure the validity of the research findings and evaluate the differences between the groups.

Figure 1 presents the results of the Mann-Whitney test, indicating a significant difference between the SSG and SSG+SET groups for both total distance and VO₂max variables, as evidenced by a significance value of <0.05.

Discussion

This study aimed to analyze the impact of combining Speed Endurance Training (SET) and Small-Sided Games (SSG) on the aerobic capacity of young amateur league soccer players. The pretest results indicated variability in players' aerobic fitness levels before the intervention. After undergoing 12 combined training sessions over one month, the post-test results revealed consistent improvements in the players' aerobic capacity. The combination of speed endurance training and small-sided games conducted over four weeks with a frequency of three sessions per week significantly enhanced the players' physical fitness (Clemente et al., 2021).

Both SSG and the combined SSG+SET training positively impacted the improvement of total distance covered during the running test and the players' VO₂max. However, statistical tests showed that the group undergoing the SSG+SET combination training demonstrated more significant improvements compared to the group that only performed SSG. This indicates that the addition of speed endurance training to small-sided game sessions provides more optimal aerobic stimulation, leading to greater enhancements in the

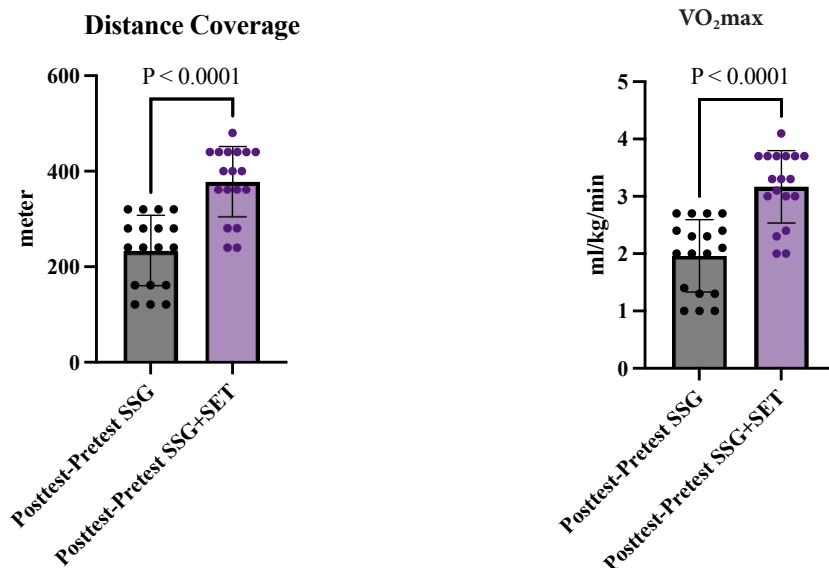


Fig. 1. Comparison of Pretest and Posttest Results for Total Distance and VO₂max Variables

players' aerobic capacity. This combination is considered effective in improving the physical performance of young amateur soccer players.

The average improvements suggest that the combined training enhances the players' physiological adaptations (Bharlaman et al., 2024). Adaptations such as increased maximal oxygen capacity (VO_{2max}), improved oxygen utilization efficiency, and enhanced lung capacity and cardiovascular function occur when players engage in high-intensity training (Atakan et al., 2021; Dunham & Harms, 2012). Additionally, the Speed Endurance Training program by Nyberg et al. (2016) reported similar findings, highlighting VO_{2max} improvements as a primary indicator of aerobic capacity. High-intensity repeated training improves the body's capacity for respiratory management, reduces fatigue, and accelerates recovery. Continuous aerobic training also boosts lung capacity and cardiovascular efficiency, enabling players to sustain optimal performance for longer periods (Modric et al., 2020).

The approach used in this study emphasizes the sustainability of physical adaptations, where repeated high-intensity training progressively improves endurance, creating long-term effects that support enhanced athletic performance. Moreover, Small-Sided Games (SSG) not only contribute to the development of technical and tactical skills but also significantly impact physical fitness (Karahan, 2020). These games require players to move quickly to find space within a limited area (Guard et al., 2022; Low et al., 2020). Previous research has shown that SSG increases players' work intensity, accelerates reactions, and challenges them to manage space and time more efficiently (Rago et al., 2018). The emphasis on rapid transitions between attack and defense in SSG helps players develop mental resilience and quick thinking under pressure, which is critical in soccer matches. Research by Arslanoglu et al. (2024) also demonstrated that combined training involving aerobic speed, small-sided games, and maximal aerobic speed effectively enhances aerobic capacity and overall performance in soccer players.

