Influence of Different Small-Sided Game Formats on Physical and Physiological Demands and Physical Performance in Young Soccer Players

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Abstract

Castillo, D, Rodríguez-Fernández, A, Nakamura, FY, Sanchez-Sanchez, J, Ramirez-Campillo, R, Yanci, J, Zubillaga, A, and Raya-González, J. Influence of different small-sided game formats on physical and physiological demands and physical performance in young soccer players. *J Strength Cond Res* XX(X): 000–000, 2019—The aim of this study was to quantify the acute impact of bout duration and individual interaction space on physical and physiological demands and on physical performance. Ten young male soccer players (age: 14.8 ± 0.6 years) from the same team playing in the National U-16 Division participated. Physical (total distance [TD]; distance covered at different speeds; and maximum velocity [Velmax]) and physiological (peak [HRpeak] and mean [HRmean] heart rate) parameters were collected for every bout during each small-sided game (SSG) format. Moreover, the effects of SSGs on horizontal jump (HJ) and 30-m sprint performances were evaluated. The SSG formats were composed of 6 players a side (including goalkeepers) and included 4 repetitions of 6 minutes in a space of 100 m^2 (SSG1) or 200 m^2 (SSG2) and 6 repetitions of 4 minutes in 100 m^2 (SSG3) or 200 m^2 (SSG4). The TD, the distance covered at different speeds, and Velmax were greater ($p < 0.01$, effect size [ES] = 1.25–5.95, large) in SSG2 and SSG4 than SSG1 and SSG3, respectively. Furthermore, the HRmean and HRpeak were lower ($p < 0.05$, ES = 1.53–2.23, large) during SSG3 than other SSGs. In addition, while a significant ($p < 0.05$, ES = 0.70–2.04, moderate to large) increase in SPR30 time in SSG1 and SSG3 was observed, HJ performance was not affected ($p > 0.05$, ES = 0.03–0.54, trivial to moderate) by any SSG format. These findings suggest increasing pitch size to induce greater physical demands and to use SSGs with smaller pitch size, and independently of the bout duration, to induce neuromuscular fatigue.

Key Words: football, training drills, neuromuscular performance, pitch size

Introduction

The use of small-sided games (SSGs) seems to be an effective strategy for optimizing the soccer training process due to their potential to improve technical, tactical, and conditional aspects in a specific atmosphere (16,30,38). In fact, coaches usually use the specific drill of SSGs due to its structural similarity to the real game (11 players a side), aiming at developing the game model while improving the aerobic fitness and soccer-specific endurance (14,17,26). In this sense, previous studies have demonstrated that SSGs induce substantial improvements in soccer-related physical fitness (15,22,28); thus, the inclusion of SSGs in soccer periodization seems to induce positive effects because of the multicomponent nature of the training drills (21,24).

Quantifying the physical and physiological demands imposed by SSGs is important to understand the training process and how it can optimize athletes' performance (33). In this sense, previous studies have highlighted the necessity to quantify the training load imposed to players during SSG (6,34,39). Accordingly, it has been demonstrated that the modification of some parameters such as pitch size (5), number of players (6), orientation of the game (39), encouragement (36), type of marking (34), number of touches (7), presence of floaters (39), duration (18), and order of presentation within session (40) can influence players' physical and physiological responses.

Concretely, concerning pitch size, previous studies have shown that greater individual interaction space (IIS) offers young soccer players the opportunity to cover higher total distance (TD) and greater distance at medium-high velocities (13.00–21.00 $km \cdot h^{-1}$) on different SSG formats played at 200 m^2 per players in comparison with those SSG played at 100 m^2 per player (8). In addition, players attain lower heart rate (HR) as increases the pitch size (small vs. large) and number of players (3 vs. 3 vs. 9 vs. 9) (35). Besides, a significant increase in HR intensity was observed in SSGs disputed on 4-minute duration rather than 6-minute SSG (18). Therefore, it would be interesting to know how differing duration of bouts (i.e., 4 and 6 minutes) affects SSG-related fatigue, maintaining constant the total duration of a session (i.e., 24 minutes) and applying different IIS formats. This knowledge could help to apply appropriate training loads during training tasks to optimize adaptation and avoid injuries in young soccer players.

