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THE INFLUENCE OF ANTHROPOMETRIC CHARACTERISTICS AND ANAEROBIC CAPACITY OF THE LOWER LIMBS ON THE TECHNICAL SKILLS OF ADOLESCENT BASKETBALL PLAYERS

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Abstract
Anthropometric characteristics, anaerobic and aerobic capacity and quality of technical skills are very important for good results in basketball. The aim of the present study was to determine the relationship between technical skills of young basketball players and their anthropometric data and anaerobic capacity of lower limb. Fifteen subjects (age 15.4±1.2 years, height 176.3±7.8 cm, weight 64.4±10.8 kg) participated in the study. Four tests suggested by AAPRHED (1984) were used for evaluation of technical skills. For determination of their body mass, body composition IOI353 Body Analyser was used and for anaerobic capacity – Wingate anaerobic test. Blood lactate concentration was measured by BIOSEN C Line. Anaerobic capacity is important for intensive runs in basketball game and could be presented as peak power and relative peak power. As higher the power was the time of 20 m speed dribbling was shorter (Pearson $r = -0.77$, $p < 0.005$). Shooting tests (speed spot shooting test and free throws test) well correlated with height, and the results of the obstacle dribble test were highly dependent on muscle mass of the subjects. The study confirms the need for anaerobic training for basketball players that will contribute to more accurate and with high speed performance of the technical elements of basketball game.

Key Words: *body composition, Wingate anaerobic test, AAPRHED*

Introduction

Basketball is a very popular sports game worldwide and in recent years it has been developing at a fast pace, with a growing number of young people choosing basketball as a sport. Basketball is a team sport that strives for its physical characteristics and is of great importance. Greater growth affects the effectiveness of some specific basketball movements with a significant vertical component (rebound, various shots to the basket, passes, blockages, rebound ball, etc). Anthropometric characteristics such as body fat, skin thickness, height, length. According to the management, the usual elements should be defined as the basic elements of elite basketball players, so it should be defined as an indicator of the level of play of the respective player (Vaquera, et al., 2015).

Because of the large number of youngsters involved in the sport, selection of the most skilled of them is necessary (Anastasiadis, 2006). The young basketball players undergo certain skills tests, where their physical abilities and technical skills are evaluated thoroughly.

The most widespread and reliable battery of skill tests of AAHPERD (1984), includes: i) speed spot shooting, ii) passing for speed and accuracy, iii) obstacle dribble, iv) defensive sliding movement and v) free throws performance. From the above tests, two of them regarding shooting and another one regarding dribbling the basketball, are the tests which evaluate the players' skill of handling the ball. However, for the proper performance of the sport's technique, the anthropometric and physical characteristics of the young players are significant, since parameters like body height, body mass, stretched arms' length, hand surface, handgrip strength and speed running, positively contribute to their performance (Apostolidis, et al., 2004; Visnapuu & Jurimae, 2009). Specifically, hand surface and handgrip strength in young ages, when body height has not been fully developed, might constitute the most decisive factors of ball handling skill.

The aim of the present study was to determine the relationship between technical skills of young basketball players and their anthropometric data and anaerobic capacity of lower limb.

Material & methods

Subjects

Fifteen adolescent basketball players were involved in the study (age 15.4±1.2 years, height 176.3±7.8 cm, weight 64.4±10.8 kg). It was conducted in October 2019. Prior to the study, participants were asked to refrain from physical exercise, food, and fluid intake. Parent of each participant in the study signed a declaration of informed consent and the study was approved by the Scientific Research Committee of South-West University "Neofit Rilski". The subjects came once at the Center for Functional Studies in Sport and Kinesitherapy of South-West University "Neofit Rilski" - Blagoevgrad, where the anthropometric measurements were made. Skill tests were conducted in the basketball hall where they train.

