INTRODUCTION

Modern training process today is unimaginable without quality athletes’ training diagnostics. In this way, a sports expert meets their athlete, i.e. their good and bad sides, and in that way they are ready to enter the training process with them.

Muscles and joints function assessment is of utmost importance in sports and recreation (exercise), not only for performance purpose, but also for the assessment and injuries rehabilitation (Baltzopoulos and Brodie, 1989). Isokinetic devices can serve as diagnostic devices for estimating different elements of strength, force, speed, average power, fatigue, acceleration and deceleration of segmental training and velocity (Baščevan, Baščevan, Janković, 2008).

Isokinetic testing is an examination of the functional muscles and joints parameters in active movement.
and in real time in relation to age, gender, body weight, daily sports activity and individual needs. Isokinetics is applied for the purpose of measurement-diagnostics, exercise-training and rehabilitation. What is relevant to the isokinetic movement is that the subject is never opposed to a resistance that cannot be overcome, because the resistance is even equal to the applied force. This means that isokinetic training is safe (Mikić, Bajrić, Selimović, Hrnjić, Ivanek, 2018). Isokinetics is a method of measuring muscle force in conditions of concentric and eccentric muscular contractions on a special isokinetic dynamometer. This method allows the definition of maximum force depending on the angle between the segments (knee), the force between agonists and antagonists ratio (lower extremities: m. Quadriceps - m. Biceps femoris).

Isokinetic diagnostics represents the best way to determine maximum muscle strength, muscular endurance, which are strong, and which weak athlete points. Taking into account specifics of football, judo and handball specifics, upper knee muscular power control is of great importance both in prevention of injuries and in creation of training process. In the study of upper knee muscular power of footballers, athletes, judoists and wrestlers, Vujkov, Golik-Perić, Drd, Vujkov, Drapšin (2008), proved statistically significant differences in variables which show maximum knee torque of extensors of both legs and the maximum knee torque of flexors of both legs in favor of the judoists and wrestlers.

By measuring the strength of individual muscle groups that trigger certain extremities, we get parameters that define this movement. One of the basic parameters is, of course, knee moment of force (torque), that is, the value of the force that the tested muscle develops around the axis of rotation during the measured motion (moment of rotation), (Iossifidou, 2000).

During the motion, a constant force moment is not developed, so that the mean force mean value (Nm) - (mean torque) represents the mean value of the rotational force generated during the measured motion for a given angular velocity. Maximum torque moment (Nm) (peak torque) represents the maximum value of the rotational force generated during the measured motion at a certain angular velocity (Jarić 2002; Lindsdrom 2006; Sykaras 2003; Veloso 2002).

Modern football game and the increasing demands for achieving top results imply the need for a better scientific and professional quality approach, both in terms of the selection of future footballers and training technology application in the work with younger age categories. Modern training technology in the work with younger selections of footballers implies the development and realnom vremenu u odnosu na uzrast, pol, telesnu težinu, svakodnevnu sportsku aktivnost i individualne potrebe. Izokinetika se primenjuje u svrhu merenja–dijagnostike, vežbanja–treninga i rehabilitacije. Ono što je bitno za izokinetički pokret jeste da subjekt nikad nije suprostavljen otporu koji ne može savladati, jer je otpor celo vreme jednak primjenjenoj sili. To znači da je izokinetički trening siguran (Mikić, Bajrić, Selimović, Hrnjić, Ivanek, 2018). Izokinetika je metoda merenja mišićne sile u uslovima koncentričnih i ekcentričnih mišićnih kontrakcija na specijalnom izokinetičkom dinamometru. Ova metoda omogućuje definisanje maksimalne sile u zavisnosti od ugla između segmenata (koleno), odnos sile između agonista i antagonista (donji ekstremiteti: m. quadriceps - m. biceps femoris).

Izokinetička dijagnostika predstavlja najbolji način da se odredi kakva je maksimalna snaga mišića, mišićna izdržljivost, koje su jake, a koje slabe tačke sportiste. Uzimajući u obzir specifičnosti fudbala, džudoa i rukometa, kontrola snage natkolene muskulature od velikog je značaja, kako u prevenciji povreda, tako i u samom kreiranju trenažnog procesa. U istraživanju natkolene muskulature futbolara, atleti, džudista i rvača Vujkov, Golik-Perić, Drd, Vujkov, Drapšin (2008) su dokazali statistički značajne razlike u varijablama maksimalni obrtni moment ekstenzora kolena obe noge i maksimalni obrtni moment fleksora obe noge u korist džudista i rvača.

