Published online: 2020-11-11

Can Small-side Games Provide Adequate High-speed Training in Professional Soccer?

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Key words
football, match demands, training-load, global positioning system (GPS)

accepted 12.10.2020
published online 2020

Bibliography
Int J Sports Med
DOI 10.1055/a-1293-8471
ISSN 0172-4622
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Georg Thieme Verlag KG, Rüdigerstraße 14, 70469 Stuttgart, Germany

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ABSTRACT

The aim was to compare the running activity in official matches with that achieved in two small-sided games, designed with the same relative area per player but with different constraints and field dimensions, aiming to stimulate high-speed and very-high-speed running. Seventeen young professional players played one 5 *vs*. 5 + 5 with 2 floaters, varying in terms of whether there was a change of playing area (SSG_{CA}) or not change (SSG_{NC}). Running activity was monitored using GPS and the following variables were recorded: total distance covered; high-speed distance (18–21 $km \cdot h^{-1}$); very high-speed distance (>21 $km \cdot h^{-1}$); peak speed; accelerations and decelerations between 2–3 $m \cdot s^{-2}$ and above 3 $m \cdot s^{-2}$. SSG_{CA} achieved statistically higher total distance, high-speed, peak speed and number of accelerations and decelerations than SSG_{NC} (large to small magnitude). Both drills showed statistically greater high speed, number of accelerations and decelerations than official matches (large to small magnitude). Moreover, SSG_{CA} exhibited statistically more total distance and distance at higher speed than official matches (moderate and small magnitude, respectively). In contrast, official matches showed statistically higher peak speeds than both training tasks and more very high speed than SSG_{NC} (large and moderate magnitude, respectively). Coaches could use SSG_{CA} to promote greater running activity in soccer players.

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Introduction

Small-sided games (SSGs) are one of the exercises most frequently used by soccer coaches [1–3]. SSGs are modified games played on reduced pitch areas using adapted rules and involving smaller numbers of players [4]. SSGs' ability to replicate technical-tactical requirements during competition [2, 5], improve decision making under pressure, reduce fatigue [6] and increase motivation and time efficiency during training sessions [7, 8] are some of the reasons behind their popularity.

Although it has also been demonstrated that SSGs simulate most of the matches' demands, they do not reproduce the distances covered at high or very high speeds [6, 9–14]. Since these actions are regarded as decisive during goal-scoring situations and important for injury prevention [15, 16], designing SSGs with constraints in order to allow players to reproduce these relevant actions is desirable. Designing these games for larger pitch areas (increasing the relative pitch area per player) or even using more players in larger spaces (medium-sided games or large-sided games) in order to reach higher speeds are some of the solutions proposed [10, 13, 17–20]. Although these changes in variables could be considered suitable solutions, following the specificity principle of training, there is a challenge to design soccer-specific contexts to stimulate these high-speed actions [21, 22]. Previous investigations concluded that the outfield players during official matches are grouped in an imaginary space of approximately 40 meters on each side (length range: 36–38 meters and width range: 43–46 meters), with a real individual area ranging from 65 m^2 to 110 m^2[23]. Actions such as counter-attacks, kicking the ball behind the defensive line or breaking defensive pressure during match play disrupt this organization, causing players to run at high or very high speeds. To our knowledge, there is a lack of SSG studies in which similar situations are imitated, causing disorganizations inducing players to run at higher speeds, as is necessary to meet the running demands of official matches and SSGs [10]. For these reasons, the aim of this study was to compare the running activity of official matches with two SSGs designed with the same relative area per player but with different constraints and field dimensions, trying to stimulate high-speed and very high-speed running.

Materials and Methods

Participants

Seventeen young professional soccer players (age: 18.7 ± 0.5 years; height: 176.8 ± 5.6 cm; weight: 71.6 ± 6.6 kg; % body fat (Faulkner): 11.4 ± 1.2 %) from the academy of an elite Spanish first division football club participated in this study. The ethical committee of the local university approved the study according to the principles of the Declaration of Helsinki and the ethical standards proposed by Harriss, Macsween & Atkinson [24] for studies involving human subjects. Participants were informed of the study design and its requirements, as well as the possible benefits and risks, and gave their consent prior to the start of the study.

