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Section III – Sports Training

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Physical Performance During Soccer-7 Competition and Small-Sided Games in U12 Players

by
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The aim of this study was to compare the activity profile (external loads) during soccer-7 competition versus 6 vs 6 small-sided games (SSGs) in U12 players. Peak velocity (V_{max}), total distance completed (DT), total distance relative to match duration, the percentage of DT in acceleration (%DAC) and in deceleration (%DEA), and the percentage of DT at different speeds were recorded. Six types of SSGs were randomly implemented: without pitch orientation-delimitation and with a limit of three ball-contacts per player (3TOU), with no limit of ball-contacts (MAN), with a greater number of players as internal-offensive wildcard players (2WI) or external-offensive wildcard players (4WE); and with pitch orientation-delimitation and crossing the rival goal-line while dribbling the ball without goalkeepers (INV) or using official goalkeepers (GKP). The physical demands of SSGs were compared with the average of two soccer-7 match plays. During soccer-7 match plays a lower %DAC and %DEA ($p < 0.05$) were observed compared to 2WI, 4WE, INV and GKP, and to INV and GKP, respectively. The V_{max} and %HI were greater ($p < 0.05$) in soccer-7 match plays compared to all SSGs. In conclusion, the demands imposed on U12 players during different formats of SSGs differ from the soccer-7 match play demands, presenting a low stimulation of the actions performed at high-speed and an adequate simulation of acceleration-deceleration actions.

***Key words**: match analysis, youth athletes, game-based training.*

Introduction

Soccer is a complex sport, with competitive success depending on multiple interrelated factors (Stølen et al., 2005). This complexity makes it difficult to establish optimal training approaches (Bishop et al., 2011). However, training interventions that resemble soccer competition may constitute an adequate practical approach (Bishop, 2009). In this sense, the small-sided games (SSGs) can be a training method that closely features soccer competition, being very popular among practitioners (Halouani et al., 2014). The SSGs mirror several aspects of the competition environment using a pitch with reduced dimensions and a reduced number of players, with modified game rules, varying according to training objectives (Sampaio et al., 2014). The SSGs offer the possibility to stress physiological as well as technical abilities (Sanchez-Sanchez et al., 2017), in a complex environment that resembles soccer matches,

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including technical-tactical decision-making actions under very specific fatigue conditions (Hill-Haas et al., 2011).

In order to turn SSGs comparable to competition in terms of physical demands and to improve players' technical and tactical abilities, coaches need to know how to manipulate pitch dimensions, the number of players, practice targets (e.g., keeping ball possession or scoring) and game rules (Halouani et al., 2014; Rampinini et al., 2007) in a suitable and informed manner. A SSG-based training program can be as effective as generic interval training to improve aerobic fitness and match-related performance (Impellizzeri et al., 2006), besides enhancing repeated sprint ability (RSA) in players with a lower initial RSA level (Rodríguez-Fernández et al., 2017). In addition, in youth (under 12 years old) players, learning, decision-making and skill execution can be also developed concomitantly to fitness after periods of SSG training (Práxedes et al., 2018). Of relevance, the latter study stresses the need to plan SSG formats that are specifically designed to the age and levels of sports expertise of the players. In this aspect, studies comparing the demands of distinct SSG formats with those encountered in real matches across different age categories are required to allow more comprehensive training prescription. This is especially relevant in developmental categories in which the match naturally involves less than 11 players per team and reduced pitch dimensions (compared to adults) due to the age and the level of technical expertise of the players.

Previous research (Allen et al., 1998; Casamichana et al., 2012; Gabbett and Mulvey, 2008) has compared the external loads during different SSG configurations against official or friendly matches, with contrasting findings. In youth players (i.e., collegiate team soccer players), the total distance covered was similar between 5 vs 5 SSGs and friendly matches, although lower walking distance and greater occurence of high-intensisity running were observed during the SSGs (Allen et al., 1998). In adult soccer players (i.e., 21 ± 2 years) of the international level, a similar work-to-rest ratio was observed during 3 vs 3 and 5 vs 5 SSGs compared to official matches, although a greater number of repeated-sprint sets was observed during the official matches (Gabbett and Mulvey, 2008). In semiprofessional players (i.e., 22.8 ± 4.5 years), when SSGs (i.e., 3 vs 3, 5 vs 5, and 7 vs 7) were compared with a friendly match, the distance covered at low-moderate velocities and the relative total distance were greater during the SSGs (Casamichana et al., 2012). However, distance covered at high speed, peak running speed, and the number of high-intensity actions were greater during the friendly matches.

