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Physical and technical performances are not associated with tactical prominence in U14 soccer matches

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ABSTRACT

The aim of this study was to analyse the association between physical/technical variables and the tactical prominence variables in U14 soccer matches. Twenty-two young amateur soccer players (13.5 ± 0.5 years old, 5.4 ± 0.5 years of practice, 163.3 ± 9.8 cm in body height) from two teams of the Portuguese regional league volunteered for the study. Our results showed positive and moderate correlation between dribbling test and betweenness centrality (r = 0.324; p = 0.142), and negative moderate correlation between %fatigue index and betweenness centrality (r = −0.390; p = 0.073). Physical and technical variables had no statistical differences among tactical positions. Nevertheless, when tactical prominence of players from four tactical positions were compared, significant differences were found in terms of degree prestige (p = 0.001) and degree centrality (p = 0.002). This pilot study did not find strong correlations between physical/technical levels and tactical prominence in soccer matches.

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Performance analysis; match analysis; individual prominence; network; technic; tactics

Introduction

Performance indicators have been used in sports science to identify, characterize, and potentiate training methodologies (Carling, Williams, & Reilly, 2005; Hughes & Bartlett, 2002). The use of such indicators aims to improve the understanding of factors that significantly contribute to improvements in performance and success (Carling, Reilly, & Williams, 2009). In football, the analysis of performance indicators has been expanding in scope and has been conducted during games by time-motion analysis and notational analysis (Franks & McGarry, 1996; Hughes & Franks, 2004).

Despite this expansion in performance analysis, performance indicators regarding physical and physiological factors have not been consistently used in association with

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match analysis categories, such as technical and tactical performance (Carling & Dupont, 2011; Mooney et al., 2011; Royal et al., 2006). The association between categories is typically made between physical/physiological performance and time-motion characteristics (Buchheit, Mendez-Villanueva, Simpson, & Bourdon, 2010), which are substantially different from technical/tactical performance in a match.

Previous studies have found a statistical decrease in physical and technical indicators during a match (Carling & Dupont, 2011; Rampinini, Impellizzeri, Castagna, Coutts, & Wisløff, 2009). In one study performed on the Italian Serie A football league, three technical measures were found to statistically decrease from the first half to the second half of the game: involvement with the ball (−9%), short passes (−11%), and successful short passes (−11%) (Rampinini et al., 2009). In another study conducted on a French team in 37 matches, the frequency of passing, ball possessions, and duels were found to be greater in the first 5 min than in the final 5 min (Carling & Dupont, 2011). Nevertheless, the authors suggested that the players were generally able to maintain skill-related performance throughout the games and throughout successive matches within a short period of time (Carling & Dupont, 2011).

Despite these results, none of the aforementioned studies associated the fitness levels of players with their tactical prominence in a match. This approach could be particularly relevant in testing whether the organizational process of the team is independent from the fitness levels and maturational status of the players or whether fitness levels influence the involvement and prominence of a player during the match.

The prominence level of a player in the structural context of the team is not the same as involvement with the ball. On one hand, in terms of involvement with the ball, the focus of analysis is the technical or skill-related performance of the player (Hughes & Bartlett, 2002). On the other hand, the prominence of players within a team can be analysed by using social network analysis (Clemente, Couceiro, Martins, & Mendes, 2014). This approach identifies how teammates cooperate and which players have high prominence in the collective organization, mainly in attacking moments (Peña & Touchette, 2012). This type of analysis allows for an understanding of individual prominence inside the global structure of cooperation (Cotta, Mora, Merelo, & Merelo-Molina, 2013). Thus, this approach is extremely relevant for identifying the prominence and centralization levels of players (Clemente, Martins, Couceiro, Mendes, & Figueiredo, 2014).

The association between the fitness levels of players and the centralization levels of a match can be an important indicator to test whether the optimal fitness condition of a young player can ensure high participation in a match (Buchheit et al., 2010; Rampinini et al., 2008). Such a relationship must be carefully analysed because different factors, such as relative age effect, can determine the intervention of players in a match, in addition to the selection of players (Costa, Garganta, Greco, Mesquita, & Seabra, 2010; Roel Vaeyens, Philippaerts, & Malina, 2005). The level of this intervention can also constrain the evolution level of players with regard to their perception of the game and their individual evolutionary processes (Ward & Williams, 2003).Therefore, a new line of research should analyse the relationship among conditioning, physical level, and match performance. Such an analysis will also provide valuable information about the possible criteria for player selection based on conditional status and ability to make a difference in a match.

