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DEAR READER,

This issue contains scientific papers written by researchers from 10 countries, with versatile research topics from the field of sports, providing specific value to this journal.

New values are promoted through research results from the areas of sports management, sports training, sports law, sports psychology, sports medicine, sports education and sports marketing.

In each issue, we strive to publish new scientific and professional achievements which represent a requirement for the development of new technologies and processes dictating the efficacy of results which are an indicator of good work and progress.

As in all other issues, we are thankful to our Editorial Board members for their devoted work, promptness and a responsible approach that demands originality and quality of authored works, thereby ensuring the journal's value and recognition. Our Editorial Board is committed to perseverance and promotion of the belief that the development of sports disciplines is only possible through the development of scientific achievements and their implementation in practice.

We are glad that our journal is becoming a platform for the development of scientific thought and creation of new sports systems accompanied by the usage of advanced technology and its application in the field of sports. Continuous changes and novelties in sports disciplines, application and usage of new equipment, adaptation of the environment to different needs of athletes, the appearance of new techniques that keep up with new technologies and many other factors impact the constant need for monitoring, researching and detecting obstacles that stand in the way of accomplishing the best results. That is precisely why our journal is a platform for modelling and presenting results which will be applied in practice. Understanding new technologies in sports is no longer a privilege of major sports milieus, but a need without which it is not possible to keep up with sports trends and

strive towards successful, top results. Promoting the results through papers in our journal is not only the fastest way to reach our readers, but also an obligation to maintain trust and the quality that will satisfy the readers' needs and expectations.

It is visible that our wish is to include an even wider auditorium and new authors in each issue so as to establish a network of as many sports systems and environments as possible, thereby creating a global sports network.

Through this issue, we would again like to invite you, readers, to become a part of our team and participate in our work so that, together, we could contribute to qualitative changes in the world of sports.

Nihad Selimović, MD, MSc
Editor in chief



DRAGI ČITATELJU,

U ovom broju nalaze se naučni radovi istraživača iz 10 zemalja sa raznovrsnom tematikom istraživanja u oblasti sporta što daje posebnu vrijednost ovom časopisu.

Nove vrijednosti su promovisane kroz rezultate istraživanja iz oblasti sportskog menadžmenta, sportskog treninga, sportskog prava, sportske psihologije, sportske medicine, sportske edukacije i sportskog marketinga.

U svakom broju želimo objaviti nova naučna i stručna dostignuća koja su uslov za razvoj novih tehnologija i procesa od kojih zavisi uspješnost rezultata koji su pokazatelji dobrog rada i napredovanja.

I u ovom broju, zahvalni smo članovima recenzentskog odbora na predanom radu, ažurnosti i odgovornom pristupu u kojem se zahtjeva originalnost i kvalitet autorskog djela čime se osigurava vrijednost časopisa i njegova priznatost. Naš urednički odbor predan je u istrajnosti i promociji uvjerenja da je razvoj sportskih disciplina jedino moguć kroz razvoj naučnih dostignuća i njihovu implementaciju u praksi.

Sretni smo što naš časopis postaje platforma za unaprjeđenje naučne misli i stvaranje novih sportskih sistema uz korištenje napredne tehnologije i njene primjene u oblasti sporta. Stalne izmjene i novine u sportskim disciplinama, primjena i korištenje nove opreme, prilagođavanje okruženja prema različitim potrebama sportista, pojava novih tehnika koje prate nove tehnologije i mnogo drugih faktora, utiču na stalnu potrebu za praćenjem, istraživanjem i otkrivanjem prepreka koje stoje na putu ostvarivanja najboljih rezultata. Upravo zato je naš časopis platforma za modeliranje i prezentaciju rezultata koji će svoju primjenu naći u praksi. Poznavanje novih tehnologija u sportu više nije privilegija velikih sportskih sredina već potreba

bez koje nije moguće pratiti sportska kretanja i težiti ka uspješnim, vrhunskim rezultatima. Promovisanje rezultata preko radova u našem časopisu je najbrži put do naših čitatelja ali i obaveza da održimo povjerenje i zadržimo kvalitet koji će zadovoljiti potrebe i očekivanja čitatelja.

Primjetna je naša želja da u svakom izdanju uključimo širi auditorij i nove autore, kako bi umrežili što više sportskih sistema i ambijenata i na taj način stvaramo sportski network svjetskih razmjera.

I kroz ovaj broj pozivamo Vas, čitatelje, da budete dio našeg tima i da učestvujete u našem radu kako bi svi zajedno doprinosili kvalitativnim promjenama u svijetu sporta.

Mr. sci. dr. Nihad Selimović
Glavni urednik

THE EFFECTS OF FLYWHEEL TRAINING ON THE STRENGTH AND POWER OF LOWER LIMBS

Sotirios Arsenis¹, Asimenia Gioftsidou¹, Ilias Smilios¹, Paraskevi Malliou¹, Athanasios Chatzinikolaou¹, Dimitrios Gkogkos¹, Anastasia Beneka¹

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ABSTRACT

The aim of this study is to compare the effects of a semi-squat exercise with a flywheel device and free weights on the parameters of physical performance. 48 well-trained male athletes were randomly divided into three subject groups ($n = 16$ each), two training groups (DT and RT) and one control group (CON). The DT group completed a training programme with a flywheel device and the RT group conducted a programme with free weights. The duration of the intervention programme was 8 weeks, with a frequency of 2 times per week. The CON group did not participate in any training programme. Isokinetic knee joint moment measurements (concentric flexors/extensors) were performed at three different angular velocities: $60^\circ/\text{s}$, $180^\circ/\text{s}$ and $240^\circ/\text{s}$. Squat jump (SJ), countermovement jump (CMJ) and drop jump (DJ) were evaluated pre- and post-programme. Additionally, mechanical parameters of the semi-squat conducted in two groups were analysed. Statistically significant differences were found on the optimum power load and the mean power for both training groups. The RT group significantly increased the height of SJ and CMJ in comparison with the CON group. Statistically significant differences in isokinetic measurement were observed in three groups. These results demonstrate that flywheel training does not have a larger effect than the one present in typical resistance training when it comes to the strength and power of the lower limbs muscles. Flywheel training can be used as a supplementary training in programme with the aim to enhance sports performance. Finally, these findings can be useful for strength and conditioning coaches when it comes to the function of the flywheel device and the design of training programmes.

Keywords: inertia, load, strength, power, performance

INTRODUCTION

A semi-squat is one of the basic exercises, used in many workout programmes designed to enhance sports performance (Schoenfeld, 2010). More specifically, a semi-squat with a bar is the most widespread resistance exercise used by athletes to improve their performance, emphasizing the vertical strength, power and speed (Chandler, Wilson, and Stone, 1989; Escamilla, Fleisig, Zheng, Barrentine, and Wilk, 1998). Although this exercise activates multiple muscle groups, it mainly brings on more adjustments to the quadriceps (Escamilla et al., 1998), while significant isometric activity of supportive muscles is required to facilitate

the stabilization of the torso (Schoenfeld, 2010). As perceived, athletes with a weak torso or upper extremities cannot make full use of the benefits related to this exercise because of the load on their spine (Norrbrand, Tous-Fajardo, Vargas, and Tesch, 2011). That is why alternative forms of exercise have been used. One of these was introduced in the early 1920s for astronauts in space (Hill, 1920). More specifically, this type of exercise is based on the use of inertia, with the help of a flywheel device that produces resistance regardless of gravity (Berg and Tesch, 1992; Berg and Tesch, 1994). The exercise with a flywheel device seems to require a similar or even greater mechanical demand for the joints, compared to the classical execution with free weights. Actually, this technique seems to be more appropriate for exercises involving dynamic activities of the lower and upper limbs (Chiu and Salem, 2006; Núñez,

Suarez-Arrones, Cater and Mendez-Villanueva, 2016). Training programmes incorporating the flywheel device have significant effects on the parameters of physical performance (Cuenca-Fernández et al., 2018; Cuenca-Fernandez et al., 2015; De Paula Simola et al., 2015; Raeder et al., 2016; Norrbrand, Tous-Fajardo, Vargas and Tesch, 2011).

Specifically, flywheel training seems particularly effective by showing significant improvement in the maximal voluntary contraction (MVC), and by increasing the length and volume of quadriceps muscle after three weeks of the intervention programme (Norrbrand, Fluckey, Pozzo and Tesch, 2008; Seynes et al., 2007). In particular, a semi-squat training programme with a flywheel device can significantly improve the jumping ability, speed and mechanical parameters of change direction (de Hoyo et al., 2015). This training method, with a frequency of once a week, can significantly improve the performance parameters in football (Tous-Fajardo et al. (2016). Finally, Mendez-Villanueva et al. (2016) examined the effect of various strength protocols on the posterior femoral muscles in their structure. In particular, thirty-six professional footballers were randomly assigned to four groups, where they performed the Nordic, deadlift, leg curl and hip extension with a flywheel device. The present study gave important findings on proper planning of hamstring training and therefore on preventing injuries in professional soccer players.

However, there are no studies comparing the effect of a semi-squat training with a barbell and flywheel device on the isokinetic peak torque of knee extensor and flexor muscles. Isokinetic measurement has been used to evaluate both muscle imbalance and muscle deficits (Croisier, Ganteaume, Binet, Genty and Ferret, 2008; Dauty, Menu, Fouasson-Chailloux, Ferréol and Charles Dubois, 2016; Lehnert, Xaverová and De Ste Croix, 2014). It is obvious that the conventional ratio (hamstrings : quadriceps) should be 2: 3 or 0.66 (Steindler, 1955). Indeed, a ratio H/Q in 0.60 can be used to prevent injury or as a recovery tool (Baltzopoulos and Brodie, 1989; Kannus, 1994). The conventional ratio, with the values ranging from 0.50 to 0.65, is necessary to prevent injuries of the posterior thigh muscles (Clanton and Coupe, 1998; Orchard, Lord, and Garlick, 1997).

Jumping ability has an important role in sports performance. The jump depends on the ability of the neuromuscular system to take the body off the ground. Certainly, the jumping ability is connected with the power capacity of the lower limbs. The improvements of muscle strength, power and rate of force development can increase the jumping performance (Dowling and Vamos, 1993). In particular, strength training programmes containing concentric and eccentric contractions can enhance the jumping performance (Young, Jenner and Griffiths, 1998). Studies have shown that sports laboratory tests include jumping ability assessment as a factor of the athletes' performance. (Chamari, et al., 2004; Kellis, et al., 1999).

The available information regarding the responses of periodical strength/power training in sports performance is limited. Therefore, this study used a comprehensive set of measurements to compare the effects of an eight-week periodical strength/ power training programme between a semi-squats resistance exercise and a semi-squats exercise with a flywheel device. The purpose of this research was to examine the concentric peak torque of knee extensors and flexors, as well as the jumping ability of well-trained male athletes.

METHODOLOGY

Participants

48 well-trained male athletes aged 20.9 ± 1.2 years, with the height of 178.2 ± 5.1 cm, weight of 76.1 ± 7.3 kg and body mass index of 23.6 ± 1.7 voluntarily participated in the survey. The criteria of participation in the study were the following: a) they took part in strength training of the lower limbs 2 - 3 times a week, b) the load of 1RM should be larger than 1.5 x body weight, c) no musculoskeletal injury and/or disease, d) abstaining from dietary supplements, smoking and medication.

