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Impact of Aerobic Power, Strength of Lower Limbs and Speed on Technical Skills in Young Soccer Players

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ABSTRACT

Borges PH, Rechenchosky L, Deprá PP, Ronque ERV, Greco PJ, Menegassi VM, Rinaldi W. Impact of Aerobic Power, Strength of Lower Limbs and Speed on Technical Skills in Young Soccer Players. **JEPonline** 2017;20(1):221-230. The purpose of this study was to analyze the impact of physical fitness on technical skills in young soccer players and identify which physical variable can discriminate level of technical behavior. The sample was composed of 64 young male soccer players aged 11.9 to 17.9 yrs. The players were evaluated according to their physical fitness and technical skills. Physical fitness was evaluated by the Yo-Yo Intermittent Recovery Test level 1, Counter Movement Jump, and the 30 m Speed Test. Technical skills were evaluated by the General Soccer Ability Skill Test Battery (dribble, pass, and shot on goal). Three discriminant analyses were performed to analyze which variable related to physical fitness can discriminate the level of technical indicators in young players ($P<0.05$). The findings indicate that the Yo-Yo test ($\Lambda=0.53$; $P<0.001$), Speed ($\Lambda=0.67$; $P<0.001$), and Counter Movement Jump ($\Lambda=0.70$; $P<0.001$) can discriminate players between technical groups. Physical variables were related to technical indicators and can help to discriminate the level of technical execution in young soccer players.

Key Words: Exercise, Physical Fitness, Soccer, Technique

INTRODUCTION

During a soccer game, a series of factors are required to help players achieve excellence in this sport. As an intermittent activity, the actions performed during a match require intense aerobic and anaerobic training as well as physical fitness (9,13). Moreover, cognitive ability is important as it helps the players to select contextual information, make better decisions, and choose an appropriate technique within the game (25,27). In this scenario, besides physical fitness performance, athletes must accomplish high levels of actions related to tactical and technical dimensions (17).

Although the technical dimension is fundamentally important in soccer, the literature discloses few tools to help coaches and teachers to assess the level of specific motor skills of young soccer players. Chronologically, in 1979, the Mor and Christian protocol (19) was proposed recommending assessment through three field tests: dribble, pass, and shot. Some studies have used this protocol to evaluate the relationship between tactical and technical performance (22), to describe the skill level of young Brazilians soccer players (1), and to identify the association between the assessment of the coach and the motor test results (20).

In 1986, the Portuguese Football Federation proposed a protocol where the players are evaluated in skills such as ball control with the body, ball control with the head, slalom dribbling with a pass, slalom dribbling, passing accuracy, and shooting accuracy. These tests have been used by researchers to compare the characteristics of regionally selected and non-selected under-14 soccer players (3), to compare the variation in size, function, sport-specific skill, goal orientation, and biological maturation in young soccer players (6), and to investigate the predictors of functional capacity and skills in youth soccer players (5).

Guilherme et al. (12) validated an instrument named the "System of assessment of functional asymmetry of the lower limbs in Football" (SAFALL-FOOT). The main objective of this protocol is to enable analysis of the frequency and effectiveness of all technical actions performed with the ball using the lower limbs. Subjects are required to play a small sided game (G+4 vs. 4+G) for 20 min, during which 6 categories and 32 subcategories are observed, such as interception/disarm, reception, passing, driving/protection, dribbling, and shooting.

Although the increase in research related to technical indicators in young soccer players is noticeable, the literature is unclear about how physical fitness influences technical tasks. It is known that during adolescence, a series of body changes take place due to growth and maturational processes. Thus, it becomes necessary to evaluate the relationship between technique and some variables related to maturation, such as physical fitness. This information could help coaches and teachers to understand the influence of energetic-functional variables on technical behaviors and chosen tasks. Therefore, the purpose of this study was to analyze the impact of physical fitness on technical skills in young soccer players and identify which physical variable can discriminate level of technical behavior.

