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Effect of skill-based training vs. small-sided games on physical performance improvement in young soccer players

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ABSTRACT: Recently, there has been increasing attention to research related to the effect of skill-based or game-based training on soccer players' physical performance. Therefore, this study aimed to compare the effectiveness of skill-based training (SBT) at maximum intensity versus the small-sided game (SSG) on the physical performance characteristics of young soccer players during the pre-season period. Twenty-two male soccer players (mean age 15.3 ± 3 years) were randomly assigned to either an SBT or SSG fully controlled intervention programme, running parallel for eight weeks and held twice a week. On three non-consecutive days before and after training players completed a test battery consisting of the 20 m sprint, T-run, countermovement jump, running anaerobic sprint test (RAST) and 20 m shuttle run. Data were analysed with a two-way ANOVA test for repeated measures. SBT and SSG interventions induced a significant improvement in the anaerobic power (10.9% vs 6.2%), explosive power (8.5% vs 5.6%), VO2max (6.7% vs 6.5%) and vertical jump (5.3% vs 2.9%), respectively. When the improvements in the physical performance variables of both groups are compared, the SBT group achieved greater improvement than the SSG group in anaerobic power (by 4.7%), in explosive power (by 2.8%), in vertical jumping (by 2.3%), in the 20 m sprint (by 2.2%) and T-test scores (by 1.7%). However, improvements in the VO2max were similar in both groups. The results of the present study suggest that SBT at maximum intensity may be more effective than SSG in improving the physical performance characteristics of young soccer players in the pre-competitive season.

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INTRODUCTION

Soccer is described as a team sport characterized by periods of a high-intensity activity such as sprinting, kicking and jumping, interspersed with low-intensity activity such as jogging and walking and active or passive recovery [1]. High-intensity, intermittent team sports require athletes to have well-developed physical performance characteristics, such as change of direction ability, speed, aerobic and anaerobic power [2]. Many training models have been used for the improvement of physical performance in soccer [3, 4]. Moreover, the fact that these training models are compatible with the technical or technical-tactical skills of sport may contribute significantly to the efficiency of the training. Well-designed, small-sided conditioning games or skill-based, high-intensity training models have recently been favoured by most soccer coaches, as they simultaneously affect technical skills, tactical awareness and conditioning development [2, 5, 6].

Studies have shown that SSGs with fewer players and a small pitch size require a higher heart rate and blood lactate level than in games with more players [7]. Halouani et al. [8] examined the effect of different small-sided games (2 vs. 2, 3 vs. 3 and 4 vs. 4) on heart rate and blood lactate levels and found that the heart rate of young soccer players varied between 171 and 178 bpm. Higher heart rates and blood lactate levels are considered internal indicators of high-intensity exercise. They also report that as the number of players decreased, the intensity of the game increased with a constant small-sided pitch dimension. With high-intensity, small-sided games, athletes could have the advantage of simultaneously improving their aerobic and anaerobic skills [9]. Previous studies have shown that small-sided games have a significant impact on the development of peak power, countermovement jump height and aerobic fitness of young male soccer players [10, 11]. Thus, small-sided games offer an effective strategy of multicomponent training in order to induce positive effects on specific skill developments of team sport-related physical fitness [9].

Skill-based exercises are considered to be the most effective training model that allows young, non-specialised players to develop technical skills and more skilled athletes to refine and maximise their skills. High-intensity, intermittent training is considered an effective alternative model to traditional endurance training that can produce similar or even superior effects on a range of skeletal muscle and metabolic adaptations [12]. If skill-based training is carried out at high or maximal intensity, it can provide athletes with significant opportunities for the simultaneous development of technical skills and physical fitness [13]. Thus, skill-based training models at high or maximum intensity, just like SSGs, have recently been the research subject of many studies. It was found that skill-based training at maximum intensity induced a significant improvement in 20 m speed, agility, the aerobic and anaerobic power of female futsal [14], basketball, volleyball and handball players [15]. In another study, Gabbett et al. [16] examined changes before and after training, and they reported that skill-based training had a significant effect on the improvement of speed and agility in young volleyball players.