This study aims to analyse the association between the fitness/technical levels and tactical prominence of young soccer players in a match. We hypothesized that in this growing stage of

players, a small/moderate correlation would be found between fitness indicators and tactical prominence and a moderate correlation would be found between technical levels and tactical prominence in a match. Moreover, we also aim to analyse the variance between tactical positions in physical/technical and tactical prominence variables.

Methods

Subjects

A total of 22 young amateur soccer players (13.5 ± 0.5 years old, 5.4 ± 0.5 years of practice, 163.3 ± 9.8 cm in body height, and 52.7 ± 10.1 kg in body weight) from two of the Portuguese regional league volunteered for the study. The study was reviewed and approved by the Coimbra College of Education (ESEC.002.11.2014) review board (ethics committee) prior to commencement of the study. One-on-one interviews were conducted by the main researcher with each player and their parents to explain the experimental procedures and to observe if the participants did not have any apparent physical or psychological diseases. Thereafter, all parents signed the free and clarified consent form according to the Declaration of Helsinki. The players were asked to maintain normal daily food and water intake during the period of study. All players were familiarized with the experimental procedures and the requirements of the physical and technical tests. The players had been previously trained for a 2 month period with three soccer-specific training sessions per week (each lasting for 60 min–70 min) and one weekly competition.

Procedures

The study was conducted for six consecutive weeks in October and November of the 2014–2015 season (i.e. early in-season). All players were tested for physical and technical performance in a week. Tactical prominence was analysed during official competitive matches. The 22 players were guaranteed to play 85% of the whole game for 5 official competitive matches. During the first week, physical (anthropometric, repeated-sprint ability, and power) and technical (dribbling and shooting accuracy) tests were conducted. The tests were distributed among the three training sessions to avoid the fatigue effect. All tests were preceded by a supervised and standardized warm up consisting of 5 min running at 55–65% HR_{max}, along with a few athletic drills, proprioceptive drills, and short bursts of progressive accelerations on the field. The training days were distributed with a 1 day interval between each training day. All field tests were conducted in dry conditions, with temperatures ranging from 8ºC to 15ºC. In the following weeks, no direct interventions were performed. Thus, only the match performances were analysed by using observational methods. All studied matches were not played in rainy conditions.

Assessment of physical and technical levels

All players were tested for their physical and technical levels before the matches were observed. Two physical tests and two technical tests were conducted to verify their association with tactical prominence.

Repeated-sprint ability test protocol

The seven-sprint test protocol (Bangsbo, 1994) was used to measure running speed. The test consists of seven separate sprints (34.2 m including slalom) with a recovery of 25 s between each sprint, during which players can walk or jog to the starting line (Sporis, Milanovic, Trajkovic, Erceg, & Novak, 2013). Players started with their heads immediately behind the start line. The fatigue index was calculated by using the following formula (Chittibabu, 2014):

$$\text{Fat index}\% = \frac{\text{Slowest sprint} - \text{Fastest sprint}}{\text{Fastest sprint}} \times 100. \quad (1)$$

The intraclass correlation coefficient for seven attempts revealed a value of 0.65, thus suggesting good internal consistency (Fleiss, 1981).

Vertical jump test

A Sargent jump test was conducted. In this jump-and-reach test, the jumping height was determined by subtracting the standing reach height from the jumping reach height (Markovic, Dizdar, Jukic, & Cardinale, 2004). The test was performed from countermovement with arm swing. Two repetitions were performed with an interval of 3 min between each repetition. The highest jump height was used for analysis. The intraclass correlation coefficient for two attempts revealed a value of 0.79, thus suggesting excellent internal consistency (Fleiss, 1981).

Dribbling test

The slalom dribble protocol was then conducted (Reilly & Holmes, 1983). This test requires total body movement in dribbling a ball around a set obstacle course as quickly as possible. The obstacles comprised plastic conical skittles that are 91 cm in height and have a base diameter of 23 cm. Two parallel lines were drawn 1.57 m apart as reference guides. Intervals of 1.83 m were marked along each line, and diagonal connections of alternate 4.89 m-long marks were made. Five cones were placed on the course itself, and a sixth cone was positioned 7.3 m from and exactly opposite the final cone at 9.14 m from the starting line (Reilly & Holmes, 1983). Two repetitions were performed with an interval of 3 min between each repetition. The shortest time to complete the course was used in this study. The intraclass correlation coefficient for two attempts revealed a value of 0.72, thus suggesting good internal consistency (Fleiss, 1981).