METHODS

Subjects

One hundred and forty young male soccer players between 11 and 17 yrs old (12.9 ± 0.3 yrs) were pre-selected to participate in this study. The players were part of an extension project of a university in the south of Brazil. The following inclusion criteria were adopted: (a) being enrolled in the extension project; and (b) having a Consent Form signed by a parent or guardian for participation in a research study. The following exclusion criteria were adopted: (a) presence of any muscular or skeletal injuries; (b) participation in regional and/or state competitions; and (c) attendance at training sessions at least twice a week. The final sample consisted of 64 players; 20 players from the U-11 category (10.2 ± 1.1 yrs), 13 players from the U-13 category (12.1 ± 0.6 yrs), 21 players from the U-15 category (14.3 ± 0.7 yrs), and 10 players from the U-17 category (16.3 ± 0.6 yrs). The project was approved by the local Institutional Review Board (Opinion 653.698).

Procedures

Anthropometric measures of body mass, height, and sitting height were obtained using a Filizola® brand scale, with a coupled stadiometer with accuracies of 0.1 kg and 0.1 cm respectively, according to the procedures described by Gordon et al. (8). Leg length was calculated by subtracting sitting height from height.

After conducting the anthropometric measurements, the relative indicator of somatic maturity (peak height velocity - PHV) was calculated by the interaction between leg length, age, body mass, and height measurements (18). This information provides the distance between current age and the period at which maximum growth in stature is achieved during adolescence.

Physical fitness, represented by aerobic power, lower limb strength, and speed were evaluated using the Yo-Yo Intermittent Recovery Test level 1 (YYIRT1) (14), the Counter Movement Jump (CMJ) (2), and the 30 m Speed Test (4), respectively. The YYIRT1 was performed in a soccer field with the help of an audio sound. The vertical jump CMJ was performed on a force platform (EMG System Brazil®). Each player jumped twice, the best height of both jumps was adopted for analysis. A photocell system was used to assess the running time in the 30 m speed test.

To assess technical skills, the General Soccer Ability Skill Test Battery proposed by Mor and Christian (19) was applied. This battery verifies performance of players in passing, shooting on goal, and dribbling. In the passing and shooting on goal, the players were requested to shoot at previously established targets, while in the dribble test the time taken to run at a previously known trajectory with the ball was assessed.

Statistical Analysis

To analyze the normality of the data, the Kolmogorov-Smirnov test and skewness and kurtosis were used. Non-hierarchical K-means cluster analysis was performed with the aim of classifying the young athletes into two groups according to level of technical performance. This multivariate method allows classification of subjects with similar technical behavior (16). Two groups were created (cluster 1 - high technical performance: n = 36; cluster 2 - low

technical performance: n = 28), and all variables used in this analysis were standardized by z-score. Next, three discriminant analyses using the Wilks´ Lambda test were performed to assess which physical variable helps to discriminate the level of technical performance. The Box´s M test was used to analyze homogeneity of matrices variance. Canonical correlation was performed to measure the association between group of variables and discriminant function. Cross-validated grouped cases were used to visualize the percentage of correct classifications made by the model. Data were processed using SPSS 20.0. The level of significance was set at 5%.

RESULTS

Table 1 shows the descriptive data of young soccer players. It can be observed that, as expected, the variables related to growth and physical fitness increase in function of the categories.

Table 1. Descriptive Data of the Young Soccer Players.

