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THE EFFECTS OF SMALL-SIDED GAMES ON FITNESS COMPONENTS AND TECHNICAL ABILITIES AMONG YOUTH SOCCER PLAYERS

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Abstract Small-sided games (SSG) is one of the increasingly popular training methods in developing fitness components and technical abilities among soccer players. The objective of this study is to investigate the effectiveness of SSG training on player's fitness components and technical abilities after six weeks of training program among youth soccer players. Sixty youth soccer players (M = 19.98 years of age; SD = 0.97) were recruited in this study and were divided into SSG intervention group (IG, N = 30) and control group (CG, N = 30). Agility, speed, cardiovascular endurance, passing and dribbling tests were conducted pre- and post- six weeks of training. Results showed that there was a statistically significant difference in speed, passing, dribbling and VO2max in the post-test among the IG group. When compared to the CG, the IG showed better performance in speed, dribbling and VO2max as these had shown a significant difference between the two groups. In conclusion, SSG training method can improve speed, passing, dribbling and VO2max. Therefore, this study recommends SSG training to be applied on youth soccer players.

Key words: small-sided games (SSG), fitness components, technical abilities, youth soccer players

Introduction

Small-sided games (SSG) is one of the training methods that mimic a competition which can improve multiple components simultaneously. It has been well described that the maximum benefits of training are achieved when the training stimuli are similar to competitive demands (Bompa, 1983) as it produces greater physiological demands compared to the normal training session (Joo et al., 2016). SSG training is expected to be more efficient for

the development of a particular set of physical characteristics that are required during matches as they involve variety of actual movement patterns that are frequently used in soccer games (Köklü et al., 2012) and at the same time, the players can experience the benefits from similar situations that they will encounter during competitive matches (Owen et al., 2004). Previous research also indicated that in order to optimize the players' match-play performance, training sessions should induce similar physiological and technical demands that are encountered during competitions (Dellal et al., 2011a; Dellal et al., 2011b). As for competitions at youth level, the format needs to be adapted in accordance to the characteristics of those that are involved in the sport and consequently the rules are modified to suit the physical development of youngsters (Tessitore et al., 2012) for the purpose of participation. Other than that, the development of technical and perceptual-cognitive skills will be beneficial after exposing them to playing form activity which also offers a way of simultaneously preparing the athletes for the current physiological demands of competitions (Hoffmann et al., 2014) which can be achieved through SSG training.

Previously, a review by Morgans et al. (2014) stated that the application of SSG creates the opportunity for coaching team to maximize their contact time with the players, increase the efficiency of training and reduce the total training time because of their multifunctional nature in developing multiple components. Additionally, other studies (Dellal et al., 2008; Owen et al., 2011) emphasized that SSG training approach is particularly beneficial for players, especially elite players, who have limited training time as a result of intense fixture periods due to participation in multiple competitions. In addition, since elite players often have busy schedules, it directly makes the coaches struggle to integrate with different training parameters and have a limited amount of time to work with their athletes (Özcan et al. 2018). Over the course of approximately 45 weeks per season, professional European soccer teams may play in excess than 60 competitive matches and thus at specific times of the year, certain players may play multiple matches within a single week (Carling et al., 2012). Currently, in Malaysian u-21 competition, each team has to play approximately 20–22 matches where the duration of the competition might go up to 5 months a year with 3–9 days resting period between matches (Football Association of Malaysia, 2020).

