Can biological maturation influence in power muscle and velocity of Young soccer players?

A maturação biológica pode influenciar na força muscular e na velocidade de jovens jogadores de futebol?

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ABSTRACT
The biological maturation is a process manifested more frequently in adolescence, and promotes many physiological changes. The purpose of this study was analysis physical performance of young soccer players in different maturity age. Participated of the study 36 young soccer players (16.5 ± 1.6 years; 178 ± 7 cm; 67 ± 9 kg). During second week of preparation period, were assessed characteristics anthropometric, for obtained the peak height velocity (PHV), vertical jump height tests and sprints tests. Were were separated in 4 groups with 9 players, having as criterion the age of PHV: PHV1 age below than 25th percentile, PHV2 = age between 25th to 50th percentile, PHV3 = age between 50th to 75th percentile and PHV4 = age above 75th percentile. A significant main effect between groups was observed for squat jump (SJ) (p = 0.005), countermovement jump (CMJ) (p = 0.001), sprint 40m (sprint20+20m) (p = 0.013) and sprint 20m (sprint20m) (p = 0.007). In conclusion, becomes important to assess the maturity status in young soccer players due the determinant abilities of match can be predict by maturation age through PHV measurement.

Keywords: Soccer, performance test, physical assessment, maturity status.

RESUMO
A maturação biológica é um processo que se manifesta com maior frequência na adolescência, e promove inúmeras alterações fisiológicas. O objetivo deste estudo foi analisar o desempenho físico de jovens jogadores de futebol em diferentes idades de maturidade. Participaram do estudo 36 jovens futebolistas (16,5 ± 1,6 anos; 178 ± 7 cm; 67 ± 9 kg). Durante a segunda semana de preparo, foram avaliadas as características antropométricas, para obtenção do pico de velocidade de crescimento (VPH), testes de salto vertical de altura e testes de sprints. Foram separados em 4 grupos com 9 jogadores, tendo como critério a idade de PHV: PHV1 idade abaixo do percentil 25, PHV2 = idade entre 25º a 50º percentil, PHV3 = idade entre 50 a 75º percentil e PHV4 = idade acima de 75º percentil. Um efeito principal significativo entre os grupos foi observado para salto de agachamento (SJ) (p = 0,005), salto de contramovimento (CMJ) (p = 0,001), sprint 40m (sprint20 + 20m) (p = 0,013) e sprint 20m (sprint20m) (p = 0,007). Concluindo, torna-se importante avaliar o estado de maturidade em jovens jogadores de futebol, pois as determinantes habilidades de jogo podem ser preditas pela idade de maturação por meio da medida do PHV.

Palavras-chave: Futebol, teste de desempenho, avaliação física, estado de maturação.

1 INTRODUCTION

The biological maturation is a process manifested more frequently in adolescence, and promotes many physiological changes (Machado, Bonfim, & Costa, 2009). In males, these changes intensify around the age of 14, and may vary from individual to individual. At this stage of development the somatic maturity stage directly influences sports performance (Menegassi, Borges, Jaime, Magossi, & Silveira, 2017), and the maturation status classification should be considered since in certain sports performance is more dependent on maturation than chronological age (Villar & Zühl, 2006).

Therefore, the maturation status can be determinate by peak height velocity (PHV) (Mirwald, Baxter-Jones, Bailey, & Beunen, 2002) being a relative indicator of somatic maturity, representing the maximum height reached in adolescence. Despite being a predict method, the anthropometric measure, is a promise method (Mills, Baker, Pacey, Wollin, & Drew, 2017), as demonstrated in the literature that relate strength influence of maturational level about anthropometrics characteristics, such height, body mass, and body mass index (BMI) (Menegassi et al., 2017).

Studies with young soccer players show significant differences in power muscle levels, speed and agility between groups of different maturational stages, and this seems to be justified by the physical-morphological relationship (Menegassi et al., 2017). In this sense Towlson et al., (2018), states that advanced somatic maturation is associated with the accelerated development of physical and anthropometric parameters, and it is important for coaches and physical trainers to understand the relationship between performance and maturation in the preparation and training of young athletes (Seabra, Maia, & Garganta, 2001).

It is knows that athlete's physical ability are determinants during performance in match, which in soccer is characterized by an intermittent nature (Krustrup et al., 2006). Some benefits of performance in young soccer players are associate with early maturation age, such as height, strength, power and velocity (Pittoli, Barbieri, Pauli, Gobbi, & Kokubun, 2010). Therefore, the purpose of this study was analysis physical performance of young soccer players in different maturity age, through of power muscle, velocity and agility tests. We hypothesizes who has early maturation age can obtain greatest performance during performance tests (Arede, Ferreira, Gonzalo-Skok, & Leite, 2019).

