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ТЕОРИЈСКИ, МЕТОДОЛОШКИ И МЕТОДИЧКИ АСПЕКТИ  
ТАКМИЧЕЊА И ПРИПРЕМЕ СПОРТИСТА**

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**INTERNATIONAL SCIENTIFIC CONFERENCE  
THEORETICAL, METHODOLOGICAL AND  
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**BOOK OF ABSTRACTS**

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Poštovane kolegice i kolege,

Dobrodošli na najstariji Fakultet sporta i fizičkog vaspitanja Univerziteta u Beogradu. Već šest decenija Fakultet stvara kadrove koji kreiraju i realizuju programe u širem prostoru sporta, fizičkog vaspitanja i rekreacije. Ponosni smo na najuspešnije koji sa svojim sportistima osvajaju trofeje i šire pozitivnu priču o našoj zemlji. Trudimo se da naši studenti budu prepoznatljivi po nivou znanja i spremnosti da stvaraju dobru i kreativnu atmosferu u okruženju u kome rade.

Posle FISU konferencije povodom Univerzijade i SPOFA međunarodne konferencije o sportskim objektima ovo je treća međunarodna konferencija ove godine koju organizuje naš Fakultet.

Dobrodošli na našu redovnu Međunarodnu naučnu konferenciju koja nas okuplja svake godine povodom Dana fakulteta 11. decembra. “**Teorijski, metodološki i metodički aspekti takmičenja i pripreme sportista**” jeste zvanični naslov i, sudeći prema broju i kvalitetu prijavljenih radova, vrlo aktuelna tema. Globalna kriza i proces približavanja Evropi su očigledno izoštrili našu svest o tome da smo potrebni jedni drugima i da svaki pojedinačni naučni doprinos razvoju trenazne tehnologije ima svoje mesto u globalnom napredovanju sportskih rezultata. Raduje nas veliki broj autora koji dolaze iz inostranstva, što i nama nameće obavezu aktivnog prisustva i učestvovanja u radu.

Potajno se nadamo da se Vaše opredeljenje da rezultate svog naučnog rada izlažete baš na ovoj Međunarodnoj konferenciji zasniva na uspešnosti naših sportista iza kojih stoji i naša dugogodišnja edukativna, pedagoška i naučna investicija.

Posebno se zahvaljujem pozivnim predavačima što su prihvatili obavezu i uklopili se u dinamiku naše Konferencije.

U ime Dekanata i svoje lično ime želim uspešan rad Konferencije i da ostvarite nove kontakte za buduću saradnju.

*Dekan*



*prof. dr Dušan Mitić*

Beograd, 23. novembar 2009.

Dear Colleagues,

Welcome to the oldest Faculty of Sport and Physical Education of the University of Belgrade. For six decades the Faculty has been producing staff which creates and realizes programs in the vast field of sport, physical education and recreation. We are proud of the most successful ones who win trophies with their athletes, spreading the positive talks about our country. We try to make our students recognized for their knowledge and readiness to create good and creative atmosphere in their working environment.

Following the FISU conference, on the occasion of the Universiade, and the International conference on sports facilities SPOFA, this is the third international conference organized by our Faculty.

Welcome to our regular International scientific conference, that gathers us every year to mark the Faculty anniversary on December 11<sup>th</sup>. **“Theoretical, methodological and didactic aspects of competition and athletes’ preparation”** is an official title, and judging by number and quality of the registered papers, it seems to be very actual issue. Global crisis and the process of accession to Europe, obviously shaped our conscience and we realized that we need each other and that each individual scientific contribution to training technology development has its position in global progress of sports results. We are glad to see great number of foreign authors stimulating us to attend and actively participate in the work.

We like to hope that your choice to present the results of your scientific studies at this international Conference is based on success of our athletes supported by our lasting educational, pedagogical and scientific involvement.

I would especially like to thank our key note lecturers for accepting this duty and fitted their schedule in the dynamics of our Conference.

In the name of the Dean’s Office and in my personal name I wish you to have successful work and new contacts for future cooperation.

*Dean*



*prof. Dušan Mitić, PhD*

Belgrade, November 23<sup>rd</sup> 2009.

Poštovane kolege!

Želimo Vam dobrodošlicu na naš fakultet i naučni skup koji se tradicionalno održava povodom Dana fakulteta i zahvaljujemo što ste prijavili svoje učešće. Skup je tradicionalan, ali se teme menjaju iz godine u godinu. Na taj način smo u veoma širokom prostoru fizičke kulture izdvajali neku oblast i određivali temu skupa. Ovog puta smo se opredelili za oblast sporta, u skladu sa tim je i naziv skupa: „**Teorijski, metodološki i metodički aspekti takmičenja i pripreme sportista**“. Smatrali smo da je ovako definisana tema ostavila širok prostor za učešće stručnjaka različitih profila i usmerenja.

Naučni odbor skupa je smatrao da uvodni predavači treba da budu naše kolege iz inostranstva sa željom i očekivanjima da se upoznamo sa novim idejama u sportskim naukama i uporedimo ih sa sopstvenim. Drago nam je da su poznati stručnjaci i univerzitetski nastavnici Vladimir Isurin (Izrael), Nikolaos Geladas (Grčka) i Radoje Milić (Slovenija) pristali da budu uvodni predavači. Zahvaljujemo im se i nadamo se da je ovo samo početak naše saradnje.

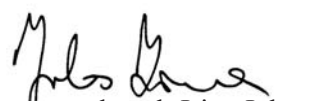
Moramo istaći i zadovoljstvo brojem prijavljenih autora i radova. Prijavljeni radovi su veoma raznovrsni po tematici. Posebno nas raduje činjenica da je, u odnosu na sve prethodne naučne skupove na našem fakultetu, sada prijavljen veći broj radova sa tematikom sporta invalida. Osim toga, prijavilo se više autora iz inostranstva, kao i autora iz oblasti medicine. Mada će neki prostori ostati na periferiji (teorija takmičenja, problemi vantagežnih i vantagežarskih faktora), jer je malo radova u tim oblastima, nadamo se da će skup biti veoma zanimljiv i koristan. U nadi da će tako zaista i biti, pozdravljamo Vas i radujemo se skorom susretu.

Predsednik Naučnog odbora



prof. dr Vladimir Koprivica

Predsednik Organizacionog odbora



doc. dr Irina Juhas

U Beogradu, 23. novembar.2009. godine

Dear Colleagues!

We would like to welcome to our Faculty and scientific meeting, traditionally held on the occasion of Faculty anniversary and to thank you for applying for participation. The meeting is traditional, but with different topics every year. This way in a very vast area of physical culture we would select a field and assign the topic for the conference. This time we have selected sports field, and the title: „**Theoretical, methodological and didactic aspects of competition and athletes' preparation**”. We thought that such a defined topic would create enough space for participation of experts of different profiles and orientations.

The scientific board thought the key note lecturers should be our colleagues from abroad wishing and expecting to get acquired with latest ideas in sports sciences and compared them with our own ones. We are glad that reputable experts and university teachers Vladimir Issurin (Israel), Nikolaos Geladas (Greece) and Radoje Milić (Slovenia) accepted to be the key note lecturers at our scientific meeting. We thank them hoping that this is only the beginning of our cooperation.

We want to underline that we are very glad with the number of registered authors and papers. The registered papers vary in their topics. We are particularly glad for the fact that compared to all previous scientific meetings at our Faculty, this time we have greater number of papers related to sport of the persons with disabilities. Additionally, many foreign authors applied, as well as authors with medicine-related papers. Although some areas will be at margins (theory of competition, problems of out-training and out-competition factors), because there are only few papers in these fields, we hope you will find the meeting interesting and useful. We are looking forward to meeting you soon.

President of the Scientific Board



Prof. Vladimir Koprivica, PhD

President of the Organizational Board



Assist. prof. Irina Juhas, PhD

Belgrade, November, 23<sup>rd</sup> 2009.

## **BLOCK PERIODIZATION AS AN ALTERNATIVE APPROACH TO HIGH-PERFORMANCE ATHLETES' PREPARATION**

**Vladimir B. Issurin**

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The traditional training periodization, a division of the entire seasonal program into smaller periods and training units, was proposed more than four decades ago. At that time it became real breakthrough in training theory and its practical application. Since then international sport and sport science have experienced tremendous changes, while the traditional training periodization has remained at more or less the same level of the initial publications. Eventually the modern demands of high-performance sport and findings of recent studies stipulated contradictions between traditional model of periodization and practical needs of advanced coaches. The most relevant restrictions of traditional model stemmed from the following circumstances, namely:

- the inability to provide multi-peak performances over the season;
- conflicting physiological responses produced by multi-targeted training directed at many athletic abilities,
- excessive fatigue elicited by prolonged periods of multi-targeted training, and
- insufficient training stimulation induced by workloads of medium and low concentration typical of "mixed" training.

The initial impetus to reform traditional periodization first began among prominent coaches in different sports. The recently developed Block Periodization (BP) model offers an alternative revamped approach for planning the training of high-performance athletes. Its general idea proposes the sequencing of specialized training cycles, i.e. blocks, which contain highly concentrated workloads directed to a minimal number of targeted abilities. Unlike the traditional model, in which the simultaneous development of many athletic abilities predominates, BP training presupposes the consecutive development of reasonably selected abilities-targets. Its basic positions encompass: (1) general principles of training designing; (2) taxonomy of specified mesocycle-blocks; and (3) general guidelines for compiling an annual plan.

The scientific background of BP system refers to two powerful mechanisms of human adaptation: homeostatic regulation and stress reaction. More specifically, exercises for developing basic athletic abilities (cardiorespiratory fitness, aerobic endurance, basic technical skills etc.) presuppose mostly homeostatic regulation, whereas heavy specialized workloads trigger mechanisms of stress adaptation. If both types of exercises are administered concurrently, stress reactions suppress homeostatic responses and have a deleterious effect on workloads intended to develop basic athletic abilities. Separation of workloads demanding homeostatic regulation or stress reactions, as proposed by the BP system, allows avoiding conflicting physiological responses and obtaining more beneficial training stimulation.



## **BLOK PERIODIZACIJA KAO ALTERNATIVNI PRISTUP PRIPREMI VRHUNSKIH SPORTISTA**

**Vladimir B. Issurin**

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Tradicionalna trenažna periodizacija, podela celog programa sezone na manje periode i trenažne celine, je predložena pre više od četiri decenije. U to vreme bio je to pravi prodor u trenažnoj teoriji i njenoj praktičnoj primeni. Od tada međunarodni sport i sportska nauka su prošli kroz ogromne promene, dok je tradicionalna trenažna periodizacija ostala na manje-više istom nivou početnih publikacija. Konačno moderni zahtevi za sportom visokog učinka i otkrića nedavnih studija doveli su do kontradikcija između tradicionalnog modela periodizacije i praktičnih potreba naprednih trenera. Najvažnija ograničenja tradicionalnog modela nastala su iz sledećih okolnosti, naime:

- Nemogućnosti da se obezbedi učinak sa više vrhova sportske forme tokom sezone;
- Konfliktnih fizioloških odgovora koji su bili proizvod više-ciljnog treniranja usmerenog na mnoge sposobnosti sportista,
- Prekomeran umor izazvan prolongiranim periodima više-ciljnog treniranja, i
- Nedovoljna trenažna stimulacija indukovana opterećenjem srednje i niske koncentracije tipičnog »mešovito« treniranja.

Inicijalni podsticaj da se reformiše tradicionalna periodizacija javio se prvo kod elitnih trenera u različitim sportovima. Nedavno razvijeni model Blok periodizacije (BP) nudi alternativni povratnog pristup planiranju treninga vrhunskih sportista. Njegova opšta ideja predlaže smenjivanje specijalizovanih trenažnih ciklusa, tj. blokove, koji sadrže visoko koncentrisano opterećenje usmereno na minimalni broj ciljnih sposobnosti. Za razliku od tradicionalnog modela, u kome je istovremeni razvoj razumno odabranih sposobnosti-ciljeva. Njegove osnovne pozicije obuhvataju: (1) opšte principe kreiranja treninga general; (2) taksonomiju specifičnih mezociklusa – blokova; i (3) opšte smernice za sačinjavanje godišnjeg plana.

Naučna pozadina sistema BP odnosi se na dva snažna mehanizma ljudske adaptacije: homeostatičku regulaciju i reakciju na stres. Specifičnije, vežbanja za razvoj osnovnih atletskih sposobnosti (kardiorespiratorni fitnes, aerobna izdržljivost, osnovne tehničke veštine itd.) pretpostavljaju uglavnom homeostatičku regulaciju, dok teška specijalizovana opterećenja okidaju mehanizme adaptacije na stres. Ako se oba tipa vežbanja primenjuju istovremeno, reakcija na stres potiskuje homeostatičke odgovore i oni imaju poguban efekat na opterećenje čija je namena razvijanje osnovne sportske sposobnosti. Razdvajanje opterećenja koje zahteva homeostatička regulacija ili reakcija na stres, kao što predlaže sistem BP, omogućava izbegavanje konfliktnih fizioloških odgovora i dobijanje korisnije trenažne stimulacije.

# CONCEPTS AND METHODS DETERMINING AEROBIC ENDURANCE: THE IMPACT OF HEREDITY AND ENVIRONMENT

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The ability to perform exercise as long as possible is known as aerobic endurance and has been recognized as one of the fundamental components of physical fitness and performance. It has been shown to be a crucial trait in endurance sport events, ball games, leisure activities and even cardiac rehabilitation and transplantation. Even though this trait is heavily predisposed by genetic endowment there is no question that environmental factors such as training and nutrition are essential for securing health and developing an elite athlete. It is now recognized that 'long distance' endurance is determined by maximal oxygen uptake (aerobic power), energy cost of exercise, and the maximal fractional utilization of aerobic power. This presentation aimed to analyze the current literature, searched mainly through 'pub-med' and 'sport-discus', regarding the effect of heredity, training methods and nutritional interventions on performance, aerobic capacity and fitness. Concepts such as: initial level of physical fitness and healthy, specificity of training, training volume, progressiveness of loading, modality of exercise, genetic, environmental and nutritional factors will be discussed on different levels of fitness, wellness, sex and age. In particular, many recent studies have focused on the effectiveness of different training methods and have compared continuous training with interval training, high intensity training with continuous moderate or high intensity training and super-maximal intensity interval training with high intensity continuous training. Furthermore, emphasis has been given to developing effective training methods to improve performance in endurance events. Innovative methods suggest that interval high intensity exercise improves more effectively cardiovascular endurance than continuous moderate or high intensity exercise. Last but not least, the direct and indirect methods for determining aerobic endurance in running, cycling and ball games will be reviewed.

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## **KONCEPTI I METODE KOJI ODREĐUJU AEROBNU IZDRŽLJIVOST: UTICAJ NASLEĐA I OKOLINE**

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Sposobnost izvođenja vežbi što je duže moguće je poznat kao aerobna izdržljivost i priznata je kao jedna od osnovnih komponenti fizičke kondicije i učinka. Pokazano je da je to ključna crta u sportovima snage, igrama sa loptom, slobodnim aktivnostima, pa čak i kod kardio rehabilitacije i transplatacije. Iako je ova crta veoma predisponirana genetskim talentom nema sumnje da su faktori okoline kao što su treniranje i ishrana veoma bitni za osiguranje zdravlja i razvoja vrhunskog sportiste. Sada se priznaje da je izdržljivost na duge staze određena maksimalnim unosom kiseonika (aerobna snaga), energetsom potrošnjom vežbanja i maksimalnim frakcionalnim iskorištenjem aerobne snage. Ova prezentacija ima za cilj analizu postojeće literature, pretražene uglavnom u 'pub-med' i 'sport-discus', koja se odnosi na uticaj naslednih faktora, trenažne metode i uticaj ishrane na učinak, aerobni kapacitet i kondiciju. Koncepti kao što su: početni nivo fizičke kondicije i zdravlja, specifičnost treniranja, obim treniranja, progresivnost opterećenja, modalitet vežbanja genetski i faktori sredine i ishrane diskutuju se na različitim nivoima kondicije, zdravlja, pola i starosti. Posebno, mnoga nedavna istraživanja su se fokusirala na efikasnost različitih trenažnih metoda i poredila kontinuirano treniranje sa treniranjem u intervalima, trening visokog intenziteta sa kontinuiranim umerenim ili treningom visokog intenziteta i treningom super-maksimalnim treniranjem u intervalima sa kontinuiranim treniranjem visokog intenziteta. Pored toga, naglasak se stavlja na razvijanje efikasnih trenažnih metoda kako bi se poboljšao učinak u aktivnostima izdržljivosti. Inovativne metode sugerišu da vežbanje visokog intenziteta u intervalima efikasnije poboljšava kardiovaskularnu izdržljivost od kontinuiranog umerenog ili vežbanja visokog intenziteta. Na kraju i ne manje važno, daje se pregled direktnih i indirektnih metoda za određivanje aerobne izdržljivosti u trčanju, biciklizmu i sportovima sa loptom.

## BIOCHEMICAL MARKERS AND HEMATOLOGIC INDICES OF IRON DEFICIENCY IN HIGH PERFORMANCE SPORTS

**Radoje Milić**

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**Introduction.** The importance of determination and the prevalence of mild iron deficiency (ID) without anemia, iron-deficient erythropoiesis (IDE) and more advanced iron-deficiency anemia (IDA) in top performance sports is seldomly neglected in published epidemiological studies. Iron deficiency (ID) is defined as a reduction in total body iron to an extent that iron stores are fully exhausted and some degree of tissue iron deficiency is present. Iron deficiency (ID) is generally evaluated by a series of blood tests and occurs in three stages (2). *Stage I*, is associated with an isolated decrease in serum ferritin with normal hemoglobin levels. *Stage II* is "IDE"; serum iron and transferrin saturation decreases, and total iron binding capacity rises. In *Stage III*, however, further depletion of iron stores occurs, and an overt microcytic and hypochromic iron-deficient anemia develops. Aim of this study was to evaluate whether the use of an algorithm for quantitative assessment of body iron described by Cook and al. (1) in addition to the screening complete blood count (CBC), improves detection of iron deficiency (ID), iron-deficient erythropoiesis (IDE) and iron deficiency anemia in the group of apparently healthy top performance athletes.

**Methods.** Hematological parameters (RBC, hemoglobin, hematocrit, MCV, MCH, MCHC, reticulocytes and reticulocytes indexes - MCVr, CHr, % hypo Er), were measured in blood specimens obtained in routine health controls from 750 Slovenian top performance athletes (498 males, avrg. Age:  $23,1 \pm 3,7$  years and 352 females, avrg. age:  $22,8 \pm 4,4$  years) by using the Bayer ADVIA 120 hematology analyzer (Bayer, Germany). We also included biochemical analyses of total iron-binding capacity (Kodak Ektachem 700 S), transferrin saturation, serum ferritin (Olympus OSR6150), serum transferrin receptor (sTfR) and serum iron (Roche/Hitachi 917). Descriptive statistics were determined for each variable recorded. General linear model analysis of variance and Bonferroni post hoc criteria were used to compare differences in parameters between athletes, both men and women, with different level of exercise load. Differences were considered statistically significant at  $P < 0.05$ . Statistical procedure was performed with SPSS 17.0 software.

**Results and conclusions.** For accurate detection of iron-deficient erythropoiesis (IDE) we need more sophisticated methods to discover an impaired supply of plasma iron to the erythroid marrow for hemoglobin synthesis. The optimal diagnostic approach is to measure both the serum ferritin as an index of iron stores and the serum transferrin receptor as an index of tissue iron deficiency. The use of an algorithm including CHr to screen for iron deficiency increase the accuracy of diagnosis, enabling early detection and treatment of iron deficiency in top performance athletes.

# BIOHEMIJSKI MARKERI I HEMATOLOŠKI INDEKSI NEDOSTATKA GVOŽĐA U VRHUNSKIM SPORTOVIMA

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**Uvod.** Važnost određivanja i pojava blagog deficita gvožđa (ID) bez anemije, eritropoeza deficita gvožđa (IDE) i naprednija anemija deficita gvožđa (IDA) u vrhunskim sportovima se često zanemaruje u objavljenim epidemiološkim studijama. Deficit gvožđa (ID) se definiše kao smanjenje ukupnog telesnog gvožđa do nivoa da depoi gvožđa postanu potpuno iscrpljeni i postoji neki stepen deficita gvožđa tkiva. Deficit gvožđa (ID) se uopšteno procenjuje serijom testiranja krvi i javlja se u tri faze (2). *Faza I*, se vezuje za izolovani pad seruma feritina sa normalnim nivoom hemoglobina. *Faza II* je "IDE"; serumsko gvožđe i prenosna zasićenost pada a povećava se vezivni kapacitet ukupnog. U *Fazi III*, međutim, dolazi do daljeg gubitka depoa gvožđa, i razvija se otvorena, mikrocitska i hipohromna anemija deficita gvožđa. Cilj ovog istraživanja je da se proceni da li korišćenje algoritma za kvantitativnu ocenu telesnog gvožđa koje su opisali Kuk i sar. (Cook and al.) (1) pored testiranja kompletne krvne slike (CBC), poboljšava otkrivanje nedostatka gvožđa (ID), eritropoeza deficita gvožđa (IDE) i anemiju deficita gvožđa u grupi naizgled zdravih vrhunskih sportista.

**Metode.** Hematološki parametri (eritrociti, hemoglobin, hematocrit, MCV, MCH, MCHC, reticulociti i indeksi retikulocita - MCVr, CHr, % hypo Er), su mereni u uzorcima krvi dobijenih rutinskom kontrolom kod 750 slovenačkih vrhunskih sportista (498 muškaraca, prosečne starosti:  $23,1 \pm 3,7$  godina i 352 žene, prosečne starosti:  $22,8 \pm 4,4$  godina) korišćenjem Bayer ADVIA 120 hematološkog analizatora (Bayer, Nemačka). Takođe smo uključili biohemijske analize ukupnog vezivnog kapaciteta gvožđa (Kodak Ektachem 700 S), zasićenosti transferina, serumskog feritina (Olympus OSR6150), receptora serumskog transferina (sTfR) i serumskog gvožđa (Roche/Hitachi 917). Deskriptivna statistika je određena za svaku beleženu varijablu. Za poredenje razlika u parametrima među sportistima, i muškarcima i ženama, korišćen je opšti linearni model analize varijanse i Bonferroni post hoc kriterijumi, sa različitim nivoom opterećenja vežbanja. Razlike su se smatrale statistički značajne na  $P < 0.05$ . Statistička procedura je obavljena korišćenjem SPSS 17.0 softvera.

**Rezultati i zaključci.** Za tačno otkrivanje eritropoeza deficita gvožđa (IDE) potrebne su nam sofisticiranije metode da se otkrije narušenost snabdevanja plazmom gvožđa eritroidne srži za sintezu hemoglobina. Optimalni dijagnostički pristup je merenje i serumskog feritina kao indeksa depoa gvožđa i receptora serumskog transferina kao indeksa deficita gvožđa tkiva. Korišćenjem algoritma uključujući CHr da bi se pratilo povećanje deficita gvožđa povećava preciznost dijagnoze te tako omogućava rano otkrivanje i lečenje nedostatka gvožđa kod vrhunskih sportista.

## NEW PERSPECTIVE TO BUILD SPORT CENTER

**Tiziana D'Isanto**  
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**Introduction.** The Naples Administration Municipality is designing the project of rebuilding of Collana Sport Center that partially closed after structural accident in 2006 and it has just allocated enough moneys to reconstruct it. The closed part is the game sport court of volleyball, basketball, handball and mini-soccer and for this reason the team sport customers have been decreased. This Sport Center is the greatest in Campania region and inside it can play all the Olympic sports per 3000 customers every day before the partial closure and 2200 after. Also the Campania region Administration spends much money to give at population the new Collana sport center. The problem is to spend well the public moneys and for this reason it is good to choose the right architectural project to optimize the sport offer at the customer demand. Thus the aim is to discover the expected demand about the real choice of the customer.

**Method.** The survey carries out the data by using statistical model to correlate a demand of multi game sport relating to a new architectural hypothesis, already designed with a new solution to optimize the space and has already shown at International Conference in Rydzyna Polon, and to correlate a demand of single sport relating to the old building. The sample is 400 customers from a population of 15.000 potential customers.

**Result.** It shows the association between demand of multisport and new architectural hypothesis and the association between demand of single sport and old building. The percentage of multi sport demand is higher than the single sport.

**Conclusion.** The new methodological approach suggests satisfying the customer demand that shares the innovative hypothesis before the beginning of the reconstruction to spend well the moneys of the local government.

## NOVE PERSPEKTIVE IZGRADNJE SPORTSKOG CENTRA

**Tiziana D'Isanto**  
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**Uvod.** Uprava opštine Napulj projektovala je rekonstrukciju i modernizaciju sportskog centra Kolana, koji je delimično zatvoren posle nesreće sa konstrukcijom 2006. i lokalna uprava je upravo dodelila 4 miliona evra za rekonstrukciju. Zatvoreni deo je teren za grupne sportove, za igru odbojke, košarke, rukometa i fudbala u zatvorenom. Zbog nesreće sa konstrukcijom korisnici za grupne sportove su se smanjili zbog nedostatka alternativnog objekta na ovoj lokaciji. Ovaj centar je najveći u oblasti Kampanija i u njemu se mogu igrati skoro svi olimpijski sportovi, i pre delimičnog zatvaranja mogao je da ugosti 3000, a posle 2200 klijenata svakoga dana. Uprava regije Kampanija želi da pomogne Opštini Napulj da odmah ponovo otvori Centar radi novog načina da se zadovolji sportska populacija, i stoga su dodelili finansijska sredstva. Problem je izbor arhitektonskog projekta kako bi se optimalizovala sportska ponuda i da bi se javni novac iskoristio na odgovarajući način. Cilj je da se otkrije očekivana potražnja sa novim metodološkim procesom kako bi se garantovalo maksimalno zadovoljstvo korisnika.

**Metod.** Istraživanje je izvedeno korišćenjem statističkog modela koji je u korelaciji sa kvalitetnim zahtevom za sportom vezano za novu arhitektonsku hipotezu (već je prikazana na međunarodnoj konferenciji Rydzyna Polon) ili tradicionalnu. Uzorak od 400 ispitanika, regrutovanih u studentskoj populaciji od 15.000 ispitanika.

**Rezultati.** Rezultati pokazuju vezu između kvalitetne potražnje više sportova i nove arhitektonske hipoteze i veze između kvalitetne potražnje jednog sporta u odnosu na tradicionalni. Procenat potražnje više sportova je mnogo veći nego jednog sporta.

**Zaključak.** Zaključuje se da novi način rekonstrukcije sportskog centra sugeriše zadovoljenje populacije za novim delom sportske potražnje tako da se na taj način dobro koristi javni novac.

## **SPECIJALIZOVAN OBJEKAT KAO USLOV ZA USPEŠAN TRENING U SPORTSKOJ GIMNASTICI SA OSVRTOM NA STANJE U BEOGRADU**

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**Uvod.** Osnova uspeha u muškoj i ženskoj sportskoj gimnastici su broj i težine tehnički pravilno izvedenih vežbi, spojeva vežbi, kao i ispunjenih zahteva propisanih za sastave na pojedinim spravama, uz najmanji broj opštih grešaka. Napredovanje u tehnici, uz istovremenu zaštitu gimnastičara od mikrotrauma, koje nastaju zbog velikog broja ponavljanja, moguće je obezbediti samo u posebnim uslovima. Razvoj sportske gimnastike u određenoj sredini zavisi od materijalnih uslova – specijalizovanog prostora, kvalitetnih sprava i pomoćnih sprava, kao i od stručnosti trenera, koji se usavršavaju i prate tendencije razvoja u sportskoj gimnastici. Od kvaliteta sprava, čije su dimenzije i materijali detaljno određeni Pravilnikom FIG-e, zavisi mogućnost izvođenja tehnički složenih vežbi. Posebna pažnja, kako na treningu, tako i na takmičenjima, posvećuje se doskočištu (strunjače i jame), kao osnovnoj pretpostavci za zaštitu vežbača. **Metod.** Kako bi se sagledao kvalitet prostora i opreme koje poseduju gimnastički klubovi u Srbiji, analizirani su uslovi u kojima gimnastičari i gimnastičarke treniraju. **Rezultati.** Ustanovljeno je da postoji jedan potpuno opremljen centar za trening, još tri centra u kojima se trenažni proces odvija u uslovima koji su prihvatljivi, od kojih dva ozbiljno rade na izgradnji novih kapaciteta. Beograd nema specijalizovan objekat za sportsku gimnastiku. Ne postoji ni prostor koji bi Grad, kao organizator Evropskog olimpijskog festivala mladih i Univerzijade, i kao potencijalni centar za sportsku gimnastiku, mogao da, postavljanjem kompleta sprava za muškarce i žene, formira kao objekat namenjen za sportsku gimnastiku. **Zaključak.** Postavlja se pitanje koje okolnosti, i pored dugogodišnjeg angažovanja stručnjaka iz sportske gimnastike, Gimnastičkog saveza Beograda, Gimnastičkog saveza Srbije, kao i podrške medija, stoje na putu izgradnje jednog specijalizovanog objekta za sportsku gimnastiku, koji je uslov za razvoj kvalitetne gimnastike. Stanje u Beogradu je u suprotnosti sa deklarisanim pozitivnim argumentima u korist gimnastike kao bazične sportske grane, kao korisne sportske aktivnosti za najmlađe i kao olimpijske sportske grane.

## **SPECIALIZED FACILITIES AS A PRECONDITION FOR SUCESSFUL TRAINING IN SPORTS GYMNASTICS WITH A REVIEW OF SITUATION IN BELGRADE**

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**Introduction.** Bases of success in both male and female sports gymnastics are number and difficulties of accurately performed exercises, series of exercises, as well as fulfilled requirements prescribed for routines on certain apparatuses, with fewest number of general mistakes. Improvement in technique, with simultaneous protection of gymnasts from micro-traumas, resulting from great number of repetitions, is possible only in special conditions. Development of sports gymnastics in certain environment depends on material conditions – specialized premises, quality apparatuses and supplementary apparatus, as well as on coach's expertise, his will to improve himself and to follow developmental tendencies in sports gymnastics. The quality of apparatuses, whose dimensions and materials are precisely provided by the FIG Book of rules, conditions the possibilities to perform technically complex exercises. Particular attention, both in training and in competitions is dedicated to landing area (mats and pits), as a basic presumption of athletes' protection. **Method.** In order to perceive the quality of space and equipment possessed by gymnastic clubs in Serbia, the training conditions were analyzed. **Results.** It was established that there is one fully equipped training center, another three centers in which training process is carried out in acceptable conditions, and two of these centers are seriously engaged in construction of new facilities. Belgrade has no specialized sports gymnastics facility. There is no space that the City, as the organizer of European Olympic festival of the youth and the Universiade, and as a potential sport gymnastics center, could form, by placing a full set of male and female apparatus, as a facility intended for sports gymnastics. **Conclusion.** The issue arises about the circumstances, regardless of long lasting engagement of sports gymnastics experts, Gymnastic Association of Belgrade, Gymnastic Association of Serbia, as well as supported by the media, which create obstacles to construction of a specialized facility for sports gymnastics, which is a precondition for development of quality gymnastics. The situation in Belgrade is contrary to the declared positive arguments in favour of gymnastic, as basic sports branch, as useful sports activity for the youngest ones as well as an Olympic sports branch.

## MENTAL PREPARATION TECHNIQUE FOR ENHANCING THE PERFORMANCE OF SWIMMERS

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**Introduction.** The purpose of the present study was to investigate the relationship between mental training with biofeedback and athletic performance. The Wingate five-step approach was used as a mental preparation technique for enhancing the performance of child swimmers. Results indicated that the experimental group exhibited the greatest increase in performance, although the control group also displayed some improvements.

**Method.** The clubs and children voluntarily participated in the study. Conditions (i.e., experimental and control) were randomized between the two clubs, with each club corresponding to only one condition in order to reduce the possibility of exchange of communication among participants from different groups and to reduce social comparison. In other words, clubs, rather than participants, were randomly assigned to either the experimental or the control conditions. To further minimize the possibility of social comparison, clubs from the two extreme parts of the city were chosen.

**Results.** Results indicated a significant difference between the groups in the outset of the study. Thus, a 2 X 3 (Condition X Measurement) mixed-factorial ANCOVA was performed, with Condition representing a between subjects factor, Measurement representing a within subjects factor and performances (swimming times) in baseline as a covariate.

**Conclusion.** The findings of the present investigation provide further support that the five-step approach can produce significant improvements in athletic performance, for example, in child swimmers. As such, these findings are important because they empirically demonstrate the possibility of successfully and effectively applying mental training incorporating BFB. It remains to be seen whether similar performance enhancements could be achieved through applying similar intervention programs in other athletic settings as well. As knowledge of the effects and limitations of such intervention programs is accrued, the credibility of these programs will be enhanced.

## TEHNIKA MENTALNE PRIPREME ZA POBOLJŠANJE PERFORMANSI PLIVAČA

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**Uvod.** Cilj ovog istraživanja je da se ispita odnos mentalnog treniranja sa bio-povratnom informacijom i sportskim učinkom. Korišćen je Vingejtov pristup od pet koraka kao tehnika mentalne pripreme za poboljšanje performansi dece plivača. Rezultati ukazuju da je eksperimentalna grupa pokazala najveće poboljšanje performansi, iako je i kontrolna grupa takođe manifestovala neka poboljšanja.

**Metod.** Klubovi i deca su dobrovoljno učestvovali u ovom istraživanju. Uslovi (eksperimentalni i kontrolni) su bili nasumice odabrani u dva kluba, a svaki klub je bio odgovarajući sa samo jednim uslovima kako bi se smanjila mogućnost razmene informacija među učesnicima iz različitih grupa i da bi se smanjilo socijalno poređenje. Drugim rečima, klubovima su, a ne učesnicima, nasumice dodeljivani ili eksperimentalni ili kontrolni uslovi. Da bi se dalje smanjila mogućnost socijalnog poređenja, odabrani su klubovi sa dva kraja grada.

**Rezultati.** Rezultati su pokazali značajnu razliku među grupama od početka ovog istraživanja. Tako je 2 X 3 (uslov X merenje) izvršena mešana faktorska ANCOVA, gde je Uslov predstavljao faktor između ispitanika, Merenje je predstavljalo faktor kod ispitanika, a performanse (vreme plivanja) u osnovnoj liniji kovarijanse.

**Zaključak.** Nalazi ovog istraživanja pružaju dalji dokaz da pristup od pet koraka može dati značajan napredak sportskih performansi, na primer kod dece plivača. Kao takvi, ovi nalazi su važni, jer empirijski pokazuju mogućnost uspešne i efikasne primene mentalnog treninga uključujući BFB. Ostaje da se vidi da li se slična poboljšanja performansi mogu postići primenom sličnih interventnih programa i u ostalim sportskim aktivnostima. Kako raste znanje o efektima i ograničenjima ovakvih interventnih programa povećavaće se i kredibilitet ovih programa.



## PLANIRANJE, PROGRAMIRANJE I REALIZACIJA MAKROCIKLUSA TRENINGA U SPINTERSKIM DISCIPLINAMA KRAUL TEHNIKE NA PRIMERU VRHUNSKE PLIVAČICE

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**Uvod.** Bez stalnog uvida u trenažno stanje sportiste nije moguće programirati trening, upravljati trenažnim procesom, niti postići sportsku formu i željene sportske rezultate. Cilj ovog istraživanja je deskriptivni opis svih trenažnih sadržaja realizovanih u trenažnom ciklusu kod vrhunske plivačice.

**Metod.** U radu je primenjena deskriptivna metoda, odnosno sprovedena analiza trenerske dokumentacije trocikličnog makrociklusa treninga realizovanog na vrhunskoj plivačici.

**Rezultati.** Opisani makrociklus trajao je ukupno 48 nedelja i sadržao je 212 trenažnih dana, 42 takmičarska dana i 82 slobodna dana. Realizovano je 235 treninga u vodi i 107 treninga na suvom. Ukupan obim plivanja iznosio je 944 kilometra (prosečno po treningu 4.017 kilometara). Rad u vodi izražen u satima iznosio je 415 sati i 10 minuta (1 sat i 46 minuta po treningu). Na suvom je održano ukupno 107 treninga, odnosno izraženo u satima 169 sati i 25 minuta (prosečno 1 sat i 35 minuta po treningu). Količina rada izražena u preplivanim kilometrima i raspoređena po trenažnim zonama iznosila je: anaerobna alaktatna zona - 36.6 kilometara (3.88%), anaerobna laktatna zona - 20.7 kilometara (2.2%), aerobna zona maksimalnog intenziteta 17.7 kilometara (1.87 %), aerobna zona submaksimalnog intenziteta 56.1 kilometar (5.94 %) i aerobna zona srednjeg i malog intenziteta 812.9 kilometara (86.11 %).

**Zaključak.** Dati primer primenjenog modela trenažnog rada imao je sledeći efekat: Od rezultata postignutih u takmičarskoj sezoni 2007/2008, koji su iznosili 57.42 sekundi u disciplini 100 metara kraul i 26.67 sekundi u disciplini 50 metara kraul, sa bodovnim ekvivalentom od 806 i 748 fina bodova, sportista je u toku jednog makrociklusa (godinu dana) popravio takmičarski rezultat koji je u sledećoj sezoni (2008/2009) iznosio 56.45 sekundi u disciplini 100 metara kraul i 26.44 sekundi u disciplini 50 metara kraul sa bodovnim ekvivalentom od 848 i 768 fina bodova.

## PLANNING, PROGRAMMING AND REALIZATION OF MACROCYCLE TRAINING IN SPRINT FRONT CRAWL TECHNIQUE BASED ON THE EXAMPLE OF A TOP FEMALE SWIMMER

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**Introduction.** Without a constant insight into trainability of a sportsperson, it is not possible for a trainer to manage a training process nor for sportspeople to reach top form and achieve planned training objectives. The aim of this research is to describe all contents of trainings realized in a training cycle.

**Method.** Analysis of training documentation was carried out by using descriptive statistical method.

**Results.** This macrocycle training covered the period of 48 weeks and consisted of 212 training days, 42 competitive days and 82 days off. 235 trainings were realized in the swimming pool and 107 in the dryland. The volume of swimming was 944 km (approximately 4.017 km per training). The training load in water lasted for 415 hours and 10 minutes (1 hour and 46 mins per training), and dryland – 169 hours and 25 minutes (1 hour and 35 mins per training). Training load in kilometers swum and divided into training zones was as follows: anaerobic alactate zone – 36.6 km (3.88%), anaerobic lactate zone – 20.7 km (2.2%), aerobic zone of maximum intensity – 17.7 km (1.87%) and aerobic zone of medium and low intensity – 812.9 km (86.11%).

**Conclusion.** The practical application of the given training model had the following effect:

Compared to the results in competition season 2007/8 (Women’s 100m Freestyle – 57.42 sec), the swimmer improved her result in the course of one macrocycle (a year), which in the next year’s season (2008/9) was 56.45 sec for 100m Freestyle and 26.44 sec – 50m Freestyle.

# ANALIZA TAKMIČARSKE AKTIVNOSTI U FUNKCIJI DEFINISANJA MODELSKIH POKAZATELJA TAKTIKE PLIVANJA NA DEONICI OD 100 M

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**Uvod.** Cilj ovog rada je definisanje modelskih pokazatelja taktike plivanja vrhunskih plivača oba pola na distanci od 100m kod svih takmičarskih tehnika.

**Metod.** Taktika plivanja je procenjivana primenom metode indeksa. Odnos rezultata prvog dela deonice (prvih 50 m) i ukupnog rezultata definiše pokazatelj - Indeks Brzinske Izdržljivosti (IBI), i ukazuje na distribuciju intenziteta plivanja u toku trke na 100 m. U istraživanju su analizirani rezultati finalnih trka evropskih (2002., 2004. i 2008.) i svetskih (2005. i 2007.) prvenstava, kao i Olimpijskih igara (2004.) svih tehnika na 100 m. Taktički modeli plivanja su definisani sa 48 ajtema po tehnici u odnosu na pol (4 tehnike x 48 ajtema = 192 ajtema po polu; ukupno 384 ajtema). Sirovi rezultati su analizirani primenom multivarijantne statističke analize.

**Rezultati.** Kod plivača i plivačica u odnosu na tehniku utvrđene su sledeće modelske vrednosti IBI: 100m kral =  $0.4786 \pm 0.0062$  vs  $0.4815 \pm 0.0049$ ; 100m ledno =  $0.4862 \pm 0.0042$  vs  $0.4863 \pm 0.0040$ ; 100m prsno =  $0.4686 \pm 0.0044$  vs  $0.4713 \pm 0.0040$ ; 100m delfin =  $0.4660 \pm 0.0049$  vs  $0.4668 \pm 0.0057$ , respektivno. Utvrđeno je da postoji statistički značajna razlika IBI između različitih tehnika u funkciji pola i to:  $F=145.44$ ,  $p=0.000$  kod plivača i  $F=153.46$ ,  $p=0.000$  kod plivačica. U odnosu na pol (M/F) nije utvrđena statistički značajna razlika vrednosti IBI (plivači =  $0.4746 \pm 0.0094$ ; plivačice =  $0.4762 \pm 0.0091$ ;  $F=2.58$ ,  $p=0.109$ ).

**Zaključak.** Na osnovu dobijenih rezultata se može zaključiti da se taktički model plivanja (definisani kao distribucija intenziteta plivanja u toku trke) na deonici od 100 m ne razlikuje između polova, ali se statistički značajno razlikuje u odnosu na tehnike plivanja. U odnosu na parametar intenziteta najjednačnije se pliva lednom tehnikom (0.4862 i 0.4863 M/F, respektivno), dok se najnejednačnije pliva delfin tehnikom (0.4660 i 0.4668 M/F, respektivno). Na osnovu dobijenih rezultata se može pretpostaviti da se taktika plivanja na trci od 100 m treba različito pripremiti u zavisti od tehnike plivanja.

## ANALYSIS OF COMPETITIVE ACTIVITY IN FUNCTION OF DEFINING MODELING INDEXES OF 100-METER SWIMMING TACTICS

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**Introduction.** The aim of this paper is to define modeling indexes of swimming tactics of elite swimmers of both genders at 100 meters in all competitive techniques.

**Method.** Swimming tactics was evaluated by application of index method. The relation of the first part of section (first 50 m) and overall result defines the Speed Endurance Index (IBI), and indicates swimming intensity distribution in the course of 100-meter race. The research analyzed the results of final races in European (2002., 2004. and 2008.) and World (2005. and 2007.) Championships as well as in the Olympic Games (2004.) of all 100-meter techniques. Tactical swimming models are defined with 48 items per technique with regard to gender (4 techniques x 48 items = 192 items per gender; totaling to 384 items). Raw results were analyzed by multivariate statistical analysis.

