Chapter 5
Acute Effects of Different Sizes of the Field

Abstract The size of the field is one of the main variables that have been analyzed in the aim of the small-sided and conditioned games. Different sizes for the same format of the game influence the acute physiological responses and the time–motion profile of players. For that reason, it is extremely important to identify the most common sizes analyzed in the studies and provide the information to the coaches to optimize the possibilities, and adjust the size of the field in the training context. Therefore, the internal and external training load and the information about the implications in technical actions and tactical behavior will be summarized in the chapter.

Keywords Training load · Size of the field · Small-sided and conditioned games · SSG · Drill-based exercises · Soccer · Football · Sports training

5.1 Introduction

The format of the game influences the acute responses of soccer players as verified in the previous chapter. Nevertheless, the size of the field may also contribute to constrain the activities made in small-sided and conditioned games (SSCG) and for that reason influences the physiological responses and also the technical performance (Clemente et al. 2014). The larger or smaller size of the field will determine the space of play to run or to make decisions. Based on the area of play, the individual space for each player will also be determined. This individual play area of SSCGs can be calculated by dividing the field size by the number of players (Casamichana and Castellano 2010; Fradua et al. 2013).

This chapter will summarize the studies that analyzed the acute effects of different playing areas per player. To make the presentation easier, the tables will be presented per format. Based on this structure, it will be possible to easily verify the most common areas per format and also the length to width ratio that coaches may use to design their SSCGs. A conclusion with some highlights and recommendations will be presented in the end of this chapter.

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5.2 Size of the Field: Review of Acute Effects

The size of the field influences the time–motion profile of players. More or less area per player constrains the motion, the actions, and the time to make decisions. The size of the field must consider the area that provides an average per player and for that reason the size will depend from the format of the game (number of players in the task). An analysis to different areas per format will be made in this section.

5.2.1 Comparison of Different Area in 1 Versus 1 Format

Only one study (Owen et al. 2004) compared different sizes of the field in 1 versus 1 format, as far as we know. The heart rate analysis revealed that the biggest areas (75 and 150 m^2) increased the beats per minute (bpm) in comparison with the smaller area (25 m^2). A difference of 6 bpm was identified between the smaller and the bigger formats (see Table 5.1).

5.2.2 Comparison of Different Area in 2 Versus 2 Format

Following the study conducted in 1 versus 1, the same authors (Owen et al. 2004; Williams and Owen 2007) compared the effects of different sizes of the field on 2 versus 2 format (see Table 5.2). The results also revealed that two biggest areas per player (75 and 125 m^2) resulted in an increase of heart rate responses. A difference of 8 bpm was found between the smaller (38 m^2) and the bigger format.

5.2.3 Comparison of Different Area in 3 Versus 3 Format

Four studies (Köklü et al. 2013; Owen et al. 2004; Rampinini et al. 2007; Williams and Owen 2007) that analyzed 3 versus 3 in different field sizes are unanimous in concluding that great sizes increase the acute physiological responses (heart rate,

Table 5.1 Acute physiological effects during 1 versus 1 with different field sizes

Study	Participants	Regimen	SF	APP (m^2)	HR (bpm)	BLa^{-1}	RPE
Owen et al. (2004)	13 (U17)	1 × 3 min/12 min rest	10 × 5	25	176	–	–
			15 × 10	75	181	–	–
			20 × 15	150	182	–	–

SF Size of the field (m); *APP* Area per player; *HR* Heart rate; *BLa^{-1}* Blood lactate concentration (mmol/L); *RPE* Rated of perceived exertion

Table 5.2 Acute physiological effects during 2 versus 2 with different field sizes

Study	Participants	Regimen	SF	APP (m^2)	HR (bpm)	BLa^{-1}	RPE
Owen et al. (2004)	13 (U17)	1 × 3 min/12 min rest	15 × 10	38	172	–	–
			20 × 15	75	179	–	–
			25 × 20	125	180	–	–
Williams and Owen (2007)	9 (U17)	–	20 × 15	75	179	–	–
			25 × 20	125	180	–	–

