DIFFERENCES IN THE INDICATORS OF EXPLOSIVE POWER OF LEGS OF ATHLETES IN DIFFERENT SPORTS ACTIVITIES

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Abstract

The sample consisted of 60 examinees aged 15 (±6 months), divided in three subsamples of 20 athletes (athletics, basketball, football) was a subject of testing using the following motor tests on the tensoplatform Kistler QuatroJump 9290AD: squat jump, countermovement jump, repetitive jumps with straight legs and the relative values of these tests. The application of multivariate analysis of variance established that there are some statistically significant differences among these groups of athletes. Discriminant analysis established the existence of two statistically significant factors.

Keywords: *explosive power of legs, football players, athletes, basketball players*

Introduction

Power is one of the dominant motor abilities in most sport games and individual sports. No movement or action in sports activities can be made without expressing some sort of muscular power. Kurelić, Momirović, Stojanović, Šturm, Radojević & Viskić-Štalec (1975) define power as ''the ability of an organism, especially muscles (as a part of movements) to resist greater efforts in a significant and efficient way''. According to Zaciorski & Kremer (2009), ''power in sports is the ability of an organism to overcome the resistance from the outside or to confront it by using exertion muscles''. Nićin (2000) gave the definition: ''Power is defined as a person's ability to confront or overcome the resistance from the outside by using exertion muscles''. Explosive power is the ability which enables athletes to give their body, an object or a partner maximum acceleration.

It is manifested in activities such as throwing, jumping, kicking and sprinting (Milanović, 1997). It is also a necessary component of top sports performances and it is manifested as the maximum engagement of motor units in the shortest possible time, such as jumps in football, basketball, athletics, sprinting up to 20 meters, throwing a ball in basketball, kicking a ball in football and the ability to make quick movements and stop suddenly. ''The ability to jump is a specific example of quick power in eccentric-concentric conditions which appears in different cyclic, acyclic and combined motor situations. The most important factors of jumping are: muscular and nervous systems. In the muscular system the ratio between fast and slow muscular fibers and the elasticity of muscles and tendons is very important'' (Čoh, 2004). Harasin (2003) used the word 'strength' which he defined as the maximum voluntary current movement force, or the greatest force of a movement which can be voluntarily manifested in a specific moment. According to Bompa (2006), the ability of an individual to do an exercise (force) is a cause and a pure movement is just a consequence (power).

Explosive power in athletics is of vital importance for the success in certain disciplines, such as jumping, sprinting and throwing, where the kinetic chain of using power starts from legs, or, in other words, as the explosive force of lower limbs. Even though specific motor information in basketball is important for successful playing, basic motor abilities determine the success in competing activities. Those abilities include the ability to start quickly, change directions and react to a stimulus in the shortest period of time. Explosive power, used for the purposes of starting, fast and short sprinting and maximum jumping in defense, is dominant during those activities and it is one of the motor abilities typical of the best basketball players and it is vital for the success in modern basketball (Barber-Westin, Noyes & Galloway, 2006). The necessity to express explosive power in football comes from the jumps goalkeepers make in order to catch a ball, as well as centre forwards' jumps in an attack. Straight line movements of players and changing directions are also described by the elastic explosive power, but dominantly from the thigh muscles (Vučetić, Čanaki & Šoš, 2005). One of contemporary precise ways of measuring explosive power of lower limbs is a tensiometric platform. When force is applied sensors register a certain amount of material deformity. Sensors send electric impulses and close the electric circle. Those elements are called piezoelectric elements and they are made from silicones and similar sensitive materials (Bubanj, 1997).

Researches in the field of young boys' motor skills have been done by Rowlands, Ingledew & Eston (2000); Hraski, Mejovšek, Antekolović & Dobrila (2003); Stojiljković, Branković, Milenković, Stojiljković & Joksimović (2007); Milenković (2009); Faigenbaum, James, Buchanan, Ratamess, Kang & Hoffman (2010), who point out that the boys in that period are different from each other in all aspects of power and speed, while the authors have different opinions when it comes to their flexibility.

A subject of this research is the analysis of motor abilities of the boys in puberty who are members of sports clubs. And also as a possibility of the existence of quantitative and qualitative differences in motor abilities. The aim of this research is to establish the differences between the indicators of explosive power of lower limbs among athletes taking part in different activities.

