



Does Short-Term Speed Endurance Soccer Training Improve Physical Performance?

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Abstract

Objectives. This study is aimed at analyzing the impact of short-term Speed Endurance Soccer Training (SEST) training on the physical performance of young soccer players.

Materials and methods. The true experiment method was used in this study. The study population comprised a total of 122 individuals. Furthermore, by using random sampling techniques, a sample of 30 persons was selected with an average age of 15.2 ± 0.81 years, height 168.1 ± 4.82 cm, weight 57.85 ± 11.93 kg, and BMI 20.34 ± 3.37 . Physical performance instruments included the Running Based Anaerobic Sprint Test (RAST), Yo-Yo intermittent test level 1, 20-meter sprint, and standing broad jump test. The study used the paired t-test to evaluate the effect of each group and the independent samples t-test to compare the improvement in the experimental (SEST) and control groups. Statistical significance was set at $p < 0.05$.

Results. The paired t-test showed significant differences between the pretest and post-test in the SEST group in anaerobic ($p = 0.000$, $\Delta\% = 8.4$), aerobic ($p = 0.000$, $\Delta\% = 7.48$), and speed ($p = 0.000$, $\Delta\% = 3.39$) capacities. Meanwhile, there were no considerable differences in the variables for the control group. According to the independent t-test results, a significant difference in effect between the SEST group and the CTRL group was revealed. The SEST group demonstrated marked differences in anaerobic, aerobic and speed variables with a p-value = 0.000.

Conclusions. The study reveals that short-term Speed Endurance Soccer Training contributes to enhancing the physical performance of soccer players. However, caution should be exercised regarding the potential risk of hamstring injury in individuals with unprepared muscles.

Keywords: soccer, speed endurance soccer training, physical performance.

Introduction

Soccer has high physical demands (Mendez-Villanueva et al., 2013; Rebelo et al., 2014). Attacking, transitioning and defending are three important soccer moments requiring high physical quality. Excellent physical quality is required to make a positive transition from defending to attacking well, and vice versa with negative transitions.

Often, training models that are partial or not holistic can become an obstacle in the player development process. Physical training is often carried out separately with technical and tactical components, such as plyometric training by Kusuma et al. (2023), Maciejczyk et al. (2021), Padrón-Cabo et al. (2021), High-Intensity Interval Training (HIIT) by Arslan et al. (2021); D'Isanto et al. (2022), Speed Endurance Training (SET) by Iaia et al. (2015), Ikhsan et al. (2023), Mohr & Krstrup (2016) and others. Even though the results of this research have a positive impact on the physical performance of soccer players, if we look at the implementation of the training, it is still separated between

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physical and other components, resulting in a lack of contact with the ball on the players, so it is possible to have an impact on the players' performance on the field. Apart from that, according to Izquierdo et al. (2023), coaches must develop training programs that suit the needs of the competition.

A holistic training model is needed so that the physical training carried out meets the competition's needs. In line with several studies that have been conducted, which found the theory that the integration of non-specific training together with soccer routines will maintain the level of technical and physical skills, according to Clemente et al. (2022), as well as player enjoyment Formenti et al. (2021), Ridwan et al. (2022).

One solution that can be adopted to overcome the problems faced in developing physical, technical, tactical and mental components is to apply the Speed Endurance Soccer Training (SEST) model. This exercise adopts the Long Interval Speed Endurance Training Maintenance (SET-M) theory with an intensity of 50-80%, 15-90 seconds duration, ratio 1:1-1:3, and repetitions 6-12 (Hostrup & Bangsbo, 2023). This approach combines elements of high-intensity speed training with tactical elements in matches, in line with the research of M. Oliva-Lozano et al. (2023), who found that repeated sprinting abilities are very much needed in soccer. The training intensity used in this exercise is classified as high intensity using anaerobic and aerobic energy systems. These drills are designed to improve a player's physical fitness, technical skills, tactical understanding and mental toughness.

This research was conducted to analyze the SEST training model on the physical abilities of football players. SEST adopts a SET and tactical approach in the game of soccer. Apart from that, this research aims to develop a holistic training method. Conducting SEST research is essential because it can provide scientific evidence about this exercise's effectiveness in improving soccer players' performance and physical fitness. This is very important because it can help soccer coaches design effective and efficient training programs and improve the overall health and performance of soccer players.

