

**Original empirical article**

**DEEP SPINAL MUSCLES ISOMETRIC POTENTIAL IN STUDENTS  
OF THE FACULTY OF SPORT AND PHYSICAL EDUCATION**

UDC 796.012+613.71/.72

**Saša Milenković<sup>1</sup>, Zoran Bogdanović<sup>2</sup>, Mladen Živković<sup>1</sup>**

<sup>1</sup>Faculty of Sport and Physical Education, University of Niš, Niš, Serbia

<sup>2</sup>Department for Biomedical sciences, State University of Novi Pazar, Novi Pazar, Serbia

**Abstract.** *The aim of this study was to analyze the possible differences in deep spinal muscles isometric potential among the students of Sport and Physical Education of the University of Niš, which are actively engaged in different sports. The sample included 30 participants (19 years  $\pm$  6 months), divided into two distinctive sub-samples in relation to the sport they are engaged in, ie., seventeen participants involved in football and thirteen participants involved in basketball. Isometric muscle potential assessment was conducted using six standardized motor movement tasks. In addition to the descriptive statistics used to determine the statistically significant differences, the t-test for independent samples was used. The t-test values indicate that no statistically significant difference exists between the variables of football and basketball players. Adequate attention should be paid to isometric work on the improvement of the potential of deep spinal muscles in athletes, fitness enthusiasts, as well as the student and school population through daily activities.*

**Key words:** *isometric potential, spinal column, students, football, basketball.*

INTRODUCTION

During the process of growth and development, the spinal column is one of the points of the locomotor system that is sensitive to the effects of external factors, and there are frequent cases of power reduction of abdominal and back muscles. Data on anthropometric characteristics and the endurance of the muscles of the lower back and abdomen are the subject of many studies that dealt with the influence of certain factors (Balague, Skovron, Nordin et al, 1995; Salminen, Okansen, and Maki, 1993), external factors (Viry, Creveuil and Marcelli, 1999; Watson et al. 2002; Balague, Dutoit, and Waldburger, 1999), as well as

---

Received November 26, 2011 / Accepted March 15, 2012

**Corresponding author:** Saša Milenković

Faculty of Sport and Physical Education, University of Niš, Čarnojevica 10A, 18000 Niš, Serbia

Tel: + 381 18 510900 • Fax: + 381 18 242482 • E-mail: stekatten@yahoo.com

the status of the spinal cord (Bajić, 1986; Dejanović and Živković, 2008). The study was carried out on a sample of 406 participants aged 7 to 10 (Dejanović and Živković, 2008) in order to determine the relationship between anthropometric characteristics and body isometric endurance of the lumbar and abdominal muscles. The general consensus is that a statistically significant correlation has been noticed between anthropometric characteristics and isometric endurance of the lumbar and abdominal muscles in the studied population. In our country the problems concerning the research of isometric endurance flexors, latero-flexor and extensor forces are systematically engaged (Dejanović, 2006). Age, height and body size of athletes of national and international levels are important for several aspects. There is much scientific and empirical evidence supporting the claim that there are differences between the body size of athletes in various sports and games and the events within the same sport. Height, weight and other anthropometric characteristics are essential for success in certain sports. In some sports, less height and weight are necessary to achieve maximum results, while in others higher height and weight are necessary for excellent results. For success in basketball, height is of great importance. Volleyball players need to be high with well developed muscles, for they must show the required physical properties of the rally (Parizkova, 1991; Maffulli, 1992). Football players have been determined to belong to a group in which morphological characteristics show considerable variability, so the logical conclusion is that the previously mentioned characteristics are not of great importance for success. In the area of mobility, it was determined that football players are characterized by high frequency and speed of movement as well as by a high level of coordination. According to Mannion et al. (1999) the relationship between the back extensor muscle strength and body height was studied on a sample of 456 respondents, age 18-42. The significant linear relationship between back muscle strength and the body height of the respondents was determined. According to Živković and Dejanović (2008) isometric endurance of the lumbar and abdominal muscles results show a few statistically significant multiple correlations between anthropometric characteristics and durability of the lumbar extensors. The multiple correlations of anthropometric characteristics and abdominal muscle endurance were not statistically significant.

The aim of this research was to determine the possible differences between deep spinal muscles isometric potential among the students of the Faculty of Sport and Physical Education, University of Niš, who are engaged in different sports activities. Special attention has been given to the participants who prefer the two most common sports among the students of the aforementioned faculty.