SSG refers to the modification of training structure such as smaller pitch, reducing number of players and rules modification from the actual official games (Halouani et al., 2014) that sort the objective of training compared to the traditional games (Hammami et al., 2017). A review from previous studies stated that the application of SSG training can improve agility, speed, VO2max, passing and dribbling (Bujalance-Moreno et al., 2018) since the demands in soccer require high-intensity movements such as agility and speed (Little & Williams, 2005) which cover between 8-12% from the total distance covered (Schmidt & Wrisberg, 2008), cover the distance between 9-14 km (Dellal et al., 2011b), involve approximately 80% of passing between teammates (LA84 Foundation, 2007) and able to dribble the ball to pass over the opponent (Laparth, 2009). There are a lot of studies that had been done to investigate the effectiveness of SSG training methodology. A study by Karahan (2020) investigated the effect between SSG and skill-based training on physical performance among youth soccer players while Özcan, Eniseler and Şahan (2018) compared between SSG with the conventional aerobic interval training on various physiological characteristics and defensive and offensive skills among amateur soccer players. Other than that, there were several studies that investigated the difference in SSG form such as Halouani et al. (2017) which investigated the physiological response on different SSG form (stop ball vs small goal rules on player's physical fitness), examined the effect of different SSG pitch size on player's technical aspects and physical demands (Joo et al., 2016), investigated the influence of the number of goal-posts and the positioning of goal-posts used within SSG on technical actions and offensive scenarios among u-12 soccer players (Pulling et al., 2016) and also compared between different SSG format (SSG

with keeper vs SSG without keeper) towards physiological responses and time-motion characteristics (Köklü, et al., 2012). In fact, there was also a comparison between different exercise orders (SSG + HIIT vs HIIT + SSG) towards fitness components among soccer players (Rabbani et al., 2019). Even though there was a study that investigated the effect of SSG on technical and physical performances among elite u-14 soccer players, to our knowledge, there is still lack of studies that investigate the effectiveness of SSG on the fitness components and technical skill simultaneously among youth soccer players. Therefore, this study intends to investigate the effectiveness of small-sided games training on player's fitness components and technical skills after six weeks of training program among youth soccer players.

Materials and Methods

A total number of sixty youth soccer players who played in the national level tournaments in Malaysia were recruited as participants in this study. The SSG training had been designed in order to investigate the effectiveness of training program on fitness components and technical skills of the intervention group (IG, N = 30) while the control group (CG, N = 30) continued their normal training routine that had been designed by their coach. Both groups were advised to maintain their normal daily routines, having proper nutritional intake and adequate rest (such as having enough sleeping time) during the study (intervention) period. This was to ensure that all the players were in a decent state in terms of health and fitness aspect before commencing the program. The data were reported as means and standard deviations. After the rejection of the multivariate normality assumption and the homogeneity of covariance matrices (using Box's M test), repeated measure of multivariate analysis of variance (repeated measure MANOVA) had been performed in order to analyze the difference within the group as well as comparing between the two groups simultaneously. Any significant differences in the data were then analyzed by using Bonferroni post-hoc analysis. The level of statistical significance was set at $p \leq 0.05$.

Table 1 shows the SSG training that were performed in 6 weeks. In Week 1, all the players had to undergo a pre-test (2 skills tests and 3 fitness tests). The players had familiarized all the tests and SSG training design once before the testing day. The tests were categorized into fitness test and skill test (Day 1 – fitness test and Day 2 – skill test for 2 consecutive days). Before each session, the players performed the usual 15–20 minutes of warm-up in order to get ready for the specific task. IG performed two different types of SSG format that were 5 vs 5 and 3 vs 3 formats as these had been purposely chosen in order to avoid bias in dividing the numbers of players during the treatment since the number of participants was only 30 players. To avoid potential imbalances and to ensure equality between small groups, players were classified according to the subjective appraisal from the coaches. In addition, in order to ensure the effectiveness of playing time, 8 – 10 balls were prepared around the edge of the pitch with an additional of 2 – 3 assistants. For Week 2, players began with 5 vs 5 format in the first session followed by 3 vs 3 format. The game rule was similar for both formats with unlimited touches-ball possession, unlimited touches-stopping a ball (Week 3) and unlimited touches-mini goal (Week 4). Then, the rules were changed to 2–3 touches-ball possession (Week 5), 2–3 touches-stopping a ball (Week 6), 2–3 touches-mini goal (Week 7) and followed by a post-test in the following week. The pitch size remained constant with 25 m x 20 m while each session was done in 3 sets x 5 mins with 1:1 work-rest ratio.

