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Influence of additional players on collective tactical behavior in small-sided soccer games

Comportamento tático coletivo em Pequenos Jogos no Futebol: influência de jogadores adicionais

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Abstract – The aim of this study was to compare the collective tactical behavior between numerically balanced and unbalanced small-sided soccer games. Eighteen male soccer players (mean age 16.4 years) participated in the study. Polar coordinate analysis was performed using positional data obtained with a 15-Hz GPS device. Collective variables including length, width, centroid distance (average point between teammates), and length per width ratio (LPWratio) were collected. Data were analyzed using Friedman's test. The results showed greater length and width values in 4vs.3 games, while a higher LPWratio was observed in 3vs.3+2 games compared to the other configurations. In games with an additional player (4vs.3), ball circulation and the increase in effective game space were alternatives to overcome the more concentrated defensive systems near the goal. On the other hand, 3vs.3+2 games allowed more actions in the length axis and a fast reach of the opponent's goal.

Key words: Physical education and training; Soccer; Task performance and analysis.

Resumo – *Este estudo objetivou comparar o comportamento tático coletivo entre situações de Pequenos Jogos em igualdade e superioridade numérica. Participaram do estudo 18 jovens jogadores de futebol com idade média de 16,4 anos. A análise de coordenadas polares foi realizada a partir dos dados posicionais obtidos com equipamento de GPS de 15Hz. O comportamento tático foi acessado por meio das medidas de largura, profundidade, distância entre os centroides (ponto médio dos jogadores de uma equipe no campo de jogo) e razão profundidade/largura (LPWratio). Dados foram analisados por meio do teste de Friedman. Resultados apontaram para um aumento dos valores de largura e profundidade na configuração 4vs.3, enquanto o jogo 3vs.3+2 apresentou aumento do valor da razão profundidade/largura em relação às demais configurações. Nos jogos com jogador adicional no campo (4vs.3), a circulação da bola e ampliação do espaço efetivo de jogo foram alternativas para superar as defesas mais fechadas e próximas à própria baliza, enquanto a presença de jogadores adicionais de suporte (3vs.3+2) permitiu o rápido alcance à baliza adversária, incentivando o jogo em profundidade.*

Palavras-chave: *Análise e desempenho de tarefas; Educação física e treinamento; Futebol.*

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INTRODUCTION

Small-sides games (SSGs) in soccer are useful tools to stimulate technical, tactical, physical and physiological components of performance in a context simulating a formal game[1,2]. Studies investigating manipulations in game configurations such as field size[3], number of ball contacts authorized per possession[4] and number of players[4,5] have shown responses of players in technical[3], physical and physiological variables[6] in an incipient and tactical collective manner[7,8].

Previous studies have compared the effect of altering the number of players in numerically balanced games, i.e., 3vs.3 and 4vs.4[5,9,10]. However, at various times during a soccer game can players encounter situations in which the number of players around the ball is the same or unbalanced between teams[11]. This situation can be mimicked in SSGs in which additional players are present inside the pitch[11,12] or by support players positioned at the sides of the pitch[13]. Situations of numerical unbalance between teams potentiate the occurrence of coordinated collective tactical structures[1]. This fact makes this manipulation particularly useful for the training of soccer players in situations simulating the demands of a real game, encouraging the development of cognitive processes related to attention, perception and decision-making in the game context[14].

Recently, studies have quantified collective tactical variables related to center of the game, length and width in SSG configurations[7,15]. Among these variables, the distance between centroids, which is defined as the distance between the average points of players of the teams, and the length per width ratio (LPWratio) have been proposed in the literature[7]. In those studies, analysis of polar coordinates is an important tool that permits to evaluate spatial-temporal interactions between players in different configurations[7]. These coordinates were first obtained using different softwares[16] and, more recently, by means of global positioning systems (GPS) that possess a sampling frequency of up to 15 Hz and are equipped with triaxial accelerometers[7,15]. Although these GPS systems are commercially available, their application to the analysis of tactical behaviors in SSGs is still limited and few studies have used these devices[7,8].

An increase in the number of passes and receptions has been demonstrated in the presence of additional players in the attack compared to an extra player in the defense[17]. Another study indicated that additional players performed a significantly larger number of sprints and covered a greater total distance than the remaining players[18]. Furthermore, a reduction in the distance of attackers and defenders in relation to the centroid of their team and in the total area covered by the teams in the attack and defense has been reported, as well as an increase in the distance between the centroids of the teams[1]. Finally, numerical superiority resulted in an increase in the distance of the player in relation to the centroid of the team[12]. As noted, studies involving additional players have focused little on the evaluation of tactical behavior and the results are inconclusive.

