

## **DIFFERENCES IN SOME MORPHOLOGICAL CHARACTERISTICS AND THIGH MUSCLE FORCE OF BOUNCE LEG BETWEEN FOOTBALL PLAYERS AND GOALKEEPERS**

Živko Kalentić, Dragana Golik-Perić, Dragan Doder, Nenad Sudarov\* and Vojin Jovančević  
Regional Institute of Sport and Sport Medicine - Novi Sad

### **Abstract**

The aim of this study is to determine the differences in certain morphological characteristics and thigh muscle force of bounce leg between football players and goalkeepers. The examined group consisted of 15 goalkeepers and 14 players, aged 15 – 18 years, from Vojvodina cadet league. Five parameters were tested by means of isokinetic dynamometer, and 6 morphological factors were measured. The differences between sub samples were gained by multivariable and univariable analysis of variance. Multivariable analysis was used to determine significant difference at the level ( $p = .00$ ), and we determined statistically significant difference on individual basis in body height and in muscle mass percentage. Almost equal results in thigh muscle force of bounce leg among the subjects and no difference in other variables can be explained by identical training process for players and goalkeepers. The data gathered demonstrate that in the future it will be necessary to implement different training process, specially designed for goalkeepers.

**Keywords:** isokinetics, morphology, football players, muscle strength

### **Introduction**

Football is a collective sport where good score cannot be achieved without unconditional cooperation among team players. Although it is a collective sport, in which touching the ball with a hand is not allowed, there is a player in a team who is not only allowed to touch the ball with the hand but who also finds it necessary to do so since it represents the basic, most commonly used method of his/her play. These players are called goalkeepers and they represent individuals in the most popular collective sport in the world – football.

---

\* Corresponding author. Regional Institute of Sport and Sport Medicine - Novi Sad, 25 Masarikova Street, 21000 Novi Sad, e-mail: [sudartri@yahoo.com](mailto:sudartri@yahoo.com)

The purpose of the science in the field of monitoring and application of contemporary technological advancements is to find and establish the principles of transformational processes of morphological characteristics which are important for football, whereas training technology should find out optimal training content for the transformation of the above mentioned characteristics. In order to implement technological and scientific advancements in an adequate manner and to minimise any possible errors, it was interesting to find out whether there were differences among players and goalkeepers and if they ought to be treated in the same way. The aim of this research is to try to demonstrate that the differences concerning thigh muscle force and some morphological characteristics exist among different players.

The word isokinetics originates from Greek words *iso* – constant and *kinesis* – movement, so we can translate it as the movement at the constant speed. Isokinetic exercises are performed at constant speed, with the resistance being adjusted and changed during the movements (according to Lohman, 2008). The musculature is under the maximum load during the whole movement range. Muscle effort is of an extremely high intensity and it is distributed on the whole area of the movement, with little load on the examined and trained ankle itself. The resistance which is produced by the device is proportional to the used force, so the possibility of injuring or overloading the ankle is minimised.

Numerous authors from the sport's world were researching morphological and motoric space of the football players (Radosav, 1990; Smajić, 2005; Stølen, Chamari, & Castagna, 2005; Svensson & Drust, 2005; Vujović & Veljović, 2010; Williams, 2000; Molnar, Popović & Smajić, 2007.), while some other authors were exploring isokinetic space (Doder, Golik-Perić, & Babiak, 2006; Doder, Savić, & Golik-Perić, 2008, Madić et al. 2008, Golik-Perić et al. 2011), and research concerning isokinetic space of the football players was conducted by the following authors (Kalentić, Jovančević, & Milojković, 2009; Golik-Perić et al., 2011; Vujkov, Golik-Perić, Drid, Vujkov, & Drapšin, 2008, Gutović, Sudarov, Fratrić, & Golik-Perić, 2011). They came to the conclusion that there was statistically significant difference in the force of a movement of flexion in favour of the attackers comparing to the players in other positions of the team.

Matković et al. (2003) concluded that only goalkeepers differ from the rest of the players regarding variable body height and body weight, whereas the rest of the players did not show statistically significant difference regarding any of the examined variables.

Swedish experts in isokinetics field of expertise (Oberg, Ekstrand, Moller & Gillquist, 1984) tested 180 football players of an elite competition range which were divided into 4 groups (goalkeepers, defence players, midfielder and attackers) in relation to their muscle force and flexibility of lower extremity of weaker leg. They came to the conclusion that the goalkeepers and defence players had statistically significant higher values of peak torque extension than the attackers, while the attackers had statistically important higher values of rational execution of movements flexion/extension than the goalkeepers and defence players. Goalkeepers also had the best results at the flexibility test.

The aim of this research is to determine whether there are differences in certain morphological characteristics and thigh muscle force of bounce leg between football players divided into sub sample groups according to their positions in the team.

