Progress in Nutrition 2021; Vol. 23, N. 2: e2021207 DOI 10.23751/pn.v23i2.11750

Original article

Exploration of the effect of small sided games on the technical skills, internal and external loads of main and joker players

Aliasker Kumak, Ali Kizilet, Tuba Kızılet Bozdoğan
Marmara University Institute of Health Sciences, Istanbul

Abstract.
Introduction: The aim of the study is to explore the impact of main and joker players on technical skill responses and internal and external load levels in SSGs. *Methods:* The participants of the study are 8 elite U17 players who plays in the academy of a professional team training regularly at least five days a week. The height of the participants is 178.9 ± 3,2cm, the body mass is 71,6 ± 4,6 kg and body mass index is 20,01 ± 1,03 kg/m'. SSGs have been performed in a 15x25 meters field, without jokers (3x3), with 1 joker (3x3+1j) and with 2 jokers (3x3+2j). While analyzing data, as a conclusion of test of normality; for the group of 2 Independent Group T-Test or Mann Whitney U test; for the groups of 3 or more ANOVA or Kruskal Wallis H Test have been performed. The significance level has been evaluated as p<0,05. *Results:* There was no statistically significant difference among HR, HRmax, HRmax% levels of the players (p>0,05). Significant difference was detected in 2 joker games (3x3+2j) in total distance, minute/distance, maximum speed and high intensity running distances of the main players (p<0,05). It is determined that the lactate level and rate of perceived exertion of main players were significantly higher compared to joker players (p<0,05). *Conclusions:* At the end of the study, it was observed that the use of joker players which provides numerical inferiority/superiority in SSGs effects internal and external load responses of both main and joker players while making the games more fastmoving.

Key words: soccer, small sided games, game with joker, technical skill, internal and external load.

Introduction

A soccer match is a competition where 2 opponent teams try to be successful or outclass one another during 90 minutes in a 100x70 field by exhibiting multiple skills, tactical behaviors, perception and decisions such as sprint, jogging, turns, feint, tackles, shooting, duels, either consecutively or in different times (1,2). While elite soccer players cover a distance of approximately 10-12 km. during a competition, the majority of their movements in total distance is aerobic. While high-intensity movements such as sprints, turns, jumps, duels are critical in competitions, high-intensity actions are required to be produced by soccer players via anaerobic metabolism (1, 3, 4). Professional soccer players are known to cover more distance compared to amateur soccer players (3, 5). Soccer-specific SSGs are often used by coaches as a training method (6, 7, 8), as they reflect many skills or activities that the team or players need during a soccer game at the same time (9, 10). Many movement activities such as technical skills, tactical behavior, physiological responses, physical activities that occur during the soccer match are applied practically and very easily by the coaches by adding different aims, goals or rules in SSGs (11, 12, 13). Compared to the traditional training method (such as revealing the situation in a static environment with a large number of repetitions of the drill), SSGs are per-

ceived as trainings that allow optimizing the training time as it simultaneously improves tactical awareness, technical skills and physical performance (13, 14).

As a result of the literature review, it has been observed that few studies have been conducted on SSGs that include joker players in soccer, and it has been determined that the researchers obtained different results in these studies. In the study where joker players are included, while Hill-Hass et al. stated that there was not any difference in physiological responses of joker players or of the other players who had numerical inferiority/superiority; Sanchez-Sanchez et al. reported that joker players had reached minimum heart beat responses when playing in their assigned position or in the wings (5, 13). In a different study, on the contrary of Praça et al. who stated that lower results were obtained in the high intensity running distance and total distance when jokers are included in the game; Hill-Hass et al. announced that, when total distance and high intensity running distance are concerned, joker players had covered more distance compared to main players (5, 13, 15).