Procedure

A randomized, three-group repeated measures experimental design was employed. Participants were assigned to two experimental groups (DT, $n = 16$, Desmotec; RT, $n = 16$, Free weights) and one control group (CON, $n = 16$; did not train). A familiarization period with the experimental/ training procedures was utilized to minimize the learning effect error. The participants followed a four-week familiarization period, and alternately performed a semi-squat with an inertia device and free weights and performance tests three times a week. Participants underwent one-week baseline testing. Measurements and data analysis took place at the Laboratory of Therapeutic Exercise and Rehabilitation of the Department of Physical Education and Sport Science, DUTH. In particular, participants took part in the measuring tests at least three hours after the last meal and without having previously had any sporting activity. All measuring tests were performed one week before and at the end of the intervention programme. The procedures were in accordance with the ethical standards of the Committee on Human Experimentation at the Institution at which the work was conducted, and in accordance with the Helsinki Declaration of 1975.

Intervention Programme

The participants took part in corresponding resistance training programmes with a total duration of eight consecutive weeks and a

frequency of two times a week. The sessions which took place were at least 48 hours apart. The DT and RT groups were asked to perform semi-squats with the knee angle at 90° using a flywheel device and barbell, respectively.

The duration of each session was 15-30 minutes. Both resistance programmes had a progressive difficulty, with a change in volume and intensity of training over the course of eight weeks. Before the start of each session, the participants of both exercise groups took part in a leg warm-up, which included a five-minute ergometer at 60W, five minutes of active leg stretching and two sets of semi-squats with 50% of 1RM (Smilios et al., 2013). The CON group was asked to not participate in any strength training programme for eight consecutive weeks.

The participants of both teams performed exactly the same volume of training with the individual load. In the first two weeks, all participants performed three sets of five repetitions and, in next two weeks, they performed four sets of five repetitions. In the fifth week, the goal of the training changed by reducing the load and by performing four sets of six repetitions and the training volume progressively changed with the stable load. So, the participants performed five sets of six and six sets of six repetitions for the sixth and seventh week, respectively. In the eighth and last week, the volume of training was reduced to three sets of six repetitions. Rest between sets was three minutes long for all trainings.

During the first four weeks, the load or inertia in corresponding training groups was applied in a load heavier than that of the OPL. This load corresponded in about 80% of OPL. The next four weeks, all participants performed the exercise protocol with their corresponding OPL.

MEASUREMENTS

Mechanical Parameters

After calculating 1RM at a semi-squat (Sander, et al., 2013), the athletes participated in the test of calculating the optimum power load in the semi-squat. Specifically, a linear transducer was applied at the end of a bar, perpendicular to the ground and, as the person moved the bar along the semi-squat, a signal was transmitted by the encoder, with the analysis of 0.075 mm and sampling frequency of 100 Hz, from an analogue to a digital converter (Muscle Lab, Ergotest Technology) connected to a computer with software to acquire and analyse the data (Muscle Lab v6.07). This allowed the calculation of mechanical parameters for the displacement, speed, force and power during the execution of the

semi-squat motion. Each participant performed four maximum repetitions with six different loads of 30, 40, 50, 60, 70 and 80% of 1RM. Among the loads, a three-minute rest was given for complete relaxation (Smilios, Hakkinen and Tokmakidis, 2010).

The same procedure was used while performing the semi-squat with a flywheel device. Specifically, each participant used the flywheel device (Desmotec, D.11, Italy) and a special vest was applied to the upper part of the body which was tied around the waist. A strain gauge and a linear transducer were placed with a carabiner between the belt of the participant and the flywheel device, and they were attached to the MuscleLab platform to digitize the data of motion.

Six repetitions with six different inertias in the amount of 0.0291, 0.0366, 0.0474, 0.0612, 0.0795, 0.0978 kg*m-2 were performed. The first two repetitions were used only for the smooth unwinding of the device band, so they were not calculated in the final analysis. Four maximum repetitions were recorded and then analysed. Participants were instructed to execute the concentric phase as quickly as possible (Martinez-Aranda and Fernandez-Gonzalo, 2017). The mean power of the concentric phase was analysed. The inertia or load which achieved a higher mean power output was selected for the optimum power load (OPL). Using these data, the load-velocity and the load-power curve for each individual was calculated by applying a second-degree polynomial model. The obtained curves were used to estimate the optimum power load of each participant (Smilios, Hakkinen and Tokmakidis, 2010). The same procedure was repeated during the fourth week and at the end of the intervention programme.

Isokinetic Measurement

The testing equipment, which was selected to evaluate the three groups, was an isokinetic evaluation machine (Isoforce, TUR GmbH, Berlin, Germany). The participants were stabilized at a seated position on the dynamometer chair by pelvic strapping with their back slightly reclined, their thighs well supported on the seat and with their hands around their chest. The rotation axis of the dynamometer was aligned with the femoral condyle of the knee. Also, the special lever arm was adjusted according to the length of the tibia, and eventually adjusted above the ankle, over the medial malleolus. The test subject's knee range of motion was defined in the range of 0° (full knee extension) to 90°. After a five-minute warm-up on an ergometer (50 - 100W), followed by 10 minutes of active stretching of the lower limbs (Rahnama, Lees and Bambaecichi, 2005), the concentric peak torque (PT) of knee extensors and flexors was measured.

The testing included one session of three maximal knee extension/flexion repetitions with each tested speed (60°/s, 180°/s, 240°/s) in a random order, separated by one-minute rest intervals. The highest value tested

for each velocity was recorded. Maximal test efforts began with the knee joint flexed at 90° and ended at full extension. A three-minute rest was given for machine resetting and evaluation of the other leg. The intra-class correlation coefficients for repeated measurements ranged between 0.92% and 0.94%.

Jumping Ability

Squat jump (SJ), countermovement jump (CMJ) and depth jumps (DJ) (ICCs: 0.92-0.95) were utilized to measure the jumping performance using the device OptoJump with software (Microgate, Bolzano, Italy) to determine vertical displacement (Glatthorn, Gouge, Nussbaumer, Stauffacher, Impellizzeri and Maffiuletti, 2011). The participants performed three maximum efforts in each ability test with one-minute rest between the repetitions. A three-minute rest was given between the tests (Bosco, Luhtanen and Komi, 1983; Gerodimos, Manou, Ioakimidis, Perkios and Kellis, 2006).

STATISTICAL ANALYSIS

The data are presented as means $\pm$ standard deviation. Data normality was verified through one-sample Shapiro – Wilk test. The data were analysed by using a Two-Way repeated measures ANOVA on different time points. For post-hoc analysis, a Bonferroni test was used. Statistical significance was accepted at the level of $p < 0.05$. For effect size determination, Eta squared (η^2) and observer power (α) values were calculated. SPSS was used for all analyses (Chicago, IL, USA).

RESULTS

There were no differences between the groups in all dependent variables examined at the baseline. The anthropometric measures remained unaltered throughout the experimental period in both groups. Mechanical Parameters

Statistical analysis showed statistically significant interaction for 1RM ($F(2.45) = 10.796$, $\eta^2 = 0.53$, $\alpha = 0.98$, $p = 0.0001$). Bonferroni multiple comparison test showed a significant difference between RT and CON (mean difference = 26.563, standard error = 6.133, $p = 0.00001$). There was no statistically significant difference in peak average power between RT and DT in pre- and post-measurements ($p > 0.05$). There was a statistically significant difference in the DT group between the measurements for OPL ($F(2.45) = 13.830$, $\eta^2 = 0.51$, $\alpha = 0.99$, $p = 0.001$). In particular, a statistically significant difference was observed between the pre- and mid-measurement (mean difference = 0.009, standard error = 0.003, $p = 0.008$), as well as mid- and post-measurement (mean difference = 0.015, standard error = 0.002, $p = 0.0001$). Also, in the RT group, there were significant differences in OPL between the measurements ($F(2.45) = 4.512$, $\eta^2 = 0.23$, $\alpha = 0.72$, $p = 0.048$). A Bonferroni multiple comparison test showed a significant difference between the mid- and post-measurement (mean difference = 14.875, standard error = 6.008, $p = 0.05$). Table 2 summarizes the mechanical parameters of the semi-squat in two groups.

Table 1: Anthropometric Characteristics

Variables	RT	DT	Con
Age (yrs.)	20.63 $\pm$ 1.45	(mean values $\pm$ std. error) 21.31 $\pm$ 1.25	20.75 $\pm$ 1.12
Weight (kg)	75.94 $\pm$ 7.80	75.81 $\pm$ 7.35	76.81 $\pm$ 7.38
Height (cm)	176.00 $\pm$ 4.14	179.06 $\pm$ 6.00	179.81 $\pm$ 4.66
BMI (kg/m ²)	24.46 $\pm$ 2.03	23.27 $\pm$ 1.16	23.05 $\pm$ 1.66

Table 2: Mechanicals parameters of the semi-squat

	RT		DT	
	OPL	Power	OPL	Power
Pre	72.13±14.01	1336.81±199.70	0.047±0.007 *	1088.50±200.64
Mid	81.19±19.50 *	1386.63±221.20	0.057±0.010 *	1117.06±208.81
Post	66.31±17.01 *	1400.81±177.48	0.042±0.010 #	1121.31±180.07

*, #: statistically significant differences within groups, $p < 0.05$

ISOKINETIC MEASUREMENT

Examining the peak torque of the lower limbs through isokinetic evaluation, statistically significant differences were observed in the following variables. Specifically, no statistically significant difference was observed in the Q60 of the dominant leg. However, marginal statistically significant interaction was observed in Q60 of the non-dominant leg ($F(2.45) = 3.345$, $\eta^2 = 0.12$, $\alpha = 0.60$, $p = 0.044$). From the Bonferroni multiple comparison test, a statistically significant difference was found only in the RT group (mean difference = 15.375, standard error = 5.360, $p = 0.006$). Regarding H60 of the dominant leg, no statistically significant difference was observed. However, H60 of the non-dominant leg showed a statistically significant effect of the "time" ($F(2.45) = 10.711$, $\eta^2 = 0.19$, $\alpha = 0.89$, $p = 0.002$) for the three groups (average difference = 6.979, standard error = 2.132, $p = 0.002$).

No statistically significant difference was observed for Q180 in both the dominant and non-dominant leg. However, a statistically significant effect of the "time" was observed for the dominant leg for H180 ($F(1.45) = 10.741$, $\eta^2 = 0.19$, $\alpha = 0.89$, $p = 0.002$) and the non-dominant leg ($F(1.45) = 5.980$, $\eta^2 = 0.11$, $\alpha = 0.66$, $p = 0.018$) for the three groups (mean difference = 5.312, typical error =

1.621, $p = 0.002$ and mean difference = 4.104 standard error = 1.678, $p = 0.018$, respectively). Furthermore, no statistically significant difference was observed in Q240 and H240 of both the dominant and non-dominant legs. As for the conventional HQ60 ratio of the non-dominant leg, a major effect of the "time" was observed with $F(1.45) = 6.926$, $\eta^2 = 0.13$, $\alpha = 0.73$, $p = 0.012$ with the mean difference = 0.032 and standard error = 0.012. In contrast, no statistically significant difference was observed for HQ60 of the dominant leg. Also, no statistically significant difference was observed for the HQ180 and HQ240 variables of both the dominant and non-dominant legs. Table 3 summarizes the isokinetic peak torque variables of the anterior and posterior femoral muscles.