SF Size of the field (m); *APP* Area per player; *HR* Heart rate; *BLa^{-1}* Blood lactate concentration (mmol/L); *RPE* Rated of perceived exertion

blood lactate concentrations, and perceived exertion). The smaller formats varied between 40 and 50 m^2, and bigger formats between 90 and 125 m^2. The studies that used the percentage of maximal heart rate reported values above 90 % in the bigger format, and in smaller formats between 87 and 89.5 % (Köklü et al. 2013; Rampinini et al. 2007). A difference of 0.5 mmol/L between the smaller and the bigger format was found in the unique study (Rampinini et al. 2007) that tested the blood lactate concentrations. The perceived exertion also confirmed the greater effort made in the bigger field (see Table 5.3).

5.2.4 Comparison of Different Area in 4 Versus 4 Format

The studies conducted in 4 versus 4 format verified once again that bigger fields increases the acute physiological responses (see Table 5.4). In this format, it verified that the values were between 82.7 and 90.7 % of HRmax in the bigger fields (100–188 m^2 per player). The smaller fields (48–75 m^2) revealed heart rate responses between 79.1 and 88.7 % of HRmax. A difference between 7 and 8 mmol/L was found between the smallest and the biggest fields. The studies also reported greater values of perceived exertion in the bigger formats.

5.2.5 Comparison of Different Area in 5 Versus 5 Format

Studies carried out in 5 versus 5 format showed more complete information (with technical and time–motion analysis). A unique study found greater heart rate intensities in smaller field than in bigger (Kelly and Drust 2009). The conclusions of the remaining studies followed the evidences described in the smaller formats: bigger area per player increases the acute physiological responses (see Table 5.5). In this format, the smaller fields varied between 56 and 101 m^2, and the biggest fields between 126 and 273 m^2. The first study conducted in this format revealed a difference of 10 bpm between the smaller and the bigger field (Owen et al. 2004).

Table 5.3 Acute physiological effects during 3 versus 3 with different field sizes

Study	Participants	Regimen	SF	APP (m^2)	HR	BLa^{-1}	RPE [0-10 scale]
Owen et al. (2004)	13 (U17)	1 × 3 min/12 min rest	15 × 20	50	167 bpm	–	–
			20 × 25	83	167 bpm	–	–
			25 × 30	125	173 bpm	–	–
Rampinini et al. (2007)[a]	20 (Amateurs)	1 × 4 min/3 min rest	12 × 20	40	89.5 % HRmax	6.0	8.1
			15 × 25	63	90.5 % HRmax	6.3	8.4
			18 × 30	90	90.9 % HRmax	6.5	8.5
Williams and Owen (2007)	9 (U17)	–	20 × 15	50	164 bpm	–	–
			25 × 20	83	166 bpm	–	–
			30 × 25	125	171 bpm	–	–
Köklü et al. (2013)	16 (U15)	4 × 3 min/2 min rest	20 × 15	50	176 bpm 87.1 % HRmax	–	5.2
			25 × 18	75	180.1 bpm 89.0 % HRmax	–	5.6
			30 × 20	100	184.2 bpm 91.0 % HRmax	–	6.1

SF Size of the field (m); *APP* Area per player; *HR* Heart rate; BLa^{-1} Blood lactate concentration (mmol/L); *RPE* Rated of perceived exertion

[a]HR values with verbal encouragement during task

Differences between 1 and 1.6 % of HRmax were found in the remaining studies (Aslan 2013; Casamichana and Castellano 2010; Hodgson et al. 2014; Rampinini et al. 2007).