Anthropometric measurements and determination of body composition was done with Body Composition Analyzer, model IoI 353. The participants in the study were wearing the lightest possible clothes and took off socks before the measurement. From the obtained results we used Body Mass Index (BMI) and Soft Lean Mass (SLM) or muscle mass. Stretched arms length was measured with a tape measure from the tip of the right middle finger to the tip of the left one when subject was in standing position face to the wall, with extended arms parallel to the ground. Upraised arms height was measured with a tape measure from the floor to the tip of the middle fingers, when subject was in standing position, face to the wall with upraised arms. The upper arm's length was measured from the top of the arm to the elbow and the forearm's length from the elbow to the wrist proximal starting point, with a tape measure to the nearest 0.1 cm. The circumference of dominant hand (Figure 1) was taken with drawing the hand and summing the distances.

Fig. 1. Measured circumference of the dominant hand.

Wingate test

The test is carried out with the Monarch 828 E mechanically-braked cycle ergometer. The Wingate typically involves 30 seconds of maximal exercise on either an arm-crank or leg-cycle ergometer. The testing device is a mechanically-braked cycle ergometer. Following a five-minute warm-up, which includes three sprints at varying resistances, the athlete may get off the bike during a three-minute recovery or stay on the bike and spin lightly. The athlete then begins to pedal as fast as possible without any or minimal resistance. Within three seconds, a fixed resistance is applied to the flywheel and the athlete continues to pedal "all out" for the duration of the test (e.g. 30 seconds). The resistance is applied to the flywheel by adding a predetermined amount of weight to the bicycle's weight tray. The resistance is a percentage of the athlete's body weight. At the end of the test, the maximum power (Peak Power) is set for 5 seconds. This is the maximum power the person can develop during the first 5 seconds. The relative maximum power is determined by dividing the maximum weight of the subject's weight. The system also allows determining the average power for 30 seconds.

Determination of blood glucose and lactate

Measurement is performed with BIOSEN C Line biochemical analyzer of the German company EKF Diagnostic. The determination of glucose and lactate in the blood is based on electrochemical measurement with a chip sensor. The sample is aspirated and entered into the system automatically. The sample contains β-D-glucose and L-lactate, which are converted by enzymes (immobilized on the chip sensors) into glucuronic acid and pyruvate, respectively, to form hydrogen peroxide. It releases free electrons that generate electrical current that is recorded by the electrode of the device. The resulting electrical signal is proportional to the concentration of glucose and lactate in the sample.

Sargent test

The purpose of this test is to determine the explosive force of the muscles of the lower limbs (Sargent, 1921). To perform the test, you need: a wall, a centimeter strip of 1 meter long, a chalk and an assistant. The subject puts chalk on the tip of his fingers. He stands sideways to the wall with the two soles firmly on the ground, stretches one hand at a maximum and marks the wall reached with his fingers (M1). From a place he jumps to the maximum height and again marks with chalk-coated fingers (M2). The difference M2-M1 was determined. The test is conducted three times, taking the best achievement.

There are different norms for different subjects. Our subjects fall into different age groups, so the data analysis is consistent with different standards. For adults, the data is compared to the Chu-adapted (Chu, 1996) scale. The maximum power is calculated using the Sayers equation because it includes the weight of the person under study. A heavier person who jumps at the same height as the lighter man should do more work because they have a larger mass of movement. It is sometimes useful to convert the vertical height of the jump to units of power. The power cannot be calculated (Power = Work ÷ Time), since the time when the force acts on the body is unknown. Formulas have been developed to measure the power of the vertical jump measurements. The prediction equation (1) of Sayers et al. (1999) was used to calculate the peak power of the legs.

(1) Peak power (W) = 60.7 x VJ (cm) + 45.3 x mass(kg) – 2055,

where Peak power - maximum power, VJ - height of the vertical jump (cm), mass - weight of the person under study (kg).

To date, a prediction equation for children is not validated, so the Sayers equation, which includes the height of the jump and mass of the participant (Taylor, et al., 2010) has been used. This equation, developed by jumps performed on a rebound platform, has a difference in adults of 2.7% with the power calculated by the platform (Sayers, et al., 1999). The Sayers equation is an improvement of the Lewis formula (Fox & Mathews, 1974), which is reported to underestimate the projected peak power by 70% (Harman, et al., 1991). It is also recommended as a substitute for Lewis's physical assessment score (Payne, et al., 2000).

