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Original Article

Locomotor activities of professional futsal players during competitions

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Abstract
This study aimed to established the quantitative characteristics for the types of movements that are used by professional futsal players but with different positional roles during competitive activities. This goal was achieved using the following methods: video recording, chronometry and by measuring the length of the step. The required data were acquired from the playback of the game videos of professional teams that participated in the study. In addition, we accounted for the pedometer information, performance of each player from these teams, and the data on the length of the step in all components of locomotor activities that were studied. Quantitative values of the main components of locomotor activities (walking, jogging, running, and sprinting) of the studied players from professional teams were established during the competitive period of 16 games. During the futsal game, the longest distance is covered by pivots, and a much shorter distance is covered by defenders. However, this distance is longer than that of goalkeepers. In the structure of pivots' locomotor activity, jogging is the dominant movement; for defenders – running is dominant; for goalkeepers – walking is dominant. During the game, pivots use jogging and sprinting more often than defenders, and defenders use walking and running more often than forwards. According to the study results, the shortcomings in locomotor activities of each player from the professional teams that participated in the study were determined in addition to possible areas of improvement. Coaches can benefit from these results to understand how players with different roles organize themselves during official matches. This will help develop training programs that will increase the effectiveness of technical and tactical training by taking into account the peculiarities of locomotor activities of futsal players.
Keywords: futsal, types of movements, quantitative parameters, players, different positional roles

Introduction

Interest in futsal, a variation of soccer, is increasing worldwide. However, in futsal, positional roles differ significantly from soccer. The main differences encompass the rules of the game as well as the technical and tactical actions of the players (Agras, Ferragut, & Abraldes, 2016; Aquino, Puggina, & Garganta, 2017; Rago, Pizzuto, Raiola, 2017). There are different approaches to the technical, tactical and other aspects of athletes' training (Button, Lee, & Chow, 2012; Davids, Araújo, & Vilar, 2013; Almeida, Volossovitch, Duarte, 2017).

The abovementioned differences and peculiarities of futsal competitive activities determine the features of a multi-year athletes' training process. The efficiency of this process is largely supported by the data about various characteristics of goalkeepers and players with different positional roles and specific sport qualifications (Lago-Peñas, Lago-Ballesteros, 2011; Serrano, Shahidian, & Leite, 2013; Moore, Bullough, & Edmondson, 2014). This primarily concerns the functional characteristics and locomotor activities because they form the basis of physical, technical, tactical (Travassos, Araujo, & McGarry, 2012; Wilmore, Costill, Kenney, 2012; Soares Leite, 2013) and to some extent psychological (Casamichana, Castellano, 2010) training. At the same time, it was determined that there are almost no data about the quantitative characteristics of important indicators of locomotor activities (i.e., various types of movements of futsal players) in terms of competitive activity. It is noted that the total distance covered by both teams (i.e., between 2,575 and 4,313 m) was in accordance with previous futsal studies (Barbero-A´lvarez, Soto, Granda-Vera, 2008). The data of M. Jd. O. Bueno et al. (2018) are connected with the analysis of futsal players' organization on the court in different categories: while attacking and defending, during interception and in shot to goal situations. The results were obtained by generalizing the data on the spread, surface area, and Euclidian distances between the teams' centroids, which were measured to

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represent the distribution of the futsal players on the court (89 players of 15 years, 102 - 18 years, 110 professional players) during official matches. The variables were analyzed during each offensive and defensive sequence and during shot to goal and interception situations with and without the outfield goalkeeper player participation. While the players were attacking, all categories presented a greater spread and surface area, compared with the values when players were defending. Among the categories, the results showed lower spread and area values for the younger players. Other researchers (Moura, Santana, & Cunha, 2011) conducted a quantitative analysis of futsal players' organization on the court. In particular, two-dimensional coordinates of 22 players' positions were obtained during a match between Brazil and Paraguay using a computational tracking system. Team organization in 58 specific shot to goal situations and 120 tackles were analyzed. The variables quantified were teams' coverage area and distance between teams' centroids. At the same time, (Agras, Ferragut, & Abraldes, 2016) suggest that it is necessary to consider the features associated with playing during the competitive activity. The main feature includes the replacement of players during the game, which frequently occurs in the form of "four" for "four". Thus, in most cases, every field player is present on the court for half the time of the game, which lasted a total of 40 minutes. Therefore, a small amount of data about the peculiarities of locomotor activity of professional futsal players with different positional roles does not help to solve the problem of increasing the effectiveness of their training and competitive activity. This determines the need for research in that direction.

