
TACTICAL PERFORMANCE, ANTHROPOMETRY AND PHYSICAL FITNESS IN YOUNG SOCCER PLAYERS: A COMPARISON BETWEEN DIFFERENT MATURATIONAL GROUPS

DESEMPENHO TÁTICO, ANTROPOMETRIA E CAPACIDADES FÍSICAS EM JOVENS FUTEOLISTAS: COMPARAÇÃO ENTRE DIFERENTES GRUPOS MATURACIONAIS

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RESUMO

O objetivo do estudo foi comparar o desempenho tático, os indicadores antropométricos e as capacidades físicas entre diferentes grupos maturacionais em jovens futebolistas. Fizeram parte do estudo 48 jogadores de futebol (14,80±1,52 anos). Foram realizadas medidas antropométricas de massa corporal, estatura e altura tronco-cefálica. O Pico de Velocidade de Crescimento (PVC) foi utilizado como indicador relativo de maturidade somática. Foram realizados os testes de sentar-e-alcançar, *Yo-Yo Intermittent Recovery Test level 1*, preensão manual, abdominal modificado e saltos verticais (Counter Movement Jump e Squat Jump). O desempenho tático foi obtido através do Sistema de Avaliação Tática no Futebol (FUT-SAT). Para análise estatística, utilizou-se a Análise de Cluster, Anova One-Way e o coeficiente de correlação de Pearson. Os resultados indicaram que os jogadores adiantados no processo maturacional apresentaram valores superiores no desempenho das capacidades físicas como resistência aeróbia e força muscular de membros inferiores ($P<0,01$). Os princípios táticos "cobertura ofensiva", "unidade ofensiva" e "concentração" foram mais executados por jogadores Pós-PVC comparativamente ao grupo Pré-PVC ($P<0,05$). Foram observadas correlações significativas entre o PVC e os princípios "cobertura ofensiva" ($r=0,32$), "unidade ofensiva" ($r=0,39$) e "concentração" ($r=0,38$). Tais resultados sugerem que o avanço na classificação maturacional exerce baixa influência sobre a gestão do espaço de jogo de jovens futebolistas.

Palavras-chave: Futebol. Crescimento corporal. Desempenho atlético.

ABSTRACT

The aim of the study was to compare the tactical performance, anthropometric indicators, and physical capabilities between different maturational groups in young soccer players. Study participants were 48 soccer players (14.80±1.52 years). Anthropometric measurements of weight, height, and trunk-cephalic height were carried out. Peak height velocity (PHV) was used as a relative indicator of somatic maturity. For evaluation of physical capabilities, the sit-and-reach test, Yo-Yo Intermittent Recovery Test Level 1, handgrip test, modified abdominal test, and vertical jumps (Counter Movement Jump and Squat Jump) were performed. Tactical performance was achieved through the System of Tactical Assessment in Soccer (FUT-SAT). For statistical analysis, non-hierarchical k-means Cluster Analysis, One-Way ANOVA, and the Pearson correlation coefficient were used. The results indicated that early players in the maturational process presented higher values in the performance of physical capabilities such as aerobic endurance and lower limb muscle strength ($P<0.01$). Tactical principles "offensive coverage", "offensive unity", and "concentration" were executed more frequently by the Post-PHV group than the Pre-PHV ($P<0.05$). Significant correlations were observed between PHV and the principles "offensive coverage" ($r=0.32$), "offensive unity" ($r=0.39$), and "concentration" ($r=0.38$). These results suggest that advancement in maturational classification has little influence on the management of gaming space.

Keywords: Soccer. Body growth. Athletic performance.

Introduction

The large number of interactions provided by the soccer game requires the player to constantly organize the playing space and make the correct decision in different scenarios. Both the tactical capabilities and cognitive processes required by these actions are considered fundamental assumptions to achieve excellence in sports performance, together with technical, physical, motor, and emotional qualities^{1,2}.

Although tactical expression is fundamental to the correct process of sports training, when compared to other sports, soccer is highly competitive from the youngest ages, which can influence the coaches to select players with advanced physical and anthropometric attributes to the detriment of technical-tactical qualities, leaving aside young people of biological age below the chronological age³. This advantage of physical performance may be associated with the maturational process, since different endogenous and exogenous factors contribute to the growth and maturation of body systems, directly impacting on morphological, motor, functional, and cognitive variables^{4,5}.