Procedures

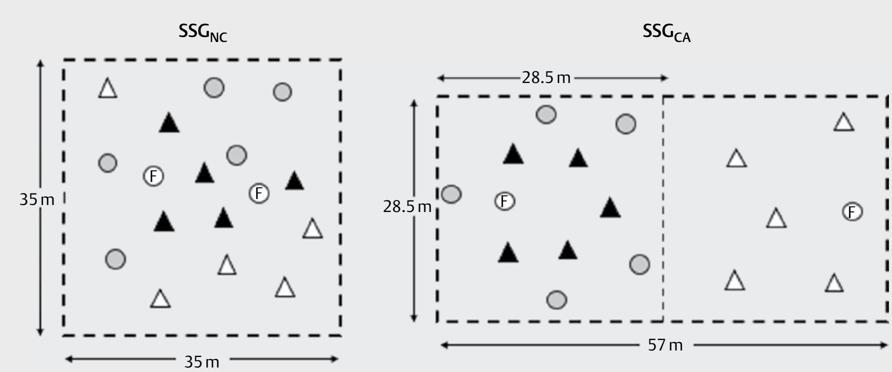
Data were collected during the first half of the 2019–2020 season (August–January). Four training sessions were recorded for analysis. Coaches used a subjective skill assessment of each player to allocate players into balanced SSG teams, as in a previous study [25]. All these sessions started with a similar 20-min standardized warm-up and were performed on a natural pitch, at the same time (10:00–12:00 am). SSGs were performed using an intermittent format of 4 rep × 4 min and played with a maximum of two touches per player.

Small-sided games and matches

Two SSGs designs were implemented in this study (▶ **Fig. 1** and ▶ **Table 1**). In both of them, players were divided into three teams, where two played an offensive role against one with a defensive role. The aim of the offensive teams was to maintain ball possession and that of the defensive team was to recover it. Both offensive teams could pass the ball between team members, but when one of them lost the ball or kicked it outside of the pitch, they had to change their role with the defensive team. SSGs were played in a 5 *vs*. 5 + 5 with 2 floaters, classified on whether there was a change of play area (SSG_{CA}) or no change of play area (SSG_{NC}). In both cases, floaters always have an offensive role, playing with teams in possession of the ball. During SSG_{CA}, two teams played in a certain area and when the attacking team scored 7 passes or the defensive team recovered the ball, they had to perform a pass to another zone where the third team was waiting the pressure of one of them. Both SSGs were designed with the same relative area per player (81 m^2), simulating matches [23]. Due to the complexity of the SSGs, players were highly familiarized with them being frequent in their daily training and standardized drills practiced for all teams of the academy. Data from nineteen official matches were collected during the first half of the season. Players that completed full games were included in the analysis (n = 100 individual data).

Running activity

Running activity was monitored using a GPS system (Wimu Pro Device, Realtrack Systems, Almería, Spain) with a sampling rate of 10 Hz. These devices have previously been validated [26–28]. Total distance covered (TD), distance covered between 18 and 21 $km \cdot h^{-1}$ (DC 18–21 $km \cdot h^{-1}$, HSD), distance covered at above 21 $km \cdot h^{-1}$ (DC > 21 $km \cdot h^{-1}$, VHSD), and peak speed were recorded. These variables have been studied in previous research [9]. The number of accelerations and decelerations between 2–3 $m \cdot s^{-2}$ and above 3 $m \cdot s^{-2}$ (Acc > 3 $m \cdot s^{-2}$ and Dec > 3 $m \cdot s^{-2}$) were also recorded. These variables have been used in the previous literature [14, 29]. All variables in matches and SSGs were relativized and expressed per minute of play.



▶ **Fig. 1** Graphical representation of the two SSGs used in the present study.