Materials and Methods

Study Participants

A total of 122 male soccer players were the population in this study, and 30 players were taken as samples. Samples were taken using a random sampling technique. Sample

characteristics: age 15.2 ± 0.81 years, height 168.1 ± 4.82 cm, weight 57.63 ± 11.93 kg, and BMI 20.26 ± 3.37 . Of the 30 samples, 15 were in the control group (CTRL), and 15 were in the treatment group (SEST).

Study Organization

The method used in this research is an experimental method with a two-group pretest and posttest design, where the sample is divided into a control group and an experimental group. Sample selection used random sampling techniques. This research uses Polar Verity Sense to monitor heart rate to keep it at a high intensity. Physical performance test instruments use the RAST Test, Yoyo Intermittent Recovery Test level 1, RAST Test, and Srint 20 meter test. This research was approved by the Health Research Ethics Committee Nahdlatul Ulama University of Surabaya (registration number 0276/EC/KEPK/UNUSA/2023 - Date of approval: July 12, 2023).

Procedure and Training Program

Both groups were given a pretest to determine their initial physical performance. Next, the treatment group was given SEST training for four weeks with a frequency of three times a week, while the control group was given training as usual with the same duration and frequency as the treatment group. Before the treatment, the 15 sample people were divided into three groups, consisting of 3 attacking players and two defensive players. The SEST implementation procedure consists of several steps. First, group one played 3v2 in the penalty box area. During training, both teams ran back and forth for four repetitions, both on attack and defence, in one set. Each team player is given five balls to score each time a team attacks or defends. After the first group completes five balls or one set, proceed to the second group. Each group's total number of repetitions was six, with three sets attacking from the right side and three from the left side of the field. To maintain a high training intensity, a training ratio of 1:3 is used, which means one work section followed by three rest sections.

The training program implemented in this research is in Table 1. In one set, the estimated distance covered by each player is around 120 meters, with an average travel time of around 88 seconds, followed by a rest of 234 seconds before the next set begins. It is estimated that the total distance travelled by players in one training session is 720 meters.

Table 1. Training Program

Set	Speed Endurance		Tactical Component		Attack Side	Intensity
	Distance (m)	Time (s)	Action	Time (s)		
1 Set	20	3	Early Cross	10	Right/Left	80-90 % HrMax
	20	3	Penetration Cross	10	Right/Left	
	20	3	Early Cross	10	Right/Left	
	20	3	Penetration Cross	10	Right/Left	
	20	3	Early Cross	10	Right/Left	
	20	3	Penetration Cross	10	Right/Left	
Estimated distance 120 meters						< 70 % HrMax
Intervals 1:3, with 78 seconds of work and 234 seconds of rest						

Statistical Analysis

Data are presented in the form of mean and standard deviation. The normality test uses the Shapiro-Wilk test, and the homogeneity test uses the Levene test. The percentage change ($\Delta\%$) between the results before and after the training period. The paired t-test was used to see the effect of each group, and the independent sample t-test was used to compare the improvement in the experimental and control groups. Statistical significance was set at $p < 0.05$. Effect sizes (ES) were calculated using Cohen's ES to measure the magnitude of differences between groups. ES above 0.8 is large, 0.8-0.5 is medium, 0.5-0.2 is small, and less than 0.2 is insignificant (Cohen, 2013).

Results

Average data for the two groups which took part in Soccer Endurance Speed Training (SEST) and the control group (CTRL) are shown in Table 2. Participants' age, height, weight, and Body Mass Index (BMI) were measured for both groups.

Table 2. Characteristic of group

Group	Age (year)	Height (cm)	Body Mass (kg)	BMI
SEST	15.27 $\pm$ 0.8	168.07 $\pm$ 5.61	57.53 $\pm$ 12.15	20.21 $\pm$ 3.30
CTRL	15.13 $\pm$ 0.83	168.13 $\pm$ 4.09	57.73 $\pm$ 12.12	20.30 $\pm$ 3.57

Data are presented as mean $\pm$ SD

The Shapiro-Wilk normality test showed that all variables in the SEST and CTRL groups had a normal distribution with a significance value of Sig>0.05. The same thing was also found in the homogeneity test using the Levene test, showing a significance result of > 0.05.