Shooting accuracy

Three shots were performed successively from the centre of the field to the goal at 16.5, 21.5, and 26.5 m, respectively. The goal was equally segmented in six sectors: (i) left and right top corners (three points); (ii) left and right down corners (two points); (iii) top centre (one point); and (iv) down centre (zero points). All-out shots were scored with zero points. The points were attributed on the basis of the assumption that the corners have been identified as the optimal ball location to beat the goalkeeper (Ali et al., 2007).

Players started on the 16.5 m mark, then moved to 21.5 m, and finally to 26.5 m. A 30 s interval between shots was given to each player. The sum of points earned in the three shots was computed and used as variable for this study. The intraclass correlation coefficient for three attempts revealed a value of 0.81, thus suggesting excellent internal consistency (Fleiss, 1981).

Assessment of tactical prominence in match

The classification of a player's prominence in a match was measured by using the centralization metrics of graph theory (Wasserman & Faust, 1994). A social network approach was used in the observation process. Each unit of attack was considered on the basis of the pass sequence of the team (Passos et al., 2011). For each unit of attack, an adjacency matrix that determines the interaction between teammates was generated (Clemente et al., 2014a). The sum of adjacency matrixes resulted in a final adjacency matrix per match. These final matrices were used to compute the network metrics. For a better understanding of the global process, refer to the study of Clemente et al. (2014b). To minimize inter-reliability error, the observation and codification of sequences of passes were performed by one researcher who has more than 5 years of experience in match analysis. The observer was previously trained and was tested in a test–retest procedure to ensure data reliability. To avoid task familiarity issues, Cohen's Kappa test adhered to a 15 day interval for reanalysis (Robinson & O'Donoghue, 2007). A Kappa value of 0.82 was obtained after testing 15% of the full data. The Kappa value ensured a recommended margin for this type of procedure (Robinson & O'Donoghue, 2007). Three centrality metrics were computed per player. The average of five matches was used as variable. Each metric is described in the following sections. Metrics computation was executed by using SocNetV (version 1.5), a free network analysis software.

Degree centralization

Degree centralization is a metric that is usually interpreted as a measure of node activity (Nieminen, 1974). In football analysis, where each edge between nodes signifies the passes between relevant teammates, players with a large degree of centralization are players who contributed more to their team's offensive attempts via passes to other teammates.

Degree prestige

Degree prestige, which is also known as in-degree centrality, is an index that considers only inbound links and is often used as an indication of the 'prestige' of each node among its peers. The data analysis shows that players with a high degree of prestige are players to whom their teammates preferred to pass the ball. These players might be the most important component for their team's offensive development because they receive the ball more often than other players during their team's attempt to attack.

Betweenness centrality

With regard to the passing game data, players with high betweenness centrality (BC) scores might be those who are often situated between their teammates. For instance, a player with a high BC score could be important in passing the ball to other teammates.

Statistical procedures

Data were expressed in mean ± standard deviation (SD). The Pearson product-moment correlation coefficient was used to assess the relationship between physical/technical and tactical prominence variables. The following scale was used to classify the correlation of the test (Hopkins, Hopkins, & Glass, 1996): trivial, 0.00–0.10; small, 0.10–0.30; moderate, 0.30–0.50; large, 0.50–0.70; very large, 0.70–0.90; nearly perfect, 0.90–1.0. One-way ANOVA was also used to analyse the variance between four tactical positions (goalkeeper, defender, midfielders, and forwards). Post hoc pairwise comparisons were made by using Bonferroni adjustment. The following scale was used to classify the effect size of the test (Hopkins et al., 1996): trivial, 0.00–0.20; small, 0.20–0.60; moderate, 0.60–1.20; large, 1.20–2.00; very large, 2.00–4.00. The statistical procedures were executed by using IBM SPSS (version 22). The level of significance was defined as $p \leq 0.05$.