To our knowledge, the comparison of external loads between SSG and soccer-7 match play has not been adressed to date in U12 players. Although the senior game is played with 11 athletes per team, in some youth soccer competitions a reduced number of players is often employed (6 vs 6 + 2 goalkeepers, soccer-7 competitions in U12) (Allen et al., 1998; Sanchez-Sanchez et al., 2017). Therefore, the aim of this study was to compare the activity profile (external loads) during soccer-7 match plays versus distinct 6 vs 6 SSGs in U12 players. The six different SSG formats implemented in this study aimed to cover most of the possibilities (i.e., different rules and constrains) used by coaches while working with players at this age category, thus adding to the limited knowledge on this relevant topic of research.

Methods

Participants

Twelve regional-level U12 players (age, 10.3 ± 0.5 years; body height, 145.4 ± 5.5 cm; body mass, 37.1 ± 4.1 kg; soccer experience, 4.9 ± 0.3 years) took part in the study. Athletes trained three times per week, 90 minutes per session, with a competitive match played every weekend. All benefits, risks and requirements of participation in the study were explained to athletes and their parents. Parents signed an informed consent form and athletes gave their verbal assent. The study was conducted according to the Declaration of Helsinki and approved by the Ethics Committee of the Pontifical University of Salamanca.

Procedures

The study was conducted during the initial 4 weeks of the competitive period. During this period, athletes randomly (simple computer-generated randomization) performed different formats of SSGs and soccer-7 match plays (Table 1). Prior to this, athletes completed 3 familiarization sessions with equipment and procedures, wearing their usual training uniforms and soccer boots, on

an artificial grass field. During the study, the players were instructed to maintain their normal habits, which included 8 hours of night-time sleep before each data collection session and optimal hydration and carbohydrate intake over the 24 hours prior to each referred session. Before soccer-7 match plays and SSGs, a standardized 15-min warm-up was completed (i.e., low-intensity running, dynamic stretching and low-intensity technical-tactical actions).

Activity profiles during soccer-7 match plays and SSGs were quantified via GPS units (K-GPS 10Hz, K-Sport®, Montelabate, PU, Italy), as previously validated in soccer players (Fernandes-da-Silva et al., 2016). The GPS units were harnessed between the shoulder blades, and anchored using an undergarment to restrict movement artefact. Data were analysed using the proprietary software, K-Fitness (K-Sport®, Montelabate, PU, Italy). Each unit was activated 15 min before SSGs and matches.

According to previous recommendations (Fernandes-da-Silva et al., 2016) data analysed during soccer-7 match plays and SSGs (dependent variables) were: peak velocity (V_{max}); total distance completed (DT) and total distance relative to match duration (D_{rel}); the percentage of DT in acceleration >1.5 m/s^2 [%DAC = (DT / DAC) x 100]; the percentage of DT in deceleration >-1.5 m/s^2 [%DEA = (DT / DEA) x 100]; and the percentage of DT performed at different speeds: 0-0.4 km/h [%V1 = (DT / DV1) x 100] (standing); 0.5-3.0 km/h [%V2 = (DT / DV2) x 100] (walking); 3.1-8.0 km/h [%V3 = (DT / DV3) x 100] (jogging); 8.1-13.0 km/h [%V4 = (DT / DV4) x 100] (medium-intensity running); 13.1-18.0 km/h [%V5 = (DT / DV5) x 100] (high-intensity running); ≥18.1 km/h [%V6 = (DT / DV6) x 100] (sprinting); ≥13.1 km/h [%HI = (DT / (DV5+DV6)) x 100] (high-intensity running and sprinting activities).