## Method

### *Participants*

Sample group consisted of 29 football players from Vojvodina cadets league who were divided into two sub sample groups according to their positions in the team (15 goalkeepers and 14 players) aged 15 – 18 years.

### *Instruments and procedures*

Testing was conducted by means of Easytech "Prima DOC" isokinetic dynamometer, with peak torque moment of 60°/sec. The system of 5 tests was used in this research: maximum strength of extensors (EXTP) and flexors (FLEXP), maximum strength of extensors (EXTP) and flexors (FLEXP) in relation to the body mass and relationship between agonists and antagonists (AGANT) of the bounce leg.

Six morphological factors were measured: body height (TV), body weight (TM), bounce leg thigh circumference (ONAT), subcutaneous adipose tissue of thigh of the bounce leg (NABN), muscle mass percentage (MASP) and adipose tissue mass percentage (MTKP) of the players examined.

Testing protocol: on the day of the testing the players did not have practice and the measuring was performed strictly according to the standard protocol. All sportsmen were familiar with the standard testing on the device for isokinetic measuring. All sportsmen had done warm up exercises on the dynamometer before they were tested and in the standard test they were conditioned into the optimal state for testing.

Apart from descriptive statistics, the significance of the difference among the tested groups of players of the whole sample group was established by means of multivariable analysis of variance (MANOVA), while the significance of differences in individual arithmetic means of the variables was calculated by means of univariable analysis of variance (ANOVA) at the level of significance of  $p \leq .05$ .

## Results

Most of the applied morphological and isokinetic variables do not deviate significantly from the normal distribution (table 1). This shows that the tests chosen were discriminatory enough, except regarding the variable MKTP (2,45) where the results show tendency towards the lower values from the normal distribution. (Modus – Mo is in small values zone), and MASP (-2,25) where the results show the tendency towards higher values (Modus – Mo is in higher values zone) from the arithmetic mean. The degree of the curve at the peak of the curve line, which represents distribution of the results, is mesokurtic and platykurtic, except for the variables NABN (2,67), MASP (9,12) and MKTP (7,39) where the peak is leptokurtic.

Table 1

*Central and dispersional parameters of morphological and isokinetic variables*

<b>Variables</b>	<b>N</b>	<b>Min</b>	<b>Max</b>	<b>M</b>	<b>SD</b>	<b>Skewnes</b>	<b>Kurtosis</b>
<b>TV</b>	29	168.60	194.60	181.40	6.32	.08	-.48
<b>TM</b>	29	51.90	85.70	73.31	8.76	-.66	-.09
<b>ONAT</b>	29	4.00	61.70	54.59	4.20	-.74	.12
<b>NABN</b>	29	4.00	17.50	9.67	2.64	.73	<b>2.67</b>
<b>MASP</b>	29	23.80	58.10	47.79	5.95	<b>-2.25</b>	<b>9.12</b>
<b>MKTP</b>	29	5.20	29.30	10.53	4.86	<b>2.45</b>	<b>7.39</b>
<b>EXTP</b>	29	119	379	261.00	57.43	-.44	.75
<b>FLEXP</b>	29	60	198	110.93	36.81	.68	.27
<b>EXTPR</b>	29	228	468	354.59	65.03	-.12	-.65
<b>FLEXPR</b>	29	92	254	150.03	42.95	.76	.09
<b>AGANT</b>	29	24	63	42.17	9.63	.09	.04

*N* – number of players; *Min* – minimal result value; *Max* – maximal result value; *M* – arithmetic mean; *SD* – standard deviation ; *TV* – body height, *TM* – body weight, *ONAT* – thigh circumference, *NABN* – thigh skinfold, *MASP* – adipose tissue percentage , *MKTP* – muscle mass percentage. Maximum torque peak of extensors (*EXTP*) and flexors (*FLEXP*), maximum torque peak of extensors (*EXTPR*) and flexors (*FLEXPR*) in relation to the body weight and relationship between agonists and antagonists (*AGANT*), bounce leg

Table 2 shows that the multivariable statistic significance between arithmetic means of the goalkeepers (*AX1*) and players (*AX2*) is at the level of .00 ( $p = .00$ ), while the statistic significance gained by the use of univariable means was obtained only for the variable of body height (*TV*) at the level of .02 ( $p = .02$ ); the muscle mass percentage (*MASP*) at the level of .02 ( $p = .02$ ); the difference in the force of the thigh musculature of agonists and antagonists (*AGAN*) was  $p = .06$ , so this significance is at the very border of the statistic significance in favour of goalkeepers.

