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Original

INVESTIGACIÓN SOBRE LA RELACIÓN ENTRE LA CIRCUNFERENCIA DE LA PANTORRILLA Y EL SALTO, LA VELOCIDAD, LA AGILIDAD EN JUGADORES JÓVENES MASCULINOS DE BALONCESTO

INVESTIGATION OF THE RELATIONSHIP BETWEEN CALF CIRCUMFERENCE AND JUMPING, SPEED, AGILITY IN YOUNG MALE BASKETBALL PLAYERS

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RESUMEN

El objetivo de este estudio es examinar la relación entre la circunferencia de la pantorrilla (CC) y el salto, la velocidad y la agilidad en jugadores jóvenes masculinos de baloncesto. 80 jóvenes jugadores masculinos de baloncesto (grupo de edad 13-16, la edad media es 14,0 ± 1,3 años, la altura corporal es 175,4 ± 10,4 cm y el peso corporal es 68,4 ± 13,9 kg respectivamente) participaron voluntariamente en este estudio. Se midió la altura, el peso y la CC y los sujetos realizaron el salto vertical y horizontal, el sprint de 20 m y la prueba de agilidad de Illinois. Se usó la prueba de correlación de Pearson (nivel significativo p <0,05) para determinar la relación entre CC y algunas características motoras. Se determinó una relación positiva entre CC y el salto vertical (r = 0,328, p = 0,003) y se encontró una relación negativa entre CC y la velocidad (r = -0,268, p = 0,016). No hubo relación entre CC y el salto horizontal y el rendimiento de agilidad. Se encontró que el aumento de CC resulta significativamente un aumento en el salto vertical y el rendimiento de la velocidad. Se sugiere aplicar los entrenamientos para aumentar el CC para proporcionar un rendimiento de salto vertical y velocidad en jugadores varones jóvenes de baloncesto.

Palabras clave: baloncesto, circunferencia de la pantorrilla, saltos, velocidad, agilidad, adolescentes

ABSTRACT

The aim of this study is to examine the relationship between calf circumference (CC) and jumping, speed, agility in young male basketball players. 80 young male basketball players (13-16 age group, the mean age is 14,0±1,3 years, body height is 175.4±10.4 cm and body weight is 68.4±13.9 kg respectively) voluntarily participated in this study. The body height, body weight and CC were measured and vertical & horizontal jump, 20 m sprint, Illinois agility test were performed by subjects. Pearson correlation test (significant level p<0,05) was used to determine the relationship between CC and some motoric characteristics. It was determined positive relationship between CC and vertical jump (r=0,328, p=0,003) and negative relationship was found between CC and speed (r=-0,268, p=0,016). There was no relationship between CC and horizontal jump and agility performance. It was found that increasing of CC results in significant increasing of vertical jump and speed performance. It is suggested to apply the trainings to increase the CC to provide vertical jump and speed performance in young male basketball players.

Keywords: basketball, calf circumference, jumping, speed, agility, adolescents

INTRODUCTION

Like in all sports branches, great importance is placed on young athletes in the European and world basketball. The physical characteristics that athletes have in young period are effective in distinguishing their positions and are important factors in terms of determining their condition-related characteristics (Ayan & Erol, 2016; Erčulj & Bračić, 2010). While assessing the potential of youth players with exceptional success in competition is simple, most youth players, due to their age and lack of experience, have not yet developed and/or are unable to fully display their abilities in a competition setting (National Strength and Conditioning Association, 2008). Therefore, there are benefits of considering other indicators of current and potential ability of youth basketball players (Štrumbelj & Erčulj, 2014).

Sports activities such as basketball include all the educational and training features required for the development of athletes (Altavilla, D'Isanto, & Di Tore, 2018; Raiola & D'isanto, 2016). The actions during basketball game include variety of movements such as running, dribbling, shuffling, and jumping, which are directional, multidirectional, intense and short-lasting. Generally, there are a large number of sprints and jumps. Speed activities take an important part of athlete development in young basketball players. Time motion analysis during a basketball game showed that on average 1000 movements were performed by basketball players, with an average duration of shorter than 3 seconds (Abdelkerim et al., 2010). On average, every 2 seconds a different movement was initiated, indicating the importance of agility in basketball. In addition to technical and tactical skills, basketball players need a high level of endurance, strength, speed, power, explosiveness, and agility (Boone & Bourgois, 2013).

The high intensity movements of basketball players are closely related to the development of strength, speed and agility (Castagna et al., 2007; Meckel, Casarla, & Eliakim, 2009). However, it is well known fact that an appropriate morphological structure has a direct influence on a basketball player efficiency and performance (Jelicić, Sekulić, & Marinović, 2002). Anthropometric variables are one of those factors which is influence the sports and physical activity of an individual's (Sudhakara, 2018). It is desirable to have long and agile players, so agility is a complex skill that depends on the coordination, common system mobility, dynamic balancing, strength, elasticity, stabilization, explosive strength, speed, and so on (Begu, Kryeziu, & Bahtiri, 2018).