The time–motion analysis may provide the justification for the greatest acute physiological responses in bigger fields (Casamichana and Castellano 2010; Hodgson et al. 2014). The study conducted by Casamichana and Castellano (2010) revealed that players covered more 43.66 % of the distance in the bigger field (273 m^2) than in the smaller (74 m^2). In the same study, it was also found that players covered more 8.66 m/min of the distance in sprint in bigger field than in the smaller. An increase of 26.24 % of the distance covered, and a greater distance covered in sprint (including accelerations) in bigger format was also found by Hodgson et al. (2014) (Table 5.6).

Despite the greater intensities found in bigger fields, the technical analysis that compared different sizes in 5 versus 5 revealed that smaller field increases the technical performance (Aslan 2013; Hodgson et al. 2014). More ball possessions, passes, and successful passes were carried out in smaller fields. By the other hand, more dribbles were made in bigger fields (maybe for the increase on the space to try the dribble and the duel) (Table 5.7).

Table 5.4 Acute physiological effects during 4 versus 4 with different field sizes

Study	Participants	Regimen	SF	APP (m^2)	HR	BLa^{-1}	RPE
Aroso et al. (2004)	14 (U16)	1 × 1 min, 30 s/1 min, 30 s rest	30 × 20	75	79.1 % HRmax	2.6	13.3 [0–20 scale]
			50 × 30	188	82.7 % HRmax	3.4	14.7 [0–20 scale]
Owen et al. (2004)	13 (U17)	1 × 3 min/12 min rest	20 × 25	63	147 bpm	–	–
			25 × 30	94	160 bpm	–	–
			30 × 35	131	158 bpm	–	–
Rampinini et al. (2007)[a]	20 (Amateurs)	1 × 4 min/3 min rest	16 × 24	48	88.7 % HRmax	5.3	7.6 [0–10 scale]
			20 × 30	75	89.4 % HRmax	5.5	7.9 [0–10 scale]
			24 × 36	108	89.7 % HRmax	6.0	8.1 [0–10 scale]
Köklü et al. (2013)	16 (U15)	4 × 4 min/2 min rest	20 × 20	50	175.0 bpm 86.5 % HRmax	–	4.4 [0–10 scale]
			30 × 20	75	179.9 bpm 88.9 % HRmax	–	5.0 [0–10 scale]
			32 × 25	100	183.5 bpm 90.7 % HRmax	–	5.3 [0–10 scale]

SF Size of the field (m); *APP* Area per player; *HR* Heart rate; BLa^{-1} Blood lactate concentration (mmol/L); *RPE* Rated of perceived exertion
[a]HR values with verbal encouragement during task

Table 5.5 Acute physiological effects during 5 versus 5 with different field sizes

Study	Participants	Regimen	SF	APP (m^2)	HR	BLa^{-1}	RPE
Owen et al. (2004)	13 (U17)	1 × 3 min/12 min rest	25 × 30	75	154 bpm	–	–
			30 × 35	105	163 bpm	–	–
			35 × 40	140	164 bpm	–	–
Rampinini et al. (2007)[a]	20 (Amateurs)	1 × 4 min/3 min rest	28 × 20	56	87.8 % HRmax	5.2	7.2 [0–10 scale]
			35 × 25	88	88.8 % HRmax	5.0	7.6 [0–10 scale]
			42 × 30	126	88.8 % HRmax	5.8	7.5 [0–10 scale]
Kelly and Drust (2009)	8 (elite)	4 × 4 min/2 min rest	30 × 20	60	91.0 % HRmax	–	–
			40 × 30	120	90.0 % HRmax	–	–
			50 × 40	200	89.0 % HRmax	–	–
Casamichana and Castellano (2010)	10 (U16)	3 × 8 min/5 min rest	32 × 23	74	93.0 % HRmax	–	6.7 [0–10 scale]
			50 × 35	175	94.6 % HRmax	–	6.7 [0–10 scale]
			62 × 44	273	94.6 % HRmax	–	5.7 [0–10 scale]
Aslan (2013)	10 (Recreational)	1 × 40 min	44 × 23	101	79.4 % HRres	–	1.2 [0–20 scale]
			57 × 30	171	81.7 % HRres	–	1.9 [0–20 scale]
Hodgson et al. (2014)	8 (Amateurs)	4 × 3 min/2 min rest	30 × 20	60	164 bpm 86 % HRmax	–	–
			40 × 30	120	168 bpm 87 % HRmax	–	–
			50 × 40	200	168 bpm 87 % HRmax	–	–