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Statistical analyses

Data are presented as mean ± standard deviation (SD). The between- and within-subject coefficient of variation (CV) was calculated [(SD/mean × 100)]. All variables presented a normal distribution (Shapiro-Wilk Test). A one-way analysis of variance (ANOVA) was used to determine differences between teams and playing positions. In the event of a significant difference, Bonferroni's post-hoc tests were used to identify any localized effects. Differences between groups and positions were analysed for practical significance using magnitude-based inferences by pre-specifying 0.2 between-subject SDs as the smallest worthwhile effect [30]. The standardized difference or effect size (ES, 90 % confidence limit [90 %CL]) in the selected variables was calculated. Threshold values for assessing magnitudes of the ES (changes as a fraction or multiple of baseline standard deviation) were < 0.20, 0.20, 0.60, 1.2 and 2.0 for trivial, small, moderate, large and very large, respectively [30].

Results

▶ **Table 2** and ▶ **Fig. 2** show running activity during SSGs and official matches. During the SSG_{CA}, players achieved statistically more TD and HSD, higher peak speed and a greater number of accelerations and decelerations than in the SSG_{NC} (large to small magnitude). When SSGs were compared with competition matches, both SSGs showed statistically higher HSD, number of accelerations and decelerations than official matches (large to small magnitude). Moreover, in SSG_{CA} players covered statistically more TD, HSD and VHSD than in official matches (moderate and small magnitude, respectively). In contrast, players in official matches achieved statistically higher absolute peak speeds than in either of the SSGs designs and engaged in statistically more VHSD than in the SSG_{NC} (large and moderate magnitude, respectively). The coefficients of variation of each variable for SSG_{NC}, SSG_{CA} and official matches are provided in ▶ **Table 2**.

Discussion

The main findings of this work suggest that play in smaller relative areas than official games will 1) increase the number of accelerations and decelerations, and 2) force players to change zones quickly during the SSG, promoting greater running activity, with higher HSD and VHSD covered per player.

It has been determined that constraints and rules during SSGs can influence the running activity of soccer players [4]. Previous studies have shown that SSGs provide insufficient stimulus to reproduce the HSD and VHSD that occur during soccer matches [9, 10, 12–14]. No previous research had analysed running activity during SSGs designed to promote high-speed running. The current analysis revealed that designing SSGs with an extra zone to which the players have to move to recover the ball is a suitable way to increase running at high speeds during these drills, with the exception of peak speeds, and probably the distances covered at a sprint (i. e. distances covered while travelling at > 25 km/h or > 85 % maximal sprinting speed). This allows coaches to compensate for some of the deficiencies that these exercises have, and achieve better reproduction of the movement patterns during official games. A previous study revealed that pitch size is a significant element to consider in the running activity of soccer players [31] and it has been shown that the orientation and availability of space can modify lo-

▶ **Table 1** Constraints, field dimensions, relative area per player and length-to-width ratio of the SSGs.

Drills	Constraint	Field dimension (m)	Area/player (m²)	Ratio L/W
5*vs*.5 + 5 with 2 floaters	NC	35 × 35	81	1:1
	CA	57 (28.5 + 28.5) × 28.5	81	2:1
Official matches	No	100 × 60	300	1.6:1

NC = SSG without change of play area; CA = SSG with change of play area; Ratio L/W = Length-to-width ratio.

▶ **Table 2** Running activity and coefficients of variation of SSGs and official matches.

	SSG_{NC}			SSG_{CA}			Official matches		
	Mean ± SD	CV_{BS}	CV_{WS}	Mean ± SD	CV_{BS}	CV_{WS}	Mean ± SD	CV_{BS}	CV_{WS}
TD (m)	104.5 ± 21.1	20 %	19 %	111.9 ± 13.7	12 %	12 %	105.2 ± 7.0	6 %	5 %
DC 18–21 ($km \cdot h^{-1}$)	6.9 ± 3.4	49 %	105 %	10.0 ± 2.4	24 %	34 %	5.0 ± 1.2	23 %	18 %
DC > 21 ($km \cdot h^{-1}$)	2.5 ± 1.8	70 %	134 %	12.8 ± 6.3	49 %	45 %	4.6 ± 2.3	49 %	22 %
Peak speed ($km \cdot h^{-1}$)	26.2 ± 2.7	10 %	10 %	27.5 ± 2.3	8 %	9 %	30.6 ± 2.1	6 %	5 %
# Acc 2–3 ($m \cdot s^{-2}$)	2.2 ± 0.6	25 %	37 %	2.6 ± 0.6	24 %	30 %	1.4 ± 0.2	17 %	12 %
# Acc > 3 ($m \cdot s^{-2}$)	0.9 ± 0.3	29 %	49 %	1.2 ± 0.3	27 %	42 %	0.7 ± 0.1	18 %	15 %
# Dec 2–3 ($m \cdot s^{-2}$)	1.9 ± 0.6	28 %	40 %	2.3 ± 0.5	22 %	31 %	1.3 ± 0.2	19 %	14 %
# Dec > 3 ($m \cdot s^{-2}$)	1.3 ± 0.4	29 %	47 %	1.6 ± 0.5	31 %	32 %	0.8 ± 0.2	19 %	15 %