Considering these differences in the literature, the aim of the study is to explore the impact of main and joker players on technical skill responses and internal and external load levels in SSGs**.** It is thought that the results of the study in question will contribute to the elimination of differences in the literature

Material and Methods

Participants

The participants of the study are 8 elite players playing in the academy of a professional soccer club, training regularly at least five days a week, with average age of 17, height 178.9 ± 3.2 cm, body mass 71.6 ± 4.6 kg, body mass index 20,01 ± 1,03 kg/m. In order to determine the subjects, the YO-YO1 test (16) was applied to the whole team one week before the start of the study, and according to the test results, 8 soccer players from 4 different positions (2 defenders, 2 wingers, 2 midfielders and 2 attackers) reaching to the highest running distance were included in the research. The YYIRT (level one) is an endurance test consisting of repetitive runs in which the running speed gradually increases according to the signal sound coming from the signal device that starts with a running speed of 10 kmh between the start, turn and finish lines in an area of 20 meter.(16).Before the study, each subject was given detailed information about the risks and discomforts that may be encountered in the study, and the approved informed consent form for voluntary participation was signed by the families of the subjects since the subjects were younger than 18 years old. Prior to the study, necessary permissions were obtained from the Marmara University Faculty of Medicine Ethics Committee. (IRB:09.2019-39).

Small Sided Games

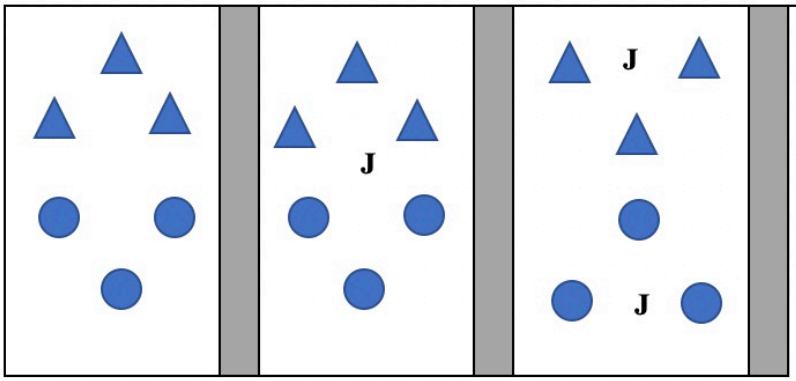
The study was carried out on a reduced soccer-specific field, 1 day a week, between 14.00-16.00 during 4 weeks. Each player was assigned as both main and joker player during the exercises. While in one joker games the joker player was free to move in all the zones of the field; in two joker games, the jokers were not allowed to play in the opponent field (field of play was divided in half with a line and each joker was in one side of the field). After 15 minutes warm up before each exercise, 3x3 4 minutes game was played in a medium sized field (15x25m) during 4 weeks with 4 minutes of rest at the end. For the next 4 minutes game (3x3+1j) 1 joker was added with a 4 minute rest at the end; and for the last 4 minutes game the other joker waiting next to the field was added to the game (3x3+2j) and the exercises were completed.

Heart Rate Measurements

Heart rate responses of soccer players were recorded via heart rate monitors during SSGs(Polar Team Pro GPS System, Finland). The heart rate (HR), maximum heart rate (HRmax) and maximum heart rate percantage (HRmax%) data were transferred to computer environment.

Rate of Perceived Exertion (RPE)

At the end of each game during SSG, players were asked to evaluate their fatigue between 0-10 points in



Week	Program	
1	1, 2, 3 4 J	5, 6, 7 8 J
2	2, 3, 4 1 J	6, 7, 8 5 J
3	3, 4, 1 2 J	7, 8, 5 6 J
4	1, 2, 4 3 J	8, 5, 6 7 J

Figure 1. Game Formations (15x25) and Program

order to estimate their rate of perceived exertion (RPE values were taken from the players immediately after the 4 minutes of practice), and the responses were recorded instantly. The scales used to monitor the fatigue levels perceived by athletes in SSGs are valid and reliable tools for determining the training load of soccer players (17). These scales have been used by research in numerous studies (18, 19).

Blood Lactate Measurement

Within 3 minutes after the end of the games, blood samples were taken from the fingertips of each soccer player in order to determine the lactate levels and the results were recorded instantly. Pre-calibrated portable analyzers (Lactate Scout Pro) were used for sampling (20).

Time Motion Characteristics

A global positioning system (Polar Team Pro GPS System, Finland) was used to track the external load parameters of soccer players in SSGs, and the GPS tracker designated for each player was placed behind the shoulder between the shoulder blades with a wearable material**.** The device was activated 10 minutes prior to each game for the purpose of the detection of total distance, distance/min., maximum speed and velocity zone distance values of each player (ZONE-1: 0-6,99 km, ZONE-2: 7-11,99 km, ZONE-3: 12-14,99 km, ZONE-4: 15-17,99 km, ZONE-5: >21 km); and deactivated after the games. This data was filtered and transferred to computer environment via a private software (Polar Team Pro System, Finland). The global positioning system (GPS) enables valid and reliable estimation of the external loads (total distance, distance covered in the velocity zone, etc.) that athletes are exposed to in SSGs (21).

