



Effect of Pitch Size on Technical-Tactical Actions of the Goalkeeper in Small-Sided Games

by

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The aim of this paper was to determine how the size of the pitch affected technical and tactical actions of the goalkeeper when playing small-sided games. The participants were 13 male youth players, including 3 goalkeepers. Three different pitch sizes were used (62 x 44 m; 50 x 35 m; 32 x 23 m). On each pitch, the players played three matches of 8 minutes, with 5-minute breaks between matches. Numerous variables were recorded and examined: defensive and offensive technical and tactical actions, opponent's shooting zone, length and zone of the offensive action, and goal zone where the shoot was directed. An ad hoc observational tool was used. A descriptive analysis was described. The Fisher's exact test was used when the expected distribution was below 5 or included values below 1%. Statistical significance was set at $p < 0.05$. The results showed that the technical-tactical actions of the goalkeeper differed among pitch sizes. In defensive actions, when the pitch was larger, the 1-on-1 situations took precedence, whereas when the pitch was smaller, the proportion of blocks increased. In offensive actions, the goalkeepers did not show a wide variety of actions when the pitch was larger, but when the pitch was smaller, passes with a hand or foot increased. These results show that the size should be taken into account when planning and designing tasks.

Key words: performance analysis, soccer, tasks.

Introduction

Small-sided games (SSGs) are currently widely used as methods of training in soccer. Hill-Haas et al. (2011) define this method of training as a technique grounded in the use of preparation matches with modifications based on the reduction of pitch size, typically using adapted rules and fewer players than in real-life competition scenarios. Based on the concept that each field has dimensions of length and width, the technique determines three types of small fields: (1) square, (2) longer than wider, and (3) wider than longer. SSGs are used by many teams since they allow training to be technical, tactical, psychological, and physical, similar to the features of competition (Reilly, 2005).

SSGs were originally used as a way to develop technical and tactical abilities (Fradua et al., 2013). Currently, different authors have confirmed SSGs as a method for conditioning of players (Hill-Haas et al., 2009; Iaia et al., 2009). The possibility of changing rules, number of players and pitch size are variables that determine the type of training and both physiological and physical responses that will allow the coaches to properly plan training sessions. The scientific community has analysed SSGs and the changes produced by the manipulation of variables in order to properly define the team's training situations. Furthermore, this information has been used to plan according to the objective or team requirements, using

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training methods that replicate the demands of competition. As a global training method, SSGs can also be used for training the goalkeeper (Sainz de Baranda et al., 2005). However, no research so far has analysed the impact of SSGs or their particular variations on goalkeeper's performance.

These variables, which are subject to change by the coaches and researchers, are predictors of the players' workloads within the tasks (Balsom et al., 1999). The dimensions of the soccer pitch and the number of participants are two of the most used variables. Regarding the size of the pitch in SSGs, in their review of different variables, Hill-Haas et al. (2011) determined that the larger the field was, the greater the physical demands were. On the other hand, higher physiological demands were achieved when the number of players participating in training decreased. Various studies have been conducted in order to determine to what extent the rules used by coaches affect the intensity of the play (Hill-Haas et al., 2010; Mallo and Navarro, 2008). In this sense, Sampaio et al. (2007) noted that when the coach implied tasks through indications, feedback, or other methods, an increase in the physiological demands on (intensity of effort by) all players could be observed. In addition, greater involvement of the coach caused greater adherence to this method of training (Coutts et al., 2004). Other factors, such as the density of work (rest between repetitions), have also been studied (Fanchini et al., 2011). The goalkeeper also appears as a variable in the scientific literature. Several studies have analysed the effect of their inclusion in SSGs. Specifically, they analysed the impact of the goalkeeper on the physiological and tactical responses of the rest of the team members participating in the SSG, depending on the goalkeeper's participation in or absence from the task (Dellal et al., 2008; Mallo and Navarro, 2008; Sassi et al., 2004).

Due to the specific role of the goalkeeper, knowledge about the different training methods and how those affect the goalkeeper should be analysed owing that the technical and tactical preparation is not suitable for a unique player in the team (Di Salvo et al., 2008). Therefore, the objective of the present study was to analyse how the variation in the size of the soccer pitch affected the technical and tactical actions

performed by the goalkeeper.