Field Tests

Field tests were performed under stable environmental conditions (ambient temperature 20-220 C and relative humidity 40-50%) in an indoor terrain.

(a) The 20 m speed dribble. Its purpose was to evaluate the skill of dribbling the ball with maximal speed. Performance was determined using stopwatch at the start and the finish line and time was determined in seconds and hundreds of seconds. Each player was allowed two trials and the total time was used.

(b) The obstacle dribble test (AAHPERD, 1984). Its purpose was to assess the skill in handling the ball while running and changing directions through obstacles. An obstacle course (3.6 m * 5.8 m) marked by six cones was set up in the free throw lane of the court. On the signal, the subject started dribbling while passing the cones and changing hands. Players were instructed to cover the distance of 17.9 m as fast as possible, maintaining the control of the basketball (Figure 2). Each subject was allowed two test trials (one for each hand) and then another two trials (one for each hand), and their time was recorded. The mean time of the two trials was used.

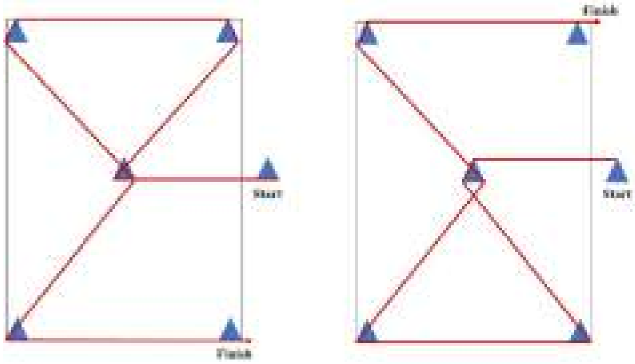

Fig. 2. Obstacle dribble basketball test (AAHPERD, 1984).

(c) The speed spot shooting test (AAHPERD, 1984). Its purpose was to assess the performance in speed and accurate shooting, under time restriction, with agility and ball handling. Five spots 4.57 m distance from the basket were marked (Figure 3). The subject started behind a marked spot and on the signal shot the ball, run to get the rebound and repeat to the next spot for 60 sec. During the trial, subjects could perform four lay-ups and the score was calculated as the sum of the successful shots * 2 points, plus the missed shots * 1 point. Subjects were allowed one test trial and another two trials. The total score was the sum of the two trials.

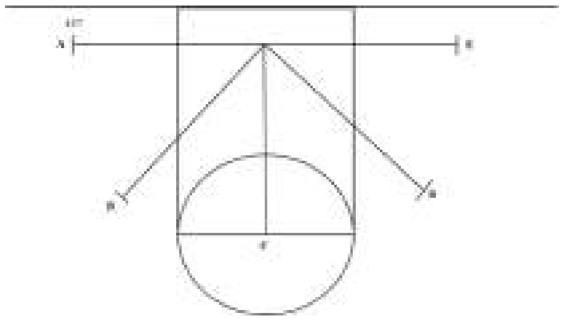

Fig. 3. Speed spot shooting basketball test (AAHPERD, 1984).

(d) The free throws test (AAHPERD, 1984). Its purpose was to assess the performance in free throws shooting. The subjects performed 20 free throw shots behind the free throw line in four sets of five shots, with at least one minute break between sets. The subjects were allowed one trial and the total score was the sum of the successful free throw shots. It is useful to be noticed that passing skill test was used in the study, because research findings indicate that none of the established reflects the players' ability on the specific skill (Sachanidi, et al., 2013).

Data analysis

For data processing and analysis GraphPad Prism (Ver 3.0) were used. The mean values and standard deviations of all variables were calculated by descriptive statistics. For the data analysis we conducted Pearson correlation analysis for the control of the relationship between the measured variables.

Results

Means and standard deviations of the measured anthropometric parameters and the athletes' performance in selected technical skills are presented in table 1.