Technical Actions

In order to examine the technical skill responses of the players, all games were recorded simultaneously with 2 digital cameras. The cameras were placed on stable tripods positioned approximately 5 meters above the corner points of the field, 10 meters distance and parallel to the playground. Technical performance responses were analyzed by video analysis method as number of accurate passes, inaccurate passes, interception, dribbling, duels and feint. Rotation analysis of the video recordings was carried out by 2 researchers twice. The average of 4 measurements was used in the evaluations.

Statistical Analysis

The data of the study were analyzed by a statistics software. The compliance of quantitative variables to normal distribution was examined using the Shapiro Wilk test. The Independent Groups T test was used for the comparison of 2 groups of quantitative variables with normal distribution, and One Way Analysis of Variance (ANOVA) was used for comparisons of 3 or more groups, and the post-hoc test was used for the subgroup comparisons of the variables whose ANOVA

Table 1. Characteristics of Participants

	Arithmetic Mean	Standard Deviation (±)
Age (year)	17	1
Height	178,9	3,2
BM	71,6	4,6
BMI	20,01	1,03

test result was significant. Mann Whitney U test was used in two group comparisons of quantitative variables that did not show normal distribution; Kruskal Wallis test was used in comparisons of 3 or more groups. Bonferonni adjusted Mann Whitney U test was used for subgroup comparisons of variables that were found to be significant as a result of the Kruskal Wallis test. In all statistical analyzes in the study, results with a p value below 0.05 were considered statistically significant.

Results

Internal Load Responses

The HR (178,9 ± 8,5 bpm), HRmax (190,0 ± 10,9 bpm), HRmax% (95,3 ± 5,4) values of the main players; HR (173 ± 8,16 bpm), HRmax (184 ± 5,03 bpm), HRmax% (92,5 ± 2,52) values for 1 joker player and HR (158,63±13,05 bpm) HRmax (175,88±11,54bpm) HRmax% (88,25 ± 5,65) values for 2 joker players were recorded, and no difference was found among the groups (p>0,05, Table 2). In the groups participating in the study, there was a significant difference in the RPE (7.0 ± 0.8) values of the main players (p <0.05, Table 2) and the highest responses were obtained in 3x3 games. Significant difference was detected for 1 joker (4,75 ± 5,00) and 2 joker players (4,13 ± 0,35) between the RPE values (p<0,05, Table 2), and it is observed that this difference is caused by the responses of the main and joker players of 3x3+2j game. The highest responses of LA values (5,72 ± 0,98) of main players were obtained in 3x3+1j game; and statistically significant difference was detected between the 1 joker LA (3,75 ± 0,49) and 2 joker LA (2,91 ± 0,24) values (p<0,05, Table 2). It has been observed that this difference is due to the results of main and joker players in 3x3+2j games.

External Load Responses

Significant difference was observed in the main players' TD (480,08±54,0 m), MD (115,7±7,8m), MS (20,06±2,61) values (p<0,05, Table 2). The highest responses were obtained in 3x3+2j games. While 1 joker player values were as follows: TD (401,75±30,78m), MD (95,50±5,45m) MS (16,12±1,09) , there has been a significant difference in 2 jokers' values: TD (220,50±67,46m), MD (52,75±15,35m), MS (13,21±2,52) (p<0,05, Tablo 2), and it has been observed that 2 joker players played with lower values compared to 1 joker and main players. Statistically significant difference has been observed among the Z-1 (166,5±18,5), Z-2 (240,8±42,9), Z-3 (85,8±32,2), Z-4 (6,92±5,61), Z-5 (1,79±3,13) values (p<0,05, Table 2); Z-1 obtained the highest values in 3x3+1j games whereas in other velocity zones the highest responses were obtained in 3x3+2j games. While in 1 joker player the responses were as follows: Z-1 (178,00±14,21), Z-2 (204,00±26,88), Z-3 (19,75±4,57), Z-4 (0±0), Z-5 (0±0), those of 2 jokers were as: Z-1 (170,25±35,61), Z-2 (47,88±36,67), Z-3 (2,50±2,20), Z-4 (0±0), Z-5 (0±0). Statistical difference was observed between 2 joker players-main and 1 joker player (p<0,05, Table 2). The lowest values obtained in velocity zones were at 3x3+2j games, and it has been detected that 2 joker players played with lower values compared to main players and 1 joker player.