#### THE METHOD

This was an empirical study of a transversal type of the 2010/2011 school year, involving students of the Faculty of Sport and Physical Education, University of Niš, Serbia. Isometric potential assessment was carried out during the regular practical hours in the presence of subject-trained teachers and students with experience in these and similar estimates.

The sample included 30 participants (19 years  $\pm$  6 months), divided into two distinctive sub-samples based on the sport they are engaged in i.e., seventeen participants who play football and thirteen participants who play basketball.

Isometric muscle potential assessment was conducted using six standardized motor movement tasks, covering the following areas: flexors of the torso (FLEKSORI), exten-

sors of the torso (EXTENZO), static contraction of the flexors of the torso (STAKOPRE), static contraction of the extensors of the torso (STAKOOPR), static contraction of the left flexor of the torso (STKOLEPR), and static contraction of the right flexor of the torso (STKODEPR). The tests for assessing isometric strength of the flexor, lateral flexor and extensor forces of the participants were carried out in the prone position on the side, with the participant lying on their forearm (the lateral flexors), lying down on the stomach with the body outside the area of support (the extension of torso) and seated position and the angle between the torso and thigh of 90 degrees, and the angle between the leg and thigh of 90 degrees (McGill, 2007).

In order to precisely show the results of this study, basic descriptive statistics were used; in order to compare mean values of the measured items in two different groups of athletes (basketball and football players) the t-test was used.

## RESULTS

**Table 1.** The frequency of the sports that participants were engaged in.

	Frequency	Percent	Valid Percent	Cumulative Percent
Football	17	35.42	35.42	35.42
Basketball	13	27.08	27.08	62.50
Volleyball	6	12.50	12.50	75
Recreation	8	16.67	16.67	91.67
Handball	4	8.33	8.33	100
Total	48	100	100	

Among the 48 participants, the majority were engaged in the two of them - football (35.42%) and basketball (27.08%); only a small percentage (16.67%) of the respondents was engaged in recreational activities, and the percentage of those involved in volleyball and handball was even smaller (12.5%, 8.33%). For further work and interpretation the football and basketball results were used.

**Table 2.** The central and dispersion parameters of the studied variables of the state of football and basketball players.

Variable	Sport	M	Sd	Min	Max	Skew	Kurt
EKSTENZO	Football	52.47	17.15	10.00	84.00	-0.55	1.22
	Basketball	57.96	16.00	35.00	95.00	0.97	1.08
FLEKSORI	Football	57.53	15.96	37.00	100.00	1.06	1.69
	Basketball	54.69	12.13	40.00	80.00	0.82	0.17
STAKOOPR	Football	113.41	46.40	51.00	208.00	0.52	-0.39
	Basketball	114.85	57.05	41.00	224.00	0.97	-0.19
STAKOPRE	Football	73.18	28.04	31.00	122.00	0.36	-0.84
	Basketball	68.23	23.07	29.00	120.00	0.28	1.63
STKODEPR	Football	90.29	33.69	40.00	174.00	0.85	1.08
	Basketball	111.08	68.71	36.00	295.00	1.72	3.63
STKOLEPR	Football	91.12	32.79	54.00	150.00	0.61	-0.98
	Basketball	92.54	45.89	32.00	215.00	1.60	3.69

According to the mean, minimum and maximum results in all six tests for the assessment of isometric potential, we can state the following:

The isometric torso flexor potential (FLEKSORI) for students involved in football is higher than for the students involved in basketball, which indicates a mean value ( $57.53 > 54.69$ ), while the maximum value obtained is also higher for football players ( $100 > 80$ ). The isometric torso extensor potential (extension), shows opposite results, where the mean value of the players is less than the value of the basketball players ( $52.47 < 57.69$ ). Also, the minimum and maximum values are lower for football players ( $10 < 35$ ,  $84 < 95$ ) than in participants who are dealing with basketball. As for the static contraction of knee extensors (STAKOOPR), the mean value is almost uniform ( $113.41 = 114.85$ ) which was confirmed by the values of maximum and minimum results of both groups ( $51 < 41$ ,  $208 < 224$ ).