Materials and methods

A total of 36 futsal players were used for determining their locomotor activities. The age range of the players was 24.7±3.3 years. All sportsmen were highly qualified and had different positional roles. Specifically, there were 4 goalkeepers, 18 defenders and 14 pivots. The qualification level of the teams is considered as professional. This means that they compete in the first League of the championship of Ukraine. Each athlete was informed about the design, requirements, benefits and risks of the study. The research was conducted in compliance with the WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects, 2013. The study protocol was approved by the Ethical Committee of Kamianets-Podilskyi National Ivan Ohiienko University.

For each match assessed, match activities were monitored using video recording. When choosing this method and peculiarities of its implementation for our study, the recommendations of the specialists (Figueroa, Leite, Barros, 2006; Barbero-A´lvarez, Soto, Granda-Vera, 2008; Di Salvo, Gregson, & Drust, 2009; Corrêa, Davids, Silva, Tani, 2014; Koryagin, Iedynak, & Borovik, 2018) were taken into account. The required data were received throughout the competition period and during each of the 16 championship games, in which players of the studied teams took part. When organizing the study, the methodology proposed by Dogramaci et al. (2011) was used. For each assessed match, match activities were monitored using video recording. Two digital video cameras (Sony HDR-AS300) were set up. Both cameras were equipped with a fish-eye lens. This allowed each camera to cover one-half of the futsal court. All matches were played at the same venue or a venue with the same court dimensions. This eliminated any potential differences that may arise from different court dimensions. The cameras were placed 10 m away from the sideline, approximately 2 m from either side of the half-way line, and 10 m from the ground level on the sideline of the court. Both cameras were set up on 1.5 m high tripods and angled inward. This provided a camera height of 11.5 m above the playing surface. All players were tracked in every match for the duration of each match, which consisted of two 20-minute halves. The duration of all matches began at kickoff and ran for 40 minutes with only halftime and time-out breaks excluded from the clock time. Video footage from the matches was transferred onto a videotape to enable postmatch analysis. Because 2 cameras recorded the matches, 2 television sets were required. The television sets were placed side by side, and the matches were played and timed to allow the game to be viewed as it was played. The quantitative characteristics of the components of locomotor activity for each player and a goalkeeper were defined throughout the game. These characteristics included the number of certain types of movements. For the types of movements, we used the terminology proposed by Dogramaci et al. (2011) and quantitative parameters. In particular, we determined the number of steps for walking, jogging, running and sprinting. The following parameters were taken into account: standing - 0 $m \cdot s^{-1}$, walking - 1 $m \cdot s^{-1}$, jogging - 3 $m \cdot s^{-1}$, running - 5 $m \cdot s^{-1}$, sprinting - 7 $m \cdot s^{-1}$. For each component, we determined the distance that the player traveled during the game using this type of locomotion. To do this, the number of steps for a certain player was multiplied by the length of his step. This step length was established before the beginning of the study. In addition, to improve the accuracy of the obtained results, the goalkeeper and all of the players used the OMRON HJ-321-E Walking Style One 2.1 pedometers. They were placed in a special inner pocket of the sport shorts that were made specifically for this purpose. The pedometer provided information about the exact number of steps made by a certain player during the game as well as additional information about his speed.

All statistical analyses were performed using SPSS Version 21. The data were normally distributed. For each characteristic, we determined the mean value (*Mean*) and standard deviation (*SD*). In addition, we determined Student's *t*-criterion for unpaired samples. The 0.05, 0.01, and 0.001 levels of probability were used to indicate statistical significance (Vincent, 2005; Thomas, Nelson, Silverman, 2011).

Results

The average result for each type of movement of the athletes with different positional roles was determined using the obtained data (see Table 1). Regarding the goalkeepers, it was noted that for one.