The influence of maturational factors on specific motor skills, anthropometric variables, and physical fitness is documented in the literature. Studies of Malina et al.⁶ and Coelho-e-Silva et al.⁷ indicated that advanced maturity status in young players provides high values of physical fitness and anthropometric variables, allowing momentary competitive advantages. With regard to technical performance, studies of Figueiredo et al.⁸, Vandendriessche et al.⁹, and Gouveia et al.¹⁰ suggest that body height and maturation are not associated with specific technical task performance.

Although this scenario is known in the specialized literature, the influences of body height, somatic maturity, and energetic-functional variables on the tactical dimension of the game are still inconclusive. In this sense, new multidimensional approaches involving physiological, cognitive, and tactical variables are required¹¹. Thus, the aim of this study is to compare tactical performance, anthropometric indicators, and physical capabilities between different maturational groups in young soccer players.

Methods

Participants

The sample was intentionally constituted. Eighty-six young soccer players were pre-selected to participate in the study, participants in an extension project of a university in the south of Brazil. The following exclusion criteria were adopted: (1) participation in systematic training for less than one year; (2) the presence of any muscular or skeletal injuries; (3) not participating in regional or state competitions; (4) training at least three times a week; (5) not presenting the Consent Form signed by parents or guardian for participation in a research study. Thus, the final sample was composed of forty-eight players (14.80±1.52 years). This study was approved by the local Research and Ethics Committee (Opinion 653.698).

Anthropometry

Anthropometric measures of body mass, height, and sitting height were obtained using a calibrated digital scale, with a maximal load of 180 kg and 0.1 kg scale and a Wooden[®] stadiometer with a scale of 0.1 cm. Leg length was achieved by subtraction between height and sitting height measures¹². Chronological age was determined by the difference between birth date of the players and collection date, as described by Guedes and Guedes¹².

Somatic Maturity

Peak Height Velocity (PHV) was used as a relative indicator of somatic maturity. This represents the age of maximum growth in stature achieved during adolescence¹³. Thus, a PHV of +1 indicates that the subject was measured 1 year after the growth peak. In the same way, a PHV of -1 demonstrates that the player was evaluated 1 year before their growth peak. The final average distance from PHV of this sample was 0.56±1.44 years. Through a multivariate statistical method that will be presented in the statistical analysis section, players were

classified into three maturational groups: Pre-PHV (players who had not passed growth peak), Age-PHV (players near growth peak), and Post-PHV (those players who had already passed growth peak).

Physical Fitness

To assess the aerobic performance of the players, the Yo-Yo Intermittent Recovery Test Level 1 was used. This test requires 20 m runs with a pre-established cadence provided by an audio, and a 10 second rest interval every 40 m¹⁴. The final score was obtained by the maximum distance the evaluated individual ran¹⁵.

The handgrip test was performed to evaluate muscular strength of the upper limbs. Three repetitions were executed with each hand with a 1 min interval between repetitions. The final score was obtained through the best value on the side of the dominant hand^{16,17}. The strength/endurance of the abdominal region was evaluated by the modified abdominal test. The players were instructed to perform the maximum number of abdominal movements in 1 min¹².

Muscular strength of the lower limbs was assessed using two vertical jumps proposed by Bosco, Luhtanen and Komi¹⁸: Squat Jump (SJ) and Counter-Movement Jump (CMJ). Jumps were performed on a jumping platform, EMG System Brazil[®]. Each jump was executed three times, the best jump in each mode being adopted for analysis. The distance in height reached in the vertical jumps was estimated based on the equation proposed by Bosco et al.¹⁹.

The flexibility of the lumbar spine and posterior part of the thigh were obtained through the sit-and-reach test. Each player repeated the test three times, the greatest distance reached being adopted for analysis²⁰.

Tactical behavior

To evaluate the tactical performance of the players, the System of Tactical Assessment in Soccer (FUT-SAT) was used. This instrument was developed by Costa et al.²¹ to be used specifically in soccer during the sports training phases. The FUT-SAT stands out as a robust instrument based on a rigorous process of validity (facial, content, and construct) and reliability (intra and inter-observer). The aim of the test is to assess the game management considering tactical actions in relation to the ball, teammates, and opponents^{21,22}. Thus, five offensive tactical principles (penetration, offensive coverage, depth mobility, width and length, and offensive unity) and five defensive (delay, defensive coverage, balance, concentration, and defensive unity) were analyzed. Players were recorded with a Samsung HMX-F80 digital camera in a GR3-GR3 test (goalkeeper + 3 players vs. 3 players + goalkeeper), on a reduced soccer field (36m vs. 27m) for 4 minutes, according to Costa et al.²³. Soccer Analyser[®] software was used to analyze the videos. The software inserts spatial references in the video, allowing rigorous evaluation of the positioning and movement of all players²¹. The frequency of execution of fundamental tactical principles was used as the final score of the test.