Groups	U-11 (n = 20) Mean ± SD	U-13 (n = 13) Mean ± SD	U-15 (n = 21) Mean ± SD	U-17 (n = 10) Mean ± SD
Age from PHV (yrs)	-3.61 ± 0.78	-2.33 ± 0.74	-0.38 ± 0.77	0.88 ± 0.46
Height (cm)	141.63 ± 9.47	151.88 ± 9.03	166.99 ± 7.86	170.50 ± 4.16
Body mass (kg)	36.04 ± 8.68	46.83 ± 11.27	59.51 ± 11.76	59.95 ± 7.87
CMJ (cm)	18.51 ± 3.86	17.70 ± 3.83	24.66 ± 4.61	28.48 ± 3.82
YYIRT1 (m)	284.00 ± 99.59	366.15 ± 159.03	708.57 ± 207.51	836.00 ± 192.71
Speed 30 m (sec)	5.29 ± 0.34	5.11 ± 0.55	4.49 ± 0.28	4.24 ± 0.38
Dribble (sec)	21.21 ± 3.45	19.40 ± 2.84	16.52 ± 2.19	14.43 ± 1.22
Pass (score)	3.25 ± 1.99	4.23 ± 2.04	4.19 ± 1.36	5.10 ± 1.85
Shot (score)	36.20 ± 17.63	41.38 ± 18.50	62.47 ± 27.91	61.20 ± 14.33

CMJ = Counter Movement Jump; **YYIRT1** = Yo-Yo Intermittent Recovery Test level 1

Cluster analysis is presented in Figure 1. It can be observed that the subjects in cluster 1 presented a high level of technical performance when compared with cluster 2 ($P<0.001$). It was identified that dribbling ($P<0.001$), passing ($P=0.002$), and shooting on goal ($P<0.001$) were significant to group the young athletes into two technical performance groups.

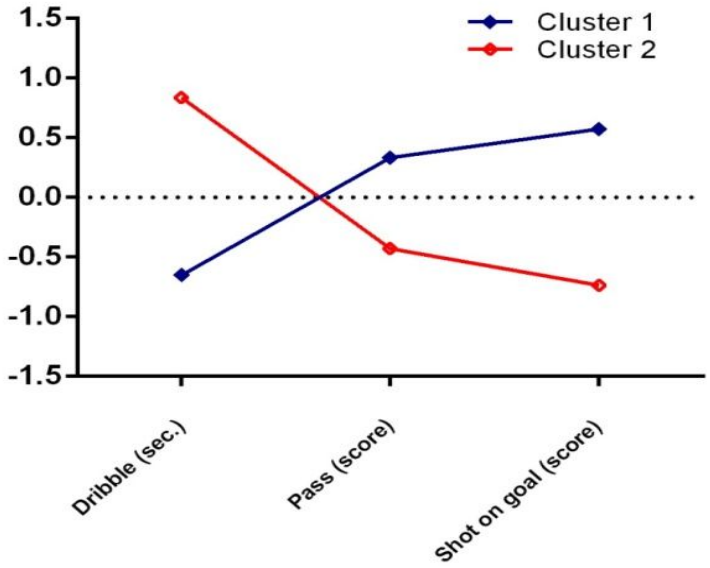

Figure 1. Z-score Cluster Analysis of Young Soccer Players Classified According to Technical Performance.

Discriminant analysis showed that the best canonical correlation was obtained for the Yo-Yo test (Λ=0.53; X^2 (1)=38.719; P<0.001), followed by Speed (Λ=0.67; X^2 (1)=24.309; P<0.001), and CMJ (Λ=0.70; X^2 (1)=21.308; P<0.001).

Table 2. Values of Discriminant Analysis Related to Physical Fitness.

	CMJ (cm)	YYIRT1 (m)	Speed (sec)
Standardized Coefficients	0.206	0.005	2.149
Constant	-4.511	-2.577	-10.384
Eigenvalue	0.414	0.877	0.485
Canonical Correlation	0.541	0.684	0.571
Wilks' Lambda	0.707	0.533	0.673
Significance	0.001	0.001	0.001
Chi-Square	21.308	38.719	24.309
Cross-Validated (%)	75	84.4	76.6

CMJ = Counter Movement Jump; **YYIRT1** = Yo-Yo Intermittent Recovery Test level 1

This confirms that the three tests can be used to discriminate high or low skill levels in young soccer players using the General Soccer Ability Skill Test Battery. Cross-validated values revealed that when using the Yo-Yo Test to discriminate level of technical skills, 84.4% of all cases were correctly classified.