With a developmental approach to the subject, skill or game-based training practices can have a significant effect on the simultaneous development of technical skills and physical performance characteristics when sufficient intensity is reached [5]. Moreover, skill- or game-based training prescriptions provide an important opportunity for refining and maximising fundamental technical skills, especially for young players who have not yet specialised in their sport-specific skills [11]. Recently, there has been increasing attention to research concerning the effect of skill-based or game-based training on soccer players' physical performance. To date, although the effects of small-sided conditioning games [9–11, 13] and skill-based training with maximum intensity [14–17] on physical performance characteristics have been emphasised, no study evaluating which form of training may be more effective has been found. Such research may be important in terms of providing practical information to athletes, coaches and researchers on which training method will be more useful for the development of physical performance characteristics during pre-competition training periods.

The purpose of this study was to determine which training regime (skill-based or small-sided games) was more effective in improving which physical performance components, such as 20 m speed, vertical jump height, change of direction, explosive power, VO_2max and anaerobic power, comparing the effects of both training models. It was hypothesized that changes in physical capacity after the training intervention would occur in both groups. Moreover, the main hypothesis of the study is that the skill-based training programmes would be more effective in improving the physical performance characteristics than small-sided games, due to the players not having enough movement time or covered distance opportunities to improve their physical performance characteristics during SSG training.

MATERIALS AND METHODS

Participants

Twenty-four volunteer young soccer players who were members of the same team and playing in the super amateur division participated in this study. Players were randomly assigned to skill-based (SBT, n = 12) and small-sided game SSG, n = 12) groups, where the demographic characteristics (age, experience, height and body mass) of the groups are shown in Table 1. Before obtaining written informed consent, all athletes and their parents and coaches were informed about the research procedures, benefits, requirements and risks. All procedures of this study were approved by the Aksaray University Human Research Ethics Committee (2016/53).

Procedure

This study was designed to determine the comparative effects of SBT or SSG on the physical performance characteristics of young soccer players. A parallel randomized, controlled longitudinal study was conducted employing two groups, SBT or SSG, for 8 weeks. SSG was randomly classified into four teams, each consisting of 3 players. Before the pre-test protocols, after interviewing coaches about whether players had previous experience with the proposed test procedures the players were familiarized with the testing procedures as they were not available for prescription training purposes several occasions in the previous seasons. Physical performance tests, in accordance with the measurement principles, were conducted within five days before and after the eight-week training programme at the same time of day (15:00–17:00) in an indoor gym with a synthetic floor. The players performed a test battery consisting of a 20-meter sprint, T-test and countermovement vertical jump (on Monday), 20-m shuttle runs (on Wednesday) and RAST (on Friday). The players were allowed to rest on Tuesday and Thursday. The players were included in the 10-minute general warm-up and 5-minute cool-down exercises before and after the test applications, respectively. Four certified soccer coaches and a conditioning specialist supervised (researcher) all training sessions to ensure that SBT or SSG was performed with maximum effort, as well as a warm-up and cool-down exercises. All players were verbally instructed and motivated by the coaches during tests to obtain higher efficiency from workloads.

TABLE 1. Demographic characteristics of groups.

	Age (year) means ± SD	Experience (year) means ± SD	Height (cm) means ± SD	Body Mass (kg) means ± SD
SBT (n = 12)	15.3 ± 0.3	3.41 ± 0.4	169.1 ± 2.1	61.0 ± 1.9
SSG (n = 12)	15.4 ± 0.6	3.37 ± 0.6	169.0 ± 1.6	60.4 ± 2.0