Jumping Ability

Statistically significant differences in the jumping ability of participants were observed. In particular, SJ was observed to have a statistically significant major effect of "time" ($F(1.45) = 45.000$, $\eta^2 = 0.42$, $\alpha = 0.99$, $p = 0.000007$). From the Bonferroni multiple comparison test, there was a significant difference between the RT and CON (mean difference = 4.084, standard error = 1.603, $p = 0.043$). Also, there was a statistically significant major factor of "time" for CMJ ($F(1.45) = 7.995$, $\eta^2 = 0.15$, $\alpha = 0.79$, $p = 0.007$). From the analysis of the main effect, marginal differences between

groups RT and CON were observed (mean difference = 5.388, typical error = 2.108, $p = 0.042$). Additionally, a statistically significant increase was observed for the height of DJ ($F(1.45) = 8.364$, $\eta^2 = 0.15$, $\alpha = 0.80$, $p = 0.006$). Finally, a statistically significant decrease was

observed for ground contact time of DJ in three groups with $F(1.45) = 20.302$, $\eta^2 = 0.31$, $\alpha = 0.99$, $p = 0.000047$. Table 4 summarizes the jumping ability variables pre- and post-intervention programme.

Table 3: Isokinetic peak torque of knee extensor and flexor muscles

	RT		DT		CON	
	Dominant	Non-dominant	Dominant	Non-dominant	Dominant	Non-dominant
Q60 Pre	212.3±31.4	209.6±26.0*	222.1±32.5	218.6±29.7	205.9±39.9	208.8±41.8
Post	207.6±32.3	225.0±30.5*	223.9±34.4	219.3±33.2	210.1±29.1	211.3±32.4
H60 Pre	118.0±21.6	110.9±16.2*	127.9±26.3	111.2±20.3*	116.1±23.1	118.7±26.2*
Post	120.0±19.9	112.7±19.4*	128.2±21.0	123.8±21.7*	119.0±23.8	125.3±26.3 *
Q180 Pre	165.6±24.1	164.6±29.0	160.1±27.4	160.6±25.1	152.5±22.9	153.8±22.5
Post	164.6±26.7	161.9±28.2	164.0±22.1	159.4±22.8	159.1±20.0	157.3±19.8
H180 Pre	92.5±17.6 *	88.2±13.4 *	97.3±17.6 *	92.5±16.1 *	91.8±18.6 *	95.4±19.3 *
Post	99.1±14.9 *	93.1±15.5 *	101.8±13.5 *	99.4±15.8 *	96.6±16.8 *	100.9±21.3 *

Q240 Pre	144.8±16.4	140.3±15.6	145.3±23.5	143.4±23.8	140.5±23.3	137.7±21.5
Post	148.6±23.8	144.3±21.9	146.7±21.8	140.9±21.9	141.0±18.2	140.8±16.2
H240 Pre	86.6±17.1	78.2±14.2	94.1±18.9	85.3±18.4	84.0±20.0	89.4±17.2
Post	91.3±14.1	77.3±16.4	92.0±13.4	90.9±16.1	84.1±13.7	89.6±18.4
Q/H60 Pre	0.56±0.10	0.49±0.06 *	0.57±0.08	0.52±0.09 *	0.56±0.08	0.57±0.10 *
Post	0.58±0.09	0.54±0.07 *	0.58±0.06	0.56±0.07 *	0.57±0.07	0.59±0.11 *
Q/H180 Pre	0.56±0.11	0.54±0.10	0.61±0.10	0.58±0.06	0.61±0.14	0.62±0.11
Post	0.61±0.11	0.55±0.10	0.62±0.09	0.62±0.09	0.61±0.12	0.64±0.11
Q/H240 Pre	0.59±0.12	0.50±0.08	0.64±0.09	0.59±0.05	0.60±0.15	0.65±0.13
Post	0.62±0.12	0.54±0.12	0.64±0.09	0.63±0.07	0.60±0.08	0.64±0.12

*: statistically significant differences within groups, $p < 0.05$

Table 4: Performance parameters of the three groups

	RT	DT	CON
1RM (kg) Pre	155.00±20.33	145.00±17.12	144.38±17.46
Post	172.18±21.52*	159.06±19.42	148.13±17.48*
SJ (cm) Pre	37.79±6.57	36.68±5.03	36.04±5.50
Post	40.71±4.66*	39.81±5.28	38.72±5.71*
CMJ (cm) Pre	44.50±7.90	43.03±6.21	42.61±6.68
Post	47.90±6.18*	44.73±5.10	41.32±7.49*
DJ (cm) Pre	31.60±5.97	32.28±4.55	29.96±5.62
Post	32.90±6.78	34.44±4.31	32.56±6.92
DJ (sec) Pre	0.21±0.02	0.21±0.02	0.22±0.03
Post	0.20±0.02	0.19±0.01	0.20±0.01

*: statistically significant differences within groups, $p < 0.05$

DISCUSSION

This is the first investigation to compare the effects of an eight-week semi-squat training programme between the flywheel device and free weight resistance training on the performance of lower limbs muscles. The results indicate that an eight-week strength/power training programme has greater improvements in the lifting capacity and peak power torque of the knee extensor and flexor muscles than the control group. Also, these findings indicate that both training programmes increased the OPL with a semi-squat exercise. In contrast, the flywheel training in DT group was not superior to the resistance training regimen in RT group when it comes to lifting performance. Although, both training groups showed an improvement in the jumping ability, the RT presented a bigger increase in all variables of the jump.

According to the international literature, strength training of the lower limbs can increase the strength and jumping ability (Chelly, Fathloun, Cherif, Ben Amar, Tabka, and Van Praagh, 2009; Christou, Smilios, Sotiropoulos, Volaklis, Pilianidis, and Tokmakidis, 2006). The eight-week squat training programme significantly increased the performance in SJ, CMJ, and reactive strength index (Wirth, Hartmann, Sander, Mickel, Szilvas and Keiner, 2016). Also, training programmes using a flywheel device seem to have a significant impact on the increase in CMJ (Nuñez, Santalla, Carrasquilla, Asian, Reina and Suarez-Arrones, 2018). The main finding of the current study is that both training programmes increased the performance in SJ, CMJ and DJ. Nevertheless, RT showed a higher improvement in jump variables relative to the DT group.

The power of the knee extensors is the most important factor for the performance in the vertical jump (Bompa, 1990; Bulgan, 2016). Significant correlations were found between knee extension strength and vertical jump height, particularly

when testing at faster angular velocities of 180°/s and 240°/s (Harrison et al., 2013; Lehnert, Svoboda and Cuberek, 2013).

Although significant differences in jumping ability have been demonstrated in this research, the power torque in isokinetic measurement was not consistent with the previous research. More specifically, the present findings showed an improvement of the non-dominant leg only in Q60 for the RT group. Also, H60 of the non-dominant leg and H180 of the dominant and non-dominant leg improved for all three groups. Finally, only the conventional HQ60 ratio of the non-dominant leg has changed significantly for all three groups.

DISCUSSION

Flywheel training is based on the unique mechanical characteristics of inertia devices. In particular, these devices provide eccentric overload on muscles. This eccentric overload may have an effect on the neuromuscular adjustments of lower limbs muscles. Furthermore, Mike, Cole, Herrera, VanDusseldorp, Kravitz and Kerksick (2017) argued that longer eccentric contractions may negatively impact explosive movements such as the vertical jump. As understood, flywheel training has the effects similar to those produced through resistance training on the performance of lower limbs muscles. Training with these devices could be an alternative exercise option of strength training. However, other research is required to investigate the effects of the flywheel training on I) longer-term intervention, II) different periodical programme, III) different exercise selection, IV) complex training.

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EFEKTI TRENINGA SA KORIŠTENJEM SPRAVE ZA VJEŽBANJE SA ZAMAŠNJAKOM NA SNAGU I SILU DONJIH EKSTREMITETA

Cilj ove studije je bio uporediti efekte izvođenja vježbe polučučnja koristeći spravu za vježbanje sa zamašnjakom i tegove na parametre fizičke sposobnosti. 48 dobro uvježbanih sportista je nasumično podijeljeno u tri grupe ispitanika ($n = 16$ za svaku grupu), dvije grupe koje su izvodile trening (DT i RT), te jednu kontrolnu grupu (CON). DT grupa je izvodila program treninga koristeći spravu za vježbanje sa zamašnjakom, dok je RT grupa isti izvodila koristeći tegove. Program intervencije je trajao 8 sedmica uz učestalost od 2 puta sedmično. CON grupa nije izvodila niti jedan program treninga. Izokinetičko mjerenje momenta zgloba koljena (koncentrični fleksori i ekstenzori) je izvršeno za tri različite kutne brzine: $60^\circ/\text{s}$, $180^\circ/\text{s}$ i $240^\circ/\text{s}$. Skok iz čučnja (SJ), skok iz čučnja sa pripremom (CMJ) i propadajući skok (DJ) su vrednovani prije i poslije provođenja programa. Nadalje, analizirani su mehanički parametri polučučnja provedenog u dvije grupe. Statistički značajne razlike su pronađene za optimalno opterećenje snage i prosječnu snagu kod obje grupe koje su podvrgnute treningu. RT grupa je značajno povećala visinu skoka iz čučnja (SJ) i skoka iz čučnja sa pripremom (CMJ) u poređenju sa CON grupom. Statistički značajne razlike u izokinetičkim mjeranjima su utvrđene kod tri grupe. Ovi rezultati pokazuju da trening na spravi za vježbanje sa zamašnjakom nema veći efekat u odnosu na onaj koji je prisutan prilikom tipičnog treninga snage kada je u pitanju snaga i sila mišića donjih ekstremiteta. Trening na spravi za vježbanje sa zamašnjakom se može koristiti kao dodatni trening u programu sa ciljem povećanja sportskog učinka. Naposljetku, ovi pronalasci mogu biti korisni trenerima snage i kondicije kada je u pitanju funkcija sprave za vježbanje sa zamašnjakom i dizajn programa treninga.

Ključne riječi: inercija, opterećenje, snaga, sila, učinak

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A MULTILAYER APPROACH FOR ASSESSING THE PSYCHOLOGICAL NEEDS OF ASPIRING SOCCER PLAYERS. IMPLICATIONS FOR OVERSEEING TALENT DEVELOPMENT

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ABSTRACT

The aim of this study was to examine the relevance of a set of psychological assessment tools for professional practice in sport psychology. Data collection on 70 talented soccer players (15 to 19 years old) from the French-speaking part of Switzerland was based on McAdams' framework. They were processed to identify the main team characteristics and the differences between subgroups, and then compared with standard values. The results suggested the need for psychological support in four directions: (a) management of emotional stability in order to reduce anxiety regarding performance (injury), interactions (coaches and support); (b) enhancement of involvement in practice, including conscientiousness, quality practice, and building positive and supportive relationships with coaches; (c) protection against substance use and doping; and (d) appropriation of activities which improve performance and increase the likelihood of benefiting from the challenges. The results showed how these tools could be packaged as a set for overseeing soccer talent development.

