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Small Sided Games 3vs3 Goalkeeper-Encouragement: Improve the Physical and Technical Performance of Youth Soccer Players

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Abstract: This study aims to investigate the effect of small sided games (SSG) 3vs3 Goalkeeper (GK)-encouragement (E) on increasing the level of physical and technical performance of youth soccer players. A true experiment with a randomized control trial (RCT) for 8 weeks was adopted. 24 youth soccer players from the positions of striker, midfielder and defender participated in this study. They were divided in two groups, SSG (n = 12, 17.33 ± 1.07 years) and SSG 3vs3 GK-E (n = 12, 18.00 ± 1.04 years). Instruments to measure physical performance included 20m sprint test, Illinois agility test and Multistage 20m fitness test, while technical performance was assessed through dribbling, passing and shooting tests. The results of the student's paired t-test showed that there were changes in physical and technical performance in SSG and SSG 3vs3 GK-E (*all*, $p < .001$) from the pre-test to the post-test. The 2-Way ANOVA with 2 × 2 repeated measures results showed that physical and technical performance had a main effect of "time" ($p < 0.05$), effect "training session" ($p < 0.05$), and an effect "interaction" ($p < 0.05$). This study confirms that SSG 3vs3 GK-E can be an alternative training in the future to increase the level of physical and technical performance in of youth soccer players.

Keywords: Small sided games 3vs3 goalkeeper-encouragement; Performance; Team sports

1. Introduction

Soccer is a team sport that has highly competitive level (Ferreira-Ruiz, García-Banderas & Tamayo, 2022). Apart from that, it also requires players to attack and defend quickly and effectively (Zaharia et al., 2023), so well-developed performance is required. Facts and data from previous studies showed that long-term development for players related to technical (Kumak, Kizilet & Bozdoğan, 2021), tactical (Caso & van der

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Kamp, 2020), physical (Batista et al., 2019), psychological (Bergkamp et al., 2020), were required to gain high achievements in soccer. Among these aspects, physical and technical performance were considered the most important in determining the success in soccer.

Physical performance is an important aspect in all types of sport including soccer, which gain attention and needs to be improved optimally. In modern soccer, physical performance such as speed (Lin et al., 2023), agility (Young, Rayner & Talpey, 2021; Di Domenico, Altavilla & Raiola, 2022), and endurance of must be maintained well, because it supports high performance (Karahan, 2020). Previous studies reported that physical performance was crucial for players, for example speed and agility are key factors for success in soccer (Konefał et al., 2020; Konefał et al., 2022). According to Lilić et al. (2022), players with high physical performance could run fast and change direction quickly without losing balance. Other research reported that the indicator of success in soccer is the development and improvement of physical performance to the highest level (Pojskic et al., 2018; Yapici et al., 2023). Meanwhile, data recorded that players with low physical quality had difficulty achieving brilliant performances and in the end their professional careers will be ended (Križaj, 2020).

Shooting, passing and dribbling are important technical performances in soccer to consider and improve (Duncan et al., 2022; Trombiero et al., 2023). A study reported that players with high technical performance were easier to attack and had a greater chance of scoring goals (Modric, Versic & Jelicic, 2022). According to Koopmann et al. (2020), high technical performance is a key factor for success in demonstrate high performance. With high technical performance, players could perform fast dribbling to get past opponents (Iuliano et al., 2023), accurate passing and shooting (Forcher et al., 2022). The study showed that a high technical performance contributed to the team's victory (Vella et al., 2022), but if players had low technical performance, it would be difficult to gain achievements in soccer (Forcher et al., 2022). Furthermore, Leal et al. (2022), revealed that in a competitive soccer, it was suggested that athletes should not only focus on physical and tactical development, but also developed technical performance at the highest level. Considering the importance of physical and technical performance aspects for players in soccer, appropriate training is needed.

Small sided game (SSG) is a type of training that has increased in popularity in the world (Ferreira-Ruiz, García-Banderas & Tamayo, 2022). SSG can be interpreted as a training pattern that modified the field dimension, duration and number of players to be smaller and apply adjusted rules (Rodrigues et al., 2022; Clemente et al., 2020; Clemente et al., 2022). According to previos studies, SSG can be modified into 2vs2, 3vs3 (Custódio et al., 2022), 4vs4, which includes 5vs5, 6vs6, 7vs7 (Beato et al., 2023), and 8vs8, types of games. 9vs9, 10vs10 (Dios-álvarez et al., 2024), until 11vs11 (Bergkamp et al., 2020). According to Kumak, Kizilet & Bozdoğan (2021), SSG presents not only a modification field size, but also numerous activities that can be performed by athletes according to their needs, for example many movement activities such as technical performance, physiological responses, tactical behavior and physical activity that occurs during SSG.