Analyzing the technical skill responses of the participants in Table 3; significant difference was observed among Accurate pass (F=19,177; p<0,05), Interception (F=11,773; p<0,05), Dribbling (F=45,875; p<0,05), Duel (F=5,237; p<0,05) and Feint (F=25,655; p<0,05). However, in "Ball loss" (F=2,683; p>0,05), no significant difference was observed among the groups. (SSG) Although there was an increase in the number of accurate passes with the participation of joker player, a decrease was recorded in other technical actions (Table 3).

Discussion

According to the current study results, when main and 1 joker player's internal load parameters were exam-

Table 2. SSG internal and external loads parameters(15x25m)

		MAIN PLAYER (MP)				1 JOKER PLAYER(J1)		
		3X3	**3X3+1J**	**3X3+2J**	**P**	**MAIN**	**1 JOKER**	**P**
Internal Loads	HR	176 (147-194)	177,5 (161-194)	181 (162-196)	,190	177,5 (161-194)	173 (163-183)	,427
	HR max	188 (174-216)	189,5 (176-201)	191(174-201)	,949	189,5 (176-201)	183 (179-191)	,095
	HR max%	94,5 (87-108)	95 (88-100)	96 (87-100)	,956	95 (88-100)	92 (90-96)	,209
	RPE	7 (6-8)	6 (6-7)	6 (5-7)	**,001**	6 (6-7)	5 (4-5)	**,001**
	LA	4,70 (3,40-6,70)	5,35 (4,30-7,50)	5,55 (3,30-7,70)	**,014**	5,35 (4,3 –7,5)	3,80 (3,1 – 4,3)	**,001**
External Loads	TD	433 (347 - 533)	426 (341 - 505)	489 (366 - 551)	**,001**	426 (341 -505)	411,5 (357-427)	,186
	MD	107 (84 - 131)	103 (81 - 118)	116,5 (101 - 131)	**,001**	103 (81 - 118)	97 (88-100)	,070
	MS	18,47 (15,55- 21,93)	18,47 (15,70- 23,71)	19,98 (15,09- 25,10)	,131	18,47 (15,70- 23,71)	15,87 (15,18-17,58)	**,007**
	Z1	134 (90 - 185)	165,5 (144 - 194)	145 (112 - 185)	**,001**	165,5 (144 - 194)	172,5 (168-199)	0,186
	Z2	230 (140 - 277)	215 (121 - 297)	255 (161 - 340)	**,030**	215 (121 - 297)	215 (164-222)	0,681
	Z3	54,5 (7 - 135)	51,5 (14 - 90)	91 (26 - 140)	**,001**	51,5 (14 - 90)	20 (14-25)	**,012**
	Z4	2 (0 - 12)	2 (0 - 13)	8,5 (0 - 21)	**,029**	2 (0 - 13)	0 (0 - 0)	0,095
	Z5	0 (0 -2)	0 (0 -6)	0(0-10)	0,205	0 (0 -6)	0 (0 -0)	0,635

		2 JOKER PLAYERS (J2)			1 JOKER X 2 JOKER		
		MAIN	**2 JOKER**	**P**	**1 JOKER**	**2 JOKER**	**P**
Internal Loads	HR	181 (162-196)	160,5 (139-181)	**,001**	173 (163-183)	160,5 (139-181)	,073
	HR max	191 (174-201)	178 (159-190)	**,001**	183 (179-191)	178 (159-190)	,368
	HR max%	96 (87-100)	89,5 (80-95)	**,001**	92 (90-96)	89,5 (80-95)	,368
	RPE	6 (5-7)	4 (4-5)	**,001**	5 (4-5)	4 (4-5)	,109
	LA	5,5 (3,3 –7,7)	2,95 (2,5 –3,2)	**,001**	3,8 (3,1 - 4,3)	2,95 (2,5 –3,2)	**,016**
External Loads	TD	489 (366 -551)	216,5 (113-319)	**,001**	411,5 (357-427)	216,5 (113-319)	**,004**
	MD	116,5 (101 -131)	56 (26-74)	**,001**	97 (88-100)	56 (26-74)	**,004**
	MS	19,98 (15,09 -25,10)	14,13 (9,70-16,02)	**,001**	15,87 (15,18-17,58)	14,13 (9,70-16,02)	**,048**
	Z1	145 (112 - 185)	184,5 (107-208)	**,001**	172,5 (168-199)	184,5 (107-208)	1,000
	Z2	255 (161 - 340)	46,5 (6-117)	**,001**	215 (164-222)	46,5 (6-117)	**,004**
	Z3	91 (26 - 140)	3 (0-5)	**,001**	20 (14-25)	3 (0-5)	**,004**
	Z4	8,5 (0 - 21)	0 (0-0)	**,001**	0 (0 - 0)	0 (0 - 0)	1,000
	Z5	0 (0-10)	0 (0-0)	0,174	0 (0 -0)	0 (0-0)	1,000