**Results.** In both male and female swimmers the following IBI modeling values were established with regard to technique: 100m crawl =  $0.4786 \pm 0.0062$  vs  $0.4815 \pm 0.0049$ ; 100m backstroke =  $0.4862 \pm 0.0042$  vs  $0.4863 \pm 0.0040$ ; 100m breaststroke =  $0.4686 \pm 0.0044$  vs  $0.4713 \pm 0.0040$ ; 100m butterfly =  $0.4660 \pm 0.0049$  vs  $0.4668 \pm 0.0057$ , respectively. It was established that there is a statistically significant difference of IBI between different techniques in function of gender:  $F=145.44$ ,  $p=0.000$  in males and  $F=153.46$ ,  $p=0.000$  in females. With regard to gender (M/F) there was no statistically significant difference of IBI values (males =  $0.4746 \pm 0.0094$ ; females =  $0.4762 \pm 0.0091$ ;  $F=2.58$ ,  $p=0.109$ ).

**Conclusion.** Based on the obtained results it can be concluded that tactical swimming model (defined as distribution of swimming intensity in the course of the race) at 100-meter section is not different related to gender, but is statistically significantly different with regard to swimming techniques. With regard to intensity parameter, the most even swimming is by backstroke technique (0.4862 and 0.4863 M/F, respectively), while the most uneven swimming is achieved by butterfly technique (0.4660 and 0.4668 M/F, respectively). Based on the obtained results it can be assumed that swimming tactics in 100-meter race should be different depending on the swimming technique.

# POVEZANOST IZMEĐU KARAKTERISTIKA SILE VUČE MERENE METODOM PLIVANJA U MESTU I REZULTATSKOG NIVOVA NA 50 M PRSNIM STILOM KOD VRHUNSKIH PLIVAČA

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**Uvod.** Cilj rada je da se utvrdi povezanost između karakteristika sile vuče i rezultatskog nivoa na 50 m prsnim stilom kod vrhunskih plivača. **Metode.** Uzorak ispitanika je činilo 10 testovnih ajtema 5 vrhunskih plivača prsnim stilom (3 iz Brazila i 2 iz Srbije) koji su nastupali za seniorske reprezentacije svojih zemalja. Svi plivači su bili testirani dva puta metodom plivanja u mestu maksimalnim intenzitetom u trajanju od 30 s pomoću tenziometrijske sonde u takmičarskom mezociklusu. Analizirane su sledeće varijable sile vuče pojedinačnih ciklusa zaveslaja cele tehnike plivanja:  $F_{\max\text{FULLSTROKE}}$  – prosek maksimuma (pikova) sile vuče, izraženo u N;  $F_{\text{avgFULLSTROKE}}$  – prosek sile vuče, izraženo u N;  $\text{Imp}F_{\text{FULLSTROKE}}$  – prosek impulsa sile vuče, izraženo u Ns;  $\text{RFD}_{\text{FULLSTROKE}}$  – prosek sile vuče ostvarene u jedinici vremena (esplozivna sila), izraženo u N/s. Merene varijable su analizirane u apsolutnim i relativnim vrednostima, za koje je korišćena alometrijska metoda. Rezultatski nivo je procenjen bodovnim ekvivalentom rezultata dva kriterijska takmičenja izračunat primenom internacionalnog bodovnog sistema (International Point Score /IPS/). Povezanost prediktora (karakteristike sile vuče) i kriterija (IPS skor) je utvrđena primenom Pirsonove korelacije. **Rezultati.** IPS rezultata ispitanika je bio  $918 \pm 34$  boda. Deskriptivni pokazatelji varijabli su bili:  $F_{\max\text{FULLSTROKE}} = 448.5 \pm 70.2$  N,  $F_{\text{avgFULLSTROKE}} = 157.4 \pm 16.4$  N,  $\text{Imp}F_{\text{FULLSTROKE}} = 134.1 \pm 19.0$  Ns i  $\text{RFD}_{\text{FULLSTROKE}} = 1010.8 \pm 309.8$  N/s, za apsolute, odnosno  $F_{\text{RelFULLSTROKE}} = 24.69 \pm 3.01$  N $\cdot$ kg $^{0.667}$ ,  $F_{\text{avgRelFULLSTROKE}} = 8.70 \pm 0.88$  N $\cdot$ kg $^{0.667}$ ,  $\text{Imp}F_{\text{RelFULLSTROKE}} = 7.39 \pm 0.59$  Ns $\cdot$ kg $^{0.667}$  i  $\text{RFD}_{\text{RelFULLSTROKE}} = 55.41 \pm 15.18$  N/s $\cdot$ kg $^{0.667}$ , za relativne vrednosti. Rezultatima je utvrđena statistički značajna korelacija IPS i pokazatelje sile vuče kod:  $F_{\text{avgFULLSTROKE}} - r = 0.697$ ,  $p = 0.013$  i  $\text{Imp}F_{\text{RelFULLSTROKE}} - r = 0.670$ ,  $p = 0.017$ , kod apsolutnih i  $F_{\text{avgRelFULLSTROKE}} - r = 0.731$ ,  $p = 0.008$  kod relativnih vrednosti. **Zaključak.** Na osnovu dobijenih rezultata moguće je pretpostaviti da su ostvarena prosečna sila i impuls sile vuče dimenzije koje dominantno pozitivno utiču na takmičarsku uspešnost na 50 m kod vrhunskih prsaša sprintera.

## CONNECTION BETWEEN FEATURES OF TOWING FORCE BY THE METHOD OF SWIM-IN-PLACE AND RESULT LEVEL AT 50 METERS BREASTSTROKE IN ELITE SWIMMERS

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**Introduction.** The aim of the paper is to establish connection between features of towing force and result level at 50 meters breaststroke in elite swimmers. **Methods.** The sample of subjects were 10 testing items of 5 elite breaststroke swimmers (3 from Brazil and 2 from Serbia) who performed for senior national teams of their country. All the swimmers were tested twice by the method of swim-in-place with maximal intensity in the course of 30 sec by tensiometric probe in competitive mesocycle. The following variables of towing force of individual cycles of strokes of the entire swimming technique were analyzed:  $F_{\max\text{FULLSTROKE}}$  – average of maximum (picks) towing force, expressed in N;  $F_{\text{avgFULLSTROKE}}$  – average of towing force, expressed in N;  $\text{Imp}F_{\text{FULLSTROKE}}$  – average of towing force impulses, expressed in Ns;  $\text{RFD}_{\text{FULLSTROKE}}$  – average towing force realized in time unit (explosive force), expressed in N/s. The measured variables were analyzed in absolute and relative values, with allometric method. The result level was estimated by point equivalent of the result of two criterion competitions calculated by application of international scoring system (International Point Score /IPS/). The connection of predictors (features of towing force) and criteria (IPS score) was established by Pearson correlation application. **Results.** IPS of the subjects' results was  $918 \pm 34$  point. Descriptive indexes of the variables were:  $F_{\max\text{FULLSTROKE}} = 448.5 \pm 70.2$  N,  $F_{\text{avgFULLSTROKE}} = 157.4 \pm 16.4$  N,  $\text{Imp}F_{\text{FULLSTROKE}} = 134.1 \pm 19.0$  Ns and  $\text{RFD}_{\text{FULLSTROKE}} = 1010.8 \pm 309.8$  N/s, for absolute, i.e.  $F_{\text{RelFULLSTROKE}} = 24.69 \pm 3.01$  N $\cdot$ kg $^{0.667}$ ,  $F_{\text{avgRelFULLSTROKE}} = 8.70 \pm 0.88$  N $\cdot$ kg $^{0.667}$ ,  $\text{Imp}F_{\text{RelFULLSTROKE}} = 7.39 \pm 0.59$  Ns $\cdot$ kg $^{0.667}$  and  $\text{RFD}_{\text{RelFULLSTROKE}} = 55.41 \pm 15.18$  N/s $\cdot$ kg $^{0.667}$ , for relative values. The results established a statistically significant correlation between IPS and indexes of towing force in:  $F_{\text{avgFULLSTROKE}} - r = 0.697$ ,  $p = 0.013$  and  $\text{Imp}F_{\text{RelFULLSTROKE}} - r = 0.670$ ,  $p = 0.017$ , in absolute and  $F_{\text{avgRelFULLSTROKE}} - r = 0.731$ ,  $p = 0.008$  in relative values. **Conclusion.** Based on the obtained results it is possible to presume that the achieved average force and towing force impulse are dimensions which dominantly positively affect competitive successfulness at 50 meters with elite breaststroke swimmers.

## STUDIJA KOMPJUTERSKE SIMULACIJE ZA EFEKTE OTPORA U PLIVANJU

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**Uvod.** Kompjuterska dinamika fluida se primenjuje u mnogim oblastima za izračunavanje aerodinamičkih i hidrodinamičkih sila koje se javljaju u automobilskoj i avionskoj industriji, hemijskoj industriji, itd. Nedavno je ova moćna tehnika počela da se primenjuje u kretanju čovekovog tela kroz polje fluida. Cilj ove studije je da se odrede efekti hidrodinamičkih sila kada se dva ili više plivača nalaze jedan iza drugog.

**Metod.** Metod konačnih elemenata za rešavanje Navije-Stoksovih jednačina i jednačine kontinuiteta je primenjen za strujanje fluida oko dva plivača kada su potpuno potopljeni u vodi. Numeričke simulacije su računane za različita rastojanja između plivača (0.4–6.0 m) i za različite brzine plivanja (1.6–2.0 m/s). Usvojena je aproksimacija da se plivači ne kreću, a da fluid struji oko njih. Distribucije pritiska i brzina su računane za svako rastojanje i brzine ponaosob.

**Rezultati.** Utvrđeno je da se otpor vodećeg plivača smanjuje kako se brzina fluida povećava. Relativni koeficijent otpora drugog plivača je manji (oko 50% od prvog plivača) za najmanje rastojanje od 0.4 m. Ova vrednost raste progresivno sve dok rastojanje između plivača ne postane 6.0 m, gde je relativni koeficijent otpora drugog plivača oko 80% od prvog plivača. Rezultati pokazuju da je otpor drugog plivača jednak otporu prvog plivača na njihovom međusobnom rastojanju.

**Zaključak.** Može se zaključiti da su izračunata rastojanja koja dopuštaju plivačima da budu u istim hidrodinamičkim uslovima za vreme treninga i takmičenja. Takođe je pokazano da kompjuterska dinamika fluida može biti veoma efikasna u planiranju i optimizaciji treninga i takmičenja. Buduća istraživanja će uključiti dinamiku gde će se strujanje fluida razmatrati u funkciji vremena.

## COMPUTER SIMULATION STUDY FOR RESISTANCE EFFECTS IN SWIMMING

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**Introduction.** Computational fluid dynamics is implemented in many areas of application for the computation of the aerodynamic and hydrodynamic forces involved in the car and airplane industry, chemical industry etc. Recently this powerful technique started to be used in the human body motion through fluid field. The purpose of this study is to determine the effect of hydrodynamics forces when two or more swimmers are close to each other.

**Method.** A finite element method of solving Navier-Stokes equations and continuity equation is applied to the fluid flow around two swimmers in a drafting situation. Numerical simulations are conducted for various distances between swimmers (0.4–6.0 m) and swimming velocities (1.6–2.0 m.s<sup>-1</sup>). An approximation of the fixed swimmers and fluid flow motion around them is applied. Pressure and velocity distributions are computed for each one of the distances and velocities.

**Results.** It is found that the resistance of the leading swimmer decreased as the flow velocity increased. The relative drag coefficient of the back swimmer is lower (about 50% of the leading swimmer) for the smallest inter-swimmer distance (0.4 m). This value increases progressively until the distance between swimmers reached 6.0 m, where the relative drag coefficient of the back swimmer is about 80% of the leading swimmer. The results indicate that the resistance of the back swimmer is equal to that of the leading swimmer at distance above 6.5m.

**Conclusion.** It can be concluded that these distances allow the swimmers to be in the same hydrodynamic conditions during training and competitions. Also it is shown that computational fluid dynamics could be very useful in planning and optimizing training and competition. The future study will include dynamics where fluid flow will be treated in time dependence.

## RAZLIKE U PARAMETRIMA ZALETA U DISCIPLINI PRESKOK KOD VRHUNSKIH GIMNASTIČARA

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**Uvod.** Dobro izveden preskok u velikoj meri opredeljuje kvalitetno realizovan zalet. Gimnastičar mora da realizuje zalet optimalnom brzinom, kako bi omogućio efikasniju kontrolu skoka.

**Metod.** Na uzorku od šest vrhunskih gimnastičara, finalista na preskoku na svetskom prvenstvu u Debrecinu 2002. (Čuk & Karacsony, 2004) i dva najbolja gimnastičara iz Srbije (Paunović Miloš i Antić Aca) izvršena je analiza brzine zaleta na preskoku. Primenom sistema foto stanica detektovana je brzina poslednjih deset koraka, pre naskoka na dasku.

**Rezultati.** Utvrđeno je da od početka do kraja zaleta brzina progresivno raste kod svih takmičara. Statistički značajne razlike aritmetičkih sredina brzine zaleta između vrhunskih takmičara i Paunovića zabeležene su na početku zaleta (prva četiri koraka i u 7. koraku – na nivou od 0.05), a sve to u korist većih vrednosti brzine zaleta Paunovića. Statistički značajna razlika aritmetičkih sredina brzine zaleta između vrhunskih takmičara i Antića dobijena je samo u 1. koraku (na nivou od 0.05).

**Zaključak.** Uočeni su visoki potencijali naših takmičara kada je u pitanju prva faza preskoka. Na ovo ukazuju veoma bliske vrednosti brzine zaleta vrhunskim takmičarima. Moguće poboljšanje rezultata treba tražiti u promeni načina zaleta, krenuti nešto sporije, a svu energiju fokusirati na kraj zaleta i poslednji korak pred naskok na dasku.

## DIFFERENCES IN PARAMETERS OF THE RUNNING SPEED AT THE VAULT OF ELITE GYMNASTS

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**Introduction.** Good vault derived largely chooses quality realized run. The gymnast has to run with an optimal velocity, which will still allow him efficient control.

**Methods.** For a sample of six top gymnast finalists at the vault at the World Championship in Debrecen 2002 (Čuk & Karacsony, 2004) and two of the best gymnasts in Serbia (Paunovic Milos and Antic Aca) an analysis was conducted on the running speed at the vault. By implementation of photo stations was detected the speed of the last ten steps before contact with the board.

**Results.** It was found that, from the beginning to the end of running, the speed of all competitors increased progressively. Statistically significant differences of the running speed between elite athletes and Paunovic were recorded at the beginning of running (the first four steps in step 7 - the level of 0.05), all in favor of larger values of Paunovic's running speed. Statistically significant differences of the running speed between elite athletes and Antic was obtained only in step 1 (at the level of 0.05).

**Conclusion.** The observed high potential of our gymnasts when it comes to the first phase of vault. At this point very close to the value of running high-speed the best gymnasts. Please improve the results should be sought to change the way running, move somewhat more slowly, and focus all energy to the end and running the last step before springboard phase.

## KINEMATIC, DYNAMIC AND EMG PARAMETERS OF SQUAT JUMP AND DROP JUMP

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**Introduction.** In real motor situations, an eccentric-concentric muscle contraction is the most common type and manifests itself in take-off power. Take-off power is a special type of explosive power in eccentric-concentric conditions and is most often seen in cyclic, acyclic and combined movement structures. Its main characteristic is the utilisation of elastic energy in the eccentric-concentric cycle of a muscle contraction. The contribution of the elastic properties of the muscle-tendon complex depends on the velocity of the transition. This study aimed to: 1. Establish the main dynamic and kinematic parameters that generate the efficiency of vertical and drop jumps and 2. Establish the EMG activation of m. erector spinae, m. gluteus maximus, m. rectus femoris, m. biceps femoris, m. vastus lateralis, m. vastus medialis, m. tibialis anterior and m. gastrocnemius medialis in vertical and drop jumps.

**Method.** In the experimental procedures were two elite athletes – triple jumpers. A system consisting of nine CCD SMART-e 600 video cameras (BTS Bioengineering, Padua) with a 50 Hz frequency and 768 x 576 pixel resolution was used for a 3-D kinematic analysis of vertical jumps. The dynamic parameters of vertical and drop jumps were established by using two independent force plates (Kistler, Type 9286A). A 16-channel electromyograph (BTS Pocket EMG, Myolab) was used to analyse electromyographic activity (EMG).

**Results.** M. gastrocnemius medialis is one of the most important muscles in the production of mechanical energy in the kinetic chain. This is a two-joint muscle and can transfer energy between its segments. One-joint muscles generate the initial mechanical energy for vertical jumps, whereas two-joint muscles control the intermuscular coordination and the final vertical impulse. In a drop jump from 25 cm the ankle joint sustains the highest loading, followed by the knee joint and the hip joint.

**Conclusion.** The results of measuring different types of vertical and drop jumps provide us with fundamental information on the status and functioning of the neuromuscular system. Based on this information the training process can be far more accurately programmed and controlled in terms of power.

## KINEMATIČKI, DINAMIČKI I EMG PARAMETERI SKOKA IZ ČUČNJA I SKOKA U DUBINU

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**Uvod.** U stvarnim motoričkim situacijama, eksentrično-koncentrična kontrakcija mišića je najčešći tip i manifestuje se u snazi odskoka. Snaga odskoka je poseban tip eksplozivne snage u ekscentrično-koncentričnim uslovima i najčešće je prisutan u cikličnim, acikličnim i kombinovanim strukturama pokreta. Njena glavna karakteristika je korišćenje elastične energije u ekscentrično-koncentričnim ciklusima mišićne kontrakcije. Doprinos elastičnih svojstava kompleksa mišić-tetiva zavisi od brzine ovog prelaza. Ova studija ima za cilj da: 1. Odredi glavne dinamičke i kinematičke parametre koji doprinose efikasnosti skoka u vis i skoka u dubinu i 2. Odredi EMG aktivaciju mišića erector spinae, m. gluteus maximus, m. rectus femoris, m. biceps femoris, m. vastus lateralis, m. vastus medialis, m. tibialis anterior i m. gastrocnemius medialis kod skokova u vis i skokova u dubinu.

**Metod.** U eksperimentalnom procesu bila su dva vrhunska takmičara u troskoku. Za 3-D kinematičku analizu skoka u vis korišćen je sistem koji se sastoji od devet CCD SMART-e 600 video kamera (BTS Bioengineering, Padua) sa frekvencijom od 50 Hz i rezolucijom od 768 x 576 piksela. Dinamički parametri skoka u vis i u dubinu uspostavljeni su korišćenjem dve nezavisne platforme sile (Kistler, Type 9286A). Elektromiograf od 16 kanala (BTS Pocket EMG, Myolab) korišćen je za analizu elektromiografske aktivnosti (EMG).

**Rezultati.** M. gastrocnemius medialis je jedan od najvažnijih mišića u stvaranju mehaničke energije u kinematičkom lancu. Ovo je dvozglojni mišić i može da prenosi energiju među svojim segmentima. Jednozglobni mišići stvaraju početnu mehaničku energiju za skok u vis, dok dvozglojni mišići kontrolišu intermuskularnu koordinaciju i krajnji vertikalni impuls. U skoku sa visine od 25 cm skočni zglob trpi najveće opterećenje, a za njim slede zglobovi kolena i kuka.

**Zaključak.** Rezultati merenja različitih tipova skoka u vis i u dubinu daju nam osnovne podatke o statusu i funkcionisanju neuromišićnog sistema. Na osnovu ovih informacija trenajni proces može se mnogo preciznije programirati i kontrolisati u smislu snage.

## UTICAJ BRZINE ZAETA NA KINEMATIKU ZAGREBAJUĆEG POKRETA KOD SKOKA U DALJ

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**Uvod.** Nauka i praksa dokazuju neophodnost korišćenja zagrebajućeg pokreta u atletskim disciplinama u kojima se trči i skače, kako bi se ekonomičnije i intenzivnije vršilo preusmeravanje kretanja tela. Zagrebanje utiče na smanjenje kočećih impulsa i smanjenje gubitka horizontalne brzine težišta tela tokom trčanja. U poslednjem koraku zaleta kod svih atletskih skakačkih disciplina zagrebajući pokret ima velikog uticaja na kvalitet odskoka, a time i na postignut rezultat. Osnovni cilj ovog istraživanja je utvrđivanje uticaja brzine zaleta na kinematiku zagrebajućeg pokreta kod skoka u dalj na osnovu izmerenih kinematičkih varijabli.

**Metod.** U istraživanju je primenjena eksperimentalna metoda na uzorku od 90 skokova u dalj iz različitih dužina, odnosno brzina zaleta. Uzorak ispitanika se sastojao od 3 skakačice i tri skakača u dalj. Uzorak varijabli su činile dve kriterijumske (horizontalna brzina zaleta i dužina skoka u dalj) i jedanaest prediktorskih varijabli. Kinematičke varijable su izmerene 3D infracrvenim sistemom marke Qualisys na zatvorenom skakalištu za skok u dalj. Dobijeni podaci su obrađeni deskriptivnom i komparativnom statistikom.

**Rezultati.** Kod svih skokova je primećena slična kinematička šema izvođenja zagrebajućeg pokreta, što je omogućilo definisanje primenjenih varijabli. Rezultati pokazuju da postoji značajan uticaj brzine zaleta na sve kinematičke varijable zagrebajućeg pokreta. Nije pronađen statistički značajan uticaj zagrebanja na trajanje odskoka. Varijable zagrebanje i maksimalna vertikalna komponenta brzine skočnog zgloba nemaju uticaja na dužinu skoka, čime je potvrđen visok uticaj brzine zaleta i nagoveštena mogućnost bitnog uticaja zagrebajućeg pokreta na dužinu skoka. Najveće uticaje brzina zaleta ostvaruje na varijable maksimalne horizontalne brzine skočnog zgloba ( $R^2=0,782$ ,  $\text{sig}=0,00$ ), brzinu noge ( $R^2=0,405$ ,  $\text{sig}=0,00$ ) i maksimalno ubrzanje skočnog zgloba ( $R^2=0,380$ ,  $\text{sig}=0,00$ ) i one najviše utiču na dužinu skoka.

**Zaključak.** Utvrđena međuzavisnost ukazuje na opravdanost i potrebu primene posmatranih varijabli, kao i neophodnost primene adekvatnih biomehaničkih procedura za analiziranje tehnike skoka u dalj.

## INFLUENCE OF THE APPROACH RUN SPEED ON THE ACTIVE LANDING ACTION KINEMATICS IN LONG JUMP

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**Introduction.** Science and practice have been proving the necessity to use active landing action in running and jumping track and field events, in order to re-direct more efficiently and intensely body movement. Active landing affects the reduction of braking impulse as well as reduction of loss of horizontal speed of body gravity center in the course of running. In the last step of the approach run in all athletic jumping events, an active landing action vitally affects the takeoff quality, and therefore the achieved result. The basic aim of this research is to establish the influence of approach run speed on the active landing action kinematics in long jump based on the measured kinematics variables.

**Method.** An experimental method was conducted in this research on a sample of 90 long jumps from various distances, i.e. approach run speed. The sample of subjects included three female and three male long jumpers. The sample of variables included two criterion (horizontal approach run speed and length of long jump) and eleven predictor variables. The kinematics variables were measured with a 3D infrared system Qualisys in the indoor long jump site. The obtained data were elaborated by descriptive and comparative statistics.

**Results.** A similar kinematics scheme was observed in all jumps related to clawing action performance, which enabled defining of the applied variables. The results of the study indicate that there is a significant influence of approach run speed on all kinematics variables of clawing action. No statistically significant influence of the clawing action to takeoff duration has been identified. The variables of clawing and maximal vertical component of ankle speed do not affect the length of the jump, which confirmed high influence of approach run speed, suggesting also the possibility of essential influence of clawing action to length of the jump. The greatest influence of the approach run speed is realized in the variables of maximal horizontal speed of the ankle ( $R^2=0,782$ ,  $\text{sig}=0,00$ ), leg speed ( $R^2=0,405$ ,  $\text{sig}=0,00$ ) and maximal acceleration of the ankle ( $R^2=0,380$ ,  $\text{sig}=0,00$ ) and they affect most the length of the jump.

**Conclusion.** The established correlation indicates to justification and necessity to apply the observed variables and to implement the appropriate biomechanical procedures for analyzing long jump technique.

## UTJECAJ NEKIH KINEMATIČKIH PARAMETARA NA REZULTAT SKOKA S MOTKOM

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**Uvod.** Osnovni cilj ovog istraživanja je utvrđivanje relacija između 12 kinematičkih parametara (prediktorski skup) i rezultatske uspješnosti (dostignuta visina) u skoku s motkom. Pokušati će se utvrditi odstupanja vrijednosti kinematičkih parametara u inicijalnim i finalnim mjerenjima.

**Metod.** Mjerenja su provedena u identičnim uvjetima (duljina zaleta, hvat motke, tvrdoća motke, broj skokova) i u razmaku od sedam mjeseci. Oba mjerenja su provedena kroz tri trening natjecanja (svakih 5 dana) na kojima je ispitanik učinio po 24 skoka. Pauza između skokova je bila 5' do 7'; duljina zaleta = 12 trčućih koraka; hvat motke 4,10; tvrdoća 18,5. Ispitivanje je provedeno na jednom ispitaniku, juniorskom reprezentativcu Hrvatske (18 godina; 181 cm; 72 kg). Rezultati su prikupljeni sa tri kamere (50 Hz; 1/1000 sec) i analizirani pomoću APAS sustava i Statistike 7.0. Učinjena je digitalizacija, 3D transformacija, filtracija podataka, izračunavanje kinematičkih parametara te deskriptivna statistika i regresijska analiza.

**Rezultati.** Ostvarene vrijednosti kinematičkih parametara u finalnom mjerenju razlikuju se od istih ostvarenih u inicijalnom mjerenju. U oba slučaja rezultati regresijske analize ukazali su da postoji značajna multipla povezanost između prediktorskih varijabli i rezultatske uspješnosti u skoku s motkom što se može pripisati razini napredovanja u tehnici. I u prvom (Zagorac, i sur., 2008), kao i u drugom mjerenju, samo jedan parametar pokazao se kao značajan pokazatelj uspješnosti u skoku s motkom (M%-maksimalno savijanje motke).

**Zaključak.** Može se zaključiti da su relacije između prediktora i kriterija ostale iste u oba slučaja. Ostvarena je veća rezultatska efikasnost u drugom mjerenju zahvaljujući boljoj ukupnoj sportskoj pripremi skakača i prikladnoj tehničkoj usvojenosti pojedinih dijelova, kao i cijelog skoka s motkom. S obzirom da postoji granica za maksimalno rezultatsko ostvarenje u ovoj disciplini, preporuča se ponoviti ovakva istraživanja s izmijenjenim karakteristikama prilikom registracije parametara skoka (veća motka, veća tvrdoća, viši hvat, duži zalet).

## THE INFLUENCE OF SOME KINEMATICS PARAMETERS ON RESULT OF POLEVAULT

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**Introduction.** The basic goal of this research is to determine the relation between 12 kinematics parameters (prediction group) and results affirmation (reached height) in pole vault. We will try to determine deviations of kinematics parameters values in the initial and final measurements.

**Method.** Measurements have been conducted in identical conditions (the length of approach, grip to the pole, firmness of the pole, number of jumps) and in the interval of 7 months. Both measurements have been conducted through 3 practise competitions (every 5 days) in which the examinee has made 24 jumps. Pause between jumps was 5 to 7 minutes, length of the approach 12 running steps, pole grip 4,10; firmness 18.5. Measurement has been made on one examinee, Croatian junior representative (18 years old male, 181 cm tall, and 72 kg). The results have been collected using 3 cameras (50 Hz; 1/1000 sec) and analysed with APAS system and statistics 7.0. Digitalisation, 3D transformation, filtration of data, calculation of kinematics parameters, descriptive statistics and regression analysis has all been made/calculated.

**Results.** Accomplished values of kinematics parameters in the final measurement differ from the values accomplished in the initial measurement. In both cases the results of regression analysis indicated that there is a significant multiple connections between prediction variables and resulting efficacy in pole vault which can be referred to the level of advancement in technique. Both in the first measurement (Zagorac and ass, 2008) and in the second measurement, only one parameter appeared as a relevant index of efficacy in pole vault (M% - maximum bending of the pole).

**Conclusion.** It can be concluded that relations between predictions and criteria remained the same in both cases. A higher result efficacy has been accomplished in the second measurement due to the better over-all preparation of the jumper and appropriate technical embracement of parts of the jump as well as the whole pole vault technique. Considering that there is a limit for maximum result achievement in this discipline, it is recommended that these case studies are repeated with altered characteristics when registrating parameters of the jump (higher pole, increased firmness, higher grip, longer approach).



## TENDENCIJE RAZVOJA TAKTIKE IGRE KROZ ANALIZU USPEŠNIH NAPADA NA XVI, XVII I XVIII SVETSKOM PRVENSTVU U FUDBALU

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**Uvod.** Predmet ovog istraživanja su identifikovani uspešni napadi na XVI, XVII i XVIII Svetskom prvenstvu u fudbalu i ispoljeni odnosi koji su bitni za utvrđivanje određenih tendencija razvoja fudbalske igre na planu taktike. Cilj istraživanja je utvrđivanje ispoljene razlike u uspešnim napadima koji su završeni udarcem na gol, na XVI, XVII i XVIII Svetskom prvenstvu.

**Metod.** Uzorak ispitanika čine ispoljavanja četiri prvoplasirane reprezentacije na tri poslednja Svetska prvenstva u fudbalu, što znači da je ukupan broj analiziranih utakmica, na jednom prvenstvu iznosio 28, ili 84 na tri Svetska prvenstva. Uspešni napadi klasifikovani su na neprecizne, precizne i efikasne. Podaci dobijeni u istraživanju obrađeni su postupcima deskriptivne statistike, a iz prostora komparativne statistike, faktorskim modelom analize varijanse (ANOVA), preko Kruskal-Wallis testa posmatrane su razlike u uspešnosti napada.

**Rezultati.** Rezultati ove analize ukazuju da se broj uspešnih napada značajno razlikuje na tri predhodna Svetska prvenstva. Najveći broj uspešnih napada imale su ekipe na XVI Svetskom prvenstvu (18 po utakmici), dok je na poslednjem Svetskom prvenstvu taj broj znatno manji (prosečno 11). Takođe, primetan je porast u procentu preciznih napada (1998 - 30%, 2002 - 33%, 2006 - 38%), dok je broj efikasnih napada, opao sa 1.9 u proseku (1998.) na 1.5 (2006.) prosečno po ekipi na jednoj utakmici.

**Zaključak.** Na osnovu rezultata ove analize može se reći da se orijentacija igre ekipa na Svetskim prvenstvima sve više okreće organizaciji odbrane svoga gola. Napadačke aktivnosti usmerene su ka povećanju efikasnosti prilikom udaraca na gol protivnika, dakle veliki "ulog", odnosno važnost takmičenja ne dozvoljava otvorenu igru na gol više.

## TENDENCIES IN THE DEVELOPMENT OF GAME TACTICS BY WAY OF ANALYSING SUCCESSFUL ATTACKS ON XVI, XVII AND XVIII WORLD CUP

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**Introduction.** The objects of this research are identified successful attacks on XVI, XVII and XVIII World Cup and expressed relationships and attitudes which are important for establishing certain tendencies in the development of football game on the tactics plan. The aim of the research is establishing expressed differences in successful attacks which ended in taking shots at the goal. On XVI, XVII and XVIII World Cup.

**Methods.** The sample for this research consists of behavior of four top-ranked team on the last four World Cups, meaning that the total number of analyzed games is 28 on one Cup that is 84 on all three World Cups. Successful attacks are classified into precise, imprecise and efficient. All the data obtained through this research are processed using methods of descriptive statistics, and from the area of comparative statistics differences in the efficiency of attacks are observed by factor analysis of variance model (AHOPA) and Kruskal-Wallis test.

**Results.** The results of this analysis indicate that the number of successful attacks differ significantly over the last three World Cups. The teams on XVI World Cup had the biggest number of successful attacks (18 per match), while on the last Cup that number decreased markedly (11 on average). In addition there is an evident rise in the percentage of precise attacks (1998 - 30%, 2002 - 33%, 2006 - 38%), whereas the number of efficient attacks dropped from 1.9 on average per team per match (1998) to 1.5 (2006).

**Conclusion.** On the basis of the results of this analysis it can be concluded that the teams on World Cups moved the focus of the game to the organisation of defence around their own goals. Attacking activities are directed towards the improvement in efficiency shots towards opponent's goal, i.e. the importance of the competition does not allow open game to the goal any more.

## ANALIZA PRIMENE OSNOVNIH UDARACA U FUDBALU U ZAVISNOSTI OD POZICIJE IGRAČA U TIMU

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**Uvod.** Posmatranjem i stručnom analizom takmičarske aktivnosti igrača u igri, mogu se definisati svi relevantni faktori uspešnosti sa aspekta tehničkih sposobnosti fudbalera. Cilj ovog istraživanja je utvrđivanje razlika u primeni osnovnih udaraca po lopti, između igrača koji igraju na različitim pozicijama u timu, ispoljenim na poslednjem, XVIII Svetskom prvenstvu 2006. u Nemačkoj.

**Metod.** Ukupan uzorak ispitanika čini 280 nastupa igrača, 4 prvoplasirane reprezentacije na Svetskom prvenstvu u Nemačkoj, 2006. Analizom osnovnih udaraca po lopti u toku igre, formiran je posmatrački list, a igrači su podeljeni na 5 subuzoraka ispitanika prema utvrđenim kriterijumima fudbalske teorije i prakse. Na osnovu klasifikacije tehnike fudbala posmatrano je ukupno 10 osnovnih udaraca po lopti i faktorskim modelom analize varijanse (ANOVA), preko LSD testa posmatrane su razlike u primeni pojedinih udaraca u zavisnosti od pozicije igrača u timu.

**Rezultati.** Defanzivni manevarski igrači izvode daleko najveći broj udaraca unutrašnjom stranom stopala. Napadački orjentisani igrači raznovrsniji su u primeni udaraca po lopti tako što, procentualno, koriste veći broj različitih udaraca u svojim akcijama. Igrači koji igraju na poziciji centralnog defanzivnog igrača izvode značajno veći broj udaraca glavom, odskokom sa jedne noge, od igrača koji igraju na ostalim pozicijama. Udarac unutrašnjom stranom hrpta stopala (duga lopta) karakteristika je igrača koji igraju po bočnim pozicijama.

**Zaključak.** Rezultati dobijeni uporednom analizom primene osnovnih udaraca u fudbalu, u zavisnosti od pozicije igrača u timu, ukazuju na razlike u njihovoj primeni i profilisanje određenih grupa fudbalera, koji po zastupljenosti pojedinih tehničkih elemenata determinišu svojevrni model igre.

## THE ANALYSIS OF IMPLEMENTATION OF THE BASIC KICKS IN FOOTBALL DEPENDING ON THE PLAYERS POSITION IN THE TEAM

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**Introduction.** All relevant factors of efficiency from the aspect of technical abilities of football players can be defined by observation and expert analysis of competitive activities of the players in the game. The aim of this research is to establish the differences in the use of basic kicks on ball, among players who play on different positions in the team, as seen on the last XVIII World Championship held in Germany in 2006.

**Method.** The total sample for the research consists of 280 performances of the players from four top-ranked national teams on the World Championship in Germany. After analyzing basic kicks on ball, observation sheet is formed, and the players are divided into 5 sub samples according to already established criteria of football theory and practice. On the basis of football technique classification total of 10 kicks on ball have been observed. In addition, the use of each kick depending on the player's position in the team has been researched using factor analysis of variance model (AHOBA), by LSD test.

**Results.** Defensive midfield players perform by far the greatest number of kicks using inner side of foot. Players in attacking positions are more diverse in the use of kicks on ball since they use bigger number of various kicks in their actions. Players on central back positions perform significantly greater number of kicks with head, jumping of one foot than players in other positions. Instep kick is typical of players in wing positions.

**Conclusion.** The results, obtained after comparative analysis of the use of basic kicks in football depending on player's position in the team, show the differences in their use and establishing certain groups of football players, who determine specific model of the game on the basis of particular technical elements.

## **UTICAJ POJEDINIH SPECIFIČNIH SPOSOBNOSTI NA EFIKASNOST U FUDBALU (NA EVROPSKOM PRVENSTVU 2008. GODINE U ŠVAJCARSKOJ I AUSTRIJI)**

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**Uvod.** Analiza efikasnih napada u dužem vremenskom periodu je predmet istraživanja čiji se rezultati implementiraju direktno u praksu. Cilj ovog istraživanja je identifikacija i analiza uspešnih napada koji su završeni efikasnim udarcem na gol na poslednjem Evropskom prvenstvu u fudbalu 2008. godine u Austriji i Švajcarskoj.

**Metod.** Ovim istraživanjem analizirane su sve utakmice na kojima je bilo efikasnih napada na Evropskom prvenstvu 2008. godine u fudbalu, tačnije 29 utakmica. Efikasni napadi analizirani su kroz sledeće varijable: broj igrača učesnika, vremensko trajanje, broj dodavanja, broj vođenja i driblinga u samoj organizaciji napada i udaljenost prilikom realizacije, kao i sama tehnika izvođenja udarca na gol prilikom postizanja gola. Nakon formiranja protokola posmatranja sve informacije prikupljene su praćenjem video materijala preuzetih sa televizijskih kanala RTS i Eurosport.

**Rezultati.** Od ukupno 77 efikasnih napada najveći procenat (27%) su napadi koji su trajali između 15-24 sekunde. Uspešne akcije koje predhode postizanju gola, sprovode se u najvećoj meri saradnjom 2-4 igrača (58%), sa najčešće 2-4 dodavanja (48%). Najveći broj golova postignut je udarcem "iz prve" (82%), desnom nogom (52%) sa rastojanja 5-11 metara od gola (48%), unutrašnjom stranom stopala.

**Zaključak.** Rezultati ove analize ukazuju da je predhodno Evropsko prvenstvo bilo veoma efikasno sa izrazitim karakteristikama ofanzivne igre, i u tom pravcu može se reći da je savremeni, evropski fudbal napadačka igra sa velikim brojem udaraca na gol. Efikasne akcije imale su odlike kontinuiranog napada, gde se pre svega kroz posed lopte dolazilo u situacije postizanja gola.

## **THE EFFECT OF PARTICULAR SPECIFIC ABILITIES ON EFFICIENCY IN FOOTBALL (ON THE EUROPEAN CHAMPIONSHIP IN SWITZERLAND AND AUSTRIA IN 2008)**

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**Introduction.** The subject of the research is the analysis of efficient attacks in long-term period, whose results are implemented directly into practice. The aim of this research is identification and analysis of successful attacks which ended in taking efficient shot on the goal on the last European Championship in Switzerland and Austria in 2008.

**Methods.** All the matches with efficient attacks on the European Championship in 2008 are analyzed in this research, 29 matches in total. Efficient attacks are analyzed using the following variables: the number of players-participants, lasting time, the number of passes, the number of leading the ball and dribbling in the organization of the attack itself and the distance when taking a shot at the goal and scoring, as well as its technique. After creating an observation protocol all the pieces of information are gathered by watching video materials taken from television channels RTS and Eurosport.

**Results.** Out of 77 efficient attacks in total, the biggest percentage is taken by the attacks which lasted between 15 and 24 seconds. More successful actions which precede the scoring, are undertaken through cooperation of 2 to 4 players (58%), most often with 2 to 4 passes (48%). the greatest number of goals was scored by first-contact shot (82%) from the distance of 5 to 11 m from the goal (48%), using inner side of the foot.

**Conclusion.** Results of this analysis indicate that the last European Championship was rather efficient with particular characteristics of offensive play, thus it can be said that modern European football is attacking game with a great number of shots at the goal. Efficient actions have characteristics of continuous attack, where above all, ball possession leads to creating goal scoring opportunities.

## PROMENE U ISPOLJAVANJU SNAGE KOŠARKAŠICA NAKON PRIPREMNOG PERIODA

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**Uvod.** Pripremni period kod košarkašica predstavlja veoma važan deo godišnjeg ciklusa treninga. Jedan od osnovnih ciljeva pripremnog perioda je poboljšanje sposobnosti ispoljavanja snage. Studija razmatra promene koje su se dogodile u pojedinim ispoljavanjima snage košarkašica nakon rada u pripremnom periodu (66 dana).

**Metod.** Tokom pripremnog perioda 12 vrhunskih košarkašica košarkaškog kluba «Hemofarm» (8 aktuelnih i 4 bivše reprezentativke Jugoslavije / SCG) su bile podvrgnute različitim trenažnim uticajima u okviru energetsko – motoričke i tehničko – taktičke pripreme, unutar kojih je sproveden i program treninga snage. Primenjeni su izotonični testovi (vežbe) snage sa procenom jedne maksimalne repeticije (1RM): potisak sa ravne klupe (BP), potisak sa kose klupe (KBP), polučučanj (SQ), potisak nogama na trenažeru (LP), i test vertikalni skok u vis sa dohvatom (VSSD) iz koga je izvedena varijabla snaga nogu (SN). Osim ovih varijabli merena je i telesna masa (TM). Prvo merenje je sprovedeno 4 dana nakon početka pripremnog perioda, a drugo merenje 1 dan nakon početka takmičarskog perioda. Podaci su obrađeni osnovnom deskriptivnom statistikom. Za testiranje značajnosti razlika između rezultata prvog i drugog merenja primenjen je T - test (paired samples statistics). Korišćen je statistički program SPSS16.

**Rezultati.** Srednje vrednosti kod svih varijabli ispoljavanja snage govore o skromnom nivou i statusu snage kod ispitanica. Kod svih varijabli ispoljavanja snage je došlo do značajnog poboljšanja rezultata ( $p < .01$ ). Telesna masa se nije značajno promenila ( $p < .94$ ).

**Zaključak.** Primenjeni program treninga snage u pripremnom periodu, uz ostale trenažne aktivnosti, izazvao je značajne promene u svim varijablama ispoljavanja snage u smislu poboljšanja rezultata. Srednje vrednosti rezultata na finalnom merenju su i dalje niže u odnosu na rezultate koje postižu košarkašice na internacionalnom nivou, što govori o potrebi daljeg sistematskog rada na razvoju snage košarkašica.