Table 1. SSG Treatment

Week	No. of players	Session 1	No. of players	Session 2	Remarks
1			Pre-test		
2	5 vs 5	Unlimited touches Ball possession	3 vs 3	Unlimited touches Ball possession	3 sets x 5 mins Work-rest ratio (1:1) 25 m x 20 m (pitch size)
3	5 vs 5	Unlimited touches Stopping a ball	3 vs 3	Unlimited touches Stopping a ball	
4	5 vs 5	Unlimited touches Mini goal	3 vs 3	Unlimited touches Mini goal	
5	5 vs 5	2-3 touches Ball possession	3 vs 3	2-3 touches Ball possession	
6	5 vs 5	2-3 touches Stopping a ball	3 vs 3	2 touches Stopping a ball	
7	5 vs 5	2-3 touches Mini goal	3 vs 3	2-3 touches Mini goal	
8			Post-test		

Agility (Agility T-test)

Players were required to face forward and not to cross their legs when shuffling between cones. Then, the players began the test with both feet behind the starting point A (refer to Figure 1). On the "GO" command, the players sprinted to point B and touched the cones before shuffling to the left and touching the cone at point C. After that, the players shuffled to the right and touched the cone at point D. Then, the players shuffled back to the cone at point B before backpedaled to point A as finishing line.

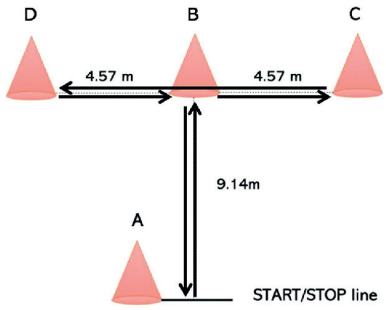

Figure 1. Schematic representation of the Agility T-test

Speed (30-m Sprint Test)

The player started from a stationary position, with one foot behind the starting line. At this starting position, the player was held for 2 seconds prior to start while no rocking movements were allowed. The tester provided hints for maximizing speed (such as keeping low, driving hard with the arms and legs) and encouraged the player to continue running hard through the finish line. On the "GO" command, the player had to sprint as fast as he could. 3 trials were allowed with a 60-second active recovery between each one.

Cardiovascular Endurance (YYIRTL1)

The player repeated a 2 x 20 m run, back and forth between lines at an increasing speed controlled by an audio bleep from a tape recorder. Between each running bout, the player had a 10-second active rest period consisting of 2 x 5 m of jogging back and forth. The distance covered, including the last incomplete shuttle, was recorded and represented the test result when the player failed to reach the line for 2 consecutive times or stopped voluntarily. The result then was converted to estimate their VO2max level by using a formula from Bangsbo et al. (2008):

$$VO2max\ (mL/min/kg) = [distance\ (m) \times 0.0084] + 36.4$$

Passing (LSPT)

The player started at the central cone (refer to Figure 2). The time started when the ball was played out from the inner rectangle. Any related color was called out randomly just before the player completed the current pass. The same examiner was used in each role so as to eliminate inter-experimenter variability. The sequence of passes was determined by 1 of 8 trial orders that were randomly generated by the investigators so that each trial consisted of 8 long (green, 1 and blue, 2) and 8 short (yellow, 3 and red, 4) passes. Passes were only executed from within the passing area. The player had been told that upon retrieval from the previous pass, the ball had to cross two of the inner marked lines before the next pass could be attempted. The players performed the test as fast as possible while making less mistakes and time was recorded when the last pass had been completed. Penalty time was awarded for the following:

- 5 seconds for missing the bench completely or wrong target.
- 3 seconds for missing the target area (0.6 × 0.3 m).
- 3 seconds for handling the ball.
- 2 seconds for passing the ball from outside of the designated area.
- 2 seconds for the ball touching any cone.
- 1 second for every second taken over the allocated 43 seconds to complete the test.
- 1 second (bonus) was deducted from the total time if the ball hit the 10-cm strip in the middle of the target.

