FACTA UNIVERSITATIS Series: Physical Education and Sport Vol. 11, N° 3, 2013, pp. 221 - 226

Original research article

# DIFFERENCES IN THE VERTICAL JUMP IN SOCCER PLAYERS ACCORDING TO THEIR POSITION ON THE TEAM

# UDC 796.332

# Marko Jezdimirović<sup>\*</sup>, Aleksandar Joksimović, Ratko Stanković, Saša Bubanj

University of Niš, Faculty of Sport and Physical Education, Niš, Serbia

Abstract. The vertical jump is used in order to estimate the explosive strength of the lower extremities. The literature generally recommends a two-foot vertical jump in order to identify talent, to assess an athlete's readiness to participate in a certain training process. The aim of the current study was to compare the variables of the demonstrated explosive leg power in relation to the player's position in the team using the vertical jump, the so-called Countermovement Jump (CMJ). The sample of participants consisted of 32 healthy male students of the Faculty of Sport and Physical Education from Nis who practice soccer, aged  $20.18 \pm 1.28$  years, body height 181.28  $\pm$  5.61 cm, weight 74.19  $\pm$  6.58 kg and average age of practicing soccer 9.38  $\pm$  2.76 years. The participants performed five CMJ rebounds with both feet. By using the wireless accelerometer Myotest (Sion, Switzerland), the values of the following variables of CMJ were determined: Height (height in cm), Power (power expressed in W / kg), Force (force expressed in N / kg) and Velocity (speed expressed in cm / s). The results of this study showed that there were statistically significant differences in the jump height variables in soccer players according to the position in the team, while the other variables showed no statistically significant differences. The obtained data can be helpful to future participants in the sense that they can improve their explosive muscle power. The results of this study can be useful in educating coaches to apply the vertical jump to assess the necessary explosive strength of the lower extremities in soccer players.

Key words: explosive power, vertical jump, soccer players, the difference.

## INTRODUCTION

Soccer is characterized by a continuous course of activities with intermittent intensity in the game and a very low success ratio (the number of achieved goals) according to

Received April 19, 2012 / Accepted August 25, 2013 **Corresponding author**: Marko Jezdimirović, <sup>\*</sup>PhD student St. Čarnojevića 10a, 18000 Niš, Serbia E-mail: jezdimirovicmarko@yahoo.com

## M. JEZDIMIROVIĆ, A. JOKSIMOVIĆ, R. STANKOVIĆ, S. BUBANJ

possession of the ball (Reilly et al, 1993). For achieving top results in this sport, it is necessary that players have an exceptionally high level of technical and tactical skills as well as significant physical fitness (Svensson & Drust, 2005). Soccer is one of the most widely played and complex sports in the world, where players need technical, tactical, and physical skills to succeed (Joksimović et al., 2009). The application of vertical jumps for the evaluation of explosive leg muscle power can be found in the professional literature, and kinesiology practice for over 80 years (Sargaent, 1921). Numerous textbooks, manuals and other publications suggest the application of vertical jump tests in order to assess explosive muscle power (Astrand & Rodahl, 1986). Explosive power is usually defined as a capability that allows an individual maximum acceleration of his own body, an object, or a partner in the activities of throws, jumps, kicks and sprints (Milanovic, 2005). This motor activity is reflected in all the movements in which the whole body, or parts of it, or load, extend movement due to a gained momentum, and due to initial acceleration. Explosive power as such is one of the determinants of success in all the activities that require the reading of muscle force peak in the shortest unit of time (Newton & Kreamer, 1994). The only valid and objective way of assessing muscle strength is measurement with a dynamometer (Bubanj, S. et al., 2010). Vertical jumps, hops, and/or bounding movements are often used to increase explosiveness and strength of the lower extremities (Ebben, 2005; McNeely, 2005). The Countermovement Jump (CMJ) represents a plyometric exercise for the lower body. The purpose of its application is to improve the reactivity and explosive strength of the lower body. An athlete takes the upright position with his feet positioned apart at shoulder width and with his hands placed on his hips (in order to reduce the arm swing). The mentioned position is followed by a quick descend into the half-squat. Then, the athlete performs a vertical jump. At the landing, the athlete quickly descends into half-squat and jumps again, with minimum contact effectuated with the ground (Bubanj, S. et al., 2010a; Brown et al., 2004). The aim of this study is to determine the difference in explosive power of the lower extremities in soccer players according to the position they play.