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Assessing SSG-related fatigue is a complex process because it is necessary to combine motion analysis throughout the bouts with physical performance tests performed before and after games (10,25,27). To assess such type of fatigue, it has been found that the linear straight sprint and vertical jump (e.g., countermovement jump [CMJ]) are considered the most reliable tests to determine the accumulated fatigue throughout SSGs (12,29,37). Although the effects of SSG-related fatigue induced by different SSG formats on acceleration (i.e., sprints in 5 and 15 m) (37) and vertical jump performance have been studied (12,28,32), it would be interesting to analyze the changes on physical performance throughout SSGs on longer sprint distances (i.e., 30-m) and horizontal jump (HJ), considered crucial physical capacities in soccer (43). This knowledge would be relevant for coaches due to young soccer players achieve their maximum speed velocity during a 30-m distance (1).

Therefore, the main aim of this study was to quantify the acute impact of bout duration and IIS on selected physical and physiological demands and on physical performance measures in U-16 soccer players engaged in SSG drills. We hypothesized that those SSGs played in larger IIS with higher bout duration will induce greater distances at higher intensities. In addition, as reported in previous studies, a decrease in sprint performance is expected in all SSGs.

Methods

Experimental Approach to the Problem

Players were familiarized with the study protocol during 4 sessions, during 2 weeks before the start of the study, including the use of HR monitors, global positioning system (GPS) units, the application of the physical fitness test, and SSG practice. The investigation was conducted over 2 weeks separated by 1 week during the in-season competitive period. In each week, 2 SSG formats were performed on Tuesday and Thursday. The SSGs were performed always at the usual training time of the team (21:00–22:30 hours), with the players wearing their training uniforms and soccer boots to play on the artificial grass field on which they normally trained. During the study duration, the players and their parents were instructed to maintain their usual habits, which included 8 hours of night-time sleep before each data collection session, adequate hydration, and carbohydrate intake over the 24 hours before each experimental SSG. Players were assessed for every bout of the SSGs formats, and the effects on HJ and sprint performances were evaluated before (pre-test) and after (post-test) each SSG (Figure 1). In each test session, players performed first the 30-m sprint test and after 1 minute the HJ.

Before each SSG, players undertook a 20-minute standardized warm-up, consisting of 7 minutes of slow jogging and strolling locomotion, followed by 10 minutes of specific soccer drills, to finish with 3 minutes of progressive sprints and accelerations.

Subjects

Ten young male soccer players (mean ± *SD*; age: 14.8 ± 0.6 years; height: 173 ± 7 cm; body mass: 60.6 ± 8.1 kg; training experience in the club: 3.8 ± 2.6 years) from the same team playing in the National U-16 Division participated in the study during the 2017–2018 competitive season. All the players regularly took part in three 90–120 minutes of training sessions per week, in addition to an official national competition match on Saturdays. The inclusion criteria were to belong to only one team and to not have been injured during the last month before the investigation. Coaches, players, and parents or tutors were informed of the research procedures, requirements, benefits, and potential risks before providing written informed consent (parents) and assent (players). Players participated voluntarily and had the possibility to withdraw at any time from the investigation without any penalty. The study was performed in accordance with the Declaration of Helsinki (2013), approved by the Ethics Committee of University Isabel I, and it also met the ethical standards for sport and exercise science research (22).