Table 3. Results of pretest and posttest physical performance

Variable	Group	Pre	Post	$\Delta\%$	P	ES
Anaerobic Power (watt)	SEST	386.63 $\pm$ 106.50	411.22 $\pm$ 113.09	6.36	0.000*	1.79
	CTRL	389.41 $\pm$ 105.87	388.53 $\pm$ 106.78	-0.22	0.469	0.19
Aerobic (ml/kg/min)	SEST	41.33 $\pm$ 3.01	44.42 $\pm$ 3.44	7.48	0.000*	2.61
	CTRL	41.30 $\pm$ 2.90	41.40 $\pm$ 2.71	0.22	0.464	0.19
Speed (second)	SEST	4.03 $\pm$ 0.25	3.89 $\pm$ 0.19	3.39	0.000*	1.27
	CTRL	4.04 $\pm$ 0.26	4.03 $\pm$ 0.27	0.05	0.866	0.04

Data are presented as mean $\pm$ SD; Δ (%): percentage of change between pre and post-training performance; p: level of significance; ES: effect size; * Significant difference, $p < 0.05$.

Table 4. Comparison of physical performance variables in both groups

Variable	SEST	CTRL	$\Delta\%$	P	ES
Anaerobic Power (watt)	24.59 $\pm$ 13.69	-0.87 $\pm$ 4.55	-103.56	0.000*	2.5
Aerobic (ml/kg/min)	3.09 $\pm$ 1.18	0.09 $\pm$ 0.47	97.07	0.000*	3.33
Speed (second)	0.14 $\pm$ 0.011	0.00 $\pm$ 0.05	98.62	0.000*	1.7

Data are presented as mean $\pm$ SD; Δ (%): percentage of change between group SEST and CTRL group; p: level of significance; ES: effect size; * Significant difference, $p < 0.05$.

The results of the pretest and posttest physical performance tests are in Table 3. The variables observed include anaerobic power (watts), aerobic power (ml/kg/min), and speed (seconds). Data were divided into two groups: the group that underwent SpeedEndurance Soccer Training (SEST) and the control group (CTRL). Pretest and posttest results and percentage changes ($\Delta\%$) are presented for each variable in both groups. In addition, significance (P) and effect size (ES) values were also reported for each variable in the two groups.

The difference in effect was significant between the SEST group and the CTRL group. Anaerobic, aerobic, and speed variables in the SEST group showed significant differences with p-value = 0.000. More complete data is shown in Table 4.

Discussion

The research results show that SEST has a significant influence on improving the physical performance of soccer players. SEST is a combination of speed endurance training and soccer tactics training. These findings are in line with previous research conducted by Sports Arslan et al. (2020), which compared running-based high-intensity interval training vs. small-sided game training programs with the results of small-sided game training become more effective training to improve technical abilities and dexterity with a greater level of enjoyment, while running-based high-intensity interval training is more suitable for speed-based conditions in soccer players young.

Previous research found that high-intensity interval training can improve soccer players' aerobic and anaerobic abilities (Arazi et al., 2017; Fang et al., 2021). In practice, high-intensity interval training induces more excellent glycolytic activity in a short time, resulting in the production of lactic acid, and this activity beneficially contributes to producing higher levels of ATP (Stöggl & Björklund, 2017). In line with the principles of the lactic anaerobic energy system,

SEST work applies a 1:3 interval with a high-intensity work time of 50 seconds and rest for 150 seconds. Other research has proven that 1:5 and 1:1 intervals significantly increase endurance tested using a yoyo intermittent recovery test level 1 (Diker et al., 2023).

The implementation of SEST covers a sprint distance of 160 meters multiplied by 6 sets, where this model has the Long Sprint Training category. In previous research, Rey et al. (2024) reported that Short Sprint Training (SST) and Long Sprint Training (LST) were effective in improving performance measures specific to soccer. However, LST had a better percentage of improvement, with analysis showing significant improvement in 5 m, 10 m, 20 m, 30 m and 40 m sprint. This strengthens the SEST findings, which are included in the ESG category.

Apart from that, SEST requires the work of the hamstrings and quadriceps to perform and stabilize sprint movements, pass the ball, and control the ball towards the goal. This is in line with a systematic review study conducted by Baroni et al. (2020), which concluded that the quadriceps play an essential role in jumping and kicking a ball, while the hamstrings are known to control running activities and stabilize the knee joint when turning or making a tackle. This aligns with research by Fransson et al. (2018), which found that high-intensity interval training with speed resistance increased muscle oxidative capacity and sports performance as well as muscle ion transporters and muscle antioxidant capacity in soccer players.