In view of the importance of considering situations of numerical superiority for the use of SSGs in the training of soccer players and the sparse production of tactical variables for performance, the objective of this study was to compare the collective tactical behavior of soccer players during SSGs in which one team has numerical superiority.

METHODOLOGICAL PROCEDURES

This study was approved by the Ethics Committee of Universidade Federal de Minas Gerais (Protocol No. 29215814.8.0000.5149). All participants and their legal guardians provided free informed consent.

Participants

Non-probabilistic sampling was used for selection of the sample. Eighteen young male soccer players (age: 16.4 ± 0.7 years), members of the same team participating in national and federated competitions, with a mean experience of 4.2 years, were selected. The standard training consists of 6-8 sessions per week (with an approximate duration of 90 min), in addition to competitive games.

Team composition

Differences in physical behaviors during soccer games according to playing position have been reported in the literature[19]. Thus, the teams were balanced in relation to the position of origin of the player, with each team consisting of a goalkeeper (not evaluated), a defender, a midfielder, and an attacker.

A second criterion adopted for composition of the teams was the level of procedural tactical knowledge of the players. This knowledge of the players was evaluated using the Procedural Tactical Knowledge Test for Sporting Orientation[20] during the first session of data collection. The test consists of an SSG in a space measuring 9 x 9 m performed by two teams of 3 players each over a period of 4 minutes. All scenes of the test were filmed and subsequently analyzed. For assessment, trained experts count the technical-tactical actions during attack (with and without the ball) and during defense (marking of the ball holder and marking of the attacker without ball). Inter- and intraobserver reliability were evaluated using Cohen's kappa coefficient, which indicated agreement of 0.806 and 0.844, respectively.

After this session, the athletes were divided into three groups according to position of origin (defender, midfielder, and attacker) and a ranking was established within each group according to performance in the Procedural Tactical Knowledge Test. Finally, the 18 players were assigned to six teams (table 1). The three best players according to position (n=9) were assigned to teams A1, B1 and C1, and the three players with lowest tactical performance (n=9) composed teams A2, B2 and C2.

Table 1. Team composition.

Group 1			
Team A1	D[1]	M[3]	A[2]
Team B1	D[2]	M[1]	A[3]
Team C1	D[3]	M[2]	A[1]
Group 2			
Team A2	D[4]	M[6]	A[5]
Team B2	D[5]	M[4]	A[6]
Team C2	D[6]	M[5]	A[4]

D: defender; M: midfielder; A: attacker. Superscript numbers indicate the final position in the Procedural Tactical Knowledge Test according to playing position. Number 1 corresponds to the best ranking in the test and number 6 to the worst ranking.

Games between teams of lower tactical level were avoided in view of the reported influence of this variable on tactical behavior[15]. Thus, teams of group 1 only played SSGs against teams of group 1 and the same was adopted for group 2.

Procedures

This study was conducted over a period of 4 weeks between April and May 2014. The players were familiarized with the SSG configurations (3vs.3, 4vs.3, and 3vs.3+2) and with the data collection equipment in week 1. In weeks 2 to 4, the participants played the games three times per week at a minimum interval of 48 h on a natural grass field at the same times of the day.

Each session was started with 15 minutes of standard preparatory activity consisting of running, acceleration and ball contacts, followed by two series of one of the SSG formats lasting 4 minutes and a passive rest of 4 minutes, corresponding to 36 SSGs (12 3vs.3, 12 3vs.3+2, and 12 4vs.3). The order of the games was randomized and balanced as shown in Table 2.

Table 2. Balancing and randomization of the data collection sessions.

Week	Day	Game	Configuration
1	Monday	PTKT	-
	Wednesday	Familiarization	-
	Friday	Familiarization	-
2	Monday	A x B	3vs.3
	Wednesday	A x C	3vs.3+2
	Friday	B x C	4vs.3
3	Monday	A x B	4vs.3
	Wednesday	A x C	3vs.3
	Friday	B x C	3vs.3+2
	Monday	A x B	3vs.3+2
4	Wednesday	A x C	4vs.3
	Friday	B x C	3vs.3

PTKT: Procedural Tactical Knowledge Test.