Keywords: personality, self-regulation, narratives, psychological services, assessment, talent

INTRODUCTION

Talent development in the sports world has attracted growing attention over the last few decades. The recent approach has been to conceive talent development as the dynamic interplay of talented athletes and their environments, thus shifting the

focus away from the individual alone (i.e., a situated, dynamical and ecological approach) (Baker, 2012; Collins, MacNamara, and McCarthy, 2016; Plucker, Rinn, and Makel, 2017). This conception has generated new inputs in areas like the design of talent development environments, the conception and regulation of training for talented athletes, and the

Identification and measurement of the skills needed for the sporting life course and/or high-level performance (e.g. Collins and MacNamara, 2018; Martindale, Collins, and Daubney, 2005). In all these areas, the psychological factors which contribute to talent development, such as the athlete's confidence, self-esteem and resilience, are regarded as capital and there is plenty of literature related to the question of "how to carry out an analysis of the athlete's psychological needs". Nevertheless, there is a lack of understanding in this area especially for sport psychologists on managing these methods and tools in practice, which can be used to assess psychological needs. For them, it is like the pieces of a jigsaw that are difficult to put together. The final picture pertaining to the athletes remains stratified. The greater effect which emerged with the combinations of the psychological characteristics in the image of an athlete remains blurred. The research problem is to identify a theoretical model which allows us to finely analyse the developmental propensities of sports talents, while keeping a holistic vision of their different psychological characteristics. And so, the purpose of this study is to test the efficiency of the psychological assessments associated with this model to provide a clear and useful image of these talents.

Hence, this article examined a set of psychological assessment tools especially dedicated to provide a complete, relevant and effective image of the talented athletes for sport psychologists. We wished to clarify the rules for a methodology that could be useful for them when working in different sports. To do that, we focused on aspiring soccer players who form the larger amount of young athletes expected to achieve excellence in the sport domain. In the following sections of the introduction, we will determine which domains of the assessment and corresponding tools are indeed suitable (i.e., relevance of the assessment) for soccer players' development in relation to the conceptual model that combines these assessments. This composes our general model to promote a complete image of the athletes in this domain (i.e., completeness of the assessment). In the result section, we show many examples of the results obtained on the assessments of aspiring soccer players engaged in talent development environments in order to demonstrate the clarity and effectiveness of the outcomes.

Theoretical basis

The assessment of psychological characteristics which are favourable for talent development in soccer should address general and sport-specific concerns. For example, at the general level, soccer players might be assessed regarding their general psychological disposition to act and perform well in

the talent development environment, and their skills in dealing with the expectations inevitably placed on them (e.g., confidence, emotional stability and achievement striving). Other general factors which might affect elite athletes in the future should also be tested, such as vulnerability to substance use or perceptions of daily hassles, both of which are predictors for physical and psychological problems (Beable, Fulcher, Lee, and Hamilton, 2017; Hauw and Bilard, 2012; Ivarsson, Johnson, and Podlog, 2013; Prinz, Dvořák, and Junge, 2016). Specifically, in a sport like soccer, players should also be evaluated regarding their potential to play fruitfully in a team. Attention is also needed for issues which are unfortunately not uncommon in the careers of soccer players, such as depression (e.g., Beable et al., 2017; Prinz, Dvořák, and Junge, 2016).

Research in psychology has provided many tools to assess psychological constructs in various environments. However, the indications that link the tools to theoretical frameworks are often lacking. In a dynamical, ecological and situated approach to talent development, multilayer models might offer a fruitful and relevant resource (Hauw, 2018; Owiti, Hauw and Collins, 2019). The McAdams model of personality (McAdams, 1996, 2009; McAdams and Pals, 2006) suggests three levels for describing identity: (a) dispositional traits, or the broad general personality traits (Costa and McCrae, 2010); (b) characteristic adaptations, or the personal action constructs (PACs) which encompass personal concerns, motivations, self-regulations or goal adaptations (Little, 2008); and (c) life stories, or the narratives constructed out of experience to give meaning to one's life (Bruner, 1990). In the following sections, we briefly present each of the levels and their potential relevance to predict the process of talent development in soccer.

The McAdams level of personality traits refers to dispositions to act in various situations. The Five Factor Model (FFM; emotional stability, extraversion, openness to experience, agreeableness and conscientiousness) is the most research-based approach to characterizing how a person usually interacts with different situations (Costa and McCrae, 2010). The relevance of including personality as an explanatory and integrative factor in models of athletic performance is now accepted (e.g., Roberts & Woodman, 2017). Indeed, personality is already considered a predictor of various types of sporting situations or key-points such as the quality of the coach-athlete relationship (e.g., Aşçı, Keleşek, & Altıntaş, 2015; Yang, Jowett, & Chan, 2015), behavioural or emotional involvement in practices like risk-taking behaviours (e.g., McEwan, Boudreau, P., Curran, T., & Rhodes, 2019; Monatserio, Mei-Dan, Hackney & Cloninger, 2018), coping in sport (e.g., Allen, Greenlees, & Jones, 2011; Kaiseler, Polman, & Nicholls, 2012), types of leadership or roles on teams (e.g., Kim, Gardant, Bosselut, & Eys, 2018; Roberts, Woodman, & Sedikides, 2017), mood states in relation to practice or competition (Smith, Hanrahan, Anderson, & Abbott, 2015), and the effects on injury occurrence (Madzar,

Milosevic, Hrabac, & Heningsberg, 2017; Slimani et al., 2018). In the context of talent development, no study has been really developed and some of the traits and facets described in the FFM might be particularly well-suited for characterizing the ways athletes think, act, and feel about the constraints typical of talented athlete environments, as well as for predicting access to professional sport (e.g., Aidman, 2007). In addition, the FFM can be used to assess the ease with which an athlete will act as part of a team (Nia and Besharat, 2010). For example, facets of extraversion and agreeableness are likely to be pertinent.

Motivation, self-regulation, goals and attitudes refer to the PACs which are used in various situations (Little, 2008). Growth Mindset (GM – Dweck, 2017), GRIT (Duckworth, Peterson, Matthews and Kelly, 2007), resilience (Fletcher and Sarkar, 2016) and self-regulation (Toering and Jordet, 2015) have been seen as attitudes which the players bring to the sport that may or may not be applied to other elements of their life. Despite their popularity, all models have been criticised on the basis of methodology, psychometric validity, or application (e.g., Credé, Tynan and Harms, 2017).

As suggested by Collins and colleagues (Collins, MacNamara, and Cruickshank, 2018), these skills seem only to address subsets of the full set required and MacNamara and Collins (2013) published a review which provided help in identifying which PACs are relevant for talented athletes in the development context and the Psychological Characteristics of Developing Excellence Questionnaire (PCDEQ) is the outcome of the analysis. This questionnaire assesses where athletes rank in the development of the psychological characteristics needed to reach the elite level. It is now available in French (Gesbert, Crettaz von Roten, and Hauw, 2018). However, this questionnaire does not cover issues which frequently arise in soccer careers, such as anxiety disorders and substance use. Thus, specific designs to develop certain PACs in soccer players should include these dimensions; two short instruments available in the French language, the Global Anxiety Disorder 7-item scale (GAD-7) (Micoulaud-Franchi et al., 2016) and the Performance Enhancement Attitude Scale (PEAS) (Hauw, Crettaz von Roten, Mohamed, and Antonini Philippe, 2016), appear to be well suited to add in the set of tools for assessing the soccer players' PACs.

Last, life stories refer to self-created narratives expressing the sense of self or one's autobiography. For talented athletes, this could be captured by analysing experience at the career level (e.g. Hauw and Bilard, 2012; Hauw and Lemeur, 2013) and the micro-experiences of training, competition, and interactions with coaches and teammates (Hauw, 2018; Gesbert, Durny, and Hauw, 2017). The assessment required various forms of interviews (e.g., enactive interviews, elicitation interviews) in which participants are invited to share their experiences regarding the topics the psychologist wishes to explore (Hauw, 2018). Putting it

all together, we have described a general model as well as its specific configuration for aspiring soccer players.

The aim of the study is to test the clarity and effectiveness of the outcomes for sport psychologists committed to aspiring soccer players in helping services for talent development and performance. Using this set of assessment tools, we expected to identify the information which could be applied to the design of goals and specific psychological interventions for talented soccer athletes. We could thus examine the effectiveness and relevance of this model.

METHOD

Participants

Seventy Swiss male soccer players in the age of 15 to 19 volunteered to take part in this study ($M = 16.83$; $SD = 2.4$). They came from four teams in high-level soccer associations (i.e., two professional soccer academies and two regional age group selections). An agreement to carry out this study was obtained from the players, their parents and the team coaches. The protocol was approved by the Ethical Committee of Research in Switzerland and it followed the guidelines of the Declaration of Helsinki.

Data Collection

Data collection was based on the multilayer model for each player. Personality traits, PACs and indicators of life narratives were collected.

Personality Traits

The French version of the Personality for Professional Inventory (PfPI) was used to examine 21 personality dimensions (e.g. sensitivity and assertiveness) and the Big Five personality traits (stability [opposite of neuroticism], extraversion, openness, agreeableness, and conscientiousness) (Rolland and Defruyt, 2009).

The PfPI is composed of 183 self-report items rated on a Likert scale ranging from 1 ("does not characterize me") to 5 ("characterizes me completely") (Rolland and Defruyt, 2009). Originally developed in French, it was chosen because the participants were expected to eventually practise their sports at a professional level, and the personality dimensions that are assessed are considered important for understanding behaviour and competencies at work. The results of PfPI scored each facet and trait on a maximum of 7-35 points and 11-55 points, depending on the number of items

along each dimension. The PfPI scale reliabilities ranged between .74 and .89 (Rolland and Defruyt, 2019, p. 26) and have been cross-validated relative to the NEO-PI-R (Rolland and Defruyt, 2019) domains and facets, underscoring the construct validity of its trait set. In addition, the PfPI has also been used with study participants as young as 16 years old (e.g., Segal, Hernandez, Graham, and Ettinger, 2018).

Personal Action Constructs for Soccer

Three validated tools which describe PACs appear to be relevant for aspiring soccer players. We scanned for (a) mental skills for excellence achievement using the French version of the PCDEQ (Gesbert and al., 2018), anxiety disorders with the French version of the GAD-7 (Micoulaud-Franchi et al., 2016), and (c) the attitude toward performance-enhancement methods and substances with the French version of the PEAS (Hauw et al., 2016). The Psychological Characteristics of Developing Excellence Questionnaire assessed the level of development for six psychological skills considered essential in the sports talent achievement process. On the Likert scales ranging from 1 ("very unlike me") to 6 ("very like me"), 59 items pertaining to the six skills (i.e., long-term performance support, use of imagery, coping, commitment to quality practice, performance evaluation and work on weak points, as well as social support) are assessed, as well as how the athletes use them according to the context in which they are embedded (MacNamara and Collins, 2011). This psychological assessment focuses on the skills assumed to be useful to face the challenges around commitment to practice and competition in the pursuit of excellence. Standards for good vs. poor developers are provided with cutoff points for good developers in team sports for three determinant factors (i.e. long-term performance support: 4.25, coping: 4.27, and performance evaluation and work on weak points: 4.99). Limit scores corresponding to poor developers in team sports have also been identified for these three main factors (respectively, 3.99, 3.87 and 4.56) (MacNamara and Collins, 2013). The Performance Enhancement Attitude Scale was used to characterize the players' attitudes about using substances and methods that favour performance (Petróczi and Aidman, 2009). The PEAS has 17 items (e.g., Doping is necessary to be competitive, Doping is not cheating since everyone does it) to assess this self-declared attitude with a Likert scale ranging from 0 (strongly disagree) to 6 (strongly agree). Studies suggest that cutoff points of 29 and 36 correspond to low, moderate and high vulnerability (Morente-Sánchez, Mateo-March, and Zabala, 2013).