Previous research conducted by Nayiroğlu et al. (2022) comparing the effects of running-based small-sided games (SSG) and high-intensity interval training (HIIT) on body composition and physical fitness in youth women's soccer found HIIT SSG and HIIT were equally effective for improving vertical and horizontal jumping ability, change of direction, and aerobic capacity status, these findings are in line with this research, but this research has a slightly different model, namely combining a high-intensity training model with football tactics. In contrast, the previous research was carried out separately. Apart from that, this research has a positive effect on anaerobic capacity. Previous research combined tactical and physical training with almost the same characteristics (Arslan et al., 2021). Previous research shows that the combination of SSG and HIIT is efficacious in improving young soccer players' physical and technical performance. These findings align with this research, but what differentiates this research is how the training is carried out, whereas previous research was carried out alternately. On the other hand, this research was carried out jointly or holistically.

An interesting limitation of SEST is that hamstring injury is possible in some samples. This is possible because the hamstring muscles are not ready before SEST treatment. This is in line with research by Moreno-Perez et al. (2023), which indicates that short periods of unusually long running can increase the risk of hamstring injury in soccer players. With these findings, it can be concluded that SEST training is unsuitable for players with weak hamstrings or players who are not used to doing repetitive sprints.

Conclusions

Overall, the research results show that SEST, a combination of speed endurance and soccer tactics training,

significantly influences players' physical performance. However, remember that this exercise can potentially cause hamstring injuries in some individuals, especially if the hamstring muscles are not ready. Therefore, when implementing SEST, players' physical condition and habits must be considered to minimize the risk of injury.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Чи покращують короткотривалі тренування з футболу на розвиток швидкісної витривалості фізичну продуктивність?

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Реферат. Стаття: 6 с., 4 табл., 27 джерел.

Мета дослідження. Це дослідження спрямоване на аналіз впливу короткотривалих футбольних тренувань з розвитку швидкісної витривалості (SEST — Speed Endurance Soccer Training) на фізичну продуктивність юних футболістів.

Матеріали та методи. У дослідженні застосовано метод істинного експерименту. Загальна кількість досліджуваних становила 122 особи. Крім того, методом рандомізації була відібрана вибірка в кількості 30 осіб із середнім віком $15,2 \pm 0,81$ року, зростом $168,1 \pm 4,82$ см, вагою $57,85 \pm 11,93$ кг та ІМТ $20,34 \pm 3,37$. Засоби оцінки фізичної продуктивності включали анаеробний тест на основі спринтерського бігу (RAST тест), Yo-Yo тест на витривалість 1-го рівня з перервами на відновлення між тренуванням, спринтерський біг на 20 метрів та тест зі стрибків у довжину з місця. У дослідженні застосовано парний t-критерій для оцінки впливу кожної групи та t-критерій для незалежних вибірок з метою порівняння покращення показників в експериментальній (SEST) та контрольній групах. Статистична значущість була встановлена на рівні $p < 0,05$.

Результати. За результатами дослідження із застосуванням парного t-критерію встановлено наявність значних відмінностей між показниками до і після проведення тесту в групі досліджуваних SEST в анаеробній ($p = 0,000$, $\Delta\% = 8,4$), аеробній ($p = 0,000$, $\Delta\% = 7,48$) і швидкісній ($p = 0,000$, $\Delta\% = 3,39$) здатностях. Натомість у контрольній групі не спостерігалось суттєвих відмінностей у досліджуваних змінних. Згідно з результатами t-критерію для незалежних вибірок, було виявлено суттєву різницю у показниках ефективності між групою SEST та контрольною групою. Група SEST продемонструвала істотні відмінності в анаеробних, аеробних і швидкісних параметрах з р-значенням = 0,000.

Висновки. Дослідження показує, що короткотривалі тренування з футболу для розвитку швидкісної витривалості сприяють покращенню показників фізичної продуктивності футболістів. Однак слід бути обережними через потенційний ризик травмування підколінного сухожилля у осіб з недостатньо розвиненими м'язами.

Ключові слова: футбол, тренування з футболу на розвиток швидкісної витривалості, фізична продуктивність.

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