Variables are presented relative to time (per minute of activity). Data are presented as mean ± DS. SSG_{NC} = SSG without change of play area; SSG_{CA} = SSG with change of play area; SD = standard deviation; CV = coefficients of variations; BS = between-subject; WS = within-subject; TD = total distance covered; DC = distance covered; # Acc = number of accelerations; # Dec = number of decelerations. All data were relativized per minute of play.

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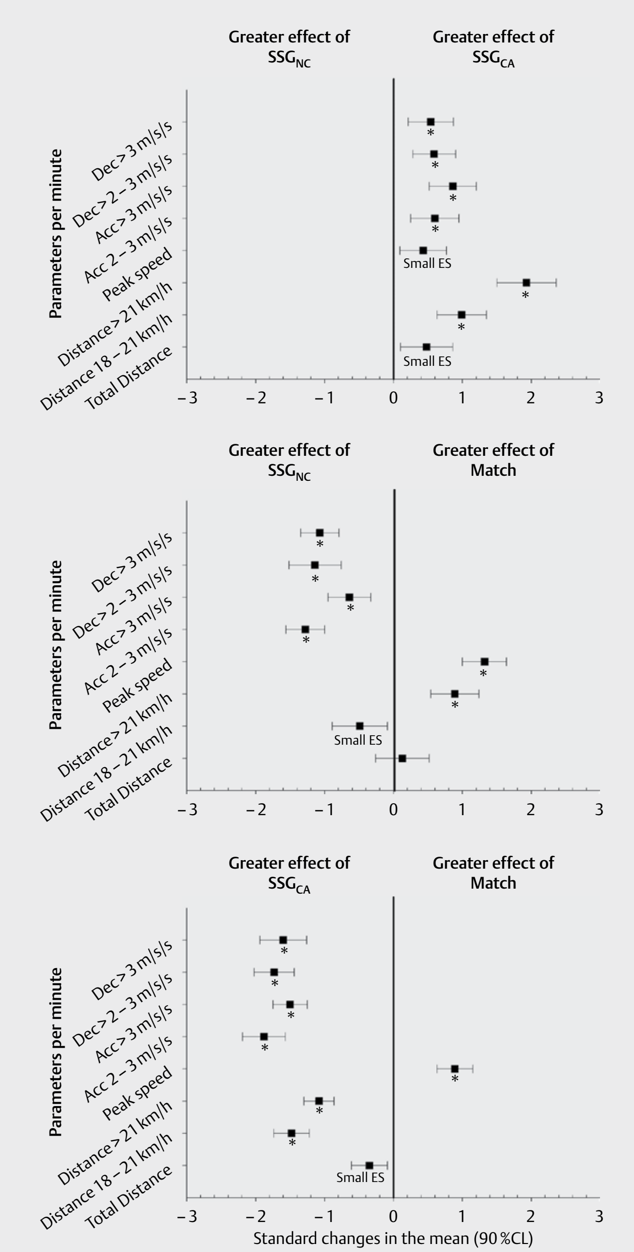

► **Fig. 2** Comparison of running activity in SSGs and official matches. SSG$_{NC}$ = SSG without change of play area; SSG$_{CA}$ = SSG with change of play area; * = $p < 0.05$.

comotor demands [31, 32]. Recent investigations have revealed that smaller pitch areas limit the necessary space for promoting high-speed running in soccer players [9, 10, 12, 14, 33, 34] and that field dimensions with greater lengths induce players to cover greater distances at high speeds than do wider fields [31, 32]. These variations in field dimensions could explain the statistical differences in running activity between the two SSG designs in this study, with lower locomotor activity in the SSG$_{NC}$ than SSG$_{CA}$ in all the analysed parameters. The substantial numerical superiority of soccer players in the SSG$_{NC}$ *vs* SSG$_{CA}$ (more than double) and the existence of a longer field (SSG$_{CA}$ = 57 meters vs. SSG$_{NC}$ = 35 meters) could be the main causes of these significant differences in running performance. According to numerical superiority, previously it has been demonstrated that a great unbalance in teams during SSGs provoked lower physical and physiological demands than lower unbalanced [35].