Small-sided games

The three SSG formats were performed on a pitch measuring 36 x 27 m, with goals measuring 6 x 2 m as used in previous studies[2]. All rules of a formal game, including impediment, were applied during the SSG. In the situation of numerical superiority (4vs.3), an additional player was employed inside the pitch. The midfielder of the team that did not participate in the data collection on that occasion was selected, i.e.., in the A1 x C1 game, the midfielder of team B1 was used. The additional player was authorized to perform all actions used by the other players, including shooting at the goal. It was the role of this player, indicated with a vest of different color, to act always for the attacking team and to move around the pitch without restrictions. In the 3vs.3+2 configuration, two support players placed at the sides of the pitch were selected. These were always the defender and attacker of the team that did not participate in the game, similar to the situation described above. The two athletes placed at the sides could only perform two ball contacts per individual possession and could only play for the attacking team.

Dependent variables

The collective tactical behavior was evaluated based on the calculation of length, width, centroid distance and LPWratio as used in other studies on soccer[7,15] and illustrated in Figure 1. The tactical behavior variables were monitored using the position data (latitude and longitude) obtained with an individual GPS system (model SPI-Pro X2, GPSports, Canberra, Australia). This device, which is attached to the athlete's chest with specific straps, is equipped with a 100-Hz triaxial accelerometer and monitors distances and positions at a frequency of 15 Hz.

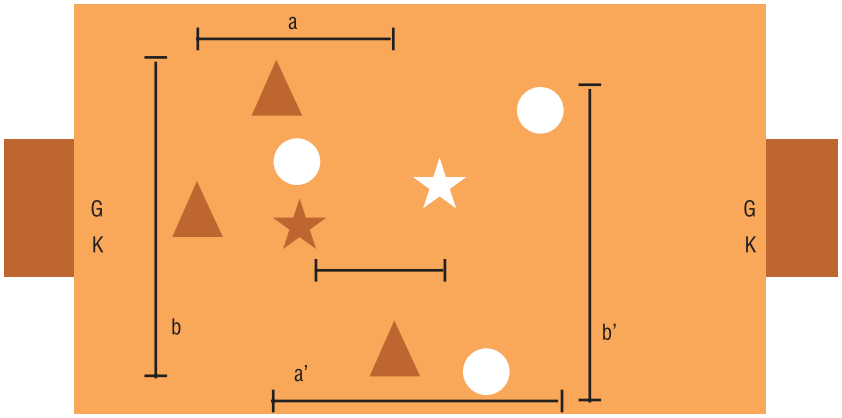

Figure 1. Variables analyzed. Triangles and circles: playing teams; stars: average point (centroid) of the two teams; a and a': measures of length; b and b': measures of width; x: centroid distance; a/b (a'/b') ratio: LPWratio; GK: Goalkeepers.

The GPS data were processed with the MATLAB 2011 software (The Math Works, Inc., Natick, MA, USA). First, the latitude and longitude data were converted into meter using the UTM protocol (Universal Transverse Mercator coordinate system). A rotational matrix was then calculated for each game based on the positions in the pitch, aligning width with the x-axis and length with the y-axis as described previously[7,15].

Data analysis

For inferential analysis, application of the Kolmogorov-Smirnov test of normality revealed significant deviations from normality for all variables studied. Thus, nonparametric statistical procedures were used. The Friedman test (nonparametric ANOVA for repeated measures) was used for the comparison of mean length, width, centroid distance and LPWratio. Additionally, the observed power (b) and effect size (partial h^2) were calculated.

RESULTS

Table 3 shows the comparison of the collective tactical variables. Length, width and centroid distance are reported as meter, while the LPWratio has no measurement unit.

Table 3. Comparison of collective tactical variables between the three different small-sided games.

	3vs.3+2	3vs.3	4vs.3	P	Power	Effect size
Length (m)	10.114 (±4.126)	10.407[1](±4.193)	10.864[1.2](±4.394)	0.001	1.000	0.5951
Width (m)	7.722[2](±4.703)	7.180(±4.394)	7.724[1.2](±4.505)	0.001	1.000	0.0774
Centroid distance (m)	4.062[2.3](±3.397)	2.652[3](±3.496)	1.890(±1.571)	0.001	1.000	0.1287
LPWratio	1.043[2.3](±1.335)	0.872(±1.040)	0.908[2](±0.904)	0.001	1.000	0.2358

[1] Value higher than the 3vs.3+2 configuration; [2] value higher than the 3vs.3 configuration; [3] value higher than the 4vs.3 configuration.

Greater length and width values were obtained for games conducted in numerical equality, while the 3vs.3+2 game exhibited a greater centroid distance and LPWratio. The LPWratio can be used to determine the prevalence of player position in the width or length axis. Values between 0 and 1 indicate a position more in the length axis than in the width axis, and values higher than 1 indicate a prevalence of player position in the width axis. In the present study, an LPWratio higher than 1 was only observed in the 3vs.3+2 situation, which was therefore the only structure with a prevalence of player position in the width axis compared to the length axis.