Methods

Experimental approach to the problem

Ethics approval was obtained from the Faculty of Physical Activity and Sport Sciences from the University of Murcia. In soccer, Sarmiento et al. (2014) carried out a systematic review describing the variables studied and how they affected performance of the players. Nevertheless, analysing the publications about the goalkeeper, the competition and training methods were not the main focus (García-Angulo and Ortega, 2015). For this aim, similarity to the competition research, the analysis of different training methods has to be considered, allowing to identify behaviours which can be similar to competition and to prove that training is effective.

Participants

The sample included 13 soccer players (age: 16.6 ± 0.9 years; body height: 1.74 ± 0.09 m; body mass: 71.7 ± 7.2 kg), of whom 10 were field players and 3 were goalkeepers. All players were members of the same team (youth category); they were competing under license in the regional division and had an average experience of 7.3 years in federated soccer. The players and their parents were informed about the study, and informed consent was signed before the start of the research project. To avoid any imbalance between the teams, individual and collective aspects were taken into account, including the following: player position, tactical/technical level, physical fitness, and participation in competitive matches.

Material

A high-frequency camera was used to record particular matches.

Design and Procedures

This study was conducted over a 3-week period in May during the 2015-2016 season. Each week was dedicated to one type of SSGs. All players were part of the same team line-up and played on Thursdays after a standard 15-minute warm-up. There were no stoppages for injury.

An ad hoc observational tool was used (modified from Sainz de Baranda et al., 2008). To assess inter- and intra-observer reliability, data were compared across two sessions with a kappa above 0.85. To define the dimensions of the SSGs, the playing area proposed by Casamichana and

Castellano (2010) was used.

The variables observed in this work are described below.

Independent variables:

Playing area

The format of the SSGs are 62 x 44 m for a *large pitch* (SSG_L) with a playing area of 2728 m² and a ratio per player of 272.8 m; 50 x 35 m for a *medium pitch* (SSG_M) with a playing area of 1750 m² and a ratio per player of 175 m²; and 32 x 23 m for a *small pitch* (SSG_S) with a playing area of 736 m² and a ratio per player of 73.6 m². The individual playing area did not take goalkeepers into account. The rules included restrictions such as keeping play in the designated area. There were no corners; thus, every time the ball went out, the goalkeeper of the team with possession made a goal kick. There was no shortage of balls.

Playing time

There were 3 matches of 8 minutes each in every SSG. A 5-minute break was taken between matches.

Dependent variables:

Attacking action of the goalkeeper

- Attacking technical actions:

Goal kick: a free kick taken by the goalkeeper after the ball, having last been touched by an offensive player, crossed the goal line;

Direct free kick: it should always be taken at the spot where the offence took place. The goalkeeper can kick the ball straight into the goal from a direct free kick;

Indirect free kick: the rule of indirect free kicks states that a player cannot score a goal straight from the kick;

Pass by hand (low height, medium height or high height);

Pass by foot (low height, medium height or high height).

- Length:

Length reached by the technical actions; back field (from the own goal line to the beginning of the centre circle of the own half), medium back field (from the beginning of the own half to the half-way line), medium forward field (from the half-way line to the ending of the centre circle of the opponent's half), forward field (from the ending of the centre circle of the opponent's half to the opponent's goal line).

- Direction (Figure 1):

Direction where the pass or goal is kicked;

right lane (1), middle lane (2), left lane (3).

Action prior to the defensive action of the goalkeeper

- Area of the soccer pitch from which shots were taken; particular zones were differentiated in relation to the shooting angle and distance (Figure 2).

Defensive action of the goalkeeper

- Defensive technical actions

No action taken;

Save (catching or blocking a shot, which prevents the opponent from scoring a goal);

Deflection (ricocheting of the ball after coming into contact with the goalkeeper);

Clear-out (technique adopted to clear a crossed ball that cannot be caught, punching with the first or kicking the ball out with the foot);

Open palm technique (used to get to balls over the goalkeeper's head, by guiding the ball over the crossbar);

Parry (tipping);

Fly (diving without contacting the ball);

1-on-1 (the opponent faces the goalkeeper, who is trying to close the widest angle of shooting);

Screen (protecting the ball from a defender by keeping the body between the ball and the defender);

Control with the foot (controlling the ball with the feet and trying to return it to a teammate with a pass);

Clear-out by the defence (technique adopted to clear).

