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MANIFESTATIONS OF EXPLOSIVE POWER: DIFFERENCES IN THE LEG SPRINGS BETWEEN FOOTBALLERS OF THE DIFFERENT COMPETITIVE LEVEL

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Abstract:
Explosive power is the dominant motoric ability in most sports, regardless of the age, gender and level of the competition, and as such participates in the equations of the specification. Vertical jump (Squat Jump) is a test for estimating the explosiveness of caudal extremities in a number of sports, most often in football, athletics, basketball, volleyball. The study included a sample of 39 respondents (19 cadets, ages 15 ± 0.5 years and 20 juniors, age 17 ± 0.5 years). The aim of this study was to determine the differences in the strength of the leg springs between players of junior and cadet ages. For the estimation of explosive power, the Squat Jump was measured using the Chrono Jump contact mat tensiometric platform (Bosco System, Spain). The analysis of the T-test showed statistically significant differences at the level of $p < 0.000$ in favor of boys of junior age.

Keywords: power, explosiveness, caudal extremities, collective sports

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1. Introduction

Football is one of the most widespread and most complex sports in the world, where players need technical, tactical and physical skills for success (Joksimović, et. al., 2009, Mirkov, et. al., 2010) and belongs to a group of complex polystructural acyclic activities (Erceg, Rađo, & Sporiš, 2018) with certain time periods. It is defined as a team sport where players must achieve high performance using primary motor and functional skills, as well as technical and tactical skills (Impellizzeri, et. al., 2004; Krespi, Sporiš, & Mandić-Jeleska, 2018). In the football game dominate intermittent activities of different aerobic and anaerobic energy sources. It is often the case that during the game the intensity of the players' activities ranges from a light walk to a sprint, a maximum speed, with the speed of the player approaching the speed of the sprinter (C. Ronaldo). Some authors evaluated factors that greatly contribute to the successful realization of the football game (Wisløff, et. al., 1998; Svensson, & Durst, 2005), and realized football-specific research showed a strong relationship between anthropometric and physical parameters with the success of the football game. It has been proven that there is a correlation between the physical composition of athletes and their functional characteristics, and that the composition of the bodies and variables that define a certain somatotype influence the achievement of good motor-functional parameters (Ostojić, 2002).

In order for to maintain its abilities during the football game, at the required level, a player must have a strong aerobic-anaerobic component that combines strength, speed and power (Gerodimos, Manou, Ioakimidis et. al., 2006). During the game, players often perform activities of great level, sometimes maximum, of intensity (Stølen, et. al., 2005; Swinnen, 2016) characterized by specific frequent movements of caudal extremities (Kocić, Joksimović, & Stevanović, 2016), which are greatly affected by the strength of the leg muscles (Bangsbo, Mohr, & Krustrup, 2006; Nikolaidis, 2014). These are usually short sprints, moment of acceleration and deceleration, ball kicks, spins and jumps, which can be performed over 500 times during the game (Stølen, et. al., 2005). All of this requires a large dose of speed, explosiveness, agility, and so on. For the assessment of explosiveness, a special group of muscle strength tests consist of tests of individual or serial vertical jumps, the measurement and interpretation of which is very widespread in contemporary sports science and practical work (Lara, Abián, Alegre et al., 2006; Ostojić, Stojanović, & Ahmetović, 2010).

Vertical jump is a component of most sports activities, which is used as a measure of the strength of the leg muscles in football (Wisloff, Castagna, Helgerud, et al., 2004; Caldwell, & Peters, 2009; Chlif, Jullien, Temfemo, et. al., 2010; Lago-Penas, Casais, Dellal, et. al., 2011; Nikolaidis, 2014). The jumps are filogenous movements that take ontogent form in the given activity and require complex motor coordination between the cranial and the caudal segments of the athlete's body. The propulsive effect of caudal extremities during vertical jumps was considered suitable for assessing the explosive characteristics of sedentary and top athletes (Bosco, & Viitasalo, 1982;