Statistical analysis

To analyze normality of the data, the Shapiro-Wilk test was used. In cases of non-parametric distribution, data were adjusted by a logarithmic equation. From the PHV variable, non-hierarchical k-means Cluster Analysis was realized to classify the players into three maturational groups: Pre-PHV, Age-PHV, and Post-PHV. This multivariate method allows grouping of subjects or variables into homogenous groups in relation to one or more common

characteristics²⁴. Next, the Levene's test was used to assess homogeneity of variances, followed by One Way ANOVA and Bonferroni Post Hoc tests to compare and identify the differences between different maturational groups, respectively. The Pearson Correlation Coefficient was adopted to determine the relationship between anthropometric, maturational, and tactical variables. Regarding tactical principles, 10% of the actions were reevaluated by two researches trained to use FUT-SAT. Reliability of assessments of tactical behavior was achieved using Cohen's Kappa test, obtaining agreement above 81% in all cases. A re-test was performed seven days after the first data collection to assess intra-rater reproducibility of anthropometric measurements with fourteen subjects. According to the criteria proposed by Perini et al.²⁵, the following technical errors of measurement were identified: body mass: 0.80%, height: 0.27%, and sitting height: 0.89%. Data were processed using SPSS 20.0 and the level of significance was set at 5%.

Results

In Table 1 it can be noted that age of PHV did not differ between maturational groups ($P>0.05$). Other anthropometric variables were higher according to progress in maturational level. Physical capabilities demonstrated similar behavior, presenting higher values according to progress in the maturational process. The Post-PHV group presented more strength and endurance than the Age-PHV and Pre-PHV ($P<0.05$), evidencing the influence of growth and maturation on physical performance.

Table 1. Comparison of anthropometric and functional variables between maturational groups

Variables	Pre PHV (n=10)	Age PHV (n=19)	Post PHV (n=19)	F	P
	M±SD	M±SD	M±SD		
Age (years)	12.62±0.58	14.57±0.90 ^a	16.19±0.62 ^{ab}	76.82	<0.01
Age from PHV (years)	14.11±0.44	14.41±0.77	14.13±0.53	1.20	0.30
Training time (months)	50.30±33.50	56.67±27.95	88.52±29.61 ^{ab}	7.64	<0.01
Body Mass (kg)	43.41±7.38	49.77±6.12	64.92±6.80 ^{ab}	41.84	<0.01
Height (cm)	153.42±5.55	162.90±6.62 ^a	171.80±4.91 ^{ab}	34.28	<0.01
Sitting Height (cm)	77.99±3.43	84.09±3.19 ^a	91.12±2.56 ^{ab}	66.31	<0.01
SR (cm)	24.34±6.84	29.40±6.15	34.27±5.20 ^{ab}	9.48	<0.01
ULS (Kgf)	11.50±3.83	19.31±5.60 ^a	29.42±5.41 ^{ab}	41.85	<0.01
CMJ (cm)*	22.30±5.73	27.26±4.90 ^a	28.08±2.77 ^a	6.88	<0.01
SJ (cm)	21.04±4.81	27.02±6.12 ^a	29.04±3.49 ^a	8.66	<0.01
YoYo Test (m)*	316.00±96.97	490.52±163.21 ^a	831.57±288.00 ^{ab}	24.95	<0.01
Abdominal (rep)	47.30±5.92	47.10±8.01	50.21±6.55	1.06	0.35

Notes: *Transformed data Log¹⁰. M = Mean; SD = Standard deviation; SR = Sit-and-reach; ULS = Upper limbs strength; CMJ = Counter Movement Jump; SJ = Squat Jump; Yo-Yo Test = Yo-Yo Intermittent Recovery Test level 1.^aSignificant difference from Pre-PHV; ^bSignificant difference from Age-PHV. $P<0.05$.

Source: The authors

With regard to the fundamental tactical principles (table 2), inferential statistics showed that Post-PHV players performed "offensive coverage" ($9.36±4.17$ vs. $5.70±2.16$), "offensive unity" ($8.42±4.82$ vs. $4.00±2.35$), and "concentration" ($7.10±3.75$ vs. $3.20±2.14$) more often than the Pre PHV group.