Basically, the main advantage of SSG is that it provides training conditions similar to real competition situations (Vilamitjana et al., 2022; Vilamitjana et al., 2020). In this study, we try to innovate combining SSG 3vs3 and GK-encouragement (E), where players practice small-sided games with encouragement from a coach. Encouragement such as "you can", "do your best" from the coach will be important for players. Data from previous studies report that verbal encouragement given by coaches will support their performance during training and competition (Aydi et al., 2022; Selmi et al., 2023).

Previous studies reported that SSG can be an effective method to improve

physical (Mikalonytė et al., 2022; Daryanoosh et al., 2023), technical (Fernández-Espínola, Robles & Fuentes-Guerra, 2020), and tactical performances (Batista et al., 2019). However, prior studies still argue how SSG can improve physical (Daryanoosh et al., 2023), and technical aspects, even has been extensive research in to SSG (Sousa et al., 2021; Paľo, Nagy & Vanderka, 2023; Tajudin et al., 2022). Apart from that, a recent research focused on examining the effects of SSG on physical and technical performance aspects through systematic reviews (Malheiro Maia Junior et al., 2023). However, to the best of our current knowledge, there is limited evidence in previous studies that reported the effect of SSG 3vs3 GK-E on improving physical and technical performance in youth soccer players, which was considered as a gap that was investigated through this study. Therefore, our research presented a novelity, in terms of analyzing the effects of SSG 3vs3 GK-E on physical and technical performance in youth soccer players through true experimental research with an 8-week randomized control trial.

This research focuses on young soccer players, this is because many of these players still have poor physical and technical abilities. Apart from that, there is still a lack of previous research that applies SSG 3vs3 GK-E to youth soccer players, so that is the reason we focus on young soccer players. Meanwhile, the study introduces a 3vs3 game format with an active goalkeeper, mimicking match conditions for training realism. Another novelty presented in this research is the combination of SSG 3vs3 GK and encouragement from the coach during training sessions. This format could provide a better understanding of the psychological and tactical development of young athletes. In addition, the study analyzes physical and technical performance of youth players, which may provide empirical evidence for the effectiveness of these games in youth training programs. So therefore, this study aims to investigate the effect of using SSG 3vs3 GK-E to improve physical and technical performance among youth soccer players.

Table 1. Demographic characteristics of groups

2. Materials and Methods

Ethical Approval **-** This research has been approved by the ethics committee with number: 405/HO-LPPM/2023. In addition, this study followed the latest Helsinki amendments. Each participant received and signed an informed consent form before to their participation. Participants were not obligated to participate in the research and were explicitly advised that they did not need to provide any justification for declining to do so.

Participants **-** G*power analysis (Version 3.1.9.4, University of Kiel, Germany) was used to show how many participants were needed in this study. Calculations (F tests through ANOVA with repeated measures, within between interaction, effect size f = 0.30, α err prob = 0.05, power (1-β err prob) = 0.85. From the calculation analysis, a minimum of 16 participants are needed who will be divided into two groups (Daryanoosh et al., 2023).

27 participants who were male youth soccer players from Kendari city (Indonesia). The participants involved have the positions of striker, midfielder and defender. Youth soccer players are chosen because they still have poor technique and physique. Participants were notified via WhatsApp by the research team, and they were selected based on inclusion criteria: (i) healthy condition, (ii) did not have serious injury and (iii) was not involving in any activities. There were 2 out of 27 participants who did not meet the inclusion criteria (e.g., the player has poor technique and physicality), and 1 participant from the SSG did not continue the research program due to injury, so those who completed the study were detailed as SSG (n = 12) and SSG 3vs3 GK-E (n = 12) (see CONSORT flow chart in Fig. 1). Participants were allocated to SSG and SSG 3vs3 GK-E using the Random Group Generator (RGG) application. The characteristics of participants are presented in Table 1.

Variables	SSG (n = 12) M ± SD	SSG 3vs3 GK-E (n = 12) M ± SD
Age (years)	17.33 ± 1.07	18.00 ± 1.04
Height (cm)	157.75 ± 1.60	159.25 ± 2.34
Weight (kg)	57.08 ± 1.62	58.17 ± 1.40
BMI (kg/m^2)	19.67 ± 1.49	21.42 ± 1.16
Training experience (years)	1.33 ± 0.49	1.25 ± 0.45

Small sided games, SSG 3vs3 GK-E = Small sided games 3vs3 goalkeeper-encouragement M; Mean, SD: Standard deviation, BMI: Body mass index.