DISCUSSION

The purpose of this study was to analyze the impact of physical fitness on technical skills and identify which physical variable can discriminate the level of technical behavior. The main findings show that physical performance can discriminate technical behavior level in young soccer players. These findings suggest that physical aspects are important and can help players increase technical performance during a soccer match.

Physical fitness is important as it allows players to execute and remain involved in the technical and tactical aspects during a game situation. This means that both aerobic and anaerobic metabolism is required to execute the technical skills to execute the movements. Cluster and discriminant analysis confirmed that CMJ, Speed, and Yo-Yo Tests can be used to discriminate players with high or low technical skills. Thus, it seems to be evident that technical task protocols are influenced by aerobic power, speed, and strength of the lower limbs.

In this regards, it was observed that during the technical test execution, the athletes with low lower limb strength - especially the U-11 and U-13 players, could not shoot at the goal appropriately (given that the protocol uses the official post and the youngest soccer players do not have the physical power to put the ball in the upper angles).

The evaluation of these movements is important since tactical and technical aspects are central components to develop young soccer athletes. However, to select a battery where physical attributes are highly required to perform all tasks must be considered with caution when used with young athletes, since it is probable the players that are more advanced in the maturational process tend to have better scores when compared with players late in the process. This might occur since biological maturity and physical performance are related in male adolescents according to Malina et al. (15). Thus, it is reasonable to consider that the data derived from the General Soccer Ability Skill Test Battery may not be reliable, especially for players who have not passed the peak height velocity are evaluated (i.e., below 15 yrs of age).

Corroborating this information, Greco and Benda (10) also stated that during the soccer learning process, technical specialization must occur after the specialization phase (above 15 yrs of age) when body systems and cognitive processes are prepared to receive this kind of information. In this way, it seems to make sense not to focus attention on evaluating technical automation at prior moments, such as in preschool, universal (6 to 12 yrs old), orientation (11 to 13 yrs old), and direction phases (13 to 15 yrs old).

In fact, motor skills are more difficult to measure than physiological indicators such as aerobic power and speed. Many factors must be considered during the technical tests. The literature reports that motor skills are performed involving complex and intentional actions and require

sensory inputs, neural control of movement, and motor mechanisms acquired during a learning process (26,27). These aspects must be considered to have great relevance when choosing a protocol to assess these kinds of actions.

Another concern is the poor ecological validity in this protocol. Although the main tools used to assess the technical soccer indicators were carried out on the athletes' own playing field and generated relevant information, it presents weakness as the roles and criteria adopted are not presented in a match situation (11). To preserve the characteristics of soccer, the tests should present the same properties as a match such as unpredictability, randomness, and a complex nature (7).

In this context, small sided games (SSGs) are recommended to assess technical and tactical factors, since they tend to promote interaction between these aspects and, especially when the techniques are executed contextualized as part of a cognitive process within the game (22). In addition, according to Raab (23), during complex situations such as soccer games, players learn movements in implicit and explicit learning processes. In this sense, SSGs also allow interaction between both processes, optimizing the learning of techniques.

Unlike a formal game (11 vs. 11), Praça and colleagues (21) identified in SSGs that there is no significant difference in heart rate or subjective perception of effort between different positions. In addition, SSGs help coaches to improve physiological aspects related to specific aerobic conditioning such as heart rate, VO_2 max, and blood lactate (13,24).

CONCLUSIONS

The results of this study revealed that physical performance can discriminate technical level in young soccer players. The Yo-Yo Intermittent Recovery Test, Counter Movement Jump, and the 30 m Speed Test are important indicators to discriminate high and low levels of technical skills. We recommend further studies with a longitudinal approach to analyze the impact of maturational and training processes on technical skills in young soccer players.

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