Table 2. Comparison of frequency execution of offensive and defensive tactical principles between different maturational groups

Principles	Pre PHV (n=10)	Age PHV (n=19)	Post PHV (n=19)	F	P	
	M±SD	M±SD	M±SD			
Offensive	Penetration	1.90±1.44	1.94±1.50	3.84±3.13 ^b	3.99	0.02
	Offensive Coverage	5.70±2.16	7.36±3.71	9.36±4.17 ^a	3.51	0.03
	Depth Mobility	2.10±1.52	1.89±2.02	2.57±2.34	0.53	0.58
	Width and Length	14.60±6.46	12.36±6.92	12.31±4.21	0.58	0.56
	Offensive Unity	4.00±2.35	7.42±3.43	8.42±4.82 ^a	4.33	0.01
Defensive	Delay	6.30±3.05	9.31±3.98	8.21±3.35	2.34	0.10
	Defensive Coverage*	1.10±1.10	1.36±1.77	1.94±1.43	0.31	0.73
	Balance	6.50±2.32	7.31±3.98	8.57±3.13	1.39	0.25
	Concentration	3.20±2.14	5.68±3.52	7.10±3.75 ^a	4.33	0.01
	Defensive Unity	12.80±3.79	14.00±5.15	14.84±6.22	0.31	0.73

Notes: *Transformed data Log¹⁰. M = Mean; SD = Standard deviation; ^aSignificant difference from Pre PHV; ^bSignificant difference from Age PHV. P<0.05.

Source: The authors

Figure 1 presents the correlations between the frequency of execution of fundamental tactical principles and the distance from PHV. Significant correlations were identified between PHV and the principles "offensive coverage" (r=0.32; P=0.02), "offensive unity" (r=0.39; P=0.01), and "concentration" (r=0.38; P=0.01).

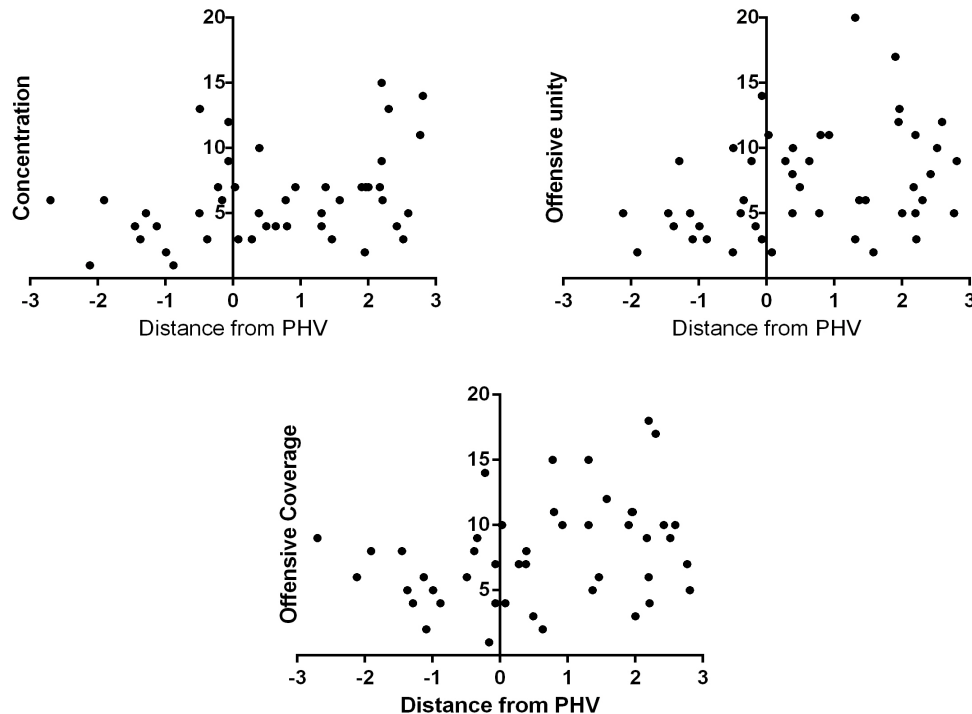


Figure 1. Correlations between maturational indicators and tactical execution frequency in young soccer players

Source: The authors

Discussion

The aim of this study was to compare tactical performance, anthropometric indicators, and physical capabilities between different maturational groups in young soccer players. The main results indicated that players advanced in maturational classification presented higher anthropometric and functional values than late players. With regard to the tactical principles, PHV players executed "offensive coverage", "offensive unity", and "concentration" more often than the Pre PHV group. Weak correlations were observed between PHV and the principles "offensive coverage", "offensive unity", and "concentration", which indicates a weak relationship between tactical principles execution and somatic maturity status.