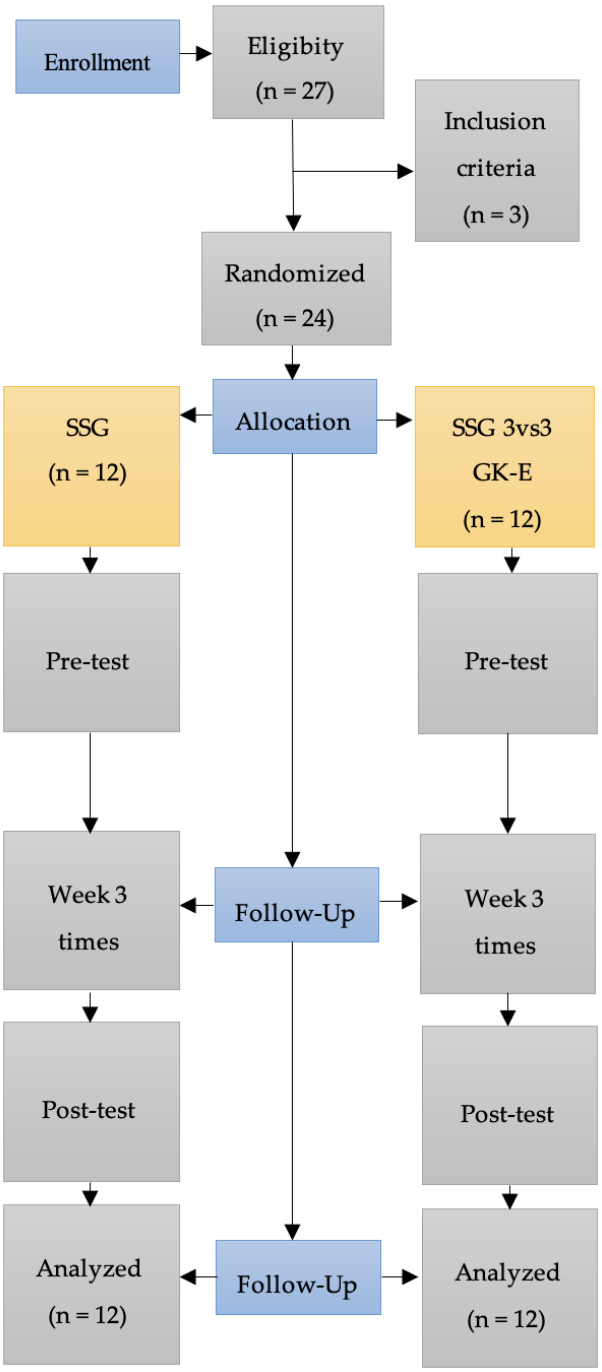


Figure 1. CONSORT flow chart

Measures *- Physical Performance* - Instruments for measuring the physical

performance of soccer athletes was batteries test that adopted from previous studies (Zaharia et al., 2023), including:

Speed (*20m sprint test*)The test aims to measure the running speed of soccer athletes. Participants stood at the starting line, after the whistle sounded, the participants run as fast as possible towards the finish line. The assessment was carried out by calculating the elapsed time from the start line to the finish line.

Agility (Illinois agility test) - This test aims to measure the agility of soccer athletes. Participants stood on the starting line, after the whistle sounded, participants run as fast as possible through the cones to the finish line. The assessment was carried out by calculating the elapsed time from starting line to finish line.

Endurance (Multistage 20m fitness test) - This test aims to measure the $V0_{2max}$ endurance of soccer athletes. The distance between cones A and B was 20m. Participants stood in cone A and after the audio sounded "bleep", participants run to cone B. Do this activity until the participant could no longer run or the participant could not follow the rhythm of the bleep sound. The assessment was carried out by calculating the number of levels and rounds obtained which was converted into Vo_{2max} (Gani et al., 2023).

The intra-class correlation coefficient (ICC) for the test–retest trial for the present study was 0.84, 0.91 and 0.95 for 20m sprint test, illinois agility test and multistage 20m fitness test respectively.

Technical Performance - The technical performance level of athletes was measured using the following instruments (Praça et al., 2015):

Dribbling - This test aims to measure dribbling abilities in soccer athletes. This test used several tools, such as balls, cones, whistle, and stopwatch. The procedure required participants to stand on the starting line after the whistle, dribble as fast as possible to pass the cones and reach the finish line. The assessment was carried out by calculating the elapsed time from the starting line to the finish line with 10m.