Marković, Dizdar, Jukić, et. al., 2004). Explosive power is the decisive motor skills in most sports (Popović, Radanović, Stupar, et. al., 2010; Joksimović et. al., 2018), and defines it as an ability to maximize the acceleration of one's own body, object or partner in activities of throwing, jumping, kicking and sprinting (Milanović, Bašić, & Milanović, 2005; Jezdimirović, et. al., 2013). It is essential for the players to get the necessary height of the jump during a duel game (Knuttgen, & Kraemer, 1987; Paoli, Bianco, Palma, et. al., 2012). Explosive power in the form of a vertical jump is considered extremely functional for optimal performance in football and is taken into account when testing capabilities and talent selection (Stølen, 2005; Castagna, & Castellini, 2013), as well as the identification of bilateral differences (Sannicandro, et. al., 2012; Menzel, et. al., 2013).

In this regard, the aim of this research is to determine the differences in the power of the extensors of the caudal extremities of a footballer of different chronological ages.

2. Methods

The survey included a sample of 39 FK Kiker players from Kraljevo divided into two sub-samples. The first sub-sample consists of 20 junior players (17 ± 0.5 years old), and the second sub-sample consists of 19 cadets (15 ± 0.5 years). All footballers volunteered to measure and did not suffer any injury of the locomotor apparatus previously, which would eventually affect the final outcome of the measuring results. For the estimation of explosive power the Squat Jump variable on the tensiometric platform with the Chrono Jump contact mat (Bosco System, Spain) was applied. Measurement was realized in FK Kiker Ballroom in Kraljevo, February 22, 2018 year. The basic central and dispersion parameters were calculated. A T-test module for small independent samples was used to determine the differences. Data was processed with the statistical package for personal computers SPSS Statistic 20.0.

3. Results

Table 1 presents descriptive parameters for footballers of different ages and competitive levels. The analysis of the results confirmed the domination of the junior players in the explosive area, which is related to the age and peak of reaching explosive power. The average junior players' jump height (32.03 cm) is well above the average cadet players' (26.13cm). This is also manifested in the maximum values of the vertical jump. The maximum junior players' jump height (45 cm) is a confirmation of the explosive dominance in relation to the cadet players and a difference of almost 20 cm in both categories. It can be concluded that the linear explosiveness relationship within the age of football players is evident.

Table 1: Basic statistical parameters of the football players

Variable	Age	Mean	Min.	Max.	Range	Std. Dev.	Skew.	Kurt.
Squat jump	Cadets	26.13	17.3	34.3	17.0	4.7047	-.153	-.410
	Juniors	32.03	25.8	45.0	19.2	4.7792	.962	1.449

Table 2: Differences in the strength of the leg springs of the football players of different ages

Variable	Age	Mean ± Std.Dev.	t-value	p
Squat Jump	Cadets	26.13±4.70	-3.882	**0.000***
	Juniors	32.03±4.77		

The analysis of the dispersion parameters showed that there are no significant deviations from the normal distribution in junior players, whereas in the cadets the distribution of frequencies with statistically negative asymmetry was formed. In terms of homogeneity, there is a slight leptokurtic curve in junior players, while the platikurtic curve is formed in cadets. Table 2 shows the results of the T-test for players of different age categories. By analyzing the T-test (t = -3.882) it is evident that there are statistically significant differences in explosive power in favor of junior (Squat Jump, p <0.000).