TD: Total Distance, **MD:** Minutes/Distance, **MS:** Maksimum Speed, **Z1:** Zone-1, **Z2:** Zone-2, **Z1:** Zone-3, **Z4:** Zone-4, **Z5:** Zone-5, **HR:** Heart Rate, **HRmax:** Heart Rate Maksimum, **HRmax%:** Heart Rate Maksimum% , **RPE:** Rating Exertion Percieved, **LA:** Lactat, **SSG:** Small Sided Games, **MP:** Main Player, **J1:** Joker Player-1, **J2:** Joker Player-2

ined, similar results were achieved in the players' heart rate responses and two joker players were observed to have played with lower responses within said parameters. During the study, the highest lactate responses for the main players were observed with games including one joker player, the highest RPE responses were observed with 3x3 games and the lowest lactate and RPE responses for joker players were recorded in games with 2 joker players. For the main players the highest lactate responses were recorded with 3x3+1j games. These results are thought to be related to the exhaustion from the previous (3x3) game and the fact that on the ball/off the ball actions such as feints, dribbling, duels, passing transitions take place with increased velocity in the presence of one joker player. Similar responses have been recorded in heart rate responses with a main and a joker player. In games with one joker player (3x3+1j), the fact that high response rates were observed for technical skills such as duels, dribbling and feint which increase the heart rate and lactate responses, support the

Table 3. Comparison of the total values of technical skill responses in 15x25m.

			SS	F	p	Significant difference
Accurate Pass	3x3	79,50	8,69	19,177	**,001***	1<2 1<3
	3x3+1	110,00	11,77			
	3x3+2	124,75	10,90			
Ball Loss	3x3	9,25	1,50	2,683	,122	
	3x3+1	7,75	2,62			
	3x3+2	6,00	1,63			
Interception	3x3	15,00	3,16	11,773	**,003***	2<1 3<1
	3x3+1	9,25	1,25			
	3x3+2	7,25	2,21			
Dribbling	3x3	22,50	2,38	45,875	**,000***	2<1 3<1 3<2
	3x3+1	16,00	1,41			
	3x3+2	11,50	,57			
Duel	3x3	14,75	4,99	5,237	**,031***	3<1
	3x3+1	9,75	1,89			
	3x3+2	7,25	2,21			
Feint	3x3	16,25	3,30	25,655	**,000***	2<1 3<1 3<2
	3x3+1	10,75	2,21			
	3x3+2	4,50	,57			

idea that joker players have similar physiological responses to that of main players. In games with 2 joker players, joker players have been recorded to have played with lower heart rate responses which is thought to be a result of the joker players being perceived as team mates that enable numerical superiority instead of as opponents for the main players; or because of the rule that two joker players must be on either side of the field, which limits the joker players.

In a study where neutral players were placed both inside and at the wings, the highest heart rate responses were achieved in games with no joker players and where the joker players were inside; the lowest heart rate responses were achieved in games where joker players were playing both inside and at the wings (5); while in games played with fewer numbers of players, higher lactate (18) and RPE responses were observed (10, 22). In SSGs, LA and RPE responses are also informative regarding the physiological responses of the players (17). Numerical inferiority/superiority effects players' physiological responses and feelings of exhaustion (23). While the RPE responses used in the games is an effective way for determining the impact (13, 22), they should be evaluated with regards to the LA and heart rate responses (24). Our study has established that jokers play with much lower RPE and LA responses. Reviewing the literature, one study examining games with joker players and the related parameters reports that the lowest RPE responses have been achieved in games with joker players (5). In a study carried out by Hill-hass et al, it has been indicated that the RPE responses of joker players were higher than main players while the LA responses were similar (13). The results of this study differ from our own, therefore, more research needs to be done to determine the RPE and LA responses of joker players. Even though soccer is played in circumstances of quantitative disequilibrium, there are very few studies on the subject of the employment of joker players which create such numerical inferiority/superiority. (25, 26).