Anthropometric variables, strength, and aerobic power presented higher values according to advance in maturational status (table 1). In this regard, Machado et al.²⁶ analyzed the relationship between physical fitness and different methods of classifying the maturation level of 209 young Brazilian soccer players. Results indicated evolution of physical variables with maturational status increase. Thus, growth indicators and functional capacities are strongly related to maturation during adolescence²⁷.

When analyzing the frequency of tactical principles execution according to different maturational stages (table 2), it was observed that the Post PHV group presented a higher quantity of the principles "offensive coverage", "offensive unity", and "concentration" than the Pre PHV. Perhaps, the more effective participation in offering support to the player with the ball, the unitary conception of the team in the offensive organization phase, and the conditioning of the opponent to find places with lower risks during the defensive organization phase represent a better understanding of the logic of the game by Post PHV players²².

The similarity of implementation of the other fundamental principles among the different groups should be cause for concern. Offensively, there is consensus in the literature that maintaining ball possession is an important element to increase soccer performance²⁸. However, similar frequency of behaviors that contributed to its manifestation, such as "depth mobility" ($P=0.58$) and "width and length" ($P=0.56$), were observed in the present study. Defensively, it is known that the proximity between players and compacting of the sectors of the team contribute to defensive effectiveness²⁹. However, actions performed outside the game center that ensure coordination and unitary defense design, such as the principles "balance" ($P=0.25$) and "defensive unity" ($P=0.73$) did not differ between maturational groups.

Thus, during sports training, it is expected that the contents addressed by the coaches increase in complexity as the categories progress, in order to improve tactical understanding and guarantee greater frequencies of actions that advance the quality of the game during the offensive and defensive phases³⁰.

With regard to the relationship between the tactical dimension and somatic maturity level, we found weak correlations between PHV and the tactical principles "offensive coverage" ($r=0.32$), "offensive unity" ($r=0.39$), and "concentration" ($r=0.38$). Few studies in the literature have investigated the implications of maturational variables on tactical performance, which makes it difficult to compare the results of the present study with other investigations. It is known that tactical capacity is related to the cognitive processes underlying decision making, requiring perceptual-cognitive variables such as central visual perception, peripheral visual perception, attention, and anticipation of time and movement³¹. In this sense, Vantinen et al.³² demonstrated that reaction time, peripheral perception and motor skills evolve during adolescence and correlate with blood levels of testosterone (maturational indicator used). This hormone plays an important role in neural maturation, which together with learning and experience directly affect brain functions. Therefore, the relationships identified in figure 1 can be explained by the contribution of the maturational

process to the cognition of players, increasing perception of the game situation and refining the perceptual strategies for decision making.

Besides cognition, some contextual variables are decisive and can influence tactical behavior of young soccer players, such as the characteristics of the athlete, level of competition, quality and amount of training, and adopted methodology^{33,34}. Players need to develop motor actions to solve problems presented by the variability, imprevisibility, and randomness scenario presented by the game^{35,36}.

Although evidence suggests a low influence of maturity level on tactical behaviors, soccer is highly competitive from the youngest ages when compared to other sports, which may influence coaches to select players with advanced physical and anthropometric attributes, leaving young soccer players of biological age below the chronological age and neglecting the tactical-technical qualities of the selected practitioners³. Thus, as a practical application of the results of the present study, the adoption of multidisciplinary criteria in the selection of players is suggested, taking into account the level of maturity achieved, physical performance, and manifestation of tactical, technical, and psychological qualities.

As limitations of the study, we can highlighted the fact that we did not verify the association and evolution of tactical variables throughout the training process, the non-observance of previous sports experiences, and the regionalized characteristic of the sample, which may underestimate the values found when compared to elite athletes. However, the results emphasize the need to avoid giving excessive value to anthropometric and functional variables to the detriment of technique and tactics, which may lead to a process of exclusion of quality players who are maturationally delayed⁵.

Conclusion

From the results found in the present study, it is possible to conclude that the level of somatic maturity contributes to the performance of functional capacities and anthropometric variables and has a weak correlation with tactical performance in young soccer players. Therefore, although the game is marked by constant physical contact, the selection of players must include criteria based not only on functional capabilities, but which also consider tactical, technical, and psychological behavioral qualities.

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