Procedures

Small-Sided Games. The SSG formats were composed of 6 players a side with goalkeepers (i.e., 5 vs. 5 +2 GK) defending an official soccer goal, and the objective of the game was to score more goals than the opponent. Because of their specific field role, goalkeepers were not included in the analyses. The whole duration for each SSG in all cases was 24 minutes, performed in the following formats: 4 bouts of 6 minutes in an IIS of 100 m^2 (SSG1; 38 × 26 m) and 200 m^2 (SSG2; 53 × 37 m), and in 6 bouts of 4 minutes in an IIS of 100 m^2 (SSG3; 38 × 26 m) and 200 m^2 (SSG4; 53 × 37 m). The teams were organized by the head coach according to playing positions (i.e., 1 goalkeeper, 1 central defender, 2 wings, 1 midfielder, and 1 forward), technical-tactical level, competitive experience, aerobic fitness, and coach qualitative evaluation (5). The same teams faced each other in each SSG format. The coach was required to give verbal encouragement and to introduce balls immediately when the ball left the playing field (2).

Physical Demands. To quantify soccer players' physical demands in each SSG bout, microsensor units containing a 10-Hz GPS and 100-Hz triaxial accelerometer (WIMU PRO; RealTrack Systems, Almería, Spain) were used (3). Microsensor units were harnessed in a tight-fitting vest that was worn by the soccer players during the experimental study. The microsensor devices were activated 15 minutes before the start of each testing session, in accordance with the manufacturer's recommendations. Data were downloaded post-SSG protocol to a computer and analyzed using a customized software package (WIMU SPRO; RealTrack Systems). The TD and the distance covered at different velocities were registered as: walking ($<$7.0 km·h^{-1}), jogging (7.0–14.0 km·h^{-1}), cruising ($>$14.0–21.0 km·h^{-1}), and sprinting ($>$21.0 km·h^{-1}), besides recording the maximal velocity (Velmax) achieved (42).

Heart Rate. The soccer players' HR was recorded continuously during each bout of an SSG (Garmin, Olathe, USA) at 5-second intervals, and the mean (HRmean) and peak (HRpeak) HR value were registered. The 2-minute rest periods between bouts were excluded from the analyses.

Physical Performance Evaluation. Participants performed 2 sprint trials of 30-m length (SPR30) (11). Players' starting position was 0.5 m behind the first timing gate (Microgate Polifemo, Bolzano, Italy). The time was automatically activated as participants passed the first gate; that is, at the 0-m line, and they were asked to run as fast as possible to the finish by crossing the line located at 30 m. The software Witty Manager (Microgate) was used to download the sprint test data.

After 1 minute of the sprint test, 2 maximal bilateral HJs were performed by each participant, starting from a standing position, swinging their arms and bending their knees to provide maximal forward drive. A take-off line was drawn on the ground, positioned immediately adjacent to a jump sandbox (9). Using