Table 1. Anthropometric parameters, data from anaerobic tests and technical characteristics of young basketball players (*M* ± *SD*).

Variable	**N=15**
Age (years)	15.4 ± 1.2
Height (cm)	176.3 ± 7.8
Weight (kg)	64.4 ± 10.8
SLM (kg)	53.1 ± 6.9
BMI (kg/m^2)	20.9 ± 2.8
Arm length (cm)	177.0 ± 9.1
Arm height (cm)	230.0 ± 11.1
Upper arm length (cm)	33.8 ± 3.2
Forearm length (cm)	26.3 ± 1.3
Hand circumference (cm)	55.3 ± 3.9
Vertical jump (cm)	50.9 ± 7.8
Power, Sayer's eq. (W)	4000.7 ± 695.8
Peak power, WT (W)	542.0 ± 114.4
Lowest power, WT (W)	379.3 ± 71.9
Relative peak power, WT (W/kg)	7.2 ± 0.4
Anaerobic fatigue, %	29.5 ± 5.4
Lactate concentration after WT (mmol/l)	11.2 ± 1.5
Speed dribble (s)	6.5 ± 0.3
Shooting performance	13.7 ± 1.7
Free throws	11.7 ± 3.5
Obstacle dribble (s)	8.5 ± 0.6

SLM – soft lean mass, BMI – body mass index

Correlations between all of the measured variables are presented in the below table 2. Shooting performance did not depend significantly on weight, BMI and forearm length, but correlation was high with muscle mass, upper arm length, stretched arms length and upraised arm height. Anthropometric parameters correlated well with results from Wingate test as well as Sargent test. Speed dribble was in a strong relationship with anaerobic capacity of lower limbs as the correlation is very high with calculated power and relative peak power. Shooting performance was also dependent on peak and lowest power. Results from dribbling tests correlate well.

Discussion

The aim of the presented study was to investigate if there was any dependence between anthropometric and anaerobic characteristics and skill tests in group of adolescent basketball players. We attempted to measure general anthropometric characteristics, ball handling ability and basketball technical skill.

According to the literature (Apostolidis & Emmanouil, 2015) the most important anthropometric characteristics regarding the influence on the ball handling skill of the young basketball players are handgrip strength (we did not measure it), standing height and upraised arms length, while the most significant skills defining ball handling are speed dribble and obstacle dribble. We found only dependence between height and upraised arm length and shooting performance as with other tests it was very low and insignificant. There was no relationship between hand circumference and technical skill.

Lower limb power is very important in performing short intensive exercises and speed tests are strongly dependent on anaerobic capacity of the legs. Anaerobic fatigue strongly correlates with speed dribble test as the whole activity is performed with anaerobic sources of energy – 6.5 s and 8.5 s for speed dribble and obstacle dribble, respectively. As higher the anaerobicity, the shorter the time for performance. These tests showed that anaerobic training of basketball players is very important and could help in improving these skills.

There is currently no special test that is accepted as a standard measure of anaerobic power for basketball players. So, we used the Wingate anaerobic test which is accepted as a gold standard for laboratory testing of anaerobic capacity of lower limb. It is applicable in different groups of subjects with different occupation and different age. Correlation between the results from Wingate test and Sargent Jump test is another evidence for us to use it for measurements of basketball players' anaerobicity of lower limb. A jump is a routine movement that basketball players perform throughout most of the game. Therefore, the results of the Sargent test show their abilities best. The result of this test in the group of young players (50.9 ± 7.8) is comparable to the results of the norms of 16-19 years old and is above average (Chu, 1996).

Conclusions

As a conclusion we could state that technical skills depend on anthropometric parameters but the dependence on anaerobic capacity of lower limb shows that the most important is training. In order to be successful, a basketball player does not have to rely solely on his height, weight and strength, but must train purposefully to develop the right technical skills. Working on development of anaerobic and aerobic capacity could help in performing better.

Conflicts of interest - The author declares that he has no conflicts of interest.

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