Isometric contraction of the flexor potential of static forces (STAKOPRE) shows slightly better results for participants who are involved in soccer, compared to the basketball players ( $73.18 > 68.23$ ), while the minimum and maximum results are very uniform ( $31 < 29$ ;  $122 > 120$ ). The mean value of the static contraction of the right flexor of the torso (STKODEPR), showed better results when compared to the one of basketball players ( $111.08 > 90.29$ ), which indicates the maximum value determined for basketball ( $295 > 174$ ), while the minimum found that respondents dealing with football show slightly higher minimum scores ( $40 > 36$ ).

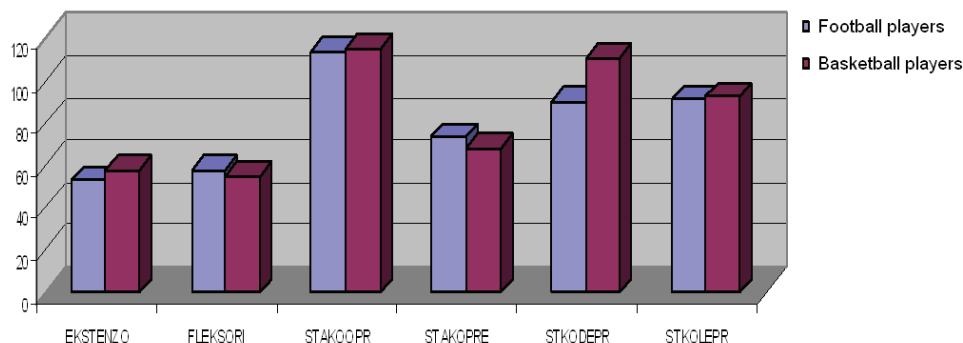
In the analysis of standard deviations, we noticed three variables higher in football players, and three in basketball. The highest values of standard deviations were determined for basketball and in the static contraction of the right flexor (STKODEPR) with a value of 68.71 and the lowest value was determined for football players during flexion (FLEKSORI) with a value of 15.96. Players in the static contraction of the right flexor of the torso (STKODEPR) have the largest range of values. The lowest range of minimum and maximum values is also the one of basketball players in the flexion forces (FLEKSORI).

Skewness values indicate that empirical results are normally distributed - they were all in the range from -1 to +1, except for players with flexion of the torso (1.06) and basketball players in the static contraction of the right flexor of the torso (1.72). In football players, the extension of torso skewness has a negative value (-0.55), indicating a greater number of good results. Kurtosis is less than three for all the variables, except for players in the static contraction of the left and right flexor, and this indicates that the results of these variables are homogeneous and that the curve is leptokurtic.

**Table 3.** The t-test significance of differences between football and basketball players compared to the studied variables.

Variable	t	df	p
EKSTENZO	0.85	28	0.40
FLEKSORI	-0.53	28	0.60
STAKOOPR	0.08	28	0.94
STAKOPRE	-0.52	28	0.61
STKODEPR	1.09	28	0.28
STKOLEPR	0.10	28	0.92

The t-test values indicate that there is no statistically significant difference between the average results of the six studied variables of the football and basketball players.



**Fig. 1.** The numerical values determined for football and basketball players in terms of the six studied variables.

Based on Figure 1 a very approximate value in five of the six studied variables can be noticed. More evident difference can be found in the static contraction of the right flexor of the torso (STKODEPR), in favor of the basketball players. This may be explained by the nature of the game of basketball, which requires a number of side curls during passing and dribbling.

### CONCLUSION

Football is a favorite activity of people of all ages on all continents. Students of the Faculty of Sport and Physical Education of University in Niš, also, in their free time are involved in football. Descriptive indicators suggest that higher values of the extensors of the body were determined for basketball players, higher torso flexors for football players, higher values for the static contraction of the extensors of the body for basketball players, higher values for the static contraction of the flexors of the body for football players, and higher values achieved by the players in the static contraction of the left flexor forces and static contraction of the right torso flexor. There are differences in the results achieved in all the variables, but they are not at the level of statistical significance. Uniform values of deep spinal muscles isometric potential point to the conclusion that this task of the training process is very seriously accomplished by football and basketball experts.