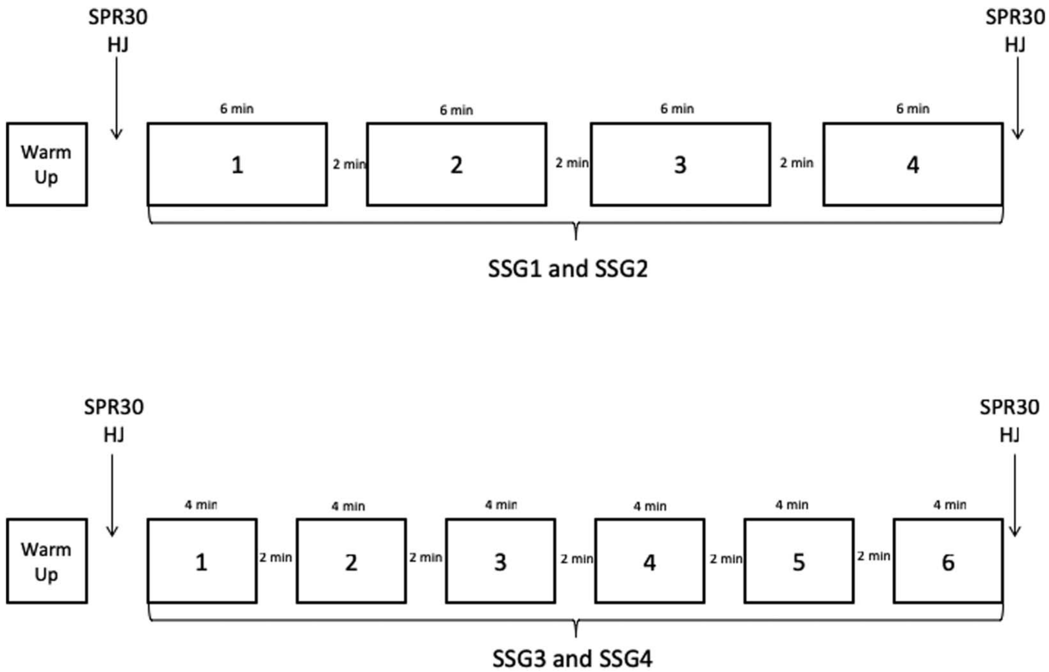

Figure 1. Temporal sequence of the fitness performances and measures obtained during each small-sided game (SSG). HJ = horizontal jump; SPR30 = sprint in 30 m.

a metric tape measure, the jump-length measurement was determined from the take-off line to the nearest point of landing contact (i.e., back of the heels). The best sprint and jump were selected for further analysis which meant a total of 80 observations (i.e., pre-SSG = 40 and post-SSG = 40 observations).

Statistical Analyses

Results are presented as mean ± *SD*. The normal distribution of the results was tested using the Kolmogorov-Smirnov test, and statistical parametric techniques were performed. The repeated-measures analysis of variance with the Bonferroni post hoc test was used to compare the physical and physiological demands among the SSG formats and to analyze the differences within each SSG bout. A paired *t*-test for dependent samples was used to compare the physical performance measures (i.e., SPR30 and HJ) in each SSG. Statistical significance was set at $p \leq 0.05$. Effect sizes (ESs) were calculated using Cohen's ES to quantify the magnitude of the difference among different SSG's physical and physiological demands and among physical performance measures. Effect size of above 0.8, between 0.8 and 0.5, between 0.5 and 0.2, and lower than 0.2 was considered as large, moderate, small, and trivial, respectively (13). Data analysis was performed using the Statistical Package for Social Sciences (version 21.0 for Windows, SPSS, Inc., Chicago, IL, USA).

Results

Physical and Physiological Demands

The TD, the distance covered at cruising and sprinting intensities, and the Velmax were greater ($p < 0.01$, ES = 1.25–5.95, large) during SSG2 and SSG4 compared with SSG1 and SSG3 formats (Table 1). Walking distance was greater ($p < 0.05$, ES = 1.73, large) during SSG3 compared with SSG4 (Table 1). Moreover, HRmean and HRpeak were lower ($p < 0.05$, ES = 1.53–2.23, large) during SSG3 compared with those with greater duration per set SSG1 and SSG2.

During the SSG1, no significant differences ($p > 0.05$, ES = 0.01–0.76, trivial to moderate) were found among bouts except that soccer players covered greater walking distance during the fourth bout in comparison with the first one ($p < 0.05$, ES = 0.56, moderate). With regard to the SSG2, lower ($p < 0.05$, ES = 1.01–2.36, large) TD and jogging distance were covered during the fourth bout compared with bouts 1 and 2 (Table 2). In addition, lower ($p < 0.05$, ES = 0.62–1.17, large) walking distance was covered during bout 4 compared with bouts 2 and 3 (Table 2). No differences ($p > 0.05$, ES = 0.03–0.45, trivial to small) were found with regard to physiological demands.

During SSG3, the TD was lower ($p < 0.05$, ES = 0.68–1.02, moderate to large) during bout 5 and 6 compared with the bout 1, and walking distance was greater ($p < 0.05$, ES = 0.83–1.29, large) during bout 4, 5, and 6 compared with the bout 1 (Table 3). With respect to the SSG4, lower ($p < 0.05$, ES = 1.63, large) cruising distance was covered in bout 5 than 4 (Table 3).

Physical Performance Evaluation

Although a significant ($p < 0.05$, ES = 0.70–2.04, moderate to large) increase in SPR30 time in SSG1 and SSG3 was observed (Figure 2B), HJ performance was not affected ($p > 0.05$, ES = 0.03–0.54, trivial to moderate) by any SSG format (Figure 2A).