Results

The relationship between physical/technical variables and tactical prominence variables are presented in Table 1. A positive and moderate correlation was found between dribbling test and betweenness centrality (r = 0.324; p-value = 0.142), and a negative moderate correlation was found between %fatigue index and betweenness centrality (r = − 0.390; p-value = 0.073). Small and negative correlations were found between dribbling test and degree prestige (r = − 0.183; p-value = 0.416) and between shooting accuracy and degree prestige (r = − 0.239; p-value = 0.285). Small and positive correlations were found between dribbling test and degree centrality (r = 0.234; p-value = 0.295) and between vertical jump and betweenness centrality (r = 0.202; p-value = 0.367).

When comparing the physical/technical variables of players from four tactical positions, no significant differences were found in Fatigue Index (F = 0.356; p-value = 0.785; $\eta^2 = 0.056$; trivial effect size, Table 2), vertical jump (F = 0.276; p-value = 0.842; $\eta^2 = 0.044$; trivial effect size), shooting accuracy (F = 2.525; p-value = 0.090; $\eta^2 = 0.296$; small effect size), and dribbling test (F = 0.660; p-value = 0.587; $\eta^2 = 0.099$; trivial effect size).

When comparing the tactical prominence of players from four tactical positions, significant differences were found in degree prestige (F = 47.252; p-value = 0.001; $\eta^2 = 0.887$; moderate effect size) and degree centrality (F = 7.202; p-value = 0.002;

Table 1. Correlation between physical/technical variables and tactical prominence variables.

	%Fatigue Index	Vertical jump	Dribbling test	Shooting accuracy
Degree centrality	−0.032	−0.004	0.234	0.080
Degree prestige	0.043	0.052	−0.183	−0.239
Betweenness centrality	−0.390	0.202	0.324	0.008

Table 2. Mean and standard deviation of performance variables per tactical position.

	GK	DF	MF	FW	*p*-value	η^2
n	2	8	6	6		
Fatigue index (%)	8.08 ± 4.50	8.38 ± 5.73	5.96 ± 2.49	9.78 ± 9.77	0.785	0.056
Vertical jump (cm)	36.00 ± 5.66	34.38 ± 5.07	36.33 ± 2.50	34.67 ± 4.59	0.842	0.044
Dribbling test (s)	13.70 ± 0.59	13.63 ± 0.76	13.72 ± 1.58	12.96 ± 0.87	0.587	0.099
Shooting accuracy	5.00 ± 1.41	3.13 ± 1.64	4.50 ± 1.87	2.50 ± 0.84	0.090	0.296
Degree centrality (%)	3.50 ± 0.44[b,c]	10.08 ± 2.69[a]	10.98 ± 2.46[a]	7.76 ± 0.93	0.002	0.546
Degree prestige (%)	1.08 ±0.32[b,c,d]	5.59 ± 1.34[a,c,d]	10.75 ± 2.60[a,b,d]	14.79 ± 1.35[a,b,c]	0.001	0.887
Betweenness centrality (%)	0.54 ± 0.10	3.67 ± 1.45	3.46 ± 2.50	1.75 ± 1.63	0.085	0.301

Significantly different compared with GK[a]; DF[b]; MF[c]; FW[d]; at $p < 0.05$.
Data are mean ± SD.
GK: goalkeeper; DF: defender; MF: midfielder; FW: forward; *n*: sample size; η^2: eta squared.

$\eta^2 = 0.546$; small effect size). No statistical difference between the four tactical positions was found in Betweenness Centrality ($F = 2.587$; p-value = 0.085; $\eta^2 = 0.301$; small effect size).

Discussion

The results of this study showed that at these ages, a small to moderate association could be observed between technical–physical tests and tactical behaviour. The correlation coefficients did not indicate large associations between physical or technical levels with tactical prominence. Only moderate associations were found among betweenness centrality, dribbling level, and % fatigue index. For the dribbling test, this result signified that players with excellent technical capabilities might be considered references for improving cooperation among teammates. These players could be the ones that show confidence in ensuring ball possession. Moreover, the %Fatigue Index was found to have a negative correlation with tactical prominence. As indicated in previous studies, the ability to repeat sprints and avoid fatigue depended on a right-shift in lactate threshold (Reilly, 2007). Thus, the ability to maintain excellent performance ensured great tactical prominence and participation in the match (Rampinini et al., 2007). Such physical and technical variables were also found to be the main indicators that characterize the selection in young male players (Vaeyens et al., 2006).