SF Size of the field (m); *APP* Area per player; *HR* Heart rate; *BLa^{-1}* Blood lactate concentration (mmol/L); *RPE* Rated of perceived exertion

[a]HR values with verbal encouragement during task

Table 5.6 Time–motion analysis during 5 versus 5 in different field sizes

Study	Regimen	SF	APP (m^2)	TD	TD 0-6.9	TD 7.0-12.9	TD 13.0-17.9	TD > 18
Casamichana and Castellano (2010)	3 × 8 min/5 min rest	32 × 23	74	695.8	401.7	238.9	50.2	4.9
		50 × 35	175	908.9	390.6	329.3	155.4	28.5
		62 × 44	273	999.6	378.2	366.3	180.9	74.2
Hodgson et al. (2014)	4 × 3 min/2 min rest	30 × 20	60	1532	–	–	–	0
		40 × 30	120	1941	–	–	–	40
		50 × 40	200	1934	–	–	–	77

TD Total distance (m); *TD* 0–6.9 Total distance at 0–6.9 km h^{-1}; *TD* 7.0–12.9 Total distance at 7.0–12.9 km h^{-1}; *TD* 13.0–17.9 Total distance at 13.0–17.9 km h^{-1}; *TD* > 18 Total distance at > 18 km h^{-1}

Table 5.7 Technical performance during 5 versus 5 in different field sizes

Study	Participants	Regimen	SF	APP (m^2)	Indicator	Indicator	Indicator (dribbles)
Aslan (2013)	10 (Recreational)	1 × 40 min	44 × 23	101	47.4 ball possessions	27.2 successful passes	13.9
			57 × 30	171	43.4 ball possessions	24.3 successful passes	15.6
Hodgson et al. (2014)	8 (Amateurs)	4 × 3 min/2 min rest	30 × 20	60	22 passes	5 shots	7
			40 × 30	120	21 passes	5 shots	8
			50 × 40	200	20 passes	3 shots	7

SF Size of the field (m); *APP* Area per player

5.2.6 Comparison of Different Area in 6 Versus 6 to 10 Versus 10 Formats

Different field sizes were compared in 6 versus 6 and 7 versus 7 formats. In the study carried out by Rampinini et al. (2007), in 6 versus 6 format it was possible to identify that the smaller format (64 m^2) had the lowest heart rate responses, blood lactate concentrations, and perceived exertion. Nevertheless, in this study, the greater intensities were found in middle size (100 m^2). The study carried in 7 versus 7 format was possible to verify that bigger format increased the heart rate responses (1.9 % of HR max) and the perceived exertion (Table 5.8).

Similar to the study conducted in 5 versus 5, the technical performance was greater in smaller field. More ball possessions, successful passes, and dribbles were made in smaller field during the 7 versus 7 format (Aslan 2013) (Table 5.9).

Table 5.8 Acute physiological effects during large-sided games with different field sizes

Study	Format	Regimen	SF	APP (m^2)	HR	BLa^{-1}	RPE [0-10 scale]
Rampinini et al. (2007)[a]	6 versus 6	1 × 4 min/3 min rest	24 × 32	64	86.4 % HRmax	4.5	6.8
			30 × 40	100	87.0 % HRmax	5.0	7.3
			36 × 48	144	86.9 % HRmax	4.8	7.2
Aslan (2013)	7 versus 7	1 × 40 min	44 × 23	72	76.8 % HRres	–	0.9
			57 × 30	122	78.7 % HRres	–	1.2