DISCUSSION

The possibility of synchronization of position data obtained with the latest GPS devices has led to an increase in the number of studies investigating collective tactical parameters in soccer[7]. Specifically, the results of this study demonstrated an increase in the length and width of teams in the 4vs.3 configuration and greater centroid distances and LPWratios in 3vs3+2 games. These results reflect both the influence of alterations in game configuration on tactical responses and the individual and collective interpretations of the participants in terms of the new environmental demands. Thus, it is believed that the level of tactical knowledge of the subjects regarding the variables analyzed was sufficient to produce the adaptive responses observed.

With respect to centroid distance, a reduction in this distance with decreasing pitch size has been reported in the literature[21], as well as higher values in SSGs played by older athletes (under-15 compared to under-11)[7]. Another study found an increase in the distance of players in relation to the centroid for numerically superior teams compared numerically inferior teams[12]. Specifically, the present study showed an increase in centroid distance for the 3vs.3+2 game compared to the other two configurations. In this game, the presence of players at the sides of the pitch permits an easily ball progression during the attack due to the frequently advanced position of a support player. Consequently, defenders that were more distant from the ball performed backward movements in the pitch to block the ball corridor if the teammate is dribbled[22], increasing the centroid distance of the teams. Thus, the increase in the centroid distance of the teams reflects, at the individual level, a reduction in the interpersonal distance between attackers and defenders and a consequently greater difficulty in recovering ball possession[22,23].

The increase in the LPWratio indicates an increase in longitudinal distance and a lateral reduction in the distance between players. This characteristic indicates the search for a rapid attack using the depth of the pitch[7], while in the defense it indicates a priority position in the central corridor, closing the most dangerous regions in the vicinity of the defending goal[1]. In the present study, a higher LPWratio was observed in the two situations with additional players compared to the situation of numerical equality. Thus, the state of defensive numerical inferiority/offensive numerical superiority permitted the players to more frequently access areas near the defending goal/opponent's goal, increasing the width of the team in relation to length. According to the results of this study, game models related to tactical principles of length and width can be best trained in situations of numerical superiority in offensive constructs of counter-attack (3vs.3+2) and positional attack (4vs.3).

The 3vs.3+2 situations were the only configurations with a prevalence of movements in the width axis compared to the length axis, the practical significance of LPWratios higher than one[7]. This result indicates the potential of this game configuration for the training of game principles related to rapidly reaching the opponent's goal (during attack), as well as greater protection of the central pitch over lateral areas (during defense).

In situations with additional players, the environment demands new adaptations from the defending teams during decision-making processes[1]. In these situations, the athletes start to worry about closing the most dangerous areas of the pitch, remaining primarily between the ball and the defender's goal[1], since individual marking alone does not solve the problem task of the game because it always leaves opponents free. During defense, the teams reduce the length and monitoring of opponents in order to close spaces in the center of the pitch, which are known to be more dangerous to their own goal, using behaviors related to defensive coverages and defensive unity[14]. In contrast, during attack, the players find the possibility to move more deeply into the pitch, performing movements aimed at increasing width due to the increased number of players for offensive process.

The selection of SSG configurations for tactical training in soccer should permanently take into consideration a game model that serves as a reference for players at the individual and collective level. However, it is at the collective level that actions gain meaning and the establishment of coordinated structures[24] between subjects that compose the "superorganism" is of fundamental importance[25]. In general, configurations with support players (3vs.3+2) are recommended to favor games that use the depth of the pitch and the inclusion of offensive numerical superiority (4vs.3) to potentiate interpersonal coordination between teammates[1].

Although methodological precautions permit to establish inferences from the results reported above, the present findings are related to the characteristics of the sample used, i.e., high-level athletes in their category (age), and generalizations to other performance levels therefore need to be investigated in future studies.

CONCLUSIONS

The present results suggest that SSGs in the 3vs.3+2 configuration permit a significant increase in player positioning in the width axis, revealing similarities between this configuration and the construction of counter-attack and direct attack game models. On the other hand, the 4vs.3 situation requires player positioning in the length axis (compared to both the 3vs.3 and 3vs.3+2 configuration) and less movement in the width axis than the 3vs.3+2 structure. In this respect, for coaches interested in the development of games from a positional attack, this structure allows a more lateralized game, in length, the basic principle of this game concept.

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