This study shows that the combination of Speed Endurance Training and Small-Sided Games significantly improves the aerobic capacity of young amateur soccer players, as evidenced by Yo-Yo Intermittent Test level 1 results, which demonstrated average improvements in aerobic capacity after 12 training sessions over one month. The intervention produced physiological adaptations, including increased VO_{2max} , improved oxygen utilization efficiency, enhanced lung capacity, and better cardiovascular function. Additionally, this approach strengthened players' technical and tactical skills, with SSG serving as a medium to refine tactical abilities in dynamic game-like conditions. These findings align with previous studies highlighting the effectiveness of speed endurance training and small-sided games in improving aerobic fitness and physical performance. Beyond physical benefits, Small-Sided Games also enhance technical and tactical skills through simulated real-game conditions, making it a holistic and efficient training method for optimizing soccer players' performance.

Conclusions

The combination of Speed Endurance Training and Small-Sided Games has proven to be effective in enhancing the aerobic capacity of young amateur league soccer players

through significant physiological adaptations and dynamic simulations of real-game conditions.

Conflict of Interest

No potential conflict of interest was reported by the author(s).

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Використання ігор неповними складами або їх поєднання із тренуванням швидкісної витривалості: Яка методика ефективніша для покращення аеробної продуктивності юних футболістів аматорської ліги?

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 2 табл., 1 рис., 30 джерел.

Мета дослідження. Мета цього дослідження полягала в аналізі відмінностей щодо впливу використання ігор неповними складами (ІНС) та їх комбінації із тренуванням швидкісної витривалості (ІНС+ТШВ) на рівень аеробної продуктивності юних футболістів аматорської ліги, визначений за показниками загального подолання дистанції та максимального споживання кисню (VO_{2max}).

Матеріали та методи. Загалом було відібрано 36 юних футболістів аматорської ліги, розподілених на дві групи із застосуванням методики групового зіставлення. Середній вік учасників вибірки становив $20,08 \pm 0,97$ років, зріст — $170,47 \pm 4,77$ см, вага — $62,98 \pm 5,89$ кг, індекс маси тіла — $20,08 \pm 0,97$ кг/м². Обидві групи провели 12 тренувань протягом чотирьох тижнів, з частотою три заняття на тиждень. Аеробну продуктивність вимірювали за допомогою тесту переривчастого відновлення Йо-Йо рівня 1 (the Yo-Yo Intermittent Recovery Test Level 1) з метою оцінки загального подолання дистанції та показника VO_{2max} перед початком та після завершення інтервенції.

Результати. Обидві методики тренувань позитивно вплинули на поліпшення рівня аеробної продуктивності. Однак група, яка проходила комбінацію ІНС+ТШВ, показала суттєвіші покращення порівняно з групою, в якій застосовувалась методика лише ІНС ($p < 0,05$). Група ІНС+ТШВ продемонструвала збільшення загального подолання дистанції та вищі значення VO_{2max} , що відображає фізіологічні адаптації, як-от поліпшення ефективності споживання кисню та функціонування серцево-судинної системи.

Висновки. Отримані дані свідчать про те, що поєднання ігор неповними складами та тренування швидкісної витривалості є ефективнішим методом щодо покращення рівня аеробної продуктивності юних футболістів аматорської ліги, зокрема, з точки зору загального подолання дистанції та показника VO_{2max} . Зазначений метод пропонує комплексний підхід до поліпшення рівня фізичної підготовленості, сприяючи при цьому розвитку технічних і тактичних навичок за допомогою специфічних ігрових симуляцій.

Ключові слова: ігри неповними складами, тренування швидкісної витривалості, загальне подолання дистанції, VO_{2max} , юні футболісти-аматори.

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