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Correlation between peak height velocity and body composition in young soccer athletes

Abstract

Soccer is considered an intermittent and high intensity sport in which a detail for a match can be an essential factor for victory achieving. Among these factors the body composition is related as an important parameter of soccer performance. Furthermore, the different maturation levels of young athletes must be considered in definition of the best moments for load training increase. The aim of this study was verifying the correlation level between fat percentages, lean body mass and fat body mass with the peak height velocity (PHV).

Methods: The participants of this study were 44 soccer players of under15 category. It was done the body composition and PHV, where it was used the interaction between age and the anthropometrics variables like height, body mass, sitting height and leg length. It was used the descriptive statistic for showing the data of folds sum, total body mass, lean body mass, fat percentage, age and body fat. The Person correlation was used for analyzing body composition variables and PHV.

Results: A positive correlation of PVC with total body mass (p=0.00000959; r=0.606), lean mass (p = 0.00000959; r =0.613) and fat mass (p =0.00636; r =0.405).

Conclusion: According to the results of the present study, soccer players showed increase of body lean mass, body fat mass and total body mass with the progress of maturity.

Keywords: soccer, PHV, body composition, maturation, performance

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Introduction

Soccer is a sport characterized by intermittent actions of high intensity, as well as a heart rate of 85% of the maximum and oxygen consumption of approximately 75% of VO2max.[1] In this sport, every detail in the physical, technical, tactical, and psychological preparation for the match can play an essential role in achieving victory. Thus, body composition is reported as a performance parameter in football is an important indicator for young athletes[2] and determinant for success in sport,[3] since people with lower fat percentages (% F) reach higher performance levels.[2] In addition, excess adipose tissue results in high energy expenditure during exercise, which makes the post-effort recovery process difficult. Bearing in mind that the period destined for recovery hardly meets the real needs of the soccer athlete's organism, since the competitive calendar makes the density of games high.[4]

Additionally, the different stages of maturation of young athletes must be considered when defining the appropriate moments for the progression of the training load.[5] There are some methods to measure the maturation stage, such as the use of skeletal age,[6] sexual[4] maturation.[7,8] Skeletal age assessment, despite being one of the best forms, requires interpretation and specialized equipment, in addition to having a high financial cost and exposing the individual to radiation.[9] Dental and morphological age are measurement techniques, but with limited applicability[10,11] and the assessment of secondary sexual characteristics has the limitation of exposing certain athletes to embarrassing situations.[9,12] On the other hand, the method that determines the peak height velocity(PHV) through an equation developed by Mirwald et al.,[9] it is characterized by being a non-invasive method, with the objective of evaluating the somatic maturation in children through anthropometric variables that determine the moment of PHV occurrence.

PHV is commonly used to measure the level of somatic maturation in longitudinal studies[13] in addition to having a lower operating cost and simple interpretation of results when compared to specialized equipment.[14]

Divergent results are found in the literature when verifying the relationship between body composition and peak height velocity[12,14] in young sprinters,[15] girls with obesity,[16] young soccer players and young non-soccer players.[17] However, no studies were found using these parameters as the main objective, mainly in Brazilian football. It is expected that the increase in lean mass and total body mass will occur with PHV, consequently influencing fat mass and the percentage of fat.[10] Thus, such information would allow adequate control of the body composition of young athletes, when taking into account the influence of maturation on body composition, since the athletes can be at the same chronological age, but at different biological ages.[10] Added that with this form of work, through the individual differences in time and pace of these young athletes that must be examined in detail, in view of how they can influence growth and performance measures during adolescence, different strategies are indicated for prescription of training loads.[5,10]

Objective

The present study aimed to verify the correlation between the percentage of fat, lean mass and fat mass with the moment of PHV, as proposed by Mirwald et al.,[9] in Brazilian soccer athletes belonging to the sub 15 category of a club in the first division of the national championship.

Material and methods

The study was carried out with male soccer athletes in the sub 15 categories, who compete in national competitions organized by the Brazilian Football Confederation and regional competitions organized by the Minas Gerais Football Federation. 44 athletes from the 15 subcategories participated in this work. The study was approved

by the ethics committee of the University of São Paulo in process 05890212.0.0000.5391 on December 20, 2012, all athletes, as well as their parents or guardians, informed of the purpose of the research, who authorized it, having signed a free and informed consent term. For the percentage of fat, the McArdle equation[18] was used, which uses two skinfolds for measurement, in addition to the sum of skinfolds, being a simple protocol, without the need for any equation, having a relationship with protocols that use some equation to measure the fat percentage, since higher values found in the skin folds tend to lead to a higher fat percentage.

The evaluation was performed in a single day, with the evaluator using an automatic digital scale (Finladek ®) and the scientific adipometer (Sanny ®) with a capacity of 78mm and tolerance ± 5mm. Each skinfold was measured three times using, for the equation, the average of these measurements. Then, the volunteers were directed to a reserved space in the club's weight room for the performance of the PHV, using the interaction between the athlete's age and anthropometric variables of height-body mass, the height of the brain, and length of the lower limbs. All volunteers were instructed by the evaluators to position the body correctly and, if necessary, interventions were made to correct posture. All PHV-related measurements were measured using a tape measure attached to the wall. After that, the values of the measures found were calculated according to the equation proposed by Milward.[9]

Descriptive statistics were used to present the data of the sum of folds, total body mass, lean mass, percentage of fat, age, and fat mass. Pearson's correlation test was used between body composition and PHV variables.