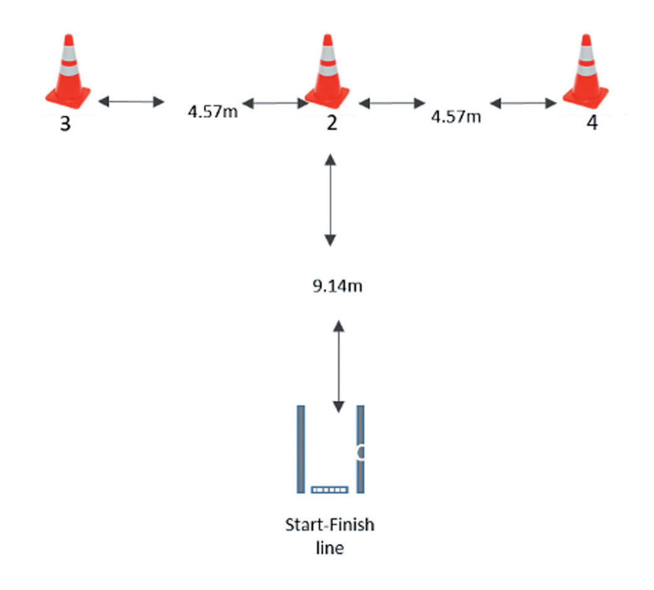

FIG. 1. *Agility T-test:* The player moves from the starting line to once 2, then shuffles to the left cone 3, then shuffles to the right cone 4, then shuffles to cone 2 again, and backwards running from cone 2 to the starting point.

Physical performance tests

Estimated VO_{2max} test: The aerobic power was determined by a 20-meter shuttle run test which was used to predict VO_2max designed by Leger et al. [18]. In the test, the players were asked to run in a 20-meter straight line to complete a shuttle following the audio signals. The test was terminated for that player when he voluntarily stopped or could not concurrently fail to reach the 20-meter end lines which were synchronized twice with the audio signals. The intra-class correlation coefficient for test-retest reliability of measurement for the shuttle run test was 0.86.

Change of direction ability test: The T-run test was used to determine players' CoD ability. The test (Figure 1) consists of the player's speed with directional changes such as forward sprinting, left and right shuffling, and backward to start line. The test was repeated twice with a 2-min active recovery interval and the best of the two performances was recorded using an electronic timing system placed at the starting line. The intra-class correlation coefficient for test-retest reliability of measurement for the T-run test was 0.95.

20-m sprint test: The sprinting speed of the players was measured via a photocell device placed at the start and finish lines at a distance of 20-m. The players ran the 20-m sprint with a maximum effort, starting in a standing position. This test was repeated three times with a 90 s recovery and the best running time was recorded. The intra-class correlation coefficient for test-retest reliability of measurement for the 20-m sprint test was 0.88.

Anaerobic power: The running anaerobic sprint test (RAST) was administered to describe anaerobic capacities. Two electronic timing systems were placed 35 m apart on an indoor synthetic surface to determine running scores. Players completed 6 x 35 m sprint running with 10 s active recovery periods allowed between each sprint for the turnaround. Each player's running scores were calculated to determine anaerobic capacities in watts using the formula defined by Zagatto et al. [19]. The intra-class correlation coefficient for test-retest reliability of measurement for the RAST test was 0.90.

Vertical jump height and explosive power: Lower limb explosive power was evaluated using a vertical countermovement jump (VCMJ). The VCMJ movement consisted of the athlete sinking into the concentric phase below and then bouncing as high as possible and landing with two feet on the ground. The height of the jump (cm) was collected with a *vertimetric* instrument placed on the athlete's ankle. During the jump, participants were asked to keep their hands on their hips to isolate the lower extremity muscular system and to eliminate the effect on the upper limb hip joint. Athletes performed three trials with a 30-second recovery between trials and the result was recorded as the average of the two best trial jump heights. Lower limb explosive power was calculated in watts by a formulation that including the athlete's height, body mass and jump height, previously determined by Johnson and Bahamonde [20]. The intra-class correlation coefficient for test-retest reliability of measurement for the explosive power test was 0.89.

Training programmes

The training programmes were designed to take place 10 weeks before the competition season for 8 weeks, four days per week and 60 min a day. All training sessions were conducted on a natural grass field and at the same time of day (15:00–16:00). Both groups underwent the supervision of their coaches, 10 minutes of general warm-up and 10 minutes of specific soccer warm-up such as low-intensity passing, ball control, and dribbling exercises, and 10 minutes of cool-down exercises before (at the end of the first week following the start of the training period before the competition season) and after each training programme. During the training programme, players were controlled to perform their activities with maximum effort and were instructed verbally by coaches to provide high motivation. Each of the SBT and SSG sessions were conducted twice a week (Tuesday and Thursday) under the supervision of two certified soccer coaches. In this study, players were matched as 3 v 3 for SSG, as the highest heart rate (91%) was reported in this game format compared to other SSG game formats such as 2 v 2, 4 v 4 and 6 v 6 [21]. In line with the coaches' consultations, the teams played alternately with each other, but during all SSGs, the players of the team remained stable to prevent the variability of the team tactical behaviour and the players' motivations that could occur with the players changing. SSG played 4 x 6 min small-sided soccer in the 20 x 25 m pitch dimension, with a 2 min passive recovery [8]. Dur-