Table 1. Quantitative characteristics of the types of locomotor activities of the goalkeeper and players during one futsal game

Role	Walking			Jogging			Running			Sprint			Total	
	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD
G (n=4)	1190.1	92.1	77.1	195.3	12.9	12.7	72.7	6.9	4.7	85.3	7.8	5.5	1543.4	86.8
D (n=18)	169.3	12.7	5.2	1125.1	59.8	34.6	1198.6	74.1	36.9	758.8	75.7	23.3	3251.8	85.4
F (n=14)	101.1	12.5	2.9	1418.7	88.7	41.0	1048.5	31.3	30.3	889.2	47.1	25.7	3457.5	89.8

Note: G - goalkeeper, D - defenders, P - pivots; % - ratio results in a specific movement to the total result in all the studied types of movement game they use different types of locomotor activities in a quantity which corresponds to overcoming the distance of 1543.4±86.8 m. However, as for the studied defenders of the respective teams, the distance appeared to be much longer, than the goalkeepers'. It confirmed the value of the total, because it was 3251.8±85.4 m. The forwards had the similar result, because the distance that they ran during one game as an average was 3457.5±89.8 m.

After that a more detailed analysis of these data was carried out. It included studying of quantitative characteristics of each researched type of locomotor activities of the goalkeeper and players. It was found out that walking of the goalkeeper amounted to 77.1% from the total number of steps that he was doing in one game. The share of other types of locomotor activities of the goalkeeper in the general structure was much lower because jogging was only 12.7% of the total distance that he covered throughout the game. Quantitative characteristics of running and sprint, like in other researched types of locomotor activities, were smaller, as they amounted to 4.7% and 5.5%, respectively. Field players got completely different results. First, we should note that in the course of the game the pivots performed a greater number of different types of locomotor activities than defenders: with total distance respectively 3457.5±89.8 m and 3251.8±85.4 m; the result of the former was larger than the result of the latter, as evidenced by the *t* value (see Table 2).

Table 2. Comparison of values of indicators of defenders (n=18) and pivots (n=14)

Walking		Jogging		Running		Sprint		Total	
t	*p*	*t*	*p*	*t*	*p*	*t*	*p*	*t*	*p*
15.18*	0.001	10.64*	0.001	7.75*	0.001	9.48*	0.001	6.57*	0.001

Note: * - statistically significant difference of the two mean values

Regarding the structure of locomotor activities, walking by the defenders amounted to 5.2%. For the pivots, this type of movement was approximately 2.9%, which was significantly lower than the defenders' results ($p < 0.001$). Similar results were obtained when comparing the quantitative characteristics of running of the defenders and pivots, with an exception that the result of the former was 1198.6±74.1 m, and of the latter – 1048.5±31.3 m ($p < 0.001$). A very different result was obtained when comparing the quantitative characteristics of jogging and sprinting, as shown by the defenders and pivots. Thus, it was determined that for both indicators, the pivots' value was significantly higher than for the defenders. During the game, the pivots used jogging and sprinting more frequently than the defenders. However, the defenders used walking and running more often than the pivots.

Discussion

Video recording can be used to obtain objective scientific information regarding a futsal game (Figueroa, Leite, Barros, 2006). The study of various characteristics of a goalkeeper and players remains an important element of obtaining information on the current status and capabilities of each sportsman in a team (Wilmore, Costill, Kenney, 2012). Some data on the characteristics of locomotor activities of the players and goalkeeper was obtained earlier (Barbero-A´lvarez, Soto, Granda-Vera, 2008; Corrêa, Davids, & Tani, 2014). The total distance covered by both teams (i.e., ranging between 2,575 and 4,313 m) remained in accordance with previous futsal studies (Barbero-A´lvarez, Soto, Granda-Vera, 2008). Although there are slight differences in the methodologies used, the similarities warrant a fair comparison between these studies and the present study. Thus, the aim of our study was to obtain answers to the following questions: a) what are the quantitative characteristics of each of the studied components of locomotor activities of the goalkeeper, defenders and pivots during a futsal game? b) how different are the quantitative characteristics of the different types of locomotor activities of the goalkeeper, defenders and pivots?

While answering these questions, we accounted for the fact that futsal is characterized by a set of features. The main features are as follows: there is a replacement of players during the game, and the total time spent by the field player in most cases is 23-24 minutes. In our study, the movement of players was recorded exclusively during the game. In addition, during the futsal game, locomotor activities of a defender, who is a member of a professional team, was approximately 135.5±1.9 m·min^{-1}. Locomotor activities of a forward in such team correspond to covering the distance of 144.1±1.3 m·min^{-1}.

For comparison, locomotor activities of a professional team player in soccer, on average, correspond to 106-110 m·min^{-1} (Bueno, Caetano, & Moura, 2014; Rago, Pizzuto, Raiola, 2017). Thus, locomotor activities of a soccer player last for 90 minutes, which is significantly more than during a futsal game.