According to the current study results, when the external load parameters of main and joker players are examined, the highest TD, MD, MS responses for main players in high velocity running zones (such as Z-3, Z-4) have been recorded in games with 2 joker players and at the same time, the lowest joker player

responses in these parameters have been recorded in 3x3+2j games. The involvement of 2 joker players has caused increase in length of the field, and the main players to play with numerical superiority (5x3 etc.) while forcing the players on the ball with the aim to protect the ball, and the players of the ball with the aim to recover the ball to change places with high velocity. These factors are thought to cause increase in the physical performance responses of the main players while causing lower physical responses in joker players depending on the fact that joker players were perceived as a passing option or that each joker was obliged to be positioned on each side of the field (in 2 jokers game, each joker player is only free to play on his own half of the field). The restrictions applied in the games are known to effect the physical and physiological responses of the players (19). Praça et al., have explained that in games with a quantitative advantage where there are 2 joker players as opposed to games where there are 1 or no joker players, players complete the games with higher total distance and high velocity running distance values (15). This study has achieved similar results to our own study (15). Hill-Hass et al. have indicated that teams that play with equal numbers of players (5x5, 6x6) cover more distance than team players that have a quantitative advantage (4x5, 5x6); that players in teams with the less number of players cover higher distances of high velocity running while the teams that have the numerical superiority cover more distance with low velocity running and less distance with high velocity running (13). It is known that adding an extra player to a team and the differences in the numbers of players increase the sprint and high velocity running distances in players (27).

When we examined the technical skill actions in our study, the games where the number of accurate passes were the lowest, yet other technical actions such as duels, feints, ball loss, winning the ball and dribbling were most common, were 3x3 games where joker players were not included. In one study Dellal et al. recorded that there was a higher percentage of passes and fewer cases of ball loss in 3x3 and 4x4 games compared to 2x2 games, and more cases of duels were observed in 3x3 games. In many studies, it has been established that the lower number of players increased the number of movements in technical skills (10, 28, 29). They have recorded that higher numbers of short passes, dribbling, goals, spoiling the game and defensive actions have occurred in trainings with fewer players (3x3) (22, 23, 29, 30). When we compared 3x3+1j and 3x3 games in our research, we observed an increase in the number of accurate passes while there was a decrease in other technical actions. When we compared 3x3+2j games with 3x3 and 3x3+1j games, the highest number of accurate passes were achieved in 3x3+2j games while simultaneously the lowest number of other actions were found also in games where 2 joker players were involved. In their study using neutral players Sanchez-Sanchez et al. have recorded a higher number of technical actions such as duels, feints and drippling in games without neutral players as opposed to exercises without neutral players. It has been argued that during games where neutral players were employed 1x1 clashes were decreased which made the team to be more co-operative and increased the number of passes (5). It is reported that the change in game rules effects the offensive skill demonstration (28), and in free game situations there are more duels taking place (7, 10). When all these studies are examined, it is understood that the game rule organization in SSGs must be made according to the aim (28, 31). It has been determined that shoots and activities aiming to spoil the game are more common in small scale fields and that the smaller the area is per player, the more frequently activities like dribbling and feint take place (32-34).

The fact that our study evaluates the internal and external load parameters of main players in games with and without jokers and that jokers are compared to each other, and the fact that other studies have not made such evaluations make our study powerful. The limitation of our study is thought to be the fact that there has been no control over players' rest and diet conditions before and after training.

Conclusion

As a result, it has been observed that the use of joker players, which provides numerical inferiority/superiority in SSGs, causes differences in the internal and external load responses of both the main and joker players. Moreover, examining the technical perfor-

mance responses, it has been revealed that the existence of joker players makes the games more fastmoving as well as reducing the frequency of actions such as dribbling, duels, ball loss, feint, which decrease the game-speed. Furthermore**,** as SSGs with and without jokers effect numerous performance parameters of the players, it can be concluded that the implementation of these games to training can have a positive effect on players' match performance.