TABLE 2. The skill-based training programme

Workload Stations	Workload (s) and Repetition no	Rest between Repetitions (s)	Set Number	Rest between Sets (min)	Total Duration of Station (min)
1	20 x 3	30	2	3	**10**
2	20 x 3	30	2	3	**10**
3	20 x 3	30	2	3	**10**

ing small-sided games, when the ball moved away from the playing area, the substitute balls which are on the side of the playing area were introduced to the game immediately by the coaches to minimize game downtimes, which will reduce the intensity of the games. At this time, the skill-based group was included in skill-based training with maximum intensity according to the programme depicted in Table 2. On Monday and Wednesday, both groups participated in their usual technical and tactical soccer drills training programme. The preparation of skill-based training stations was carried out by two certified soccer coaches. The coaches paid particular attention to ensure that the drills prepared at the stations would not adversely affect the workout intensity of the players.

Station 1: Shuttle sprint run and shooting the ball to the goal exercises. This exercise involves running continuously between two lines that are 15 m apart and then shooting the ball with a dominant or non-dominant foot at the goals after each sprint. The balls were located at one-meter intervals on lines 15m apart from each other at a distance 10 m from goals each of 2 x 2 m in size.

Station 2: An arc of 18 m in diameter was drawn, at a distance of eight meters from the goal line. The five balls were placed on this arc-line three meters apart. Six cones of 45-cm height were placed two meters away from this arc-line and in a 60-degree angle to each ball. The start point was marked two meters away from the first ball and on the right of the pitch. The players shot the balls with their right and left feet by making turns around the cones. After directly turning back from the last cone, the same actions were continuously repeated for 20 seconds [14].

TABLE 3. SBT and SSG responses on young soccer players' physical performance characteristics.

	SBT (n = 12) means ± SD		***ES***		**SSG (n = 12) means ± SD**		***ES***			
	Pre-test	**Post-test**		**Magnitude**	**Pre-test**	**Post-test**		**Magnitude**	**F**	**η2**
20-m Sprint (s)	3.81 ± 0.2	3.67 ± 0.3*	*0.7*	Medium	3.81 ± 0.3	3.74 ± 0.3	*0.23*	Small	37,535ǂ	0.63
Vertical Jump Height (cm)	37.5 ± 1.2	39.5 ± 1.2*	*1.5*	Large	39.5 ± 1.7ǂ	40.7 ± 1.3*	*0.79*	Medium	9,483ǂ	0.30
Change of Direction (s)	11.1 ± 0.4	10.69 ± 0.4*	*1.02*	Medium	10.9 ± 0.4	10.74 ± 0.4	*0.32*	Small	15,070ǂ	0.40
Explosive Power (watt)	1257.2 ± 50	1362.9 ± 53*	*2.05*	Very large	1275.6 ± 68	1346.4 ± 62*	*1.08*	Medium	15,494ǂ	0.41
VO_{2max} (ml/kg/min)	41.4 ± 1.3	44.1 ± 1.2*	*2.15*	Very large	41.5 ± 1.6	44.7 ± 2.5*	*1.52*	Large	122	0.06
Mean Anaerobic Power (watt)	384.8 ± 21	427.1 ± 26*	*1.78*	Large	409.9 ± 38	434.8 ± 35*	*0.68*	Medium	42,165ǂ	0.65

* A significant ($p < 0.05$) when compared within group pre-posttest.
ǂ A significant ($p < 0.05$) intergroup difference (time x group effect).

Station 3: The player performs a 5-second headshot to the hanging ball, which is fixed 5 cm below the maximum jump height of each player, by jumping vertically with both feet. Immediately after that, he runs a 5 m sprint and kicks the ball which is 10-meter from the goal and returns to his starting position. The movements are repeated for 20 seconds..