Passing - This test aims to measure the passing ability of soccer athletes. The procedure required participant to hold on to cone A after the whistle, participants passing to cone B (target) for 1 minute. The assessment was carried out by counting the number of passes that reached the target in 1 minute.

Shooting - This test aims to measure the shooting ability of soccer athletes. The procedure consisted of the participant standing at cone. A after the whistle. The participant shot towards the goal with a target attached (numbers from 1-5) for 1 minute. Assessment was carried out by counting the number of shots that hit the target number within 1 minute.

The ICC for the test–retest trial for the present study was 0.94, 0.77 and 0.88 for dribbling, passing and shooting respectively.

Procedures - This research was carried out in July-August 2023 (developing in a total of 8 weeks) at Halu Oleo University (Indonesia). The first meeting was held on July 1, 2023, and all participants carried out pre-tests, namely physical and technical performance, from 09.00 am to 11.00 pm at the Halu Oleo University field. At the second meeting (July 5, 2023) the experimental group carried out the SSG 3vs3 GK-E program and the SSG group, these activities were carried out until 25 August 2023. The last meeting was in the eighth week (26 August 2023) carried out the post-test, namely physical and technical performance from 08.00 to 10.00 am.

SSG 3vs3 GK-E Intervention - The SSG 3vs3 GK-E program was carried out in the morning from 08.00-finish in the Halu Oleo University field in 5 minutes for each session (total of 10 sessions). SSG 3vs3 GK-E was conducted with the same format (the same number of players and the same field size) but different players. During each training session, 1 minute of recovery was used between training sessions. SSG 3vs3 GK-E was played on a field with dimensions of 18×22m (Dios-álvarez et al., 2024). The players had a task to play in an area of a predetermined size. Players were divided into 4 teams and each team had 3 players.

Each team must dribble, passing 4 times between each other and cooperating to put the ball into the goal, so they could get points. If the ball went out the field, then that team played the ball from its place. Apart from that, when athletes are doing training, the role of the coach is to provide verbal encouragement such as "do your best", "that's right", "don't give up", "you can do it".

Statistical Analysis **-** Descriptive statistic was presented in terms of mean (M) and standard deviation (SD). Normality testing via Shapiro-Wilk and the normality test in this study proved to be normally distributed (*all*, $p > 0.05$). Student's paired t-test would be used to test differences in physical and technical performance score in the SSG and SSG 3vs3GK-E groups at the pre-test and post-test stages. Meanwhile, the 2-Way ANOVA with 2 × 2 repeated measures to test the effect "Training" (SSG and SSG 3vs3 GK-E), "Time" (pre-and post-test session), and their interaction (training x time) on the physical and technical performance score. Partial eta squared (ηp^2) effect size values were reported and classified as 0.01 = small, 0.06 = medium, 0.14 = large. Cohen's test (d) was used to analyze the effect size (ES) of SSG and SSG 3vs3 GK-E with the following criteria: 0 to 0.20 (small), > 0.20 to 0.50 (moderate), > 0.50 to 0.80 (large) and > 0.80 (very large) (Cohen., 1988). Analysis was using the Jamovi statistics application (v2.3.2.8) and the significance level was set at $p < 0.05$.

3. Results

Physical performance - Student's paired t-test were used to compare the effects of the two-training sessions (SSG and SSG 3vs3 GK-E) on physical performance (*all*, $p < .001$). Ratings of physical performance were significantly higher in SSG 3vs3 GK-E compared to SSG (Tables 2).

The 2-Way ANOVA with 2 × 2 repeated measures results in Table 4 show that for the 20m sprint there is a main effect of "time" ($F^{1.22} = 65.1$; $p < .001$), Illinois agility ($F^{1.22} = 285$; $p < .001$), Multistage 20m fitness ($F^{1.22} = 200$; $p < .001$). There was a "training" effect on 20m sprint ($F^{1.22} = 10.8$; $p = 0.003$), Illinois agility ($F^{1.22} = 26.6$; $p < .001$), Multistage 20m fitness ($F^{1.22} = 18.6$; $p < .001$). There was an "interaction" effect on 20m sprint ($F^{1.22} = 22.2$; $p < .001$), Illinois agility ($F^{1.22} = 149$; $p < .001$), Multistage 20m fitness ($F^{1.22} = 104$; $p < .001$).