Methods

The sample of examinees consisted of 20 athletes (jumpers and sprinters), 20 football players and 20 basketball players. All examinees were male, aged 15 (± 6 months) and with at least four-year experience in sports. All sports clubs involved were from the territory of the municipality of Novi Sad. The examinees and their parents all gave their consent to taking part in this testing. Performances of explosive power of lower limbs and the values of body weight were obtained by using the tensiometric platform Kistler QuatroJump 9290AD. The sample of measuring tools consisted of: 1) squat jump (SJ), 2) relative power of squat jump (SJrel), 3) countermovement jump (CMJ), 4) relative power of countermovement jump (CMrel), 5) repetitive jumps with straight legs (RJBL), 6) relative power of repetitive jumps with straight legs (RJBLrel) and body weight (BW).

The testing was done in the Sports-diagnostic department of the Faculty of Sport and Physical Education in Novi Sad. During testing and measuring all the rules and preconditions for the application of the protocol were obeyed. The testing was done in two parts. In the first part body weight was measured and in the second the examinees were tested on a tensoplatform. The results were processed in the statistical package SPSS 15.0. Arithmetic means and standard deviations were calculated for all variables. For the purposes of establishing the significance of differences in the indicators of explosive power of lower limbs among the groups of athletes, a multivariate analysis of the variance (MANOVA) and a discriminant analysis were used.

Results and discussion

Table 1 shows the arithmetic means (AM) and standard deviations (S) of the examined groups of athletes. The last column of Table 1 shows the results of the univariate analysis of variance (ANOVA), the purpose of which is establishing the differences among every individual variance used for the estimation of explosive power. Those results clearly show that the examinees are statistically very different in all variables, at the level of significance p=0.00.

Table 1. The differences in the indicators of explosive power among the groups of athletes

Variables	Athletes		Basketball players		Football players			
	AM	S	AM	S	AM	S	f	p
SJ (cm)	69,4	4,8	58,6	4,7	44,6	5,5	121,7	0.00
SJrel (W/kg)	22,8	2,8	18,67	2,1	17,2	3,1	23,7	0.00
CMJ (cm)	61,9	5,3	55,6	8,5	40,7	5,2	56,2	0.00
CMJrel (W/kg)	26,2	2,2	23,6	4,4	22,6	3,1	6,1	0.00
RJBL (cm)	45,4	3,5	41,1	4,2	31,6	3,8	67,9	0.00
RJBLrel (W/kg)	44,7	7,3	41,6	6,7	35,0	4,0	12,7	0.00
BW(kg)	67,4	5,8	71,5	11,0	55,6	10,5	23,7	0.00

F= 16,48 P= 0,00

Multivariate analysis of the variance shows that there are statistically significant differences among the groups in the whole system of variables (F=16,48). The result P=0,00 makes us conclude that all three groups are statistically significantly different according to the observed features. The table 2 gives the values of percentage values of the variance of discriminant functions, where the first one explains 94,9% of the variance of the overall system of six motor variables and the other one much less, 5,1%. It can be concluded that both discriminant factors are statistically significant, so both will be interpreted. According to the results from the Table 2, which show the coefficients of canon discrimination, which represent the correlation between every discriminant function and variable individually, it can be noticed that the greatest factor of discrimination among the groups in the first discriminant function was the test squat jump (SJ) (0,654), while the greatest factor of discrimination among the groups in the second discriminant function were the tests of a relative power of the squat jump (SJrel) (0,658),

Table 2. The results of discriminant analysis

VARIABLES	DF1	DF2
SJ	0,654*	0,554
SJrel	0,056	0,568*
CMJ	0,229	-0,615*
CMJrel	0,012	0,631*
RJBL	0,365	-0,611*
RJBLrel	0,096	-0,142
Variance	94,9	5,1
CR	0,92	0.48
λ	0,119	0,773
χ^2	116,10	14,01
p	0,000	0,015
Group	C1	C2
Athletes	2,573	0,453
Basketball	0,412	-0,740
Football	-2,985	0,288

DF – discriminant factor, CR – coefficient of canon correlation, λ – Wilks' Lambda indicator, χ^2 – hi-squared test, p – the level of statistical significance of hi-squared distribution, C – centroids of the groups.