Merjenjem snage pojedinih mišićnih grupa koji pokreću određene delove ekstremiteta, dobijaju se parametri koji definišu taj pokret. Jedan od osnovnih parametara je, svakako, moment sile (torque), odnosno vrednost sile koju testirani mišić razvija oko ose rotacije tokom merenog pokreta (moment rotacije), (Iossifidou, 2000).

U toku izvođenja pokreta ne razvija se konstantan moment sile, tako da parametri srednja vrednost momenta sile (Nm) - (mean torque) predstavlja prosečnu vrednost rotacione sile ostvarene u toku merenog pokreta za određenu vrednost ugaone brzine. Maksimalni moment sile (Nm) (peak torque) predstavlja maksimalnu vrednost rotacione sile ostvarene u toku merenog pokreta pri određenoj ugaonoj brzini (Jarić 2002; Lindsdrom 2006; Sykaras 2003; Veloso 2002).

Savremena fuđbalska igra i sve veći zahtevi za postizanjem vrhunskih rezultata nameću potrebu za što kvalitetnijim naučnim i stručnim pristupom, kako po pitanju same selekcije budućih fužbalera tako i po pitanju primene trenažne tehnologije u radu sa mladim uzrastnim kategorijama. Savremena trenažna tehnologija u radu sa mladim selekcijama futbolera podrazumeva izradu takvih programa trenažnog rada koji će u potpunosti biti
ment of such training programs that will be completely subordinate to the characteristics and individual abilities of each individual, thereby contributing to the optimal development of all the qualities and abilities that define the anthropological status of the individual at all stages of its development (Lolić, Bajrić, Lolić, 2011). Analyzing component structure, considerably greater opportunities for managing and guiding football training techniques as well as the selection of future young generations are opened, and with the help of such analysis it is possible to provide monitoring and directing of connections functions between each subsystem within the football game (Radosav, Molnar, Smajić, 2003; Bajrić, 2008).

From the structural judo analysis itself, it follows that various manifestations of power, and then coordination are most important capabilities that determine success in judo fighting. From various types of strengths, it is considered that the ability to maximize energy mobilization in a unit of time is of utmost importance, ability to perform the maximum number of contractions with certain resistance, and the ability to develop maximum muscular strength. Modern superb judo fighter is characterized by the pronounced body muscularity and as far as motor skills are concerned, exceptional absolute, repetitive and explosive strength, perfect coordination, enviable speed, excellent balance and superb flexibility. The main goal of each judo athlete is to gain good competitive advantages in relation to its sport opponents (Lolić, Nurkić, 2011).

Handball game structure, match duration, technical-tactical activities during the match and training, requires that the team has handball players with highly developed physical characteristics. In relation to the position in the team, motor-functional abilities of individuals are also different. The power of the upper knee muscular is of great importance to the players in all positions. All of this suggests that isokinetic diagnostics is necessary in order to determine the current strength in order to program the training process and to prevent injury.

The aim of this paper is to determine upper knee muscular strength of football and handball players, judo athletes, and the existence of similarities or differences in the maximum torque of upper knee muscular between athletes’ groups.

**Work Method**

The research involved 30 respondents aged 14-18, divided into three groups: 10 football players, 10 judoists and 10 handball players. Testing was done at the premises of the Provincial Institute for Sport and Sports Medicine in Novi Sad. For the needs of the test, the isokinetic dynamometer “Easytech Prima DOC” was used, at a torque of 60 step° / sec. podređeni uzrsnim karakteristikama i individualnim sposobnostima svakog pojedinca i time doprineni optimalnom razvoju svih osobina i sposobnosti koji definišu antropološki status individue u svim fazama njenog razvoja (Lolić, Bajrić, Lolić, 2011). Analizom komponentne strukture otvaraju se znatno veće mogućnosti za upravljanje i usmeravanje trenažne tehnologije u fudbalu kao i samoj selekciji budućih mladih naraštaja, a ujedno uz pomoć takve analize moguće je obezbediti praćenje i usmeravanje funkcija veza između svakog subsistema unutar fuudsalske igre (Radosav, Molnar, Smajić, 2003; Bajrić, 2008).