- The zone of goalkeeper intervention: zone from which the ball was passed or shot and the goalkeeper's reaction. Three scenarios were distinguished:

When the opponent's attack ended with a shot on the goal: the zone where the ball ended up (Figure 3);

When the ball was close to the goal and the goalkeeper performed a defensive action (goal area, penalty area or outside the penalty area);

When a teammate made a pass to the goalkeeper (goal area, penalty area or outside the penalty area).

Statistical analysis

A descriptive analysis was performed based on behaviours of the goalkeepers (frequency and percentage). When the expected frequency distribution was below 5 or the variable

included values below 1%, the Fisher's exact test (Monte Carlo adjustment) was used (Field, 2009) to analyse the correlation between the variables observed and the different sizes of the SSGs. Cramer's V was applied to measure the strength of the relationship (Φ) (0.10 = small effect; 0.30 = medium effect; 0.50 = large effect) (Volker, 2006). Statistical analyses were performed using SPSS 24.0, and statistical significance was set at $p < 0.05$.

Results

There were a total of 327 technical actions, of which 150 were defensive and 177 were offensive actions. The results showed that of the 150 defensive actions, 45 were performed in large SSGs, 35 in medium SSGs and 70 in small SSGs. Offensive actions were distributed as follows: 45 in large, 49 in medium and 83 in small SSGs.

Table 1 shows data regarding the defensive technical tactical actions used by

goalkeepers, such as technical actions and the zone of the goalkeeper's intervention. There were no significant relationships among the defensive technical actions, even though there was a significant trend ($p = .057$, $\Phi = .441$). Specifically, it was observed that mostly in medium as well as small SSGs, the percentage of times when there was no action or block was quite high. In contrast, analysis of the percentage of 1-on-1 actions showed that it was twice as high in large SSGs as in medium and small SSGs. The zones in which the goalkeeper performed most were the small box, followed by zone 1. There were statistically significant relationships between the zone of the goalkeeper intervention and the pitch size ($p = .003$, $\Phi = .551$). Thus, we observed a trend of shooting towards zone 3 in small SSGs, towards zone 11 in medium SSGs, and towards zone 13 in large SSGs.