Discussion

The aim of this study was to quantify the acute impact of bout duration and IIS on selected physical and physiological demands and on physical performance measures in U-16 soccer players. The results showed that the TD, the distance covered at different speeds, and Velmax were greater ($p < 0.01$, ES = 1.25–5.95, large) in SSG2 and SSG4 than SSG1 and SSG3, respectively.

Table 1

Results (mean ± *SD*) of the physical and physiological demands within the 4 small-sided game (SSG) formats.*

	SSG1	SSG2	SSG3	SSG4
TD (m)	2,254 ± 206	2,603 ± 246†	2,191 ± 291‡	2,655 ± 217†§
Walking (m)	1,192 ± 104	1,091 ± 107	1,198 ± 70	1,076 ± 91§
Jogging (m)	893 ± 207	1,174 ± 284	880 ± 280	1,182 ± 250
Cruising (m)	165 ± 45	315 ± 86†	113 ± 64‡	364 ± 105†§
Sprinting (m)	5 ± 5	23 ± 16†	0 ± 1‡	32 ± 24†§
Velmax ($km \cdot h^{-1}$)	22.1 ± 1.9	24.4 ± 2.2	19.6 ± 2.1‡	24.9 ± 2.5†§
HRmean ($b \cdot min^{-1}$)	180 ± 8	180 ± 10	161 ± 15†	176 ± 11
HRpeak ($b \cdot min^{-1}$)	195 ± 10	197 ± 10	180 ± 15†‡	193 ± 10

*TD = total distance covered; Velmax = maximum velocity achieved during SSG; HRmean = average heart rate; HRpeak = peak heart rate; SSG1 = small-sided game played for 4 bouts of 6 minutes in 100 m^2; SSG2 = small-sided game played for 4 bouts of 6 minutes in 200 m^2; SSG3 = small-sided game played for 6 bouts of 4 minutes in 100 m^2; SSG4 = small-sided game played for 6 bouts of 4 minutes in 200 m^2.

†Significant differences ($p \le 0.05$) with SSG1.

‡Significant differences ($p \le 0.05$) with SSG2.

§Significant differences ($p \le 0.05$) with SSG3.

Furthermore, the HRmean and HRpeak were lower ($p < 0.05$, ES = 1.53–2.23, large) during SSG3 than other SSGs. In addition, although a significant ($p < 0.05$, ES = 0.70–2.04, moderate to large) increase in SPR30 time in SSG1 and SSG3 was observed, HJ performance was not affected ($p > 0.05$, ES = 0.03–0.54, trivial to moderate) by any SSG format.

It was observed that TD, distance covered at cruising and sprinting categories, and Velmax were greater in SSGs played on IIS of 200 m^2 than 100 m^2. These results are in line with those reported in previous studies with youth and senior elite soccer players (4,7,8,18,39). In this sense, some authors demonstrated that U-12 and U-13 soccer players covered higher TD on bigger pitch size (i.e., IIS = 200 vs. 100 m^2) (8). Likewise, in U-16 players, higher TD and distance at medium and high velocities were covered on SSGs played on bigger pitch sizes (5). Also, higher distance at sprinting velocity was covered during SSGs when a bigger pitch size was used in professional players (41). Finally, Castellano et al. (8) observed that the Velmax achieved in large SSG (i.e., IIS = 200 m^2) was higher than in small-pitch SSGs (i.e., IIS = 100 m^2). However, in the current study, the Velmax was higher (~23 vs. ~21 $km \cdot h^{-1}$) due to the players' category because older players (U-16 vs. U-12) require different space to achieve maximum speeds (4), and SSGs imply different physical and physiological demands depending on the age of the players (8). The use of soccer tasks such as SSG2 and SSG4, which demand displacements of high speed (i.e., cruising and sprinting activities), seems to be necessary to exert a protective effect on soccer players against suffering injuries (31), as performing sprints during training can increase sprint performance along with eccentric hamstring strength (19).