## METHODS

The sample of participants consisted of 32 healthy male students of the Faculty of Sport and Physical Education from Nis who practice soccer, aged  $20.18 \pm 1.28$  years, body height  $181.28 \pm 5.61$  cm, weight  $74.19 \pm 6.58$  kg and average age of practicing soccer  $9.38 \pm 2.76$  years. The sample included 3 goalkeepers of  $187 \pm 4.58$  cm height, weight  $76.33 \pm 7.57$  kg and average period of playing soccer  $7 \pm 3$  years, 10 defensive players of  $182.7 \pm 5.88$  cm height, weight  $75.7 \pm 7.57$  kg and average period of playing soccer  $10.4 \pm 1.07$  years, 13 midfielders of  $179.92 \pm 5.75$  cm height, weight  $73 \pm 5.78$  kg and average period of practicing soccer  $9.69 \pm 3.06$  years, and 6 forwards of  $179 \pm 3.22$  cm height, weight  $73.17 \pm 6.99$  kg and average period of practicing soccer  $8.17 \pm 3.43$  years (Mean  $\pm$  STD). The participants were informed about the terms of the research, conducted in accordance with the Helsinki Declaration, and they gave their written consent for their voluntary participation. They were asked to perform five vertical jumps (CMJ), with their hands placed on their hips in order to minimize arm contribution to leg extensor assessment. The CMJ was measured by a wireless accelerometer Myotest (Sion, Switzerland), positioned safely on a belt, which the participants carried around

222

223

their lower trunk. The aforementioned device tested four different variables that are important determinants of explosive strength performance: Height (expressed in cm); Power (expressed in W/kg); Force (expressed in N/kg) and Velocity (expressed in cm/s). The CMJ protocols included the following technique: from the initial position, normal standing position (on both legs) and hands placed on their hips, through the flexion in the knee joints up to 90°, after the audio signal from the device, the participants performed the maximum vertical take-off, and landed with affable flexion (up to 110°) in the knee joints and finally, went back to the starting standing position, while waiting for the new sound signal, when the specified jump technique was repeated. For data statistical analysis and interpretation of the results, software SPSS version 20 was used. Descriptive statistics were used for every position of the player on the team. The Height, Power, Force and Velocity at each protocol were compared by using a one-way analysis of variance (ANOVA). The criterion for establishing statistical significance was P < 0.05.

#### RESULTS

Table 1 Descriptive statistics of variables (CMJ) according to positions on the team

	goalkeeper	defenders	midfielders	forwards
Ν	3	10	13	6
Height (in cm)	$41.33\pm2.082$	$38.2\pm2.098$	$35.77 \pm 2.619$	$39.33 \pm 4.885$
Power (in W/kg)	$41 \pm 3.606$	$48.1 \pm 7.951$	$43.62 \pm 9.553$	$43.67\pm4.676$
Force (in N/kg)	$25 \pm 1$	$28.1 \pm 3.542$	$25.69 \pm 4.785$	$27 \pm 1.549$
Velocity (in cm/s)	$243\pm15.524$	$253.8\pm15.49$	$238.69 \pm 21.203$	$240.67 \pm 18.991$

From descriptive statistics, we see that the greatest results in the variable Jump height are in goalkeepers, while the best results in variables Jump strength, Force and Speed jump are in defensive players. The lowest values found in variables Jump height and Speed are in midfielders, while the lowest values found in variables Power and Force are in goalkeepers.

One-Sample Kolmogorov-Smirnov Test								
		Body	Body	Height	Power	Force	Velocity	
		height	weight					
N		32	32	32	32	32	32	
Normal	Mean	181.28	74.19	37.72	44.78	26.63	244.19	
Parameters <sup>a,b</sup>	Std. Dev.	5.612	6.587	3.391	7.987	3.782	19.037	
Most Extreme Differences	Absolute	0.108	0.124	0.165	0.127	0.202	0.108	
	Positive	0.108	0.081	0.165	0.127	0.202	0.077	
	Negative	-0.092	-0.124	-0.104	-0.056	-0.091	-0.108	
Kolmogorov-Smirnov Z		0.61	0.7	0.935	0.718	1.142	0.608	
Asymp. Sig. (2-tailed)		0.85	0.711	0.346	0.682	0.147	0.853	

Table 2 The results of Kolmogorov-Smirnov Test

a. Test distribution is Normal; b. Calculated from data.

By using Kolmogorov Smirnov Test it was checked whether the data distribution was normal, in aim of adequate application of ANOVA test or Friedman' test.

		Sum of	df	Mean	F	Sig. (2-tailed)
		Squares		Square		
Height	Between Groups	106.561	3	35.520		
	Within Groups	249.908	28	8.925	3.980	.018*
	Total	356.469	31			
Power	Between Groups	178.158	3	59.386		
	Within Groups	1799.310	28	64.261	.924	.442
	Total	1977.469	31			
Force	Between Groups	41.831	3	13.944		
	Within Groups	401.669	28	14.345	.972	.420
	Total	443.500	31			
Velocity	Between Groups	1395.172	3	465.057		
	Within Groups	9839.703	28	351.418	1.323	.287
	Total	11234.875	31			
	Total	11234.875	31	551.410	1.525	.201

Table 3 One-way analysis of variance (ANOVA)

\* The mean difference is significant at the 0.05 level.