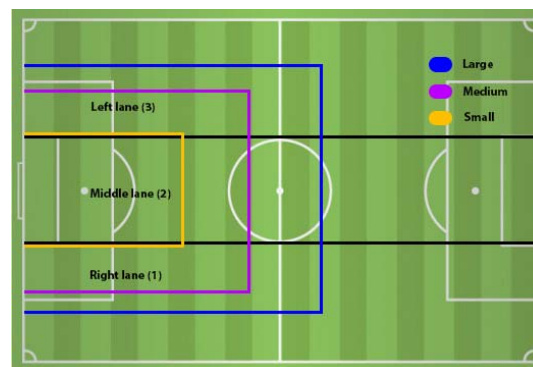


Figure 1

Direction of passing

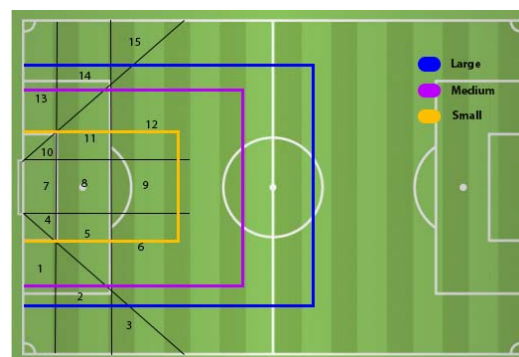


Figure 2

Field zone where shots were taken

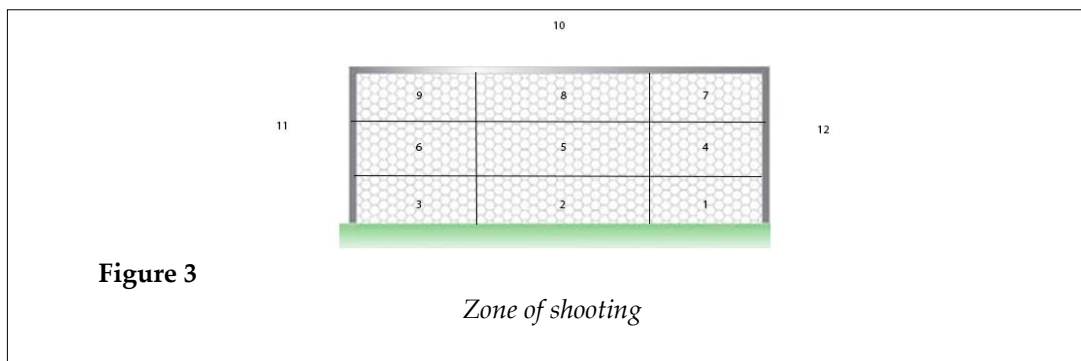


Figure 3

Zone of shooting

Table 1

*Defensive technical tactical actions. Note: SSG_L: Large pitch; SSG_M: Medium pitch; SSG_S: Small pitch; %: percentage; *p < 0.05*

Defensive Action	SSG _L		SSG _M		SSG _S		Total		p
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
No action taken	7	15.56	12	34.29	18	25.71	37	24.67	0.057
Save	4	8.89	8	22.86	11	15.71	23	15.33	
Parry	5	11.11	4	11.43	7	10	16	10.67	
Clear-out	0	-	0	-	1	1.43	1	0.67	
Deflection	2	4.44	1	2.86	8	11.43	11	7.33	
Open palm technique	0	-	1	2.86	0	-	1	0.67	
Fly	9	20	6	17.14	13	18.57	28	18.67	
Screen	2	4.44	0	-	1	1.40	3	2.0	
Control with the foot	3	6.70	0	-	5	7.10	8	5.30	
Clear-out by the defence	4	8.9	0	-	0	-	4	2.70	
1-on-1	9	19.96	3	8.57	6	8.57	18	12.00	
Total	45	30	35	23.33	70	46.67	150	100	
Zone of goalkeeper intervention									
Zone 1	7	15.56	5	14.29	9	12.86	21	14.19	.003*
Zone 2	2	4.44	4	11.43	8	11.43	14	9.49	
Zone 3	3	6.67	2	5.71	12	17.14	17	11.41	
Zone 4	2	4.44	0	-	0	-	2	1.33	
Zone 5	5	11.11	2	5.71	0	-	2	1.33	
Zone 6	1	2.22	4	11.43	3	4.29	8	5.49	
Zone 7	0	-	0	-	1	1.43	1	0.67	
Zone 8	1	2.22	0	-	0	-	1	0.67	
Zone 9	0	-	0	-	1	1.43	1	0.67	
Zone 10	6	13.33	2	5.71	1	1.43	9	6.08	
Zone 11	3	6.67	6	17.14	5	7.14	14	11.52	
Zone 12	3	6.67	5	14.29	9	12.86	17	11.52	
Zone 13	7	15.56	2	5.71	19	27.14	28	18.74	
Zone 14	5	11.11	3	8.57	0	-	8	5.45	
Zone 15	0	-	0	-	0	-	0	-	
Total	45	30	35	23.33	70	46.67	150	100	

Table 2

Field zone from where shots were taken. Note: SSG_L: Large pitch; SSG_M: Medium pitch; SSG_s: Small pitch; %: percentage; * $p < 0.05$

Field zone	SSG _L		SSG _M		SSG _s		Total		<i>p</i>
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Zone 1	5	11.11	1	2.86	5	7.14	11	7.33	0.018*
Zone 2	0	-	2	5.71	0	-	2	1.33	
Zone 3	0	-	0	-	0	-	0	-	
Zone 4	2	4.44	2	5.71	7	10	11	7.33	
Zone 5	6	13.33	4	11.43	10	14.29	20	13.33	
Zone 6	0	-	2	5.71	1	1.43	3	2	
Zone 7	5	11.11	4	11.43	11	15.71	20	13.33	
Zone 8	8	17.78	8	22.86	9	12.86	25	16.67	
Zone 9	4	8.89	2	5.71	1	1.43	7	4.67	
Zone 10	7	15.56	0	-	6	8.57	13	8.67	
Zone 11	7	15.56	6	17.14	16	22.86	29	19.33	
Zone 12	0	-	4	11.43	0	-	4	2.67	
Zone 13	0	-	0	-	4	5.71	4	2.67	
Zone 14	1	2.22	0	-	0	-	1	0.67	
Zone 15	0	-	0	-	0	-	0	-	
Total	45	29.61	35	23.03	70	46.05	150	100	