2 MATERIAL & METHODS

2.1 PARTICIPANTS

Participated of the study 36 young soccer players (16.5 ± 1.6 years; 178 ± 7 cm; 67 ± 9 kg) of the sub15 and sub17 categories of the team from 1st division championship Paulista. The inclusion criteria were: (a) players have minimal 3 years of systematic training in soccer; (b) freely previous injuries in last 6 months; (c) participated in 2 official competitions on last year before the study. The 36 subjects were separated in 4 groups with 9 players in each group, having as criterion the age of PHV: PHV1 age below than 25th percentile (PHV = -1.51 to 0.20), PHV2 = age between 25th to 50th percentile (PHV = 0.21 to 0.48), PHV3 = age between 50th to 75th percentile (PHV = 0.49 to 1.41) and PHV4 = age above 75th percentile (PHV = 1.42 to 2.21). The study was conducted in second week of preparation period for official competitions of the team. The responsible person of the players signed the consent form, it was necessary this conduct due the subjects young about 14 to 17 years old. The present study was approved by ethic committee of the local institution (protocol n. 16/14).

2.2 ANTHROPOMETRICS MEASURE AND DETERMINATION OF MATURATION STATE

All measures were taken in the morning, following standardization of International society for advancement in kinantropometry (ISAK).The height stature, trunk-cephalic height, leg length, body weight and skinfolds were measured. The body weight was measured through a balance digital. The skinfolds were measured in right side for calculate the fat percentage through equation Slaughter. The height stature was measured with a stadiometer, and the trunk-cephalic height with a stadiometer mounted on a purpose-built table. The height stature were subtracted by trunk-cephalic height for calculated the leg length. Yet, trunk-cephalic height were measured in sitting position, with knee facing forward, the hips forming a 90 degree angle with the trunk, and posterior surfaces of the pelvic girdle, shoulder girdle, and occipital region in contact with stadiometer scale. The height of lower extremity were obtained through measurement from trochanteric to sole of the food. Since of this measurements, the HV age was obtained through interaction between leg (L) and trunk-cephalic (TC) height, age, as ratio between weight and height (Mirwald et al., 2002). As shown below for boys:

PHV = – 9,236 + 0,0002708 (L x TC) – 0,001663 (age x L) + 0,007216 (age x TC) + 0,02292 (weight/height) .

2.3 VERTICAL JUMP HEIGHT TESTS

The power muscle was obtained through 2 vertical jump tests: squat jump (SJ) and countermovement jump (CMJ). Before jump tests, athletes performed a 10- minute warm-up that consisted of jogging and sprint exercises with changes of direction. The assessment was performed on a contact mat (CEFISE, Nova Odessa-SP, Brazil) according recommendation (Bosco et al., 1995). Each athlete performed jumps 3 times with 3 minutes interval between jumps and recorded the best performance jump.

2.4 SPRINTS TESTS

The agility and velocity of the athletes was obtained through sprint 20m ($sprint_{20m}$) and sprint 40m ($sprint_{20+20m}$) tests. An electronic photocell system was used to record the time of the sprints (Speed Test 6.0 CEFISE®, Nova Odessa, SP, Brazil). Players commenced each $sprint_{20m}$ from a standing start behind the timing gate, and were instructed to sprint as fast as possible over the full 20 meters (m). The $sprint_{20+20m}$ consist of 1 repeated-straight-line 20m and return immediately, with sprints as fast as possible (Rampinini et al., 2007) . All athletes performed 3 times each test with 3 minutes interval between sprints and tests. The best sprint performed was recorded.

2.5 STATISTICAL ANALYSES

The normality and homogeneity of the variances were verified using the Shapiro-Wilk and Levene tests, respectively. To compare mean values of the descriptive variables between-groups (PHV1, PHV2, PHV3 and PHV4) a analysis of variance (ANOVA) was used. Post hoc comparisons were performed with the Bonferroni correction. Effect sizes were evaluated using a partial eta squared (η^2p), with < 0.06, 0.06 - 0.14 and, > 0.14 indicating a small, medium, and large effect, respectively (Hopkins, Marshall, Batterham, & Hanin, 2009).

3 RESULTS

A significant main effect between groups was observed for SJ ($F_{3,35} = 4.898$, $p = 0.005$, $\eta^2_p = 0.452$), CMJ ($F_{3,35} = 6.090$, $p = 0.001$, $\eta^2_p = 0.632$), $Sprint_{20+20m}$ ($F_{3,35} = 4.767$, $p = 0.013$, $\eta^2_p = 0.338$) and $Sprint_{20m}$ ($F_{3,35} = 4.915$, $p = 0.007$, $\eta^2_p = 0.396$). Table 1 presented descriptive data of the subjects, ANOVA and Bonferroni post hoc between groups.