Technical Performance - Student's paired t-test were used to compare the effects of the two-training sessions (SSG and SSG 3vs3 GK-E) on technical performance (*all*, $p < .001$). Ratings of physical performance were significantly higher in SSG 3vs3 GK-E compared to SSG (Tables 3). The 2-Way ANOVA with 2 × 2 repeated measures results in Table 5 show that for Dribbling there is a main effect of "time" ($F^{1.22} = 94.5$; $p < .001$), Passing ($F^{1.22} = 120.6$; $p < .001$), Shooting ($F^{1.22} = 126.5$; $p < .001$). There is a "training" effect on Dribbling ($F^{1.22} = 8.61$; $p = 0.008$), Passing ($F^{1.22} = 10.7$; $p = 0.004$), Shooting ($F^{1.22} = 4.84$; $p = 0.039$). There is an "interaction" effect on Dribbling ($F^{1.22} = 15.3$; $p < .001$), Passing ($F^{1.22} = 34.6$; $p < .001$), Shooting ($F^{1.22} = 26.7$; $p < .001$).

4. Discussion

The present study showed that SSG 3vs3 GK-E is a training pattern that modifies a smaller field size and promotes many activities that lead to the development of physical conditions such as speed, agility and endurance. This is in line with results from several previous studies, a weekly training of SSG 3vs3 GK-E has been proven to significantly improve physical performance related to Vo_{2max} endurance (Karahan, 2020), speed or agility (Hammami et al., 2018; Konefał et al., 2020). In SSG 3vs3 GK-E, each athlete conducts the task of running, turning around, kicking the ball, jumping, so that these activities were effective to improve

Table 2. Results of the student's paired t-test on physical performance in the pre-and post-test; SSG and SSG 3vs3 GK-E group

Variables	Training	Time	n	M ± SD	t	p	ES
Physical Performance							
20m sprint (sec)	SSG	Pre-test	12	39.8 ± 6.31	4.06	0.002	1.17
		Post-test	12	37.6 ± 5.76			
	SSG 3vs3 GK-E	Pre-test	12	49.5 ± 4.80	7.02	< .001	2.03
		Post-test	12	41.3 ± 3.70			
Illinois agility (sec)	SSG	Pre-test	12	67.5 ± 5.18	4.75	< .001	1.37
		Post-test	12	63.3 ± 5.18			
	SSG 3vs3 GK-E	Pre-test	12	68.3 ± 3.22	16.7	< .001	4.83
		Post-test	12	42.5 ± 6.93			
Multistage 20m fitness (ml/kg/min)	SSG	Pre-test	12	34.0 ± 4.49	-7.00	< .001	-2.02
		Post-test	12	36.9 ± 4.46			
	SSG 3vs3 GK-E	Pre-test	12	33.5 ± 2.50	-12.7	< .001	-3.66
		Post-test	12	51.4 ± 5.45			

SSG = Small sided games, SSG 3vs3 GK-E = Small sided games 3vs3 goalkeeper-encouragement. Significance level was set at p < 0.05.

Table 3. Results of the student's paired t-test on technical performance in the pre-and post-test; SSG and SSG 3vs3 GK-E group

Variables	Training	Time	n	M ± SD	t	p	ES
Technical Performance							
Dribbling (sec)	SSG	Pre-test	12	80.5 ± 8.60	7.53	< .001	2.17
		Post-test	12	73.3 ± 6.51			
	SSG 3vs3 GK-E	Pre-test	12	77.5 ± 8.39	7.74	< .001	2.23
		Post-test	12	60.0 ± 6.03			
Passing (point)	SSG	Pre-test	12	8.17 ± 0.83	-13.0	< .001	-3.75
		Post-test	12	9.25 ± 0.83			
	SSG 3vs3 GK-E	Pre-test	12	8.42 ± 0.90	-8.60	< .001	-2.48
		Post-test	12	12.00 ± 1.75			
Shooting (point)	SSG	Pre-test	12	7.50 ± 0.79	-5.00	< .001	-1.44
		Post-test	12	8.33 ± 0.88			
	SSG 3vs3 GK-E	Pre-test	12	6.17 ± 0.71	-10.3	< .001	-2.98
		Post-test	12	8.42 ± 0.66			

SSG = Small sided games, SSG 3vs3 GK-E = Small sided games 3vs3 goalkeeper-encouragement. Significance level was set at p < 0.05.