The Generalized Anxiety Disorder scale was used to screen for generalized anxiety over the previous two weeks (Micoulaud-Franchi, 2016). The questionnaire contains seven items (e.g., Over the last two weeks, how often have you been bothered by feeling nervous, anxious or on edge?) which players assess between 0 (not at all) and 3 (nearly every day). Cutoff points of 5, 10, and 15 correspond to mild, moderate, and severe levels of anxiety on the GAD-7, similar to levels of depression on the PHQ-9 (Spitzer, Kroenke, Williams, and Löwe, 2006).

Narratives

A brief interview was held with each athlete to elicit narrative stories along the lines of McAdams's concepts of "coherent themes" and "nuclear episodes" in the narrative (McAdams, 1996).

An important part of players' narrative identities can be grasped through their reports on their involvement in practice and the hassles they deal with, and we thus designed a guideline that divided the interviews into two parts: the first part sought to determine their preferences about the types of training they were committed to (coherent themes in involvement in practice) through their assessments of experiences of fun, effort and concentration regarding the types of practice, and the second part explored the types and effects of hassles that the players experience (nuclear negative episodes). Each interview lasted between 15 and 30 minutes ($M = 17.8$; $SD = 3.95$).

Data Analysis

All the collected data were processed with the aim of characterizing the needs for psychological support that emerged based on comparisons of the players' descriptions. The questionnaire responses were analysed one after another and considering all the players of the different teams together searching for differences within the scores of the psychological constructs.

First, we ran descriptive statistics and processing to identify the main team scores characteristics. Then, we examined whether the differences between subgroups could be identified (k-means cluster and one-way ANOVA).

For example, we used cluster analysis to examine if the variability of the scores at the Big Five may be converted in the identification of the sub-group related to the needs which combined different types of strengths and weaknesses. In addition, all the scores were also compared with standard values (e.g., PfPI, PCDEQ, GAD-7, PEAS).

These frames of reference are particularly important to identify whether the scores obtained for each construct

are different from other populations and context. By doing this type of comparison, we could also target the importance of the needs for psychological support. The interviews were transcribed. The assessment of involvement regarding the types of training were based on the comparison with a level of 100 % in personal experiences of fun, effort and concentration. This composes the frame of reference for each player who is then asked to assess, in percentages, his/her own level of experience for each type of training.

We then compute the mean in percentages of fun, effort and concentration experiences in the different types of training. The second part of the interview coded the types and effects of hassles that the players experience (nuclear negative episodes) using the pre-constructed categories inspired by Hornig et al.'s study, and typical experiences were identified (Hornig, Aust, and Güllich, 2016).

RESULTS

Personality Traits

Table 1 shows that the mean scores for emotional stability and agreeableness were significantly lower than those of a standard population. The scores for the facets of sensitiveness, trust and self-discipline were also significantly lower, while competitiveness and frustration tolerance were significantly higher. These results suggest that psychological support for enhancing emotional stability and conscientiousness – respectively, with regard to sensitiveness and self-discipline, might be designed. The psychological strengths in this sample were frustration tolerance, indicating the capacity to deal with setbacks, and competitiveness.

The results also showed that inter-player variability regarding traits and facets was generally high, suggesting that the descriptions of the players at the level of personality traits were not very uniform.

Thus, the individual results of the PfPI might be considered for the design of one-to-one psychological support interventions. However, developing a team collectively is another approach, which points to the importance of scanning these data to identify subgroups of players with common personality traits who would thus have similar needs in psychological intervention. A k-means cluster analysis was therefore performed on traits to distinguish groups with specific psychological priorities regarding talent development. We defined three optimal groups. Table 2 shows the significantly

different means between the groups for each trait, except agreeableness, indicating that three types of psychological services might be designed. Group 1 was composed of players who scored low on all traits except agreeableness.

Taking into consideration how traits are known to predict performance, this group was labelled the ESCS (emotional stability-conscientiousness) priority group. Group 3 was composed of players who scored medium on emotional stability and high on the other traits. This group was labelled the ES (emotional stability) priority group. Group 2 was composed of players who scored high on emotional stability and extraversion and medium on the other traits. This group was labelled the CS (conscientiousness) priority group. This analysis distinguished two main types of psychological services for collective development, focusing on emotional stability, conscientiousness or both.

To determine whether any facets would be useful in designing well-focused types of psychological support, multiple comparisons (Tukey method) were processed to find groups with similar traits who showed differences in Table 2. Groups 1 and 3 showed no difference on emotional stability ($p = 0.079$), nor did groups 2 and 3 ($p = 0.072$). However, groups 1 and 3 showed differences on some facets (self-confidence $p = 0.016$, stress vulnerability $p = 0.009$), but not on others (sensitiveness $p = 0.694$, frustration tolerance $p = 0.236$), whereas groups 2 and 3 showed differences on different facets (sensitiveness $p = 0.007$, frustration tolerance $p = 0.018$), but not on others (self-confidence $p = 0.270$, stress vulnerability $p = 0.963$).

Differences for emotional stability were observed between all groups: the differences between groups 1 and 3 were recorded for self-confidence and stress vulnerability, while the differences between groups 2 and 3 were recorded for sensitiveness and frustration tolerance. Thus, the design for psychological support regarding emotional stability could be particularly focused on self-confidence and stress vulnerability for group 1 and sensitiveness and tolerance frustration for group 2 (Table 3).

For the other traits, the multiple comparisons did not suggest groups to compare on the facets. There was no difference in conscientiousness for groups 1 and 2 ($p = 0.758$), and also no difference for any of the facets (organization $p = 0.888$, self-discipline $p = 0.334$, impulse control $p = 0.755$, achievement striving $p = 0.662$).

There was no difference in extraversion for groups 2 and 3 ($p = 0.998$), and also no difference for any facets (enthusiasm $p = 0.953$, sociability $p = 0.876$, energy $p = 0.610$, assertiveness $p = 0.948$). To sum up, the results showed that emotional stability and agreeableness were significantly lower than those of a standard population.

Sensitiveness, trust and self-discipline were also significantly lower, while competitiveness and frustration tolerance were significantly higher. Three groups could be identified (i.e., low on all traits except agreeableness, medium on emotional stability and high on the other traits, high on emotional stability and extraversion and medium on the other traits). Facets such as self-confidence, stress vulnerability, sensitiveness, and frustration tolerance were included in the differences between these groups.

The results indicated that the PCDEQ scores for the "long-term performance support" and "coping" factors could be judged as unsatisfactory regarding the MacNamara and Collins (2013) standards for talent development. The need for psychological support could be defined in terms of understanding the goals and sub-goals of development in relation to the coach and also in relation to stress management.

Other factors with moderate scores could be considered as needed to be supervised (i.e. quality of practice, support from others) and those with good scores (i.e. imagery and work on weak points) were considered as satisfying the request for talent development as they suggest the same standard. PEAS scores indicated that players were more vulnerable to, than protected from doping and substance use affordances based on previous research which set the threshold at 37 points (Morente-Sánchez et al., 2013). This result adds a new dimension to consider in the psychological support of these players.

GAD-7 scores also showed that most players suffered from moderate anxiety disorders according to the Spitzer et al.'s standards (Spitzer et al., 2006). This result indicates the difficulties that these athletes deal with, confirms the importance of the anxiety facets in the domain of emotional stability, and underlines the poor resources for coping identified with the PCDEQ.

Again, designing psychological support for these players in this direction appeared meaningful.

To sum-up, the results show specific needs for these players which relate to the management of the project including support towards goal setting, coping strategies as well as the quality of practice. Vulnerabilities to doping and anxiety disorders are respectively high and moderate.

Experience

Coding the part of the interview which focused on the players' preferred experiences showed differences regarding the enjoyment of physical conditioning and video sessions in comparison with other types of activity. The levels of effort showed a good correspondence with the demands of these types of activity. Concentration was relatively high for most of the activities. In addition, these results added another dimension for psychological support regarding the involvement in practice, especially in relation to increasing the players' enjoyment for conditioning and video session in order to promote a better involvement.

The second part of the interviews revealed three typical negative nuclear episodes experienced by these athletes during their sporting life to date: (a) hassles linked to their physical integrity (mainly injury or illness), (b) negative social interactions with head coaches and assessors, and (c) difficulties in combining their sports development and other life domains (private, studies, etc.).

The problems of physical integrity mainly concerned injuries during competition or training, fears of injury recurrences that caused them to engage differently (e.g. twisting an ankle again), and illness (e.g. growth problems). The problems of negative interactions in the sports environment were related to not being selected for the national team, poor relations with the coach or teammates, and poor performances.

The organizational, cultural and social difficulties mostly concerned the management of dual sports/study projects, language barriers, and distance from family. This part of the interviews offered complementary and new insights for the design of psychological support for these players.

To sum up, the interviews have revealed that these players experienced their activity with a level of concentration and effort that could be enhanced.

In addition, the negative experiences are concentrated on the difficulty to manage their dual projects, and on the interaction with the coaches.

Table 1: Psychometric Properties of the Sample's Facets and Traits

	M	SD	Min	Max	M std	t	p
Sensitiveness	26.6	3.82	19	32	29.63	-3.23	0.005
Self-confidence	25.6	4.18	18	32	25.51	0.13	0.894
Stress vulnerability	26.2	4.25	19	33	27.23	-1.02	0.322
Frustration tolerance	22.2	4.27	13	31	19.17	2.96	0.009
Enthusiasm	27.5	3.71	22	33	26.47	1.18	0.256
Sociability	23.7	3.53	13	30	24.73	-1.20	0.249
Energy	34.4	6.37	21	42	34.59	-0.11	0.910
Assertiveness	21.9	3.33	16	27	22.76	-1.02	0.325
Innovativeness and creativity	25.2	3.96	18	34	26.75	-1.64	0.121
Intellectual vs. Action orientation	32.3	6.29	23	50	33.41	-0.73	0.475
Self-observation	23.4	4.42	17	31	25.25	-1.72	0.105
Openness to change	37.2	5.59	27	45	37.7	-0.39	0.705
Competitiveness	32.8	4.07	24	41	28.57	4.25	0.001
Orientation towards others	31.5	4.86	24	40	33.53	-1.70	0.109
Trust	30.9	7.85	16	40	35.07	-2.17	0.045
Compliance	22.9	4	15	30	23	-0.12	0.905
Organization	34.6	6.11	26	49	36.54	-1.32	0.207
Self-discipline	34.3	6.78	19	48	38.37	-2.48	0.025
Impulse control	32.6	4.99	23	42	33.45	-0.71	0.487
Achievement striving	33.1	7.58	21	49	33.97	-0.46	0.649
Emotional stability	115.1	12.9	93	141	107.82	2.32	0.034
Extraversion	108.8	14.1	78	130	108.55	0.06	0.951
Openness to experience	118.1	15	87	140	123.1	-1.39	0.184
Agreeableness	112.6	13.9	81	136	123.04	-3.10	0.007
Conscientiousness	102	18.2	66	139	108.88	-1.56	0.139

Table 2: Differences in traits between groups [M (SD)]

	Group 1	Group 2	Group 3	F	p
Emotional stability	103.3 (8.6)	129 (9.8)	115.5 (9.1)	8.92	0.003
Extraversion	92.6 (9.3)	115.2 (10.7)	115.6 (9.5)	9.86	0.002
Openness to experience	109.2 (16.3)	110.7 (17.1)	127.2 (7.3)	3.88	0.046
Agreeableness	116 (11.9)	102.5 (18.6)	115.5 (11.7)	1.46	0.27
Conscientiousness	86 (13.2)	91.2 (8.4)	117.4 (10.5)	15.21	0.000

Table 3: Comparison of means related to emotional stability facets among groups [M (SD)].