During the course of adolescent development, in addition to increases in size and weight, running speed, resistance, agility and strength improve (Coelho E Silva et al., 2010a; Sickles & Lombardo, 1993). Adolescent athletes constitute a unique population in that they are still in a developmental phase of their physical and technical abilities (Rousanoglou, Nikolaidou, & Boudolos, 2006). The relationship between the physical changes and accompanying motor abilities in the adolescence period is attention-grabbing. Moreover, in basketball practice, motor tests are the most suitable and applicable because they are implemented in conditions similar to those of training or competition. Motor abilities play an important role in the selection of young basketball players and the progress in their playing performance (Erculj, Blas, & Bracic, 2010).

Research on the body structure of basketball players has identified the anthropometric attributes desirable in this sport (Ayan & Erol, 2016; Basturk & Marangoz, 2018). For displaying a better performance, increasing leg strength is significant for athletes (Mavi Var & Marangoz, 2018). Although there are many studies in which anthropometric measurements were taken in basketball players and other branches; the number of the studies in which motoric characteristics were associated with CC is limited (Fattahi, Ameli, Sadeghi, & Mahmoodi, 2012; Sudhakara, 2018; Temur, 2017; Wyon, Allen, Angioi, Nevill, & Twitchett, 2006). This situation reveals the reason of this research. When it comes to adolescent players, it may be difficult to distinguish the effects of physical and biological growth from the training (Coelho E Silva et al., 2010b; Torres-Unda et al., 2013). However, this research is important in terms of clarifying the physical characteristics of this age group and their relationship with some motoric parameters. Accordingly, the aim of this study is to investigate of the relationship between calf circumference and jumping, agility, speed performance in young male basketball players.

METHODS

Participants

80 young male Turkish basketball players (in 13-16 age groups) voluntarily participated in the research. The subjects regularly participate in basketball training for 1,5 hours three days a week. The criteria for participating in the study are (a) to be training at least 3 times a week for the last 3 years in the 13-16 age group in basketball team (b) participating in basketball training regularly (c) sports age is to be at least 3 years. The participants were informed before the research and parent permission documents were obtained. The subjects, who have sustained any injury or surgery in the last six months, were not included in the research.

Study Protocol

Body height of the athletes were determined by Holtain brand (UK) stadiometer, body weight of the athletes (body analysis with right & left upper and lower extremities) were determined by bioimpedance device (Tanita BC 418 (Japan) body composition analyzer measuring with 0.1 kg sensitivity). All motoric tests and anthropometric measurements were performed on four separate days. A rest day is given between measurements. All the measurements were performed in basketball court during the training hours of the basketball team. The study plan is given below:

-Day 1: The subjects were informed about the research and preliminary information about the tests was shared. Anthropometric measurements (body height, body weight, calf circumference) were taken.

-Day 2: Vertical and horizontal jump test were applied.

-Day 3: 20 m sprint test were performed.

-Day 4: Agility test were taken.

After the subjects reported their voluntary participation, they were subjected to the research after they performed approximately 20-minute general and specific basketball warm-up.
Calf circumference (CC): The measurements were made from the widest point of the calf in a way that the legs were slightly open and the body weight was equally distributed to both feet when the subject was standing upright (Temur, 2017). The measurements were made using gullick strip and the skin should not be depressed by squeezing during the measurements. Two measurement was made in each participant and their mean values were taken. If the difference between these two measurements was greater than 7 mm, the test was repeated (Canlı, 2017b).

Vertical jump test: The participants were required to jump using both legs to reach as high as possible on a wall mounted tape. Before the test, standing height measurement was taken and after the test, net height was determined by subtracting the standing reach height from the jump height and recorded in centimeter. The tests were taken twice and the better scores were used (Ayan & Erol, 2016).

Horizontal jump test: Long jump was performed from the standing position with two feet take off. The distance between take off point and the players back heel mark on the pit was measured in centimeters. The participants were allowed two trials and the better scores were recorded (Ayan & Erol, 2016).

20 m sprint test: The participants ran a 20 m distance at their maximum running speed. Their scores were recorded with photoelectric cells (Newtest Power Timer, 2000) in seconds. Subjects were encouraged to decelerate as soon as possible after passing over the finish line and to reach the starting line walking slowly and waiting still for the next sprint on a line set 50 cm before the starting line covered by the photocell beam. The participants were allowed two trials and the better scores were recorded.

Agility test: Illinois agility test was applied to measure agility performance. The participant began the test lying prone on the floor behind the starting line with his arms at his side and his head turned to the side or facing forward. On the “go” command, the participant ascended to his feet and ran quickly. The participants were allowed two trials and the better scores were recorded.