### REFERENCES

- Balague, F., Skovron, M.L., Nordin, M., Dutoit, G., Pol, L.R., Waldburger, M. (1995). Low back pain in schoolchildren: a study of familiar and psychological factors. *Spine*, (20), 1265-1270.
- Balague, F., Dutoit, G., & Waldburger, M. (1999). Low back pain in schoolchildren: an epidemiological study. *Scandinavian Journal of Rehabilitation Medicine*, (20), 175-179.
- Bajić, Lj. (1986). *Statički poremećaji kao uzrok bola u lumbarnom delu leđa (Static disorders as a cause of lumbar pain)*. Unpublished doctoral dissertation, Belgrade: Faculty of Medicine. In Serbian
- Dejanović, A. (2006). *Релације антропометријских карактеристика и изометријског мишићног потенцијала лумбалне и абдоминалне регије код деце (Relations between anthropometric characteristics and isometric muscle potential in the lumbar and abdominal region in children)*. Unpublished doctoral dissertation, Niš: Faculty of Sport and Physical Education. In Serbian

- Dejanović, A., & Živković, D. (2008) Relations between anthropometric characteristics and body isometric endurance of the lumbar and abdominal muscles of children. *Facta Universitatis, Series: Physical Education and Sport*, 6 (2), 85-93.
- Mannion, A.F., Adams, M.A., Cooper, R.G., & Dolan, P. (1999). Prediction of maximal back muscle strength from indices of body mass and fat-free body mass. *Rheumatology*, 38 (7), 652-655.
- Maffulli, N. (1992). Growing children in sport. *British Medical Bulletin*, 48 (3), 561-568.
- Parizkova, J. (1991). Human growth, physical fitness and nutrition in different ecological conditions. Shephard, R. J Parizkova, J.( Eds), *Human Growth, Physical Fitness and Nutrition*. Medicine and Sport Science, Basel, Karger, 31:7, 8, 9 (E).
- McGill, S.M. (2007). *Lumbar spine stability: Mechanism of injury and restabilization*. In Liebensohn, C. (Eds): *Rehabilitation of the spine-A practitioner's Manual*. Second Edition. Lippincott Williams & Wilkins.
- Salminen, J.J., Okansen, A., Maki, P. et al. (1993). Leisure time physical activity in the young. Correlation with low back pain, spinal mobility and trunk muscle strength in 15 year old schoolchildren. *International Journal of Sports Medicine*, (14), 406-410.
- Viry, P., Creveuil, C., & Marcelli, C. (1999). Nonspecific back pain in children: a search for associated factors in 14 year old schoolchildren. *Revue du Rhumatisme* (English ed.), (66), 381-388.
- Watson, K.D., Papageorgiou, A.C, Jones, G.T., Taylor, S., Symmons, D.P.M., Silman, A.J., & Macfarlane, G.J. (2002). Low back pain in schoolchildren: occurrence and characteristics. *Pain*, (97), 87-92.
- Živković, D., & Dejanović, A. (2008) Prediction of the isometric endurance of the lumbar and abdominal muscle boys. *Facta Universitatis series Physical Education and Sport*, 6 (2), 95-104.

## IZOMETRIJSKI POTENCIJAL DUBOKIH MIŠIĆA KIČMENOG STUBA KOD STUDENATA FAKULTETA SPORTA I FIZIČKOG VASPITANJA

Saša Milenković, Zoran Bogdanović, Mladen Živković

*Cilj aktuelnog istraživanja bio je da se analiziraju moguće razlike u izometrijskom potencijalu dubokih mišića leđa kod studenata Fakulteta sporta i fizičkog vaspitanja, koji aktivno upražnjavaju sportske aktivnosti. Uzorak je sačinjavalo 30 ispitanika (19 years  $\pm$  6 meseci), podeljenih u dva sub-uzorka u odnosu na sport kojim se bave tj., 17 fudbalera i 13 košarkaša. Procena izometrijskog mišićnog potencijala sprovedena je koristeći šest standardizovanih motoričkih zadataka. U obradi rezultata, pored deskriptivne statistike, korišćen je t-test za nezavisne uzorke. Rezultati t-testa ukazuju da ne postoje statistički značajne razlike ni u jednoj od istraživanih varijabli kod fudbalera i košarkaša. Vežbe na poboljšanju izometrijskog potencijala dubokih mišića leđa sportisti, rekreativci, kao i studenti i daci treba da sprovode svakodnevno.*

Ključne reči: izometrijski potencijal, kičmeni stub, studenti, fudbal, košarka.