## CHANGES OF STRENGTH AND POWER OF FEMALE BASKETBALL PLAYERS AFTER PREPARATION PERIOD

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**Introduction.** Preparation period in basketball is very important part of one-year training cycle. One of the basic aims of preparation period is improvement of basketball players' strength and power. This study considers changes which happened in some demonstration of strength and power of female basketball players after preparation period work (66 days).

**Method.** During preparation period, 12 varsity female basketball players of BK "Hemofarm" (8 actual and 4 former players of national team of Yugoslavia / Serbia and Montenegro) were expose to different condition training influences, including strength and power program. Isotonic 1 RM tests (exercises) of strength were applied: bench press (BP), incline bench press (IBP), semisquat (SSQ), leg press (LP). Vertical jump test (VJ) was also applied and calculated leg power (LEP). Initial measurement was done 4 days after beginning of preparation period, and final measurement was done 1 day after start of competition period. Data analysis was done with basic descriptive statistics. Significance of differences between first and second measurements was test with T – test (paired samples statistics) in program SPSS16.

**Results.** Means of results of all tests on first measurement showed poor level and status of female basketball players' strength and power. Results of second measurement shown significant improvement in all tests ( $p < .01$ ). Body weight was not change ( $p < .94$ ).

**Conclusion.** Applied strength and power program during preparation period, in accordance with others activity, provoked significant changes and improvements in all strength and power tests. Means of results of all tests on second measurement were lower compare with results of varsity international level female basketball players. That point out to need of systematic strength and power training in the future.

## EKSTERNA VALIDNOST RAZLIČITIH VARIJABLI JAČINE ZA PREDIKCIJU SPOSOBNOSTI SKAKANJA KOD ELITNIH KOŠARKAŠA

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**Uvod.** Cilj studije je bio da se utvrdi eksterna validnost različitih varijabli standardnog testa jačine (STJ) za predikciju sposobnosti skakanja kod elitnih košarkaša. **Metod.** Petnaest elitnih košarkaša (uzrast 23±3 godine, telesna masa 104±14 kg i visina 205±9 cm) je učestvovalo u studiji. Varijable jačine, maksimalna sila (Fmax) i vremenski integrisana sila na intervalima 150, 200 i 250 ms, kao i maksimalna brzina razvoja sile (BRSmax) i BRS izračunata na intervalima 150, 200 i 250 ms, su dobijene iz bilateralne i unilateralne maksimalne izometrijske kontrakcije mišića opružaća nogu i normalizovane telesnom masom. Takođe, vertikalni skok iz polučučnja, vertikalni skok sa počučnjem sa i bez zamaha rukama, vertikalni skok sa počučnjem sa jedne noge i sedam uzastopnih vertikalnih skokova su bili primenjeni za procenu snage mišića ekstenzora nogu. **Rezultati.** Mali do umereni koeficijenti korelacije su dobijeni između varijabli STJ (Fmax, BRSmax, F150-250ms i BRS150-250ms) i varijabli snage koje su dobijene iz skokova (visina i faza leta/faza kontakta). Međutim, apsolutne vrednosti korelacionih koeficijenata dobijenih za F150-250 ms i BRS150-250 ms bili su značajno veći nego odgovarajući koeficijenti dobijeni za Fmax and BRSmax ( $W=2729$ ;  $p=0.003$ ; Viloksonov neparametrijski test). **Zaključak.** Ova studija je pokazala malu do umerenu eksternu validnost varijabli STJ za predikciju funkcionalnih zadataka koji podrazumevaju ispoljavanje velike sile u ograničenom vremenskom periodu (npr. skokovi). Takođe, pokazano je da sila i brzina razvoja sile, dobijene na kraćim vremenskim intervalima (npr. 150-250 ms) koji odgovaraju vremenskom trajanju primenjenih skokova, imaju veću eksternu validnost u odnosu na standardne varijable BRSmax i Fmax. Međutim, iako varijable dobijene na početku kontrakcije pokazuju nešto veću eksternu validnost, buduća istraživanja trebalo bi da idu u smeru evaluacije novih testova mišićne funkcije koji bi mogli bolje da prate šemu nervne aktivacije rapidnih i drugih funkcionalnih zadataka.

## EXTERNAL VALIDITY OF STRENGTH PREDICTORS OF JUMPING PERFORMANCE IN ELITE BASKETBALL PLAYERS

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**Introduction.** The main aim was to examine external validity of various variables of standard strength test (SST) for predicting the jumping performance in elite basketball players. **Methods.** Fifteen elite male basketball players (age 23±3 years, body mass 104±14 kg, height 205±9 cm) participated in the present study. The derived strength variables, such as the maximum force (Fmax), force impulse calculated over the time intervals of 150, 200 and 250 ms, and both the maximum rate of force development (RFDmax) and RFD calculated over the time intervals 150, 200 and 250 ms, were determined during bilateral and unilateral maximal isometric contractions of leg extensors muscles and body size normalized. In addition, the squat jump, countermovement jump with and without arm swing unilateral countermovement jumps and seven repeated jumps were applied for the assessment of leg extensor power. **Results.** Low to moderate correlation coefficients were obtained between the strength (Fmax, RFDmax, F150-250ms and RFD150-250ms) and power variables obtained from the applied jump tests (height and t flight/t contact). However, absolute values of correlation coefficients observed for F150-250 ms and RFD150-250 ms were significantly higher than the corresponding coefficients observed for Fmax and RFDmax ( $W=2729$ ;  $p=0.003$ ; Wilcoxon signed-rank tests). **Conclusions.** The present study revealed low to moderate external validity of SST regarding the prediction of functional tasks based on muscle actions that provide limited time for force exertion (i.e. jumps). However, force and rate of force development obtained from short time intervals (e.g., 150-250 ms) that correspond to the duration of the applied jump tests showed higher external validity than the most often used variables RFDmax and Fmax. Since the variables derived at beginning of force contractions could have somewhat higher external validity, the future research should be focused upon evaluation of novel tests of muscle function that could better capture neural activation pattern of rapid and short lasting functional tasks.

# AN AUTOMATIC TRACKING ANALYSIS OF THE MOVEMENT VELOCITIES OF NATIONAL LEVEL BASKETBALL GUARDS, FORWARDS AND CENTRES

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**Introduction.** Knowledge of the physical demands undertaken by basketball players during the match can help coaches to develop appropriate training regimes and optimise players' performances. A notational analysis has been assessed on many occasions to evaluate a player's activity profiles for different types of player. Consequently, movement patterns were not described in physical units. The aim of this study is to analyse players' movement intensities in respect to different velocity classes and to distinguish differences between different types of players by using computer-vision technology.

**Methods.** 15 players were recorded with two video cameras fastened to the ceiling. Digital images were processed by the SAGIT tracking system and movement intensity was classified into 4 different velocity categories (walking, slow run, fast run and sprint). The percentage of time players spent in each velocity class was assessed using a three way repeated measures ANOVA.

**Results.** The two way interactions between velocity class and quarter ( $F = 2.34$ ,  $df = 9$ , 405;  $p < 0.05$ ) and velocity class and position ( $F = 11.64$ ,  $df = 6$ , 405;  $p < 0.001$ ) suggested that the different playing positions undertook different amounts of work and these were influenced by the period of the game in which they were playing. Specifically the amount of time spent in slower movement classes tended to be greater during the earlier time periods and as time progressed the amount of time spent in faster movement categories decreased.

**Conclusion.** These results suggest that further work is needed to assess the practical application of the findings. For example, to what extent does a player's velocity relate to the different role being undertaken. For example when players gain possession of the ball as the play transits from defence to offence are the highest velocities reached? Therefore, we need to explore movement patterns in defence, offence and during transitions.

## ANALIZA AUTOMATSKOG PRAĆENJA BRZINE KRETANJA ODBRAMBENIH IGRAČA, NAPADAČA I CENTARA NA NACIONALNOM NIVOU

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**Uvod.** Znanje o fizičkim zahtevima košarkaša tokom utakmice može da pomogne trenerima da razviju odgovarajuće režime treniranja i optimalizuju učinak igrača. Analiza notacijom je bila ocenjivana u mnogo prilika kako bi se vrednovali profili igračke aktivnosti za različite tipove igrača. Shodno tome, obrasci kretanja nisu opisani fizičkim jedinicama. Cilj ovog istraživanja je da se analiziraju intenziteti kretanja igrača u pogledu različitih klasa brzine i da se ustanove razlike između tipova igrača korišćenjem kompjuterske-vizuelne tehnologije.

**Metode.** 15 igrača je snimano sa dve video kamere pričvršćene na plafon. Digitalne slike su obrađene AGIT sistemom za praćenje, a intenzitet kretanja je svrstan u 4 različite kategorije brzine (hodanje, sporo trčanje, brzo trčanje i sprint). Procenat vremena koje su igrači proveli u svakoj kategoriji brzine je ocenjivan korišćenjem na tri načina ponovljenih mera ANOVA.

**Rezultati.** Dvosmerne interakcije između kategorije brzine i četvrtine ( $F = 2.34$ ,  $df = 9$ , 405;  $p < 0.05$ ) i kategorije brzine i položaja ( $F = 11.64$ ,  $df = 6$ , 405;  $p < 0.001$ ) sugerišu da različite pozicije u igri angažuju različitu količinu rada i da su pod uticajem perioda igre u kome su igrali. Posebno, količina vremena koje se provede u kategoriji sporog kretanja ima tendenciju da je veća tokom ranijih vremenskih perioda i kako vreme napreduje količina vremena provedenog u bržim kategorijama kretanja opada.

**Zaključak.** Ovi rezultati sugerišu da je potreban dodatni rad kako bi se ocenila praktična primena ovih nalaza. Na primer, do koje mere je brzina igrača u relaciji sa različitim ulogom koja se preduzima. Na primer kada igrači dobiju loptu u posed dok igraju na prelazu iz odbrane u napad, da li se postiže najviša brzina? Stoga, je potrebno da istražimo obrasce kretanja u odbrani, napadu i tokom prelaska.

## VREDNOVANJE INDIVIDUALNOG I EKIPNOG UČINKA NA VRHUNSKIM TAKMIČENJIMA RUKOMETAŠA

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**Uvod.** Vrednovanje (ocenjivanje) pojedinačnog i (ili) ekipnog učinka na velikim sportskim takmičenjima, posebno u sportskim igrama kao što je rukomet, predstavlja ozbiljan problem. Površno posmatrano, „ogledalo“ uspešnosti je - konačan plasman. Dakle, prvaku sleduje najviša, a poslednjem, najniža ocena! Međutim, sportski stručnjaci znaju da u postupku ocenjivanja ostvarenog učinka, kako pojedinačnog, tako i ekipnog, treba uzeti u obzir čitav niz raznorodnih činilaca. U sportskim igrama posebno, identifikovan je određeni broj tzv. parazitarnih faktora, od kojih, nekad u značajnoj meri, zavisi učinak pojedinih igrača ili čitavog tima, kako na pojedinim utakmicama, tako i na čitavom prvenstvu (turniru).

**Metod.** Radi se o transferzalnom istraživanju, empirijskog karaktera. Prikupljanje podataka je obavljeno posmatranjem odgovarajućih tehničko-taktičkih elemenata iz faze odbrane i napada, na svim utakmicama koje je muška seniorska rukometna reprezentacija Srbije odigrala na Svetskom prvenstvu 2009. godine. Evidentiranje podataka vršeno je u realnom vremenu, što je od osobe koja je to radila zahtevalo izuzetnu osposobljenost, kako u pogledu informatičkih, tako i neposrednih, stručno-sportskih (rukometnih) znanja.

**Rezultati.** Posebnom statističkom procedurom praćen je i detaljno obrađen učinak tima u celini, kao i individualni učinak svih igrača, na svim utakmicama. Primera radi, utvrđeno je da je uspešno (pogotkom) završeno 45% svih izvedenih napada, nepreciznih šuteva bilo je 36%, a u 19% slučajeva lopta je izgubljena iz nekog drugog razloga. Individualno, Momir Ilić je ocenjen kao nauspešniji igrač. Konkretno, on je postigao 52 gola, imao 26 asistencija, 11 osvojenih lopti, itd. **Zaključak.** Dobijeni rezultati mogu poslužiti za korekciju grešaka i unapređenje efikasnosti, i u fazi napada i u fazi odbrane, kako igrača pojedinačno, tako i tima u celini.

## EVALUTATION OF INDIVIDUAL AND TEAM RESULTS AT TOP HANDBALL COMPETITIONS

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**Introduction.** Evaluation (judgment) of individual and (or) team effect on big sport events, especially in sport games such as handball, represents serious problem. Shallow view shows that the success “reflector”- is final placement. However, first gets the highest, and last, gets the worst grade! Whether, sport experts know that evaluation process of reached goals, both, individual and team, it should include many different factors. In sport events especially, it have been identified that there are so called parasitical factors, of which some of them take a great impact on result of individual players or even a whole team, during the each match or a whole championship (tournament).

**Method.** Main is in transversal research, with empiric character. Data collecting was done through “watching” and corresponding technical/tactical elements from defense and attack, at all matches of Senior Man representation of Serbia which were held at World Championship 2009. Data review was made during the games, which was done by a person with a certain qualification, which had to possess an informatics skill and have certainly had expert (handball) knowledge. **Results.** Special statistical procedure was followed and treated in detail the effect of the team as a whole, as well as individual performance of all players in all matches. For example, it was found that successful (hit) completed 45% of all executed attack, missed shots was 36%, and 19% of cases the ball is lost for another reason. Momir Ilić is rated as the most successful player. Specifically, he scored 52 goals, had 26 assists, 11 won the ball and so on.

**Conclusion.** The results can be used for the correction of errors and improve efficiency, and being under attack and defense, both players individually and the team as a whole.

## FIZIOLOŠKI ZNAČAJ OKSIDATIVNOG STRESA KOD VRHUNSKIH OBOJKAŠICA

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**Uvod.** Postoji veliki broj dokaza o povezanosti fizičkog vežbanja i povećanog stvaranja slobodnih radikala, koji za posledicu imaju modifikaciju različitih biomolekula. Čelije konstantno stvaraju određene količine slobodnih radikala tokom metaboličkih procesa. Ravnoteža koja se održava između stvaranja ovih visoko reaktivnih molekula i njihove eliminacije održava se pomoću dva zaštitna mehanizma: enzimskog, koga čine superoksid dizmutaza, katalaza, paraoksonaza i glutation peroksidaza i ne-enzimskog, koji podrazumeva učešće supstanci, kao što su vitamin C, vitamin E, retinol, bilirubin, mokraćna kiselina i redukovani glutathion. Metode za određivanje nivoa oksidativnog stresa uglavnom su zasnovane na merenju oštećenja koja su slobodni radikali izazvali na lipidima, DNK molekulama i proteinima i na merenju aktivnosti antioksidantnih enzima. **Metod.** Pedeset četiri vrhunske odbojkašice su podeljene u tri grupe prema dužini trenažnog staža: 1) trenažni staž ispod proseka, < 8.0 godina; 2) prosečan trenažni staž, između 8.0 i 10.5 godina i 3) trenažni staž iznad proseka, > 10.5 godina. Mereni su sledeći parametri: reaktivni kiseonični metaboliti (ROMs), biološki antioksidantni potencijal (BAP), superoksidni anjon ( $O_2^-$ ), malondialdehid (MDA), oksidovani proteinski produkti (AOPP), lipidni hidroperoksidi (LOOH), aktivnosti enzima paraoksonaze (PON1) i superoksid dizmutaze (SOD) kao i koncentracija sulfhidrilnih grupa (SH-grupe). **Rezultati.** Preciznost klasifikacije pedeset četiri vrhunske odbojkašice podeljenih u tri grupe na osnovu dužine trenažnog staža iznosila je 66.7% za grupu 1, 60.9% za grupu 2 i 81.3% za grupu 3. Biomarkeri oksidativnog stresa, uglavnom manje vrednosti superoksidnog anjona i veća aktivnost superoksid-dizmutaze, adekvatno su definisali sportistkinje u skladu sa dužinom trenažnog staža i razlikovali ih u 68.58% slučajeva. **Zaključak.** Dobro razvijena antioksidativna zaštita, posebno povećana aktivnost superoksid-dizmutaze, ukazuje na prednosti treniranja odbojke, što dodatno potvrđuje i činjenica da se količina oksidovanih proteina tokom godina nije povećavala. Aerobna, anaerobna kao i mešovita vrsta treninga mogu doprineti smanjenju oksidativnog stresa kod sportista ukoliko je trenaži staž dovoljno dug i praćen odgovarajućim intenzitetom treninga tako da može da izazove adaptaciju sistema antioksidativne odbrane.

## PHYSIOLOGICAL RELEVANCE OF OXIDATIVE STRESS IN ELITE FEMALE VOLLEYBALL ATHLETES

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**Introduction.** There is sufficient evidence to suggest that exercise is accompanied by an increased free radical generation, resulting in a measurable degree of oxidative modifications to various biomolecules. Cells continuously produce free radicals as a part of normal metabolic processes. A delicate balance between the production and the elimination of the reactive oxygen species is maintained via the activity of two complex internal protective mechanisms: firstly enzymatic (superoxide dismutase, catalase, paraoxonase and glutathione peroxidase) and secondly non-enzymatic (vitamin C, vitamin E, retinol, bilirubin, uric acid and reduced glutathione). The most frequently used methods for oxidative stress estimation are measurements of free radical-mediated damages on lipids, proteins or DNA molecules and antioxidant enzymatic activity. **Methods.** Fifty four elite female volleyball players were divided into 3 groups according to training experience: 1) training experience < 8.3 years; 2) training experience between 8.4 and 11.3 years and 3) training experience > 11.4 years. Following parameters were measured: reactive oxygen metabolites (ROMs), biological anti-oxidative potential (BAP), superoxide anion ( $O_2^-$ ), malondialdehyde (MDA), advanced oxidation protein products (AOPP), lipid hydroperoxides (LOOH), paraoxonase (PON1) activity, superoxide-dismutase (SOD) activity and sulphhydryl group concentration (-SH). **Results.** The accuracy of classification in fifty-four elite female volleyball players was 66.7% for Group 1, 60.9% for Group 2 and 81.3% for Group 3. Oxidative stress biomarkers, mainly lower superoxide anion and higher superoxide-dismutase activity, adequately defined athletes with different years of training and, generally, discriminated them in 68.5% of cases. **Conclusion.** The well-developed anti-oxidant defense, particularly superoxide-dismutase activity, is a very positive attribute to participating in volleyball and the unmodified amount of oxidized proteins over time confirms this fact. Aerobic, anaerobic or mixed training can contribute to decreasing oxidative stress if the training programme is sufficiently long and intense to trigger a consequent adaptive response of the antioxidant system.



# OPŠTE I SPECIFIČNE KARAKTERISTIKE EKSPLOZIVNE SILE MIŠIĆA EKSTENZORA NOGU VRHUNSKIH ODBOJKAŠA SRBIJE ŽENSKOG POLA U ODNOSU NA RAZLIČITO TRENIRANE POPULACIJE

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**Uvod.** Cilj rada je definisanje opštih i specifičnih karakteristika eksplozivne izometrijske sile mišića ekstenzora nogu ( $RFD_{LegExt_{iso}}$ ) kod različito treniranih populacija ženskog pola. Testirano je 50 ispitanika raspoređenih u 3 grupe: vrhunsko trenirane odbojkašice (Elite, N=20), nespecifično trenirane sportistkinje sa aspekta eksplozivne sile (Non-spec, N=18) i kontrolna grupa sačinjena od netreniranih osoba ženskog pola (Control, N=12). **Metod.** Za procenu eksplozivne izometrijske sile ekstenzora nogu korišćena je standardizovana oprema, tenziometrijska sonda i standardizovan test u sedećoj poziciji. **Rezultati.** Praćene su sledeće kontraktilne karakteristike: opšte karakteristike eksplozivne sile -  $RFD_{BASIC} ExtLeg_{iso}$  (N/s), razlika između Elite i Non-spec=107.62%, Elite i Control=52.40%; odnos između opšte eksplozivne sile i maksimalne izometrijske sile ekstenzora nogu  $RFD_{BASIC} ExtLeg_{iso} / F_{max} ExtLeg_{iso}$ , u indeksnim vrednostima, razlika između Elite i Non-spec=85.85%, Elite i Control=31.61%; specifične karakteristike eksplozivne sile - S gradijent,  $RFD_{50\%} ExtLeg_{iso}$  (N/s), razlika između Elite i Non-spec=338.32%, Elite i Control=364.36%; odnos između S gradijenta i maksimalne izometrijske sile,  $RFD_{50\%} ExtLeg_{iso} / F_{max} ExtLeg_{iso}$ , u indeksnim vrednostima, razlika između Elite i Non-spec=260.06%, između Elite i Control=262.73%; odnos između S gradijenta i sile dostignute na 50% od  $F_{max} ExtLeg_{iso}$ ,  $RFD_{50\%} ExtLeg_{iso} / F_{50\%} ExtLeg_{iso}$ , u indeksnim vrednostima, razlika između Elite i Non-spec=260.06%, Elite i Control=262.73%. Multivarijantna statistička analiza je utvrdila da između posmatranih sub uzoraka postoji generalna statistički značajna razlika svih ispitivanih kontraktilnih karakteristika na nivou Wilks Lambda 0.425, F=5.865, p=0.000. Statistički značajne razlike utvrđene su u svim ispitivanim varijablama posmatranih subuzoraka: kod  $RFD_{BASIC} ExtLeg_{iso}$  F=10.162, p=0.000;  $RFD_{50\%} ExtLeg_{iso}$  F=19.761, p=0.000;  $RFD_{BASIC} ExtLeg_{iso} / F_{max} ExtLeg_{iso}$  F=6.046, p=0.005;  $RFD_{50\%} ExtLeg_{iso} / F_{max} ExtLeg_{iso}$  F=20.646, p=0.000;  $RFD_{50\%} ExtLeg_{iso} / F_{50\%} ExtLeg_{iso}$  F=20.646, p=0.000. **Zaključak.** Rezultati svih ispitivanih opštih i specifičnih varijabli sile ekstenzora nogu pokazuju da su maksimalne vrednosti izmerene kod odbojkašica. Različiti tipovi treninga i značajna uloga mišića ekstenzora nogu kod odbojkaša doprineli su specifičnoj adaptaciji koja je rezultirala većom eksplozivnom silom odnosno odnosu između RFD i maksimalne sile na različitim nivoima ispoljavanja sile mišića ekstenzora nogu vrhunskih odbojkašica u odnosu na nespecifično trenirane populacije.

## BASIC AND SPECIFIC PARAMETERS OF THE EXPLOSIVE FORCE OF LEG EXTENSORS IN TOP LEVEL SERBIAN FEMALE VOLLEYBALL PLAYERS CONSIDERING THE DIFFERENT TRAINED POPULATION

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**Introduction.** The aim of this study is to define basic and specific characteristics of explosive isometric force of leg extensors  $RFD_{LegExt_{iso}}$  in different trained population. Sample included 50 examinees: top level female volleyball players (Elite, N=20), unspecific trained female athletes from the aspect of explosive force (Non-spec, N=18) and untrained female (Control, N=12). **Methods.** In order to assess the  $RFD_{LegExt_{iso}}$  different contractile characteristics, we used standardized equipment, a tensiometric probe and standardized "Seating leg extension" test. **Results.** The following contractile characteristics were evaluated: basic characteristics -  $RFD_{BASIC} ExtLeg_{iso}$  (N/s), different between Elite and Non-spec=107.62%, Elite and Control=52.40%; the relation between  $RFD_{BASIC} ExtLeg_{iso}$  and the maximal force,  $RFD_{BASIC} ExtLeg_{iso} / F_{max} ExtLeg_{iso}$  (index units), different between Elite and Non-spec=85.85%, Elite and Control=31.61%; specific characteristics, S gradient -  $RFD_{50\%} ExtLeg_{iso}$  (N/s), different between Elite and Non-spec=338.32%, Elite and Control=364.36%; the relation between  $RFD_{50\%} ExtLeg_{iso}$  and  $F_{max} ExtLeg_{iso}$ ,  $RFD_{50\%} ExtLeg_{iso} / F_{max} ExtLeg_{iso}$  (index units), different between Elite and Non-spec=260.06%, Elite and Control=262.73%; the relation between  $RFD_{50\%} ExtLeg_{iso}$  and the value of force achieved for 50% of  $F_{max} ExtLeg_{iso}$ ,  $RFD_{50\%} ExtLeg_{iso} / F_{50\%} ExtLeg_{iso}$  (index units), different between Elite and Non-spec=260.06%, Elite and Control=262.73%. Multivariate statistical analysis established that there is a significant difference in all contractile characteristics at the level of Wilks' Lambda 0.425, F=5.865, p=0.000, among the observed sub-samples. Partial statistically significant difference was established in following variables: in  $RFD_{BASIC} ExtLeg_{iso}$  F=10.162, p=0.000;  $RFD_{50\%} ExtLeg_{iso}$  F=19.761, p=0.000;  $RFD_{BASIC} ExtLeg_{iso} / F_{max} ExtLeg_{iso}$  F=6.046, p=0.005;  $RFD_{50\%} ExtLeg_{iso} / F_{max} ExtLeg_{iso}$  F=20.646, p=0.000;  $RFD_{50\%} ExtLeg_{iso} / F_{50\%} ExtLeg_{iso}$  F=20.646, p=0.000. **Conclusion.** The results of all obtained basic and specific variables of leg extensors' explosive force showed that the maximal values are in volleyball players. Different types of training and important role of legs extensors in volleyball players contributed the specific adaptation which resulted the higher explosive force, accordingly the relation between RFD and maximal force on different level of manifestation force of leg extensors in top level female volleyball players considering the different trained population.

## COMPARATIVE MOVEMENT ANALYSIS OF THE WINNERS AND THE LOSERS OF THE RALLIES IN SQUASH

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**Introduction.** Squash is a very competitive sport and at the highest playing levels of the game players are forced to move intensively around the court. In previous studies some authors reported that winners of the game covered a greater distance during the time when the ball was in play. These findings led the authors to conclude that individual game analysis might not be the best indicator of a player's overall performance. The aim of this study was to examine the distance covered by winners and losers at the rally level.

**Method.** Top Slovenian players were recorded with a fixed video camera. Altogether 1048 rallies were analyzed by the sagit/squash tracking system and separated to four different time related categories. A paired sample t-test and a non parametric Wilcoxon signed ranks test was used to compare rally winners and losers in terms of distance covered.

**Results.** Rally losers covered more distance during the very short, short and medium rallies than rally winners (3.22m-2.78m, 10.16m-9.34m and 23.54m-22.67m, respectively). It is likely that winners controlled the playing situation most of the time in these rally categories. However, during the long rallies losers covered a similar distance to the rally winners (56.78m-56.17m). This could be due to the proportionate time spent in a stable situation i.e. no player having an advantage over the other. Consequently, it would seem that the duration of time whereby the winner of the rally had dominance and thus made the loser of the rally move a greater distance was so small in comparison to the overall rally duration.

**Conclusion.** These findings provide clearer information on movement patterns during rallies with the data suggesting that the endpoints of the rally are characterised by more movement by the loser of the rally in comparison to the winner of the rally.

## KOMPARATIVNA ANALIZA POKRETA POBEDNIKA I POBEĐENIH NA IZMENI UDARCA U SKVOŠU

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**Uvod.** Skvoš je veoma kompetitivan sport i na najvišim nivoima igre igrači su prinuđeni da se intenzivnije kreću po terenu. Analizom ukupno pređenih relacija Vučković, Dežman, Erčulj, Kovačić, i Perš, (2004) otkrili su da pobjednici u igri pređu veće relacije tokom vremena kada je lopta u igri. Ova studija dovela je autore do zaključka da bi analiza pojedinačne igre mogla da bude najbolji pokazatelj ukupnog učinka igrača. Cilj studije je bio da se ispita pređena relacija kod pobjednika i pobjeđenih na nivou izmene udarca.

**Metod.** Vrhunski slovenački igrači snimani su fiksiranom SVHS video kamerom. Analizirano je ukupno 1048 izmena udaraca sistemom praćenja sagit/squash i izdvojeno u 4 različite kategorije prema vremenu: vrlo kratke, kratke, srednje i veoma duge izmene. Korišćeni su t-test uparenih uzoraka i neparametrijski Vilkokson test rangova za poređenje izmene pobjednika i pobjeđenih u smislu pređene relacije.

**Rezultati.** Pobjednici u izmenama pređu veće relacije tokom veoma kratkih, kratkih i srednjih imena nego pobjednici. Verovatno je da pobjednici kontrolišu situacije u igri većinu vremena u ovim kategorijama i stoga prinude pobjedene u izmeni da prelaze veće relacije. Međutim, tokom dugih izmena pobjednici pređu slične relacije kao i pobjednici izmena. Razlog toga može biti proporcionalno vreme provedeno u stabilnoj situaciji tj. ni jedan igrač nema prednost nad drugim. Stoga, izgleda da vremensko trajanje u kome je pobjednik izmene imao dominaciju i tako naterao pobjeđenog da se više kreće je tako mala u poređenju sa ukupnim trajanjem izmene.

**Zaključak.** Shodno tome, ova otkrića daju jasnije informacije o obrascima kretanja tokom izmena sa podacima koji sugerišu da krajnje tačke izmene karakteriše više kretanja pobjeđenog u izmeni u poređenju sa pobjednikom izmene. Ova studija istakla je svojstva obrazaca kretanja na nacionalnom nivou iako su potrebne dalje analize kako bi se otkrilo da li ovi nalazi važe i za ostale nivoe igrača.

## DIFFERENT PROTOCOL FOR DETERMINING THE BASIC FUNCTIONAL PARAMETERS IN ORIENTEERING

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**Introduction.** The aim is to determine the validity of the specific for orienteering laboratory protocol (“Orienteering – National Sports Academy”, elaborated by G. Mateev, V. Garkov, S. Tzvetkov, B. Pencheva, T. Pedev) for establishing the level of functional capacity of the top-level orienteering athletes.

**Method.** Twelve male orienteers, all of who were members of either the Bulgarian national team volunteered participated in this study. Each orienteer performed the two different protocols with interval between them – 28 hours. The following parameters were measured: time, maximal speed on maximal inclination,  $W_{max}$ ,  $W_{max/kg}$  and  $VO_2max$  (ml/min, ml/kg/min,  $HR_{max}$ ,  $O_2HR$  (max/ml),  $VE_{max}$  (l/min),  $VT_{max}$ /l,  $BF_{max}$  (min/l) and  $MET_{max}$ .

**Results.** The statistically significant differences are established for a reached maximal ( $t=4,03$ ,  $t=4,86$ ,  $\alpha=0,00$ ) and relative ( $t=6,18$  и  $t=9,96$ ,  $\alpha=0,00$ ) for a new protocol related to a Respiratory exchange ratio ( $\Delta=0,11$ ,  $t=2,50$ ,  $\alpha=0,00$ ).

**Conclusion.** The created original specific protocol “Orienteering NSA” seems to be a successful and effective for orienteers providing the possibility to determine their specific endurance and discovering new aspects for evaluation of their condition and preparedness. However, it is necessary they obtained results to be confirmed with a new data and more dippy statistical treatment and interpretation.

## RAZLIČITI PROTOKOLI ZA ODREĐIVANJE OSNOVNIH FUNKCIONALNIH PARAMETARA U ORIJENTIRINGU

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**Uvod.** Cilj rada je odrediti važnost specifičnih laboratorijskih protokola u orijentiringu (“Orijentiring – Nacionalna Sportska Akademija” koji su izradili G. Mateev, V. Garkov, S. Tzvetkov, B. Pencheva, T. Pedev) radi uspostavljanja nivoa funkcionalnog kapaciteta vrhunskih orijentiraca.

**Metod.** Dvanaest orijentiraca, svi članovi bugarske reprezentacije, dobrovoljno je učestvovalo u ovom istraživanju. Svaki sportista je učestvovao u dva različita protokola sa intervalom of 28 sati između njih. Mereni su sledeći parametri: vreme, maksimalna brzina na maksimalnom nagibu,  $W_{max}$ ,  $W_{max/kg}$  i  $VO_2max$  (ml/min, ml/kg/min,  $HR_{max}$ ,  $O_2HR$  (max/ml),  $VE_{max}$  (l/min),  $VT_{max}$ /l,  $BF_{max}$  (min/l) and  $MET_{max}$ .

**Rezultati.** Utvrđene su statistički značajne razlike za dostignuti maksimalne ( $t=4,03$ ,  $t=4,86$ ,  $\alpha=0,00$ ) i relativne ( $t=6,18$  i  $t=9,96$ ,  $\alpha=0,00$ ) za novi protokol koji se odnosi na respiratorni obim razmene ( $\Delta=0,11$ ,  $t=2,50$ ,  $\alpha=0,00$ ).

**Zaključak.** Kreirani originalni specifični protokol “Orijentiring NSA” je izgleda bio uspešan i efikasan za takmičare i omogućio da se odredi njihova specifična izdržljivost i otkriju novi aspekti za vrednovanje njihove kondicije i spremnosti. Neophodno je, međutim potvrditi dobijene rezultate novim podacima i dubljom statističkom obradom i tumačenjem.

## THE EFFECT OF BIOMECHANICAL VARIABLES ON THE PERFORMANCE ACCURACY OF BACKHAND TOPSPIN IN TABLE TENNIS

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**Introduction.** The backhand topspin is one of the important strokes that used in the table tennis competitions where the player performs this stroke quickly in a short time. Therefore, the importance of biomechanics becomes vital while performing this stroke. This study addressed the issue of how biomechanical variables (i.e. velocity, acceleration, displacement, and angle) related to the performance accuracy in the backhand topspin table tennis. The second aim examined the mean difference between the techniques and the maximum velocity trails in performance accuracy in this stroke. The third aim attempted to determine the mean difference between the expert and the novice players in performance accuracy of this stroke.

**Method.** Two groups of players participated in this study, four expert players selected from the German team and three novice players. All players were right-handed and performed 40 backhand topspin strokes. The mean (SD) age of expert and novice players was 13.6 (2.4) and 14.3 (1.63) years, respectively.

**Results.** The independent sample t-test results showed that the difference between technique and maximum velocity was significant. Moreover, the expert players were much better than novice players in the performance accuracy. Finally, the multi-regression analysis supported the prediction that, the biomechanical variables effects on the efficiency of the stroke.

**Conclusion.** The mixed between technique and maximum velocity are better than separating them. In addition, the angle velocity is an important factor in explaining the performance accuracy. Therefore, it is important for players and coaches to know the effects of biomechanical variables on the performance accuracy during table tennis matches.

## UTICAJ BIOMEHANIČKIH VARIJABLI NA PRECIZNOST IZVOĐENJA BEKHENDA TOP SPIN U STONOM TENISU

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**Uvod.** Bekhend top spin je jedan od važnih udaraca koji se koristi na takmičenjima u stonom tenisu u kome igrač izvodi ovaj udarac brzo za kratko vreme. Stoga važnost biomehanike postaje veoma važna pri izvođenju ovog udarca. Ovaj rad obrađuje pitanje odnosa biomehaničkih varijabli (npr. brzina, ubrzanje, pomeranje i ugao) na preciznost izvođenja bekhend top spin udarca u stonom tenisu. Drugi cilj je ispitivanje sredine razlike među tehnikama i maksimalni trag brzine u preciznosti izvođenja ovog udarca. Treći cilj je pokušaj da se odredi sredina između iskusnih i novih igrača u preciznosti izvođenja ovog udarca.

**Metod.** U ovom istraživanju su učestvovala dve grupe igrača, 4 iskusna igrača iz nemačke reprezentacije i 3 nova igrača. Svi igrači su dešnjaci i izveli su 40 udaraca top spin bekhendom. Srednja (SD) starost iskusnih i novih igrača bila je 13.6 (2.4) odnosno 14.3 (1.63) godina.

**Rezultati.** Rezultati nezavisnog uzorka t-testa su pokazali da je razlika između tehnike i maksimalne brzine značajna. Pored toga, iskusni igrači su bili mnogo bolji od novih igrača u preciznosti izvođenja. Konačno, multiregresiona analiza je podržala predviđanje da biomehaničke varijable utiču na efikasnost udarca.

**Zaključak.** Mešanje tehnike i maksimalne brzine je bolje nego njihovo razdvajanje. Pored toga, brzina ugla je važan faktor u objašnjavanju preciznosti izvođenja. Stoga je važno za igrače i trenere da znaju efekte biomehaničkih varijabli na preciznost izvođenja tokom mečeva stonom tenisa.

## TELESNI SASTAV VRHUNSKIH SRPSKIH TAKMIČARA U BODIBILDINGU

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**Uvod.** Vrednosti telesnog sastava, između ostalog, mogu informisati o uspešnom nastupu sportista na takmičenju. U tom smislu izdvajaju se sportovi gde je ocena estetično-vizuelnog prikaza glavni kriterijum za postizanje optimalnog takmičarskog rezultata. Standardizovane vrednosti telesnih komponenti, najzastupljenije su u bodibildingu i fitnessu. Vrednosti telesnog sastava mogu poslužiti kao vrlo informativan prediktor za planiranje i programiranje treninga i ishrane, kao i za uspešan nastup na takmičenju u ovim sportovima.

**Metod.** Cilj istraživanja je opservacija izmerenih parametara telesnog sastava elitnih srpskih bodibildera takmičara na samom početku pripremnog perioda treninga i stavljanje tih rezultata u funkciju planiranja i programiranja optimalnih trenažnih stimulusa u cilju postizanja maksimalnih takmičarskih rezultata. Merne procedure su sprovedene po protokolima koje zahteva BIA tehnologija (Bioelectrical impedance analysis), na analizatoru Data Input GmbH 2000, uz korišćenje softvera Nutri 3. Istraživanje je sprovedeno na uzorku od 12 najkvalitetnijih srpskih bodibilding takmičara seniora ( $27,3 \pm 4,7$  godina starosti), kategorisanih u savezni i internacionalni razred.

**Rezultati.** U istraživanju su dobijeni brojni podaci, od kojih će se pomenuti samo neki. Ispitanici su prosečno visoki  $177,8 \pm 6,6$ cm, a teški  $94,3 \pm 11$ kg. Prema indeksu telesne mase ( $BMI = 29,8 \pm 2,4$ kg/m<sup>2</sup>) oni se nalaze na granici između blago povišene telesne težine i gojaznosti, dok po količini telesne masti ( $16,6 \pm 6,4\%$ ) imaju malo prekomernu količinu masti za sportiste, što nije loše s obzirom na upravo završen prelazni period. Odnos vanćelijske i ćelijske mase (ECM/BCM) je jedan od najvažnijih parametara pri sagledavanju nutritivnog statusa. Dobro je da količina vanćelijske mase bude manja od količine ćelijske mase. Kod naših ispitanika iznosi  $0,59 \pm 0,05$ , što upravo spada u vrednosti koje se sreću isključivo kod vrhunskih sportista i bodibildera.

**Zaključak.** Određivanje telesnog statusa BIA tehnologijom pruža važne informacije o zdravstveno-nutritivnom statusu sportista, korisne za planiranje i vođenje trenažnog procesa, kao i za predikciju sportskog postignuća.

## BODY COMPOSITION OF HIGH LEVEL SERBIAN COMPETITORS IN BODYBUILDING

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**Introduction.** The values of body composition, among other, can inform about successful competitors' performance at a competition. In this sense, the sports with assessment of esthetic-visual presentation as the main criterion for achievement of optimal competitive result are highlighted. The standardized values of body components are most manifested in bodybuilding and fitness. The values of body composition can serve as a very informative predictor for planning and programming of the training session and nutrition, as well as for a successful performance at competitions of these sports.

**Method.** The aim of the research was observation of the measured parameters of body composition of elite Serbian bodybuilding competitors at the very beginning of the preparation period of training and using of these results in function of planning and programming of optimal training stimulus aimed at achieving of maximal competing results. The measuring procedures were implemented according to protocols required by BIA (Bioelectrical impedance analysis) technology, on the analyzer Data Input GmbH 2000, using Nutri 3 software. The research was conducted on a sample of 12 elite senior bodybuilding competitors (aged  $27,3 \pm 4,7$ ), categorized in federal and international class.

**Results.** The research resulted in numerous data, but only some of them will be mentioned. The subjects were of average height  $177,8 \pm 6,6$  cm, weighting  $94,3 \pm 11$  kg. According to the body mass index ( $BMI = 29,8 \pm 2,4$ kg/m<sup>2</sup>) they are on the margin between slight overweight and obesity, while according to the quantity of body fats ( $16,6 \pm 6,4\%$ ) they have little excessive quantity of fat for athletes, which is not bad having in regard the finished transitional period. The ratio of extracellular mass to body cell mass (ECM/BCM) is one of the most important parameters when considering the nutritive status. It is good that the quantity of extracellular mass is lower than body cell mass. With our subjects it amounts to  $0,59 \pm 0,05$ , which ranks among the values encountered strictly with the top athletes and bodybuilders.

**Conclusion.** Determination of body status by BIA technology offers significant information on health-nutritive status of athletes, useful for planning and leading of training process, as well as for prediction of sports achievement.

## SAVREMENI PRISTUP U POSTAVCI TEJPERA U FAZI NEPOSREDNE PRIPREME ZA TAKMIČENJE

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**Uvod.** Tejper je ključni element u kondicionoj pripremi sportista u nedeljama koje neposredno prethode takmičenju. Postojeća istraživanja su definisala tejper, identifikovala različite forme tejpera koje se koriste u savremenom sportu i ispitala postavku trenažnog obima, opterećenja, inteziteta, trajanja i tipa tejpera. Cilj ove studije je bio da se prikupe i sintetizuju postojeća znanja o tejperu.

**Metod.** Pretražene su tri baze podataka (PubMed, Sport Discus, and Web of Science) za prikupljanje istraživačkih i preglednih radova iz oblasti tejpera.

**Rezultati.** Optimalna strategija za poboljšanje performansi sportista podrazumeva primenu tejpera u trajanju od 2 nedelje, gde se trenažni obim eksponencijalno smanjuje od 41 do 60%, bez ikakvih modifikacija u trenažnom intenzitetu ili frekvenciji. Generalna preporuka je da se primenjuje progresivno eksponencijalni tip tejpera.

**Zaključak.** Savremena strategija obezbeđuje teorijski okvir koji može biti koristan za sportiste, trenere i sportske naučnike sa ciljem optimizacije trenažne procedure.