Iz same strukturalne analize džudao proizlazi da su različite manifestacije snage, a zatim i koordinacije najvažnije sposobnosti koje determinišu uspeh u džudo borbi. Od različitih vidova snage smatra se da su za borbu od najvećeg značaja sposobnost maksimalne mobilizacije energije u jedinici vremena, sposobnost izvođenja maksimalnog broja kontrakcija uz određeni otpor, te sposobnost razvijanja maksimalne mišićne sile. Modernog vrhunskog džudo borca krasa naglašena muskuluznost građe tela, a što se tiče motoričkih sposobnosti izuzetna apsolutna, repetitivna i eksplozivna snaga, perfektna koordinacija, zavodna brzina, odlična ravnoveža i nadprosećna fleksibilnost. Glavni cilj svakog džudiste je da stekne dobre takmičarske prednosti u odnosu na svoje sportske protivnike (Lolić, Nurkić, 2011).

Struktura rukometne igre, trajanje utakmice, tehničko-taktičke aktivnosti u toku treninga i meća zahteva da ekipa u svom sastavu ima rukometaše sa visoko razvijenim fizičkim karakteristikama. U odnosu na poziciju u ekipi, razlikuju se i motoričko-funkcionalne sposobnosti pojedinaca. Snaga natkolene muskulature je od izuzetnog značaja za igrače na svim pozicijama. Sve ovo nas upućuje da je izokinetička dijagnostika neophodna radi utvrđivanja trenutne snage u cilju programiranja trenažnog procesa i prevencije povreda.

Cilj rada je utvrđivanje snage natkolene muskulature fudbalera, džudista i rukometaša i postojanja sličnosti ili razlika maksimalnog obrtnog momenta natkolene muskulature između grupa sportista.

**Metod Rada**

U istraživanju je učestvovalo 30 ispitanika, uzrasta 14-18 godina, podeljenih u tri grupe: 10 fudbalera, 10 džudista i 10 rukometara. Testiranje je izvršeno u prostorijama Pokrajinskog zavoda za sport i medicinu sporta u Novom Sadu. Za potrebe testiranja korišćen je izokinetički dinamometar “Easytech Prima DOC”, pri obrtnom momentu sile 60 step/sec.
Testing Protocol: On test day, athletes didn’t have training, and only testing was done according to standard protocol in identical manner for everyone. Each athlete was introduced to the protocol individually before the test, then heated up adequately and prepared for testing. Dynamometer was calibrated before each test. For each respondant the dynamometer seat was specially adjusted. They were immobilized by seatbelts in order to maximally isolate tested musculature. Testing started with heating, then 2min break, and then starts the test itself. During the test, 4 maximum contractions were carried out, first with the front upper knee muscles, and then with rear, rotating. The same procedure was performed with one leg, and the other leg later. Body mass was measured before isokinetic testings on InBody 270 (bioelectric impedance) where athletes were in shorts and barefoot.

Photo 1. Testing on Isokinetic dynamometer “Easytech Prima DOC”

In this study, 8 tests were applied. Tests for assessment of upper knee muscular strength:
- Maximum torque of right knee extension - PTQR
- Maximum torque of left knee extension - PTQL
- Maximum torque of right knee flexion - PTHR
- Maximum torque of left knee flexion – PTHL
- Relative maximum torque of right knee extension - PTQR / W
- Relative maximum torque of left knee extension - PTQL / W
- Relative maximum torque of right knee flexion - PTHL / W
- Relative maximum torque of left knee flexion - PTHL / W
- Body mass - BM

Software package SPSS 20.0 was used for data processing. Data analysis was carried out using descriptive statistics for calculating basic descriptive parameters of the observed variables. To determine statistically significant differences in muscular strength between subjects, a univariate variance analysis (ANOVA) was used, a level of statistical significance (p <0.05).