Table 1. Descriptive Data of the Subjects.

Variables	PHV1	PHV2	PHV3	PHV4
SJ (cm^{-1})	30.6 ± 4.1	30.2 ± 5.6	30.5 ± 3.1	34.2 ± 3.1[a,b,c]
CMJ (cm^{-1})	32.6 ± 4.4	33.1 ± 5.8	34.8 ± 2.6	38.4 ± 4.4 [a,b,c]
$Sprint_{20m}$ (s^{-1})	3.13 ± 0.17	3.06 ± 0.23	2.93 ± 0.26 [a,b]	2.95 ± 0.12 [a,b]
$Sprint_{20+20m}$ (s^{-1})	9.63 ± 0.75	9.46 ± 0.67	9.04 ± 0.47 [a,b]	9.18 ± 0.44 [a,b]

PHV; Peak Height Velocity, SJ; Squat Jump, CMJ; Countermovement Jump. a = significantly greater than the PHV1 ($p < 0.05$), b = significantly greater than the PHV2 ($p < 0.05$), c = significantly greater than the PHV3 ($p < 0.05$).

4 DISCUSSION

The present study had as aim investigates if the biological maturation can influence power muscle and the velocity in young soccer players. The main finding of this study suggest that power and velocity was influenced by maturity status. The athletes of group PHV4 shown higher performance in power muscle. Besides, PHV3 and PHV4 groups obtained better performance in velocity when compared with PHV1 and PHV2 groups.

Young soccer players in post-PHV have better performance in CMJ when compared to pre-PHV (Arede et al., 2019; Buchheit, Simpson, Al Haddad, Bourdon, & Mendez-Villanueva, 2012), according to the findings of this study. Previous studies suggest an accelerated adaptation “window” for CMJ and SJ in young post- PHV due to performance improvement is attributable to adaptations of muscle (Loyd, Liver, & Ughes, 2011), that directly influences power muscle. According (Suchomel, Nimphius, Bellon, & Stone, 2018) the neural aspects and morphological including cross-sectional area and architecture, musculotendinous stiffness, motor unit recruitment, rate coding, motor unit synchronization, and neuromuscular inhibition, are determining factors for the development of strength the consequently of power muscle.

In addition, our data corroborate the results of Menegassi et al., (2017) which had better under-17 strength scores than under-15, justifying that players were more mature, and that male adolescents tend to increase on average 41, 8% the percentage of muscle mass during puberty, where there is greater production of hormones, such as testosterone,

which influences protein synthesis and is related to strength, which explains the difference between PHV4 and the other groups, being that PHV4 represents a post PHV group.

Our results verified better running performance of groups PHV3 and PHV4 compared to PHV1 and PHV2 that can be explain by physiological changes related to maturation (Towlson et al., 2018). Such as greater muscular size, increased limb length, changes musculotendinous tissue, enhanced neural and motor development and better movement quality and coordination (Moran, Sandercock, Rumpf, & Parry, 2017). A longitudinal study reports that for male adolescent populations in general the maximum velocity growth occurs before PHV (Philippaerts et al., 2006). However, for young soccer players during PHV there is a period of sensitivity to velocity development (Towlson et al., 2018), which probably differentiated the best PHV3 results in relation to the PHV2 group, which are in the PHV phase.

In relation to agility, a better performance of PHV3 and 4 was found when compared to the group PHV1 and 2, similar to the difference of the groups for speed, corroborating previous studies that correlated acceleration, maximum speed and agility without ball, demonstrating that such abilities share common physiological and biomechanical determinants in young soccer players. In addition, showed that agility performance was weakly correlated with squat jump heigth, suggesting that the potential effect of age or experience may affect the relationship between these locomotor skills (Köklü, Alemdaroğlu, Özkan, Koz, & Ersöz, 2015). Thus, our data suggest that speed and agility are sharing common skills for this population, unlike power performance.

As a possible practical application of the study, the verification of the relationship between maturation measure and performance is important for understanding the stage and development of young athletes regarding training, since in football competitions are categorized by age chronological and individuals may present different performance values from the group due to their maturational classification.

Although a relationship between performance and biological maturation has been demonstrated, a possible limitation of the study is that no type of training was carried out, assuming that the individuals were are already trained. It is suggested that, for future studies, greater control of anthropometric and performance variables be carried out with training intervention, since in the case of maturational state it is known that these variables can be influenced by both maturational development and training..

5 CONCLUSIONS

In conclusion, becomes important to assess the maturity status in young soccer players due the determinant abilities (power muscle, velocity and agility) of match can be predict by PHV.

Conflicts of interest

All authors declare that they have no conflicts of interest relevant to the content of this paper.

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