## THE CURRENT STRATEGY OF THE TAPER PRESCRIPTION FOR THE PRE-COMPETITION PERIOD

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**Introduction.** The taper is a key element of the physical preparation of athletes in the weeks immediately preceding competition. Existing research has defined the taper, identified various forms of taper used in contemporary sport, and examined the prescription of training volume, load, intensity, duration, and type. The aim of this study was to compile and synthesise the present knowledge of the taper application in sports.

**Method.** Three databases (PubMed, Sport Discus, and Web of Science) were searched for the research and review articles on the topics of taper.

**Results.** The optimal strategy to optimize performance appear to be a tapering intervention of 2 week duration, where the training volume is exponentially decreased by 41–60%, without any modification in either training intensity or frequency. A progressive exponential (i.e., a fast decay) taper pattern is generally recommended.

**Conclusion.** The current taper strategies provide a framework that can be useful for athletes, coaches, and sport scientists to optimize training procedures.

## TEORIJSKI PRISTUP ISTRAŽIVANJU MODELNIH KARAKTERISTIKA TAKMIČARSKE AKTIVNOSTI U BORILAČKIM SPORTOVIMA

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**Uvod.** Problem takmičarske aktivnosti u savremenom sportu, pa i u borilačkim sportovima, jedan je od najaktuelnijih. Naučna istraživanja takmičarske aktivnosti u borilačkim sportovima su od izuzetnog značaja, jer otkrivaju osnovne zakonomernosti u procesu takmičenja, glavne faktore koji određuju uspešnost na takmičenjima, promene u učešću tih faktora uslovljene promenom sistema pripreme, zvaničnih pravila takmičenja, promenama u selekciji takmičara za vrhunska ostvarenja i drugim. Otkrivene zakonomernosti i faktori uspešnosti, povratno utiču na procese selekcije i pripreme za takmičenje i značajno menjaju trenažnu praksu.

**Metod.** U radu je primenjen metod teorijske analize rezultata dobijenih u istraživačkim radovima brojnih autora i u sopstvenim istraživanjima.

**Rezultati.** U radu su predstavljeni rezultati istraživanja raznih autora koja se bave izučavanjem takmičarske aktivnosti u borilačkim sportovima.

**Zaključak.** Analizom rezultata istraživačkih radova moguće je identifikovati sistem za praćenje takmičarske aktivnosti u borilačkim sportovima, otkriti pokazatelje takmičarske aktivnosti čiji se značaj, uprkos dinamičnim promenama, bitnije ne menja, ali i otkriti pokazatelje koji su veoma osetljivi na te promene.

## THEORETICAL APPROACH TO RESEARCH OF MODEL CHARACTERISTICS OF MARTIAL ARTS COMPETITIVE ACTIVITIES

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**Introduction.** The problem of competitive activity in modern sport, as well as in martial arts, ranks among the most actual ones. Scientific research of competitive activities in martial arts is of great importance, because it reveals the basic regularities in the process of competition, the main factors that determine successfulness in competitions, changes in share of these factors caused by changes in the preparation system, in the official competition rules, changes in selection of competitors for the top achievements etc. The discovered regularities and factors of successfulness, retroactively affect the selection process and preparations for competition and significantly alter the training practice.

**Method.** The method of theoretical analysis of the results obtained in research of numerous authors in their own studies was applied in the paper.

**Results.** The paper presents results of investigations of various authors dealing with competitive research activities in martial arts.

**Conclusion.** Analysis of the research results enables an identification of a system for monitoring of martial arts competitive activities, revealing of indicators of competitive activities whose importance, despite the dynamic changes, do not alter significantly, as well as discovery of those indicators that are very sensitive to these changes.

## OKSIDATIVNI STRES KAO ODGOVOR NA RAZLIČITE TRENING PROGRAME

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**Uvod.** Fizička aktivnost je jedan od činilaca koji uzrokuje oksidativni stres i poremećaj homeostaze u organizmu. Faktori koji određuju nivo ovako izazvanog oksidativnog stresa su: vrsta, intenzitet i trajanje fizičke aktivnosti, stanje utreniranosti i dijeta ispitanika, vrsta biomarkera i vreme uzorkovanja materijala koji se ispituje.

**Metod.** Promena određenih markera oksidativnog stresa praćena je kroz više ciljanih istraživanja tokom različitih trening programa: 1. uporednog treninga snage i izdržljivosti uz tehničke elemente džudoa (14 ispitanika muškog pola, eksperimentalna i kontrolna grupa, 12 nedelja treninga); 2. posebno planiranog džudo treninga (10 ispitanika muškog pola, 4 nedelja treninga snage uz tehničke elemente džudoa i borbe); 3. tae-bo treninga (7 ispitanica ženskog pola, 12 nedelja treninga); 4. pilates treninga (7 ispitanica ženskog pola, 12 nedelja treninga). Uzorci krvi uzimani su u mirovanju, na početku i na kraju odgovarajućeg perioda treninga, i analizirani u cilju određivanja markera oksidativnog stresa (malondialdehida-MDA, katalaze u plazmi-CAT, karbonilnih i sulfhidrilnih grupa, ukupnog antioksidativnog statusa).

**Rezultati.** Statistički značajno povećanje MDA u eritrocitima i CAT u plazmi kod ispitanika eksperimentalne grupe utvrđeno je nakon završetka prvog treninga programa. Odsustvo statistički značajnih razlika u markerima oksidativnog stresa konstatovano je nakon drugog trening programa. Statistički značajno povećanje ukupnog antioksidativnog statusa rezultat je nakon trećeg trening programa. Statistički značajno povećanje aktivnosti katalaze u plazmi utvrđeno je nakon četvrtog trening programa.

**Zaključak.** Različiti trening programi dovode do značajne promene nivoa određenih markera oksidativnog stresa, ali je evidentno da antioksidativna odbrana organizma adekvatno deluje na porast intenziteta fizičke aktivnosti u većini istraživanih slučajeva. Povećanje nivoa oksidativnog stresa ne deluje negativno na učinak sportista u kratkom vremenskom periodu, dok je dugotrajni uticaj na zdravlje još uvek nedovoljno ispitan.

## OXIDATIVE STRESS RESPONSE TO DIFFERENT TRAINING PROGRAMS

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**Introduction.** Physical exercise increases oxidative stress and causes disruptions of the homeostasis. Several factors appear to play a significant role in the exercise-induced oxidative stress response including mode, duration, and intensity of exercise, specific biomarkers chosen, time course of tissue sampling, as well as the training status and dietary intake of the subject population.

**Method.** Conducted investigations aimed to evaluate response of selected markers of oxidative stress to different training programs: 1. concurrent strength and endurance training and perfecting of specific judo techniques (14 male subjects, experimental and control group, 12 weeks training); 2. specially designed judo training program (10 male subjects, strength training with perfecting of specific judo techniques and fights); 3. tae-bo training (7 female subjects, 12 weeks training); 4. pilates training (7 female subjects, 12 weeks training). Blood samples, collected at rest before and after training programs, were analyzed for the determination of selected markers of oxidative stress (erythrocyte malondialdehyde-MDA, plasma catalase-CAT, carbonil and sulphhydryl group assay and total antioxidant status-TAS).

**Results.** A significant increase in erythrocyte malondialdehyde and plasma catalase can be considered negative effects of first training program. Second pattern of preparation period training program did not have any effects on oxidative stress levels. TAS increased significantly higher with third training, whereas CAT was significantly higher with forth training.

**Conclusion.** The results obtained suggest that different training programs affects oxidative stress biomarkers, but in most cases the body's natural antioxidant defenses respond adequately to increases in training program. There is no evidence that this affects sporting performance in the short term, although it may have longer term, not necessarily detrimental, health consequences.



## FEMALE VOLLEYBALL REACTION TIME WITH THE HELP OF BODILY COMMUNICATION

**Raiola Gaetano**

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**Introduction.** In volleyball the ball is constantly rejected by the players in little court and the speed of it is too high to be well perceived by athletes. The players often cannot consciously reject the ball, first they play and then they exactly understood the shoot. The bodily communication can help the players to give an immediate right response. Motor control research has not investigated yet on which role the bodily communication has, included the feint, on the rejecting the ball in volleyball and the effects of it on the final outcomes. Particularly bodily communication could be the anticipation of the reaction motor time of the blocker. The aim of this study is to investigate how the motor control system could usefully play by blocker to constrain the attacker and what is the tactical choice. We analyzed three volleyball skills: the off speed hit goes over the opposing block, the second ball to the opposite court and the powerful spike as fast as possible. Finally to correlate the reaction-times of the blocker and the optional or reading choice.

**Method.** By video analysis of 26 matchs female volleyball championship with slow down and go back mode, it assesses the reaction times and analyzes the making tactical decisions in order to read and option, that means with and without visual feedback

**Results.** It shows the block response is in 90% read and 10% option regarding the off speed hit and reaction-time is short, it is 65% read and 35% option regarding the second ball and reaction-time is not short, it is 5% read and 95% option regarding the powerful spike as fast as possible and reaction-time is zero.

**Conclusion.** There is a significant correlation between tactical choice and reaction-time.

## VREME REAKCIJE ODBOJKAŠICA POMOĆU KOMUNIKACIJE TELOM

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Univerzitet u Kasinu, Italija

**Uvod.** U odbojci se lopta konstantno odbija o igrače na malom terenu, a njena brzina je suviše velika da bi bila dobro shvaćena. Igrači suviše često ne mogu svesno da odbiju loptu, prvo igraju, a onda shvate kako igraju. Komunikacija telom može pomoći igračima da trenutno daju pravi odgovor. Istraživanja motorne kontrole još nisu istražila ulogu komuniciranja telom, uključujući fintu i njene efekte na rezultat. Posebno, komunikacija telom bi mogla da bude početak za predviđanje reakcije motoričkog vremena blokera. Cilj ove studije je da identifikuje kako bi blokeri mogli koristiti sistem motorne kontrole da ograniče napadača i koji je taktički izbor. Analizirali smo tri odbojkaške veštine: plasiranu loptu, drugu loptu u akciji na protivnički teren i smeč što je brže moguće u odnosu na suprotstavljajući blok. Konačno da bi uporedili reakciju motoričkog vremena blokera i pročitani taktički izbor.

**Metod.** Video analizom 26 utakmica ženskog odbojkaškog šampionata, sa usporenim gledanjem i vraćanjem snimaka, ocenjuje se vreme reakcije i analizira donošenje taktičkih odluka da se pročita i izabere (sa ili bez vizuelne povratne informacije).

**Rezultati.** Rezultati pokazuju da je odgovor na blok u 90% pročitanih situacija i 10% opcionalnih u plasiranom udarcu i njegovo motoričko vreme reakcije je kratko, u 35% opcionalnih situacija i 65% pročitanih je zahvaljujući drugoj lopti i njegovo vreme reakcije nije kratko, u 95% opcionalnih situacija i 5% pročitanih je u osporavanju smeča što je brže moguće i njegovo motoričko vreme reakcije je nula.

**Zaključak.** Pronađena je značajna zavisnost između taktičkog izbora i vremena reakcije.

## PERFORMANCE ANALYSIS OF BODILY COMMUNICATION IN THREE SPECIFIC VOLLEYBALL SKILLS TO CONTRAST FUNDAMENTAL BLOCK

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<sup>2</sup> ISEF Napoli

**Introduction.** Many coaches do not agree how to attribute specifically the outcomes to the single volleyball fundamentals such as attack and block. What tool could use for evaluating the effects of the bodily communication, as the feint, on the final outcomes. In this case we examine three specific skills regarding the attacker role and the setter one. These are the second ball goes to the opposite court instead to set for attacking, the attack as fast as possible in the middle of the net and the off speed hit instead of power spike over the block. The aim of this paper is to quantify the outcomes of these skills for 26 matches that were played by the C female team in Italian championship.

**Method.** The skills are observed by the analyst on specific demand of team coach who establishes exactly how to attribute the outcomes for the attacker and blocker. By using the performance analysis software with slow down and go back mode and applying the performance indicators, the analyst collects data on bodily communication outcomes and elaborates by a statistical model.

**Result.** It shows the influence of bodily communication on the outcomes for every match and the correlation with the total outcomes of the matches. The relationship between the percentage of bodily communication outcomes and the other kinds of percentage of outcomes is significant.

**Conclusion.** It suggests including the bodily communication theory in training course for coaches to teach the fundamentals and the skills. It needs to elaborate the good practice applications of bodily communication theory according to training methodology to improve the technical skills of the attacker, defender and blocker.

## ANALIZA UČINKA KOMUNIKACIJE TELOM U TRI SPECIFIČNE ODBOJKAŠKE VEŠTINE DA SE SPREČI OSNOVNI BLOK

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**Uvod.** Mnogi treneri se ne slažu o atribuciji ishoda koji se pripisuju specifično pojedinačnim odbojkaškim osnovama, kao što su napad i blok. Kojim oruđem se vrednuju efekti komunikacije, kao što je finta, na ishode? U ovom slučaju ispitali smo tri specifične veštine koje se odnose na ulogu napadača i dizača. Ove veštine su druga lopta koja ide na protivnički teren umesto da servira za napad, napad što je brže moguće na sredini mreže i kontrolisani (meki dodir) udarac umesto mogućeg smeča. Cilj ovog rada je da se kvantifikuju ishodi za svaki od 26 mečeva koje je odigrala italijanska ženska C reprezentacija.

**Metod.** Sve veštine je pratio analitičar učinka na zahtev trenera tima koji utvrđuje tačno koliko da pripiše ishodima za napadača ili protivničkog blokera. Korišćenjem softvera za analizu učinka sa usporavanjem i vraćanjem i primena pokazatelja učinka koje je prethodno naveo trener tima, analitičar učinka prikuplja podatke o ishodima komunikacije telom i elaborira statističkim modelom.

**Rezultati.** Rezultati pokazuju uticaj komunikacije telom na ishode za svaku utakmicu i odnos sa ukupnim ishodima utakmica. Odnos između procenta ishoda komunikacije telom i drugih vrsta procenta ishoda je značajna.

**Zaključak.** Ovo navodi na uvođenje teorije o komunikaciji telom u kurs obuke za trenere da bi naučili osnove. Treba razraditi primenu ovog polja prema trenažnoj metodologiji kako bi se poboljšale tehničke veštine napadača, odbrane i blokera.

# ANALIZA GENERALNIH POKAZATELJA TAKMIČARSKJE EFIKASNOSTI IGRE ŽENSKE ODBOJKAŠKE EKIPE U TOKU GODIŠNJEG MAKROCIKLUSA – PRIMER ŽOK „KIKINDA“

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**Uvod.** Predmet ovog istraživanja je prikaz dostignutog nivoa, kao i promena generalne takmičarske efikasnosti metodom analize takmičarskih rezultata koje je ostvarila ženska odbojkaška ekipa Kikinde, koja se u sezoni 2008/09 takmičila u II Saveznoj ligi – sever R. Srbije.

**Metode.** U radu su korišćeni rezultati takmičenja ŽOK „Kikinda“ u toku sezone 2008/09. Analizirani su rezultati sa ukupno 16 odigranih utakmica. Pokazatelje takmičarske efikasnosti su predstavljale sledeće varijable: 1) TOTAL – ukupni rezultat ostvaren na utakmici, izražen sumom osvojenih/izgubljenih setova i poena; SET<sub>total</sub> – rezultat ostvaren u svakom odigranom setu na utakmici, izražen sumom osvojenih/izgubljenih setova i poena; Index<sub>Effic</sub> – koji predstavlja odnos osvojenih i izgubljenih poena u toku utakmice, kao i u odnosu na setove. Parametri efikasnosti su analizirani deskriptivnom statističkom metodom. Takođe, korišćena je i linearna regresiona metoda, gde je na osnovu trenda promene koeficijenta regresije definisan inicijalni nivo efikasnosti igre, dok je regresiona konstanta predstavljala nivo promene date efikasnosti u funkciji odigranih setova (mera procene specifične izdržljivosti).

**Rezultati.** Rezultati su pokazali da je u toku cele sezone ekipa imala – TOTAL = 1358 osvojenih i 1274 izgubljenih poena, odnosno u proseku po utakmici 84.88 vs 79.63 osvojenih / izgubljenih poena. Indeks efikasnosti igre se može definisati prosečnom vrednošću od  $1.13 \pm 0.31$  indeksnog broja osvojenih i izgubljenih poena, gde je dati indeks u prvom delu sezone imao vrednost od  $1.16 \pm 0.39$ , a u drugom delu  $1.10 \pm 0.22$ . Definisani modeli trenda promena su imali sledeći oblik: cela sezona,  $y = -0.0946x + 1.367$ ; prvi deo sezone  $y = -0.1516x + 1.5132$ ; drugi deo sezone  $y = -0.0447x + 1.2236$ .

**Zaključak.** Pomoću dobijenih rezultata je definisan model generalnog pokazatelja takmičarske efikasnosti igre jedne ženske odbojkaške ekipe u toku cele sezone, gde je data efikasnost numerički izražena.

## ANALYSIS OF THE GENERAL INDICATORS OF COMPETITIVE EFFICIENCY OF PERFORMANCE OF FEMALE VOLLEYBALL TEAM DURING THE ANNUAL MACROCYCLE - AN EXAMPLE OF FEMALE VOLLEYBALL CLUB “KIKINDA”

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**Introduction.** The object of the research is achieved level and changes in general competitive efficiency by the method of analysis of competitive results achieved by the Female Volleyball Club (FVC) “Kikinda”, which in the 2008/09 season competed in Second National League – North, R. Serbia.

**Methods.** The competition results of FVC “Kikinda” in the season 2008/09 were used for this paper. The results from a total of 16 played games have been analyzed. The indicators of competitive efficiency are presented by the following variables: 1) TOTAL – the overall score achieved in match, expressed by a sum of won / lost sets and scores; SET<sub>total</sub> - the result achieved in each set played in the game, expressed by a sum of won/lost sets and score; Index<sub>Effic</sub> - which represents the ratio of won and lost scores during the game and when compared to the sets. The performance parameters were analyzed by descriptive statistical methods. Additionally, linear regression method was used, in which, based on the trend of modification of the regression coefficient, defined the initial level of game efficiency, while the regression constant represent the level of change of the given efficiency in the function of played sets (measure of estimate of specific endurance).

**Results.** The results indicated that during the whole season the team had - TOTAL = 1358 won and 1274 lost scores, i.e. on average 84.88 won vs. 79.63 lost scores per game at. The index of game efficiency can be defined by the average value of  $1.13 \pm 0.31$  of index number of won and lost scores, where the given index in the first part of the season had a value of  $1.16 \pm 0.39$ , and  $1.10 \pm 0.22$  in the second part. The defined model of trend changes had the following form: the whole season,  $y = -0.0946x + 1.367$ ; the first part of the season,  $y = -0.1516x + 1.5132$ ; the second part of the season,  $y = -0.0447x + 1.2236$ .

**Conclusion.** The obtained results helped defining a model of general competitive efficiency indicator of a female volleyball team play during the entire season, with numerical expression of the said efficiency.

## PRILOG PROUČAVANJU DVA MODELA PROCENE SNAGE RUKOMETAŠA

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**Uvod.** Cilj rada je bio da se utvrdi uticaj dva različita načina testiranja na transformaciju snage rukometaša, u uslovima samoprevazilaženja i prevazilaženja partnera (tražene su moguće rezerve sportista izazvane kompetitivnim faktorom).

**Metod.** Istraživanje je realizovano u avgustu 2009. godine i obuhvatilo je 25 rukometaša MRK Radnički-Morava iz Svilajнца člana II lige Centar. Za procenu snage, primenjena su tri standardizovana kretna zadatka, a to su: skok u dalj iz mesta - za procenu eksplozivne snage opružaća nogu, ležanje - sed za 30 sek. - za procenu repetitivne snage trbušnih mišića i pregibača u zglobu kuka i dinamometrija dominantne ruke - za procenu statičke sile dominantne ruke. Rezultati istraživanja pored postupaka deskriptivne statistike, obrađeni su t-testom za zavisne uzorke kojim je testirana značajnost razlika između rezultata merenja dobijenih u dve varijante izvođenja (sami i u paru).

**Rezultati.** Deskriptivni pokazatelji ukazuju na prednost testiranja snage rukometaša u uslovima kompetitivnog izvođenja. Na osnovu vrednosti t-testa, konstatovana je statistički značajna razlika, između pojedinačnog i kompetitivnog izvođenja, kod sve tri istraživane varijable i ona je u korist kompetitivnog realizovanja testova.

**Zaključak.** Dobijeni rezultati upućuju na razmišljanje o vrednostima i praktičnoj primeni ponuđenog modela u proceni fizičkih sposobnosti sportista.

## A SUPPLEMENT TO THE STUDY OF TWO MODELS OF EVALUATION OF HANDBALL PLAYERS' STRENGTH

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**Introduction.** The goal of this work was to determine the influence of two different models of testing on transformation of handball players' strength in the conditions of self prevailing and prevailing of a partner (the possible reserves of sportsmen provoked by competitive factor were searched).

**Method.** This research was realized in August 2009 and 25 handball players from the team MRK „Radnicki-Morava“ in Svilajnac, Serbia, a second league Center member, participated in this research. Three standardized movement tasks were used for the evaluation of strength: long jump from the spot – for evaluation of explosive strength of leg muscles, a 30 second lie-sit – for evaluation of repetitive strength of abdomen muscles and hip muscles and dynamometry of dominant hand – for evaluation of static force of dominant arm. The researched results, apart from procedures of descriptive statistics, were also processed by t-test for dependant specimen by which the significance of differences was tested between the results acquired by two models of performance (individual and in pairs).

**Results.** Descriptive indicators show the advantage of testing in conditions of competitive performance. On the basis of T-test, there was statistically significant difference, between individual and competitive performance, for all three researched variables and it is favor of competitive realization of tests.

**Conclusion.** The results direct to thinking about application of the offered model in evaluation of sportsmen abilities.

## PRIMENA ROLERA U TRENINGU ALPSKIH SKIJAŠA

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**Uvod.** Skijanje kao sezonski sport ima ograničene mogućnosti specifičnog treninga. Zato je poželjno da „suvi“ treninzi imaju određen stepen sličnosti podražavanja pokreta takmičarske tehnike. Vežbe moraju biti u saglasnosti sa parametrima koji određuju strukturu pokreta na skijama. Predmet rada je utvrđivanje mogućnosti da se trening na rolerima uvrsti kao sastavni deo „suvog“ treninga.

**Metod.** Analizom rezultata dosadašnjih istraživanja nastojalo se da se utvrdi u kojoj meri se poklapaju osnovni parametri elemenata tehnike slaloma na skijama (SL) i slaloma na rolerima (ISL): položaji i međusobni odnosi segmenata tela, aktivnost aktuelnih mišićnih grupa (režim rada, stepen aktivacije, vremenskim parametrima) i kinematci pokreta (trajanje pojedinih faza zaokreta) i dr.

**Rezultati.** Rezultati istraživanja ukazuju na koordinativnu bliskost tehnike promene pravca na skijama i na rolerima. Evidentne su pojedine razlike u brzini kretanja, intenzitetu ispoljavanja sile, tačkama opterećenja, kao i sličnosti u položajima segmenata tela, angažovanosti aktuelnih mišićnih grupa, intenzitetu mišićnog naprezanja i dr.

**Zaključak.** Saznanje o sličnostima i razlikama može unaprediti primenu rolera u treningu skijaša. Promene pojedinih parametara (nagib terena, brzina kretanja) mogu značajno doprineti pozitivnom transferu kada je u pitanju struktura pokreta u skijanju.

## USING IN-LINE SKATING IN THE TRAININGS OF ALPINE SKIERS

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**Introduction.** Being a seasonal sport, skiing has limited possibilities for specific trainings. Hence, it is desirable for the dry land trainings to possess a certain degree of similarities of simulate the competition techniques. Exercises need to be in accord with the parameters defining the structure of the movements on skis. The subject of the paper is determining the options for in-line skating to be introduced as part of the dry-land training.

**Method.** With analyzing the results of the research thus far, the goal was to establish the actual correlation between the basic elements of the technique in ski slalom (SL) and in-line skates slalom (ISL): positions and mutual positions of parts of the body, activities of certain muscle groups (manner of functioning, activation level, time parameters) and kinematics of the movements (duration of certain phases of turns/ spins) and other.

**Results.** The research results point to the coordination similarities in the techniques of changing the direction on skis and rollers. Certain differences in the speed of movements, intensity of expressing the power, points of pressure are evident, and so are the similarities in the positions of certain parts of body, engagement of certain muscle groups, intensity of muscle strain etc.

**Conclusion.** The knowledge on those differences and similarities can advance using the in skating in the training of skiers. Changes in certain parameters (speed of movements, elevation) may significantly contribute to the positive transfer, in regard to movement structure in skiing.

## JEDNAČINA SPECIFIKACIJE GIPKOSTI SPORTISTA

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**Uvod.** Gipkost se definiše kao sposobnost čoveka da izvede pokret sa što većom amplitudom. Kao merilo, najčešće se uzima maksimalna amplituda pokreta u raznim delovima tela (Malacko, Doder, 2008). Cilj ovog rada je da se utvrdi nivo slaganja teorijski i matematički izvedene jednačine specifikacije sa krivom empirijski dobijenih vrednosti gipkosti zadnje lože buta i kičmenog stuba kod sportista.

**Metod.** Na uzorku od 1884 sportista starosti od 8 do 30 godina utvrđen je status gipkosti zadnje lože buta i kičme testom duboki pretklon trupa. U okviru uzorka obuhvaćeni su sportisti 25 sportova.

**Rezultati.** Matematički izvedena jednačina specifikacije ima visoki nivo slaganja rezultata gipkosti zadnje lože buta i kičmenog stuba sa krivom empirijski dobijenih vrednosti kod sportista. Jednačina je definisana na sledeći način:  $y = -4E-06x^6 + 0,0003x^5 - 0,0106x^4 + 0,1477x^3 - 0,9292x^2 + 3,3896x + 21,503$ , sa  $R^2 = 0,9925$ . Dobijeni rezultati pokazuju da razvoj gipkosti u odnosu na teoretsku krivu blago oscilira. Ispitivani uzorak je pokazao intenzivni, ali dosta neravnomeran razvoj gipkosti od 8. do 17. godine. Posle toga rezultat ima tendenciju neznatnog porasta i stabilizaciju vrednosti. U 21. godini zabeležen je maksimum vrednosti, posle čega sledi blag pad vrednosti. Kod sportista posle 25. godine je zabeležena tendencija bržeg pada vrednosti. Razloge takve orijentacije u razvoju treba tražiti u nekim biološkim momentima (rast, razvoj, mišićna masa).

**Zaključak.** Dobijeni rezultati govore o postojanju zakonitosti u razvoju gipkosti kod ispitanika. One mogu biti orijentacija za sve one stručnjake koji rade na trenažnim procesima sportista skoro svih uzrasta, uz činjenicu da je optimalna zona najboljih vrednosti gipkosti kod sportista u periodu od 17. do 25. godine.

## FLEXIBILITY EQUATION OF SPECIFICATION IN SPORTSMEN

**Ján Babiak, Dragan Doder**

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**Introduction.** Flexibility is determined as human ability to perform a movement with highest amplitude possible. As criteria, usually is used maximum movement amplitude in different body segments (Malacko, Doder, 2008). The goal of this report is to determine composition level of theoretical and mathematical specification equation with curve of empirically derived data of back thigh and spinal column sportsmen flexibility.

**Method.** On sample of 1884 sportsmen from 8 to 30 years old flexibility status of back thigh and spinal column is determined by test deep forward bend. Within sample 25 different sports are comprised.

**Results.** Mathematically derived equation of specification have high matching result level of flexibility of back thigh and spinal column with curve empirically values within sportmen. Equation is defined as:  $y = -4E-06x^6 + 0,0003x^5 - 0,0106x^4 + 0,1477x^3 - 0,9292x^2 + 3,3896x + 21,503$ , with  $R^2 = 0,9925$ . Calculated results are showing that flexibility development relation with theoretical curve is slightly oscillating. The examined sample has shown intensive, but uneven development of flexibility from 8 to 17 years of age. After that, result have slight trend increase with value stabilisation. Maximum value is found in the age of 21 and after that it slightly decreases. After the age 25 values in sportsmen rapidly decreases. Reasons for this orientation in development should be found in biological moments (growth, development, muscular mass).

**Conclusion.** Results show validity in development of flexibility in tested sportsmen. They can be orientation for experts who work in training process with sportsmen of almost all ages, with the fact that the optimal zone of best flexibility values are between the age of 17 to 25.

## JEDNAČINA SPECIFIKACIJE BRZINE POJEDINAČNOG POKRETA KOD SPORTISTA

**Dragan Doder, Ján Babiak**

Pokrajinski zavod za sport, Novi Sad, Srbija

**Uvod.** Brzina se definiše kao sposobnost čoveka da izvrši veliku frekvenciju pokreta za najkraće vreme ili da se jedan pokret izvede što je moguće brže u datim uslovima. Smatra se da je to jedna od najznačajnijih motoričkih sposobnosti (Malacko, Doder, 2008). U dosadašnjim istraživanjima, pored genske uslovljene opšte brzine, u sportu je utvrđeno postojanje sledećih specifičnih brzina: brzina motorne reakcije, brzina pojedinačnog pokreta, brzina kretanja sa promenom pravca i brzina sprinterskog trčanja (Malacko i Rađo, 2004; Milanović, 2007; Malacko i Doder, 2008). Cilj ovog rada je da se utvrdi nivo slaganja matematički i teorijski izvedene jednačine specifikacije sa krivom empirijski dobijenih vrednosti kod sportista.

**Metod.** Na uzorku od 1884 sportista starosti od 8 do 30 godina iz 25 sportova utvrđen je status brzine pojedinačnog pokreta na elektronskoj taping dasci na zvučni signal.

**Rezultati.** Matematički izvedena jednačina specifikacije ima visoki nivo slaganja rezultata brzine pojedinačnog pokreta sa krivom empirijski dobijenih vrednosti kod sportista. Ta jednačina definisana je na sledeći način:  $y = -2E-05x^3 + 0,0013x^2 - 0,0202x + 0,2901$ , sa  $R^2 = 0,9826$ . Brži razvoj ove sposobnosti zabeležen je do 14. godine, a stabilizacija na maksimalnim vrednostima je do 20. godine. Posle toga sledi pad vrednosti, a posle 26. godine još se više usporava. Zona najboljih vrednosti brzine pojedinačnih pokreta kod sportista je u periodu od 14. do 20. godine.

**Zaključak.** Motorna brzina je sposobnost potpuno dispozicionog tipa. Dobijeni rezultati govore o postojanju zakonitosti u razvoju brzine. Razvoj ove sposobnosti zabeležen je do 14. godine, stabilizacija je do 20. godine, a posle sledi pad vrednosti.

## SINGLE MOVEMENT SPEED EQUATION OF SPECIFICATION IN SPORTSMEN

**Dragan Doder, Jan Babiak**

Provincial Institute for Sport, Novi Sad, Serbia

**Introduction.** Speed is defined as capability of men to perform large frequency of movement in shortest time or to perform one movement as fast as possible in given conditions. It is considered to be one of the most significant motor ability (Malacko & Doder, 2008.). In so far research, beside genetically conditioned general speed, in sports it is determined existence of specific speeds: motor reaction speed, single movement speed, speed of movement with direction change, and sprint running speed (Malacko & Radjo, 2004.; Milanovic, 2007., Malacko & Doder, 2008.). The goal of this report is to determine level of composure mathematically and theoretically derived equation of specification with curve empirically derived data in sportsmen.

**Method.** On sample of 1884 sportsmen from 8 to 30 years old from 25 sports status of single movement speed is determined on electronic taping board with sound signal.

**Results.** Mathematically derived equation of specification have high matching result level of single movement speed with curve empirically values within sportsman. Equation is defined as:  $y = -2E-05x^3 + 0,0013x^2 - 0,0202x + 0,2901$ , with  $R^2 = 0,9826$ . Faster development of this ability is found until the age of 14, and stabilisation on maximum values is until the age of 20. After that values decreases, and after the age of 26 decreases even more. Zone of best values in single movement speed in sportsmen is between the ages of 14 to 20.

**Conclusion.** Motor speed is disposing type ability. Calculated results show validity in speed development. Development of this ability is found in the age of 14 years, and stabilisation until the age of 20 years, after that it decreases.

## RACIONALIZACIJA BIPEDALNOG KRETANJA - BRZINA KRETANJA -

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**Uvod.** Prvi cilj ovog istraživanja bio je utvrđivanje da li se aktuelna težišta tijela kreću istom brzinom ili se njihove brzine kretanja razlikuju, zavisno od toga da li se te brzine posmatraju u periodu odupiranja ili u periodu leta, a drugi cilj bio je utvrđivanje da li je tehnika sprinta tipična samo za sprintere, ili isti tehnički principi važe i za srednjeprugaše i dugoprugaše.

**Metod.** Obrađuju se kinogrami, koji su dobijeni specijalnim snimanjem subjekta, koji se kreće ispred kamere. Na taj način se snimi veliki broj pozicija u jedinici vremena. U ovom istraživanju kamera je bilježila 60 snimaka u svakoj sekundi. Za razliku od statističkih istraživanja, kinematičkom metodom se ne istražuje status neke populacije, nego najracionalniji način kretanja, uglavnom u sportski složenim kretanjima. U kinematičkom istraživanju po pravilu se koristi metod paradigme, odnosno ne istražuju se grupe ispitanika nego samo pojedinac, i to pojedinac koji ima najbolji rezultat u domenu koji se istražuje.

**Rezultati.** Tematika ovog istraživanja ograničena je samo na problem brzine kretanja težišta tijela, težišta kranijanog i težišta kaudalnog dijela tijela, sa ciljem da se utvrde brzine kretanja aktuelnih segmenata tijela i to atletičara sprintera, srednjeprugaša i dugoprugaša, koji su trčali maksimalnom, srednjom i malom brzinom. Nakon mjerenja dobijeni su sljedeći rezultati: Brzina kretanja težišta tijela sprintera u fazi odupiranja, kada se kretao maksimalnom brzinom, iznosila je 9.40 m/s., kod srednjeprugaša 8.26 m/s, a kod dugoprugaša iznosila je 7.73 m/s.

**Zaključak.** Uzimajući u obzir biomehaničke postulate tehnike trčanja, može se generalno zaključiti da razlike u tehnici trčanja kod trkača sa različitim specijalnostima su po pravilu kvantitativne prirode, tj. što je brzina kretanja manja, samo je kraći korak i samo su amplitude zamaha manje. Tipično za racionalnu tehniku trčanja je prisustvo oscilatornog kretanja uzdužne ose aparata za kretanje u sagitalnoj ravni.

## RATIONALIZATION OF BIPEDAL MOVEMENT – SPEED –

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**Introduction.** The primary aim of this investigation was to determine if the actual centers of bodily gravitation move in the same speed or whether their movements differ in speed, depending on the periods the speeds are observed, namely the period of resistance and the period of flight. Whereas the other aim of the investigation was to determine whether the sprint technique is typical only for the professional sprinters, or the same principles are valid to both medium and long-distance runners.

**Method.** Analyzing kinograms we get special recording of the subject who is moving in front of the camera. This methodology allows us to record numerous positions in a time unit. During this research, camera made 60 records in each second. Contrary to the statistic research, kinematics methodology is not interested in a status of a population, but in a most rational way of movement, mainly with the regard to complex sport movements. As a principle, kinematics research uses the method of paradigm, i.e. it does not investigate the groups but the individual subjects. Moreover, it is a subject who has achieved the best result in the investigated domain.

**Results.** This research is primarily focused on the problem of the speed of the gravitational centre of the caudal part of the body, cranial part of the body, and the centre of gravity of the whole body. We aimed at determining the speed of the actual parts of the body at the athletic sprinters, medium and long-distance runners, who used maximum, medium, and low speed. After the measurements, we are given the following results: the speed of the gravitational centre of a sprinter's body in the phase of resistance, when he moved in a maximum speed, was 9.40 m/s, the medium distance runner made 8.26 m/s, while the long distance runner made 7.73 m/s.

**Conclusion.** Having in mind the biomechanical postulates of the running technique, we've come to a general conclusion that the differences in the running technique at variously specialized runners are, by a rule, of quantitative nature, i.e. as the speed decreases the step becomes shorter and the amplitudes of the swing become smaller. Typical of the rational running technique is the presence of the oscillatory movement of the longitudinal axis of the moving apparatus in the sagittal plane.



## INTEGRALNI PLAN TRENINGA U TENISU REALIZOVAN KOMPATIBILNIM SREDSTVIMA

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**Uvod.** Sve veće trenažne i takmičarske zahteve u vrhunskom sportu nije moguće ostvariti bez novih trenažnih tehnologija, sistema treninga i preciznog planiranja svakog treninga. U ovom radu objašnjava se potreba integralnog planiranja treninga u tenisu.

**Metod.** U ovom radu korišćeni su eksplikativni istraživački metodi. U prvom redu spekulativno-bibliografski u kojima su relevantna saznanja iz oblasti sportskog treninga prikupljena, analizirana i interpretirana teorijsko-kontemplativnim putem. Ovaj metod filozofske orijentacije logički je doveden u sklad sa empiriskim zapazanjima autora nakon višegodišnjeg bavljenja sportskim treningom.

**Rezultati.** U tenisu je tokom treninga moguće realizovati taktičke, tehničke i ciljeve u vezi sa fizičkom pripremom. U praksi sportskog treninga najčešće se dešava da se tehničko-taktički ciljevi rešavaju odvojeno u odnosu na ciljeve iz domena fizičke pripreme. U slučajevima kada se iz fizičke pripreme planira usvršavanje latentnih motoričkih struktura, koje se odnose na mehanizme za regulaciju trajanja i intenziteta ekscitacije, može se reći da takav tretman ima opravdanje. Međutim, kada se planira usavršavanje mehanizmima za struktuiranje kretanja, mehanizmima za regulaciju tonusa i sinergijsku regulaciju, i mehanizama za usavršavanje energetskih potencijala organizma, onda je poželjna primena sredstava koji će svojim sadržajem i formom omogućiti ostvarenje zadataka iz sva tri domena sportskog treninga. Planiranje i realizacija treninga na ovaj način podiže kvalitet treninga i preciznije struktuiranje celokupnog trenažnog procesa. Podaci evidentirani planom treninga omogućavaju kvantifikovanje kvaliteta pojedinih elemenata tehnike u odnosu na intenzitet fizičkog opterećenja. Informacije takve vrste korisne su u modeliranju taktike u određenom stanju sportske forme.

**Zaključak.** U ovom radu primenom eksplikativnih istraživačkih metoda, prikazan je integralni način planiranja sportskog treninga u tenisu. Analizirane su prednosti, ali i ograničenja ovakvog načina planiranja treninga.

## INTEGRAL PLAN OF TRAINING IN TENNIS REALIZED BY COMPATIBLE MEANS

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**Introduction.** All bigger training and competitive requirements in top sport can not be realized without applying new training technologies, training system and precise plan for each training. In this work we explain the necessity of the integral training plan in tennis.

**Method.** In this work have been used the explicatory research methods. On the first place, speculative and bibliography methods have been used in order to get together, analyze and interpret all relevant experiences concerning the sports training. This method of philosophical orientation has been brought into accord with empirical observations of the author after many years of going in for sports training.

**Results.** In tennis it is possible, during the training, to achieve tactical and technical goals such as those goals that concern physical preparations. In practice the most usual thing is that tactical and technical goals are separated regarding the goals that concern physical preparations. In situations when physical preparations mean advancing latent mobile structures which concern the mechanism for regulation of lasting and intensity of excitement, we can consider that justified. However, when it is planned the advancing of the mechanism for structuring of mobility, mechanism for regulation of tonus and synergic regulation, such as the mechanism for advancing the energetically potentials of the organism, then it is more useful to apply the means that, thanks to their content and their form, will make possible accomplishment of goals from all three fields of sports training. By planning and realizing the training in this way the quality of training becomes higher and the structuring of training process more precise. The facts noted with the plan of training make possible the quantification of quality of single elements of the technique in regard to intensity of physical load. Such information is useful for modeling the tactic in particular state of physical condition.

**Conclusion.** In this work, by applying the explicatory research methods, it has been presented the integral approach of planning sports training in tennis. There have been analyzed both the advantages and limitations of planning the training in this way.

## EFFECTS OF 6-MONTHS RUNNING PROGRAMME ON ENDURANCE AND AEROBIC CAPACITY IN MALE RECREATIVE RUNNERS

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University of Ljubljana, Faculty of Sport, Ljubljana, Slovenia

**Introduction.** Regular and systematic aerobic exercise has many and diverse positive effects on man's health and vitality. The study aimed to establish the effect of 24 weeks of complex recreational exercise on the running preparedness of adults and find out the extent to which individual mechanisms of aerobic capacity respond to a complex running exercise.

**Method.** The sample included 11 male subjects, aged on average  $47.5 \pm 7.7$  years. The sample of variables for assessing aerobic and anaerobic capacity included spiroergometric and biochemical parameters which were measured using a graded load treadmill test. The differences between individual parameters in terms of the initial and final levels were established using a t-test for dependent samples.

**Results.** During the load test the final running velocity and the running velocity at  $VO_{2max}$  increased by 9.4% ( $P < 0.001$ ) and 9.6% ( $P < 0.01$ ), respectively, whereas the distance covered in the test run was 18.6% longer ( $P < 0.001$ ). The subjects' competitive result in a 10-km run improved by 6 min and 24 sec (11.8%) ( $P < 0.001$ ). The improvement in the maximum oxygen uptake ( $VO_{2max}$ ) by 7.4% and 8.4% ( $P < 0.001$ ), respectively, is mainly due to better central mechanisms – an increased heart stroke volume ( $P < 0.001$ ) and maximum minute ventilation ( $P < 0.05$ ). The blood lactate concentration rose by 10.5% ( $P < 0.05$ ).

**Conclusion.** Based on the results it can be concluded that the diverse running programme for the selected adults was efficient as it significantly increased their running endurance. The latter is due to an improvement in their aerobic and anaerobic lactate capacity.

## EFEKTI ŠESTOMESEČNOG PROGRAMA TRČANJA NA IZDRŽLJIVOST I AEROBNE SPOSOBNOSTI KOD MUŠKARACA REKREATIVNIH TRKAČA

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**Uvod.** Redovno i sistematsko aerobno vežbanje ima mnogo i različitih pozitivnih efekata na zdravlje i vitalnost muškaraca. Studija ima za cilj da odredi efekat 24 nedelje složenih rekreativnih vežbanja na pripremi za trčanje odraslih i da otkrije stepen do koga će individualni mehanizmi aerobnih sposobnosti odgovoriti na složeno vežbanje trčanja.