To compare the dependent variables, mean values were used for analysis. In this way, mean data collected from soccer-7 match plays were calculated as [(soccer-7 match play 1 + soccer-7 match play 2)/2] and from SSGs as [(SSG1 + SSG2)/2].

Soccer-7 match plays

During the two soccer-7 match plays each team was composed of 6 outfield players and one goalkeeper (6 vs 6 + 2 GKP). Matches took place on a 40 x 64 m soccer pitch. Two halves of 30 minutes were played, with a break of 10 min in-between. Unlimited substitutions were allowed, although game rules established that each player should play at least 15 minutes per match. For the analyses, the goalkeepers were not included and the physical demand of the outfield players was taken during the time of effective participation in the game. The soccer-7 match plays took place always at 11:00 h, and the analysed team played as the local team, with final scores of 3–1 and 5–1.

Small-Sided Games

Six different SSGs formats were designed (Table 2). Each SSG was performed twice, on different days. The SSGs were played 6 vs 6, during 12 min, on an artificial grass-turf of 20 × 32 m size. The players selected to the teams during the SSGs were always the same, matched per competitive experience, player position (i.e., 4 defenders, 2 central midfielders, 4 external midfielders and 2 forward midfielders), and coach evaluation (Casamichana and Castellano, 2010). Four SSGs were played without pitch orientation-delimitation, where the aim of the game was not scoring goals, but to retain the ball as much time as possible, with a limit of three ball-contacts per player (3TOU), with no limit of ball-contacts (MAN), with a greater number of players as internal-offensive wildcard players (2WI) or external-offensive wildcard players (4WE). Two SSGs were played with pitch orientation-delimitation, where the aim of the match was to score goals, either crossing the rival goal-line while dribbling the ball without goalkeepers (INV) or by usual scoring techniques while using official goalkeepers (GKP). The technical staff of the team was always present, motivating the players to achieve maximal effort (Rampinini et al., 2007). Several soccer balls were made available around the soccer pitch with the aim to maximize the effective playing time and reduce resting time (Kelly and Drust, 2009).

Statistical analysis

Variables are presented as means ± SD. A Shapiro-Wilk test was used to analyse the normally distributed data. The homoscedasticity was assessed through the Levene's test. To identify significant differences in movement patterns between soccer-7 match plays and SSGs, the *t*-test was conducted with significance set at $p<0.05$. The standardized difference or effect size (ES) in the selected variables was calculated using the pooled

SD. Threshold values for Cohen's ES statistics were > 0.2 (small), > 0.6 (moderate), and > 1.2 (large) (Hopkins et al., 2009). Data were analysed using SPSS Statistics 22.0 (*SPSS Inc, Chicago, IL, USA*).

Results

Greater D_{rel} ($p < 0.05$) was covered in soccer-7 match plays compared to SSGs. During soccer-7 match plays, a lower %DAC ($p < 0.05$) was observed compared to 2WI, 4WE, INV and GKP. The %DEA during soccer-7 match plays was lower ($p < 0.05$) compared to INV and GKP. The V_{max} and %HI were greater ($p < 0.05$) in soccer-7 match plays compared to all SSGs. The results are presented in Table 3.

The %V2 was lower ($p < 0.05$) in soccer-7 match plays compared to 2WI (ES = -2.65), INV (ES = 1.72), GKP (ES = -3.15) and MAN (ES = -2.35), and lower ($p < 0.05$) in %V3 compared to INV (ES = -2.05) and GKP (ES = -2.19). On the other hand, %V4 was greater ($p < 0.05$) in soccer-7 match plays compared to 2WI (ES = 2.21), INV (ES = 1.80) and GKP (ES = 2.56), and greater ($p < 0.05$) in %V5 (ES = 2.35 to 4.53) as well as %V6 (ES = 1.60 to 3.42) compared to all SSGs (Figure 1).

Table 1

Chronological random-distribution of official matches and small-sided games.