Statistical analyses

Descriptive statistics and statistical differences of data were calculated using the SPSS 23 package and results were presented as means ± standard deviations (SD). The normality of data was assessed using the Shapiro-Wilk test. Homogeneity of variance between the two groups was examined with Levene's test. After confirming the normality of distributions, the significance of the percentage of pre- and post-test differences between the groups was determined by the independent t-test. The intra-class correlation coefficient (ICC) was used to determine the consistency of the measures (test-retest reliability). Based on the 95% CI of the ICC estimate, values less than 0.5, between 0.5 and 0.75, between 0.75 and 0.9, and greater than 0.90 were determined as indicative of poor, moderate, good, and excellent agreements, respectively. A two-way analysis of variance (ANOVA) with repeated measures (2 group x 2time) was used to evaluate the main (partial eta squared = η^2) and interactive effects of training. The independent variables included 1 "within-subjects factor" with two levels (time: pre- and post-test changes) and 1 "between-subject factor" with two levels (group: SBT vs. SSG). Bonferroni post hoc tests were used if interactions were detected. The practical significance level of training programmes on the improvement of physical performance parameters was also evaluated by calculating Cohen's *d* effect size. The effect size (ES) was considered as trivial (< 0.2), small (0.2–0.59), medium (0.60.1.19), large (1.2–1.99) and very large (≥ 2.0) changes [22]. The level of significance for all data was considered as $p < 0.05$.

RESULTS

All the players of both groups involved in this final study completed 16 training sessions of skill-based or small-sided games and 16 training sessions of technical-tactical soccer drills. Physical performance characteristics of the SBT and SSG groups before and after the training programme are depicted in Table 3.

The homogeneity of the variances and the normality of the data have been confirmed. The intra-class correlation coefficients ranged between 0.88 and 0.95, which were acceptable values for physical performance characteristic tests. When baseline values of randomly assigned groups were compared, vertical jump height in the SSG group was higher than in the SBT group ($p < .05$), but there was no significant difference between the groups for speed, agility, explosive power, VO_2max and mean anaerobic power (Table 3).

Both training interventions induced a significant improvement in the vertical jump height (SBT: P = 0.01, ES = 1.5 [large effect] and SSG: P = 0.048, ES = 0.79 [medium effect]), explosive power (SBT: P < 0.001, ES = 2.05 [very large effect] and SSG: P < 0.001, ES = 1.08 [medium effect]), VO_2max (SBT P < 0.001, ES = 2.15 [very large effect] and SSG: P < 0.001, ES = 1.52, [large effect]), and mean anaerobic power (SBT: P < 0.001, ES = 1.78, [large effect] and SSG: P = 0.046; ES = 0.68, [medium effect]). In addition, substantial improvement was observed in 20-m sprint (P < 0.001, ES = 0.7 [medium effect]), and CoD ability (P = 0.016, ES = 1.02, [medium effect]), in the SBT group, but not in the SSG group (Table 3).

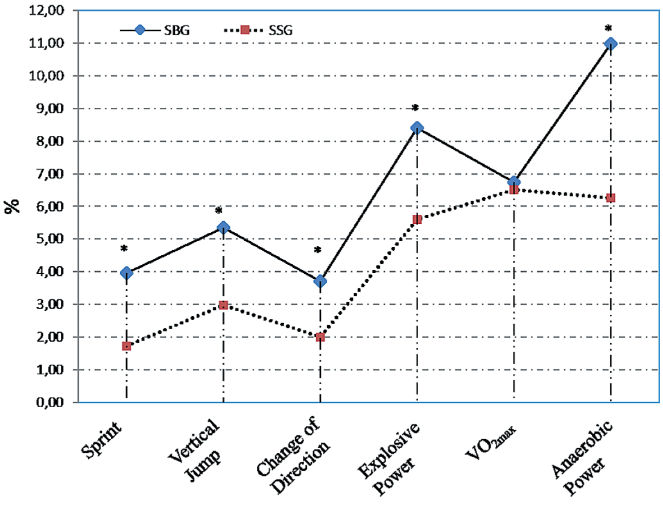

FIG. 2. Percentage values of pre and post-test differences of groups.
* A Significant difference (p < 0.05) between SBG and SSG.