Small correlations were found between vertical jump and shooting accuracy and tactical prominence. In this case, these groups of variables were associated with power and strength. Such variables might not also be sufficiently significant to result in great tactical prominence. Despite the importance of strength and power in ensuring good fitness condition and performance in a match (Turner & Stewart, 2014), such variables were not determinants of great intervention in the field. Players with excellent power and strength are generally goalkeepers, central defenders, and forwards (Boone, Vaeyens, Steyaert, Vanden Bossche, & Bourgois, 2012; Wong, Chamari, Dellal, & Wisløff, 2009), and such tactical positions are not highly required in the regular attacking process and passing sequence (Clemente et al., 2014a; Cotta et al., 2013; Duch, Waitzman, & Amaral, 2010). However, the investigation promoted by this study on the relationship between physical/technical levels and tactical prominence could not provide sufficient evidence to fully support this discussion.

The association between physical/technical levels and tactical prominence was analysed with the variance of physical/technical levels and tactical prominence between different tactical positions in a match. No statistical differences in various physical/technical levels were found between tactical positions. Nevertheless, statistical differences in degree prestige and degree centralization were found between tactical positions. Defenders and midfielders were found to have statistically greater values of degree centrality than goalkeepers. These results can be justified by the great prominence of these tactical positions in the moment of building the attack. The large number of passes performed by defenders to initiate the attack and by the midfielders to manage the passing sequence determines the greater out-degree values (Clemente et al., 2014; Cotta et al., 2013). Such values can be justified by the specific tactical mission of these players that act as a link between team sectors (Reilly & Holmes, 1983). Statistical differences in degree prestige were found between tactical positions. The greatest values were found in forwards, followed by midfielders and defenders. The degree prestige values reveal that among the team, forwards were the most recruited players by their teammates. Such results might suggest that these game strategies are more counter-attack-related (Malta & Travassos, 2014). In teams that opt to play in ball circulation, the greatest values of degree prestige were found in midfielders that receive a large number of passes from their teammates (Clemente et al., 2014a). In this work, the resulting participation of defenders, which was the highest among tactical positions, might be justified by the limitation of the midfielders in promoting open spaces to obtain passes from defenders, thus imposing a long pass to forwards. These considerations should account for the long-term learning process of the game and the normal difficulties of the players at these ages. Moreover, U14 is the earliest age group that adopts the formal game approach (11 vs. 11) with the necessary adaptations to the new reality of the number of players (different number of collaborations and oppositions), to new space dimensions, and to new approaches to the perceptual–cognitive domain.

This study found small correlations between physical/technical and tactical variables in young football players. Dribbling performance had the greatest value of correlation with tactical performance in match. These results suggested that tactical performance did not depend only on physical and technical performance in youth football. A second analysis found no statistical differences in the physical and technical performances between different tactical positions. However, statistical differences were observed in physical and technical performances between different tactical positions for tactical prominence in a match. The most prominent players in building the attack were the external defenders and midfielders. Forwards and midfielders were the players that received the most passes from their teammates and were the most relevant in the end of the attacking process. This study was the first to investigate the correlations between physical/technical performances with tactical prominence in match. As a pioneer study in this field of analysis, this work will benefit future studies in further analysing physical/technical variables and in associating time-motion analysis with tactical prominence during official matches.

Conclusion

Small and moderate correlations between physical/technical performance and tactical prominence levels were found. Repeated-sprint ability and dribbling skills had moderate correlations with betweenness centrality. In the analysis of the variance between tactical positions, statistical differences were found in tactical prominence only; the greatest values of degree prestige and degree centrality among the results were found in midfielders that made a high number of passes to their teammates and in forwards that received a high number of passes from their teammates.

Some results could be associated with one of the study limitations, that is, few performance indicators could be associated with physical capabilities. Future studies should collect a broad range of performance tests. Moreover, technical skills such as the quality of passes and ball control could be analysed for comparison with tactical prominence. Therefore, future studies could collect variables that could further analyse tactical prominence in a match. Despite such limitations, the present study has the merit of cross-examining physical/technical variables with tactical performance. This approach has not been performed in previous studies, thus allowing an incremental advance in the knowledge of matches in youth soccer categories and in understanding the relationships between monitoring and ecological (game) variables. Further studies are needed to improve our understanding of the different age groups that compose the youth soccer organization.

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Disclosure statement

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