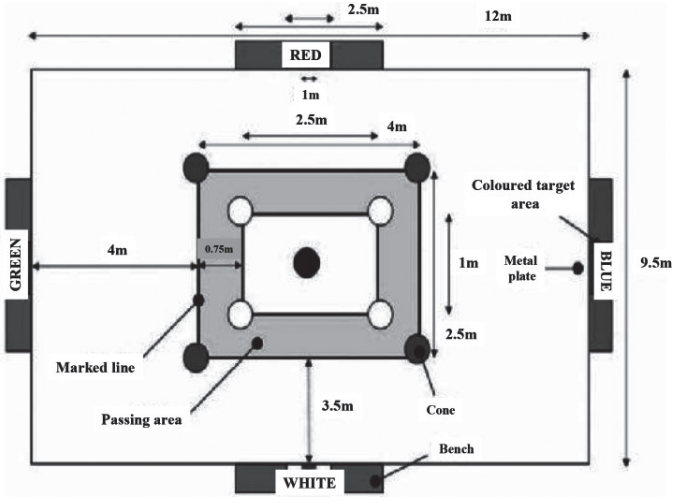

Figure 2. Schematic representation of the LSPT

Dribbling (Slalom Dribble Test)

On command, the players dribbled the ball from the starting line to the right of the first cone. Alternately, the players dribbled around the outside of the remaining 5 cones in a zigzag pathway. The players then stopped and left the ball at the 6th cone before running as fast as they could in a straight line across the finishing line. Two trials were allowed with the average of both times being used as the test score. Figure 3 shows the schematic representation for Slalom Dribble Test.

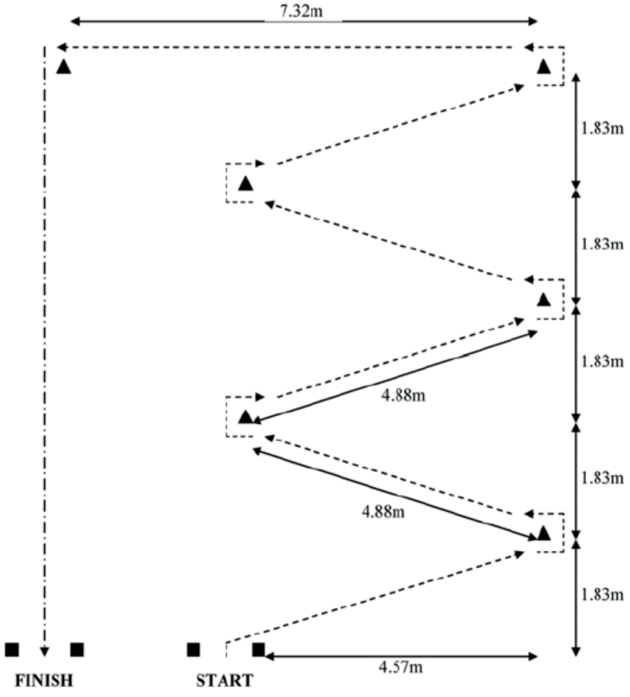

Figure 3. Schematic representation of the Slalom Dribble Test

Results

Table 2. Demographic data for youth soccer players

Group		Age (years old)	Height (m)	Weight (kg)
IG (n = 30)	Mean	19.8	1.71	62.4
	Std. Dev	0.85	0.06	5.8
CG (n = 30)	Mean	20.15	1.71	61.2
	Std. Dev	1.13	0.04	6.3

For inferential statistical analysis, a repeated measure of multivariate analysis of variance (RM MANOVA) had been conducted and the result indicated that there was statistically a significant difference in pre- and post- after 6 weeks of SSG training among IG soccer players $F (5, 50) = 28.075$, $p < 0.001$; Wilk's Lambda = 0.263, partial eta

squared = 0.737. Since the main effect showed a significant difference value, this study then had done a further analysis of these significant MANOVA with Bonferroni post-hoc tests, as shown in Table 3. For IG soccer players, this study had found no significant difference in agility between pre- and post- after 6 weeks of SSG training (p = 0.149, >0.05). Meanwhile in contrast, there was a significant difference in speed (p = 0.000, <0.05), VO2max (p = 0.000, <0.05), passing (p = 0.000, <0.05) and dribbling (p = 0.008, <0.05). For CG soccer players, there was a significant difference in agility between pre- and post- (p = 0.035, <0.05). Meanwhile in contrast, there was no significant difference in speed (p = 0.542, >0.05). In addition, there was a significant difference in both VO2max (p = 0.000, <0.05) and passing (p = 0.000, <0.05) while no significant difference was found in dribbling (p = 0.087, >0.05).