Interactions (time x group) and main effects were identified concerning 20-m sprint time ($p < 0.001$, $\eta^2 = 0.63$), vertical jump height ($p = 0.005$, $\eta^2 = 0.30$), CoD ability ($p = 0.002$, $\eta^2 = 0.40$), explosive power ($p = 0.002$, $\eta^2 = 0.41$) and mean anaerobic power ($p < 0.001$, $\eta^2 = 0.65$). No significant between-group difference was observed in VO_2max (Table 3).

A comparison of the effects of both SBT and SSG on young soccer players' physical performance characteristics is presented in Figure 2.

SBT and SSG programmes induced an improvement in all tested values. Post hoc comparisons revealed significant differences between SBT and SSG groups after the intervention programme for 20 m sprint (3.99 vs. 1.72%, p<.05), vertical jump height (5.35 vs. 2.99%, p<.05), CoD (3.7 vs. 2%, p<.05), explosive power (8.4 vs. 5.6%, p<.05) and anaerobic power (10.98 vs. 6.26%, p<.05), respectively. However, no significant difference was detected between the VO_2max (6.7 vs. 6.5%) of the groups (Figure 2).

DISCUSSION

The present study was designed to compare the responses of physical performance characteristics, such as 20 m speed, vertical jump height, CoD ability, explosive power, VO_2max and anaerobic power, within and between skill-based training with maximum intensity and small-sided games in young male soccer players during the pre-season period. The study showed that eight-week skill-based training with maximum intensity significantly improved all tested physical performance characteristics ($p < 0.05$), while small-sided games were only effective in the development of vertical jump height, VO_2max and mean anaerobic power ($p < 0.05$). When both groups were compared, improvements in SBT were found to be more significant than SSG in all tested physical performance profiles except VO_2max ($p < 0.05$).

The SBT and SSG groups' aerobic performances improved substantially by 6.74% and 6.51%, respectively, and there was no significant difference between the two groups. These findings are in line with Dellal et al.'s results [5], which showed that aerobic performance improved by 5.1% and 6.6% over the six-week high intensity intermittent and soccer small-sided games training. Similarly, Arslan et al. [23] reported that there was no significant difference between high-intensity interval training and SSG concerning the improvement of VO_2max values of young soccer players. The present study indicated that both skill-based training with maximum intensity and small-sided games equally affected VO_2max improvement and/or its corresponding soccer performance. Although aerobic capacity development has generally been associated with continuous or interval training, it has been emphasised that short-duration intermittent exercises with high or maximal intensity significantly improve the VO_2max of soccer players [24]. In this study, the players' heart rates during SSGs were not monitored for information about the intensity of training; however, previous studies show that the workload intensities were about 85–91% of the maximum heart rate for SSGs in different formats [8 ,21, 24] and 93–95% for one-minute soccer ball dribbling with maximum intensity [25]. A possible explanation is that both the training models and their intensities are convenient, providing for an increase in aerobic enzymes and performance or VO_2max improvement based on it [26].

Significant improvements were observed in CoD ability (3.7%) and 20 m sprint performances (3.9%) in SBT. This could be explained by the high number of directional changes with maximal intensity movements and covered sprinting distances performed by SBT players at regular intervals that are part of the training protocol [6]. However, sprint (1.7%) and change of direction (2%) improvements in SSG were not statistically significant. One hypothesis made when designing this study was that players would not have enough time or covered distance opportunities during the SSGs to improve their maximal sprint and change of direction characteristics compared to SBT. This was supported by Davies et al.'s [27] study, where during 3 x 45 second SSG (3 vs. 3), players performed 11 change of direction manoeuvres and 0.8% sprint activities of total running distance. Moreover, the results of the present study are consistent with the findings of two previous studies, which reported that the eight-week game profile [6] and multidirectional sprint training [28, 29] were more effective than SSG in improving change of direction and 20 m sprint performances. However, Dellal et al. [5] reported that SSG and high-intensity interval training led to a similar improvement in the repeat directional changes abilities of amateur soccer players. Conversely, Radziminski et al. [11] pointed out that both four-week SSG and high intensity running (4 x 4 min) intervention programmes do not have a significant impact on the improvement of young soccer players' sprint performances. Although the movement pattern which characterises SSGs includes both a higher number directional changes with acceleration and deceleration and a higher number of sprint activities due to the adopted game format, several internal and external factors (e.g. pitch size, team tactical behaviours and players' motivation) may affect the players and limit their maximal change of direction and sprint activities [30].