Table 3

Attacking technical tactical actions. Note: SSG_L: Large pitch; SSG_M: Medium pitch; SSG_s: Small pitch; %: percentage; * $p < 0.05$

Technical action	SSG _L		SSG _M		SSG _s		Total		<i>p</i>
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Goal kick	31	68.89	29	59.18	44	53.01	104	58.76	0.039*
Direct free kick	0	-	0	-	0	-	0	-	
Indirect free kick	0	-	0	-	0	-	0	-	
Pass by hand									
Low	3	50	8	66.6	24	96	35	81.40	
Medium	3	50	4	33.33	1	4	8	18.60	
High	0	-	0	-	0	-	0	-	
Total	6	13.33	12	24.49	25	30.12	43	24.29	
Pass by foot									
Low	8	100	8	100	14	100	30	100	
Medium	0	-	0	-	0	-	0	-	
High	0	-	0	-	0	-	0	-	
Total	8	17.78	8	16.33	14	16.87	30	16.95	
Length									
Zone 1	41	91.11	44	89.80	83	100	168	94.92	0.004*
Zone 2	4	8.89	5	10.20	0	-	9	5.08	
Zone 3	0	-	0	-	0	-	0	-	
Zone 4	0	-	0	-	0	-	0	-	
Total	45	25.42	49	27.68	83	46.89	177	100	
Orientation									
Zone 1	4	8.89	0	-	0	-	4	2.26	0.000*
Zone 2	39	86.67	49	100	83	100	171	96.61	
Zone 3	2	4.44	0	-	0	-	2	1.13	
Total	45	25.42	49	27.68	83	46.89	177	100	

Table 2 shows the shooting zones most used by the opponent. In particular, there were statistically significant relationships between the shooting zone and the pitch size ($p = .018$, $\Phi = .548$). Zone 11 was the most common, with fewer shots when the pitch size was smaller. The longer the pitch was, the lower the percentage of shots.

In Table 3, data in relation to the technical offensive actions carried out by the goalkeeper show that the action most repeated in all three types of SSGs was the goal kick where there were statistically significant relationships ($p = .039$, $\Phi = 260$). In detail, the larger the pitch size was, the higher the percentage of goal kicks and the lower the percentage of flat passes with the hand. Regarding the length achieved by the goalkeeper for each kick or pass made, there were statistically significant relationships ($p = .004$, $\Phi = 223$) regarding the length and pitch size, showing that in small pitches, there were only actions in the first length. The results show data related to the area of distribution of the goal kick or pass by the goalkeeper in offensive actions. There were statistically significant relationships ($p < .000$, $\Phi = 320$) regarding the orientation and pitch size. Thus, in medium and small SSGs, there were only actions in zone 2 (middle), while large SSGs used zones 1 and 3 with very low values.

Discussion

The main objective of this study was to determine the effect of modifying the soccer pitch size on technical and tactical responses of the goalkeeper, in both offensive and defensive phases. The most significant results show that the technical-tactical actions of the goalkeeper differed among the pitch sizes. In defensive actions, when the pitch was larger, the 1-on-1 situations took precedence, whereas when the pitch was smaller, the proportion of blocks increased. In offensive actions, the goalkeepers did not show a wide variety of actions when the pitch was larger, but when the pitch was smaller, the number of passes with a hand or foot increased.

From a general perspective, data show that when the dimensions of the SSG are smaller, there are more appearances of both defensive and offensive interactions by the goalkeeper. One of the main reasons for the increase in action frequency may depend on the concept of the

individual game area. While in large SSGs, the surface is 272.8 m², in small SSGs, it is 73.6 m², increasing the confluence of players during offensive and defensive phases in different parts of the field. Furthermore, as Owen et al. (2014) indicated in their study, this increase can be attributed to the small space that players have for passing due to the decrease in field size.

When defensive actions are discussed in more detail, it has been shown that goalkeepers achieved an average of 23.4 defensive actions per game (Sainz de Baranda et al., 2008). Accordingly, SSGs encourage the manifestation of technical and tactical skills. In particular, the most-used action by the goalkeeper is the block, as the pitch size is smaller, in relation to the increase in the number of shots. An increase in 1-on-1 situations has also been observed when the pitch is larger, creating stimulating versions of major games by constraining the practice, which allows players to perform in a situation of variability in a competitive environment (Davids et al., 2013). This is necessary in order to develop skills with a high level of accuracy (Liu et al., 2015).