Protokol testiranja: Na dan testiranja sportisti nisu trenirali, a samo testiranje izvedeno po standardnom protokolu na identičan način za svakog. Svaki sportista pojedinačno pre testa upoznat sa protokolom, zatim se adekvatno zagrejao i pripremio za testiranje. Dinamometar je pre svakog testiranja kalibriran. Za svakog ispitanika posebno se podešavalo sedište dinamometra. Ispitanci su bili imobilizirani trakama za sedište kako bi se maksimalno izolovala testirana muskulatura. Testiranje je počinjalo zagrevanjem, zatim 2 minuta pauze, a nakon toga se prešlo na sam test. Tokom testa izvodile su se 4 maksimalne kontrakcije, prvo prednjom, a zatim zadnjom ložom, neizmenično. Identičan postupak je izvoden prvo jednom, pa drugom nogom.

Slika 1. Testiranje na izokinetičkom dinamometru “Easytech Prima DOC”

U ovom istraživanju primenjeno je 8 testova. Uzorak varijabli za procenu snage natkolene muskulature:
- Maksimalni obrtni moment ekstenzije desnog kolena – PTQR
- Maksimalni obrtni moment ekstenzije levog kolena – PTQL
- Maksimalni obrtni moment fleksije desnog kolena – PTHR
- Maksimalni obrtni moment fleksije levog kolena – PTHL
- Relativni maksimalni obrtni moment ekstenzije desnog kolena – PTQR/W
- Relativni maksimalni obrtni moment ekstenzije levog kolena – PTQL/W
- Relativni maksimalni obrtni moment fleksije desnog kolena – PTHR/W
- Relativni maksimalni obrtni moment fleksije levog kolena – PTHL/W

Za obradu podataka korišćen je programski paket SPSS 20.0. Analiza podataka se sprovodila pomoću descriptivne statistike za izračunavanje osnovnih deskriptivnih statistika posmatanih varijabli. Radi utvrđivanja statistički značajnih razlika snage natkolene muskulature
RESULTS AND DISCUSSION

Correct development of upper knee muscles, unilateral relationship (relationship within a single muscular composition) and bilateral relationship (relationship between left and right side of the body that can be in the torso and extremities) are of utmost importance for sports structure such as football, judo, handball, both in terms of performance and in terms of injury prevention. Right time diagnosis and taking certain actions can help us with proper physical development of the athlete, and therefore in injuries prevention.

Descriptive statistics analysis (Table 1) of the observed variables based on the significance of Leven homogeneity variance test (p <0.05) indicates the homogeneity of all tested variables results in all three groups of athletes. The values of the asymmetry coefficient (Sk-Skewness) and the coefficient of curvature (Kurt-Kurtosis) indicate that the distributions of the analyzed variables do not deviate significantly from normal distribution. Average body weight of athletes involved in this study is 53-120kg ± 14.66SD. Mean values of measured variables that reflect upper knee musculature strength of the entire sample are shown in Table 1.

### Table 1. Basic descriptive statistics for maximum knee torque and athletes body mass (whole sample)

| Variable / Variables | N  | MIN | MAX | AS  | SD  | Sk  | Kurt | Levenov test F p |
|----------------------|----|-----|-----|-----|-----|-----|------|------------------|
| uzras / age          | 30 | 14.00 | 18.00 | 15.80 | 1.03 | 0.63 | -0.49 | 0.04 | 0.96 |
| TM                   | 30 | 53.00 | 120.00 | 74.47 | 14.66 | 0.89 | 1.73 | 2.26 | 0.12 |
| PTHL                 | 30 | 123.00 | 335.00 | 230.50 | 54.95 | -0.41 | -0.71 | 0.95 | 0.40 |
| PTQL                 | 30 | 80.00 | 337.00 | 230.50 | 67.55 | -0.58 | -0.38 | 0.42 | 0.66 |
| PTHR                 | 30 | 52.00 | 192.00 | 112.60 | 36.87 | 0.43 | -0.58 | 0.04 | 0.97 |
| PTQR                 | 30 | 32.00 | 182.00 | 107.40 | 36.38 | 0.12 | -0.73 | 0.32 | 0.73 |
| PTQL/W               | 30 | 2.08 | 4.10 | 3.10 | 0.48 | -0.26 | 0.38 | 0.63 | 0.54 |
| PTHL/W               | 30 | 0.98 | 4.25 | 2.84 | 0.90 | -0.71 | -0.34 | 1.81 | 0.18 |
| PTHR/W               | 30 | 0.77 | 4.16 | 1.77 | 0.74 | 1.47 | 2.54 | 1.87 | 0.17 |
| PTHL/W               | 30 | 0.60 | 3.18 | 1.49 | 0.52 | 1.13 | 2.44 | 1.23 | 0.31 |