Statistical Analysis

The descriptive statistics and hypothesis tests were performed by using the Sigma Plot 12.0 (Systat Software Inc.) program. Pearson correlation analysis test (significance level: $p<0,05$) was used to examine the relationship between the calf circumference and some motoric characteristics.

RESULTS

The characteristics, anthropometric data and data belonging to some performance tests of 80 male basketball players participated in this research are shown in Table 1.

Table 1. The characteristics of the subjects and some performance variables (n=80).

	All	Max	Min
Age (years ± SD)	14,0 (1,3)	16	13
Years of experience (years ± SD)	6,9 (1,7)	10	3
Body height (cm ± SD)	175,4 (10,4)	197	151
Body weight (kg ± SD)	68,4 (13,9)	94	38
CC (cm ± SD)	68,4 (13,9)	45,3	29
Vertical jump (cm ± SD)	68,4 (13,9)	63	25
Horizontal jump (cm ± SD)	193,9 (25,8)	256	137
20 m sprint (sec ± SD)	3,5 (0,3)	4,11	3,08
Agility (sec ± SD)	17,3 (1,0)	19,78	15,2

CC: Calf circumference

The mean age of the players was determined as 14,0±1,3 years, the mean years of experience 6,9±1,7 years, the mean body height 175,4±10,4 cm, the mean body weight 68,4±13,9 kg, the mean CC 38,0±3,5 cm, the mean vertical jump 43,1±8,9 cm, the mean horizontal jump 193,9±25,8 cm, the mean 20 m speed 3,5±0,3 sec, and the Illinois agility test mean 17,3±1,0 sec.

A positive relationship was detected between CC and vertical jump (r=0,328, p=0,003), and a negative relationship was detected between CC and speed performance (r=-0,268, p=0,016); no relationship was found between CC and horizontal jump & agility performance in young male basketball players (Table 2).

Table 2. Relationship between CC and jump, sprint and agility of the subjects

	CC	
	r	p
Vertical jump	0,328	<0,01*
Horizontal jump	0,212	0,06
20 m sprint	-0,268	0,02*
Agility	-0,03	0,81

**p<,05, Significant difference, r: Correlation coefficient value, CC: Calf circumference*

DISCUSSION

Basketball is a team sport game that requires explosive power of the lower extremities, as well as multiple high intensity sprint type efforts throughout the game and especially at training (Rexhepi, Brestovci, & Mucolli, 2012). Basketball requires an extremely pronounced body height and some other longitudinal measures. They chiefly influence the performance of certain specific basketball movements with a pronounced vertical component (rebounds, different shots, blocking of shots, jumping at the jump ball etc., Erčulj & Bračić, 2010).Explosive strength, take-off power, speed, and agility are abilities that importantly contribute to efficient movement with and without the ball, thus playing an important role in basketball technique and tactics (Erculj et al., 2010).

Physical attributes and physiological performance are important in determining success in basketball. On the one hand, there are differences in physical attributes between players with different skill levels. On the other hand, basketball players may not need to have an extraordinary capacity in any of the areas of physiological performance but most possess a reasonably high level across all areas and, specifically, players with better skill levels are faster, more agile and have better performance in vertical jump tests (Carvalho et al., 2011; Torres-Unda et al., 2013).

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Hoare (2000) determined in his study conducted with elite young basketball players that children's anthropometric and physiological values were important for predicting the success according to the playing positions.

Jumping plays an integral part of basketball performance. Jumping acts are part of various defensive (e.g., blocking, rebounding, and stealing) and offensive (e.g., passing, rebounding, and shooting) maneuvers performed by basketball players in practices and games (Ziv & Lidor, 2010). Jumping ability of the basketball players depends on their strong thigh and calf muscles. Players need to have strong hips to hyperextend their legs and propel the body forward as well. Also, a basketball player to attain a balanced body needs to build the strong muscles of the body (abdominal, upper bodies, as well upper extremities muscles, Rexhepi et al., 2012). Jump depends on the speed of muscle contraction and development of muscle strength. Considering the movement of jump, it is known that the quadriceps group (thigh) muscles must be actively contracted, especially in the upper leg, in order to take off the ground (Luebbers et al., 2003). Torres-Unda et al. (2013) found the jump height of 13-14 year-old male basketball players as 42,9±5,9 cm and 20 m sprint performance as 3,14±0,32 sec. Canlı (2017a) determined the CC of 14 year-old male basketball players as 34,1±3,2 cm and vertical jumps as 40,0±9,4 cm. Coelho E Silva et al. (2010) determined the vertical jump height as 31,3±5,1 cm in 13-year-old male basketball players. In our study, the CC of the male basketball players between the ages of 13-16 was determined as 38,0±3,5 cm and the jump height as 43,1±8,9 cm.