Week -1			
Familiarization			
Week 1			
GKP	4WE	INV	OM1
Week 2			
2WI	MAN	2WI	
Week 3			
MAN	3TOU	3TOU	OM2
Week 4			
GKP	INV	4WE	

Note: OM = Official match; GKP = small-sided game with goalkeepers; 4WE = small-sided game with four external wildcards; INV = small-sided game with invasion objective; 2WI = small-sided game with two internal wildcards; MAN = small-sided game with maintenance objective; 3TOU = small-sided game with three touches to the ball.

Table 2

Small-sided games characteristics.

	Score aim*	Number of ball-contact per player	Goalkeepers	Wildcards
2WI	No	Free	No	2 internal
3TOU	No	3 per player	No	No
4WE	No	Free	No	4 externals
INV	Yes	Free	No	No
GKP	Yes	Free	Yes	No
MAN	No	Free	No	No

*Note: 2WI = small-sided game with two internal wildcards; 3TOU = small-sided game with three touches to the ball; 4WE = small-sided game with four external wildcards; INV = small-sided game with invasion objective without goalkeepers; GKP = small-sided game with goalkeepers; MAN = small-sided game with maintenance objective; *: in matches with a score aim, players tried to score as many goals as possible, and during matches with no score aim, players tried to retain the ball as much time as possible.*

Table 3

Physical demands during soccer-7 match plays and small-sided games.

	OM	2WI	3TOU	4WE	INV	GKP	MAN
D_{rel}	88.9 ± 7.2	73.4 ± 9.4*	77.9 ± 9.8*	72.3 ± 13.4*	73.4 ± 5.1*	64.6 ± 6.5*	77.3 ± 10.7*
		ES = 1.87	ES = 1.29	ES = 1.61	ES = 2.52	ES = 3.55	ES = 1.30
%DAC	9.92 ± 0.9	11.7 ± 1.2*	11.0 ± 1.5	11.5 ± 0.7*	12.4 ± 0.8*	12.0 ± 0.5*	10.7 ± 1.4
		ES = -1.70	ES = -0.90	ES = -1.98	ES = -2.92	ES = -2.97	ES = -0.68
%DEA	10.2 ± 0.9	11.6 ± 1.3	11.1 ± 1.7	11.7 ± 0.9	12.5 ± 1.0*	12.2 ± 0.5*	11.3 ± 1.4
		ES = -1.27	ES = -0.69	ES = -1.67	ES = -2.42	ES = -2.86	ES = -0.96
Vmax	23.2 ± 1.3	18.8 ± 1.3*	19.1 ± 1.7*	19.0 ± 1.5*	19.4 ± 1.1*	18.4 ± 1.0*	19.8 ± 0.9*
		ES = 3.38	ES = 2.73	ES = 3.00	ES = 3.17	ES = 4.17	ES = 3.09
%HI	20.6 ± 2.8	7.34 ± 2.6*	10.8 ± 3.9*	10.0 ± 4.2*	12.2 ± 4.4*	8.05 ± 2.3*	7.07 ± 2.6*
		ES = 4.91	ES = 2.93	ES = 3.03	ES = 2.33	ES = 4.92	ES = 5.01

Note: D_{rel} = relative distance (m/min); %DAC = percentage of total distance in acceleration; %DEA = percentage of total distance in deceleration; V_{max} (km/h) = maximum speed; %HI = percentage of total distance performed at ≥ 13.1 km/h; OM = soccer-7 match plays; 2WI = small-sided game with two internal wildcard; 3TOU = small-sided game with three touches to the ball; 4WE = small-sided game with four external wildcard; INV = small-sided game with invasion objective; GKP = small-sided game with goalkeepers; MAN = small-sided game with maintenance objective; ES = effect size with respect to OM.
*Significant differences ($p < 0.05$) compared with OM. To avoid a misinterpretation, positive results indicate a greater value for OM, while negative results show a higher value for SSG