Legend: N-number of research entities, TM- body mass, Min-minimum values, Max-peak values, AS-arithmetic mean, S-standard deviation, Sk-asymmetry factor, Kurt-curvature coefficient, maximum torque of right knee extension – PTQR, maximum torque of left knee extension – PTQL, maximum torque of right knee flexion – PTHL, maximum torque of left knee flexion – PTHR, relative maximum torque of right knee extension - PTQR/W, relative maximum torque of left knee extension - PTQL/W, relative maximum torque of right knee flexion - PTHL/W, relative maximum torque of left knee flexion - PTHR/W

### REZULTATI I DISKUSIJA

Pravilna razvijenost natkolene muskulature, unilateralni odnos (odnos unutar jednog mišićnog sastava) i bilateralni odnos (odnos između leve i desne strane tela koji može biti u trupu i ekstremitetima) od izuzetnog su značaja za samu strukturu sportova kao što su fuđbal, džudo, rukomet, kako u pogledu uspešnosti, tako i u pogledu prevencije povreda. Pravovremena dijagnostika i preduzimanje određenih radnji može nam pomoći pri pravilnom fizičkom razvoju sportiste, a samim tim i u prevenciji povreda.

Analiza deskriptivnih statistika (Tabela 1) posmatranih varijabli na osnovu vrednosti statističke značajnosti Levenovog testa homogenosti varijansi (p<0.05), ukazuje na homogenost rezultata svih testiranih varijabli kod sve tri grupe sportista. Vrednosti koeficijenta asimetričnosti (Sk-skjumis) i koeficijenta zakrivljenosti (Kurt-kurtosis) ukazuju da distribucije analiziranih varijabli ne odstupaju značajno od normalne distribucije. Prosečna telesna masa sportista obuhvaćena ovim istraživanjem iznosi 53,00-120,00kg ±14,66SD. Srednje vrednosti izmerenih varijabli koje oslikavaju snagu natkolene muskulature čitavog uzorka su prikazane u tabeli 1.
Analysis of the basic descriptive parameters for the maximum torque of knee joint extension and flexion of football players, judo and handball players is shown in Table 2. Of all tested athletes, highest average body weight is found in judoists (AS = 83.30kg), then handball players (AS = 74.90kg ), and the lowest footballers (AS = 65.20kg). From the table, we can notice that there are differences in the variables that describe the force of upper knee musculature in absolute and relative values.

Table 2. Basic descriptive statistics for the maximum knee torque and body mass of football players, judo and handball players

| Variable | sport | N | AS  | SD  | Min  | Max  |
|----------|-------|---|-----|-----|------|------|
| TM       | 1     | 10| 65.20| 6.41| 53.00| 75.00|
|          | 2     | 10| 83.30| 16.92| 56.00| 120.00|
|          | 3     | 10| 74.90| 13.37| 53.00| 92.00|
| PTQR     | 1     | 10| 198.00| 35.98| 157.00| 271.00|
|          | 2     | 10| 262.00| 52.25| 152.00| 335.00|
|          | 3     | 10| 239.80| 57.94| 123.00| 308.00|
| PTQL     | 1     | 10| 190.70| 62.11| 83.00| 293.00|
|          | 2     | 10| 267.00| 51.98| 157.00| 337.00|
|          | 3     | 10| 233.80| 69.96| 80.00| 308.00|
| PTHR     | 1     | 10| 97.20| 38.80| 67.00| 192.00|
|          | 2     | 10| 132.40| 32.67| 92.00| 182.00|
|          | 3     | 10| 108.20| 32.98| 52.00| 148.00|
| PTHL     | 1     | 10| 89.20| 34.78| 63.00| 156.00|
|          | 2     | 10| 125.10| 26.16| 84.00| 154.00|
|          | 3     | 10| 107.90| 46.07| 32.00| 182.00|

Legend: 1 - football, 2 – judo, 3 – handball

Using single-factor analysis of variance (ANOVA) of different groups, the results were compared between groups in the indicators of upper knee muscular strength of athlete, where we determined on the basis of F and the level of statistical significance (p <0.05) that there are statistically significant differences between athletes in body mass (F = 4.29, p = 0.02), maximum torque extension of the right knee (F = 429, p = 0.02), maximum torque extension of the left knee (F=3,83, p= 0.03). In other variables that describe the force of tested musculature, statistically significant differences were not observed (Table 3).