Recommendations

It may be suggested to ensure that SSGs take place under competition conditions and find more place in trainings. Therefore, it can be recommended to coaches to include these games in their training plans. Besides, it may be suggested that researchers conduct studies with larger sample groups in different field sizes and with different number of players for further research on this subject.

References

1. Bangsbo, J., Mohr, M., & Krustrup, P. Physical and metabolic demands of training and match-play in the elite football player. Journal of sports sciences, 2006; 24(07), 665-674.
2. Frybort P, Kokstejn J, Musalek M, Süss V. Does physical loading affect the speed and accuracy of tactical decision-making in elite junior soccer players? Journal of Sports Science and Medicine. 2016; 320-326.
3. Mohr, M., Krustrup, P., & Bangsbo, J. Match performance of high-standard soccer players with special reference to development of fatigue. Journal of sports sciences, 2003; 21(7), 519-528.
4. Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. Physiology of soccer. Sports medicine, 35(6), 2005; 501-536
5. Sanchez-Sanchez, J., Hernández, D., Casamichana, D., Martínez-Salazar, C., Ramirez-Campillo, R., & Sampaio, J. Heart rate, technical performance, and session-RPE in elite youth soccer small-sided games played with wild-card players. The Journal of Strength & Conditioning Research, 2017; 31(10), 2678-2685.
6. Fradua, L., Zubillaga, A., Caro, Ó., Iván Fernández-García, Á., Ruiz-Ruiz, C., & Tenga, A. Designing small-sided games for training tactical aspects in soccer: Extrapolating pitch sizes from full-size professional matches. Journal of sports sciences, 2013; 31(6), 573-581.
7. Hill-Haas, S. V., Dawson, B. T., Coutts, A. J., & Rowsell, G. J. Physiological responses and time–motion characteristics of various small-sided soccer games in youth players. Journal of sports sciences, 2009; 27(1), 1-8.
8. Reilly, T. An ergonomics model of the soccer training process. Journal of sports sciences, 2005; 23(6), 561-572.
9. Davids, K., Araújo, D., Correia, V., & Vilar, L. How small-sided and conditioned games enhance acquisition of movement and decision-making skills. Exercise and sport sciences reviews, 2013; 41(3), 154-161.
10. Dellal, A., Chamari, K., Pintus, A., Girard, O., Cotte, T., & Keller, D. Heart rate responses during small-sided games and short intermittent running training in elite soccer players: a comparative study. The Journal of Strength & Conditioning Research, 2008; 22(5), 1449-1457.
11. Eniseler, N., ahan, Ç., Özcan, I., & Dinler, K. High-intensity small-sided games versus repeated sprint training in junior soccer players. Journal of human kinetics, 2017; 60(1), 101-111.
12. Gabbett, T., Jenkins, D., & Abernethy, B. Game-based training for improving skill and physical fitness in team sport athletes. International Journal of Sports Science & Coaching, 2009; 4(2), 273-283.
13. Hill-Haas, S. V., Coutts, A. J., Dawson, B. T., & Rowsell, G. J.Time-motion characteristics and physiological responses of small-sided games in elite youth players: the influence of player number and rule changes. The journal of strength & conditioning research, 2010;24(8), 2149-2156.
14. Rampinini, E., Impellizzeri, F. M., Castagna, C., Azzalin, A., & Wisløff, U. Effect of match-related fatigue on short-passing ability in young soccer players. Medicine and science in sports and exercise, 2008; 40(5), 934-942.
15. Praça, G. M., Custódio, I. J. D. O., & Greco, P. J. Numerical superiority changes the physical demands of soccer players during small-sided games. Revista Brasileira de Cineantropometria & Desempenho Humano, 2015;17(3), 269-279
16. Krustrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., ... & Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. Medicine & Science in Sports & Exercise, 35(4), 697-705
17. Impellizzeri, F. M., Marcora, S. M., Castagna, C., Reilly, T., Sassi, A., Iaia, F. M., & Rampinini, E.. Physiological and performance effects of generic versus specific aerobic training in soccer players. International journal of sports medicine, 2006; 27(06), 483-492.
18. Rampinini, E., Impellizzeri, F. M., Castagna, C., Abt, G., Chamari, K., Sassi, A., & Marcora, S. M. Factors influencing physiological responses to small-sided soccer games. Journal of sports sciences, 2007; 25(6), 659-666.
19. Aguiar, M. V., Botelho, G. M., Gonçalves, B. S., & Sampaio, J. E. Physiological responses and activity profiles of football small-sided games. *The Journal of Strength & Conditioning Research*, 2013; *27*(5), 1287-1294
20. Torres-Ronda, L., Gonçalves, B., Marcelino, R., Torrents, C., Vicente, E., & Sampaio, J. Heart rate, time-motion, and body impacts when changing the number of teammates and opponents in soccer small-sided games. The Journal of