**Metod.** Uzorak je činilo 11 ispitanika muškaraca prosečne starosti  $47.5 \pm 7.7$  godina.

Uzorak varijabli za procenjivanje aerobnih i anaerobnih sposobnosti uključujući spiroergometrijske i biomehaničke parametre koji su mereni korišćenjem kalibriranog testa opterećenja na tredmilu. Razlike između individualnih parametara u smislu početnih i krajnjih nivoa određene su korišćenjem t-testa za zavisne uzorke.

**Rezultati.** Tokom testa opterećenja konačna brzina trčanja i brzina trčanja pri  $VO_{2max}$  je povećana za 9.4% ( $P < 0.001$ ) odnosno 9.6% ( $P < 0.01$ ), dok je pređena razdaljina na testu trčanja bila 18.6% duža ( $P < 0.001$ ). Takmičarski rezultati ispitanika na trčanju na 10 km popravili su se za 6 min i 24 sec (11.8%) ( $P < 0.001$ ). Pобољшanje maksimalnog unosa kiseonika ( $VO_{2max}$ ) za 7.4% odnosno za 8.4% ( $P < 0.001$ ), je uglavnom rezultat boljih centralnih mehanizama – povećani volumen srčanog udara ( $P < 0.001$ ) i ventilacija maksimalno minut ( $P < 0.05$ ). Koncentracija laktata u krvi je porasla za 10.5% ( $P < 0.05$ ).

**Zaključak.** Na osnovu rezultata može se zaključiti da su različiti programi trčanja za odabrane odrasle bili efikasni, jer su značajno povećali njihovu izdržljivost kod trčanja, zbog poboljšanja u njihovim aerobnim i anaerobnim laktatnim kapacitetima.

## KOMPARATIVNA ANALIZA STRUKTURE TRENINGA RAZLIČITIH GRUPNIH FITNES PROGRAMA

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**Uvod.** Osnovna karakteristika grupnih fitnes programa vežbanja je da su različiti po svom sadržaju, biomehaničkim parametrima, nameni, upotrebi sprava i rekvizita, ali isti po aerobnom režimu rada i grupnom vođenju časa uz zvuke muzike.

**Metod.** U radu je data analiza strukture treninga programa "high –low", "step", "tae-bo", "workout" i pilatesa.

**Rezultati.** Zajednička karakteristika strukture treninga ovih fitnes programa je da se svaki trening sastoji iz: uvodno-pripremnog dela, glavnog tzv. kondicionog dela, i na kraju završnog dela treninga, u kojem se sprovode vežbe istezanja. Osnovna razlika u strukturi treninga fitnes programa, ogleda se u glavnom tzv. kondicionom delu treninga. U ovom delu treninga u "high-low" i "step" aerobiku se kombinuju različiti plesni koraci, koji se spajaju u nizove, čineći koreografiju, u "tae-bo"-u se izvode kombinacije udaraca rukama i nogama preuzete iz ručnih i nožnih tehnika borilačkih veština, dok se u "workout"-u izvode vežbe za jačanje pojedinih mišićnih grupa uz korišćenje različitih rekvizita. Osnovna karakteristika pilatesa je izvođenje vežbi usmerenih na jačanje pojedinih mišićnih grupa, kao i povećanju pokretljivosti u pojedinim zglobovima.

**Zaključak.** Pored različitosti u glavnom delu treninga, navedeni grupni programi fitnesa usmereni su ka očuvanju zdravlja, utiču na podizanje funkcionalnih sposobnosti, poboljšanje srčane efikasnosti i mišićne snage, odnosno fizičke kondicije, kao i psihosocijalnih osobina ličnosti.

## COMPARATIVE ANALYSIS OF THE TRAINING STRUCTURE IN DIFFERENT GROUP FITNESS PROGRAMMES

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**Introduction.** The main characteristics of group fitness exercising programmes is that they vary in content, biochemical parameters, aims, use of apparatus and equipment while sharing the same aerobic regiment alongside the group performance of a routine accompanied by a music piece.

**Methods.** The papers analyses the training structure of the following programmes: "high –low", "step", "tae-bo", "workout" and Pilates.

**Results.** The common characteristics of the training structures in the above mentioned programmes is that each session consists of a warming up, the main or the conditioning part and finally the stretching part. The main difference in the training structures of the fitness programmes is reflected in the main or the conditioning training. In the respective part of the training in "high-low" and "step" aerobics different dance steps are combined and merged into sequences resulting in a choreography, in "tae-bo" combinations of punches and kicks derived from martial arts techniques are performed while in "workout" the exercises are performed to strenghten individual muscle groups with the use of various equipment. The main characteristics of the pilates are the exercises aimed at strenghtening individual muscle groups and increasingly mobilising individual joints.

**Conclusion.** Regardless the differences in the main part of the training sessions, the treated group fitness programmes are all health oriented as they raise functional capabilities, improve heart efficiency and muscular strenght, that is the overall physical condition as well as the psycho – social personality characteristics.

## MODEL OBEZBEĐIVANJA USLOVA ZA RAD MLADIM SPORTSKIM TALENTIMA U BEOGRADU

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**Uvod.** Rad predstavlja prikaz modela obezbeđivanja uslova za rad mladim sportskim talentima u Beogradu. U okviru sistema sporta u Beogradu, a prema Zakonu o sportu i Odluke o gradskoj upravi grada Beograda Sekretarijat za sport i omladinu vrši poslove koji se odnose i na obezbeđivanje uslova i poboljšanja kvaliteta rada sa mladim sportskim talentima. Od 2001. godine na osnovu gradske kategorizacije sportova i po posebnoj metodologiji kandidovanja programa rada saveza vrši se sufinansiranje gradskih sportskih organizacija za rad sa sportistima mlađih kategorija.

**Metod.** Analizom razvoja sporta u Beogradu uvidela se potreba da se izvrši analiza ostvarenih rezultata reprezentativaca u kategoriji kadeta, juniora i seniora u olimpijskim sportovima na velikim sportskim takmičenjima i izvršena je kategorizacija i vrednovanje beogradskih sportskih klubova sa ciljem da se obezbeđivanjem finansijske pomoći obezbede bolji uslovi za rad. Pomoć klubovima sa izuzetnim rezultatima je uvedena od 2005. god.

**Rezultati.** Od 2008. godine Sekretarijat je podržao preporuku Međunarodnog olimpijskog komiteta i Olimpijskog komiteta Srbije da je potrebno da se da veća podrška ženama u sportu. U cilju afirmacije žena u sportu i poboljšanja kvaliteta i uslova za rad, odobreno je sufinansiranje beogradskih klubova u kojima su sportistkinje osvojile prvo mesto na Prvenstvu Srbije za kategoriju juniorki ili kadetkinja. Sredstva budžeta grada se namenski koriste za obezbeđivanje sportskog objekta za potrebe treninga sportista i sportsku opremu.

**Zaključak.** Rad ukazuje da se stalnim i planskim ulaganjem u mlade sportske talente i trenere koji rade sa njima daje sigurnost za razvoj i popularizaciju određenih sportskih disciplina što omogućava da se Beograd kandiduje za organizaciju velikih međunarodnih sportskih takmičenja.

## MODEL OF PROVIDING WORKING CONDITIONS FOR YOUNG TALENTED ATHLETES IN BELGRADE

**Gordana Todoric**

Secretariat for Sport and Youth, Belgrade, Serbia

**Introduction.** On the scope of the sports system in Belgrade, and according to Sports Law and Decision concerning the Belgrade City Department, Secretariat for Sport and Youth shall run affairs also referring to providing conditions and quality improvement of working with young talented athletes. Since 2001. on the basis on city categorization of sports, and according to special methodology for candidate federation working program, the co-financing of the city sports organizations for working with young athletes has being performed.

**Method.** The need for analysis of achieved results of the representatives in categories: cadets, juniors and seniors in Olympic sports and other main competitions was brought to a light by the analysis of sports in Belgrade and the categorization was done, as the evaluation of Belgrade sports clubs in order to provide better working conditions by providing financial support.

**Results.** Secretariat for Sport and Youth supported the recommendation of the International Olympic Committee and Serbian Olympic Committee from 2008. and related to better support given to women in sports. Co-financing of the Belgrade clubs, whose female athletes won first place at the Serbian Championship in categories: juniors or cadets, was approved in order to improve quality and working conditions and also to affirm the women in sports. The finances from the City budget intended for this special purpose are being used for sports venues supply, for the training needs of the athletes, and for the sports equipment.

**Conclusion.** The safety for development and popularization of the specific sports events is made by constant and planned investment in talented young athletes and their coaches, which makes possible to run the city of Belgrade for the organization of the main international sports competitions.

## POUZDANOST I OSETLJIVOST VARIJABLI ZA PROCENU PRECIZNOSTI I BRZINE ŠUTA KOD MLADIH PERSPEKTIVNIH FUDBALERA

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**Uvod.** Primarni cilj ovog rada je bio da se ispita pouzdanost i osetljivost varijabli za procenu preciznosti i brzine kao očekivanih kvaliteta šuta kod mladih perspektivnih fudbalera, a sekundarni cilj je bio da se ispita koliko je pokušaja potrebno za dostizanje prihvatljivog nivoa pouzdanosti podataka.

**Metode.** U studiji je učestvovalo ukupno 53 fudbalera (12,7±0,6 godina, 45,21±7,34kg i 158,84±8,41cm), kandidata za mladu nacionalnu selekciju. Vrednovanje kvaliteta performansi šuta vršeno je na osnovu sposobnosti pogađanja u zadatu metu i brzine šuta. Svaki ispitanik je imao 3 serije po 10 šuteva dominantnom i nedominantnom nogom u centar mete, dimenzija 2x2m, i po tri pokušaja za merenje maksimalne brzine šuta. Apolutna, konstantna i varijabilna greška su korišćene za procenu sposobnosti pogađanja u metu, dok su maksimalna brzina lopte pri letu i brzina lopte prilikom šutiranja u metu korišćene za vrednovanje brzine šuta. **Rezultati.** Dobijeni podaci su pokazali nisku i umerenu pouzdanost za apsolutnu (ICC=0.59-0.65) i varijabilnu grešku (ICC=0.45-0.60), dok je konstantna greška pokazala veoma nisku pouzdanost (ICC=0.00-0.38). Primena Spearman-Brown formule predviđanja je ukazala da je za prihvatljiv nivo pouzdanosti apsolutne i varijabilne greške (ICC≥0.7) neophodno da se kvalitet šuta, prilikom pogađanja u zadatu metu, vrednuje na osnovu najmanje 23 šuta. Za varijable maksimalne brzine i brzine prilikom šuta u metu dobijena je visoka pouzdanost (ICC>0.8). Osim konstantne greške, sve varijable su se pokazale dovoljno senzitivne da detektuju statistički značajne razlike između dominantne i nedominantne noge.

**Zaključak.** Iako su neke od primenjenih varijabli za ocenu sposobnosti pogađanja u metu pokazale nisku i umerenu pouzdanost, može se zaključiti da ove varijable mogu bolje da opišu postignute rezultate u poređenju sa ranije korišćenim tehnikama. Osim toga, visoka senzitivnost primenjenih varijabli ukazuje na potrebu njihovog daljeg razvoja. Za primenu ovih varijabli u budućim istraživanjima preporučuje se veći broj pokušaja za postizanje prihvatljivog nivoa pouzdanosti.

## RELIABILITY AND SENSITIVITY OF VARIABLES FOR EVALUATION ACCURACY AND KICKING VELOCITY OF ELITE YOUNG SOCCER PLAYERS

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**Introduction.** The main aim of the present study was to evaluate the reliability and sensitivity of variables for evaluation accuracy and kicking velocity in elite young soccer players, while second aim was to estimate a minimum number of experimental trials for reaching an acceptable level of reliability.

**Methods.** Fifty-three elite young soccer players (age 13 ± 1 years) participated in the present study. The evaluation quality of the kicking performance was based on the kicking accuracy and velocity. The participants were instructed to kick the ball towards a target (2 m by 2 m) with the bull eye placed in its center as accurate as possible 10 times in each of 3 consecutive series. In addition, the participants also performed 3 maximal kicks. The tests were performed by both the dominant and non dominant leg. Accuracy (absolute error), bias (constant error) and consistency (variable error) were used to reveal the kicking accuracy, while the recorded ball speed was used for the evaluation kicking velocity.

**Results.** The results suggested a low-to-moderate reliability for the accuracy and consistency (ICC=0.61-0.67 and ICC=0.45-0.61, respectively), while the bias revealed exceptionally low reliability (ICC=0.00-0.35). The applied Spearman-Brown prophecy formula suggested that at least twenty-three trials could be needed for achieving the acceptable level of reliability (>0.7) for both accuracy and consistency. Conversely, a high reliability (>0.8) was revealed for both the maximal ball speed and ball speed while aiming the target. Finally, with the exception of bias, all applied variables proved to be sensitive enough to demonstrate differences in the outcome variables between the dominant and non-dominant leg.

**Conclusion.** Although some of the applied variables suggested a low to moderate reliability, it could be concluded that the evaluated test could have advantage over previously used methods. In particular, the recorded high sensitivity of the applied variables encourages further development of the method. For routine application one could currently recommend a higher number of experimental trials for achieving an acceptable level of reproducibility.

## UTICAJ BAZIČNIH MOTORIČKIH SPOSOBNOSTI NA REZULTATE SITUACIONO-MOTORIČKIH TESTOVA MLADIH FUDBALERA

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**Uvod.** Osnovni cilj ovog istraživanja je da se utvrdi uticaj multidimenzionalnog prostora bazičnih motoričkih sposobnosti na rezultate u situaciono – motoričkim testovima, od kojih direktno zavisi i uspješnost u realizaciji određenih situacionih struktura motoričkog kretanja u fudbalu. Očekuje se da će analizirani nivo bazičnih motoričkih sposobnosti (kao skupa prediktorskih varijabli) ukazati na statistički značajan uticaj na rezultate u situaciono – motoričkim testovima (kao skupa kriterijskih varijabli).

**Metod.** U ovom istraživanju na uzorku 97 fudbalera uzrasta od 10 – 12 godina, koji se takmiče u pionirskoj ligi Republike Srpske odabrano je 15 varijabli koje će hipotetski pokriti bazične motoričke sposobnosti, kao i 5 varijabli za prostor situaciono-motoričkih sposobnosti.

**Rezultati.** Analizom vrijednosti aritmetičke sredine i medijane tretiranih motoričkih varijabli, uočava se da veći broj testova ima približno iste vrijednosti tih parametara, što ukazuje na činjenicu da su primijenjeni testovi bazičnih motoričkih sposobnosti dobro prilagođeni ispitanicima ovog uzrasta. Prediktorskim sistemom varijabli objašnjeno je 52% ( $R^2=.515$ ) zajedničkog varijabiliteta sa kriterijem, dok povezanost cjelokupnog prediktorskog sistema sa kriterijem, odnosno koeficijent multiple korelacije  $R$  iznosi .717, što predstavlja značajnu vrijednost na nivou  $Sig.=.000$ .

**Zaključak.** Generalni zaključak rezultata dobijenih regresionom analizom ukazuje da je postavljena hipoteza o statistički značajnom uticaju bazičnih motoričkih sposobnosti (kao skupa prediktorskih varijabli) na rezultate situaciono-motoričkih testova (kao skupa kriterijskih varijabli) mladih fudbalera u cjelosti potvrđena.

## INFLUENCE OF BASIC MOTOR SKILLS ON RESULTS OF SITUATIONAL-MOTOR TESTS OF YOUNG FOOTBALL PLAYERS

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**Introduction.** Basic objective of this study is to determine the influence of multidimensional space of basic motor skills on results regarding situational-motor tests, which directly influences success of realization of certain situational structures of motor moving in football. It is expected that analyzed level of basic motor skills (as a collective of predictor variables) will point out statistically important influence on results in situational-motor tests (as a collective of criterion variables).

**Method.** This study used sample of 97 football players age 10-12 who compete in Pioneer League of Republic of Srpska and 15 variables were chosen to hypothetically cover basic motor skills as well as 5 variables for situational-motor skills space.

**Results.** Analysis of arithmetic mean value and median of treated motor variables, shows that greater number of tests have approximately the same values of those parameters, which indicates to the fact that applied tests of basic motor skills are adjusted well to the examinees of this age. Predictor system of variables explains 52% ( $Square=.515$ ) of common variability with criterion, while connectivity of cumulative predictor system with criterion that is coefficient of multiple correlation  $R$  is .717 which indicates significant value on  $Sig. = .000$  level.

**Conclusion.** General conclusion of the results gained from regression analysis shows that set hypothesis, on statistically important influence of basic motor skills (as a collective of predictor variables) on results in situational-motor tests (as a collective of criterion variables), with young football player, confirms completely.

## RAZLIKE U SPECIFIČNIM MOTORIČKIM SPOSOBNOSTIMA KOD MLADIH FUDBALERA RAZLIČITOG NIVOVA TAKMIČENJA

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**Uvod.** Na uzorku od 74 mlada fudbalera iz 6 klubova, hronološke starosti od 16 do 18 godina, koji su redovno uključeni u trenažni proces i redovno se takmiče, izvršeno je istraživanje sa ciljem da se utvrde razlike u specifičnoj izdržljivosti u održavanju plitke formacije kod mladih fudbalera različitog nivoa takmičenja.

**Metod.** Prvi subuzorak čini 38 fudbalera koji se takmiče u Premijer ligi Bosne i Hercegovine. Drugi subuzorak čini 36 fudbalera koji se takmiče u omladinskoj ligi Republike Srpske. Inicijalno mjerenje svih 6 klubova urađeno je na početku pripremnog perioda a finalno na kraju pripremnog perioda, takođe u približno jednakim uslovima.

**Rezultati.** Centralni i disperzioni parametri, mjere asimetrije i spljoštenosti kod specifične izdržljivost u održavanju plitke formacije ispitanika inicijalno-finalno ukazuju da se kod oba nivoa vrijednosti nalaze u očekivanom rasponu, a vrijednosti koeficijenta varijacije ( $k.var$ ) ukazuju na homogenost oba analizirana nivoa. Korišteni su multivarijantni postupci MANOVA, MANOCOVA (je  $p = .947$  i  $p > .1$  nema razloga da se ne prihvati hipoteza  $H_1$ , što znači da nije uočena značajna razlika između dva nivoa takmičenja) i diskriminativna analiza ( $p = .972$  što znači da nije uočena značajna razlika i jasno definisana granica između bilo kojeg nivoa takmičenja). Od univarijantnih postupaka primjenjena je ANOVA, ANOCOVA, a dobijeni rezultati takođe ukazuju da ne postoje značajne razlike između nivoa po analiziranim prostorima

**Zaključak.** Rezultati istraživanja ukazuju da nije uočena statistički značajna razlika između dva nivoa takmičenja ispitanika kod: brzog trčanja 5x60 m sa intervalnim odmorom (BT 5x60 m .951), brzog trčanja 5x80 m sa intervalnim odmorom (BT 5x80 m .821).

## DIFFERENCES IN SPECIFIC MOTOR SKILLS OF YOUNG SOCCER PLAYERS AT DIFFERENT LEVELS OF COMPETITION

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**Introduction.** A study was performed on sample including 74 young soccer players from 6 teams ages 16-18, who train on a regular basis and who compete on regular basis, aiming to determine differences in specific endurance at maintaining shallow formation with young soccer players at different levels of competition.

**Method.** The first sub sample consists of 38 soccer players who compete in Premier League of Bosnia and Herzegovina. The second sub sample consists of 36 soccer players who compete in Youth League of Republic of Srpska. Initial survey of all 6 teams was performed at the start of preparation stage, and final survey at the end of preparation stage, with approximately similar conditions.

**Results.** Central and dispersion parameters, asymmetry measures and oblateness with specific endurance in maintaining shallow formation of the examinees initially-finally show that at both levels the values sit at expected range, and value of variation coefficient ( $k.var$ ) pinpoint homogeneity of both analyzed levels.

Multivariate analyses were applied: MANOVA, MANOCOVA ( $p = .947$  and  $p > .1$  no reason not to accept hypothesis  $H_1$  which means that no significant difference was noticed between two levels of competition) and discriminative analysis ( $p = .972$  which means that no significant difference was noticed and clearly defined boundary among any level of competition). *Univariant analyses* that were applied include: ANOVA, ANOCOVA, and received results also pinpoint that no significant differences exist among levels according to analyzed spaces.

**Conclusion.** Results of this study show that statistically important difference between two levels of examinee competition was not found including: racewalking 5x60 m with interval break (BT 5x60 m .951), sprint 5x80 m with interval break (BT 5x80 m .821).

## ANTHROPOMETRIC CHARACTERISTICS OF ELITE YOUNG EUROPEAN FEMALE BASKETBALL PLAYERS

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**Introduction.** Basketball is a sport where anthropometric and/or morphological characteristics have a strong influence on athletes' performances. This influence is mainly reflected in longitudinal dimensions but also in other morphological dimensions. The study chiefly aimed to establish and analyse the morphological characteristics or morphological potential of elite European young female basketball players. Another area of interest was the development level of morphological characteristics of various types of players and potential differences amongst them.

**Methods.** The sample of subjects consisted of 22 female basketball players from nine European countries, aged between 14 and 15 years and competing in the A division of the European Championship for this age group. As a rule, these were the top players in their countries. The sample was further divided into guards (N=7), forwards (N=7) and centres (N=8). In the study a battery of 23 morphological measures was applied. They served as a basis for calculating somatotype components, percentages of fat, muscle and bone mass and some other morphological indexes.

**Results.** The study established statistically significant differences between individual types of young female players in terms of their body height ( $P=0.000$ ) and body weight ( $P=0.002$ ). As far as somatotype is concerned, the guards had all three components (ectomorphic, endomorphic and mesomorphic) in relative balance, whereas the centres and the forwards revealed a less pronounced mesomorphic component. No statistically significant differences were identified between the different player types in terms of fatty and bone tissue, whereas they were established in the share of muscle tissue ( $P=0.020$ ).

**Conclusion.** Data on the structure of the morphological characteristics of young female basketball players of such a high quality are important and valuable for both basketball theory and practice. They enable model values to be generated which can greatly assist both basketball coaches and basketball researchers.

## ANTROPOMETRIJSKE KARAKTERISTIKE VRHUNSKIH EVROPSKIH MLADIH KOŠARKAŠICA

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**Uvod.** Košarka je sport u kome antropometrijske i/ili morološke karakteristike vrše jak indirektan ali i direktan uticaj na učinak sportista. Ovaj uticaj se uglavnom ogleda u longitudinalnim a nešto manje u drugim morfološkim dimenzijama. Primarni cilj istraživanja je uspostavljanje i analiza morfoloških karakteristika ili morfološkog potencijala vrhunskih mladih evropskih košarkašica. Druga oblast interesovanja bio je razvojni nivo morfoloških karakteristika raznih tipova igrača i potencijalne razlike među njima.

**Metod.** Uzorak ispitanika sastojao se od 22 košarkašice iz devet evropskih zemalja uzrasta između 14 i 15 godina koje se takmiče u A ligi evropskog prvenstva za ovu starosnu grupu. Po pravilu, ovo su bile vrhunske košarkašice u svojim zemljama i odabrali su ih selektori njihovih reprezentacija. Uzorak je dalje podeljen na osnovu položaja u timu na odbranu (N=7), krila (N=7) i centre (N=8). Baterija od 23 morfološka testa je primenjena u studiji, tj. indikatori longitudinalnih i transferzalnih dimenzija, obima i masnog tkiva. Oni su bili osnova za izračunavanje komponenti somatotipa, procenta masti, mišića i koštane mase i nekih drugih morfoloških indeksa.

**Rezultati.** Istraživanjem su ustanovljene statistički značajne razlike između individualnih tipova mladih košarkašica u pogledu njihove telesne visine ( $P=0.000$ ) i telesne težine ( $P=0.002$ ). Što se tiče somatotipa, odbrana je imala sve tri komponente (ektomorfni, endomorfni i mezomorfni) u relativnoj ravnoteži, dok je kod centara i krila otkrivena manje naglašena mezomorfna komponenta. Nisu otkrivene statistički značajne razlike kod različitih tipova igrača u smislu masnog i koštanog tkiva, dok su one uspostavljene u količini mišićnog tkiva ( $P=0.020$ ).

**Zaključak.** Podaci o strukturi morfoloških karakteristika mladih košarkašica tako visokog kvaliteta su važni i vredni i za teoriju i za praksu košarke. Oni omogućuju kreiranje modela vrednosti što u velikoj meri pomaže i košarkaškim trenerima i istraživačima u košarci.



## TEHNIČKE VEŠTINE MLADIH KOŠARKAŠA UZRASTA OD 12, 13 I 14 GODINA

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**Uvod.** U osnovi košarkaških aktivnosti su košarkaške veštine. One se baziraju na tehnicima košarke, koja predstavlja, za košarku, specifične i stilizovane motoričke strukture kojima igrači rešavaju određene situacije u igri. U odnosu na značaj tehnike u košarci ova studija razmatra tehničke veštine mladih košarkaša uzrasta od 12 do 14 godina.

**Metod.** Na uzorku od 185 mladih košarkaša, podeljenih u tri grupe na osnovu uzrasta: grupa G1 – uzrast 14 godina (N=73), grupa G2 – uzrast 13 godina (N=48) i grupa G3 – uzrast 12 godina (N=64) primenjeno je deset testova tehničkih veština. Tri testa driblinga: dribling 20 metara (D20), slalom driblingom (SLD) i kontrola driblinga (KD); tri testa dodavanja: dodavanje lopte u metu sa dve ruke (D2RU), dodavanje lopte u metu sa jednom rukom (D1RU) i dodavanje u kretanju (DUK); dva testa kretanja bez lopte: odbranbeno kretanje (DEFK) i povratna trčanja (TRA30); i dva testa šutiranja: brzo šutiranje za 60 sekundi (BŠ60) i šut sa pet spoljnih pozicija (Š5SP). Osim toga, izmerene su telesna visina (TV) i telesna masa (TM) svakog ispitanika. Podaci su obrađeni osnovnom deskriptivnom statistikom. Za testiranje značajnosti razlika između grupa primenjen je T – test.

**Rezultati.** Dobijena je značajna razlika između prve i druge grupe u varijablama *dodaavnja*, (D2RU, D1RU i DUK) i *šutiranja* (BŠ30 i Š5SP), gde su ispitanici prve grupe imali bolje rezultate u varijablama dodavanja, a ispitanici druge grupe u varijablama šutiranja. Druga i treća grupa se značajno razlikuju u svim varijablama, u korist druge grupe, dok se prva i treća grupa razlikuju u svim varijablama, izuzev varijablama šutiranja. Sve grupe se značajno razlikuju u varijablama telesna visina i telesna masa.

**Zaključak.** Košarkaši, četrnaestogodišnjaci, se razlikuju od košarkaša trinestogodišnjaka u varijablama koje zahtevaju, pre svega, preciznost (varijable dodavnja i šutiranja), dok nema razlike u varijablama u kojima dominira eksplozivnost, brzina i agilnost (varijable driblinga i kretanja bez lopte); a od dvanestogodišnjaka u svim varijablama, izuzev varijabli šutiranja. Košarkaši, trinaestogodišnjaci, se razlikuju od košarkaša dvanaestogodišnjaka u svim varijablama tehničkih veština.

## TECHNICAL SKILLS OF 12, 13 AND 14 YEARS OLD BASKETBALL PLAYERS

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**Introduction.** Basketball skills are in the base of basketball activity. Fundamentals of basketball skills are basketball technique which represents, for basketball, specific and styling motor structure. Basketball players use basketball technique for solving different game situations. Purpose of this study is to investigate technical skills of 12 to 14 years old basketball players.

**Method.** Participants in this study were 185 young basketball players divided in three groups according their age: group G1 - 14 years old players (N=73), group G2 - 13 years old players (N=48) and group G3 - 12 years old players (N=64). Ten tests of technical skills were applied. Three dribble tests: dribble 20 meters (variable D20), slalom dribble (variable SLD) and control dribble (variable KD); three passing tests: passing in target with both hands (variable D2RU), passing in target with one hands (variable D1RU), passing (variable DUK); two tests of movement without ball: defensive movement (variable DEFK) and transition movement (variable TRA30); and two tests of shooting: speed spot shooting test (variable BS60) and shooting from five perimeter positions (variable S5SP). Beside that, stature (variable TV) and body weight (variable TM) were measured.

**Results.** There was find significant differences between group G1 and G2 in all passing and shooting variables, in which participants of group G1 had better results in passing variables, but worse results in shooting variables than G2. Groups G2 and G3 were different in all variables, where participants of group G2 had a better results. Groups G1 and G2 were different in all variables (G1 had better results than G2), besides shooting variables. All groups were different in stature and body weight.

**Conclusion.** Compare with 13 years old players, 14 old basketball players are different in variables which request accuracy, but not different in variables which request quickness, explosiveness and agility, and compare with 12 year old players they, also, were different in all variables, except shooting variables. 13 old basketball players are different in all variables compare with 12 year old players.

## FITNESS PROFILE OF HANDBALL PLAYERS ACCORDING TO PLAYING POSITIONS

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**Introduction.** Fitness profile is an important aspect of the modern complex handball game and contributes to the high performance of the team. The results from fitness tests will allow coaches to identify players abilities and design training programmers for improving specific players according to playing positions, also follow up the players improvement during a competitive season. The aim of the study was to identify differences in the physical fitness profile at the mid of season duration of young handball players according to playing positions.

**Methods.** Thirty-two young handball players were members of handball sport clubs on south west of Germany participated in this study. Players mean  $\pm$  (SD) were, age 13.63 (0.91) years, height 1.56 (0.10) m, weight 53.56 (12.02) kg and body mass index 21.73 (2.99) kg/m<sup>2</sup> and classified into the following positions (Wings, Pivots, Backs, and Goalkeepers). All players completed the following physical fitness tests: 30m run, sit and reach, handgrip, medicine ball throw, standing high jump, standing long jump, copper test with heart rate and coordination's tests in mid of season.

**Results.** The results of this study demonstrate that handball players of different positions show differences in some fitness profile. These differences are more significant among the goalkeepers and the wings groups.

**Conclusion.** Each position has a different fitness profile, demonstrates that some of the training sessions should be regulated to training specific to each position. In this finding, we recommend the coaches when planning the training sessions of young handball, the players should be grouped either according to the playing positions because this is to more efficiently structure for physical fitness training and this may provide the resulting matches.

## PROFIL FIZIČKOG RAZVOJA RUKOMETAŠA PREMA POZICIJAMA U IGRI

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**Uvod.** Profil fizičkog razvoja je važan aspekt moderne rukometne igre i doprinosi velikom učinku tima. Rezultati testova fizičkog razvoja će omogućiti trenerima da identifikuju sposobnosti igrača i osmisle programe treniranja za unapređenje specifičnih igrača prema poziciji u igri, kao i praćenje napretka igrača tokom takmičarske sezone. Cilj studije je bio da se identifikuju razlike u profilu fizičkog razvoja u sredini sezone mladih rukometaša prema poziciji u igri.

**Metode.** 32 mlada rukometaša članova rukometnih klubova sa jugo-istoka Nemačke su učestvovala u istraživanju. Srednje vrednosti igrača  $\pm$  (SD) su bile starost 13.63 (0.91) godina, visina 1.56 (0.10) m, težina 53.56 (12.02) kg i indeks telesne mase 21.73 (2.99) kg/m<sup>2</sup> i klasifikovane u sledeće pozicije (krila, pivoti, bekovi i golmani). Svi igrači su obavili sledeće testove fizičkog razvoja: trčanje na 30 m, trbušnjaci, stisak šake, bacanje medicine, skok u vis iz mesta, skok u dalj iz mesta, Kupreov test sa brzinom otkucaja srca i testovi koordinacije na sredini sezone.

**Rezultati.** Rezultati ovog ispitivanja pokazuju da rukometaši na različitim pozicijama pokazuju razlike u nekim od profila fizičkog razvoja. Ove razlike su značajnije kod golmana i krilnih grupa.

**Zaključak.** Svaka pozicija ima različit profil fizičkog razvoja, što pokazuje da neke od trenažnih sesija treba da budu prilagođene specifičnom treningu za svaku poziciju. Stoga, preporučujemo da treneri kada planiraju treninge mladih rukometaša, treba da grupišu prema pozicijama u igri radi efikasnije strukture za trening fizičkog razvoja i to može da pruži rezultirajuću igru.

# OPŠTI POKAZATELJI OBIMA PLIVANJA KRAUL TEHNIKOM VATERPOLISTA JUNIORSKOG UZRASTA NA UTAKMICI

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**Uvod.** Za vreme utakmice vaterpolista u horizontalnoj poziciji provede oko 37% ukupnog vremena igre, a od toga oko 90 % pliva kraul tehnikom. Taj podatak ukazuje da je horizontalna pozicija manje zastupljena aktivnost za vreme igre u odnosu na druge. Horizontalna pozicija podrazumeva kretanje igrača paralelno sa površinom vode, odnosno plivanje tehnikama kraul, leđno i prsno i kombinacijom tih tehnika. Zadatak ovog istraživanja je definisanje obima kretanja u horizontalnoj poziciji, odnosno obima plivanja kraul tehnikom koje vaterpolista juniorskog uzrasta realizuje u toku utakmice, kao najzastupljenije takmičarske tehnike plivanja.

**Metod.** Korišćenjem video snimaka utakmica analizirano je 35 vaterpolista. Variable u ovom istraživanju pokrivaju strukturu plivanja kraul tehnikom. Varijable su: obim plivanja na utakmici ( $UO_{kraul}$ ), obim plivanja po četvrtinama ( $UO\check{C}_{kraul}$ ), broj preplivanih deonica na utakmici ( $UD_{kraul}$ ) i broj preplivanih deonica po četvrtinama ( $UD\check{C}_{kraul}$ ), distribucija deonica na utakmici ( $DD_{kraul}$ ), distribucija deonica po četvrtinama ( $DD\check{C}_{kraul}$ ). Rezultati su podvrgnuti deskriptivnoj statističkoj analizi i statističkoj metodi ANOVA radi utvrđivanja razlika posmatranih varijabli između četvrtina.

**Rezultati.** Obim plivanja na utakmici je 542,83m, a po četvrtinama: I četv. – 171,51m; II četv – 124,97m; III četv. – 132,49m; IV četv. – 113,86m. Broj preplivanih deonica je 48,06; I četvrtina 14,29; II četvrtina 11,37; III četvrtina 12,14 i IV četvrtini 10,26 deonica. Nakon analize varijanse pokazalo se da ne postoji značajna razlika između prosečno preplivanih deonica po četvrtinama ( $p=0,173$ ), dok između isplivanih dužina po četvrtinama ( $p=0,000$ ) i broja deonica po četvrtinama ( $p=0,016$ ) postoji značajna razlika. Kako se utakmica odigrava broj deonica se smanjuje. Najzastupljenije su deonice od 11-15m, 14,72 deonica ili 30.62% i deonice od 5-10m, 14,43 deonica ili 30.02%.

**Zaključak.** Preko 60% deonica između 5 i 15m ukazuje da se igra uglavnom svodi na prebacivanje ekipa sa jednog dela terena na drugi, a da se preostali deo igre ispred gola uglavnom svodi na pozicioni napad sa vrlo malo kretanja.

## GENERAL INDEXES OF CRAWL SWIMMING VOLUME OF JUNIOR WATER POLO PLAYERS AT A MATCH

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**Introduction.** In the course of a match a water polo players spends around 37% of the total playing time in horizontal position, and 90% of that he uses crawl technique. The data indicate that horizontal position is less manifested activity during a match in comparison to other positions. The horizontal position means players movement parallel with water, i.e. swimming by using crawl, backstroke, breast stroke and a combination of these techniques. The task of this research is to define movement volume in horizontal position, i.e. swimming volume by crawl technique employed by junior age players during a match, as the most represented competitive swimming technique.

**Method.** 35 water polo players were analyzed by using video recordings. The variables used in this research cover swimming structure of crawl technique. The variables are: swimming volume per match ( $UO_{kraul}$ ), swimming volume per quarters ( $UO\check{C}_{kraul}$ ), number of sections swam per match ( $UD_{kraul}$ ) and number of sections swam per quarters ( $UD\check{C}_{kraul}$ ), section distribution per match ( $DD_{kraul}$ ), section distribution per quarters ( $DD\check{C}_{kraul}$ ). The results were elaborated by descriptive statistical analysis and statistical method ANOVA in order to determine difference of the observed variables between the quarters.

**Results.** Swimming volume per match was 542,83m, and per quarters: I quarter – 171,51m; II quarter – 124,97m; III quarter – 132,49m; IV quarter – 113,86m. The number of covered sections was 48,06; I quarter 14,29; II quarter 11,37; III quarter 12,14 and IV quarter 10,26 sections. Upon the variance analysis it was demonstrated that there is no statistically significant difference between the average of sections covered per quarters ( $p=0,173$ ), while the length swam per sections ( $p=0,000$ ) and number of sections per quarters ( $p=0,016$ ) display significant difference. As the match proceeds the number of sections decreases. The most represented sections are 11-15m, 14,72 of the sections or 30.62% and sections of 5-10m, 14,43 sections or 30.02%.

**Conclusion.** Over 60% of the sections between 5 and 15m indicate that game is mostly reduced to transfer of teams from one side of the pool to another, and that the remaining part in front of the goal is mostly limited to position attack with very little movement.

## UTICAJ TRENINGA PLIVANJA NA SPECIFIČNO-MOTORIČKE POKAZATELJE TEHNIKE KRAUL KOD TAKMIČARA PREDPUBERTETSKOG UZRATA

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**Uvod.** Cilj rada je da se utvrdi uticaj šestomesečnog treninga na specifično-motoričke pokazatelje tehnike kraul kod takmičara predpubertetskog uzrasta.

**Metod.** Uzorak ispitanika je činilo 30 plivača-takmičara, od 9 do 12 godina, muškog pola. Uzorak varijabli je činilo šest pokazatelja specifične motorike kraul tehnike. Testiranja su vršena u tri vremenske tačke: inicijalno, tranzitno (posle tri meseca) i finalno (posle šest meseci). U prvom mezociklusu trening je bio usmeren na razvoj brzinskih sposobnosti plivača, a u drugom na razvoj tehničkih sposobnosti kroz plivanje dužih distanci u aerobnom režimu. Prvi mezociklus je bio pre državnog prvenstva za kada je i tempirana forma plivača.

**Rezultati.** U tranzitnom testiranju je lociran značajan porast u svim varijablama u odnosu na inicijalno, dok u finalnom je u odnosu na inicijalno statistički značajno povećana frekvencija zaveslaja, a smanjen plivački korak (što plivačku tehniku čini manje racionalnom).

**Zaključak.** Ovo pokazuje da je dobra tehnika plivanja posledica i dobre fizičke pripreme plivača.

## INFLUENCE OF SWIMMING TRAINING ON SPECIFIC-MOTOR PARAMETERS OF CRAWL AT COMPETITORS OF PREPUBESCENT AGE

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**Introduction.** The aim of paper is to estimate influence of six months on specific-motor parameters of crawl swimming at prepubescent competitors.

**Method.** Sample of examinees were 30 competitor male swimmers, from 9 to 12. Sample of variables were six parameters of crawl swimming. Testings were done in three time points: initial, transit (after three months), final (after six months).

In first mezocycle training was directed on development speed abilities of swimmers, in second mezocycle on development of technical abilities through long distance swimming in aerobic regime. The first mezocycle was before state championship, the goal of preparation of swimmers.

**Results.** In transit testing, significant incensement at all variables was located in relation of initial; in final testing in relation of initial was significantly increased stroke frequency and decreased swimming leinght (what represents swimming technique less efficient).

**Conclusion.** This shows that good swimming technique is result of good physical preparateness of swimming.

## UTICAJ GIPKOSTI NA USPEŠNOST IZVOĐENJA ELEMENTARNE TEHNIKE U SINHRONOM PLIVANJU

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**Uvod.** U ovom istraživanju ispitan je uticaj gipkosti na uspešnost izvođenja elementarne tehnike u sinhronom plivanju.

**Metod.** Ispitivanje je sprovedeno na uzorku od 21 sinhrono plivačice uzrasta od 11 – 14 godina. U istraživanju je primenjeno sedam mernih instrumenata podeljenih u dve grupe. Primenjene su četiri varijable za procenu gipkosti (ISKR – Iskret, PRED - Predklon na klupi, MOST - Most , BOŠP – Bočna špaga) i tri za procenu uspešnosti izvođenja elementarne tehnike u sinhronom plivanju (BANO – Baletska noga jednostruka, ŠPAG – Špaga izdržaj, PRŠE – Prednja šetnja).

**Rezultati.** Na osnovu rezultata istraživanja izračunati su deskriptivni statistički parametri (*Min, Max, Mean, Error, SD* i *Range*). Za utvrđivanje relacija između gipkosti i uspešnosti izvođenja elementarne tehnike u sinhronom plivanju primenjena je kanonička korelaciona analiza. Da bi utvrdili uticaj gipkosti na uspešnost izvođenja elementarne tehnike u sinhronom plivanju, primenjena je regresiona analiza. Na osnovu dobijenih rezultata uočeno je da postoji statistički značajna povezanost između gipkosti i uspešnosti u izvođenju elementarne tehnike u sinhronom plivanju, kao i značajan uticaj gipkosti na rezultate u testovima baletska noga ( $p<0,03$ ), špaga ( $p<0,00$ ) i prednja šetnja ( $p<0,00$ ).

**Zaključak.** Povezanost prediktorskog sistema sa kriterijumskim varijablama objašnjen je koeficijentom multiple korelacije ( $R$ ) i koeficijentom determinacije ( $R^2$ ) za varijablu baletska noga ( $R=0,69$  i  $R^2=0,48$ ), varijablu špaga ( $R=0,86$  i  $R^2=0,74$ ) i povezanost prediktorskog sistema sa kriterijumskom varijablom prednja šetnja ( $R=0,79$  i  $R^2=0,62$ ).

## IMPACT OF FLEXIBILITY FOR SUCCESSFUL PERFORMANCE OF TECHNICAL ELEMENTS IN SYNCHRONIZED SWIMMING

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**Introduction.** In this research the influence on flexibility in performance of technical elements in synchronized swimming was examined.

**Method.** We examined 21 synchronized swimmers, of age 11-14. In this research is applied 7 measuring instruments, divided in two groups (4 for assessment of flexibility - ISKR, PRED, MOST, BOSP, and 3 for successful performance of elements –BANO, SPAG, PRSE). On the bases of results of this research there was descriptive parameters examined (*Min, Max, Mean, Error, SD* i *Range*). For estimation relation between flexibility and bases technical elements in synchronized swimming performance, it was canonic correlation analysis estimated. To estimate flexibility influence on bases technical elements in synchronized swimming performance, it was regression analyses estimated.