In order to determine among which athletes there are statistically significant differences at level (p <0.05), LSD Post Hoc Tests was used (Table 3). Using the Tukey HSD test, it was found that in the variable Body Mass, where the

Primenom jednofaktorske analize varijanse (ANOVA) različitih grupa, poređeni su rezultati između grupa u pokazateljima snage natkolene muskulature sportista, gde smo utvrdili na osnovu vrednosti F, te nivoa statističke značajnosti (p<0.05), da postoje statistički značajne razlike između grupa sportista u telesnoj masi (F=4,86, p=0,02), maksimalnom obrtnom momentu ekstenzije desnog kolena (F=4,29, p=0,02), maksimalnom obrtnom momentu ekstenzije levog kolena (F=3,83, p=0,03). U ostalim varijablama koje opisuju silu natkolene muskulature statistički značajne razlike nisu uočene (tabela 3).

Da bi se utvrdilo između kojih grupa sportista postoje statistički značajne razlike na nivou (p<0.05), pribeglo se korišćenju LSD Post Hoc Testa (Tabela 3). Primenom Tukeyevog HSD testa ustanovljeno je da se
mean value of the football players body mass (AS = 65.20, SD = 6.41) is statistically significantly lower (p = 0.01) than the mean value of judo athletes body mass (AS = 83.30, SD = 16.92), the observed difference in the AS weight of these athletes’ groups is 18.10kg in favor of the judoists. Additional comparisons with the HSD test indicate that the mean value of the maximum torque of the right knee extensions of footballers is statistically significantly lower (p = 0.02) in relation to the judo athletes. Similar situation is with variables of maximum torque of the left knee extension (p = 0.03), where for 76.30 AS judo athletes higher than the footballers in the observed variable. Using statistical procedures, differences were found in other variables that describe the extension and flexion in the knee joint, but differences are not significant. However, the results tell us that in all variables the best results were achieved by the judo, and that handball players are better than the footballers.

Table 3. Results single-factor ANOVA analysis and Post Hoc Test TukeyHSD

| Dependent Variable | ANOVA | (I) sport | (J) sport | Mean Difference (I-J) | p |
|--------------------|-------|-----------|-----------|-----------------------|---|
| Telesna masa / Body mass (TM) | 4.86 | 0.02 | Fudbaleri / footballers | Džudisti / judoists | -18.10 | 0.01 |
|                     |       |           | Rukometali / handballers |                   | -9.70 | 0.24 |
|                     |       |           | Džudisti / judoists      | Fudbaleri / footballers | 18.10 | 0.01 |
|                     |       |           |                        | Rukometali / handballers | 8.40 | 0.34 |
|                     |       |           | Rukometali / handballers | Fudbaleri / footballers | 9.70 | 0.24 |
|                     |       |           |                        | Džudisti / judoists | -8.40 | 0.34 |
| Max obrtni moment ekstenzije desnog kolena (PTQR) | 4.29 | 0.02 | Fudbaleri / footballers | Džudisti / judoists | -64.00 | 0.02 |
|                     |       |           |                        | Rukometali / handballers | -41.80 | 0.16 |
|                     |       |           | Džudisti / judoists | Fudbaleri / footballers | 64.00 | 0.02 |
|                     |       |           |                        | Rukometali / handballers | 22.20 | 0.58 |
|                     |       |           | Rukometali / handballers | Fudbaleri / footballers | 41.80 | 0.16 |
|                     |       |           |                        | Džudisti / judoists | -22.20 | 0.58 |
| Max obrtni moment ekstenzije levog kolena (PTQL) | 3.83 | 0.03 | Fudbaleri / footballers | Džudisti / judoists | -76.30 | 0.03 |
|                     |       |           | Rukometali / handballers |                        | -43.10 | 0.28 |
|                     |       |           | Džudisti / judoists | Fudbaleri / footballers | 76.30 | 0.03 |
|                     |       |           |                        | Rukometali / handballers | 33.20 | 0.46 |
|                     |       |           | Rukometali / handballers | Fudbaleri / footballers | 43.10 | 0.28 |
|                     |       |           |                        | Džudisti / judoists | -33.20 | 0.46 |