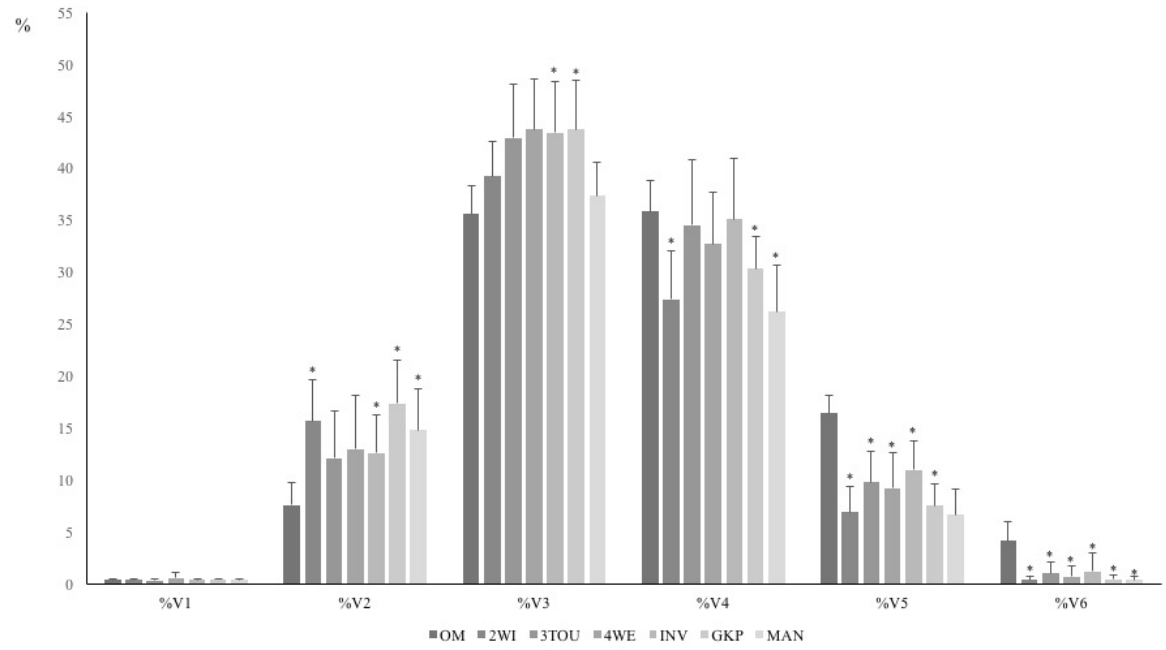

Figure 1

Distance at different speeds during soccer-7 match plays and small-sided games. Note: %V1 = percentage of total distance performed at 0-0.4 km/h; %V2 = percentage of total distance performed at 0.5-3.0 km/h; %V3 = percentage of total distance performed at 3.1-8.0 km/h; %V4 = percentage of total distance performed at 8.1-13.0 km/h; %V5 = percentage of total distance performed at 13.1-18.0 km/h; %V6 = percentage of total distance performed at ≥18.1 km/h; OM = soccer-7 match plays; 2WI = small-sided game with two internal wildcards; 3TOU = small-sided game with three touches to the ball; 4WE = small-sided game with four external wildcards; INV = small-sided game with invasion objective; GKP = small-sided game with goalkeepers; MAN = small-sided game with maintenance objective

**Significant differences ($p < 0.05$) compared with OM.*

Discussion

The aim of this study was to compare the activity profile (external loads) during competitive soccer-7 match plays versus 6 vs 6 SSGs in U12 players. The main outcomes refer to the manipulation of different constraints of the task (including soccer-7 match plays) such as the constrain of the pitch area, the number of contacts with the ball, the presence of goalkeepers and the presence of the wildcard players. In general, the SGGs formats investigated here failed to reproduce the average demands of the soccer-7 match plays, under-representing the actions at high-speed, but magnifying those related to acceleration and deceleration.