countermovement jump (CMJ) (-0,615), a relative power of the countermovement jump (CMJrel) (0,631) and the repetitive jumps with straight legs (RJBL) (-0,611), while the least significant factor of discrimination among the groups was the test relative power of repetitive jumps with straight legs (RJBLrel) (-0,142). The explained coefficient of correlation among the whol set of motor tests has a high value for both functions (χ^2=116,10, or 14,01). The Table 2 also shows the values of centroid groups for the first and second discriminant functions. Centroids show to which extent groups differ from each other according to every discriminant function. It can be noticed that the third group (football players) are significantly different from the first two groups according to the first discriminant function. This difference is especially significant between football players and track-and-field athletes (the 3rd and 1st group). The second discriminant function shows a significant difference between the 2nd group (basketball players) on one and the 1st and 3rd group (track-and-field athletes and football players) on the other side. The 1st and 3rd groups are relatively similar according to the second discriminant function (values 0,453 and 0,288). The results of this research established some statistically significant differences among track-and field athletes, basketball players and football players in the indicators of explosive power of legs. Vučetić, Čanaki and Šoš (2005), as well as Krsmanović and Krulanović (2008) made the same conclusion. Knowing the characteristics of the period of ontogenesis in certain periods is the basic assumption for a rational managing of an individual development of motor abilities and optimal programming of the process of doing exercises, or training (Peterson, Alvar, Rhea, 2006). The conclusion that the development of the above mentioned motor abilities follows a certain trend, or that it has a certain dynamics, was also reached by Hraski, Mejovšek, Antekolović & Dobrila (2003); Stojiljković, Branković, Milenković, Stojiljković & Joksimović (2007); Rowlands, Ingledew & Eston (2000); Faigenbaum, James, Buchanan, Ratamess, Kang & Hoffman (2010); Milenković (2009); Đinić, Mihajlović & Petrović (2010); as well as Krsmanović & Berković (1999); Nićin (2000); Jovović (2006) and Gamble (2010). The results obtained in this research still cannot be generalized on all basketball, football and athletic clubs, so they are taken with certain precautions. Most movements in athletics are actually different variations of expressing the development of (explosive) power, which explains why the track-and field athletes showed the best results in all variables, not only when it comes to absolute values, but in relative values of the tests as well, taking into account that those activities are performed daily during a training process. Basketball is a multi structural sport in which jumping is the most frequent (both one-legged and two-legged), as well as sprinting and sudden changes of direction, all of which are the activities dominated by explosive power.

That is one of the reasons why basketball players had the results similar to track-and-field athletes, which can also be seen from the position of a centroid (Table 2). The author has found out that the basketball team which was tested has strength and conditioning coach who works with the players according to a plan of fitness consisting of a wide variety of movements used in athletics, which is why they showed similar results to track-and-field athletics. Football players who took part in this research do not follow any pattern of fitness preparations, which can be concluded from the results they showed. The necessity of programmed and controlled training for the development of strength is supported by the fact that most of the mentioned track-and-field athletes and basketball players are members of the national teams in their categories, while the football players are on a lower competing level. The conclusions which were made show that the fitness-biomotor preparation (Čoh, Antekolović, Blažević & Mejovšek, 2009) occupies most of the time in all sports preparations. The results of this research also give us an insight into the current shape of the tested players and they can be compared to the criteria for the estimation of motor abilities and continuously monitored in a cycle which lasts for several years.

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RAZLIKE U INDIKATORIMA EKSPLOZIVNE SNAGE DONJIH EKSTREMITETA SPORTAŠA RAZLIČITIH SPORTSKIH AKTIVNOSTI

Sažetak

Uzorak za ovo istraživanje se sastojao od 60 ispitanika uzrasta 15(±6 mjeseci), podijeljenih u tri subgrupe po 20 sportaša (atletika, košarka, nogomet). Testirani su korištenjem slijedećih motoričkih testova na Tenso platformi Kistler QuatroJump 9290AD: squat skok, povratni skok, ponovljeni skokovi ispruženim nogama i relativne vrijednosti ovih testova. Primjena multivarijantne analize varijance utvrdila je postojanje nekih statistički značajnih razlika izmešu ovih grupa sportaša. Diskriminativna analiza donijela je dva značajna diskriminativna faktora.

Ključne riječi: *eksplozivna snaga, noge, nogometaši, atletičari, košarkaši*

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