SF Size of the field (m); *APP* Area per player; *HR* Heart rate; BLa^{-1} Blood lactate concentration (mmol/L); *RPE* Rated of perceived exertion

[a] HR values with verbal encouragement during task

Table 5.9 Technical performance during large-sided games with different field sizes

Study	Format	Regimen (min)	SF	APP (m^2)	Indicator (ball possessions)	Indicator (successful passes)	Indicator (dribbles)
Aslan (2013)	7 versus 7	1 × 40	44 × 23	72	45.0	21.8	12.1
			57 × 30	122	40.5	20.9	11.3

SF Size of the field (m); *APP* Area per player

5.3 Conclusions

The size of the field influences the performance of players during SSCGs. Bigger sizes increased the heart rate responses, blood lactate concentrations, perceived exertion, distance covered, and the distance covered in sprint in all formats that have been studied. In the other hand, better technical performances were achieved in smaller sizes, thus suggesting that the decrease of the space may increase the opportunity to exploit skills. Larger sizes may be more adequate to increase the physiological and physical demands of the game and the smaller formats to develop the technic. To better identify the meaning of smaller and bigger sizes of the field, Table 5.10 summarizes the dimensions used by different authors per format of the game.

Only two studies analyzed the tactical behavior that emerges from different sizes of the field (Frencken et al. 2013; Vilar et al. 2014). A study analyzed the influence of three dimensions (40 × 20—80 m^2 per player; 52 × 26—132.5 m^2 per player; and 28 × 14—39.2 m^2 per player) during 5 versus 5 game in the shaping opportunities to maintain the ball possession, pass to teammates, and shoot at goal (Vilar et al. 2014). The results of this study revealed that interpersonal distances between players were significantly lower in smaller field and afforded greater opportunities to maintain the ball possession (Vilar et al. 2014). Nevertheless, no statistical differences between field sizes were observed for opportunities to shoot at goal and pass to teammates.

In the other study (Frencken et al. 2013), the collective organization of the teams in four different sizes of the field (30 × 20—75 m^2 per player; 24 × 20—60 m^2 per player; 30 × 16—60 m^2 per player; and 24 × 16—48 m^2 per player) during 4 versus 4 games was analyzed. The results revealed that reducing the field length causes players to close in on each other longitudinally (Frencken et al. 2013). It was also found that the teams' centroids tend to move more in the same direction longitudinally in smaller fields. The decrease in the width of the field reduced the lateral distances between teammates (Frencken et al. 2013).

Both studies (Frencken et al. 2013; Vilar et al. 2014) suggested that smaller sizes increase the capacity to play with small interpersonal distances and increase the capacity to maintain the possession of the ball. It was also suggested that small

Table 5.10 Field sizes considered small, medium, and large in different formats of the game

Format	Small		Medium		Large	
	Dimensions	APP	Dimensions	APP	Dimensions	APP
1 versus 1	10 × 5	25	15 × 10	75	20 × 15	150
2 versus 2	15 × 10	38	20 × 15	75	25 × 20	125
3 versus 3	20 × 15	50	25 × 18	75	25 × 30	125
4 versus 4	20 × 25	63	30 × 20	75	30 × 35	131
5 versus 5	30 × 20	60	35 × 25	88	42 × 30	126
6 versus 6	32 × 24	64	40 × 30	100	48 × 36	144
7 versus 7	40 × 25	71	44 × 23	72	57 × 30	122

Dimensions length × width (m); *APP* Area per player (m^2)

fields also contribute to ensure synchronization between opponent's centroids, thus being an important indication to improve the capacity to flow based on the opponents' dynamics and ball.