In the study where the relationship between foot structure and jump was examined, the results revealed that the best jumpers had longer lateral heel lengths ($r=0,871$; $p=0,001$) and longer toes ($r=0,712$; $p=0,021$). However, no significant relationship was found between jump height and other anthropometric variables including calf circumference (stature, mass, lower extremity lengths). As a matter of fact, in this research, the subject group consisted of only 10 healthy males and it should be noted that these subjects were not athletes (van Werkhoven & Piazza, 2017). In elite male volleyball players, a significant relationship was determined between the jump height and CC (Fattahi et al., 2012). In young female basketball players, a significant relationship was observed between calf volume and anaerobic performance (Taş et al., 2013). These results also support our findings.

Polat, Çınar, Şahin, & Pepe (2003) reported a significant relationship between the CC and jump height in their study conducted on 14-year-old children. Temur (2017) determined that there was no significant relationship between the right and left CC measurements and vertical and horizontal jump in his study where he examined the relationship between the lower and upper extremity circumferential measurements and hand grip strength and jump distance ($p>0,05$). He reported that the data obtained were in contradiction with the literature and that the reason for this could be explained by the fact that most of the individuals included in the study group were doing sports in the branches which do not require much jumping (boxing, tennis, etc.) and even some of them were not engaged in any sports branch. In addition, he stated that good practice of jump technique may also play a role besides many physiological factors. In another sports branch, Wyon, Allen, Angioi, Nevill, & Twitchett (2006) specified that thigh and CC had a significant effect on the jump height of ballets.

Trainings should be provided to enhance the strength of the quadriceps and hamstring muscles to increase the vertical and horizontal jump distances (Temur, 2017). Muscle strength is significantly affected by the mass of the muscles involved in the movement, the total cross-sectional areas (physiological cross-sectional area) and the structure of the muscles in the form of leverage systems (Nicolay & Walker, 2005). Yıldırım & Özdemir (2010), in their study where they examined the effect of anthropometric characteristics of senior male handball players on the horizontal and vertical jump distance, detected that the CC had a statistical and significant effect on the vertical jump distance while the calf length was significantly and statistically effective on the horizontal jump distance ($p<0,01$). They also found that as the CC increased, the horizontal jump distance also increased to a certain extent. They reported that the increase in the horizontal and vertical jump distance as the CC increased may be due to the significant effect of CC on explosive force.

Agility and speed are integral aspects of almost every defensive and offensive maneuver performed by basketball players in practices and games (Ziv & Lidor, 2009). Jakovlevic, Karalejic, Pajic, Gardasevic, & Mandic (2011) studied the relationship between anthropometric characteristics and sprint in 14-year-old male basketball players. The mean 20 m sprint performance of the subjects was found to be 3,54±0,26 sec and CC 35,21 ± 2,67 cm. Furthermore, they determined a significant relationship between 20 m sprint and lower limb length. A significant and positive relationship was found between sprint performance and CC and step length in young and senior male sprinters (Aerenhouts et al., 2012). In our research, a significant relationship was determined between sprint and CC in young male basketball players and this finding also supports the literature.

Agility plays an important role in physical activities and it is revealed to a great extent in sports and games involving efficient footwork and quick change in body position such as in basketball, football, tennis etc (Sudhakara, 2018). In the research where the relationship between anthropometric measurements and agility in male football players was examined; whereas a significant relationship was detected between body height and agility (r=0,451), body weight (r=0,446) and leg length (r=0,448), no significant relationship was detected between agility and thigh circumference (r=0,322) and CC (r=0,336,Sudhakara, 2018). In the study where the relationship between agility and anthropometric characteristics in 14-15-year old male basketball players was examined, no significant relationship was found between CC and agility although a low level of relationship was determined between body height, leg length and thigh circumference and agility (Begu et al., 2018). The agility test that they performed was a T drill test and we performed the Illinois agility test in our research. Despite the differences of the tests, no significant relationship was found between calf circumference and agility.

Ayan & Erol (2016) determined the CC as 38,7±2,7 cm, vertical jump 49,0±6,5 cm, horizontal jump 210.6±15.0 cm and 20 m sprint 3,3±0,19 sec in 15-year-old male national basketball players. In their research, they correlated the somatotype data only with the motoric characteristics.

CONCLUSIONS

This research was conducted to determine whether the speed, agility and jump strength parameters of male basketball players in the 13-16 age group were related to the CC. As a result of the research, it was determined that the increase in CC resulted in significant increase in vertical jump and speed performance of male basketball players. Our research reveals the range of the quantitative value of some motoric characteristics of young basketball players between the ages of 13 and 16; and it is thought that these data will provide basketball coaches with a reference along with other data available in the literature. It also provides information regarding the physical and motoric characteristics of young basketball players. As a result, it is recommended to provide trainings to increase CC in order to increase vertical jump and sprint performance in young male basketball players.

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