Although SSGs are usually thought to simulate the physical demands of competition (Little, 2009), and are very effective training strategies to improve soccer players physical performance (Hill-Haas et al., 2009; Rodríguez-Fernández et al., 2017), this may not be applicable to all SSG formats and variables of physical demands (Castellano and Casamichana, 2013). Specially, the investigated SSGs formats provided an insufficient stimulus for important competitive soccer performance requeriments (i.e., high-speed and sprint actions) (Casamichana et al., 2012; Gabbett and Mulvey, 2008) in youth soccer players. This may limit the utility of SSGs to develop specific fitness requirements, given the high-speed demands of competitive matches (Sanchez-Sanchez et al., N.d.), which grow in importance during senior soccer matches (Barnes et al., 2014).

Our results are in agreement with those obtained in adult players (Casamichana et al., 2012), where the reduction of absolute dimensions of the playing space (640 m2 in SSGs vs. 2480 m2 in soccer-7 match plays) changed the physical demands of the players (Casamichana and Castellano, 2010; Hodgson et al., 2014; Owen et al., 2014). However, to our knowledge, this is the first study to corroborate such an effect in youth soccer players (U12) competing in the soccer-7.

The use of SSGs seems to underestimate several demands obtained during the match (Hodgson et al., 2014). A low stimulation of Drel was observed in all SSGs formats studied. However, previous studies in adult soccer players indicated that, contrary to our findings, SSGs may increase D_{rel} with respect to the values of the official matches (Casamichana et al., 2012; Dellal et al., 2012; Owen et al., 2014). It can be speculated that the meaningful differences in technical-tactical abilities between youth and professional soccer players may modulate the effect of the pitch dimensions on the intensity of the game (Clemente et al., 2012).

However, it seems that there is a relative consensus in the literature that SSGs under-stimulate the demands related to the high-speed actions compared to the average demands of soccer-7 match plays. Our results indicated that %HI and Vmax were lower during the SSGs compared to the soccer-7 match plays. In order to allow players to achieve the thresholds corresponding to high-speed or a sprint, longer time and space while accelerating are needed (Djaoui et al., 2017). Hence, distances covered during these actions increase in proportion to increases in absolute (m2) and relative (m2 per players) playing areas (Castellano and Casamichana, 2013; Hill-Haas et al., 2009; Lacome et al., 2018). Nevertheless, the distance covered normally observed during SSG training sessions seem to be shorter and less variable compared to real matches (Fradua et al., 2013). In our study, the absolute size of pitches was 640 m2 for several of the SSG formats and 2480 m2 during soccer-7 match plays, whereas the area per player varied between 45 m2 per player during the 2WI and 54 m2 in the rest of SSG formats (excluding the goalkeeper and the external wildcard players), while during the soccer-7 matches players could ocuppy an average of 206 m2.

Based on the results obtained here, and in agreement with previous research (Owen et al., 2014), the high-speed and sprint actions are less stimulated with SSGs played on small pitches. Therefore, during soccer-7 training, other tasks should be included to avoid under-stimulation of high-speed and sprint actions. Thus, it is necessary to include in the training process formats of games with larger absolute dimensions and larger relative dimensions to each participant, or some exercise such as high-intensity interval runs, that have shown to exceed the values obtained in the worst possible scenario of the competition in variables such as distance covered or especially distance covered at high-speed (Lacome et al., 2018). On the other hand, in the current study a greater %V2 was observed during 2WI, INV, GKP and MAN compared to soccer-7 match plays, which contrasts with previous findings where a greater covered distance at low-speed was observed during friendly matches compared to SSGs (Allen et al., 1998). This may be related to the greater high-speed actions and repeated sprints observed during SSGs performed in large pitch dimensions (Hodgson et al., 2014).

Of note, the demands of acceleration and deceleration during SSGs exceed the values of the soccer-7 match plays. It seems that, independent of the format of the SSGs, a reduced game surface seems to increase neuromuscular demands (Castellano and Casamichana, 2013; Hodgson et al., 2014), with repeated recruitment of muscles to complete concentric-eccentric actions (Hodgson et

al., 2014), with effects similar to those achieved by repeated-sprint training (Chaouachi et al., 2014). In this case, SSGs resemble the demands of a competitive match, increasing the training specificity of the SSGs training approach from a physiological point of view. However, in our opinion, more studies are necessary to verify whether the acceleration-deceleration demands of SSGs (Rago et al., 2017) are sufficient to stimulate match-specific training adaptations or if well-designed physical training drills should be implemented and added to the game-based strategies. Nevertheless, a reduced pitch surface during SSGs may stimulate technical and tactical demands (Sanchez-Sanchez et al., 2017), being similar to those observed during competition.