**Results.** Based on the results, is observed that there is statistically important connection between flexibility and successful performance of elements in synchronized swimming, and great influence of flexibility on results in tests, performing ballet leg, split and walk over front - BANO ( $p<0,03$ ), SPAG ( $p<0,00$ ) PRSE ( $p<0,00$ ).

**Conclusion.** Predictor system connection with criteria variable could describe by coefficient multiple correlation ( $R$ ) and coefficient determination for variable BANO ( $R=0,69$  i  $R^2=0,48$ ), SPAG ( $R=0,86$  i  $R^2=0,74$ ) and criteria variable PRSE ( $R=0,79$  i  $R^2=0,62$ ).

## PROMENE EKSPLOZIVNE SNAGE NOGU POD UTICAJEM PLIOMETRIJSKOG METODA TRENINGA – PILOT STUDIJA

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**Uvod.** Jedan od osnovnih ciljeva trenažnog rada u individualnim sportovima je povećanje nivoa eksplozivne snage. Cilj istraživanja bio je utvrđivanje efikasnosti pliometrijskog metoda treninga za razvoj eksplozivne snage nogu učenika osmog razreda osnovnih škola.

**Metod.** Uzorak ispitanika činili su učenici-sportisti koji se aktivno bave atletikom najmanje 2 godine, prosečne starosti 14-15 godina. Ukupan broj ispitanika bio je 40, ali je eksperimentalni program završilo njih 31. Za procenu eksplozivne snage nogu primenjeni su sledeći testovi: skok u dalj iz mesta, troskok i petoskok iz mesta.

**Rezultati.** Rezultati istraživanja pokazali su da postoji statistički značajna razlika u promeni vrednosti skoka u dalj iz mesta ( $p = .005$ ), a na granici značajnosti kod troskoka iz mesta ( $p = .068$ ).

**Zaključak.** Realizovani program pliometrijskog treninga utiče na promene kod pojedinih testova za procenu eksplozivne snage nogu.

## CHANGES IN EXPLOSIVE POWER OF LEGS UNDER THE INFLUENCE OF PLIOMETRIC METHOD OF TRAINING – PILOT STUDY

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**Introduction.** One of the basic goals of training work in individual sports is increasing of explosive power level. The aim of this research is to determine the efficacy of the pliometric method of training for the development of the explosive power of legs of the 8th grade elementary schoolboys.

**Methods.** The sample of subjects was composed of the schoolboys – athletes actively engaged in athletics for at least 2 years, average age 14-15. The total number of subjects was 40 but 31 of them finished the experimental program. For the estimation of the explosive power of legs the following tests were applied: standing long jump, triple jump, five step standing jump.

**Results.** The obtained research results (t-test) have shown that the realised program of training exerts statistically significant influence on the change of values in standing long jump ( $p = .005$ ), and on the border of significance is standing triple jump ( $p = .068$ ).

**Conclusion.** Realised programme of pliometric training have influence on some tests or estimation of explosive power of legs.

## SEASONAL CHANGES IN STRENGTH AND SPRINT PERFORMANCE OF ELITE YOUTH FIELD HOCKEY PLAYERS

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**Introduction.** Seasonal changes periods is very important factor for monitoring training methods and provides the coaching feedback about the training programs for every physical factors like strength and speed. However, there is no information available on changes in strength and sprint during the periods season in elite youth field hockey players and the recent studies have only been investigated in physical characteristics but not at periods season. The purpose of this study was to examine the effects of training and competition season on strength and sprint performance in elite hockey players.

**Methods.** Eighteen elite youth players participated in the study and their mean  $\pm$  (SD) were: age 14.10 (0.71) years, training experience 5.06 (1.22) years, height 1.59 (0.09) m, weight 53.88 (10.19) kg and body mass index 21.19 (3.12) kg/m<sup>2</sup>. The measurements included speed tests (5-10-20-30m), explosive power tests (medicine ball throw, vertical jump and standing long jump), isometric strength test (handgrip) at the pre, mid and end season.

**Results.** Running speed over 10-20-30m, medicine ball throw and standing long jump tests at the end of the season were significantly higher than levels at the pre and mid-season ( $p < 0.05$ ) with mean  $\pm$  (SD) 2.34 (0.25), 3.57 (0.38) and 5.04 (0.37) sec (10-20-30m), 7.79 (1.25) meter (medicine ball) and 1.81 (0.30) meter (standing long jump), respectively. There were no significant differences in 5m sprint, vertical jump and grip strength during the periods season.

**Conclusion.** The main finding of the present study was that sprint over 10, 20 and 30m and explosive power of elite hockey players increased during the mid and end season than the pre-season but the maximum isometric handgrip, vertical jump and 5m sprint were not changed during pre-season and competitive period. Therefore these variables are important predictors for coaches to monitor and plan training programmes.

## SEZONSKE PROMENE U SNAZI I SPINTERSKIM SPOSOBNOSTIMA VRHUNSKIH MLADIH HOKEJAŠA NA TRAVI

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**Uvod.** Periodi sezonskih promena su veoma važan faktor za praćenje trenažnih metoda i pružaju povratne informacije o trenažnim programima za svaki fizički faktor, kao što su snaga i brzina. Nisu, međutim, dostupne informacije o promenama snage i brzine tokom sezone kod vrhunskih mladih hokejaša na travi, a nedavne studije su ispitivale jedino fizičke karakteristike, ali ne u periodu sezone. Cilj ove studije je da se ispituju efekti treniranja i takmičarska sezona na učinak snage i sprinta kod vrhunskih hokejaša.

**Metode.** 18 vrhunskih mladih igrača učestvovalo je u istraživanju i njihove srednje vrednosti  $\pm$  (SD) su bile: starost 14.10 (0.71) godina, iskustvo treniranje 5.06 (1.22) godina, visina 1.59 (0.09) m, težina 53.88 (10.19) kg i indeks telesne mase 21.19 (3.12) kg/m<sup>2</sup>. Mere uključuju testove brzine (5-10-20-30 m), testove eksplozivne snage (bacanje medicinke, skok u vis, skok u dalj iz mesta), test izometrijske snage (stisak šake) u pred sezoni, u sredini i na kraju sezone.

**Rezultati.** Testovi brzine trčanja na 10, 20, 30m, bacanje medicinke i skok u dalj iz mesta su bili značajno viši nego nivoi u pred sezoni ili u sredini ( $p < 0.05$ ) sa srednjom vrednošću  $\pm$  (SD) 2.34 (0.25), 3.57 (0.38) i 5.04 (0.37) sec (10-20-30m), 7.79 (1.25) metara (medicinka) odnosno 1.81 (0.30) metara (skok u dalj iz mesta). Nije bilo značajnih razlika na testovima tokom sezone u sprintu na 5m, skoku u vis i snazi stiska šake.

**Zaključak.** Glavni zaključak ove studije je da su sprint preko 10, 20 i 30 m i eksplozivna snaga vrhunskih hokejaša u sredini i na kraju sezone povećani u odnosu na predsezona ali da se maksimalni izometrijski stisak šake i sprint na 5 m sprint nisu promenili u predsezoni i takmičarskom periodu. Stoga su ove varijable važni prediktori za trenere za praćenje i planiranje trenažnih programa.

## “ČEK-LISTA ZA PROCENU KVALITETA RELEVANTNIH ZA BAVLJENJE RITMIČKOM GIMNASTIKOM – RG23” – PRELIMINARNI REZULTATI

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**Uvod.** U oblasti sporta od izuzetnog značaja je pitanje identifikacije darovitih pojedinaca, koji potencijalno mogu postizati vrhunske sportske rezultate. U tom smislu, postoji potreba za jednim empirijski definisanim instrumentom koji će predstavljati pouzdan i validan okvir za procenu kvaliteta potrebnih za uspešno bavljenje sportom. Rad predstavlja preliminirane rezultate ispitivanja mogućnosti identifikacije devojčica darovitih za ritmičku gimnastiku pomoću instrumenta “Ček-lista za procenu sposobnosti relevantnih za bavljenje ritmičkom gimnastikom – RG23” konstruisanog za ovu svrhu. **Metod.** Istraživanje je sprovedeno na uzorku od 47 devojčica (prosečnog uzrasta 12,7 godina) koje se ritmičkom gimnastikom bave takmičarski (N=29) i rekreativno (N=18). Konstruisani instrument se sastoji od 23 stavke, sa pridruženim petostepenim skalama procene Likertovog tipa. Stavke su formirane na osnovu dva izvora informacija: usmerenih intervjuja sa trenerima ritmičke gimnastike i priručnika Međunarodne gimnastičke federacije. Stavke predstavljaju skup od 15 fizičkih i motoričkih odlika, četiri sudijska parametra za procenu takmičarskih i netakmičarskih nastupa u ritmičkoj gimnastici i četiri bihevioralna pokazatelja motivisanosti za treniranje. **Rezultati.** Rezultati pokazuju da instrument ima veoma dobre metrijske karakteristike (reprezentativnost, pouzdanost i homogenost). Analiza grupisanja i faktorska analiza sa Varimaks rotacijom su pokazale da se stavke skale grupišu u dva faktora, interpretirana kao *Faktor psihofizičkih kvaliteta* i *Faktor motivacionih kvaliteta*, koji objašnjavaju oko 72% varijanse. Klaster i analiza kontingencijskih tabela su pokazale da u pogledu diskriminativne moći instrumenta, tj. mogućnosti identifikacije darovitih u grupi onih koji se bave ovim sportom, instrument pokazuje veoma dobre rezultate. Takođe, rezultati ukazuju da ček-lista RG23 ima i zadovoljavajuću kriterijumsku validnost, u pogledu moći instrumenta u predikciji uspešnosti u bavljenju ritmičkom gimnastikom. **Zaključak.** Dobijeni rezultati pokazuju da konstruisani instrument ima dobre metrijske karakteristike, prediktivnu i kriterijumsku validnost. Ipak, pošto je reč o rezultatima istraživanja na malom uzorku, neophodna su dalja istraživanja sa ciljem provere dobijenih rezultata.

## CHECKLIST FOR ASSESSMENT OF QUALITIES RELEVANT FOR PRACTICING RHYTHMIC GYMNASTICS - RG23” – PRELIMINARY RESULTS

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**Introduction.** In sport, question of identification of gifted individuals, which potentially can achieve top results, is highly important. With respect to that, there is need for empirically defined, reliable and valid instrument for assessment of qualities necessary for practicing sport. This paper presents preliminary results of possible identification of girls gifted for rhythmic gymnastics via “Checklist for assessment of qualities relevant for practicing rhythmic gymnastics – RG23”. **Method.** Sample consisted of 47 girls (average age 12, 7 years) which train rhythmic gymnastics, 29 competitively and 18 recreationally. Constructed instrument consists of 23 Likert type items. Items are based on two information sources: directed interviews with coaches of rhythmic gymnastics and Manual of International gymnastics federation. In the instrument, 15 items represent physical and motor skills, four are judge criteria for assessment of competitive and noncompetitive performance and four are behavioral indicators of motivation to train. **Results.** Results show that instrument has good psychometric properties (representativeness, reliability, homogeneity). Cluster and factor analysis with Varimax rotation show that checklist items group into two factors (that explain 72% of variance), interpreted as *Factor of psychophysical qualities* and *Factor of motivational qualities*. Cluster and analysis of contingency tables show that regarding discriminative power (i.e. possibilities for identification of gifted rhythmic gymnasts) checklist show good results. In addition, RG23 has satisfactory criterion validity (i.e. prediction of success in rhythmic gymnastics). **Conclusion.** Data indicate that instrument has satisfactory both psychometric properties and predictive and criterion validity. However, having in mind size of the sample, additional researches are needed.



## EFEKTI DVA RAZLIČITA PROGRAMA PRIPREMA NA SPECIFIČNU MOTORIKU MLADIH DŽUDISTA

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**Uvod.** Specifične motoričke sposobnosti su stečene i uslovljene specifičnošću trenažnog procesa sportske grane koju upražnjava sportista. Ove sposobnosti su veoma bitne za džudo zbog menjanja dinamičke situacije tokom borbe pa se od džudaista zahtijeva dobra usvojenost taktičko - tehničkih stereotipa koje primjenjuju tokom borbe, kao i reorganizacija tih stereotipa, te stalna manifestacija napada, odbrambenih akcija i kontranapada. Osnovni cilj istraživanja je utvrđivanje razlika u efektima dva trenažnog programa na specifično motoričke sposobnosti mladih džudista.

**Metod.** Istraživanje je sprovedeno na uzorku od 60 mladih visoko selekcionisanih džudista (30 džudista je radilo po eksperimentalnom programu a 30 po standardnom programu), članova šireg spiska kadetske reprezentacije Srbije i Bosne i Hercegovine, starosne dobi od 16 do 18 godina. Svi oni še svojim plasmanom na Prvenstvima Države obezbediti mesto na spisku potencijalnih reprezentativaca za Prvenstvo Evrope i Prvenstvo Balkana. Primenjeno je pet mernih instrumenata za procenu specifičnih motoričkih istraživanja. Eksperimentalni tretman istraživanja trajao je 24 nedelje za vreme redovnog trenažnog rada reprezentacija. Realizovano je 205 treninga. U toku eksperimentalnog postupka izvršena su merenja specifično – motoričkih sposobnosti kod svih ispitanika na početku i na kraju eksperimenta.

**Rezultati.** Pošto nam je osnovni zadatak bio da utvrdimo kakve promene doživljava svaka grupa nakon završenog eksperimentalnog postupka urađena je diskriminativna analiza na rezultatima stvarnih promena između inicijalnog i finalnog stanja. Rezultati diskriminativne funkcija su tako skalirana da na njoj viši rezultati pripadaju ispitanicima koji su pripadali grupi džudista koji su radili po eksperimentalnom programu a niži pripadaju ispitanicima koji su radili po laskičnom programu.

**Zaključak.** Utvrđena razlika između dva programa je ukazala na opravdanu potrebu uvođenja inovacija u trenažnom programu mladih sportista.

## THE EFFECTS OF TWO DIFFERENT PRELIMINARY PROGRAMS ON THE SPECIFIC MOTORICS OF YOUNG JUDOKAS

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**Introduction.** Specific motor skills are acquired and condition by the specific nature of the training process for any type of sport the athlete is involved in. These abilities are very important for judo due to the changes in the dynamic situation during a match, so it is necessary for the judokas to properly acquire the technical-tactical stereotype which is used during a match, as well as the proper reorganization of these stereotypes, and thus the constant manifestation of attacks, defensive actions and counter-attacks. The basic aim of our research is to determine the differences in the effects of two training programs on the specific motor skills of young judokas.

**Method.** The research was carried out on a sample of 60 young highly selected judokas (30 judokas worked according to an experimental program and 30 following a standard program), members of the extended list of the cadet national teams of Serbia and Bosnia and Herzegovina, all aged 16 to 18. Their placement in National League events will enable them access to the list of potential national team members for the European Championship and the Balkan Judo Championship. Five measuring instruments were used for the evaluation of specific motor tests. The experimental treatment lasted for a period of 24 weeks, during the regular training of the national team. A total of 205 training sessions were realized. During the experimental procedure, measurements of the specific motor skills of all the subjects were carried out at the beginning and end of the experiment.

**Results.** Since our basic aim was to determine the type of changes that each group underwent following the completion of the experimental procedure, a discriminant analysis of the results of actual changes between the initial and final state was carried out. The results of the discriminant functions were ranked in such a manner that the higher results belonged to the subjects who were members of the judo group working according to the experimental program, and the lower results are those of the subjects who worked according to a standard program.

**Conclusion.** Established differences between two programs revealed the need for innovation in training program of young athletes.

## RAZLIKE U FIZIČKOM RAZVITKU KARATISTKINJA BEZ I SA MENARHOM U RANOM ADOLESCENTNOM UZRASTU

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**Uvod.** Na uzorku od 114 ispitanica (38 karatistkinja koje imaju menarhu i 76 karatistkinja koje nemaju menarhu), uzrasta između 12 i 13 godina, sprovedeno je istraživanje sa ciljem definisanja faktorskog strukturalnog morfološkog modela i kvantitativnih razlika između klastera ispitanica u antropometrijskom domenu.

**Metode.** Uzorak od 11 morfoloških varijabli je obrađen analizom glavnih komponenti (Promah rotacijom) i modelom diskriminativne analize.

**Rezultati.** U skupu ispitanica sa menarhom definisan je dvokomponentni model latentnih morfoloških dimenzija, interpretiran kao faktor potkožnog masnog tkiva, obima i mase tela (H<sub>1</sub>) i faktor longitudinalne dimenzionalnosti skeleta (H<sub>2</sub>), dok je u skupu karatistkinja bez menarhe izolovan faktor transverzalne dimenzionalnosti skeleta (H<sub>1</sub>) i faktor volumena tela (H<sub>2</sub>). Dobijene vrednosti standardnih koeficijenta korelacije, kao i 79,91% proporcije zajedničke varijanse ukazuju, na nivou značajnosti  $p < .002$ , relevantnu nepodudarnost između istraživanih klastera ispitanica u skupu manifestnih antropometrijskih varijabli. Dominantan parcijalni doprinos diferencijaciji klastera karatistkinja dale su varijable: telesna visina, masa tela, obim nadlaktice u opuštenom položaju i kožni nabor nadlaktice (m. triceps), što je omogućilo da se dobijena latentna dimenzija hipotetički definiše kao diskriminativna funkcija longitudinalne dimenzionalnosti, volumena tela i potkožnog masnog tkiva. Izračunate vrednosti centroida grupa (sa verovatnoćom percentila od oko 66%) signalizirale su na to da karatistkinje koje imaju menarhu, definišu diskriminativni faktor sa većim somatskim vrednostima, dok njihove vršnjakinje koje nemaju menarhu, imaju manje vrednosti antropometrijskih karakteristika, uspešnije dijagnostikuju strukturalni morfološki model i utiču na optimalan razvoj somatskih obeležja karatistkinja.

**Zaključak.** Rezultati imaju značajne implikacije u verovatnoći da se na osnovu uspešne dijagnoze strukturalnog morfološkog modela karatistkinja uspešnije utiče na njihov optimalan fizički razvoj i programiranje somatskih obeležja.

## DIFFERENCES OF PHYSICAL KARATE GIRLS DEVELOPMENT WITH AND WITHOUT MENARCHE IN EARLY ADOLESCENT PERIOD

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**Introduction.** The aim of the research was to define factor structural morphological model as well as quantitative differences between the clusters of examinees in anthropometric domain. Research included the sample of 114 examinees (38 female karate players with menarche and 76 female karate players without menarche) aged from 12 to 13.

**Methods.** The sample of 11 morphological variables was processed with Main Component Analysis (Promah rotation) and discriminant analysis method.

**Results.** We have defined two-component model of latent morphological dimension with examinees with menarch. The model was interpreted as subcutaneous fat factor, body mass and body circumference factor (H<sub>1</sub>) and longitudinal skeleton dimension factor (H<sub>2</sub>). We have isolated transversal skeleton dimension factor (H<sub>1</sub>) and body volume factor (H<sub>2</sub>) with examinees without menarch. Obtained values of standard correlation coefficients, as well as 79,91% proportion of mutual variance point out relevant difference between clusters of examinees in the set manifest anthropometric variables with the level of significance  $p < .002$ . Following variables contributed to cluster differentiation of karate players: body height, body mass, upper arm scope, upper arm skinfold. Thus, we have hypothetically defined obtained latent dimension as discriminant function of longitudinal dimension body volume and subcutaneous fat. Obtained values of group centroids (with percentil probability of 66%) signalize that karatist players with menarche define discriminant factor with higher somatic values, whereas their peers without menarche have lower values of anthropometric characteristics.

**Conclusion.** The results have significant implications of the probability that according to the successful diagnosis of structural morphological karate girls model we can more successfully influence their optimum development and somatic character programming.

## EXPERT MODELLING AS IMPORTANT PART OF PLANNING AND CONDUCTING TRAINING OF YOUNG CATEGORIES OF COMPETITORS IN ALPINE SKIING IN SLOVENIA

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**Introduction.** For more than twenty years, expert modelling has represented an important part of planning and conducting training and analysing the effects of training of different categories of competitors in Alpine skiing.

**Method.** On the basis of a heuristic approach and practical experience, a model of successfulness was formed. In the category of older boys, the model consists of 17 dimensions of a motor subsystem and of 8 dimensions of a morphological subsystem; on the other hand the competitive successfulness (criterion variable) is assessed on the basis of the calculation of the points won in the Argeta Cup competitions in the 2008/09 season. Motor and morphological dimensions were measured on the sample comprising 31 active competitors in the category of older boys. With the help of the SMMS program package, marks were calculated at all levels of a potential model of successfulness. In the second part of the survey, we intended to establish the connection between the marks calculated by means of the expert system method (heuristic approach) and the criterion variable.

**Results.** The values of final marks based on the expert system method are in accordance with the quality of the selected sample. On the basis of the calculation of Pearson's correlation coefficient between the marks obtained by the expert system method and the actual successfulness, we established a statistically significant level of connection.

**Conclusion.** The calculation of the level of connection between the assumed assessment of the competitive successfulness (expert system) and the actual successfulness (points) is a relevant indicator of the validity and quality of the reduced model of potential successfulness.

## EKSPERTSKO MODELOVANJE KAO VAŽAN DEO PLANIRANJA I OBAVLJANJA TRENIRANJA MLADIH KATEGORIJA TAKMIČARA U ALPSKOM SKIJANJU U SLOVENIJI

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**Uvod.** Više od dvadeset godina, ekspertsko modelovanje je predstavljalo važan deo planiranja i sprovođenja treniranja i analiziranja efekata treniranja različitih kategorija takmičara u alpskom skijanju.

**Metode.** Na osnovu heurističkog pristupa i praktičnog iskustva, formiran je model uspešnosti. U kategoriji starijih dečaka, model se sastoji od 17 dimenzija motoričkog podsistema i od 8 dimenzija morfološkog podsistema; s druge strane takmičarska uspešnost (kriterijumska varijabla) se ocenjuje na osnovu izračunavanja osvojenih bodova na takmičenjima Argeta kupa u sezoni 2008/09. Motoričke i morfološke dimenzije su merene na uzorku koji se sastoji od 31 aktivnog takmičara iz kategorije starijih dečaka. Pomoću SMMS programskog paketa, izračunate su ocene na svim nivoima potencijalnog modela uspešnosti. U drugom delu studije, nameravali smo da odredimo vezu između dobijenih ocena izračunatih pomoću ekspertskog sistema metod (heuristički pristup) i kriterijumske varijable.

**Rezultati.** Vrednosti konačnih ocena bazirani na ekspertskom sistemu Metod su u skladu sa kvalitetom odabranog uzorka. Na osnovu izračunavanja Pirsonovog koeficijenta korelacije između ocena dobijenih ekspertskim sistemom Metod i stvarne uspešnosti, dobili smo statistički značajan nivo povezanosti.

**Zaključak.** Izračunavanje nivoa povezanosti između pretpostavljane ocene takmičarske uspešnosti (ekspertski sistem) i stvarne uspešnosti (bodova) je relevantan pokazatelj valjanosti i kvaliteta redukovano modela potencijalne uspešnosti.

# ULOGA ŠKOLE SKIJANJA U PROCESU SOCIJALIZACIJE DECE PREDŠKOLSKOG UZRASTA

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**Uvod:** Predmet rada je škola skijanja i njena uloga u procesu socijalizacije dece predškolskog uzrasta. Socijalizacija je proces socijalnog učenja putem kojeg jedinka stiče socijalno-relevantne oblike ponašanja i formira se kao ličnost sa svojim specifičnim karakteristikama. Socijalizacija i razvoj ličnosti se ostvaruje pod uticajem socijalnih agenasa (faktora) u sredini koja ima grupna obeležja. Agensi socijalizacije mogu biti: porodica, škola, sportska škola, vršnjaci, masovna sredstva komunikacije i druge institucije i osobe sa kojima je pojedinac u kontaktu npr. trener, instruktor i dr.

**Metod.** Rad je empirijskog karaktera i bazira se na saznanjima iz oblasti pedagogije, sociologije, psihologije.

**Rezultati.** Škola skijanja, u kojoj se deca susreću sa vrednostima, zahtevima i normama, koje vladaju u društvu može da bude jedan od faktora socijalizacije. Značajnu ulogu u tom procesu može da ima: igra, grupa vršnjaka i instruktor. Igra je najpogodniji metod u školi skijanja, za usvajanje tehnike, ali i sredstvo socijalizacije, gde se međusobno prepliću, razvoj sposobnosti pojedinih funkcija i socijalnih odnosa. Igra podstiče i razvija osećanja. Motivi koji su nadahnuti osećanjima postaju podstrekači i usmerivači dečijih aktivnosti. Grupa vršnjaka može da predstavlja važno sredstvo socijalizacije pojedinca, doprinosi razvoju društvenosti, usvajanju novih socijalnih stavova, normalnom psihofizičkom razvoju, izbegavanju ekscentričnog ponašanja i podsticanju lične samostalnosti. Instruktori skijanja, njihove osobine ličnosti i njihovi postupci prema deci, mogu biti od presudnog značaja za formiranje ličnosti, jer predstavljaju za dete uzore na koje se ono ugleda i sa kojima se indentifikuje.

**Zaključak.** Škola skijanja sa svojim osnovnim karakteristikama značajnim za socijalizaciju (igra kao metod rada, grupni vid nastave, instruktor u svojstvu pedagoga), predstavlja značajan faktor u procesu socijalizacije dece predškolskog uzrasta. Program škole, trajanje časa i rad sa decom treba prilagoditi specifičnostima, potrebama i sposobnostima, u skladu sa njihovim razvojem.

## SKI SCHOOL IN THE PRE-SCHOOL CHILDREN SOCIALIZATION PROCESS

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**Introduction.** The object of this paper is ski school and it's role in socialization process of preschool children. Socialization is the process of social learning through which an individual obtains the socially relevant behavioral patterns and is formed as a personality with all of the specific features. Socialization and development of personality, being provided through social agents (factors) in the society that has the characteristics of a group. The following could be the socialization agents: family, school, peers, mass communication media and other institutions and persons with which and whom the individual has the contact with, for instance the coach, instructor and other.

**Method.** Thiis work has empirical character based on pedagogical, sociological, psychological knowledge.

**Results.** Ski school, in which the children actually meet with those values, requests and norms which exist and rule the society, might be one of the socialization factors. An important role in that process could be taken by: playing, peer group and the ski instructor. Playing is the most appropriate method for adopting the techniques and also for socialization, where there is an interaction between developing the certain functions and social relations. Playing stimulates and develops emotions, too. Motives inspired by the emotions can be the prompters and directors of children's' activities. A peer group can represent an important agent in the socialization process of an individual; it helps developing sociality, adopting the new social attitudes, regular mental and physical development, avoiding the eccentric behavior and encourages personal independence. Ski instructors, their personalities and their actions toward children could be of extreme relevance for the formation of personality as those people represent the role models for children, to look up to and identify with.

**Conclusion.** Ski school with its own characteristic important for socialization (play as work method, group learning method, ski instructor as educator) is important factor in socialization process of preschool children. School programs, durations of lessons and working with pre-school children should be adapted to specific requirements, needs and abilities, in accordance with their development.

## EFEKTI RAZLIČITIH PROGRAMA SPORTSKE ŠKOLICE NA PROMENE MOTORIČKOG PONAŠANJA DECE PREDŠKOLSKOG UZRASTA

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**Uvod.** Mototričko ponašanje dece predstavlja celokupnu mototriču aktivnost koju deca izvode u igri, sportskim i rekreativnim aktivnostima, kao i u drugim svakodnevnim aktivnostima kod kuće, u školi i u slobodno vreme. Većina mototričkih sposobnosti i navika razvija se i stiče isključivo u periodu detinjstva, a naručito se mogu razvijati i na njih se može povoljno uticati u predškolskom uzrastu. U tom periodu se izgrađuje struktura mototričkog prostora na osnovu genetskih i spoljašnjih faktora koji utiču na celokupan rast i razvoj dece (Bala, Kiš i Popović, 1996). Ovo straživanje predstavlja samo jedu segmrnt velike studije koje je rađeno na osnovu odobrenog projekta Ministarstva omladine i sporta a koja je osim mototričkog prostora obuhvatala morfološki, posturalni i funkcionalni status dece predškolskog uzrasata. Osnovni cilj istraživanja je alaniza trenda razvoja mototričkih sposobnosti dece predškolskog uzrasta, pored toga analiziraće se efekti različitih programskih sadržaja sportske školice na promene mototričkih sposobnosti dece predškolskog uzrasta.

**Metod.** Istraživanje je obuhvatilo 80 dečaka i devojčica, a primenjeno je pet mototričkih testova kao i morfološke mere visina i masa tela.

**Rezultati.** Dobijeni rezultati su pokazali da je prosečna visina dece u kontrolnoj grupi  $119\pm 5,87$ , raspon visine se kreće od 105,60 do 132,60 cm. Prosečna masa tela dece predškolskog uzrasta u kontrolnoj grup je  $23,53\pm 4,63$  kg. Prosečna visina dece eksperimentalne grupe je  $117\pm 4,65$ . Prosečna masa tela dece eksperimentalne grupe je  $24,15\pm 5,55$ . Rezultati istraživanja su pokazali da je za vreme eksperimentalnog tretmana došlo do poboljšanja rezultata kod testova koji su merili snagu trbuha, brzinu segmentalnih pokreta, koordinaciju i eksplozivnu snagu u kontrolnoj i eksperimentalnoj grupi. **Zaključak.** Promene do kojih je došlo kod dece u eksperimentalnoj grupi su bile znatno većih vrednosti. Program eksperimentalnog tretmana je bio tako koncipiran da pozitivno deluje na razvoj pomenutih sposobnosti.

## THE EFFECTS OF VARIOUS PRESCHOOL SPORTS EDUCATION PROGRAMS ON THE CHANGES IN THE MOTOR BEHAVIOR OF PRESCHOOL CHILDREN

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**Introduction.** What we mean by the motor behavior of children is the overall motor activity that children engage in during play, sports and recreational activities, as well as other daily activities at home, in school, and during their free time. Most motor abilities and habits are developed and acquired exclusively during childhood, and are prone to development and influence when children are at the preschool age. During this period, the structure of the motor area develops on the basis of genetic and outside factors which influence the overall growth and development of the children (Bala, Kiš & Popović, 1996). This research represents only a segment of a greater study carried out with the help of a project grant awarded by the Ministry of Youth and Sport, and which in addition to motor space also included the morphological, postural and functional status of children of a preschool age in its scope. The basic aim of this research is to analyze the trend of development of the motor skills of preschool children, in addition to analyzing the effects of various preschool sports education programs on changes to the motor skills of preschool children.

**Method.** The research encompassed 80 boys and girls, and a total of five motor tests, in addition to the morphological measurements of height and body mass, were also used.

**Results.** The obtained results have shown that the average height of the children in the control group was  $119\pm 5,87$ , and that their height ranged from 105,60 up to 132,60 cm. The average body mass of the preschool children in the control group was  $23,53\pm 4,63$  kg. The average height of the children in the experimental group was  $117\pm 4,65$ . The average body mass of the children in the experimental group was  $24,15\pm 5,55$ . The research results have shown that during the experimental treatment, an improvement in the test results was found in the case of the tests which measured abdominal strength, segmental movement speed, coordination and explosive strength among the members of both the control and experimental group.

**Conclusion.** The changes that occurred among the children of the experimental group showed significantly higher values. The experimental treatment program was conceived in such a manner so as to have a positive effect on the development of the abovementioned skills.

## EATING HABITS OF CHILDREN ATTENDING B-FRESH DANCE STUDIO

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**Introduction.** B-fresh Dance assembles children, young and adult people for the purpose of support and development of the art of modern dance and its promotion among the public. The dancers train 2–3 times a week, they take part in weekend workshops and holiday week-long dance workshops. B-fresh Dance Studio has over 120 members. B-fresh Dance Studio divides its dancers into 3 age groups: children 6–10, juniors 11–14 and adults 15–X. The research presented in this paper dealt with the nutrition of children who do sports actively, with focus on the diet of dancers.

**Methods.** In total, 40 persons took part in the research, out of which 36 were juniors aged 11–14, one child aged 10 and 3 persons from the adult group aged 15–16 (a 15-year-old girl and a girl and a boy aged 16). The research was conducted using questionnaires. The questionnaires were filled in anonymously.

**Results.** The children wrote, they consume most often 4 foods per a day. Most of the girls (27) and all 3 boys drink 1 – 2 l liquid daily. The surveyed children drink most often water (18 girls and 1 boy) or sweet spring water (14 girls and 2 boys). The most of children wrote they consume fruits once a week. The same number of children consumed vegetable once a week (13 girls and 1 boy) or multiple times a week (14 girls, no one boy). 16 girls and 2 boys said, they have an experience with alcohol. Only 2 girls have cigarette experience.

**Conclusion.** The children attending B-fresh Dance Studio consume the right number of meals during a day. Most of the children drink 1–2 l of liquid daily, although high percentage of the children (30 %) prefer sweetened mineral water. The consumption of fruits and vegetable in surveyed children were absolutely deficient. Alarming fact is that nearly a half of the children at their early age already have some experience with alcohol (45 % of the children declare so); on the other hand, it is positive that only 2 girls out of the entire sample have experience with cigarettes.

## NUTRITIVNE NAVIKE KOD DECE KOJA POHAĐAJU PLESNI STUDIO B-FRESH

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**Uvod.** B-fresh Dance okuplja decu, mlade i odrasle u cilju podrške i razvoja umetnosti modernog plaesa i njegove promocije u javnosti. Plesači treniraju 2–3 puta nedeljno, učestvuju u radionicama vikendom a preko raspusta i nedeljnim plesničkim radionicama. B-fresh Dance Studio ima preko has 120 članova. B-fresh Dance Studio deli svoje članove u 3 starosne grupe: deca 6–10, juniori 11–14 i odrasli 15–X. Istraživanje predstavljeno u ovom radu bavi se ishranom dece koja se aktivno bave sportom sa fokusom na ishrani plesača.

**Metode.** U istraživanju je učestvovalo 40 osoba od kojih 36 juniora starosti 11–14, jedno dete od 10 godina i 3 osobe iz grupe odraslih starosti 15–16 (petnaestogodišnja devojčica i dečak i devojčica od 16 godina). Istraživanje je sprovedeno pomoću upitnika, koji su anonimno popunjavani.

**Rezultati.** Deca su napisala da najčešće konzumiraju 4 obroka dnevno. Većina devojčica (27) i sva 3 dečaka pila su 1 – 2 l tečnosti dnevno. Ispitivana deca najčešće piju vodu (18 devojčica i 1 dečaka) ili slatku izvorsku vodu (14 devojčice i 2 dečaci), ali nije moguće preporučiti slatka pića. Konzumiranje voća i povrća kod ispitivane dece je bilo apsolutno deficitarno. Većina dece je napisala da uzimaju voće jednom nedeljno. Isti broj dece je uzimao povrće jednom nedeljno (13 devojčica i 1 dečak) ili više puta nedeljno (14 devojčica, 0 dečaka). 16 devojčica i 2 dečaka je navelo, da su imali iskustava sa alkoholom a samo 2 devojčice su imale iskustvo sa cigaretama

**Zaključak.** Deca koja pohađaju B-fresh Dance Studio konzumiraju pravi broj obroka tokom dana. Većina dece pije 1–2 l tečnosti dnevno, iako veliki procenat dece (30 %) daje prednost slatkoj mineralnoj vodi. Uzimanje voća i povrća kod ispitivane dece je apsolutno deficitarno. Alarmanтна činjenica je da je gotovo polovina dece u svom ranom dobu imala iskustva sa alkoholom (45 % dece je to izjavilo); s druge strane, sigurno je samo da su 2 devojčice od ukupnog uzorka imale iskustva sa cigaretama.

## UTICAJ SPORTSKE AKTIVNOSTI NA ANTROPOMETRIJSKE KARAKTERISTIKE, LIPIDNI PROFIL I OKSADATIVNI STATUS KOD ŠKOLSKE DECE

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**Uvod.** Cilj naše studije bio je utvrđivanje uticaja sportske aktivnosti na antropometrijske karakteristike, lipidni profil i oksidativni status kod školske dece uzrasta od 7 do 15 godina. Sportski aktivnom decom smo smatrali decu koja su se osim kroz nastavu fizičkog vaspitanja aktivno bavila još nekim sportom (košarka, fudbal, karate, odbojka, plivanje). **Metod.** Antropometrijske karakteristike [indeks telesne mase (ITM), debljina kožnog nabora, procenat telesnih masti (TM %) i obim struka i kuka], parametri lipidnog profila (koncentracija ukupnog holesterola, LDL-holesterola, HDL-holesterola i triglicerida), parametri oksidativnog statusa [lipidna peroksidacija, merena kao tiobarbiturna kiselina-reagujuće supstance (TBKRS), aktivnost enzima superoksid-dizmutaze (SOD), koncentracija superoksid anjon radikala ( $O_2^-$ ) i koncentracija ukupnih sulfhidrilnih grupa] mereno je kod školske dece (n=186). Deca su podeljena u dve grupe, 59-oro mlađe dece (17 sportski aktivnih i 42 neaktivnih) i 127 starije dece (29 sportski aktivnih i 98 neaktivnih). **Rezultati.** Kao što se i očekivalo, kod mlađe, sportski aktivne dece dobijene su statistički značajno niže vrednosti obima struka, obima kukova i TM% ( $p < 0.05$ ). Lipidni profili ove dve grupe mlađe dece bili su bez značajnih razlika. Sportski aktivna deca su imala statistički značajno manje koncentracije TBKRS i značajni porast u SOD aktivnosti u poređenju sa sportski neaktivnom mlađom decom. Interesantno je da nismo našli statistički značajne razlike u antropometrijskim karakteristikama između sportski aktivne i neaktivne starije dece ali bilo je razlike u njihovim lipidnim profilima. Sportski aktivna starija deca imala su statistički značajno niže koncentracije LDL-holesterola ( $p < 0.05$ ) i više koncentracije HDL-holesterola ( $p < 0.05$ ). **Zaključak.** Rezultati naše studije pokazali su pozitivan uticaj sportske aktivnosti na antropometrijske karakteristike i oksidativni status kod mlađe dece. Kod starije dece, sportska aktivnost je povezana sa promenom lipidnog profila (niže koncentracije LDL-holesterola i više koncentracije HDL-holesterola). Na osnovu ovih rezultata možemo pretpostaviti da sportska neaktivnost može biti razlog povećanog rizika za razvoj kardiovaskularnih bolesti u starijem dobu.

## THE RELATIONSHIP BETWEEN CHILD SPORT ACTIVITY AND ANTHROPOMETRIC CHARACTERISTICS, LIPIDE PROFILE AND OXIDATIVE STRESS STATUS

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**Introduction.** The aim of our study was to investigate the relationship between sport activity and anthropometric characteristics, lipid profile and oxidative stress status in schoolchildren aged from 7-15 years. We have deemed the children as sport-active, when they besides regular physical activity in school were practicing one more sport (basketball, football, karate, volleyball, swimming). **Method.** Anthropometric characteristics [body mass index (BMI), skinfold thickness (SF), percent of body fat (BF%) and waist and hip circumferences], lipid profile parameters [total cholesterol (t-C), LDL-cholesterol, HDL-cholesterol and triglycerides] and oxidative stress status parameters (lipid peroxidation measured as thiobarbituric acid-reacting substances (TBARS), superoxide anion ( $O_2^-$ ), superoxide dismutase (SOD) activity, total sulphhydryl groups content) were assessed in 186 children. Children were divided in two groups, 59 younger children (17 sport-active and 42 non-active children) and 127 older, schoolchildren (29 sport-active and 98 non-active children). **Results.** As expected, younger children, sport-active, had significantly lower BF% and waist and hip circumferences comparing with non-active counterparts ( $p < 0.05$ ). Lipid profile parameters were similar in the two younger subgroups. Sport-active children had significantly lower concentrations of TBARS and increased SOD activity compared with non-active younger children. It is interesting, that we didn't find statistically significant differences in anthropometric characteristics between sport-active and non-active older children, but we found significant difference in lipid profile between these two groups. Sport-active older children had significantly lower LDL-C concentration ( $p < 0.05$ ) and higher HDL-C concentration ( $p < 0.05$ ) comparing to non-active children. **Conclusion.** Our study demonstrated that sport activity positively influenced on anthropometric characteristics and oxidative stress status parameters in younger children. In older children, sport activity change lipid profile (higher HDL-C concentrations and lower LDL-C concentrations) and we could speculate that sport non-activity could be the reason of increased risk for cardiovascular disease development in later life.

## PODVRSTE ŠAHA KAO DOPUNSKO DIDAKTIČKO SREDSTVO U RANOJ FAZI OBUKE

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**Uvod.** Tokom šahovske obuke početnika u osnovnoškolskom uzrastu u Srbiji uočena je pojava pada zainteresovanosti za dalje učenje šaha usled predugog trajanja obuke tempom od jednog časa sedmično. „Inicijalan impuls sa kojim deca dolaze na nastavu je da se igraju šaha, a suočavaju se sa ne tako kratkim periodom kada izostaje praktična igra, čime mogu biti do te mere nezadovoljni da ih to može obeshrabriti i odbiti od daljeg rada.“ (Marković, Vuksanović i Koprivica, 2009, p. 306).

**Metod.** Na osnovu sprovedene metode teorijske analize predlaže se plansko uvođenje odabranih podvrsta šaha koje bi svojom privlačnošću igre unapredile dinamiku obuke i podstakle aktivnost i motivaciju dece, pre svega u mlađem školskom uzrastu. Metodom modelovanja došlo se do sistematizacije podvrsta šaha, koju prati skup specifičnih metodičko-didaktičkih uputstava, čime se dobija dopunsko sredstvo za utvrđivanje i provežbavanje određenih tematskih jedinica i obogaćuju se sadržaji obuke.

**Rezultati.** Navedena razmatranja predstavljaju polazišnu osnovu za uvođenje podvrsta šaha u ranu fazu procesa obuke (nastave i/ili treninga), kao i za kasnija istraživanja efekata takvog rada. Preliminarna testiranja u beogradskoj osnovnoj školi „Kreativno pero“ ukazuju na vidljiv porast dečje motivacije i stečenih veština. Uzorak je suviše mali da bi bio statistički značajan, tako da su neophodna dalja istraživanja koja bi potvrdila ili osporila ove nalaze.