When analysing the overall structure of the small fields used in this training method, it is clear that the sides are not used, which had already been observed in the study carried out by Hill-Haas et al. (2011). During competition, the sides of the field are mostly used for finishing with a shot coming from a cross, although they contain only one-third of the actions performed before a shot. One of the results of the study by Liu et al. (2015) is the use of long passes. This is a specific type of the task, including depth passes, that cannot be performed in SSGs because SSGs limit the area of intervention, but not the development of the competition profile of the player.

Regarding offensive actions performed by the goalkeeper, the most frequent action is the goal kick. Simultaneously, an increase in the frequency of passes with both a hand and a foot has been observed in small SSGs. This may be due to the concept studied by Fradua et al. (2013), suggesting that the SSG is a more valid design for representing tactical conditions experienced in competition matches, where the distance between the goalkeeper and the closest companion is reduced as the ball moves closer to the goal, which defends itself (which is much more

encouraged in small SSGs due to the short dimensions of the playing field). This encourages a closer relationship between the goalkeeper and other players in regard to building the game after a loss of the possession of the ball by the opposing team, adding a possibility other than passing in regard to having the goalkeeper in possession. However, the variability of this conduct and the perceptive work of the goalkeeper are not entirely appropriate, since there are many possible actions to perform. Analysing these passes and the length and direction reached indicated a lack of variety in the distribution. The majority of actions were carried out in short lengths and towards the centre. Therefore, if the objective is to improve the relationship between the goalkeeper and the other players, SSGs could be used as a training method to promote these behaviours and include the goalkeeper in the process of constructing plays. However, we must consider that sometimes there will be actions that are not carried out and therefore must be changed if the objective is not met.

Taking into account the results obtained, it is important to review and analyse how the different variables that define SSGs can modify the appearance or absence of some goalkeeper behaviours in order to design complete and effective training for the goalkeeper. The use of SSGs can be considered suitable for conducting training based on a global methodology, but the SSGs must be analysed, designed and modified according to the initial objectives and achievement of the same. Therefore, it is worth mentioning the need for further research on how changes to the SSG may influence the emergence of a series of tactical actions, in both defensive and offensive phases. This study is the first to describe the goalkeeper's performance in SSGs. However, a few limitations of this study concern the low number of participants for the analysis, the interrelationships between physical and technical and tactical actions, as well as the need for increasing the control and modification variables. Limitations in this topic include the shortage of studies examining the role of the goalkeeper from technical and tactical perspectives (Di Salvo et al., 2008; García-Angulo and Ortega, 2015). It is important to note the great number of possibilities that exist when designing SSGs; therefore, further studies should be conducted to analyse the

consequences of those modifications on different physiological, physical, and tactical variables, both in players and goalkeepers (Di Salvo et al., 2008; Ortega and Sainz de Baranda, 2003). The goalkeeper's role is affected by the design of the SSG, yet one question not addressed is the use of mini-goals, which affect decision-making of the field players (Aguilar et al., 2012).

Conclusions

The present study indicates that SSGs can be used as a global training method for the goalkeeper. Regarding the objective of analysing how the variation in the size of the field affects the tactical actions performed by the goalkeeper, the results show that the presence or absence of different behaviours may vary depending on the size of the field, as well as the areas of action and the level of security in handling the ball.

SSGs of larger dimensions can be used to work 1-on-1 as defensive actions, and smaller SSGs can be used to work on blocks, though an increase in the level of security was noted when the goalkeeper had no effective contact with the ball. When designing tasks, it must be remembered that reducing the field dimensions also affects the number of shots and the frequency with which the goalkeeper does not carry out a defensive action.

Offensive actions in fields with larger dimensions do not offer wide variability in terms of the emergence of these actions, while smaller fields have shown greater numbers of passes with both a foot and a hand, which has repercussions for the association between the goalkeeper and the players around him.

In conclusion, the dimensions of the pitch in SSGs must be taken into account by the coach when designing workouts, since these dimensions affect technical and tactical actions of the goalkeeper in both offensive and defensive phases.

Practical Implications

Considering the results, attention should be paid when training sessions are under design. If the aim of goalkeeper's training is the relationship with defence and participation in the attacking phase, as well as 1-on-1 or a high frequency of participation, SSGs can be a suitable training method, being a part of specific training of the goalkeeper.

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