This study compared the activity profile (external loads) during soccer-7 match plays versus 6 vs 6 SSGs in U12 soccer players. Future studies may expand the current findings, incorporating a greater sample of players from different field positions, adding psychophysiological, technical, and tactical measurements in order to better understand the effects of these different game formats in relation to the demands of the soccer-7 match plays. This would allow for better planning of training loads. In addition, the comparison of the demands of the SSGs with the "worst scenarios" that come out during the soccer-7 match plays could give more information related to the capacity of the SSG tasks to replicate or even exceed the demands of these activities within the soccer-7 match plays.

Conclusions

The demands imposed on U12 players during different formats of SSGs differ from the soccer-7 match plays demands, presenting an under-stimulation of the actions performed at high-speed, but an adequate simulation of acceleration-deceleration actions. Exposure to these formats of SSGs repeatedly over time could lead to an over- or under-stimulation of different abilities, with implications for both sports performance and for the athlete's health (e.g., injury risk).

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References

Allen JD, Butterly R, Welsch MA, Wood R. The physical and physiological value of 5-A-Side soccer training to 11-A-Side match play. *J Hum Movement Stud,* 1998; 34(1): 1–12

Barnes C, Archer DT, Hogg B, Bush M, Bradley PS. The Evolution of Physical and Technical Performance Parameters in the English Premier League. *Int J Sports Med*, 2014; 35(13): 1095–1100

Bishop D, Girard O, Mendez-Villanueva A. Repeated-sprint ability - part II: recommendations for training. *Sports Med*, 2011; 41(9): 741–756

Bishop D. Game sense or game non sense? *J Sci Med Sport,* 2009; 12(4): 426–427

Casamichana D, Castellano J. Time-motion, heart rate, perceptual and motor behaviour demands in small-sides soccer games: effects of pitch size. *J Sports Sci*, 2010; 28(14): 1615–1623

Casamichana D, Castellano J, Castagna C. Comparing the physical demands of friendly matches and small-sided games in semiprofessional soccer players. *J Strength Cond Res*, 2012; 26(3): 837–843

Castellano J, Casamichana D. Differences in the number of accelerations between small-sided games and friendly matches in soccer. *J Sports Sci Med*, 2013; 12(1): 209–210

Chaouachi A, Chtara M, Hammami R, Chtara H, Turki O, Castagna C. Multi-directional sprints and small-sided games training effect on agility and change of direction abilities in youth soccer. *J Strength Cond Res*, 2014; 28(11): 3121–3127

Clemente F, Couceiro MS, Martins FML, Mendes RUI. The usefulness of small-sided games on soccer training. *J Phy Ed Sport*, 2012; 12(1): 93–102

Dellal A, Owen A, Wong DP, 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. *Hum Mov Sci*, 2012; 31(4): 957–969

Djaoui L, Chamari K, Owen AL, Dellal A. Maximal Sprinting Speed of Elite Soccer Players During Training and Matches. *J Strength Cond Res*, 2017; 31(6): 1509–1517

Fernandes-da-Silva J, Castagna C, Teixeira AS, Carminatti LJ, Guglielmo LGA. The peak velocity derived from the Carminatti Test is related to physical match performance in young soccer players. *J Sports Sci*, 2016; 34(24): 2238–2245

Fradua L, Zubillaga A, Caro O, Fernández-García A, Ruiz-Ruiz C, Tenga A. Designing small-sided games for training tactical aspects in soccer: extrapolating pitch sizes from full-size professional matches. *J Sports Sci*, 2013; 31(6): 573–581

Gabbett TJ, Mulvey MJ. Time-motion analysis of small-sided training games and competition in elite women soccer players. *J Strength Cond Res*, 2008; 22(2): 543–552