On the other hand, the HRmean and HRpeak registered during SSG3 were lower than in other SSG formats. In SSG3, players probably do not have enough time (only 4 minutes) nor space (only

Table 2

Results (mean ± *SD*) of the physical and physiological demands across small-sided games (SSGs) completed with the same bout duration (4 bouts of 6 minutes) but different pitch size (100 and 200 m^2).*

	Bout number			
	1	2	3	4
SSG1				
TD (m)	595 ± 58	541 ± 62	561 ± 57	557 ± 64
Walking (m)	289 ± 27	301 ± 29	297 ± 27	304 ± 28†
Jogging (m)	252 ± 51	210 ± 63	218 ± 60	213 ± 62
Cruising (m)	53 ± 29	29 ± 10	44 ± 16	39 ± 11
Sprinting (m)	1 ± 2	1 ± 3	1 ± 2	1 ± 2
Velmax ($km \cdot h^{-1}$)	19.4 ± 2.1	19.9 ± 2.0	20.2 ± 2.0	20.4 ± 2.3
HRmean ($b \cdot min^{-1}$)	180 ± 11	179 ± 9	180 ± 9	179 ± 7
HRmax ($b \cdot min^{-1}$)	192 ± 12	193 ± 10	192 ± 10	192 ± 8
SSG2				
TD (m)	707 ± 67	690 ± 72	658 ± 69†	548 ± 53†‡
Walking (m)	276 ± 48	282 ± 27	282 ± 25	251 ± 24‡§
Jogging (m)	344 ± 92	304 ± 68	292 ± 78	235 ± 65†‡
Cruising (m)	82 ± 29	95 ± 35	79 ± 24	59 ± 29
Sprinting (m)	5 ± 5	10 ± 9	5 ± 7	3 ± 5
Velmax ($km \cdot h^{-1}$)	22.1 ± 2.1	23.1 ± 2.2	21.6 ± 2.3	21.4 ± 2.7
HRmean ($b \cdot min^{-1}$)	179 ± 12	183 ± 11	181 ± 8	178 ± 10
HRpeak ($b \cdot min^{-1}$)	192 ± 11	195 ± 11	193 ± 8	192 ± 9

*SSG1 = small-sided game played for 4 bouts of 6 minutes in 100 m^2; SSG2 = small-sided game played for 4 bouts of 6 minutes in 200 m^2; TD = total distance covered; Velmax = maximum velocity achieved during SSG; HRmean = average heart rate; HRpeak = peak heart rate.

†Significant differences ($p \le 0.05$) with bout 1.

‡Significant differences ($p \le 0.05$) with bout 2.

§Significant differences ($p \le 0.05$) with bout 3.

Table 3

Results (mean ± *SD*) of physical and physiological demands across small-sided games (SSGs) completed at the same bout duration (6 bouts of 4 minutes) and different pitch size (100 and 200 m^2).*