Table 2

*Statistic parameters of univariable and multivariable analysis of variance (ANOVA/MANOVA)*

<b>Variables</b>	<b>MI</b>	<b>M2</b>	<b>SD1</b>	<b>SD2</b>	<b>F</b>	<b>p</b>
<b>TV</b>	184.06	178.55	6.35	5.09	6.59	<b>.02</b>
<b>TM</b>	75.66	70.80	8.83	8.28	2.33	.14
<b>ONAT</b>	55.30	53.84	3.94	4.49	.87	.36
<b>NABN</b>	9.81	9.54	3.60	1.03	.07	.79
<b>MASP</b>	50.27	45.14	4.46	6.34	6.42	<b>.02</b>
<b>MKTP</b>	12.09	8.86	6.40	1.05	3.48	.07
<b>EXTP</b>	263.27	258.57	59.16	57.65	.047	.83
<b>FLEXP</b>	121.13	38.71	38.91	9.63	2.52	.12
<b>EXTPR</b>	344.60	365.29	64.60	66.17	.72	.40
<b>FLEXP</b>	158.27	141.21	44.75	40.68	1.15	.29
<b>AGANT</b>	45.40	100.00	8.749	32.24	3.84	.06

$$\lambda = .44 \quad F = 10.91 \quad p = .00^*$$

*MI* – arithmetic mean of the 1<sup>st</sup> group (goalkeepers); *M2* – arithmetic mean of the 2<sup>nd</sup> group (players); *SD1* – standard deviation of the 1<sup>st</sup> group (goalkeepers), *SD2* – standard deviations of the 2<sup>nd</sup> group (players);  $\lambda$  -Wilk's lambda; *F* -test; *p* - statistic significance

Statistically significant difference was determined by multivariable analysis of variance (MANOVA) of the whole sample group between sub samples at the level of  $p < .00$ .

## Discussion

The research of certain morphological characteristics and the force of the thigh musculature of the bounce leg of the football players who were divided into two groups according to the position they play in the team (goalkeepers and players) and who were tested on the isokinetic dynamometer PrimaDOC (EASYTECH – Italy) in Regional Institute of Sport and Sport Medicine in Novi Sad, showed the results which do not coincide with the previous research in this field of interest.

Descriptive analysis determined mostly normal distribution of the results, with the increased values of skewness (distribution is positively asymmetric) for the variable MKTP (2,45), indicating a tendency for lower values from the normal distribution, and MASP (-2,25) where the distribution is negatively asymmetric, i.e. the results show tendency for higher value from the normal distribution.

The results of the univariable analysis of variance (ANOVA) show that there is a statistically significant difference among the players divided according to their positions in the team regarding their body height (TV)  $p = .02$  and muscle mass (MASP)  $p = .02$  in favour of goalkeepers. This could be anticipated, since the goalkeepers have special tasks during the match where the body height is an advantage. It is well known fact that goalkeepers often have short moving tasks which end in explosive jumps, contrary to the players who spend most of the training and match in constant running. That is probably the reason why the players have lower values of percentage of adipose tissue comparing to the goalkeepers.

Statistically significant difference between the sub samples was obtained only in comparison of agonists and antagonists (AGANT)  $p = .06$  by analysing the force of the thigh musculature. That significance is at the very border in favour of goalkeepers, whereas in other examined variables there is no difference among the players concerning their bounce legs.

This research did not confirm the research in the field of isokinetics done by the Swedish scientists, who came to the conclusion that the goalkeepers and defence players had statistically significant higher values of peak torque extension comparing to the attackers, while the attackers had statistically significant higher values of the rational execution of movements flexion/extension (HQ RATIO) comparing to goalkeepers and defence players.

A possible cause of this non-confirmation of results of Swedish authors may be lying in fact that this research used the results of the tests performed on the players who compete in cadets league, who are still developing. For this reason they were not subjected to the same training process as the elite football players who were used in the research done by the above mentioned authors.

The results of the univariable analysis of variance show us that there is a statistically significant difference regarding body height and muscle mass percentage among players divided according to the positions in the team, and the relationship between agonists and antagonists was at the border of the statistic significance in favour of goalkeepers. In other examined variables there is no difference concerning bounce legs of the players. One has to bear in mind the fact that the examined group consisted of players of cadet league, and that, in most football clubs, this is the period when the goalkeepers are directed to individual work with specially trained coaches. For this reason, more significant differences are expected in older category and in senior teams. On the other hand, early selection influenced taller children to become goalkeepers. Their height is the advantage, bearing in mind specific requirements and movements which are necessary for this position in team.

## Reference

- Golik-Perić, D., Vujanović, S., Đukić, B., Jovančević, V., Bašić, G., & Sudarov, N. (2011). Razlike antropometrijskih karakteristika i maksimalne sile odrazne/stajne noge između vrhunskih rukometaša i fudbalera. U *Izvodi saopštenja sa 50. Kongresa Antropološkog društva Srbije sa međunarodnim učešćem* (p. 12). Beograd: Antropološko društvo Srbije.