Table 3. Post-hoc analysis with Bonferroni Pairwise Comparisons (within subjects)

Variables	Group	(I) Pre-test	(J) Post-test	Mean Dif.(I-J)	Std.Error	Sig.
Agility	IG	9.95 sec	9.87 sec	0.078	0.053	0.149
	CG	10.00 sec	10.11 sec	–0.115*	0.053	0.035
Speed	IG	4.09 sec	3.96 sec	0.129	0.027	0.000
	CG	4.19 sec	4.21 sec	–0.017	0.027	0.542
VO_2max	IG	48.2 mL/kg/min	51.63 mL/kg/min	–3.432*	0.362	0.000
	CG	43.79 mL/kg/min	45.54 mL/kg/min	–1.743*	0.362	0.000
Passing	IG	44.11 sec	39.37 sec	4.749*	1.119	0.000
	CG	47.01 sec	42.42 sec	4.59*	1.119	0.000
Dribbling	IG	16.03 sec	15.49 sec	0.535*	0.193	0.008
	CG	16.77 sec	16.43 sec	0.337	0.193	0.087

Further pairwise comparison analysis indicated that there was statistically a significant difference between IG and CG soccer players F (5, 50) = 23.737, p < 0.001; Wilk's Lambda = 0.296, partial eta squared = 0.704. Since the value showed a significant effect between the groups, this study had done a further analysis of these significant MANOVA with Bonferroni post-hoc tests, as shown in Table 5 where there was no significant difference between the groups (IG vs CG) in agility performance (p = 0.109, >0.05). There was a significant difference between the groups in speed performance (p = 0.006, <0.05) and VO2max (p = 0.000, <0.05) where IG soccer players had performed better in both variables while there was no significant difference found in passing (p = 0.098, >0.05). Lastly, there was a significant difference between the groups in dribbling (p = 0.019, <0.05) as the result indicated that IG soccer players had performed better time.

Discussion

The finding of this study was found to be similar with a previous study by Karahan (2020) who also found no significant improvement in agility after the application of SSG training among young soccer players. The contributing factor might be due to the size of the player's density (area per player) which was big during 3 vs 3 game format. As being highlighted in a study done by Davies et al. (2013) when comparing between a different player's densities, it was stated that a greater agility demand is placed on players involved in the denser playing field. The possible explanation might be due to the bigger space which enables players to move freely in a straight line rather than changing the direction which lead to no significant improvement across time. In comparison with CG, this study found no significant difference in their agility performance. A possible factor could be due to the adaptation on the

variation of training stimulus. In this study, even though CG did not use SSG training, they still had to continue with their normal training routine by their coaches as the other training method might assist the players to develop their soccer-related components as players may adapt with any kind of training stimulus for them. This was agreed by Arslan et al. (2020) who had compared between two training interventions (SSG vs HIIT) and found a similar result between these two interventions that directly showed that young elite soccer players might benefit from any method of training. This finding indicates that the physiological load on body is similar between the two groups, and it should be remarkable that SSG probably provides a similar physiological training stimuli with daily training routines in CG soccer players.

For speed variables, this study found a significant improvement over time where the speed time decreased after SSG implementation. The factor that may contribute to the decrement of speed time performance is due to the method of scoring – stopping a ball inside the scoring zone. The possible explanation is due to the action of this rule where the players might be expected to accelerate into the scoring zone as to stop the ball inside the area before being intercepted or cleared by the opponent. Therefore, those actions might happen multiple times during the session and indirectly can enhance their sprinting ability. This previously had been claimed by Halouani et al. (2019) that a number of accelerations is higher during the format of stopping the ball inside the scoring zones. Next, this study had compared the speed skills between the groups and showed that there was a significant difference. In this, IG was able to present better high-speed performance due to the proper training schedule as compared to CG. This can be seen through the implementation of SSG training such as stopping the ball inside the scoring zones rules where this has an impact on the decrement in the sprinting time after 6 weeks of SSG intervention. This had been claimed by Halouani et al. (2019) that show the increment of sprinting time during the implementation of these rules.