	Bout number					
	1	2	3	4	5	6
SSG3						
TD (m)	390 ± 50	369 ± 59	373 ± 57	356 ± 50	364 ± 55†	339 ± 46†
Walking (m)	201 ± 19	198 ± 15§	213 ± 12	199 ± 16§	190 ± 13§‖	198 ± 12§
Jogging (m)	166 ± 50	151 ± 58	145 ± 48	138 ± 55	151 ± 50	129 ± 47
Cruising (m)	23 ± 16	20 ± 16	16 ± 11	19 ± 10	23 ± 19	12 ± 10
Sprinting (m)	0 ± 0	0 ± 0	0 ± 1	0 ± 0	0 ± 0	0 ± 0
Velmax ($km \cdot h^{-1}$)	17.8 ± 2.4	17.4 ± 1.9	17.7 ± 2.3	17.6 ± 1.6	17.6 ± 2.2	17.4 ± 2.1
HRmean ($b \cdot min^{-1}$)	152 ± 19	163 ± 18	163 ± 15	164 ± 15	165 ± 14	159 ± 16
HRmax ($b \cdot min^{-1}$)	168 ± 19	175 ± 19	176 ± 15	176 ± 16	178 ± 16	172 ± 15
SSG4						
TD (m)	461 ± 37	444 ± 47	436 ± 50	468 ± 38	422 ± 51	423 ± 50
Walking (m)	179 ± 20	173 ± 15	178 ± 18	179 ± 20	205 ± 25‡§	182 ± 20
Jogging (m)	223 ± 29	208 ± 46	194 ± 54	191 ± 56	177 ± 57	189 ± 36
Cruising (m)	57 ± 29	61 ± 34	58 ± 21	80 ± 26	38 ± 18‖	50 ± 13
Sprinting (m)	2 ± 3	2 ± 3	6 ± 8	18 ± 19	3 ± 4	1 ± 3
Velmax ($km \cdot h^{-1}$)	21.1 ± 1.9	20.6 ± 2.1	22.2 ± 1.8	23.7 ± 3.4	21.0 ± 2.5	20.6 ± 1.5
HRmean ($b \cdot min^{-1}$)	174 ± 11	178 ± 10	174 ± 12	178 ± 11	173 ± 14	178 ± 10
HRpeak ($b \cdot min^{-1}$)	188 ± 11	189 ± 10	187 ± 11	190 ± 11	187 ± 15	189 ± 9

*SSG3 = small-sided game played for 6 bouts of 4 minutes in 100 m^2; SSG4 = small-sided game played for 6 bouts of 4 minutes in 200 m^2; TD = total distance covered; Velmax = maximum velocity achieved during SSG; HRmean = average heart rate; HRpeak = peak heart rate.
†Significant differences ($p \leq 0.05$) with bout 1.
‡Significant differences ($p \leq 0.05$) with bout 2.
§Significant differences ($p \leq 0.05$) with bout 3.
‖Significant differences ($p \leq 0.05$) with bout 4.

100 m^2 per player) to reach high physiological responses (23). In this way, it could be that the structure of SSG3 does not allow players greater HR values (18). Although commonly used, monitoring HR is not considered the most reliable indicator during intermittent activities that involve a high anaerobic metabolic component as it happens in SSGs (14). Considering these results, if coaches want to design drills with greater physical demands they should increase the pitch size (i.e., IIS), but if they rather want to involve players in a lower physiological effort they should prescribe SSGs on a smaller pitch, using short-duration bouts.

To investigate the acute impact of SSGs, it is necessary to combine motion analyses with physical performance tests performed before and after an SSG (10,25). In our study, most of the physical and physiological demands remain constant throughout the SSG bouts at IIS of 100 m^2, except walking distance, which was higher in the fourth bout during SSG1 compared with the first one (Table 2), and TD and distance walking in SSG3, which were lower in the last bouts (Table 3). However, a significant ($p < 0.05$, ES = 0.70–2.04, moderate to large) decrease in SPR30 was observed without decrease in HJ performance (Figure 2). These results are consistent with those reported by previous studies showing an increase in 5- and 15-m sprint time and a decrease in a CMJ performance post-SSG played by 5 vs. 5 players at an IIS of 140 m^2 in a 3 × 6-minute bout format (37). Also, Johnston et al. (28) observed a decrease in a CMJ performance post-SSG played by 6 vs. 6 players at an IIS of 175 m^2 in a 2 × 8-minute bout format. Accordingly, these findings suggest the appearance of neuromuscular fatigue probably produced by greater number of changes of direction, accelerations, and decelerations in smaller SSG formats (25). It seems that soccer players revealed neuromuscular fatigue (i.e., reduced sprint performances) in those SSGs played on a small pitch (i.e., IIS = 100 m^2) independently of the bout duration (i.e., 6 or 4 minutes) and number of exercise periods (i.e., 4 or 6 bouts).