Explosive power, a product of the combination of force and speed, is an essential component of musculoskeletal fitness and one of the main indicators of anaerobic performance in short-term activities, such as jumping and sprinting [31]. In this study, explosive power was calculated by formulating the athletes' body mass, height and vertical jump height; thus, possible changes in the explosive power could be associated with changes in the athletes' body mass and height. Although the baseline vertical jump height of the SSG group was significantly higher than SBT, no significant difference was found between post-test values. Also, significant improvements were observed in the explosive power and vertical jumping performances of both groups after the intervention period. From a conditioning perspective, these improvements could be explained by the cumulative effects of repeated short-term and high-intensity actions that frequently stimulate the athlete's lower limb muscles during SBT and SSGs [31]. The SBT group showed greater improvements in vertical jump height (5.9% vs. 2.9%, mean difference = 2.3%, $p < 0.05$) and explosive power (8.4% vs 5.6%, mean difference = 2.8%, $p < 0.05$) compared to the SSG group, respectively. These results were confirmed by Rodriguez-Fernandez et al. [32] and Paul et al. [33], who reported that five-week pre-season and four-week SSG-based conditioning training was not sufficient to improve amateur soccer players' vertical jump heights. These significant developmental differences for the vertical jump height and explosive power between the groups may be explained by the fact that the SBT group had more chances to perform jumping and short-term actions during its sessions than the SSG group did [34].

Anaerobic power is expressed as the rate of utilization of skeletal muscle energy stores (ATP-PC), which is considered to be an indication of the athlete's ability to use anaerobic metabolism efficiently during maximal intensity exercises lasting 5–6 seconds [35]. Thus, skeletal muscle phosphagen stores are depleted in short-term and maximum intensity exercises and re-synthesised by 70% within an active recovery period of 30 seconds. Carrying out training in accordance with this protocol is an important factor in increasing the available level of phosphagen enzyme activity [36]. The intervention programmes have a significant effect on the mean anaerobic power of both groups, with an improvement of 10.9% and 6.2% for the SBT and SSG groups, respectively. Studies show that repeated-sprint activities significantly increase the anaerobic enzyme activity of skeletal muscles and their associated anaerobic power [37]. During SSGs and SBT, players often have to perform high or maximal intensity movement repetitions. Therefore, both training models may have significantly affected the development of anaerobic power. Similar results were reported by Aquino et al. [38], where the pre-season six-week SSG training made a significant contribution to the improvement of the mean anaerobic power of young soccer players. Karahan [14] also explained that the effect of skill-based training at maximum intensity affects the development of female futsal players' anaerobic power by 10.7%. The study demonstrated that SBT were more effective than SSGs in improving anaerobic power, with a 4.7% difference between the groups. This difference may be explained by the fact that SBT sessions were regularly performed with work-rest intervals, during the training sessions. The SBT group also could have more chances than the SSG group to perform the movement patterns with the maximal intensity that affects the improvement of anaerobic power.

CONCLUSIONS

This study revealed that an eight-week intervention period, including skill-based training at the maximum intensity or small-sided games, could improve the physical performance of young soccer players during the preparation period for a season. Both kinds of training were found to be effective in substantially improving anaerobic power, explosive power, VO_2max, and the vertical jump heights of young soccer players. However, while the improvements in 20 m sprint time and CoD ability were significant in the SBT group, this was not the case in SSG. A notable improvement was observed in both groups in terms of anaerobic power, explosive power, VO_2max, and the vertical jump heights of young soccer players at the end of the intervention period. Although SBT and SSG were similarly effective in enhancing VO_2max (6.7 vs. 6.5%, respectively), SBT resulted in significant improvement in anaerobic power by 4.7%, in explosive power by 2.8%, in vertical jump height and 20 m sprint time by 2.3%, and CoD ability by 1.7% compared to SSG. Therefore, the results of this study reveal that SBT may be more appropriate than SSG in terms of improving the pre-season physical performance of young male soccer players. This study could offer significant practical information to coaches and researchers on which training methods would be more useful for the improvement of the physical performance of young soccer players during pre-competition training periods.

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Conflict Interest

The author declares no potential conflict of interest regarding the publication of this manuscript.

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