There was a significant difference in the VO2max level across the groups where the level increased from pre- to post-treatment. The possible factor might be due to the SSG format that was played in high-intensity mode. This was proven by a previous study where high-intensity training had been shown to induce improvements in aerobic fitness among young individuals (Dellal et al., 2012). This study had implemented the rules of 2-3 touches and expected the players to do high-intensity movements such as sprinting and changing direction to ask for the ball as those might generate high-intensity movement in order to develop VO2max. Then, when compared to CG soccer players, the result showed a statistical difference between both groups where IG had performed better. In line with the finding of this study, previous studies by Vasileios et al. (2018) showed that VO2max level differs between playing levels (amateurs and professionals) and different ranks among junior soccer players (Haugen et al., 2014). This indicates that, VO2max level is as an important component in achieving high-level soccer performance and accurately discriminates between IG and CG youth soccer players in Malaysia.

There was also a significant difference in the passing skills after 6 weeks of SSG intervention where the time taken for completing the test reduced from pre- to post-test. The factor might be due to the rules of touches during the SSG training. In this study, there was a session where players had limited touches (2-3 touches) and due to that, they had to release the ball as fast as possible. The possible explanation might be, in order to make sure that their team does not lose the ball possession, each player has to make sure that their passing is accurate. This indirectly enhances their passing skills. This had been agreed by a previous study where passing decision-making performance in soccer becomes important because a good pass may reach a teammate who is directly or indirectly unmarked and therefore creates a chance to score a goal (Romeas et al., 2016). In addition, there was also no significant difference in the passing skills between groups. The possible explanation might be due to the

skills test that was used which was less familiar among both soccer groups since the familiarization session had been done only once and due to that, players might find it difficult to adapt with this type of soccer skill test. This had been agreed by a previous study (Malina et al., 2005) which found that the performance in soccer skill tests is influenced by many factors and one of them is the type of test that is used. One previous study by Ounis et al. (2013) had implemented 4 trials for the players to adapt with the nature of the test. This might become the reason why the performance on LSPT test has no statistical difference between IG and CG. However, LSPT test is still beneficial in discriminating between players' levels and is also a useful tool for talent identification (McDermott, et al., 2015).

There was a significant difference on the dribbling skills after 6 weeks of SSG training intervention which showed that IG soccer players had taken less time to perform the test. The possible explanation is since the player density is increased, it directly increases the difficulty of passing and leads the players to keep the ball to themselves or dribbling as to ensure that the ball is still under their possession before it is the right time and position to pass the ball to their teammates. In addition, since the purpose of the training session is to keep the ball possession as long as they can in the smaller area per player, it might limit the time of possession of the ball due to the close proximity of the opponents. This might force players to dribble the ball past over the nearest opponents (this might happen multiple times) which directly increases the percentage of dribbling skills. This had been agreed by a previous study where small pitch areas might constrain the players, but it can directly lead them to attempt the dribble to past over their closer opponents (Vilar et al., 2014). In addition, this study found a significant difference between IG and CG in dribbling skills. In line with that, a study by Vaeyens et al. (2006) showed that there is a significant difference in dribbling between elite and non-elite soccer players under-13, 14, 15 and 16 years old. The factor that leads to the difference between both groups might be due to their experience in playing at different levels of competition and also their training hours. In this study, IG had represented the state (up to national level, some might have played in international competitions) while CG represented the university team who play in IPT (higher learning institution) competitions (some might have played in international university competitions) which indicate the different levels of competition.

Conclusion

In conclusion, SSG training has become the best training method in order to improve speed, passing, dribbling and VO2max. Even though no significant difference was found on agility performance over time, SSG still remains as one of the methods that can be implemented in developing agility performance. Other than that, when compared to CG soccer players, there was no significant difference between the groups in speed, VO2max and dribbling. Therefore, this study recommends SSG intervention as a method in coaching soccer players as it is beneficial to improve multiple variables simultaneously. Future study is recommended to investigate the effectiveness of SSG in a shorter duration such as 4 or 5 weeks of training since this method has an effect in developing variables.

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