By using univariate analysis of variance it can be concluded that there is a statistically significant variable Jump height (Height) in soccer players according to the position on the team, while there is no statistical significance in other variables.

Dependent Variable						nfidence	
			Mean			Interval	
-		Difference	Std.	Sig.	Lower	Upper	
	(I) Players	(J) Position	(I-J)	Error	(2-taled)	Bound	Bound
Height	goalkeepers	defenders	3.133	1.967	.122	90	7.16
		midfielders	$5.564^{*}$	1.914	.007	1.64	9.48
		forwards	2.000	2.112	.352	-2.33	6.33
	defenders	goalkeepers	-3.133	1.967	.122	-7.16	.90
		midfielders	2.431	1.257	.063	14	5.00
		forwards	-1.133	1.543	.469	-4.29	2.03
	midfielders	goalkeepers	-5.564*	1.914	.007	-9.48	-1.64
		defenders	-2.431	1.257	.063	-5.00	.14
		forwards	-3.564*	1.474	.022	-6.58	54
	forwards	goalkeepers	-2.000	2.112	.352	-6.33	2.33
		defenders	1.133	1.543	.469	-2.03	4.29
		midfielders	$3.564^{*}$	1.474	.022	.54	6.58
* The mean difference is significant at the 0.05 level.							

Table 4 Post Hoc Multiple Comparisons – LSD

From the presented table (Post Hoc Multiple Comparisons - LSD), we can conclude that there is statistically significant difference in Jump height variable between the midfielders, goalkeepers and forwards.

## DISCUSSION

In soccer practice it is normally considered that the quadriceps muscle group plays an important role in jumping and ball kicking while the hamstring controls the running activities and stabilizes the knee during turns or tackles (Fried & Lloyd, 1992). As soccer player jumps on average 15.5 times, with about nine headers a match (Bangsbo, 1994). A higher level of all strength parameters would be preferable and would reduce the risk for injuries and allow for more powerful jumps, kicks, tackles, and sprints among other factors (Wisloff et al., 1998). Authors showed that vertical jump performance of professional soccer players was relatively stable at various stages of the competitive season. (Thomas & Reilly 1979). It has been shown that it is the level of maximal strength and the rate of force development that influence both jump height and sprint performance (Hoff et al., 2001; Schmidtbleicher, 1992). The device Myotest calculates jump height from flight time (Myotest, n.d.). In the selection process, agility and the jump tests were the most discriminating for forwards. In contrast, agility and endurance were the key factors for midfielders. These differences fit with their different workload in a game (Gil et al., 2007). The present study showed that goalkeepers were taller and heavier (Davis et al., 1992) than outfield players, and displayed a greater leg extension power. The important tasks of a goalkeeper are to react and move quickly, to jump or dive to save or deflect shots, and to cover a large perimeter. In our study vertical jump heights for goalkeeper, defense and forward players were significantly higher compared with midfield players. Higher values for vertical jump height of defense and forward players compared with midfield players may be explained by the tendency for defense and forward players to be involved in more jumping and tackling compared with midfield players (Wisloff et al., 1998).

# CONCLUSION

The results of the present study support previous investigations indicating differences in vertical jump in soccer players according to the position on the team. Greater emphasis on these aspects could help the coach to effectively develop training programs and thus further improve the level of play in soccer. Finally, this study will enable future scientists and coaches to improve the explosive strength of the lower extremities in soccer players according to their position on the team.

#### REFERENCES

Astrand, P.O., & Rodahl, K. (1986.). Textbook of Work Physiology, New York, McGraw-Hill.

- Bangsbo, J. (1994). The physiology of soccer-with special reference to intense intermittent exercise. Acta Physiologica Scandinavica, 15 (suppl. 619), 1–156.
- Brown, L., Ferrigno, V., & Santana, J. C. (2004). Training For Speed, Agility, Quickness. Copyright "GOPAL", Zagreb, In Croatian.
- Bubanj, S., Bubanj, R., Stanković, R., & Đorđević, M. (2010). Praktikum iz biomehanike-The workbook in biomechanics. Faculty of Sport and Physical Education in Niš. Bilingual, in Serbian and in English.
- Bubanj, S., Stanković, R., Bubanj, R., Dimić, A., Bednarik, J., & Kolar, E. (2010). One-Leg vs Two-Legs Vertical Jumping Performance. *Facta Universitatis series Physical Education and Sport*, 8 (1), 89-95.
- Davis, J.A., Brewer, J., & Atkin, D. (1992). Pre-season physiological characteristics of English first and second division soccer players. *Journal of Sports Sciences*, 10,541–547.