- Gutović, D., Sudarov, N., Fratrić, F., & Golik-Perić D., (2011). Maximum and relative isometric muscle force in junior football, basketball, volleyball players and cadets. In *6th International Conference on Kinesiology* (pp. 457-460). Zagreb: Faculty of Kinesiology.
- Doder, D., Golik-Perić, D., & Babiak, J. (2008). Isokinetic muscle training of young athletes. In *5<sup>th</sup> International scientific conference on kinesiology* (pp. 445-448). Zagreb: Faculty of Kinesiology.
- Doder, D., Golik-Perić, D., & Vojinović, J. (2008). The ratio of agonists and antagonists of upper knee muscles at first-rate wrestlers. In *Review of papers of 17<sup>th</sup> International interdisciplinary symposium "Sport, physical activities and health of youth"* (236-241). Novi Sad: University of Novi Sad; Novosadski maraton.
- Doder, D., Savić, B., & Golik-Perić, D. (2006). Izokinetika. *Aktuelno u praksi*, 17(4), 77-84
- Kalentić, Ž., Jovančević, V., & Milojković, I. (2009). Differences in muscle strength and flexibility of football players at different positions in team. U *Zbornik radova Internacionalni simpozijum "Sport, turizam, zdravlje"* (str. 95-99). Bihać: Pedagoški fakultet, Univerzitet u Bihaću.
- Lohman V. (2008). Primjena izokinetičke dijagnostike i vježbi kod pacijenata s osteoartritisom koljena. U *IV Hrvatski kongres fizikalne i rehabilitacijske medicine: Zbornik radova* (str. 22-28). Zagreb: Hrvatsko društvo za fizikalnu i rehabilitacijsku medicinu; Hrvatski liječnički zbor.
- Madić, D., Doder, D., & Golik-Perić, D. (2008). Relations of jumping successfulness and strength of upper leg muscles evaluated by isokinetic method applied on top gymnasts. *Sport Mont*, 6(15-17), 172-176.
- Matković, B., Mišigoj-Duraković, M., Matković, B., Janković, S., Ružić, L., Leko, G. et al. (2003). Razlike u morfološkim karakteristikama nogometaša koji igraju na različitim položajima. *Collegium Antropologicum*, 27 suppl, 167-174.
- Molnar, S., Popović, B., & Smajić, M. (2007). Relacije između bazično motoričkih i pojedinačnih varijabli specifično motoričkih sposobnosti dečaka u fudbalskoj školi. U *Zbornik naučnih i stručnih radova, III Međunarodni simpozijum "Nove tehnologije i sport"* (str. 150– 156). Sarajevo: Univerzitet u Sarajevu, Olimpijski komitet BiH.
- Oberg, B., Ekstrand, J., Moller, M., & Gillquist, J. (1984). Muscle strength and flexibility in different positions of soccer players. *International Journal of Sports Medicine*, 5, 213-216.
- Radosav, R. (1990). *Odabiranje dečaka za fudbal na osnovu longitudinalnog praćenja i usmeravanja razvoja bazičnih i specifičnih karakteristika i sposobnosti*. Neobjavljena doktorska disertacija. Univerzitet u Novom Sadu, Fakultet fizičke kulture.
- Smajić, M. (2005). *Relacije morfoloških karakteristika i bazičnih motoričkih sposobnosti sa specifičnom preciznošću fudbalera uzrasta 10 – 12 godina*. Neobjavljena doktorska disertacija. Univerzitet u Novom Sadu, Fakultet fizičke kulture.
- Stølen, T., Chamari, K., & Castagna, C. (2005). Physiology of soccer: an update. *Sports Medicine*, 35, 501- 505.
- Svensson, M., & Drust, B. (2005). Testing soccer players. *Journal of Sports Sciences*, 23, 601–618.
- Vujkov, S., Golik-Perić, D., Drid, P., Vujkov, N., & Drapšin, M. (2008). Specifičnosti mišićne snage natkolene muskulature kod fudbalera, atletičara, džudista i rvača. U I.

- Jukić, D. Milanović, & C. Gregov (ur.). *Zbornik radova sa 6.godišnje međunarodne konferencije: "Kondicijska priprema sportaša"* (str. 172-176). Zagreb: Kineziološki fakultet Sveučilišta u Zagrebu; Udruga kondicijskih trenera Hrvatske.
- Vujović, P., & Veljović, D. (2010). Odnos između nivoa funkcionalnih sposobnosti i aktivnosti vrhunskih fudbalera tokom utakmice. *TIMS Acta*, 4, 16-20.
- Williams, A. M., & Reilly, T. (2000). Talent identification and development in soccer. *Journal of Sports Sciences*, 18, 657-667.

*Submitted April 5, 2012*

*Accepted June 15, 2012*