Halouani J, Chtourou H, Gabbett T, Chaouachi A, Chamari K. Small-sided games in team sports training: Brief review. *J Strength Cond Res*, 2014; 28(12): 3594–3618

Hill-Haas SV, Coutts AJ, Rowsell GJ, Dawson BT. Generic versus small-sided game training in soccer. *Int J Sports Med*, 2009; 30(9): 636–642

Hill-Haas SV, Dawson B, Impellizzeri FM, Coutts AJ. Physiology of small-sided games training in football: a systematic review. *Sports Med*, 2011; 41(3): 199–220

Hodgson C, Akenhead R, Thomas K. Time-motion analysis of acceleration demands of 4v4 small-sided soccer games played on different pitch sizes. *Hum Mov Sci*, 2014; 33: 25–32

Hopkins WG, Marshall SW, Batterham AM, Hanin J. Progressive statistics for studies in sports medicine and exercise science. *Med Sci Sports Exe*, 2009; 41(1): 3–13

Impellizzeri FM, Marcora SM, Castagna, C, Reilly C, Sassi A, Iaia FM, Rampinini E. Physiological and performance effects of generic versus specifici aerobic training in soccer players. *Int J Sports Med,* 2006; 27(6): 483-492

Kelly DM, Drust B. The effect of pitch dimensions on heart rate responses and technical demands of small-sided soccer games in elite players. *J Sci Med Sport,* 2009; 12(4): 475–479

Lacome M, Simpson BM, Cholley Y, Buchheit M. Locomotor and Heart Rate Responses of Floaters During Small-Sided Games in Elite Soccer Players: Effect of Pitch Size and Inclusion of Goal Keepers. *Int J Sport Physiol Perfrm*. 2018; 13(5):668-671

Little T. Optimizing the Use of Soccer Drills for Physiological Development. *Strength Cond J*, 2009; 31(3): 67–74

Owen A, Wong DP, Paul D, Dellal A. Physical and Technical Comparisons between Various-Sided Games within Professional Soccer Physical and Technical Comparisons between Various- Sided Games within Professional Soccer. *Int J Sport Med*, 2014; 35: 286–292

Práxedes A, Moreno A, Gil-Arias A, Claver F, Del Villar F. The effect of small-sided games with different levels of opposition on the tactical behaviour of young footballers with different levels of sport expertise. *PLoS One,* 2018; 13(1): e0190157

Rago V, Silva JR, Mohr M, Barreira D, Krustrup P, Rebelo AN. The inter-individual relationship between training status and activity pattern during small-sided and full-sized games in professional male football players. *Sci Med Foot*, 2017: 1–8

Rampinini E, Impellizzeri FM, Castagna C, Abt G, Chamari K, Sassi A, Marcora SM. Factors influencing physiological responses to small-sided soccer games. *J Sports Sci*, 2007; 25(6): 659–666

Rodríguez-Fernández A, Sánchez JS, Rodríguez-Marroyo JA, Casamichana D, Villa JG. Effects of 5-week pre-season small-sided-game-based training on repeat sprint ability. *J Sports Med Phys Fit*, 2017; 57(5): 529-536

Sampaio JE, Lago C, Gonçalves B, Maçãs VM, 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. *J Sci Med Sport*, 2014; 17(2): 229–233

Sánchez-Sánchez J, Hernandez D, Casamichana D, Martinez C, Ramírez-Campillo R, Sampaio J Heart rate, technical performance and session-RPE in elite youth soccer small-sided games played with wildcard player. *J Strength Cond Res*, 2017; 31(10): 2678–2685

Sanchez-Sanchez J, Sanchez M, Hernandez D, Ramirez-Campillo R, Martínez C, Nakamura FY. Fatigue in U12 soccer-7 players during repeated one-day tournament games - a pilot study. *J Strength Cond Res*, N. d.

Stølen T, Chamari K, Castagna C, Wisløff U. Physiology of Soccer. *Sports Med*, 2005; 35(6): 501–536

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