Trying to identify the appropriate sizes to design SSCGs, a pilot study determined the individual playing area of players during full-size matches by dividing the area of the rectangle that includes all outfield players by twenty (Fradua et al. 2013). Six goal-to-goal areas split the field and the individual area per player was determined per positioning of the ball in these areas. A larger area per player was verified in the moments the ball circulated in the area closer to the opponent's goal. On the other hand, the smaller area per player was found in the moments the ball circulated in the middle of the field. This study verified that individual area during matches varies between 78.97 and 93.87 m^2. The authors made the following considerations for designing SSCGs according to the particular phase of play (Fradua et al. 2013):

- Build-up play: 90 m^2 [range 70–110] area per player, with length to width ratio of 1:1
- Transition play: 80 m^2 [range 65–95] are per player, with length to width ratio of 1:1.3
- Finishing phase: 90 m^2 [range 70–110] area per player, with length to width ratio of 1:1

These interesting findings can be useful to coaches during the designing moment of the games. Another important issue that may arrive from the use of different sizes is the application during training sessions. Different sizes lead to different places to organize the task. The use of games requires some visual marks of the boundaries. Nevertheless, coach should save time to organize these fields. For that reason, he may use the boundaries of a full soccer field to reduce some time in place the visual marcs. Let us provide in Fig. 5.1, the official sizes of a soccer field.

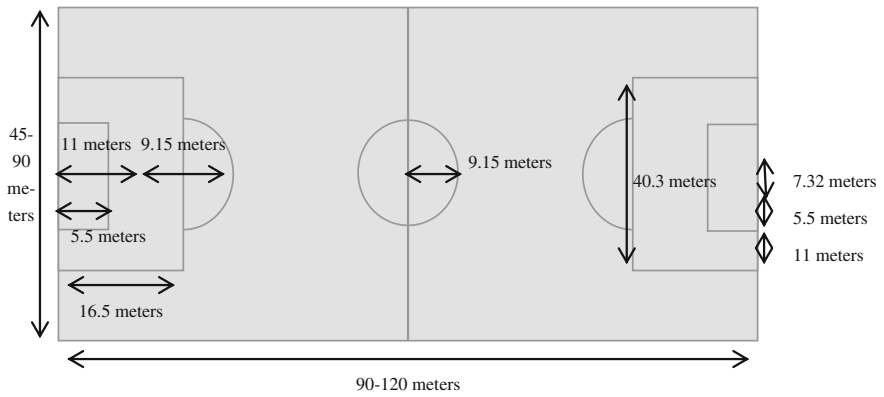

Fig. 5.1 Standard soccer field measurements

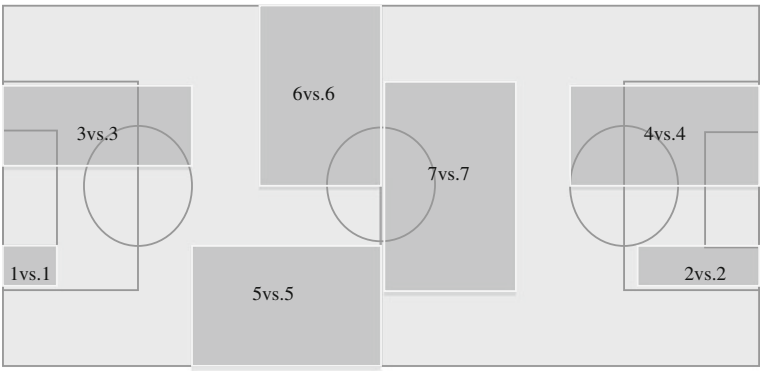

Fig. 5.2 A possible place to develop different formats of the game for smaller sizes

Coaches may use some specific places in the field to mark the zone for SSCGs. We would like to proposesome specific places in the field for some formats Fig. 5.2.

In summary, this chapter found that bigger sizes increases the acute physiological and physical responses, and thus are more appropriate to develop the fitness. On the other hand, smaller sizes are more appropriate for technical performance and to increase the tactical behavior and collective organization of the teams. These findings should be considered in the moment of designing SCCGs to soccer players in different stages and competitive levels.

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