	Group 1	Group 2	Group 3
Self-confidence	21.4 (4)		26.7 (2.8)
Stress vulnerability	29.8 (1.6)		24.6 (3.4)
Sensitiveness		21.7 (3.6)	28.4 (3)
Frustration tolerance		26.7 (4)	21.7 (2.3)

Table 4: Means, SD of PCDEQ, PEAS and GAD-7 with mean cutoffs for poor and good developers regarding the PCDEQ

Scales	Factors	M(SD)	Poor developers	Good developers
PCDEQ	Long-term performance support	3.93 (.72)	4.25	3.99
	Imagery use	4.17 (.73)	3.99	3.81
	Coping with pressure	4.02 (.48)	4.27	3.87
	Quality of practice	4.85 (.71)	4.9	4.77
	Evaluating performances and working on weaknesses	5.07 (.6)	4.99	4.56
	Social support	4.53 (.44)	4.62	4.45
PEAS		38 (9.9)		
GAD-7		5.3 (4.3)		

Table 5: Assessment of fun, physical effort and concentration experienced in the different types of training and competition (in %)

	Training forms						
	Conditioning	Technical tasks	Tactical tasks	Games	Futsal	Video	Competition
Fun	38	71	56	77	70	49	83
Effort	87	41	35	69	94	10	89
Concentration	65	78	75	76	90	74	89

DISCUSSION

The aim of this study was to examine the usefulness of a psychological model and psychological instruments associated to provide a complete, relevant and effective image of aspiring soccer players. Based on the evidence regarding the development of psychological characteristics in the sports talent environment and McAdams's multilayer framework for understanding personality, the instruments we selected furnished rich descriptions of these players and their needs so that their development can be optimally supported. Thus, the quality and fine detail of these results showed the relevance of these tools within a conceptual framework and their meaningful and discriminant roles in identifying psychological needs in this environment. Furthermore, the results suggest that these tools could be packaged as a set that centres for soccer talent development could fruitfully use.

One of the main findings in this French-speaking part of Switzerland sample is that the PfPI results indicated that two traits (emotional stability and conscientiousness) should be particularly targeted for talent development. Our results are in line with research showing that these two traits are associated with a wide range of behaviours, including those oriented towards health and achievement (Helsen, Starkes, and Hodges, 1998; Hornig et al., 2016; Oshio, Taku, Hirano, and Saeed, 2018; Piedmont, Hill, and Blanco, 1999; Steca, Barett, Greco, D'Addario, and Monzani, 2018; Tedesqui and Young, 2018). In addition, despite the relative stability of personality traits and facets over time, recent research has also shown how these dimensions can be transformed with intervention [e.g. Van Maarseveen, Oudejans, and Savelsbergh, 2018]. Thus, a focus on these traits and corresponding facets would be beneficial for these players in order to develop their resources for performance goals and mental and physical health.

At the second level of the McAdams framework, the PAC results with the PCDEQ suggested that support for the long term (skills and attitude for identifying goals and sub-goals and working on them) and involvement in quality practice (practice is not only considered as just a game, but also a series of achievement tasks) did not score at the level expected for good developers. This suggests that the interaction between our players and their environment was not stimulating enough to provoke the expected development (Collins and MacNamara, 2018; Martindale et al., 2005). Second, the level of coping identified by the PCDEQ and the anxiety scored on the GAD-7 indicated that these players were vulnerable to further detrimental effects on health and performance [e.g. Beable et al., 2017; Williams and Reilly, 2000]. Third, the PEAS scores suggested that these players were weakened regarding performance development by their attitudes towards substance use and other artificial performance-enhancement methods (De Mondenard, 1994; Morente-Sanchez et al., 2013).

At the narrative level, the results suggested that percentages of effort and/or concentration were mostly above 70% in most activities and attained the value observed by Helsen et al. (1998). These results did not completely match with the PAC results. However, the "fun" dimension assessments indicated very low scores for conditioning and video, suggesting that these activities were more perceived as constraints than as the suitable use of affordances for talent development. It might even be said that they were not appropriate in psychological terms as a meaningful practice but as a compulsory one (Van Maarseveen et al., 2018). A way to understand the meaning of the relatively low involvement in quality practice, as reflected in the PACs, emerged at this narrative level. Other results regarding nuclear episodes showed that these players were dealing with well-known constraints to sports talent development in terms of injury, coach relationships and compatibility with studies (e.g., Collins and MacNamara, 2018). These data suggest that the players may have encountered challenges that could have helped them in the talent development process (Sarkar, Fletcher, and Brown, 2015). However, Savage et al. suggested that three support mechanisms (i.e. psychological disposition, social support and psychological skills) are crucial to ensure that these challenges are beneficial for talent development (Savage, Collins, and Cruickshank, 2017). Our results suggested that all these mechanisms were not adequately developed in our sample.

For the French-speaking part of the Swiss population, the results showed that talented soccer players might be supported in mainly four directions: (a) management of emotional stability – including self-confidence, stress vulnerability, sensitiveness and tolerance frustration – in order to reduce anxiety and coping strategies regarding performance (injury), interactions (coaches and support) and studies; (b) enhanced involvement in practice, including conscientiousness (planning and self-discipline), quality practice, and building positive and supportive relationships with coaches; (c) protection against substance use and doping; and (d) the appropriation of activities that improve performance and increase the likelihood of benefiting from the challenges of talent development. Considered in isolation, the information produced by each instrument appeared to be useful. First, at the personality trait level, the results obtained with the PfPI showed that each player could be described individually at a very fine grain and that group needs could also be distinguished through cluster analysis for the design of small groups for psychological support programmes. Second, at the PAC level, the results of the three questionnaires provided information which could be used to design complementary themes for psychological support.

Third, at the narrative level, the results that simply focused on a coherent theme and nuclear episodes suggested unexpected factors which should be considered in the design of psychological support for talent development.

Several limitations could be identified in this study. First, we focused on French instruments which applied to our population. Several other tools could be used in other countries. Second, our separate analysis of the results was a limitation. Although the three levels are interconnected in McAdams's model, each can nevertheless be analysed in isolation. Therefore, because our aim was to analyse the impact of each of them, distinguishing the results in this case was relevant. Yet it would be interesting to develop a combined approach to reveal the relationships between the results. For example, it is impossible to know whether the GAD-7 score is mostly determined by trait dispositions or nuclear episodes or both. Future research might be developed in this direction, with an eventual definition of a single score that sums up the psychological characteristics needed for talent development which can also be used to monitor the athletes during the talent development process.

Applied implications

Taken together, the instruments provided a rich synopsis of psychological descriptions for talent development in soccer: the PfPI and PCDEQ offered a two-level description of these athletes regarding their dispositions and skills in interacting and developing with training and competition. The PEAS furnished a valid indication of their vulnerabilities and compliance with the requirements for elite performance. The GAD-7 assessed the early potential fragility regarding intensive exposure to stress if they are drafted as professional players. Lastly, the interviews focused on narratives and completed the descriptions on how they qualitatively interacted with the types of development practices and the unavoidable

problems they encountered. Among the panel of tests, instruments and inventories available for research and practice in sports psychology, the choice is often difficult for sports psychologists in their work with athletes. This study showed that a theory-driven approach is needed to organize this choice. The McAdams model provides a complete and useful framework for defining the levels of psychological characteristics in athletes that might be assessed. The tools selected in this study are solid instruments which can be used in other contexts. Indeed, this study revealed a methodology that can be replicated to identify the needs of aspiring soccer players in other countries and in other sports. In addition, and despite the specificity of the PCDEQ and PEA, the other instruments can be substituted with equivalent tools, validated in other languages, and this without reducing the relevance of the practice of assessment for professionals. Other tools can also be added to enrich the assessment of these three levels of personality and again, this without modifying the coherence of the framework.

The results suggest that the sets of needs that professionals might define using this methodology are multiple: at a global level, a set of general needs can be defined for a team or a group of athletes in a team centre and then be used to design a psychological service. At a more specific level, the data can be processed to determine whether the groups of needs emerge in a squad of players from an elite sport centre and even to identify individuality.

Lastly, for those who oversee programmes like athletic talent development, these instruments offer the possibility to accurately scan a situation to determine where the development of the psychological characteristics of talent is in progress and where it has stopped. This differential view of psychological levels is also well-suited to monitor the effects of psychological interventions and adjust the services. To conclude, we underline that these three levels of assessment are well-suited for professionals to support here-and-now talent development and to help consolidate the players' personalities in preparation for the inevitable future issues in cases of professional outcome.

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VIŠESLOJNI PRISTUP PROCJENI PSIHOLOŠKIH POTREBA IGRAČA FUDBALA KOJI TEŽE USPJEHU. IMPLIKACIJE PRAĆENJA RAZVOJA TALENTA

Cilj ove studije je ispitati relevantnost grupe instrumenata psihološke procjene za profesionalnu praksu u sportskoj psihologiji. Prikupljanje podataka o 70 talentovanih igrača fudbala (od 15 do 19 godina starosti) iz dijela Švicarske u kojem se govori francuski jezik je zasnovano na modelu koji je razvio McAdams. Podaci su obrađeni kako bi se utvrdile glavne karakteristike timova i razlike između podgrupa, te se potom uporedile sa standardnim vrijednostima. Rezultati ukazuju na potrebu za psihološkom podrškom u četiri pravca: (a) upravljanje emocionalnom stabilnošću kako bi se smanjila tjeskoba u vezi sa izvedbom (povredama), interakcijama (trenerima i podrškom); (b) povećanje sudjelovanja u praksi uključujući savjesnost, kvalitetnu praksu i izgradnju pozitivnih i potpornih odnosa sa trenerima; (c) zaštita od zloupotrebe supstanci i dopinga; i (d) usvajanje aktivnosti koje poboljšavaju izvedbu i povećavaju mogućnost ostvarivanja koristi od izazova. Rezultati su pokazali kako se ovi instrumenti mogu kompletirati tako da čine grupu instrumenata za praćenje razvoja talenta u fudbalu.

Ključne riječi: ličnost, samoregulacija, naracija, psihološke usluge, procjena, talent

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FATIGUE VS THE CHANGE OF KINEMATIC PARAMETERS DURING THE OVERHEAD PITCHING MOTION IN BASEBALL

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ABSTRACT

The purpose of this study was to find out the effect of fatigue on ball velocity in relation to kinematic changes in the sequence of motion performed by baseball pitchers. The samples of this study were 12 baseball male athletes, who played as pitchers of Universitas Pendidikan Indonesia, aged ± 19 years old, with the height of ± 171.4 cm and weight of ± 64.3 kg. The method used in this study was descriptive quantitative method with a pre-test and post-test design. The instruments of this study were three handy cams, a high speed video camera, a speed gun radar, a set of calibration tools, a force platform, a set of light markers, a motion capture system software and a heart rate monitor. The results of this study showed that there were six indicators which had a significant relationship with the overhead pitching speed when the pitchers were in the normal and fatigue conditions, including stride length percentage height, elbow flexion, maximum shoulder horizontal adduction, maximum elbow extension angular velocity, maximum shoulder internal rotation angular velocity, and lateral trunk tilt. The body segment motions which have high contributions on the pitcher's overhead pitching outcomes include the internal shoulder rotation, elbow extension angular velocity, and lateral trunk tilt.