Our data indicated that the differences between SSG$_{NC}$ and official matches were in line with previous studies, with players performing a greater number of accelerations and decelerations relative to time in SSG$_{NC}$, but with higher peak speeds and VHSD covered during matches [9, 12, 14, 36]. Unsurprisingly, this was due to the different relative areas per player available during SSG$_{NC}$ *vs*. official matches (81 m^2 vs. 300 m^2), as has been revealed in previous studies showing that a greater relative area per player results in more HSD and VHSD covered per player [10, 12, 13, 31, 33]. The comparison between SSG$_{CA}$ and official matches yielded a novel outcome of interest to practitioners and coaches, with greater running activity relative to time obtained during the SSG$_{CA}$ in comparison with the official matches, including HSD and VHSD travelled, in addition to a higher number of accelerations and decelerations. Our findings showed that using an extra zone to which soccer players had to move quickly to recover ball possession could be an important resource for increasing the global external workload and high-speed running demands. This approach could simulate the physical and tactical requirements of official games, reproducing specific scenarios such as counter-attacks or where two players challenge for the ball in a wider space. This type of task, carried out in small spaces but with an extra zone to which the players have to move quickly to recover the ball, could be an alternative to analytic high-intensity interval runs to complement SSGs with HSD and VHSD, in addition to the overload in number of accelerations and decelerations. However, the variability of these soccer drills should be considered [13, 36]. Variability of the external load between players within a soccer drill or game (evidenced by the CV of a measurement) is of great significance for scientists and practitioners in avoiding biased interpretation when assessing the load in different SSGs during training, in order to determine how the external load fluctuates between players. The present study showed that the movement patterns during SSG$_{NC}$ had a higher variation between players (TD (20 %), HSD (49 %) and VHSD (70 %)) compared to the SSG$_{CA}$, with a fluctuation closer to the competition. The within-player variability was substantially greater in HSD and VHSD (+ 100 %) during the SSG$_{NC}$ than SSG$_{CA}$ and official matches (34–45 % and 18–22 %, respectively), due to the fact that when the players play in small spaces it is very difficult for them to reach high speeds. Based on this, coaches should be aware that not all players receive the same external load stimulus during specific soccer drills, with major or minor differences between players based on the characteristics and constraints of the soccer drill, and the contextual variables during official matches [37, 38]. Finally, the most important aspect is to ensure that soccer players receive the necessary stimulus required for competition. For such purposes, coaches can choose between an almost infinite variety of soccer exercises, or complement soccer drills with analytic training to ensure that all players receive similar amounts of high- or very-high-speed stimulus [13, 17].

Although this study provides new insights for designing specific training in soccer, it has some limitations. Firstly, only a format

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of 5vs.5 + 5 with 2 floaters were investigated, so these data cannot be extrapolated to other formats. Secondly, in this study playing positions were not differentiated, so it is not possible to compare with the specific positional requirements of competition. Future studies should investigate similar SSGs with different numbers of players and positional roles in comparison with match demands.

Conclusion

This study provides useful information for coaches aiming to provide soccer training using specific SSGs. The results indicated that when soccer is played in smaller relative areas than those used for official games, the accelerations and decelerations will be increased. Similarly, forcing players to change spaces quickly during SSGs promotes greater running activity, with higher HSD and VHSD covered per player. Although most of the running demands during matches were simulated with the proposed SSGs, it may be necessary to design other types of tasks to train for peak speed and distance covered at sprint speed.

Funding

No external sources of funding were provided for this study

Conflict of Interest

The authors declare that they have no conflict of interest.

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