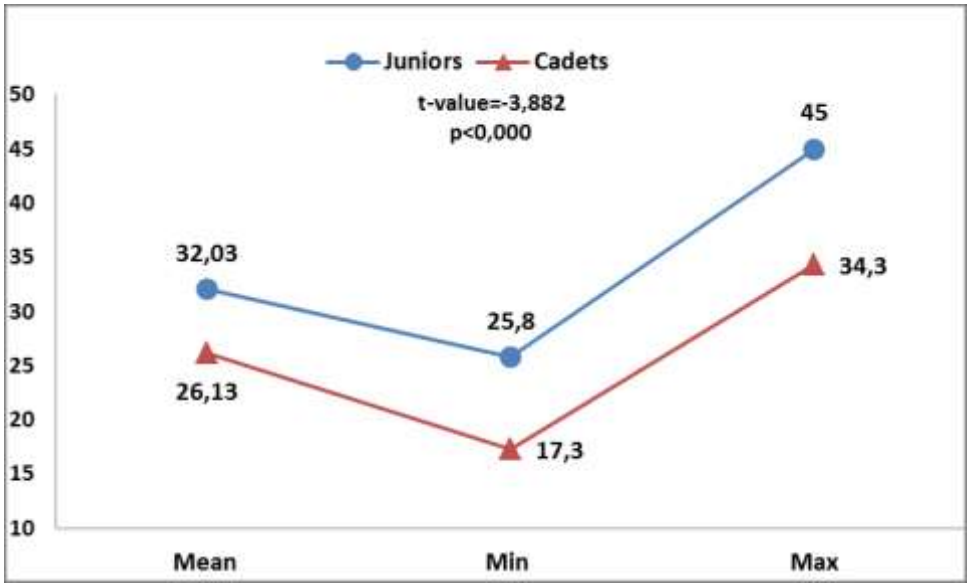

Figure 1: Distribution of the results (Squat Jump)

4. Discussion

The problem of relations and functioning of motor and functional space in concrete sports activities raises many questions. In particular, this is actualized in the case of young age categories, the same or different competitive level, chronological age or degree of fitness. Some studies (Wisloff, et. al., 2004; Cometti, et. al., 2001; Diallo, et. al., 2001; Helgerud, et. al., 2001, Joksimović, 2018) comparing the sprinting skills of junior

and senior soccer players, elite and non-elite, professional and amateur players, higher ranking and lower ranking competitions, confirmed that higher level players have greater speed than lower. This variation can be attributed to the different training levels and requirements of the competition for each category, the time and maturity of the players, and the ability of the body to accept higher loads and strength of training in caudal extremities. On the basis of the facts presented in this research, the aim of the research is to determine the differences in the force of the caudal extremes in the soccer players of different ages using the Squat Jump motor test. The analysis of the results concluded that there are significant differences in favor of junior football players ($t = -3.882$; $r < 0.001$). Despite the popularity of football in adolescence, several studies have been carried out on the physical properties and motor skills of these athletes in a lab environment, especially with regard to the strength of the leg muscles (Nikolaidis, 2014).

The vertical test jump is one of the most common estimation methods in sports games and sports in general (Linthorne, 2001). This type of jump is in high correlation with the strength of the leg springs. Power, and especially the ability of a vertical jump as an indicator of the strength of the caudal extremities, is a very important parameter for the performance of the football players. Some studies have shown that the force of a football player, measured by a vertical jump, is on average between 38 and 45 cm (Cometi, et. al., 2001; Gil, et. al., 2007). The players of our research, juniors, had larger numerical parameters of explosive power (average 32.03 cm), than cadet age players (an average of 26.13 cm). This study also showed that after the end of puberty young footballers achieve better results in explosive tests. This is particularly manifested in explosive force, a type of vertical jumping ability, which is in line with the results of previous research (Garganta, Maia, Silva, et. al., 2003; Kukolj, Koprivica, & Ugarković, 2002; Gerodimos, et. al., 2006; Veljović, & Stojanović, 2009). The results are obtained from the results of the Asian authors when it comes to the vertical jumping ability of the younger age group. In relation to European and African football players, Asian football players have less explosive power, a type of vertical jumping. This was confirmed by Wong, & Wong, (2009) on a relatively small sample of 16 players, an age of 16.2 ± 0.6 years. However, this might not be generalized to the general population, although the ''yellow race'' in terms of morphological features is inferior to the European, while motor skills did not retain that qualification. Reilly, et al., (2000) state that the differentiation of performance in a vertical jump can be explained by many reasons, of which the most important are power, speed and endurance.