**Zaključak.** Prilikom izbora podvrsta šaha koje se mogu uvrstiti u nastavu šaha u školama predlažu se sledeći kriterijumi: kompatibilnost sa nastavnim jedinicama koje su predviđene planom i programom, ostvarljivost u pogledu raspoloživih školskih resursa i zadatih prostorno-vremenskih okvira, usklađenost sa duhom i pravilima ortodoksnog šaha, primerena složenost zahteva koji se postavljaju učenicima, kao i privlačnost same igre.

## CHESS VARIANTS AS ADDITIONAL DIDACTIC TOOLS IN THE EARLY STAGES OF CHESS TEACHING/TRAINING

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**Introduction.** During beginner-level chess classes children in Serbia have displayed a significant drop of interest for further learning due to an overly lengthy period of acquiring basic skills at a pace of one lesson per week. “The initial child’s impulse is to play the game and postponing it may result in dissatisfaction and demoralization to the point when they refuse to cooperate” (Marković, Vuksanović and Koprivica, 2009, p. 301).

**Method.** Based on the theoretical analysis of the said phenomenon, systematic introduction of chess variants is proposed to improve the teaching/training dynamics and enhance younger schoolchildren’s motivation and activity. Classification of selected chess variants, accompanied by a set of specific didactic instructions, thus yields an additional teaching/training tool that can be used to reinforce and exercise multiple topics and thematic units, as well as to enrich both teaching and training contents.

**Results.** These considerations represent the basis for introduction of chess variants in the early stages of chess teaching/training, as well as for further research of its effects. Preliminary testing in Belgrade primary school “Kreativno pero” has shown visible improvement in children motivation and skills. The sample is too small to be statistically significant, thus further research is due to support or disprove these findings.

**Conclusion.** Based on our research, we recommend the following criteria for selecting chess variants that can be included in the school curriculum: compatibility with the syllabus, feasibility in terms of school resources and space/time constraints, compatibility with the spirit and rules of orthodox chess, appropriate difficulty of requirements, and the addictive quality and playability of the variant itself.



## AKTUELNO STANJE I PROJEKCIJA NEKIH EKSTREMNIH SPORTOVA MEĐU SREDNJOŠKOLSKOM OMLADINOM BEOGRADA

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**Uvod.** Ekstremni sportovi su u svetu odavno u ekspanziji, a na prostorima Srbije zadnje dve decenije. Od mnoštva ekstremnih sportova, danas su u Srbiji prepoznatljivi: planinski biciklizam (mountain bike), slobodno penjanje (free climbing), koturaljke ili roleri (inline skating), daska za tvrde podloge (board), daska za sneg (snowboard), spuštanje specijalnim čamcima niz brze reke (rafting), jedrenje na dasci (windsurf), slobodno letenje krilom (paraglajding) i drugi. Većina aktivnih učesnika u ekstremnim sportovima su mladi, ali sa različitim ulogama i učešćem u odnosu na takmičarski (sportski) ili rekreativni deo. Cilj ovog rada je da se ispita aktuelno stanje u ovom prostoru i predloži projekcija daljeg razvoja.

**Metod.** Da bi bio ostvaren osnovni cilj, sprovedena je anonimna anketa učenika srednje škole (XIII gimnazija u Beogradu) u kojoj je učestvovalo 127 učenika trećeg razreda (uzrasta 17 i 18 godina). Za ovo transverzalno istraživanje korišten je empirijski metod, kao osnovni, odnosno deskriptivni, kao pomoćni. Dobijeni rezultati obrađeni su deskriptivnom statistikom. Iz prostora statistike određena je distribucija frekvencije za odgovore na pitanja postavljena u upitniku. Parametri distribucije frekvencija koji su korišteni u ovom radu su frekvencija i relativna frekvencija.

**Rezultati.** Ekstremni sportovi u Beogradu su u uzlaznoj putanji, naročito posle kriznih godina. Od ukupnog učešća istraživane populacije, brojniji su muškarci u ukupnom učešću u ekstremnim sportovima. Kod devojaka najbrojnije je učešće u vožnji koturaljki, biciklizma i zimi u vožnji borda. Kod učenika planinski biciklizam, koturaljke, daska za tvrde podloge i zimi bord.

**Zaključak.** Učešće u „komplikovanijim“ i „skupljim“ sportovima može se očekivati većim materijalnim ulaganjima, jeftinijim kursevima i obukom, ali i pojavljivanjem specijalističkih klubova, realnim predstavljanjem svakog sporta i pedagoškim pristupom obuci, uz precizne informacije o prednostima i manama, koje se mogu desiti u toku bavljenja aktivnostima.

## THE CURRENT STATE AND PROJECTION OF SOME EXTREME SPORTS AMONG BELGRADE HIGH SCHOOL YOUTH

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**Introduction.** In the world, extreme sports have been in the expansion for a long time, and in Serbia in the last two decades. From the variety of extreme sports, those which are recognizable in today's Serbia are: mountain biking, free climbing, inline skating, boarding, snowboarding, rafting, windsurfing, paragliding and other sports. Most of active participants in extreme sports are young, but with different roles and participation in relation to the competitive (sports), or recreational part. The aim of this paper is to examine the current state in this area and projection of future development.

**Method.** To achieve the main goal we conducted a survey among secondary school students (XIII Belgrade Grammar School) in autumn, 2008. 127 third grade students (17-18 years of age) participated in the survey. The empirical method was the basic method used for this transverse research, and the descriptive method, was the additional one. The results which were obtained by using the anonymous survey technique were later processed by descriptive statistics. The frequency distribution for the answers to the questions in the questionnaire was determined from the space of statistics. Parameters of the distribution of frequencies that are used in this research are frequency and relative frequency.

**Results.** Extreme sports in Belgrade are on an upward path, especially after years of crisis. Of the total participation of the population, men are more numerous in the overall participation in extreme sports. Girls mostly participate in inline skating, cycling, and snowboarding in winter. For students, the most popular sports are mountain biking, inline skating, boarding and snowboarding.

**Conclusion.** Participation in the “more complicated” and “more expensive” sports can be expected with greater financial investment, low-cost courses and training, but also with the appearance of specialized clubs, realistic presentation of each sport and pedagogical approach to training, along with the precise information on the advantages and disadvantages which can occur during tackling the activities.

## THE INFLUENCE OF ANTHROPOMETRICAL CHARACTERISTICS AND MOTOR ABILITIES ON THE AEROBIC ENDURANCE OF 4 TH GRADE ELEMENTARY SCHOOL STUDENTS

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**Introduction.** In the introductory part of the work so far, we present thinking about the impact of physical activity on the development of relevant anthropological characteristics of children. The aim of this study was to verify the influence of anthropometrical and motor abilities on the aerobic endurance of 4th grade elementary school students in Primorje-Gorski kotar County on a sample of 1058 students ( 540 boys and 518 girls ).

**Methods.** The sample of variables consisted of 11 tests which are applied in education in Republic of Croatia. With the regression analysis, was formulated the influence of 4 anthropometrical and 6 motor variables to 1 variable of aerobic endurance. The results obtained show, that the boys and girls of the predictive (anthropometrical and motor) variables has a statistically significant impact on the criterion (aerobic endurance) variable.

**Results.** In boys, the biggest impact on the variable „3 MINUTES RUN“ have variables: body weight, long jump from one place, body lifting, body bending, while girls have the biggest impact of variables in hand tapping, long jump from one place, polygon ( backwards ) and withstand in higher knuckle.

**Conclusion.** The results obtained for boys and girls, of 4th grade elementary school students showed that the expression of resistance in participate running motor skills, formed the basis of the integral, with which explosive leg power in running shows dominant motor ability in both sexes. The results for boys in aerobic endurance in running are often achieved at the expense of explosive and repetitive strength, and girls results on the speed of the frequency of movement, body coordination and strength in the force, considering that they have the optimal morphological characteristics.

## UTJECAJ ANTROPOMETRIJSKIH KARAKTERISTIKA I MOTORIČKIH SPOSOBNOSTI NA AEROBNU IZDRŽLJIVOST UČENIKA ČETVRTIH RAZREDA OSNOVNE ŠKOLE

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**Uvod.** U uvodnom dijelu rada predstavljamo dosadašnja razmišljanja o utjecaju tjelesne aktivnosti na razvoj relevantnih antropoloških obilježja djece. Cilj ovog rada bio je provjeriti utjecaj antropometrijskih i motoričkih sposobnosti na aerobnu izdržljivost učenika 4. razreda osnovne škole u Primorsko-goranskoj županiji na uzorku od 1058 učenika (540 dječaka i 518 djevojčica).

**Metod.** Uzorak varijabli činilo je 11 testova koje se primjenjuju u školstvu u Republici Hrvatskoj. Regresijskom analizom utvrđivan je utjecaj 4 antropometrijskih i 6 motoričkih varijabli na 1 varijablu aerobne izdržljivosti. Dobiveni rezultati pokazuju da kod dječaka i djevojčica primijenjeni sustav prediktorskih (antropometrijskih i motoričkih) varijabli ima statistički značajan utjecaj na kriterijsku (aerobna izdržljivost) varijablu.

**Rezultati.** Kod dječaka najveći utjecaj na varijablu Trčanje 3 minute imaju varijable tjelesna masa, skok udalj s mjesta, podizanje trupa i pretklon trupa, dok kod djevojčica najveći utjecaj imaju varijable tapping rukom, skok udalj s mjesta, poligon natraške i izdržaj u visu zgibom.

**Zaključak.** Dobiveni rezultati kod dječaka i djevojčica, učenika četvrtih razreda osnovne škole (10±6mjeseci) pokazali su da u ispoljavanju izdržljivosti u trčanju sudjeluju motoričke sposobnosti oblikovane na integralnoj osnovi, s tim, što eksplozivna snaga nogu u trčanju predstavlja dominantnu motoričku sposobnost kod oba spola. Dječaci rezultate u aerobnoj izdržljivosti trčanjem postižu najčešće na račun eksplozivne i repetitivne snage, a djevojčice na temelju brzine frekvencije pokreta, koordinacije tijela i izdržljivosti u snazi, s obzirom da posjeduju optimalnija morfološka obilježja.

## EFEKTI „MINI TRENINGA” NA USPJEŠNOST U PLIVANJU

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**Uvod.** Na uzorku od 42 ispitanika školske 2008/09. i 52 ispitanika školske 2007/08. godine, studenata Fakulteta fizičkog vaspitanja i sporta Univerziteta u Istočnom Sarajevu, upisane u II godinu studija, muškog pola hronološke dobi 22 godine  $\pm$  6 mjeseci izvršena je komparacija rezultata u sledećim varijablama: plivanje na 100 metara kraul i leđno. **Metod.** Tokom istraživanja koristila se deskriptivna statistika sa mjerama centralne tendencije: srednja vrijednost, minimum, maksimum, standardna devijacija. Osim toga koristio se i t-test.

**Rezultati.** Komparacija rezultata u plivanju jedne grupe studenata 42 ispitanika 2008/09., podvrgnuta trenažnom kondezovanom vidu nastave u odnosu na rezultatsku uspješnost u plivanju druge grupe 52 ispitanika koja je imala program “mini trening” tokom praktične nastave iz plivanja u školskoj 2007/08. godini. Komparacijom rezultatske uspješnosti u plivanju tehnikama kraul 100m dobijeni rezultati mjera centralne tendencije kod 52 ispitanika inicijalnim mjerenjem rezultati su P100Ki (srednja vrijednost=132,86; minimum=80,96; maximum=201,21; std.dv=24,66), dok finalnim mjerenjima 100 kraul P100Kf (srednja vrijednost=120,77; minimum=78,04; maksimum=189,32; std.dv=21,68). Ista populacija ispitanika u plivanju 100 leđno na inicijalnom mjerenju imala je vrijednosti (P100Li srednja vrijednost=168,88; minimum=110,22; maksimum=234,11; std.dv=26,72), dok ista varijabla u finalnom mjerenju 100 leđno (P100Lf srednja vrijednost=159,21; minimum=104,68; maksimum=221,67; std.dv=26,01). Analizom t-testa iskazana je statistička značajnost između inicijalnog i finalnog mjerenja u korist „mini treninga” studentske populacije 2007/08. godine u odnosu na kondezovani vid nastave populacije studenata 2008/09. školske godine. Rezultati t-testa populacije (52 ispitanika školske 2007/08. plivanjem 100 kraul su (P100ki/P100kf t=8,30), nivo značajnosti (p=0,00). Tehnike 100 leđno (P100Li/P100Lf vrijednosti t-testa su 7,25, uz nivo značajnosti p= 0,00).

**Zaključak.** Dobijeni rezultati plivanja 100 m kraul i leđno na uzorku od 52 ispitanika školske 2007/08. godine favorizuju “mini trening” u odnosu na kondezovani vid praktičnog dijela nastave plivanja 42 ispitanika školske 2008/09. godine.

## THE EFFECTS OF ‘MINI-TRAINING’ ON THE SWIMMING EFFICIENCY

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**Introduction.** The sample of tested students consisted of 42 students during 2008/09. academic year and 52 students during 2007/08. academic year. All of them were the male students at the second year at the Faculty of the Physical Education at the University in East Sarajevo and they were 22 years and  $\pm$ 6 months old. There was done the results comparison on this sample in the following variables: swimming the crawl and back-stroke at 100m. **Method.** During the research, there was used descriptive statistics with the measures of central tendencies: mean, minimum, maximum, standard deviation. Besides, there was used t-test. **Results.** There were compared the results of two groups of students. One group consisted of 42 tested students in 2008/09 academic year. They were exposed to the condensed training teaching type. The other group consisted of 52 tested students. This group was subjected to the programme called ‘mini training’ during the practical swimming classes in 2007/08 academic year. Comparing the results success of 52 students in swimming the crawl at 100 m by using initial measuring there were got the following results of the measures of central tendencies S100Ci (mean=132,86; minimum= 80,96; maximum=201,21; stand. dev.=24,66), while the results got by using final measuring were the following: S100Kf (mean=120,77; minimum= 78,04; maximum=189,32; stand. dev.=21,68 ). The same population of the students at swimming 100m back stroke at initial measuring had the following results (S100Bi mean=168,88; minimum=110,22; maximum=234,11; stand. dev. =26,01). Analyzing t-test there was shown the statistic difference between the initial and final measuring. There was the results difference in favor of the ‘mini training’ of the students population during 2007/08 in comparison to condensed teaching type applied to the students population during 2008/09 academic year. Applying t-test on 52 students swimming the crawl in 2007/08 there were got the following results (S100ci/S100kf t=8,30), the level of importance (p=0,00) and the results at swimming the back stroke were (S100Bi/S100Bf, t-test=8,30, level of importance p=0,00). **Conclusion.** The results at 100m swimming the crawl and back stroke on the sample of 52 tested students during 2007/08 academic year showed the difference in favor of ‘mini training’ in comparison to condensed teaching type applied to 42 tested students during 2008/09 academic year.

## EFIKASNOST PROGRAMIRANE NASTAVE AKTIVNOSTI U PRIRODI NA REZULTATSKU USPJEŠNOST RONJENJA I PLIVANJA

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**Uvod.** Na uzorku od 54 ispitanika studenata Fakulteta fizičkog vaspitanja i sporta Univerziteta u Istočnom Sarajevu hronološke dobi od 23-27 godina  $\pm$  6 mjeseci školske 2008/09. godine izvršena je komparacija rezultata u sledećim varijablama: ronjenje apneom na dalj (ADALj), zaron do 2 metra (AZAR) i plivanje 200 metara (PL200) tehnikom kraul. Cilj istraživanja je bio da se utvrdi efikasnost programirane praktične nastave iz predmeta Aktivnosti u prirodi stacioniranog kampa na Tjentištu. **Metod.** U metodi istraživanja i interpretacija rezultata koristila se deskriptivna statistika. Rezultati deskriptivne statistike izraženi su mjerama centralne tendencije kao što su: srednja vrijednost (mean), minimum, maksimum, standardna devijacija. Pored toga koristio se i t- test. **Rezultati.** Rezultati istraživanja dobijeni mjerama centralne tendencije tokom plivanja 200 m na inicijalnom mjerenju su: PL200i Men=332,67, minimum=186,22, maksimum=624,38, std. dv.=88,68. Ista varijabla na finalnom mjerenju imala je sledeće vrijednosti: PL200f Men=319,59, minimum=180,45, maksimum=609,12, std.dv =89,90. Apneom ronjenja u dalj, izražena varijablom ADALj, na inicijalnom mjerenju dobijeni su sledeći rezultati: mean=12,86, minimum=4,67, maksimum=23,96 i std.dv.=4,90, ista varijaba na inicijalnom mjerenju imala je rezultate: mean=14,97, minimum=5,86, maksimum=35,53, std.dv.=5,46. Rezultati zaronu u dubinu na 2 m, iskazani varijablom AZAR, na inicijalnom mjerenju imali su sledeće vrijednosti: mean=3,39, minimum=1,56, maksimum=8,18, std.dv=1,27. Ista varijabla tokom finalnog mjerenja pokazala je sledeće rezultate: Mean=2,96, minimum=1,12, maksimum=5,67, std. dv.=0,96. Rezultati t-testa na inicijalnom i finalnom mjerenju u varijablama PL200 m t-12,69, uz p=0,00; ADALj t-6,15, uz p=0,00; AZAR, t-5,56 sa p-0,00 vrijednošću. **Zaključak.** Dobijeni rezultati deskriptivne statistike iskazane mjerama centralne tendencije i t- testa na 54 ispitanika studentske populacije školske 2008/09. godine ukazuju na efikasnost praktične nastave aktivnosti u prirodi stacioniranog kampa na Tjentištu, u plivanju 200 m, ronjenju na apneu u dalj i zaronu na 2 m.

## THE EFFICIENCY OF THE PLANNED TEACHING THE ACTIVITIES IN THE NATURE ON THE RESULTS SUCCESS IN DIVING AND SWIMMING

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**Introduction.** The sample consisted of 54 tested students at the Faculty of Physical Education at the University in East Sarajevo. The students were 23-27 years old in 2008/09. There was done the results comparison in the following variables: diving without taking a breath at length (BLENGTH), diving to 2 m (BDIVING) and swimming the crawl at 200m (SW200). The aim of the research was to find out the efficiency of the planned teaching at the academic subject Activities in Nature during the stationary camp at Tjentiste. **Method.** Descriptive statistics was used for the interpretation of the results during the research. The descriptive statistics gave the pieces of information about the measures of central tendencies: minimum, maximum, mean, standard deviation. Besides, there was used t-test. **Results.** The results at swimming 200m, which were got by the measures of central tendencies, were the following: at initial measuring SW200i Mean=332,67, minimum=186,22, maximum=624,38, stand. dev.=88,68 ; the same variable at final measuring had the following values: SW200f Mean=319,59, minimum=180,45, maximum=609,12, stand. dev.=89,90. Diving without taking a breath at length, denoted by the variable BLENGTH, at initial measuring, had the following results: mean=12,86, minimum=4,67, maximum=23,96 and stand. dev.=4,90, the same variable at initial measuring had the following results: mean=14,97, minimum=5,86, maximum=35,53, stand. dev.=5,46. The results at diving to 2m denoted by the variable BDIVING at initial measuring had the following results: mean=3,39, minimum=1,56, maximum=8,18, stand. dev. =1,27. The same variable at the final measuring showed the following results: mean=2,96, minimum=1.12, maximum=5,67, stand. dev.=0,96. The results got using t-test at initial and final measuring were the following : SW200M t-12,69, p=0,00; BLENGTH t-6,15, p=0,00; BDIVING t-5,56, p=0,00. **Conclusion.** The results got by testing 54 students during 2008/09 academic year, using descriptive statistics were shown in the measures of central tendencies and t-test . The results showed that the practical teaching the activities in nature at swimming 200m, diving without taking a breath at length and diving to 2m during the stationary camp at Tjentiste was efficient.

## NASTANAK I RAZVOJ SPORTA OSOBA SA INVALIDITETOM U SRBIJI

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**Uvod.** Sport osoba sa invaliditetom postaje sve popularniji i masovniji. Na prvim Paraolimpijskim igarama u Rimu 1960. godine nastupilo je 400 sportista. U Pekingu 2008. godine je nastupilo njih 3.951, dok se za London 2012. godine predviđa rekordan broj od čak 4.200 sportista sa invaliditetom.

**Metod.** U radu su analizirani relevantni podaci svetski priznatih institucija i domaćih organizacija iz vladinog i nevladinog sektora sa ciljem pronalaženja i prikupljanja što većeg broja primarnih i sekundarnih izvora i činjenica o nastanku i razvoju sporta osoba sa invaliditetom u Srbiji.

**Rezultati.** Svetska zdravstvena organizacija procenjuje da čak 10% svetske populacije, njih oko 600 miliona, čine osobe sa invaliditetom. U Srbiji je taj procenat oko svetskog proseka, između 10-14%, što je oko 800.000 ljudi. Jugoslavija, a samim tim i Srbija kao njen pravni naslednik, ima osvojenih 87 paraolimpijskih medalja. Najuspešnija godina je bila 1984. kada je osvojena 31 medalja. Samostalna Srbija ima dve srebrne medalje osvojene u Pekingu 2008. godine.

**Zaključak.** U Srbiji sport osoba sa invaliditetom nije dovoljno razvijen. U Savezu za sport i rekreaciju invalida Srbije registrovano je oko 17.000 sportista sa invaliditetom, što predstavlja svega 2% ukupnog broja osoba sa invaliditetom.

## THE EMERGENCE AND DEVELOPMENT OF SPORT FOR PEOPLE WITH DISABILITIES IN SERBIA

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**Introduction.** Sport for people with disabilities is more and more popular and becomes mass sport. At the first Para-Olympic Games in Rome 1960. there were 400 athletes taking part. In Beijing 2008. there were 3.951, while in London 2012. there is expected the number of even 4.200 athletes with disabilities.

**Method.** In this body of work are analysed relevant information world renowned organizations and domestic institutions within governmental and non-governmental sectors with the aim of discovering and collecting a greater number of primary and secondary sources and facts about the origin and development of sport for people with disabilities in Serbia.

**Results.** World Health Organization estimates that 10% of world population, around 600 million, are people with disabilities. Some estimates show that number of people with disabilities is around 10-14%, which is around 800.000 people. Yugoslavia, it means Serbia as her legal successor is a winner of 87 paralympic medals. The most successful year was 1984. with 31 medals. Independent Serbia has two silver medals gained in Beijing 2008.

**Conclusion.** In Serbia sport for people with disabilities is not developed enough. In Serbian Association for sport and recreation for people with disabilities there are 17.000 registered athletes, that makes only 2% of all people with some disability.

## SPECIFIČNOSTI STRUKTURE TRENINGA KOD SPORTISTA SA OŠTEĆENIM VIDOM

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**Uvod.** Osobe sa invaliditetom sve više uzimaju učešće u sportu, a među njima je i značajan broj sportista sa oštećenim vidom. Uključivanje ove populacije u sportske aktivnosti pratili su mnogi problemi, a neki od njih odnose se na stručni rad i neodgovarajuće obrazovanja stručnih kadrova.

**Metod.** Cilj rada je da ukaže na specifičnosti pojedinih elemenata strukture treninga osoba sa oštećenim vidom, ali i da apostrofira razlike u odnosu na trening osoba bez invaliditeta. U tom cilju posmatrani su i analizirani sledeći elementi: pojedinačni trening, mikrociklus, mezociklus, makrociklus, metode obuke, trenažna opterećenja i trenažna sredstva.

**Rezultati.** Specifičnost problema, koji se javljaju u treningu osoba sa oštećenim vidom, zahtevaju poseban pristup i specifična znanja vezana za trenažnu tehnologiju osoba sa oštećenim vidom.

**Zaključak.** Tehnologiju treninga sportista sa oštećenim vidom karakterišu određene specifičnosti, zbog čega je potrebno da stručnjaci, koji rade sa ovom populacijom sportista, budu dodatno edukovani.

## SPECIFICS OF TRAINING STRUCTURE FOR VISUALLY IMPAIRED ATHLETES

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**Introduction.** People with disabilities are increasingly taking part in sport activities, and among them are a significant number of athletes with visual impairments. Inclusion of this group in the sports activities often leads to several problems, some of which are related to professional work and inadequate education of professional staff.

**Method.** The aim of this paper is to point out the specifics of certain elements in the training framework of persons with visual impairments, as well as to stress the differences in relation to the training of persons without a disability. For this purpose, we observed and analyzed the following elements: individual training, microcycle, mezocycle, makrocycle, training methods, training loads and training funds.

**Results.** Specificity of problems which occur in the training of individuals with visual impairments requires special approaches and specialised knowledge for the technology involved in training people with visual impairments.

**Conclusion.** The training technology needed for athletes with visual impairments is characterised by certain specific features, which is why it is necessary that specialists who work with this group of athletes be further educated.

## ADAPTED WATER SPORTS CAMP FOR PERSONS WITH INTELLECTUAL DISABILITIES

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National Sports Academy „Vasil Levski”, Sofia, Bulgaria

**Introduction.** Summer camps at the Black sea are a typical life experience for students and youth in Bulgaria. Camp is a setting where they can learn new skills, build friendships, and experience personal growth. Unlike the school setting, with its emphasis on academics, the camp setting provides a unique experience in which the emphasis is on sports, social interaction, and having fun. Lately, under the pressure of the European Union requirements, there has been a slight increase in camp opportunities for children with disabilities, particularly children with intellectual disabilities (ID).

**Method.** While the majority of summer camps available to children with ID have been segregated, the only opportunity available for camp experiences that bring together youth with and without ID is the Adapted Water Sports Camp organised by the National Sports Academy. This Program brings individuals with ID and students from NSA together to train activities and compete as teams. During the ten days session, campers and staff are participating in water sports activities: sea swimming, aquatic games, kayaking and sailing. The aim of the program is to provide new sports opportunities for all participants as well as strengthen existing sports camp experiences for people with intellectual disabilities and to create an atmosphere of understanding, learning, and sharing. To estimate the social impact we employed a qualitative design combining semi-structured interviews, field notes and thematic analysis.

**Results.** Through the shared team experience this program provides the opportunities for all participants to learn about each other, to create friendships and overcome the barriers that have thus far prevented the social inclusion of individuals with ID in the society.

**Conclusion.** There are sound reasons to believe that physical activity remains a viable process for reducing social exclusion and improving social well-being, however the effects of physical activity on social outcomes, remain a challenge for evaluation.

## ADAPTIRANI VODENI SPORTSKI KAMP ZA INTELEKTUALNO OMETENE OSOBE

**Stefka Djobova, Daniela Dasheva, Maya Nikolova, Pencho Geshev**

Nacionalna Sportska Akademija, Sofija, Bugarska

**Uvod.** Letnji kampovi na Crnom moru su jedinstveno životno iskustvo za studente i omladinu u Bugarskoj. Kamp je okruženje gde mogu da nauče nove veštine, steknu prijateljstva i iskuse lični razvoj. Za razliku od školskog okruženja, gde je akcenat na učenju, okruženje kampa pruža jedinstveno i iskustvo sa akcentom na sport, društvenu interakciji i zabavu. Nedavno je, pod pritiskom zahteva Evropske Unije, došlo do blagog porasta pogodnosti kampa za decu sa invaliditetom, naročito za intelektualno ometenu decu (ID).

**Metod.** Dok je većina letnjih kampova koji su bili dostupni ovoj deci bila odvojena, Nacionalna Sportska Akademija organizovala je u Adaptiranom vodenom sportskom kampu mogućnost koja stavlja na raspolaganje iskustva kampa koji spaja omladinu sa i bez invaliditeta. Ovaj program spaja intelektualno ometene osobe i studente Nacionalne Sportske Akademije kako bi trenirali i takmičili se kao timovi. U toku deset dana boravka, kamperi i osoblje učestvuju u aktivnostima vodenih sportova: plivanje u moru, igre na vodi, kajak i jedrenje. Cilj programa je da obezbedi nove sportske mogućnosti za sve učesnike kao i da poboljša postojeća sportska iskustva u kampu za intelektualno ometene osobe i da kreira atmosferu razumevanja, učenja i razmene. Da bi se procenio društveni uticaj koristili smo kvalitetan projekat kombinacije polu-strukturiranih intervjuja i tematsku analizu.

**Rezultati.** Kroz zajedničko timsko iskustvo ovaj program pruža mogućnosti za sve učesnike da uče jedni o drugima, da stvaraju prijateljstva i prevazilaze barijere koje su do sada sprečavale socijalnu inkluziju u društvo intelektualno ometenih osoba.

**Zaključak.** Postoje jaki razlozi da verujemo da fizička aktivnost ostaje održiv proces za smanjenje socijalnog isključenja i unapređenje socijalnog blagostanja, ali efekti fizičke aktivnosti na socijalne ishode, ostaju izazov koji treba vrednovati.

## PLIVANJE OSOBA SA PARAPLEGIJOM I REKVIZITI KOJI SE KORISTE U TRENAŽNOM PROCESU

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**Uvod.** Da bi plivanje nekoga ko je u kolicima bilo uopšte moguće, potrebna je ogromna volja i želja, na prvom mestu za životom. Plivanje može mnogo da pomogne u procesu rehabilitacije i poboljšanju kvaliteta života. Plivanje osoba sa paraplegijom je gotovo identično plivanju osoba bez ovog oštećenja. Jedina razlika je u tome što se neke plivačke tehnike moraju prilagoditi stanju u kome se nalaze ovi sportisti. Rekviziti su identični onima koje koriste sportisti bez oštećenja, osim invalidskih kolica i rampe za ulazak u bazen.

**Metode.** U radu je analizirano stanje i rekviziti u plivanju osoba sa paraplegijom u Beogradu. Sagledane su mogućnosti bazena u okviru sportskih centara za održavanje trenažnog procesa ovih osoba i upoređene sa svetskim standardima.

**Rezultati i diskusija.** Nažalost, jedino mesto u Beogradu gde se osobe sa paraplegijom pripremaju u plivanju je na bazenu SRC „Banjica”. U gradu od dva miliona stanovnika, samo dvojica aktivno treniraju sa ciljem da osvoje neku od medalja na velikim takmičenjima. Rezultat toga je svega 20 osvojenih paraolimpijskih medalja u plivanju u periodu od 28 godina.

**Zaključak.** Mogućnosti sportskih objekata u Beogradu ne odgovaraju potrebama osoba sa paraplegijom koje se bave plivanjem. Činjenica je da se u sport osoba sa invaliditetom ne ulaže dovoljno. Ulaganja u plivanje osoba sa paraplegijom je još manje.

## SWIMMING FOR PEOPLE WITH PARAPLEGIA AND THE EQUIPMENT UTILIZED WITHIN THE TRAINING SYSTEM

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**Introduction.** In order for someone who is in a wheelchair to start swimming, there is a great necessitate for an extreme amount of willpower and determination, primarily for life. Swimming can aid in the rehabilitation process and enhance the quality of life. Swimming for people with paraplegia is almost the same as for people without this disability. The only difference is that some swimming techniques must be adapted to their condition. The equipment is the same as the one that are used by athlets without disability, except wheelchar and ramp for the pool entrance.

**Method.** In this body of work is analised the state and equipment for swimming of people with paraplegia in Belgrade. The condition of the swimming pools in sport centers for organising training of these persons were analised and compared with world's standard.

**Results.** Unfortunately, the only place where people with paraplegia can conduct there swimming trainings is at the swimming pool of the Sport center Banjica. In a city with two million people, there are only two active sportsmen with a goal to win a medal at some big sport event. The result of that is the accumulation of 20 medals within a 28 year period.

**Conclusion.** Sport centers in Belgrade don't corespond to persons with paraplegia who want to take in swimming. It is evident that very little is done for sport for people with disabilities. Even worse is the situation in swimming for people with paraplegia.

*Key words:* people with disabilities, people with paraplegia, sport, swimming, Para-Olympic games, Paralympic Games, people with special needs



## REALIZACIJA FIZIČKOG VASPITANJA CEREBRALNO PARALIZOVANIH UČENIKA U KOLICIMA KAO DETERMINANTA ZA BAVLJENJE SPORTOM

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**Uvod.** Od ukupnog broja osoba sa invaliditetom u našoj zemlji samo 2% se bavi rekreativnim ili vrhunskim sportom (Kasum, 2008). Razlozi tako malog broja su mnogobrojni, ali jedan od razloga svakako treba tražiti i u realizaciji nastave fizičkog vaspitanja sa ovim osobama kao inicijalnog trenutka za bavljenje sportom. Fizičko vaspitanje predstavlja vrlo diskretan i spontan način uvođenja dece sa invaliditetom u sportske aktivnosti. Ciljevi našeg rada su: a) utvrditi broj dece koja za potrebe kretanja koristi invalidska kolica i njihovu sposobnost samostalnog korišćenja istih i b) uraditi kvalitativnu analizu plana i programa fizičkog vaspitanja da bi utvrdili koje se programske celine mogu realizovati u radu sa učenicima u invalidskim kolicima. **Metod.** Uzorak za istraživanje je sastavljen od 45 učenika podeljenih u dve škole. U prvoj je ispitano 27 učenika (60%) od I do VIII razreda, dok u drugoj 18 učenika (40%) od I do IV razreda. Svi učenici imaju medicinsku dijagnozu cerebralna paraliza. Za potrebe istraživanja koristili smo posebno konstruisan upitnik. **Rezultati.** Rezultati našeg istraživanja pokazuju da veliki broj ispitanih učenika za kretanje koristi neko ortopedsko pomagalo, kod polovine se radi o invalidskim kolicima. Većina koriste kolica od rođenja, a samo polovina može samostalno da ih pokreće, što je jako bitan podatak za realizaciju nastave fizičkog vaspitanja. Od programskih sadržaja koji su dati u planu i programu za rad sa ovom decom većina je neizvodljiva kada se radi o detetu koje je u kolicima. **Zaključak.** Analizom postojećeg nastavnog plana i programa i na osnovu rezultata o sposobnostima ispitanih učenika zaključujemo da većina programskih oblasti nije primenljiva u radu sa decom koja su u kolicima i da je u velikoj meri potrebno modifikovati postojeći plan i program kako bi se pružila što veća mogućnost uključivanja ove dece u sve aspekte edukacije, a svakako jedan od njih je i sport.

## REALIZATION OF PHYSICAL EDUCATION OF STUDENTS WITH CEREBRAL PARALYSES IN WHEELCHAIR AS A DETERMINANT OF DOING SPORTS

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**Introduction.** Of total number of persons with disability in our country, only 2% are practice recreational or professional sports (Kasum, 2008). Reasons of so small number are numerous but only one of the reasons is surely need to look in realization of teaching physical education with these persons as initial moment for doing sports. Physical education represents wary discreet and spontaneous way of implementation of children with disabilities in sport activates. Goals of our work are: a) determine the number of the children who, for needs of moving, uses wheelchair and their ability to use them on independently and b) make qualitative analysis of plan and program of physical education so we can determine which program units can be realized with students in wheelchair. **Methods.** Sample for study is made of 45 students divided in two schools: in first we examined 27 students (60%) from I to VIII grade and in second we examined 18 students (40%) from I to IV grade. All students in our sample have medical diagnoses cerebral palsy. For the purposes of research, we used specially designed questionnaire. **Results.** Results of our study are showing that big number of examined students uses some kind of orthopedic tool, in half of examinees those are wheelchair. For the most part of them wheelchair use from birth and only half of them can independently move chairs which is wary important fact for organizing teaching of physical education. Since the program content, which are given in the curriculum for most children with this is impracticable when it comes to the child who is in wheelchair. **Conclusion.** By analyzing the existing teaching plan and program and in the nature of results about abilities of examined students we will conclude that majority of program domains is not doable in work with children that are in wheelchair and that in grate need it is important to modify existing plan and program so it make place for possibility to include new children in all aspects and by all means sport as one of them.

## BITNE PRETPOSTAVKE VEZANE ZA FIZIČKO VASPITANJE I SPORT DECE SA RAZLIČITIM OBLICIMA OMETENOSTI

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**Uvod.** Nivo uključenosti, odnosno inkluzija, učenika sa različitim oblicima ometenosti razlikuje se širom Evrope, ali sve više postaje redovna praksa u mnogim zemljama, pa tako i kod nas. Kada se radi o inkluziji u oblasti fizičkog vaspitanja i školskom sportu, nailazimo na zaključke da je ova praksa u razvoju, pa su i radovi iz ove oblasti još uvek oskudni po broju i sadržaju bez obzira što je tema uvek aktuelna. Fizičko vaspitanje i sport na najbolji način kod dece izgrađuje samopouzdanje, osećaj sigurnosti, emocionalnu kontrolu, uspešan razvoj psihomotornih funkcija, ali samo primenjeno u skladu sa sposobnostima i mogućnostima svakog učenika. Kada u odeljenje redovne škole, na čas fizičkog vaspitanja, dođe dete sa nekim od oblika ometenosti neretko se dešava da nastavnik fizičkog vaspitanja nailazi na problem. Zbog toga je cilj našeg rada da ukažemo na neke od najčešćih problema sa kojima se susreću svi edukatori koji rade sa decom sa invaliditetom bilo da se radi o izvođenju nastave fizičkog vaspitanja ili o školskom sportu u specijalnoj, a pre svega u redovnoj školi.

**Metod.** Istraživanje je obavljeno tekuće 2009. godine u specijalnim i redovnim osnovnim školama na teritoriji Beograda, analizirajući probleme, mogućnosti i teškoće nastavnika i samih učenika u realizaciji fizičkog vaspitanja.

**Rezultati.** U skladu sa rezultatima sprovedenog istraživanja dati su predlozi za prevazilaženje problema i postizanje što produktivnijeg rada kod dece sa mentalnom retardacijom, sa autizmom, cerebralnom paralizom, oštećenjem vida, oštećenjem sluha, poteškoćama u učenju, multiplom sklerozom, poremećajima u ponašanju i hiperaktivnom decom.

**Zaključak.** Rad sa ovim učenicima pored posedovanja elementarnih znanja zahteva i edukaciju, adekvatnu stručnu pomoć i podršku, kako bi sam proces inkluzije u oblasti fizičkog vaspitanja tekao što brže i bolje. Fizičko vaspitanje predstavlja preduslov za uključivanje u sportske aktivnosti kao jednim od najboljih vidova socijalizacije ovih osoba.

## IMPORTANT ASSUMPTIONS RELATED TO PHYSICAL EDUCATION OF CHILDREN WITH DIFFERENT KINDS OF DISABILITIES

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**Introduction.** Level of inclusion, of students with different kinds of disabilities, is different across Europe but it's starting to be regular practice in many countries as well as in our country. When we talk about inclusion in field of physical education, we can find conclusions that this field is in development and that papers in this field are very poor in number regardless of very popular topic. Through physical education and sport children develop self-confidence, feeling of stability, emotional control, and successful development of psychomotor functions but only if applied in harmony with abilities of every single student. When in a regular school class, a child with any kind of disability comes, it often results as a problem for P.E teacher. This is why the goal of our paper is to indicate some of most often problems encountered by all the educators who work with children with disabilities in both special and regular schools.

**Method.** The research was conducted in 2009 in both special and regular elementary schools at the territory of Belgrade, by analyzing problems, possibilities and difficulties of both teachers and students in realization of PE classes.

**Results.** In compliance with the results of the conducted research the proposals were provided for overcoming the problems and achieving productive work with children with mental retardation, children with autism, cerebral paralysis, damaged eyesight, impairment, difficulties with studying, multiple sclerosis, disturbances in behavior and hyperactive children.

**Conclusion.** However, work with these students, besides possessing of elementary knowledge, requires also education, adequate expert help and support so that the process of inclusion in the field of physical education proceeds in the best way. Physical education is a prerequisite for including in sport activates as one of the best ways of socialization of these persons.

## **SPECIFIČNOSTI OBUČAVANJA TEHNIKE BACANJA KOPLJA SA SLABOVIDIM SPORTISTIMA**

**Srdan Jovović**

Asocijacija atletske Srbije, Beograd, Srbija

**Uvod.** Metodika bacanja koplja je sama po sebi jako složena i kompleksna, a u slučaju slepih i slabovidnih je još komplikovanija i zahteva veliku sistematičnost i strpljenje.

**Metod.** U radu je korišten deskriptivni metod, a posebno su istaknute specifičnosti obučavanja tehnike bacanja koplja kod slabovidnih sportista.

**Rezultati.** Metodika obučavanja tehnike bacanja koplja slabovidnih sportista zahteva više pažnje, postupnosti i sistemačnosti, nego što je to slučaj kod sportista bez oštećenja vida. Kod ovih sportista projekcija slike položaja pravilnog izvođenja pokreta pretežno se oslanja na informacije dobijene putem čula dodira i sluha. Posebna pažnja posvećuje se i pojedinim elementima fizičke pripreme, kao na primer koordinaciji.

**Zaključak.** Rad sa slabovidnim sportistima vrlo je zahtevan i iziskuje dosta strpljenja, a proces unapređenja takmičarskog nivoa je sporiji nego kod osoba bez invaliditeta. Usled nedostatka vidnog analizatora, metodski postupak rada sa ovim sportistima dominantno se zasniva na informacijama koje se primaju putem čula dodira i sluha.

## **SPECIFICITY OF TECHNIQUE TEACHING JAVELIN THROWING FOR PURBLIND PERSONS**

**Srdjan Jovovic**

Atheltic Trainers Association of Serbia, Belgrade

**Introduction.** Methodology of javelin throwing is very complex by itself and in the case of purblind athletes is more difficult and requires systematic approach and a lot of patience.

**Method.** The descriptive method is used to describe specificity of teaching techniques javlin throwing for purblind athletes.

**Results.** Methodology of javelin throwing for purblind athletes requires more systematic and gradual or step by step approach then in case of athletes without sight impairment. Projection of correctly performed specific movement image relies on sense of touch or hearing. Developing coordination with purblind athletes is the most important element of physical preparation.

**Conclusion.** Training with purblind athletes is very demanding and requires a lot of patience. Process of developing competitive level is slower than as it is case with athletes without disability. Due to luck of visual analyzer training methodology additionally is based on information that they receive by sense of touch and hearing.

## UČEŠĆE OSOBA SA INVALIDITETOM NA PRVENSTVIMA BEOGRADA U ATLETICI OD 2003. DO 2008. GODINE

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**Uvod.** Društvena integracija osoba sa invaliditetom podrazumeva da aspekt zadovoljavanja potrebe za agonistikom u sportu kroz sistem takmičenja bude prilagođen stepenu invalidnosti. na svim nivoima sportskih takmičenja organizuju se osobe sa telesnim ili intelektualnim poteškoćama čime dokazuju socijalnu i društvenu pripadnost svakodnevnom okruženju.