Strength & Conditioning Research, 2015; 29(10), 2723-2730.
21. Dellal, A., Owen, A., Wong, D. P., Krustrup, P., Van Exsel, M., & Mallo, J. Technical and physical demands of small vs. large sided games in relation to playing position in elite soccer. Human movement science, 2012; 31(4), 957-969.
22. Silva, P., Vilar, L., Davids, K., Araújo, D., & Garganta, J. Sports teams as complex adaptive systems: manipulating player numbers shapes behaviours during football small-sided games. SpringerPlus, 2016; 5(1), 1-10.
23. Clemente, F., Couceiro, M. S., Martins, F. M., & Mendes, R. U. I. The usefulness of small-sided games on soccer training. Journal of Physical Education and Sport, 2012; 12(1), 93-102.
24. Coutts, A. J., Rampinini, E., Marcora, S. M., Castagna, C., & Impellizzeri, F. M. Heart rate and blood lactate correlates of perceived exertion during small-sided soccer games. Journal of Science and Medicine in Sport, 2009; 12(1), 79-84.
25. Rábano-Muñoz, A., Asian-Clemente, J., Sáez de Villarreal, E., Nayler, J., & Requena, B. Age-related differences in the physical and physiological demands during small-sided games with floaters. Sports, 2019; 7(4), 79.
26. Torres-Ronda, L., Gonçalves, B., Marcelino, R., Torrents, C., Vicente, E., & Sampaio, J. Heart rate, time-motion, and body impacts when changing the number of teammates and opponents in soccer small-sided games. The Journal of Strength & Conditioning Research, 2015; 29(10), 2723-2730.
27. Sampaio, J. E., Lago, C., Gonçalves, B., Maçãs, V. M., & Leite, N. Effects of pacing, status and unbalance in time motion variables, heart rate and tactical behaviour when playing 5-a-side football small-sided games. Journal of science and medicine in sport, 2014; 17(2), 229-233.
28. Almeida, C. Ferreira, A. P., & Volossovitch, A. Manipulating Task Constraints in Small-Sided Soccer Games: Performance Analysis and Practical Implications. The Open Sports Science Journal, 2012; 5(October), 174-180
29. Katis, A., & Kellis, E. Effects of small-sided games on physical conditioning and performance in young soccer players. Journal of sports science & medicine, 2009; 8(3), 374.
30. Owen, A. L., Wong, D. P., Paul, D., & Dellal, A. Physical and technical comparisons between various-sided games within professional soccer. International journal of sports medicine, 2014; 35(04), 286-292.
31. Mallo, J., & Navarro, E. Physical load imposed on soccer players during small-sided training games. Journal of sports medicine and physical fitness, 2008; 48(2), 166.
32. Hodgson, C., Akenhead, R., & Thomas, K. Time-motion analysis of acceleration demands of 4v4 small-sided soccer games played on different pitch sizes. Human movement science, 2014; 33, 25-32.
33. Martone, D., Giacobbe, M., Capobianco, A., Imperlini, E., Mancini, A., Capasso, M., ... & Orrù, S. Exercise intensity and technical demands of small-sided soccer games for under-12 and under-14 players: effect of area per player. The Journal of Strength & Conditioning Research, 2017; 31(6), 1486-1492
34. Guven, F., Erkmen, N., Aktas, S., & Taskin, C. (2016). Small-sıded games ın football: effect of field sızes on technıcal parameters. Sport Scientific & Practical Aspects, 2016; 13(2).

Correspondence:
Aliasker Kumak
Marmara University Institute of Health Sciences, Istanbul
Email: aliaskerkumak@gmail.com