To some extent, these data confirm the results of the study by Bueno et al. (2014). Taking into account only the time of the game, during the first half, the players covered the distance of 136,6± 17,2 m·min^{-1}, in the second half - within 129,2±16,7 m·min^{-1}. However, these results were obtained without taking into account positional roles of field players. This does not contribute to a more accurate determination of the parameters of training loads for the defenders and pivots. At the same time, the data showed that during the first half of the game, the locomotor activity of the players is more intensive than during the second half of the game.

According to the result of the analysis of empirical data by Corrêa et al. (2014), the quantitative characteristics of various types of movements of goalkeepers that they use while playing futsal differ from the quantitative characteristics of such movements of defenders and pivots. It is possible to reduce the discrepancies of these quantitative characteristics if the goalkeeper performs the functions of a field player. The greatest walking distance is covered by a goalkeeper, a much smaller distance is covered by defenders, and the least distance is covered by pivots. Jogging and sprinting are frequently used by pivots, while running is frequently used by defenders. These data confirmed the results, which indicated a significant discrepancy in the distance that field players overcome using specific type of movements during a futsal game (Bueno, Caetano, & Moura, 2014). According to these authors, this feature largely depends on the age of the group of futsal players (i.e., U-15, U-18, and professionals) and the manner of playing (e.g., offensive, defensive, and with counterattacks). Walking by the players from professional teams during a futsal game accounts for 3%, jogging - 33%, running - 32% and sprinting - 14%. The players from a professional futsal team travelled a 42% longer total distance (i.e., 4,277±103 m compared with 3,011±99.9 m of the first) (Dogramaci, Watsford, Murphy, 2011). These data are to some extent consistent with those obtained in our study, with the exception of the quantitative characteristics of certain types of movements, particularly sprinting. The differences were explained by different tactical schemes that were used by the coaches of these teams. At the same time, our data differ from the trends identified by the youth soccer researchers. In particular, during a game, the defenders have to travel a greater distance (8910 m) than pivots (7941 m) (Buchheit, Mendez-Villanueva, & Bourdon, 2010). These discrepancies can be explained by the differences in intensity of gaming activities, namely, extremely high dynamics, which means a rapid change of attacking actions of the team by defensive actions of the team and vice versa (Buchheit, Mendez-Villanueva, & Bourdon, 2010; Moura, Marche, & Cunha, 2017; Rago, Pizzuto, Raiola, 2017). As noted by Rago et al. (2017), previous studies (Bradley, Sheldon, & Krustrup, 2009; Di Salvo, Gregson, & Drust, 2009; Rampinini, Coutts, & Impellizzeri, 2009) showed that central defenders cover less total distance and perform less high-intensity running compared with other positions, whereas fullbacks and midfielders seem to perform more sprinting activity. Yet, strikers and wings had a greater decline in high-intensity bursts when their own team had ball possession (Di Salvo, Gregson, & Drust, 2009). Indeed, a limitation of this study is that we did not analyze fatigue. In addition, central midfielders with a slow pace covered more distance than they performed acceleration and deceleration (Akenhead, Harley, Tweddle, 2016). Whereas, there are some differences in the travelled distance by the players with different positional roles. These differences seem to extrapolate on recovery time between high-intensity bursts. Specifically, wide and central midfielders need less time for recovery between intense actions (Bradley, Sheldon, & Krustrup, 2009). As a consequence of the variation that is likely to be mediated by both the inherent demands of the game and individual's ability to regulate their own activity, the variability in running seems to be very large (Gregson, Drust, & Salvo, 2010).

Conclusions

Futsal teams of sub-elite level, competing in the first League of the championship of Ukraine differ in quantitative characteristics of locomotor activity components. During a futsal game, the longest distance is covered by pivots, a much shorter distance is covered by defenders, but the distance is longer than that of a goalkeeper. The structure of pivots' locomotor activity is dominated by jogging, that of the defenders is dominated by running, and that of the goalkeeper is dominated by walking. During the game, pivots use jogging and sprinting more often than defenders; defenders use walking and running more often than pivots. Coaches can benefit from these results to understand how players of different positional roles organize themselves during official matches and to develop training programs that will increase the effectiveness of player training and the result of their competitive activity.

Conflicts of interest

No conflicts of interest exist.

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