Results

The results found are presented in tables 1 described as mean and standard deviation and in table 2 the value of P and its respective correlation are described.

Table 1 Anthropometric variables: biological age; fat percentage; the sum of skinfolds; total body mass; lean mass and fat mass. Table 2 Correlation of PHV with fat percentage; the sum of skinfolds; total body mass; lean mass; fat mass.

Table 1 Anthropometric variables

Biol. age	% Fat	Σ skinfolds	TBM	LM	FM
14.8±0.5	8.7±1.7	55.2±12.5	64.9±7.4	59.2±6.3	5.7± 1.5

Table 2 Correlation of PHV with antropometric variables

	% Fat	Σ skinfolds	TBM	LM	FM
PHV	r=0.213	r= 0.257	r= 0.606	r= 0.613	r= 0.405
	p=0.166	p= 0.0918	p= 0.0000131	p= 0.00000959	p= 0.00636

Discussion

The present study found a positive correlation between PHV and total body mass, lean mass, and fat mass. Therefore, advancing maturity showed changes in body composition, even with the participation of specific training and nutritional monitoring, PHV influenced the profile of body composition, which is relevant information for professionals who work with young soccer athletes, and few studies have investigated this issue in this population.

With the approach of PHV, the individual tends to increase his height and his total body mass more sharply. One of the factors responsible for this is due to the increase in released hormones, responsible for growth, such as growth hormone, testosterone, and insulin-like growth factor (IGF-1).[19]

Regarding lean mass, a positive correlation was also found with PHV. This result may have occurred because it is at this moment that an increase in growth hormone (GH) occurs in young people.[20] This is the hormone responsible for influencing protein metabolism, also acting in the liver, so that this organ produces IGF-1, which is one of those responsible for stimulating protein synthesis and increasing cell proliferation (Mitosis). As a result, nitrogen retention, cell division, and tissue construction occur.[10] At this time, there is also a tendency for an increase in testosterone in the body,[21] the effects are the basis of the drastic growth spurt in adolescence in muscles and fat-free mass in males.[3,10]

For PHV and fat mass, a positive correlation was found. This may be due to the sample having athletes who meet before and after the PHV period. Possible arguments for the previous moment of PHV are that, at this stage, there is a tendency for an increase in fat up to a plateau moment, which occurs close to PHV.[10] This accumulation may be due to an increase in the concentration of dehydroepiandrosterone,[22,23] an adrenal hormone that appears to be related to the accumulation of fat in this period.[10] Another hypothesis is due to the decrease in the levels of leptin,[24] a hormone related to satiety, causing the young person to eat more, which can cause a peak of insulin and thus stimulate the increase in the transformation of glucose into fatty acids, which will be converted into triglycerides.

After PHV, there is a tendency to decrease fat mass, one of the factors that can influence this phenomenon is the increase in GH, thus having an increase in the mobilization of lipids in the individual's fat deposit. Another hormone responsible for this mobilization of fat would be testosterone, this hormone accompanied by the greater activity of enzymes responsible for the breakdown of lipids could lead to this decrease in this fat mass.

Thus, with this rapid increase in the growth of lean mass that occurs in this period, while the accumulation of fat mass occurs in a slower way, accompanied by a greater mobilization of fat,[10] added by athletes in different phases in relation to PHV, may be factors responsible for this non-correlation of the fat percentage.

In the study by Herdy et al.[25] made with 1115 grassroots athletes from an elite club, measured between the years 2007 and 2015, an increase in lean mass was observed over the years has been visibly increased from the sub 11 category to the sub 13 category, having a large increase at the beginning of puberty.

In the study by Silva[14] carried out with 115 athletes aged between 11 and 17 years old from a soccer club in the state of São Paulo, where other variables were analyzed in addition to body composition, before, during and after PHV, it was observed an increase in body mass in relation to PHV, accompanied by an increase in the percentage of fat until PHV and after this moment, a decrease occurs. Similar values were also found in the study by Lovell et al.[26] done with 1212 athletes aged 9 to 18 years, in which he observed a significant increase in body mass in the sub 13 and sub 14 categories in relation to the previous categories, being explained by these categories being at the time of PHV.

In the study by Nikolaidis and Karydis[2] carried out with 290 young people who practiced football for a determined volume, they observed a gradual increase in body mass, following this trend the percentage of fat had a gradual increase with the passing of the categories.

These studies corroborate our results in which an increase in total body mass, lean mass, and fat mass is expected, however, the percentage of fat in the present study was not influenced by PHV.

Therefore, it is important to raise the awareness of professionals who work with athletes at the ages where the PHV moment frequently occurs, in order to have knowledge about the morphological changes that occur in this period, avoiding incorrect diagnoses and consequently early dismissals, showing, even more, the importance of adequate nutrition, which helps the young athlete to go through puberty and all the changes that accompany him in this period. A study with a control group and individual and longitudinal monitoring would be interesting, thus allowing greater external validity.

Conclusion

According to the result of the present study, soccer athletes present an increase in lean mass, fat mass, and total body mass with advancing maturity. Therefore, this information can contribute to the effective prescription of young athletes.

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Conflicts of interest

Author declares there are no conflicts of interest.

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