Keywords: baseball, fatigue, kinematics, pitcher, sports biomechanics

INTRODUCTION

Fatigue is a crucial problem in baseball tournaments which has long been discussed in some scientific studies. Fatigue could be a factor which prevents and interrupts the decision making process of the player as well as prevents the cognition of the player during the tournament (Rusdiana, Ray & Umaran., 2017). Fatigue is an important factor to be recognized when assessing the performance and injury risks (Zwambag & Brown, 2009). In addition, fatigue is also becoming the factor which influences the quality of motion mechanics of a pitching motion technique as the effort to maintain the speed and accuracy of an ideal pitch (Grantham et al., 2014). It is also the key component of the injury risk since it could cause the

loss of the accurate mechanics of motion (Mullaney, et al 2005). This theory supports the fact that the exceeding number of pitches conducted by the pitcher will induce muscle fatigue (Fortenbaugh & Fleisig, Glenn S., 2009). During the pitching motion in baseball, it is believed that the most frequent injuries happen to the shoulder and elbow (Jílek, Josef., 2004). An overhand pitching motion consists of a sequence of body movements starting from lifting the leg, moving the hip and trunk, and concluding with the upper body extremity movement to push the ball towards the home plate (Seroyer & Nho, 2010). The pitching motion of a pitcher consists of a continuous sequence requiring dynamic power with the precise time and coordination of body segments to produce maximum accuracy and speed (Kinoshita & Obata, Satoshi., 2017). The result of the study conducted by Escamilla, et al (2006) shows that a pitcher begins to feel muscle fatigue

at the 5th and 6th inning. At those innings, the speed of the pitch significantly decreases which is caused by the decline of the maximal shoulder external rotation speed and the change in the angle of the knee joint when releasing the ball (Mullaney et al., 2005). The average velocity of the ball reaches 40m/s at the first inning and gradually decreases during the game until it lasts only 24 m/s at the last inning (Murray, et al 2001). Furthermore, the result of the study conducted by (Okoroha et al., 2018), when the simulation condition was conducted, discovers that the fatigue experienced by the pitcher increases after a successive inning. Maintaining the physical condition of a pitcher during a tournament will have impacts on the pitching speed performance since the 1 m/s escalation of speed would have an impact on the reaction time of the batter (Caldwell, Alexander, & Ahmad.). The quality of a pitcher depends on the hand muscle strength capacity and a series of perfect movement phase mechanisms involving six phases, namely, wind-up, lead foot contact, arm cocking, arm acceleration, ball release phase, and follow-through (Escamilla et al., 2006). Effective pitching is decided by a complicated relationship of the increased body segment speed starting from the lower to the upper body segments (Wilk & Macrina., 2011). The accuracy and speed in pitching should be taken into account to prevent the opponent from beating the ball (James, 2010). According to Solomito, Garibay, & Nissen (2018), pitching in baseball requires a series of complex movements as the coordinated fast movement occurs to provide an energy transfer from the lower leg to the pitching arm, and finally to the ball. Internal shoulder rotation during pitching is the fastest human motion recorded which happens for about 7250 degrees per second (Wilk & Macrina., 2011). The initial motion to the follow-through helps in transferring the energy from the leg during the drive and helps in improving the energy after the leg contact. Due to the importance of the pitching motion phase and the kinetic chains during pitching, a distraction of the body function will lead to a weak performance of pitching which would increase the risk of injury (Laudner, Wong, & Meister., 2018). According to the description in the introduction given above, the aim of this study was to find out the effect of maximum fatigue on the speed of pitching related to kinematic changes of the baseball pitcher's sequence of motion.

METHOD

A. Participants

The samples of this study were male baseball players of Universitas Pendidikan Indonesia which consisted of 12 pitchers aged ± 19 years old, with a height of ± 171.4 cm and the weight of ± 64.3 kg.

B. Research Method

The method used in this research was a descriptive quantitative method with a pre-test and post-test design.

C. Instruments

The instruments used in this study were three high resolution handy cams (Sony Mc 2500 Professional), a high speed video camera (Fastec TS5-H), a speed gun radar (Bushnell 101922), a set of calibration tools, a force platform (The AMTI Optima Series 20210), a set of light markers, a motion capture system software (Frame DIAZ IV, Ltd) and a heart rate monitor (Polar M400).

D. Statistical Analysis

The data analysis was administered by using the SPSS programme (Statistical Product and Service Solutions) version 21.0 for Windows. After analysing the normality and homogeneity of data, the relationship between the velocity of the ball and the pitcher kinematics indicator variable was administered by employing the bivariate correlation technique with the degree of trust set to 95%.

E. Data Collection Procedures

To examine the pitcher's pitching motion, three video cameras were needed. The first camera was placed perpendicularly beside the pitcher with a 3m distance. Camera 2 was placed perpendicularly in front of the pitcher with a 2m distance. Meanwhile, the camera 3 was placed perpendicularly above the pitcher with a 1.5m distance. The 3D Force Platform was placed in front of the pitcher's foot with a 30cm distance as the aim to discover the leg power and force, while the speed gun radar, used to measure the speed of the ball, was placed perpendicularly in front of the pitcher at a 4m distance. The scheme of the data collection procedure can be seen in the following figure

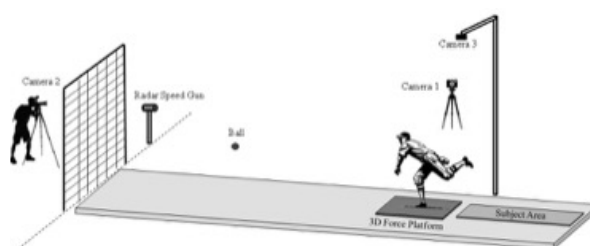


Figure 1: The data collection scheme at the field

During the process of the first data collection stage, each pitcher performed the pitching ten times, alternately, after the first pitcher's pitching to avoid fatigue. Furthermore, during the second stage, each pitcher received a running activity treatment on the treadmill until reaching the maximum pulse rate, above 85%, using the direct testing maximal aerobic capacity approach by Cosmed K4b2 and Polar heart rate monitor.

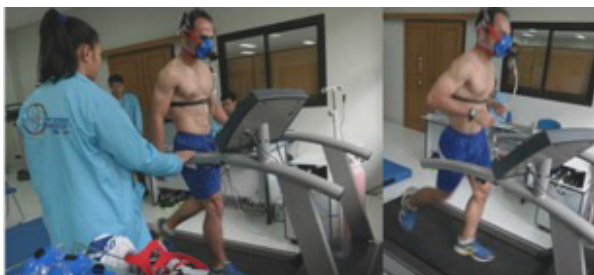


Figure 2: Fatigue testing using the Cosmed K4b2 and Polar heart rate monitor.



Figure 3: The picture taken during the data collection process at the sport science laboratory of the Faculty of Sport and Health Education UPI

F. Kinematics - Motion Analysis

During the lead foot contact, the stride length, elbow flexion, shoulder external rotation, shoulder abduction, shoulder horizontal abduction, knee flexion, leg power, and ground reaction force indicators were measured. Moreover, there were three kinematic indicators measured during the arm cocking phase, including the maximum elbow flexion, maximum shoulder external rotation, and maximum shoulder horizontal adduction.

During the phase of arm acceleration, there were three kinematic indicators measured, namely, the maximum elbow extension angular velocity, maximum shoulder internal rotation, and shoulder abduction. There were five kinematic indicators measured during the ball release phase, including knee flexion, forward trunk tilt, lateral trunk tilt, shoulder horizontal adduction, and elbow flexion.

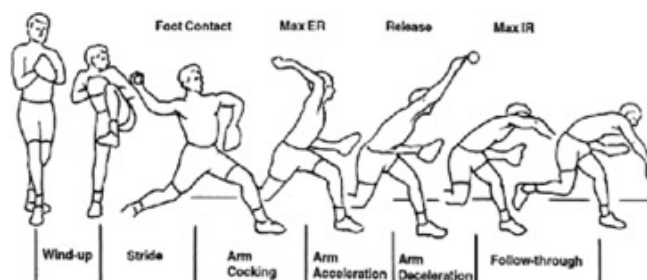


Figure 4: Temporal phases of pitching mechanics (Fleisig et al., 2006)

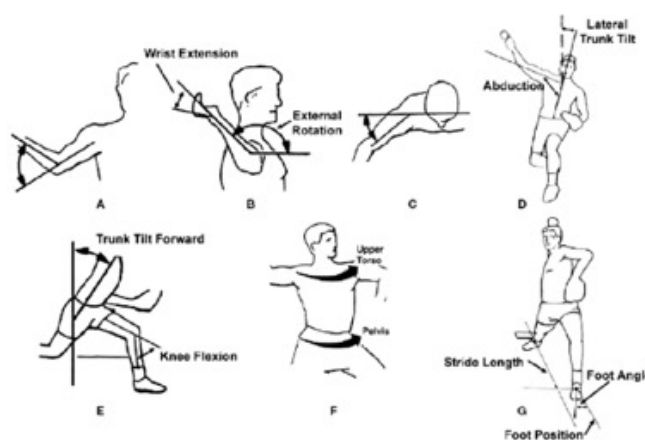


Figure 5: Depiction of kinematic parameters (Fleisig et al., 2006)

RESULTS

A. The Kinematics of the Pitcher's Motion Analysis
The result of data analysis pertaining to 15 pitchers at the lead foot contact phase presents the description of each indicator in the normal condition (Table 1), and in the maximum fatigue condition (Table 2). After the data analysis was conducted, the mean and standard deviation of each indicator were gained:

Table 1: Descriptive analysis of the indicators at the lead foot contact phase in the normal and maximum fatigue condition

Lead Foot Contact Phase Parameter	Normal		Fatigue	
	Mean	SD	Mean	SD
Stride length height (cm)	68.4	7.8	53.6	6.4
Shoulder abduction (deg)	103.5	12.3	97.5	11.2
Shoulder external rotation (deg)	99.1	17.7	94.1	16.9
Shoulder horizontal adduction (deg)	25.5	1.34	23.9	1.25
Knee flexion (deg)	130.2	20.3	128.5	19.6
Elbow flexion (deg)	82.7	11.6	70.7	10.2
Leg power (kg/watt)	93.3	29.3	91.7	28.6
Ground reaction force (N)	767.2	171.3	755.9	164.7
Ball velocity (m/s)	18.7	1.58	12.1	1.04

Table 2: Descriptive analysis of the indicators at the arm cocking phase in the normal and maximum fatigue condition

Arm Cocking Phase Parameter	Normal		Fatigue	
	Mean	SD	Mean	SD
Maximum shoulder external rotation (deg/s)	161.6	6.3	158.4	5.8
Maximum shoulder horizontal adduction (deg/s)	155.7	7.3	140.5	9.3
Maximum elbow flexion (deg/s)	69.0	8.3	67.1	7.7

Table 3: Descriptive analysis of the indicators at the arm acceleration phase in the normal and maximum fatigue condition

Arm Acceleration Phase Parameter	Normal		Fatigue	
	Mean	SD	Mean	SD
Shoulder abduction (deg)	107.3	8,1	101.4	7.8
Maximum elbow extension angular velocity (deg/sec)	2361.8	29.2	2021.4	24.3
Maximum shoulder internal rotation angular velocity (deg/s)	2617.3	21.2	2134.7	26.7

Table 4: Descriptive analysis of the indicators at the ball release phase in the normal and maximum fatigue condition

Ball Release Phase Parameter	Normal		Fatigue	
	Mean	SD	Mean	SD
Knee flexion (deg)	134.9	10.8	131.4	10.1
Forward trunk tilt (deg)	39.7	5.5	35.1	5.1
Lateral trunk tilt (deg)	29.9	10.9	15.1	8.2
Angle elbow flexion (deg)	140.3	19.1	136.6	18.4
Shoulder horizontal adduction (deg)	56.5	5.8	54.5	5.4

B. Differences Between Fatigue and Normal Condition During Pitching

To measure the level of relationship between the kinematics of the motion variable with the ball velocity produced in the normal and maximum fatigue condition, the difference between two mean tests (t-test) was conducted.