Ebben, W.P. (2005). Practical guidelines for plyometric intensity. *NSCA's Performance Training Journal*, 6 (5), 12–16.

Fried, T., & Lloyd, G.J. (1992). An overview of common soccer injuries. Management and prevention. Sports Medicine, 14, 269-275.

- Gil, S., Gil, J., Ruiz, F., Irazusta, A., & Irazusta, J. (2007). Physiological and anthropometric characteristics of young soccer players according to their playing position, Relevance for the selection process, *Journal of Strength & Conditioning Research*, 21(2), 438-445.
- Hoff, J., Berdahl, G.O., & Bråten, S. (2001). Jumping height development and body weight considerations in ski jumping. In, Müller, E., Schwameder, H., Raschner, C. et al, eds. Science and skiing II. Hamburg, Verlag Dr Kovac, 403–12.
- Joksimovic, A., Stankovic, D., Ilic, D., Joksimovic, I., & Jerkan, M. (2009). Hematological Profile of Serbian Youth National Soccer Teams. *Journal of Human Kinetics*, 22, 51-60.
- McNeely, E. (2005). Introduction to plyometrics, Converting strength to power. NSCA's Performance Training Journal, 6 (5), 19–22.
- Milanović, L., Bašić, M., & Milanović, M. (2005). Razvoj brzinsko-eksplozivnih svojstava u tenisu (Development of the speed-explosive characteristics in tennis). 14. ljetna škola kineziologa, Rovinj. In Croatian

Myotest. (n.d.). Retrieved 20.12.2012. on World Wide Web, http://www.myotest.eu/Vertical/faq.aspx

Newton, R.U., & Kraemer, W.J.(1994). Developing explosive muscular power; implications for a mixed methods training strategy. *Strength & Conditioning*, 16 (5), 20 – 31.

Reilly, T., Clarus, J., & Stibbe, A. (1993). Science and Soccer II. New York, E&FN Spon.

Sargent, D.A. (1921.). The physical test of a man. American Physical Education Review, 26,188-194.

Schmidtbleicher, D. (1992). Training for power events. In, Komi P, ed. Strength and power in sport. London, Blackwell Scientific Publications, 381–395.

Svensson, M., & Drust, B. (2005). Testing soccer players. Journal of Sports Sciences, 23, 601-618.

- Thomas, V., & Reilly, T. (1979). Fitness assessment of English league players through the competitive season. British Journal of Sports Medicine, 13, 103±109.
- Wisloff, U., & Helgerud, J., Hoff, J. (1998). Strength and endurance of elite soccer players. *Medicine & Science in Sports & Exercise*, 30, 462±467.

# RAZLIKE U VERTIKALNOM SKOKU KOD FUDBALERA U ODNOSU NA POZICIJU U TIMU

Vertikalni skok se koristi u cilju procene ekplozivne snage donjih ekstremiteta. U literaturi se uglavnom preporučuje sunožni vertikalni skok u cilju identifikacije talenata, procene spremnosti sportiste da se uključi u određeni trenažni proces. Cilj aktuelnog istraživanja bio je da se uporede varijable ispoljene eksplozivne snage donjih ekstremiteta kod fudbalera u odnosu na poziciju u timu primenom vertikalnog skoka, tzv. Countermovement Jump (CMJ). Uzorak ispitanika se sastojao od 32 zdrava studenta Fakulteta sporta i fizičkog vaspitanja iz Niša, koji upražnjavaju (bave fudbalom) fudbal, muškog pola, starosti 20,18  $\pm$  1,28 godina, telesne visine 181,28  $\pm$  5,61 cm, telesne težine 74,19  $\pm$  6,58 kg i prosečne godine bavljenja fudbalom 9,38  $\pm$  2,76 godina. Ispitanici su izveli pet CMJ odskokom sa obe noge. Upotrebom bežičnog akcelerometra «Myotest» (Sion, Švajcarska), utvrđene su vrednosti sledećih varijabli CMJ: Height (visine izražene u cm), Power (snage izražene u W/kg), Force (sile izražene u N/kg) i Velocity (brzine izražene u cm/s). Rezultati ovog istraživanja pokazali su da postoje statističke značajne razlike u varijabli visina skoka kod fudbalera u odnosu na poziciju u timu, dok kod ostalih varijabli ne postoje statističke značajne razlike. Dobijeni podaci mogu biti od pomoći budućim ispitanicima u poboljšanju njihove eksplozivne snage mišića. Rezultati aktuelnog istraživanja mogu biti korisni pri eđukaciji trenera da primenjuju vertikalne skokove u proceni neophodne eksplozivne snage donjih ekstremiteta kod fudbalera.

Ključne reči: eksplozivna snaga, vertikalni skok, fudbaleri, razlika.