**Metod.** U ovom istraživanju korištena je istoriografsko-ideografska metoda sa elementima deskriptivne statistike. Predmet istraživanja je analiza biltena prvenstava Beograda u atletici za osobe različitih kategorija invalidnosti, u periodu od 2003. do 2008. godine, a cilj istraživanja je da se utvrdi trend učešća sportista sa invaliditetom.

**Rezultati.** Analizom biltena sa prvenstava Beograda u atletici za osobe sa invaliditetom dobijen je ukupan broj učesnika takmičenja, broj učesnika po kategorijama invalidnosti, kao i broj učesnika po atletskim disciplinama.

**Zaključak.** Rezultati istraživanja govore da je, u periodu od 2003. do 2008. godine, među sportistima sa invaliditetom značajno povećano interesovanje i uključivanje u atletska takmičenja.

## DISABLED INDIVIDUALS PARTICIPATION ON BELGRADE ATHLETICS CHAMPIONSHIPS FROM 2003 TO 2008 YEAR

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**Introduction.** Disabled person social integration implicate that aspect of needs responding for agonism in sport, throughout competition system, have to be adjusted to disability level.

In all sports competition levels disabled individuals with physical or intellectual difficulties are organized, whereby they prove their social relevance to everyday's encompassment.

**Method.** In this study historiographic-ideographic method with elements of descriptive statistics was used. The object of the study was bulletin analysis of Belgrade athletics championships for different disabled individuals categories, including period from 2003 to 2008 year. The aim of the study was to determine participation trend of disabled athletes.

**Results.** Analysing bulletins from Belgrade athletics championships for disabled individuals, total number of participants was obtained, as well as number of participants per disability categories and number of participants per athletics disciplines.

**Conclusion.** In the group of disabled athletes, in the period from 2003 to 2008., there is significant increase of interest and inclusion in athletics competitions.

## KARAKTERISTIKE LIČNOSTI PROFESIONALNIH KOŠARKAŠA I KOŠARKAŠA SA INVALIDITETOM

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**Uvod.** Bavljenje sportom, i uopšte, fizičkom aktivnošću, predstavlja veoma korisno i blagotvorno sredstvo u poboljšavanju života osoba sa invaliditetom. U tom cilju se u Srbiji polako razvija košarka u kolicima. Treneri koji rade sa košarkašima u kolicima imaju veoma malo iskustva u radu sa njima, jer su do sada radili sa košarkašima bez invaliditeta. Da bi bolje radili ovaj posao neophodno je da se treneri što bolje upoznaju sa karakteristikama i sposobnostima košarkaša u kolicima. U tom smislu ova studija razmatra karakteristike ličnosti košarkaša i košarkaša sa invaliditetom.

**Metod.** Na uzorku od 31 profesionalnog košarkaša (grupa G1) i 25 košarkaša u kolicima (grupa G2) primenjen je Katelov 16PF upitnik. Podaci su obrađeni osnovnom deskriptivnom statistikom. Za testiranje značajnosti razlika između grupa primenjen je T – test. U obradi podataka je korišćen statistički program

**Rezultati.** Dobijena je značajna razlika između grupa u pet dimenzija ličnosti: emocionalna stabilnost - nestabilnost (S), dominacija - potčinjavanje (E), surgencija-desurgencija (F), uobrazilja - praktičnost (M) i prepređenost - prostodušnost (N). Košarkaši u kolicima su imali više skorove na dimenzijama M i N, a košarkaši su veće skorove imali na skalama: S, E i F.

**Zaključak.** Košarkaši u kolicima su, u odnosu na profesionalne košarkaše, emocionalno nestabilniji, povučeniji i zavisniji, potišteniji, manje spontani i sentimentalniji. Treneri koji rade sa košarkašima u kolicima treba da prilagode svoje ponašanje i odnos ovim njihovim karakteristikama, tj. da imaju adekvatan pristup i model ponašanja u trenažnim i takmičarskim aktivnostima.

## PERSONALITY OF PROFESSIONAL AND WHEELCHAIR BASKETBALL PLAYERS

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<sup>2</sup> Colege of Sport and Health, Belgrade, Serbia

**Introduction.** Sport and physical activity brings a lot of benefits for disabled people. From this reason, wheelchair basketball in Serbia is developing during last few years. Coaches, who work with wheelchair basketball players, have not a lot of experience in wheelchair basketball. These coaches worked until now with professional basketball players without disabilities. They must be informed about specific characteristics and abilities of wheelchair basketball players. The purpose of this study is was to investigate personality characteristics of professional basketball players and wheelchair basketball players.

**Method.** Participants in this study were thirty-one professional basketball players (group G1) and twenty-five wheelchair basketball players. Cattell 16 PF questionnaire was applied. Data analysis was done with basic descriptive statistics. Significance of differences between two groups was calculated with T – test (paired samples statistics) in program SPSS16.

**Results.** There find a significant difference in five personality scales: emotional stability (C), dominance (E), liveliness (F), abstractedness (M), privateness (N). Wheelchair basketball players had higher scores in scales M and N, and professional basketball players had higher scores in scales S, E and F.

**Conclusion.** Wheelchair basketball players are more affected by feelings, deferential, restrained, abstracted, forthrighted than professional basketball players. Coaches who work with wheelchair basketball players have to adapt their behavior and relationship to these players' characteristics. They must have adequate approach and behavior model in practice and competition.

## ZAINTERESOVANOST SLEPIH I SLABOVIDIH OSOBA ZA BAVLJENJE REKREATIVNIM I SPORTSKIM AKTIVNOSTIMA

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**Uvod.** Posebnu grupu osoba sa invaliditetom čine slepe i slabovide osobe. Čovek prima oko 90 % informacija putem čula vida, što znači da je slepim i slabovidim osobama uskraćen veliki broj informacija iz okruženja. Zato se ovakve osobe često povlače u sebe, a time lišavaju sebe i mnogih životnih sadržaja koji su im još uvek dostupni. Jedna od važnih stvari koje utiču na popravljjanje zdravlja u najširem smislu, kod slepih i slabovidih osoba je bavljenje rekreacijom i sportom.

**Metod.** Cilj istraživanja bio je da se ustanovi zainteresovanost slepih i slabovidih osoba za bavljenje rekreativnim i sportskim aktivnostima, kao i da se prikupe sugestije i predlozi vezani za rad Beogradskog saveza slepih i slabovidih lica, kako bi se ovaj rad unapredio, a ove osobe dobile veće mogućnosti da se iskažu u rekreaciji i sportu. Sa tim ciljem sprovedena je anketa sa 65 slepih i slabovidih osoba (42 ispitanika muškog i 23 ženskog pola; od toga 12 mladih do 20 godina, 30 odraslih od 20-50 godina i 23 ispitanika preko 50 godina).

**Rezultati.** Rezultati istraživanja govore da se 19 osoba (29% anketiranih) bave rekreacijom i sportom, ali samo 10 njih to čini redovno nekoliko puta nedeljno (15% anketiranih). Radom Saveza je zadovoljan veliki broj anketiranih (74%), ali je najveći broj anketiranih takođe imao i predloge za unapređenje rada (79%).

**Zaključak:** Učešće slepih i slabovidih osoba u rekreativnim i sportskim aktivnostima nije na zadovoljavajućem nivou. Predlozi za unapređenje od strane samih slepih i slabovidih osoba sugerišu da bi trebalo organizovati veći broj izleta i nabaviti veći broj specijalnih rekvizita za ovu kategoriju invalida (zvučne lopte, tandem bicikli koje bi u paru vozile osoba koja vidi i slabovida ili slepa osoba).

## INTEREST OF THE BLIND AND IMPAIRED VISION PERSONS FOR ENGAGING IN RECREATIONAL AND SPORTS ACTIVITIES

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**Introduction.** A special group of disabled persons are blind and impaired vision persons. A man receives about 90% of information by sight, which means that blind and impaired vision persons are denied a great deal of surrounding information. That is why such persons often withdraw and therefore deprive themselves of many life contents which are still available to them. One of the important things influencing health improvement in the broadest sense, with the blind and impaired vision persons is practice of recreation and sport.

**Method.** The aim of the research is to establish interest of the blind and impaired vision persons in recreational and sports activities, as well as to gather suggestions and proposals regarding the activities of the Belgrade Association of blind and impaired vision persons, in order to promote this work and to provide greater possibilities for such persons to express themselves in recreation and sport. Therefore a questionnaire was administered with 65 blind and impaired vision persons (42 males and 23 females; out of which 12 up to the age of 20, 30 adults from 20-50 and 23 respondents over the age of 50).

**Results.** The research results indicate that 19 persons (29% of the respondents) are engaged in recreation and sport, but only 10 of them do it regularly several times a week (15% of the respondents). Great number of the respondents is satisfied with the activities of the Association (74%), but the majority of the respondents also had suggestions for work promotion (79%).

**Conclusion.** The participation of blind and impaired vision persons in recreational and sports activities is not on a satisfactory level. The proposals for promotion by the blind and impaired vision persons themselves suggest that greater number of excursions should be organized and greater number of special equipment for this category of the disabled should be provided (sound balls, tandem bicycle ridden in pairs by well sight person and an impaired vision or blind person).

## RODNE ULOGE U KONTEKSTU BORILAČKIH VJEŠTINA

**Jelena Ilić**

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**Uvod.** Rodna uloga je jedna od najistaknutijih i najuočljivijih uloga, jer ni jedna druga uloga ne određuje u većoj mjeri ponašanje, aktivnosti, obaveze, interesovanja, karakteristike ličnosti, stavove, vrijednosti neke osobe. Ona se usvaja procesima socijalizacije u porodici, ali i kroz druge agense socijalizacije: obrazovanje, sport, posao, itd. Cilj našeg istraživanja je bio da ustanovimo da li postoji razlika u usvojenosti različitih rodni uloga između sportista i sportistkinja koji se bave borilačkim vještinama. Naša pretpostavka je bila da će kod sportista preovladavati maskulina, a kod sportistkinja androgina rodna uloga, te da će ispitanici koji usvoje androginu rodnu ulogu sebi pripisivati više socijalno poželjnih, a manje socijalno nepoželjnih osobina ličnosti.

**Metod.** U ispitivanju je korištena Beogradska revizija instrumenta BSRI, a ispitivanjem su bili obuhvaćeni slijedeći sportovi: karate, džudo i kjokušinkai. Za analizu podataka je korišten t-test za nezavisne uzorke.

**Rezultati.** Na uzorku od 93 ispitanika dobili smo da je kod sportista najusvojenija androgina, a kod sportistkinja neizdiferencirana rodna uloga. Takođe, sportisti su postizali veće skorove na skali maskuliniteta, a sportistkinje na skali socijalno poželjnih osobina. Utvrdili smo i da skorovi na skalama maskuliniteta i femininosti pozitivno koreliraju sa skalom socijalno poželjnih osobina.

**Zaključak.** Iako u našem istraživanju nisu potvrđeni rezultati prethodnih istraživanja u pogledu usvojenosti rodni uloga u populaciji sportista, ipak možemo reći da je njime potvrđen značaj sporta kao važnog agensa socijalizacije koji pozitivno utiče na razvoj ličnosti, ali i povezanosti i značaja koji koncept androginiteta ima u sportu.

## GENDER ROLES AND MARTIAL ARTS

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**Introduction.** Gender role is the one of the most important and the most obvious social roles because there is no other role which better defines behaviour, activities, duties, interests, personal traits, personal values. It is being adopted not only by processes of socialisation in family, but also with assistance of other agencies of socialisation: education, job, sports. The aim of our research is to find out if there is the difference in adoption of gender roles between males and females in martial arts. We presumed that males are mostly going to adopt masculine gender role, and females are mostly going to adopt androgynous gender role, and that athletes who adopt androgynous gender role are going to assign to themselves more socially appreciated and less socially undesirable personal attributes.

**Method.** In our research we used Belgrade revision of BSRI. Our sample include athletes from following martial arts: judo, karate and kyokushinkai. Data were analysed by t-test for independent samples.

**Results.** On the sample of 93 athletes, we found that androgynous gender role is the most adopted by male athletes and the most adopted gender role by female athletes is the undifferentiated one. We also found that scores at scales of masculinity and femininity are positively correlated with results on the scale of socially undesirable personal attributes.

**Conclusion.** Although our results doesn't confirm the results of previous researches, we still might say that they confirmed importance of sports as important part of socialisation which positively affects on personal growth, and also confirm importance of implications of concept of androgyny on domain of sports.

## MAČEVANJE - PRVI BORILAČKI SPORT SRPSKOGA NARODA

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**Uvod.** Petovekovna porobljenost srpskoga naroda pod Otomanskom imperijom, nametnula je da se fizičko vaspitanje prvo pojavi u obliku borenja. Vekovne patnje Srba dovode borilačke veštine u prvi plan, kako kroz organizovanu nastavu u školama, tako i kroz samoinicijativno vežbanje u domaćinstvima.

**Metod.** U radu je primenjen istorijski metod, koji podrazumeva pronalaženje i prikupljanje primarnih i sekundarnih izvora o predmetu i problemu istraživanja, povezivanje izučavanih pojava, otkrivanje uzročno posledičnih veza među njima i donošenje naučnih zaključaka.

**Rezultati.** Organizovana nastava borenja u obliku mačevanja počela je još u vreme Prvog srpskog ustanka, pa već druga generacija Velike škole, koju 1808. godine otvara Dositej Obradović, kao jedan od predmeta ima fehtovanje (mačevanje) sabljama. Poseban značaj za razvoj mačevanja u Srbiji imao je dolazak belgijskog mačevaoca Šarla Dusea za profesora borenja na Vojnoj akademiji 1889. godine, kao i osnivanje Boračkog društva „Srpski mač“ 1897. u Beogradu.

**Zaključak.** Može se zaključiti da je mačevanje najstarija borilačka veština koja se organizovano vežba kod Srba. Mada mačevanje ima dugu tradiciju, tek 28. 04. 1928. godine osniva se Jugoslovenski mačevalački savez. Danas, 112 godina nakon osnivanja prvog mačevalačkog kluba, Mačevalački savez Srbije broji šesnaest klubova.

## FENCING – FIRST MARTIAL ART OF THE SERBIAN PEOPLE

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**Introduction.** Five centuries under the rule of the Ottoman Empire imposed physical culture in Serbian people to be first introduced as the art of fighting.

Many centuries of suffering of the Serbian people had put martial arts (fighting skills) in the first plan, through organized teaching in schools and self-teaching at home.

**Method.** Historical method was applied while working on this project. It includes finding and gathering primary and secondary information about the problem in perspective, linking the scientific data and determining the causality between them, and also making scientific conclusions/

**Results.** Organized martial art teaching programs which included only fencing at the time, began in the period of the “First Serbian Rebellion”. As the result of that practice the second generation of students in the “Great School” which was established in 1808. by Dositej Obradovic, had “fehting” (fencing) as one of the subjects. Special recognition for developing and promoting fencing in Serbia goes to Belgian fencing master Charles Dusseau which was pointed professor of fighting skills at the “Serbian Military Academy” in 1889. Also, great contribution in promoting fencing in Serbia is attributed to “Fencing Society – Serbian Sword” founded in 1897. in Belgrade.

**Conclusion.** It can be positively concluded that fencing is the oldest martial art which was organized and taught in Serbian people. Although fencing has a long tradition it wasn't until 28<sup>th</sup> of May 1928. that the “Yugoslavian Fencing Association” was established. Today, one hundred and twelve years after the establishment of the first fencing club, “Fencing Association of Serbia” counts 16 fencing clubs.



## **DRAGOMIR NIKOLAJEVIĆ OSNIVAČ ENGLESKOG I FRANCUSKOG BOKSA U SRBIJI**

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**Uvod.** Pesničenje, nakon stare Grčke i Rima, posredstvom rimskih legionara, dolazi u Englesku, u kojoj je pesničenje postalo boks, gde postaje sport i dobija današnji oblik. Savate ili francuski boks se pojavljuje u Francuskoj još u 16. veku, ali za prvog učitelja uzima se Michel Pisseux koji u prvoj polovini XIX veka obučava Parižane savateu.

**Metod.** Osnovni cilj rada je da istraži i sistematizuje činjenice vezane za nastanak i početak razvoja engleskog i francuskog boksa u Srbiji. U radu je korišćen istorijski metod, a posebna pažnja posvećena je prikupljanju i kritičkoj analizi izvora, vezanih za predmet istraživanja, koji se odnose na period prve decenije 20–og veka.

**Rezultati.** Godine 1904. artiljerijski kapetan Dragomir T. Nikolajević, nakon povratku u Srbiju sa školovanja u Francuskoj, gde je u Vojnoj školi Joinville Le Pont pohađao nastavu u koju je uključena i obuka u savateu (francuski boks) i engleskom (klasični boks), počinje da realizuje obuku engleskog i francuskog boksa. Ove dve vrste boksa ravnomerno se razvijaju do početka prvog svetskog rata.

**Zaključak.** Počeci boksa i savatea na prostorima Srbije vezani su za povratak artiljerijskog kapetana Dragomira T. Nikolajevića sa školovanja u Francuskoj. Dinamičnost ova dva sporta, kao i vrlo naglašeno interesovanje Srba za sve oblike borenja, doprineli su njihovoj snažnoj ekspanziji u Srbiji, kako u pogledu masovnosti, tako i u pogledu sportskih rezultata na međunarodnoj sceni.

## **DRAGOMIR NIKOLAJEVIC – THE FOUNDER OF ENGLISH AND FRENCH BOXING IN SERBIA**

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**Introduction.** After Ancient Greeks and Romans, Roman Legionaries brought fist-fighting into England, where it became boxing and it was developed into the modern form of sport as it is nowadays. As Savate. French boxing, is believed that its beginnings were back in the 16<sup>th</sup> century, still Michel Pisseux, who trained Parisians French boxing in the first part of the 19 century was claimed to be the first teacher of Savate.

**Methods.** Main goal of this project is to research and systematize facts related to the beginnings and development of English and French boxing in Serbia in period of the first decade of the 20<sup>th</sup> century. Historical Method is used during research with focus on collecting and critical analyzing resources related to the researched issue.

**Results.** An Ordnance Captain Dragmir T. Nikolajevic, came back from France where he attended Military School (Joinville Le Point) which included Savate (French Boxing) and English Boxing (Classic Boxing). In 1904 he started training English and French Boxing in Serbia. Both kind of boxing were equally developed from the beginning of the First World War.

**Conclusion.** Beginnings of boxing in the region of Serbia are related to the Ordnance Captain Dragomir T. Nikolajevic who implemented and introduced French and English boxing knowledge he achieved in French Military School. Both of these sports dynamics and strongly underlined interest of Serbs for these kinds of fighting resulted their expansion in Serbia in the mass public response as well as in sport result achievements on international boxing scene.

## RAZVOJ VOJNOG SPORTA REPUBLIKE SRBIJE OD 2007. DO 2009. GODINE

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**Uvod.** CISM (Conseil International du Sport Militaire) je neprofitabilna organizacija čiji je cilj da promoviše fizičko vaspitanje i sportske događaje, obezbeđuje uzajamnu tehničku pomoć i pomaže siromašnijim članicama u ime prijateljstva i solidarnosti. Moto ove sportske vojne organizacije je „Prijateljstvo kroz sport“ (“Friendship through sport”), odnosno uspostavljanje globalnog mira kroz sport. Republika Srbija je primljena u članstvo ove organizacije kao njena punopravna 127. članica u maju 2003. godine.

**Metod.** U ovom preglednom istraživanju primenjeni su istorijsko-komparativni i deskriptivni metod. Analizirani su nastupi i rezultati oficira, podoficira, studenta i vojnika Vojske Republike Srbije (331 pripadnik, starosti  $30 \pm 5$  godina) reprezentativnog takmičarskog ranga u disciplinama: vojni višeboj, streljaštvo, padobrans-tvo, džudo, orijentiring, atletika, futsal, košarka, odbojka, jedrenje, veslanje, mačevanje, slalom i veleslalom.

**Rezultati.** Od ukupno 61 sportske aktivnosti koje su planirane i održane u periodu od 2003. do 2009. godine, za prvih 4. godine održano je 33 sportske aktivnosti, a za poslednje 2. godine 28 sportskih aktivnosti. Možemo konstatovati da je Vojska Republike Srbije imala znatno više učestvovanja na takmičenjima i stručnim kongresima i to je pokazatelj napretka u organizaciji rada koje je u nadležnosti kancelarije za vezu sa CISM.

**Zaključak.** Prikazano je sveukupno učešće i uspeh sportista Vojske Republike Srbije unutar Međunarodnog saveta za vojne sportove (CISM), koji su predstavljali Vojsku Republike Srbije na „4. Vojnoj Olimpijadi“ održanoj u Indiji (14.-21.10.2007. godine) zaključno sa realizacijom svih takmičenja u 2009. godini.

## DEVELOPMENT OF MILITARY SPORTS REPUBLIC OF SERBIA FROM 2007. TO 2009. YEAR

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**Introduction.** CISM (Conseil International du Sport Militaire) is a non-profit organization whose goal is to promote physical education and sporting events, provide mutual technical assistance and assist poorer members in the name of friendship and solidarity. Motto of the military sports organization is “Friendship through sport”, or the establishment of global peace through sport as a factor. Republic of Serbia was admitted to membership of the Organization as its 127th full members in May 2003.

**Method.** Historical-comparative and descriptive method was used in this review study. Sport activities and results of officers, NCOs, students and soldiers of the Army of the Republic of Serbia (331 members, age  $30 \pm 5$  years) representative in the competition ranking was analyzed in disciplines: military-pentathlon, shooting, parachuting, judo, orienteering, athletics, futsal, basketball, volleyball, sailing, rowing, fencing, slalom and giant slalom.

**Results.** Of the total 61 sports activities held in the period since 2003 until 2009 for the first four years was held 33 sports activities, and for the last two 28 sports activities. Participation in competitions and many professional congresses is doubled as the result of progress in the organization of liaison offices with the CISM.

**Conclusion.** They shoes all sports participation and success of the Army of the Republic of Serbia is demonstrated within the International Council for military sports (CISM) who represented the Army of the Republic of Serbia on the “4th Military Olympics” held in India (14<sup>th</sup> October 2007 to 21<sup>st</sup> October 2007) ending with the realization in all competitions in 2009.

## NEINVAZIVNO ODREĐIVANJE DEFORMACIJA U HRSKAVICI KOLENA PRI SKOKU NA PLATFORMU ZA MERENJE SILE

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**Uvod.** Kompjuterske tehnologije i kompjuterska biomehanika postaju sve popularnije u dijagnostici i analitici sportskih nauka, kao i u svakodnevnom treningu sportista. Cilj ovog istraživanja je bio da se utvrdi na neinvazivan način deformacija hrskavice kolena kod sportiste prilikom skoka na platformu za merenje sile.

**Metod.** Urađen je niz eksperimenata na platformi za merenje sile sa našom vrhunskom atletičarkom Oliverom Jevtić korišćenjem ultrabrze kamere i kompjuterskog sistema sa softverom koji je specifično razvijen za ovu namenu. Za obradu slika je korišćen algoritam za prepoznavanje boja. Upotrebljen je prvo pojednostavljeni model masa-opruga-prigušenje za određivanje globalne sile i momenta na koleno. Razvijen je poseban softver za fitovanje spregnutih parametara kod ovog modela. Dobijeni rezultati su bili ulaz za složenu trodimenzionalnu analizu računanja deformacija hrskavice kolena metodom konačnih elemenata.

**Rezultati.** Rezultati kompjuterske simulacije su poređeni sa prosečno merenom silom na platformi. Početni rezultati su pokazali potpuno trodimenzionalni raspored deformacija unutar zapremine hrskavice kolena. Prosečna maksimalna sila je određena preko mernog sistema odskočne platforme i rešavanjem jednodimenzionog sistema jednačina. Trodimenzione deformacije hrskavice kolena za prosečnu maksimalnu silu od 166 N su fitovana sa Jangovim modulom elastičnosti od  $E = 4.5 \times 10^3$  [N/m<sup>2</sup>] i hidrauličnom provodljivosti od  $K_f = 2.2 \times 10^9$ .

**Zaključak.** Kombinacija tehnologije prepoznavanja slika, merenja sila sa platforme, i metode konačnih elemenata u određivanju deformacija hrskavice kolena može biti korišćeno u budućnosti kao neinvazivni alat za predviđanje povreda kod sportista. Takođe su ova istraživanja značajna za ispitivanje modela i karakteristika sportske obuće.

## NONINVASIVE DETERMINATION OF DEFORMATION IN THE KNEE CARTILAGE DURING JUMPING ON THE FORCE PLATE

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**Introduction.** Computer technologies and computational biomechanics becomes very popular in diagnostics and analytics of sport science as well as in every day sports training. The aim of this research was to investigate in a noninvasive manner the deformation in the knee cartilage during athlete's jumping on a force plate.

**Method.** A set of experiments on the force plate with high level athlete professional Olivera Jevtic using high-speed video camera system and our in-house software were applied. The image processing was performed on each video slice using a color recognition algorithm. A simplified mass-spring-damper model for determination of global force and moment on the knee was used. A specific software for fitting the coupling characteristics was developed. Simulated results were used as input data for the finite element calculation of cartilage deformation in the athlete's knee.

**Results.** Computer simulation was compared with the average experimental ground force. The initial results have shown the three-dimensional mechanical deformation distribution inside the cartilage volume. The average peak force was determined from the ground reaction force measured on the force plate and solving a one-dimensional system of equations. Three-dimensional cartilage deformation for the average peak force of 166 N was fitted with Young modulus of elasticity  $E = 4.5 \times 10^3$  [N/m<sup>2</sup>] and hydraulic permeability  $K_f = 2.2 \times 10^9$ .

**Conclusion.** Combination of the image recognition technology, force plate measurement and the finite element cartilage deformation in the knee may be used in future as an effective noninvasive tool for prediction of the sportsman injury. It is also important for investigation of sports shoes models and their different characteristics.

## PRIMENA IZOKINETIČKE DINAMOMETRIJE U PROCENI MIŠIĆNE JAČINE SPORTISTA NAKON POVREDA KOLENA

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**Uvod.** Povrede kolena spadaju u najčešće povrede u sportu, a neretko se nakon takvih povreda javlja dilema da li je neophodno i kada najranije operisati nastalu leziju. Bilo da se pristupi operativnom ili konzervativnom lečenju, važno je proceniti funkcionalnost kolena. U tim procenama retko se koristi dinamometrija iako procena mišićne jačine predstavlja važan funkcionalni pokazatelj. Uključivanjem izokinetičke dinamometrije u preoperativne protokole omogućilo bi svestranije sagledavanje funkcionalnog stanja, odnosno olakšalo donošenje odluka na koji način povredu dalje tretirati. Cilj ove studije je da se ispita primenljivost izokinetičke dinamometrije, odnosno pri kojim ugaonim brzinama vršiti odgovarajuća merenja.

**Metod.** Testirano je 14 ispitanika (profesionalnih sportista) sa akutnom povredom kolena (starost 24±6 god., TV 1,81±0,05m, TM 81±9kg). Mišićne jačina ekstenzora i fleksora testirane su pri ugaonim brzinama od 0°/s (izometrija), 60°/s, 120°/s i 180°/s. Kao varijable od značaja za istraživani problem odabrane su relativne razlike (Diff%) i odnosi jačine fleksora i ekstenzora (HQ) povređene i zdrave noge.

**Rezultati.** Dobijeni rezultati ukazuju na to da HQ odnos raste za povećanjem ugaone brzine, pri čemu je veći kod povređene noge (slabost ekstenzora). Značajne razlike ( $p > 0.05$ ) u HQ odnosima dobijene su pri malim ugaonim brzinama (0°/s i 60°/s). Relativne razlike u jačini između povređene i zdrave noge su manje od 20%; i najveće su pri malim ugaonim brzinama, a sa povećanjem ugaone brzine se smanjuju.

**Zaključak.** Relativne razlike jačina i HQ odnosi pri malim ugaonim brzinama (0°/s i 60°/s) mogu poslužiti za procenu narušene funkcionalnosti kolena. Dobijeni rezultati predstavljaju osnov da se nakon operacije, preoperativne jačine i skorovi koriste kao kontrolne vrednosti, a ne one dobijene na prvom kontrolnom merenju nakon operacije, jer je u toj fazi evidentan pad u mišićnoj jačini i kod neoperisane noge. Dobijene rezultate bi trebalo proveriti na većem broju ispitanika, i u odnosu na vrstu dijagnostikovane povrede.

## ISOKINETIC MUSCLE STRENGTH ASSESSMENT IN PROFESSIONAL ATHLETES WITH KNEE INJURY

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**Introduction.** Knee injuries are among most frequent in sport, and often there is a dilemma should they be treated surgically, and if so, how early can surgery be performed. Whether they are treated surgically or conservatively, it is important to perform functional assessment of both knees. Dynamometry is rarely used, even though muscle strength is an important indicator of knee functionality. Inclusion of isokinetic dynamometry in preoperative protocols would enable overall assessment of functional status, and help make decisions regarding further treatment of injury. The aim of this study was to examine the applicability of isokinetic dynamometry, i.e. which angular velocity is the most appropriate for some measurements.

**Method.** 14 subjects (professional athletes) with acute knee injury were tested (age 24±6 yrs., Height 1.81±0.05 m, Weight 81±9kg). Knee extensors and flexors muscle strength was tested under the angular velocities of 0°/s (isometric), 60°/s, 120°/s and 180°/s. The variables are the relative difference (%Diff), and hamstring to quadriceps strength ratio (HQ) of the injured and healthy leg.

**Results.** The results indicate that as the angular velocity increases the HQ ratio increases too, with higher values for the injured leg (quadriceps weakness). Significant differences ( $p > 0.05$ ) in HQ ratio were obtained at 0°/s and 60°/s. Relative differences between injured and healthy leg are less than 20%, with highest values at low angular velocities, and a decrease with greater angular velocity.

**Conclusion.** Differences and HQ ratios obtained at 0°/s and 60°/s can be used for knee function assessment. Acquired results indicate that preoperative strength results before surgery can be used as control values, and not the results obtained at the first measurement postoperatively because it is evident that muscle strength decreases in healthy leg, too. The obtained results should be tested on a larger sample, and in relation to the type of injury diagnosed.

## ALGORITAM PROGRAMA FIZIČKE AKTIVNOSTI OBOLELIH OD MYASTHENIAE GRAVIS

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**Uvod.** Myasthenia gravis (MG), bolest neuromišićne spojnice, spada u grupu autoimunih bolesti, a manifestuje se slabošću i brzim zamorom muskulature. U medicinskoj praksi se leči skoro isključivo medikamentozno i/ili hirurški. Cilj istraživanja je ispitati stepen potrebe za fizičkom aktivnošću kao dodatnom terapijom i u skladu s tim odrediti algoritam programa fizičke aktivnosti obolelih od MG.

**Metod.** Analizom dosadašnjih istraživanja ispitana je moguća štetnost dugotrajne medikamentozne terapije, čime se ukazuje potreba sprovođenja individualnih programa fizičke aktivnosti, kao dodatne terapije.

**Rezultati.** Utvrđeno je na osnovu dosadašnjih istraživanja da dugotrajna terapija kortikosteroidima, najčešće, dovodi do pojave osteoporoze, pada imuniteta, gojaznosti i drugih posledica lečenja.

**Zaključak.** Algoritam programa fizičke aktivnosti bi trebao da osim dijagnostičkih postupaka za utvrđivanje stepena i vrste MG obuhvati i strogo individualni program fizičke aktivnosti usmeren na održavanje opšte fizičke kondicije (aerobnih sposobnosti), smanjenje uticaja osteoporoze izazvane upotrebom kortikosteroida i poboljšanja psihosocijalnog stanja bolesnika.

## ALGORITHM OF PHYSICAL ACTIVITY PROGRAM OF PATIENTS WITH MYASTHENIA GRAVIS

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**Introduction.** Myasthenia gravis (MG), is a disease of neuromuscular junction and it belongs to a group of autoimmune disorders, manifested with weakness and fast musculature fatigue. In medical practice myasthenia is treated almost exclusively with drugs or/and surgically. The aim of the paper is to examine the level of necessity for physical activity as an additional treatment and therefore to determine algorithm of physical activity program of patients with MG.

**Method.** By the analysis of the researches up to date, possible harms of long termed drug therapy were examined, with an indicated necessity to implement individual programs of physical activities, as an additional therapy.

**Results.** Based on the previous researches it was established that long lasting therapy with corticosteroids, most often leads to osteoporosis, immunity fall, obesity and other consequences of treatment.

**Conclusion.** The algorithm of physical activity program should, besides diagnostic procedures for determination of the level and type of MG, also include a strict individual program of physical activity directed to maintenance of general physical fitness (aerobic abilities), reduction of influence of osteoporosis caused by administration of corticosteroids and improvement of psycho-social status of the patient.

## SUPLEMENTACIJA ANTIOKSIDANSIMA U SPORTU

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**Uvod.** Nema sumnje da intenzivno fizičko vežbanje povećava produkciju reaktivnih vrsta kiseonika i azota (RONS). Organizam čoveka razvija antioksidativnu odbranu koju čine endogeni deo - glutation i enzimi, dok egzogeni deo čine neke hranljive materije. Glavni antioksidansi u ishrani su vitamini C, E i beta-karoten. Smatra se da disbalans produkovanih RONS i antioksidativne odbrane dovodi do oksidativnog stresa. Oksidativni stres dovodi do peroksidacije lipida ćelijskih membrana, mišićnog oštećenja i razvoja zapaljenske reakcije u mišićnom tkivu. Pitanje koje je već dugo prisutno je da li snažno fizičko vežbanje povećava potrebu za antioksidansima u ishrani?

**Metod.** Pregled radova od 1990-2009. dostupnih na *Medline*.

**Rezultati.** Rezultati istraživanja suplementacije vitaminima C i E još uvek su kontradiktorni. Nameće se stav da suplementacija ovim vitaminima neće imati ergogeni efekat. Nije se ispoljila pravilnost po kojoj će suplementacija jednim ili kombinacijom ova dva vitamina uvek uzrokovati signifikantne promene markera lipidne peroksidacije ili mišićnog oštećenja. Dugotrajan nedovoljan dijetni unos ovih vitamina nije bio obavezno praćen porastom pokazatelja oksidativnog stresa. Dvosmislenost dobijenih istraživanja pripisuje se metodološkim greškama i neusaglašenosti u istraživanjima. Neke od njih su vezane za razlike u karakteristikama ispitanika, različito doziranje primenjenih suplemenata, kao i antioksidativnom statusu ispitanika. Pouzdanost dobijenih rezultata uslovljena je vremenom uzimanja biološkog uzorka, brzinom obnove mišića i promenama u imunom odgovoru. Neki autori su postavili pitanje štetnosti dugotrajnog dodatnog unosa ovih suplemenata.

**Zaključak.** U velikom broju istraživanja ističe se značaj dobro balansirane ishrane i adekvatne zastupljenosti antioksidanasa. Smatra se da je opravdana suplementacija antioksidansima koja je dozirana u skladu sa preporučenim dnevnim unosom (DRI) nutrienata.

## ANTIOXIDANTS SUPPLEMENTATION IN SPORT

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**Introduction.** There is no doubt that intensive physical exercising increases the production of reactive oxygen and nitrogen species (RONS). Human body develops antioxidative defense which consists of the endogenous part - glutathione and enzymes, while the exogenous part consists of certain nutrients. The main antioxidants in the diet are vitamins C, E and beta-carotene. It is believed that imbalance of the produced RONS and antioxidant defense leads to oxidative stress. Oxidative stress leads to cell membrane lipids peroxidation, muscle damage and development of inflammatory reactions in muscle tissue. The question that has long been present is whether strong physical exercising increases the need for antioxidants in the diet?

**Method.** A review of articles from 1990-2009. available on *Medline*.

**Results.** The results of the study of supplementation with vitamins C and E are still contradictory. The attitude is imposed that supplementation with these vitamins shall not produce ergogenous effect. No regularity was manifested that supplementation with one or a combination of these two vitamins shall always cause significant changes in markers of lipid peroxidation or muscular damage. Long lasting insufficient diet intake of these vitamins was not necessarily accompanied by increased oxidative stress indicators. The ambiguity of the obtained studies is attributed to methodological errors and disparateness in researches. Some of them refer to differences in the characteristics of the respondents, different dosing of the administered supplements or antioxidant status of subjects. Reliability of results is conditioned by time of biological sampling, the speed of muscle recuperation and changes in the immune response. Some authors have made a question of the hazards from long-term additional input of these supplements.

**Conclusion.** A large number of research highlights the importance of a well balanced diet and adequate representation of antioxidants. It is considered that antioxidants supplementation is justifiable when it is dozed in compliance with the dietary reference intake (DRI) of nutrients.

## ACCESS TO TRAINING SESSION METHODOLOGY AT PEOPLE WITH ANOREXY

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**Introduction.** Anorexy is the mental problem of the own body perception when the ill person maintains the body weight at subminimal level. To be able to train, the person must not have heavier medical problems and anorexy must not be a chronic disease.

**Method.** The groups at risk are teenagers, metrosexuals and sportsmen. The recommended elements of gymnastics are breathing exercises, stretching, aerobic exercises, elements of simple sports games, easy walks in nature.

**Results.** The aim of gymnastics is to prepare the total body condition regarding the level of complete satisfaction, cardiovascular and pulmonary functions and digestive tract.

**Conclusion.** During the two-year period of practical experience in preparing and performing the programs of training for persons who have long period of nutrition disorder monitoring and examining them we have come to certain conclusions. These conclusions need not be scientifically proved facts however they can serve as a small segment of broader examinations. Anyhow it must be pointed out that there is no unique, the best and equally successful approach to preparation of training process but only the basic postulates that have to be adapted to individuals and to the disorder rate. Recovery is a long term process.

## PRISTUP METODOLOGIJI TRENINGA KOD OSOBA SA ANOREKSIJOM

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**Uvod.** Anoreksija je mentalni problem percepcije sopstvenog tela kada bolesna osoba održava telesnu težinu ispod minimalnog nivoa. Kako bi mogla da trenira, takva osoba ne sme da ima teže medicinske probleme, a anoreksija ne sme biti hronična bolest.

**Metod.** Rizične grupe su tinejdžeri, metroseksualci i sportisti. Preporučeni elementi vežbanja su vežbe disanja, istezanje, aerobno vežbanje, osnove jednostavnih sportskih igara, laka šetnja u prirodi.

**Rezultati.** Cilj vežbanja je da se razvije ukupna telesna kondicija u pogledu nivoa ukupnog zadovoljenja kardio-vaskularnih i pulmonarnih funkcija i digestivnog trakta.

**Zaključak.** U toku dvogodišnjeg perioda praćenja i ispitivanje praktičnog iskustva u pripremanju i izvođenju trenažnih programa za osobe koje imaju duge periode poremećaja ishrane došlo se do izvesnih zaključaka. Ovi zaključci možda nisu naučno dokazane činjenice, ali ipak mogu služiti kao mali segment šireg ispitivanja. U svakom slučaju mora se istaći da nema jedinstvenog, najboljeg i podjednako uspešnog pristupa pripremi trenažnog procesa, već postoje samo osnovni postulati koje treba prilagoditi pojedincima i stepenu poremećaja. Oporavak je dugotrajan proces.

## FIZIČKO VEŽBANJE U PREVENCIJI RAKA DOJKE I PROSTATE

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**Uvod.** Rezultati brojnih epidemioloških studija koji su objavljeni u protekle dve decenije ukazuju na značajno smanjenje rizika obolevanja od raka dojke i prostate, kako kod profesionalnih sportista, tako i kod osoba koje su se rekreativno bavile fizičkim vežbanjem. Sa druge strane, epidemiološka ispitivanja su pokazala da je procenat obolelih od raka dojke i prostate znatno manji kod HIV pacijenata nego u opštoj populaciji. Molekularni mehanizam na kojima se zasniva protektivna uloga fizičke aktivnosti odnosno HIV infekcije kod ovih malignih obolenja do danas nije poznata.

**Metod.** (i) Poređenje informacionih karakteristika proteina gp120 iz omotača virusa HIV-1 i vazoaktivnog intestinalnog peptide (VIP), (ii) testiranje seruma HIV-pozitivnih osoba i sportista na prisustvo anti-VIP antitela ELISA testom zasnovanim na peptidu NTM.

**Rezultati.** Pokazano je da serumi osoba koje se intenzivno bave sportom i serumi HIV pacijenata sadrže visok titar prirodnih anti-VIP antitela. S obzirom da VIP i njegovi receptori igraju važnu ulogu u patogenezi raka dojke i prostate, može se pretpostaviti da anti-VIP antitela imaju protektivnu ulogu kod ovih hormon zavisnih tumora.

**Zaključak.** Fizička aktivnost stimuliše prirodna antitela koja sprečavaju dejstvo VIP-a, kao faktora rasta, na maligne ćelije raka dojke i prostate. S toga, fizička aktivnost predstavlja važan protektivni faktor, što bi trebalo primeniti u prevenciji šire populacije od raka dojke i prostate.

## PHYSICAL EXERCISE IN PREVENTION OF BREAST AND PROSTATE CANCER

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**Introduction.** Results of numerous epidemiological studies, which are reported in last two decades, show reduced risk of breast and prostate cancer in well-trained sportsman subjects, as well as in those who perform the regular recreational physical exercise. On the other hand, studies performed in Europe, America and Africa showed that breast and prostate cancer risk is significantly reduced in the HIV-infected population in comparison with the normal population. The molecular mechanisms underlying protective effect of the physical activity and HIV infection on the breast and prostate cancer may serve as a base for development of a new platform for prevention of these two very frequent cancers.

**Method.** (i) Comparison of informational properties of HIV-1 gp120 and vasoactive intestinal peptide (VIP) by the informational spectrum method (ISM); (ii) screening of HIV-positive and HIV-negative sera for natural anti VIP/NTM antibodies by the NTM-based ELISA immunoassay.

**Results.** We showed that the sera from subjects performing the physical exercise, as well as the sera collected from HIV-infected individuals, contain high titer of natural antibodies recognizing VIP and peptide NTM, derived from HIV-1 gp120. Based on these results, we suggest that natural anti-VIP/NTM antibodies contribute to a decrease risk of breast and prostate cancer in physically active people and in HIV-infected individuals by suppression of VIP, which might play a pro/oncogenic function.

**Conclusion.** Physical activity can bust production of natural VIP/NTM-reactive antibodies which contribute to the control of breast and prostate cancer. Accordingly, physical exercise should be considered as an important nontoxic and inexpensive approach for prevention of these two frequent cancers in general population.





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