On the other hand, in those SSGs played on a bigger pitch (i.e., 200 m^2), lower TD and distance jogging were observed

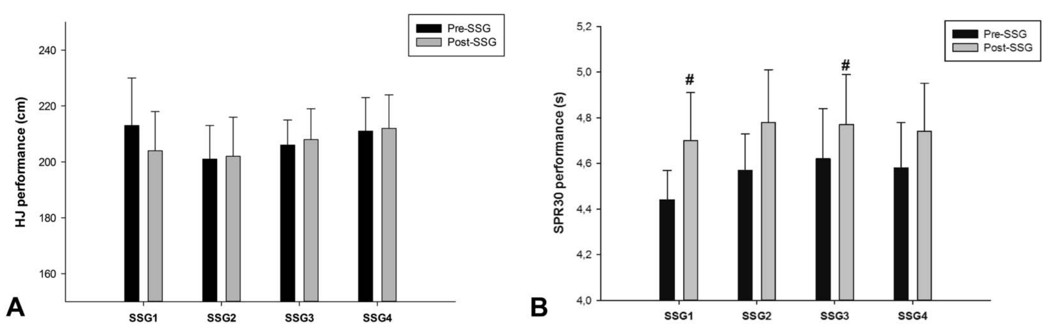

Figure 2. Pre-small-sided game to post-small-sided game (SSG) differences in the horizontal jump (HJ) (A) and in the sprint in 30-m (B) performances. #Significant difference between pre-SSG and post-SSG ($p < 0.05$).

during the fourth bout in comparison with the first 2 in 4 × 6-minute format (Table 2), and lower cruising distance was covered in the fifth bout than in the fourth bout in 6 × 4-minute format (Table 3). However, no significant differences were found on post-SSG physical performance tests compared with pre-SSG physical performance tests (i.e., SPR30 and HJ performance) (Figure 2). These results coincide with those reported by other authors who observed lower TD and distance at high velocities and a decrease in the number of sprints throughout the bouts in 4 vs. 4 and 6 vs. 6 formats (6,32,37). It seems that playing on a greater IIS (i.e., 200 m^2) implies lower physical responses in terms of TD and distance covered at high velocities in the last bouts of the development of SSG; however, no changes in explosive strength are registered. These results could be due to a metabolic fatigue (i.e., depletion of substrates) that affects soccer players because on a bigger pitch (i.e., 200 m^2), the aerobic contribution is determinant to meet the physical and physiological demands of SSG (20). These findings could be useful for coaches in appropriately planning the physical training contents within a session and during the microcycle. In addition, coaches should pay attention to the number of bouts prescribed to players recover completely or induce some degree of fatigue to promote adaptation.

This study is not exempt of limitations. The main one is the need to perform a maximal test to obtain true values of peak HR and to establish the intensity of effort and/or to quantify the HR load. In addition, a larger sample of players would be more appropriate to obtain more representative results. Finally, the analysis of football-related performance (i.e., technical-tactical actions) would have helped coaches to a better insight of the SSG phenomenon.

Higher TD, distance covered at cruising and sprinting velocities, and Velmax were registered in SSGs played on larger pitches (i.e., IIS = 200 vs. 100 m^2). In addition, a significant decrease in sprint performance (i.e., SPR30) was observed post-SSG in those SSGs with smaller pitch size, independently of the bout duration. Finally, it seems that physical demands of SSG formats were sufficient to induce fatigue in those SSGs with bigger pitch size in terms of a reduction in physical and physiological responses during the practice, while in those SSGs with smaller IIS (i.e., SSG1 and SSG3), it would be necessary to consider the physical performance measures such as neuromuscular performance tests that can indicate pre-SSG to post-SSG fatigue.

Practical Applications

The main findings of this study suggest some practical implications for coaches. First, it would be convenient to increase pitch size if coaches want to design tasks with greater physical demands. Conversely, they should prescribe tasks in a small space and with short-duration bouts (4 vs. 6 minutes) if they want to involve players in a lower physiological effort mainly in recovery or activation sessions. Second, it is possible that neuromuscular fatigue could appear in those SSGs with smaller pitch size and independently of the bout duration. Finally, depending on the objective of the SSG, players should be given enough time between SSG bouts to completely recover or not enough time to induce some degree of fatigue.

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