Legend: BM-body mass, PTQR-maximum torque of right knee extension, PTQL-maximum torque of left knee extension, p-level of statistical significance of ANOVA

From the above data we can conclude that the differences between the examined sub-surveys of our research made by footballers (10), judoists (10) and handball players (10) aged 14-18 from the area of AP Vojvodina were established. Significant differences were observed in the maximum torque of both legs (PTQR, PTQL) force between the judo and football players in favor of judo. A statistically signifi-cantly lower (p=0.01) mean value of the maximum torque of the right knee extension in the footballers is statistically signifi-cantly lower (p=0.02) than that in the judoists. A statistically significant difference of 18.10kg mean value of the maximum torque of the right and left knee extensions of footballers is statistically significant lower (p=0.02) than that in the judoists. Using statistical procedures, differences were found in other variables that describe the extension and flexion in the knee joint, but differences are not significant. However, the results tell us that in all variables the best results were achieved by the judo, and that handball players are better than the footballers.

Table 3. Results single-factor ANOVA analysis and Post Hoc Test TukeyHSD

| Dependent Variable | ANOVA | (I) sport | (J) sport | Mean Difference (I-J) | p |
|--------------------|-------|-----------|-----------|-----------------------|---|
| Telesna masa / Body mass (TM) | 4.86 | 0.02 | Fudbaleri / footballers | Džudisti / judoists | -18.10 | 0.01 |
|                     |       |           | Rukometali / handballers |                   | -9.70 | 0.24 |
|                     |       |           | Džudisti / judoists | Fudbaleri / footballers | 18.10 | 0.01 |
|                     |       |           |                        | Rukometali / handballers | 8.40 | 0.34 |
|                     |       |           | Rukometali / handballers | Fudbaleri / footballers | 9.70 | 0.24 |
|                     |       |           |                        | Džudisti / judoists | -8.40 | 0.34 |
| Max obrtni moment ekstenzije desnog kolena (PTQR) | 4.29 | 0.02 | Fudbaleri / footballers | Džudisti / judoists | -64.00 | 0.02 |
|                     |       |           |                        | Rukometali / handballers | -41.80 | 0.16 |
|                     |       |           | Džudisti / judoists | Fudbaleri / footballers | 64.00 | 0.02 |
|                     |       |           |                        | Rukometali / handballers | 22.20 | 0.58 |
|                     |       |           | Rukometali / handballers | Fudbaleri / footballers | 41.80 | 0.16 |
|                     |       |           |                        | Džudisti / judoists | -22.20 | 0.58 |
| Max obrtni moment ekstenzije levog kolena (PTQL) | 3.83 | 0.03 | Fudbaleri / footballers | Džudisti / judoists | -76.30 | 0.03 |
|                     |       |           | Rukometali / handballers |                        | -43.10 | 0.28 |
|                     |       |           | Džudisti / judoists | Fudbaleri / footballers | 76.30 | 0.03 |
|                     |       |           |                        | Rukometali / handballers | 33.20 | 0.46 |
|                     |       |           | Rukometali / handballers | Fudbaleri / footballers | 43.10 | 0.28 |
|                     |       |           |                        | Džudisti / judoists | -33.20 | 0.46 |

Legend: PTQR-max obrtni moment ekstenzije desnog kolena, PTQL-max obrtni moment ekstenzije levog kolena, p-nivo statističke značajnosti jednofaktorske Anova analize

From the above data we can conclude that the differences between the examined sub-surveys of our research made by footballers (10), judoists (10) and handball players (10) aged 14-18 from the area of AP Vojvodina were established. Significant differences were observed in the maximum torque of both legs (PTQR, PTQL) force between the judo and football players in favor of judo. A statistically signifi-cantly lower (p=0.01) mean value of the maximum torque of the right knee extension in the footballers is statistically signifi-cantly lower (p=0.02) than that in the judoists. Using statistical procedures, differences were found in other variables that describe the extension and flexion in the knee joint, but differences are not significant. However, the results tell us that in all variables the best results were achieved by the judo, and that handball players are better than the footballers.