The maximum speed of running, not large distance (10-30 m) and jumps are explosive actions (Faude, Koch, & Meyer, 2012), which should be developed from a younger age, with precisely defined sensitive periods (Loyd, et. al., 2014). According to some authors (Berthoin, Dupont, Mary, et al., 2001; Wisløff, 2004), the explosive force is in a positive correlation with running at short distances. Changes in the motor skills of adolescent footballers suggest that the quality of the vertical jump is constantly improving during the teenage years (Williams, Oliver, & Faulkner, 2010). Čoh (2004)

and Petrović et. al., (2012) state that the most important factors of this kind of movement are the muscular and nervous system. Anatomically speaking, in the muscular system, the relationship of fast and slow muscle fibers is important, which is genetically predicted, as well as the elasticity of the muscles and tendons. Research have suggested that children before puberty have a higher percentage of type I muscle fibers (Brownstein, 2015) whose contraction rate is 0.01-0.06 seconds (Rankovic, et. al., 2006). Oertel (1988) conducted a study in which he analyzed the morphometric analysis of skeletal muscle fibers in children, adolescents and adults. The proportion of muscle fibers of type I in children aged 6-10 years was 54%, 10-15 years of age 47%, 15-20 years of age 42%, which clearly defines the inverse relationship of male-fiber type aging with age.

A similar study was carried out by Lexell, et al., (1992), where they recorded a higher proportion of type II muscle fibers in adolescents (as much as 50%) compared to pre-puberty of 35% (Brownstein, 2015), with a contraction rate of up to 0.01 seconds (Rankovic, et. al., 2006). These muscles are important neural factors for the performance of explosive activities. It is very interesting to analyze the relationship between the muscle force and its volume, which is of great importance in jumps. The force the muscle can perform during a vertical jump depends more on the muscle cross-section than on the muscle volume (Funato, Kanehisa, & Fukunaga, 2000; Haff, & Triplett, 2016). This can be explained by the fact that the rate of force generation within the muscle group depends on the number of chambers, where the muscles with long sarcomers perform greater force per unit of cross-section (Zatsiorsky, & Kraemer, 2006). In many muscles, units that generate force are oriented at an angle to the direction of pulling the muscles of the tendon, where the length of the fibers is shorter than the length of the muscle because the fibers do not work to the end, i.e. from one end to the other, where the angle of pinification varies from 0-0.4 work (Ilić, & Mrdaković, 2009). Explosive activities play a major role during the football game, and they depend on the maximum power (Chelly, et. al., 2009). Muscle strength increases with age, but not explosive power, which can be associated with changes in the structure, size and muscle metabolism (Vescovi, et. al., 2011; Van Praagah, & Dore, 2002). The size of the muscular fibers, the cross-sectional area, and the morphological characteristics of the muscles are closely related to the generation of force, and they increase during growth with the tendency to reach the plateau at the age of 16-17 years, depending on the carefully defined training load (Van Praagah, & Dore, 2002). Based on all of the above, and taking into account the results of this research, the training of young athletes should not be based on the principles of adult training, which is a common mistake of many trainers, but it must be in line with their biological, chronological, psychological and physical development (Aksović, & Berić, 2017). We should never forget the proven fact that training of the Olympic or World Champion, copied in all segments, to the smallest details to our athlete or a team, does not imply compulsory success. It is necessary that at every point of the training process, the basic principles are also

respected. Only with consistent respect for established rules a good result can be expected in any sport branch.

5. Conclusion

The research was carried out on a sample of 39 FC Kiker players from Kraljevo with the aim to determine the differences in the strength of the leg springs between the junior and cadet age players. The analysis of the T-test showed that there are statistically significant differences in favor of junior footballers, since the boys after achieving puberty have better results in explosive power; the explosive force is approaching its maximum peak of manifestation and also their CNS works better. This research provides relevant information for the profession and science, football trainers, to be aware of the biological and chronological laws to be considered when planning training for explosive power with athletes of different ages, training and competitive levels.

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