Table 4. Results of the ANOVA with 2 × 2 repeated measures on physical performance

Variables physical performance	Time			Training			Interaction		
	$F^{(1.22)}$	p	η^2_p	$F^{(1.22)}$	p	η^2_p	$F^{(1.22)}$	p	η^2_p
20m sprint (sec)	65.1	< .001	0.748	10.8	0.003	0.330	22.2	< .001	0.502
Illinois agility (sec)	285	< .001	0.928	26.6	< .001	0.547	149	< .001	0.871
Multistage 20m fitness (ml/kg/min)	200	< .001	0.901	18.6	< .001	0.459	104	< .001	0.825

Significance level was set at p < 0.05.

Table 5. Results of the ANOVA with 2 × 2 repeated measures on technical performance

Variables technical performance	Time			Training			Interaction		
	$F^{(1.22)}$	p	η^2_p	$F^{(1.22)}$	p	η^2_p	$F^{(1.22)}$	p	η^2_p
Dribbling (sec)	94.5	< .001	0.818	8.61	0.008	0.291	15.3	< .001	0.422
Passing (point)	120.6	< .001	0.846	10.7	0.004	0.338	34.6	< .001	0.611
Shooting (point)	126.5	< .001	0.852	4.84	0.039	0.180	26.7	< .001	0.548

physical condition among soccer players (Dios-álvarez et al., 2024). In addition, SSG 3vs3 GK-E presents a real competitive situation for each team to win the game, thus having the potential to gradually develop the physical aspect (Vilamitjana et al., 2020). Caso & van der Kamp (2020), reported that SSG 3vs3 GK-E in soccer is a game that has been modified to be a small size game, so that it becomes a tool for coaches to improve the physical performance of soccer players. Other studies also supports the results of this research, in which the impact of using SSG 3vs3 GK-E can enhance physical performance in team sports (Fernández-Espínola, Robles & Fuentes-Guerra, 2020; Mikalonytė et al., 2022). On the other hand, SSG 3vs3 GK-E can effectively provide a great stimulus for physical conditioning among soccer players (Daryanoosh et al., 2023). According to Fenner et al. (2022), the main advantage of SSG 3vs3 GK-E was to provide abundant experiences of movement which could improve the physical aspects.

Other findings in our research showed that SSG 3vs3 GK-E also has a positive effect on improving technical performance. For example, we observed that soccer players experienced improvements such as able to pass opponents and entered the opponent's defense area, passing more accurately and shooting right on the target. The quality of technical performance could be improved due to SSG 3vs3 GK-E was designed as a training that intended to improve the technical performance of soccer players (Sarmento et al., 2018), or team sports (Tajudin et al., 2022). SSG 3vs3 GK-E required athletes to carry out movement tasks (dribbling, passing and shooting) that were similar to actual soccer, which could triggering technical performance improved significantly (Barba et al., 2020). According to Clemente et al. (2020), carried out SSG consistently for several weeks could encourage changes in technical performance. Bonney, Ball & Larkin (2020), reported the same results, SSG 3vs3 GK-E became an effective multicomponent training strategy in developing technical performance related to team sports such as soccer. Basically, the advantage SSG 3vs3 GK-E that we observed is that it has the characteristics of a fun game, so it can make soccer players more active and enthusiastic in increasing the level of technical performance.

The main strength of our research is that it presents a different program from previous SSG research, combining SSG 3vs3 GK-E, to positively effect the development of physical and technical performance among youth soccer players. These results are in line with previous research which reported that SSG 3vs3 GK-E was proven to significantly influence psychophysiological and affective responses better (Sahli et al., 2020).

The importance of implementing the SSG 3vs3 GK-E program to improve physical and technical performance for youth soccer players. We recommend using SSG 3vs3 GK-E to obtain far more optimal results than SSG in improving physical and technical

performance. However, this research still has limitations in terms of limited participants (youth soccer players) which only cover one gender (men), so further research is needed in the future to investigate the effects of SSG 3vs3 GK-E on both genders, men and women. Apart from that, another limitation is this study only applied the SSG 3vs3 GK-E type, so there is a need to analyze the effect of SSG with other types such as 4vs4, 5vs5 or others. The final limitation is that player positions are not evenly divided into SSG and SSG 3vs3 GK-E groups.

5. Conclusions

We highlight the importance of consistent application of SSG 3vs3 GK-E in order to improve the quality of physical and technical performance of youth soccer players. This research contributes to the development of the modern soccer training process and provide important information for coaches in maintaining the physical and technical performance of youth soccer players and also offers practical recommendations for coaches, bridging the gap between research and practice in youth soccer training.

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