Iz gore navedenih podataka možemo konstatovati da su ustanovljene razlike između ispitivanih subuzoraka našeg istraživanja koji su činili fudbaleri (10), džudisti (10) i rukometali (10) uzrasta od 14-18 godina starosti sa područja AP Vojvodine. Signifikantne razlike su uočene u maksimalnom obrtnom momentu telesne mase, preko nje u maksimalnom obrtnom momentu telesne mase, u oba od džudista i fudbaleru, u ko-
Significant difference in maximum flexing torque moment of both knees was not established among athletes. Statistically significant differences in the rotational muscular force of the musculature in relation to the body weight of athletes were not observed. Differences in relative values were not seen in the tested variables of the judo and football players, as the TM judiciary was statistically significantly higher than the TM player, and in the calculation of the relative values influenced the obtained result.

**Conclusion**

For the purpose of determining the differences in upper knee musculature, 30 athletes aged 14-18 participated, divided into three groups: 10 football players, 10 judoists and 10 handball players who play in the clubs from the area of AP Vojvodina. Testing was done at the premises of the Provincial Institute for Sport and Sports Medicine in Novi Sad. For the needs of the test, the isokinetic dynamometer “Easytech Prima DOC” was used, at a torque of 60 step°/sec.

The results of this study confirm results of Vujkov and Associates Research (2008) who found on the sample of 50 respondents (10 judoists, 10 footballers, 10 wrestlers, 10 athletes and 10 non-sporters) that the wrestlers and judoists achieved the best results of the maximum torque of the knee extension, and judoists as far as knee flexors were concerned. Isokinetic diagnostics was subject of research for Trivić, Vujkov and Drid (2008), where they studies muscle disbalance of upper knee musculature among different group of athletes and non-athletes.

Obtained results by isokinetic diagnosis can be used to compare the effects of therapeutic procedures in sports injuries, but also to analyze the effects of different training protocols. The main advantages of this method in relation to others in evaluating the function of the locomotor system are efficiency, reliability, objectivity and non-invasiveness (Golik-Perić, 2016). The training process itself can be enriched by certain motor skills from other sports that will not violate the techniques adopted so far, and will affect the “awakening” and the development of targeted muscles and muscle groups that dominantly participate in the structure of movements and movements of a particular sports branch.

Rezultati ovog istraživanja potvrđuju rezultate istraživanja Vujkov i saradnika (2008) koji su na uzorku od 50 ispitanika (10 džudista, 10 fotbalera, 10 rvača, 10 atletičara i 10 nesportista) ustanovili da su rvači i džudisti postigli najbolje rezultate maksimalnih obrtnih momenata ekstenzora kolena, a džudisti kada su fleksori kolena u pitanju. Dobijena razlika u rezultatima između posmatranih grupa se mogu pripisati specifičnostima trenažnog procesa različitih sportskih grana, tj. izvođenja određenih tehniku u samom sportu. Sama struktura treninga u borilačkim sportovima je podređena usvajanju i usavršavanju pojedinih tehniku koje od sportista zahtevaju veliko angažovanje natkolene muskulature.

Rezultati dobijeni izokinetičkom dijagnostikom mogu se koristiti za poređenje efekata terapijskih procedura kod sportskih povreda, ali i za analizu efekata različitih trenažnih protokola. Glavne prednosti ove metode u odnosu na druge u evaluaciji funkcije lokomotornog sistema su efikasnost, pouzdanost, objektivnost i neinvazivnost (Golik-Perić, 2016). Sam trenažni proces može se obogatiti i određenim motoričkim znanjima iz drugih sportova koji neće narušiti do tada usvojene tehnike, a utiče na “buđenje” i razvoj ciljanih mišića i mišićnih grupa koji dominantno učestvuju u strukturi kretanja i pokreta određene sportske grane.
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