Table 5: The result of the t-test for ball velocity on the kinematics of motion changes at the lead foot contact phase

Lead Foot Contact Phase Parameter	T-value
Stride length percentage height	0.041*
Shoulder abduction	0.071
Shoulder external rotation	0.791
Shoulder horizontal adduction	0.706
Knee flexion	0.848
Elbow flexion	0.046*
Leg power	0.865
Ground reaction force	0.408

Table 5 presents the results indicating the existence of a significant different effect, in the normal and fatigue condition, of the stride length percentage height indicator ($p = 0.041$) and the elbow joint indicator ($p = 0.046$) on the velocity of ball pitching in the lead foot contact phase.

Table 6: The result of the t-test for ball velocity on the kinematics of motion changes in the arm cocking phase.

Arm Cocking Phase Parameter	T-value
Maximum shoulder external rotation	0.821
Maximum shoulder horizontal adduction	0.041*
Maximum elbow flexion	0.742

Table 6 contains the result indicating a significant different effect, in the normal and fatigue condition, of the maximum shoulder horizontal adduction indicator ($p = 0.041$) on the ball pitching velocity in the arm cocking phase.

Table 7: The result of the t-test for ball velocity on the kinematics of motion changes in the arm acceleration phase

Arm Acceleration Phase Parameter	T-value
Shoulder abduction	0.828
Maximum elbow extension angular velocity	0.035*
Maximum shoulder internal rotation	0.029*

Table 7 shows that there is a significant difference in the normal and fatigue condition of the maximum elbow extension angular velocity indicator ($p = 0.035$) and the maximum shoulder internal rotation indicator ($p = 0.029$) on the velocity of the pitcher's ball pitching in the arm acceleration phase.

Table 8: The result of the t-test for ball velocity on the kinematics of motion changes in the ball release phase

Ball Release Phase Parameter	T-value
Knee flexion	0.398
Forward trunk tilt	0.937
Lateral trunk tilt	0.009*
Elbow flexion	0.340
Shoulder horizontal adduction	0.878

Table 8 indicates that there is a significant difference, in the normal and fatigue condition, of the lateral trunk tilt indicator ($p = 0.009$) on the velocity of ball pitching performed by the pitcher during the ball release phase.

DISCUSSION

The results of the analysis in this research focus on analysing the kinematics of the pitcher's motion with 19 indicator parameters divided into four phases, including the lead foot contact phase, arm cocking phase, arm acceleration phase, and ball release phase. The motion of a pitcher involved a coordinated movement from the lower and upper muscle groups to push the ball with the aim to create maximum velocity.

The ball velocity reached 17.7m/s when the pitcher was in the normal condition and 12.1m/s when the pitcher was in the fatigue condition, indicating a significant difference ($p = 0.0345$). The result of the t-test when the pitcher was in the normal and fatigue condition shows significant differences of

the six parameters on ball velocity, involving the stride length percentage height, elbow flexion, maximum shoulder horizontal adduction, maximum elbow extension angular velocity, maximum shoulder internal rotation angular velocity, and lateral trunk tilt indicators.

The main contribution of the rotation motion of the elbow extension angular velocity and internal shoulder rotation when pitching the ball is not only found in the baseball game, but also in the badminton sport game during smash (Laudner et al., 2018), in tennis serve (Murray & Cook., 2001), and during the penalty throw in handball games (Solomito & Garibay., n.d.).

From the results of the research mentioned above, there were also two indicators that had an

effect on ball velocity during the lead foot contact phase named stride length percentage height and elbow flexion, which is consistent with the research conducted by Werner, Suri, Jr, Meister., et al (2008).

The result of another study conducted by Trigt, Schallig, & Graaff, (2018) entitled "Knee Angle and Stride Length in Association with Ball Speed in Youth Baseball Pitchers" is also in line with the finding of the study that the lateral trunk tilt has a significant relationship with the ball velocity during the ball release.

This result is consistent with several research related to the role of trunk tilt as the major support of the sequence of pitching kinetics to produce the maximum ball velocity.

The increase of the lateral trunk tilt angle, which is far from the hand during pitching, could improve ball velocity.

There are six indicators that have a significant relationship with the velocity of the ball pitching when the pitcher is in the normal and fatigue condition, including stride length percentage height, elbow flexion, maximum shoulder horizontal adduction, maximum elbow extension angular velocity, maximum shoulder internal rotation angular velocity, and lateral trunk tilt. The body segment motions which highly contribute to the outcome of the pitcher's ball pitching involve internal shoulder rotation, elbow extension angular velocity, and lateral trunk tilt.

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POREĐENJE UMORA I PROMJENE KINEMATIČKIH PARAMETARA TOKOM POKRETA BACANJA LOPTE U BEJZBOLU

Svrha ove studije je ispitati efekat umora na brzinu lopte u odnosu na kinematičke promjene u nizu pokreta koje izvode bacači u bejzbolu. Uzorci u ovoj studiji su bili 12 igrača bejzbola koji su igrali na poziciji bacača na Edukacijskom univerzitetu u Indoneziji, dobi ± 19 godina starosti, visine ± 171.4 cm i težine ± 64.3 kg. Metoda korištena u ovoj studiji je bila deskriptivna i kvantitativna metoda sa pretestiranjem i posttestiranjem. Instrumenti korišteni u ovoj studiji su bili tri Handycam kamere, video kamera velike brzine snimanja, ručni radar, komplet alata za podešavanje, platforma za mjerenje sile reakcije podloge, komplet svjetlosnih označivača, software za bilježenje pokreta i monitor srčane frekvencije. Rezultati ove studije su ukazali na postojanje šest indikatora koji su imali značajnu vezu sa brzinom bacanja lopte kada su bacači bili u normalnom i stanju umora uključujući prosječnu dužinu koraka, savijanje lakta, maksimalnu horizontalnu adukciju ramena, maksimalnu kutnu brzinu ekstenzije lakta, maksimalnu kutnu brzinu unutrašnje rotacije ramena, i bočni nagib trupa. Pokreti dijelova tijela za koje smo utvrdili da su uvelike doprinijeli rezultatima bacanja lopte od strane bacača uključuju unutrašnju rotaciju ramena, kutnu brzinu ekstenzije lakta i bočni nagib trupa.

Ključne riječi: bejzbol, umor, kinematika, bacač, biomehanika sporta

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FINANCIAL MANAGEMENT PROCEDURES OF OLYMPIC SPORT FEDERATIONS OF BOSNIA AND HERZEGOVINA AND THE OLYMPIC SPORT FEDERATIONS OF SERBIA, CROATIA, SLOVENIA AND MONTENEGRO

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ABSTRACT

This article explores the current level of development and differences of Sport Federations with regard to financial management. The paper provided an insight into the financial practices and procedures through a questionnaire addressed to Sport Federations which are members of the National Olympic Committee of Bosnia and Herzegovina, Croatia, Serbia, Montenegro and Slovenia. The research attempted to inspect the current level of development and differences between the Sport Federations in order to provide recommendations that will serve to improve the current practices of the Sport Federations of Bosnia and Herzegovina.

Keywords: Olympic Sport Organisations, financial performance, financial planning

INTRODUCTION

Olympic Sport Organisations (OSO), such as National Sport Federations, are generally non-profit oriented.

In fact, as Chappelet (2017) indicates, they combine certain characteristics of commercial organisations (especially when they sell broadcasting or marketing rights for their events) with those of public organisations (when they draw up rules

for their sports and their events). The main goal of these organisations is to promote their sport, therefore, their resources are directly linked to the development of sport activities and competitions for their members (Winand, Zintz, and Scheerder, 2012). National Sport Federations are responsible for governing all aspects of a sport within their respective countries (Pedras, Taylor, and Frawley, 2019).

The specific goals for each sport have been found to focus on what the National Sport Federations colloquially refer to as the 3Ms: money (increasing revenues), membership (increasing the number of people who are members or the numbers of participants in their sport), and medals (increasing the number of medals won at international competitions, and in particular, the Summer and Winter Olympic Games (Pielke, Harris, Adler, Sutherland, Houser, and McCabe, 2019).

The tasks of National Sport Federations include representing one or more sports, acting on behalf of their interests in relation to society, national and international sport organisations, promoting competitive sport and organising competitions, championships and sport events as well as articulating the rules and regulations which govern them (Nagel, Schlesinger, Bayle, and Giauque, 2015). For this reason, their financial performance focuses on financial stability, balanced budget and funding goals, which might be considered as a central topic for long-term sustainability (Harrison, and Sexton, 2004).

However, it is important to understand that, even if these associations might be not-for-profit, they are certainly not-for-loss either (Casteuble, 1997). This is the reason why non-profit financial performance is crucial for their survival and of interest to be analysed (Winand, Zintz, and Scheerder, 2012). In addition, if one is to take into account the analysis of their performance, apart from administration, competitions, membership, athlete development, coach education, facilities and equipment, honours and awards, finance as well needs to be taken into account (Robinson, and Minikin, 2011).

Funding in these organisations vary between membership fees, fund raising, financial support through sponsorship, unconditional grants and grants related to specific objectives (Kikulis, Slack, and Hinings, 1992). Most of the countries taken into consideration in this paper have a combined method of funding consisting of public funding, sponsorship, fund raising and other available sources of income. No matter what sources of income they have or how developed they are, finances are crucial for good functioning of an OSO. As Camy and Robinson (2007, p. 164) said, "no matter how great the potential within an OSO, how well designed its

internal structure or how good the athletes it produces, an OSO with poor financial management will experience problems at several levels. Finances are the lifeblood of an organization. Simply put, if finances are out of control, so is the organization".

This paper explores six key factors in financial management: the average annual incomes of federations, financial planning procedures, financial management responsibilities, financial policies and procedures in place, controls of payments and auditing procedures that federations have in place. The aim was to determine whether there was a difference in financial management procedures and development between Bosnia and Herzegovina and the neighbouring Western Balkan countries: Serbia, Croatia, Slovenia and Montenegro.

These countries have been used as the sport industry benchmark given the fact that they have better sporting results and are considered generally more successful in sport. They are also countries of similar size in terms of population numbers and countries with a rather similar sporting system background as they have been part of the same country (SFR Yugoslavia) until the 1990s.

Even at the very beginning of the research, it was evident that Bosnia and Herzegovina, when compared to the neighbouring countries (mentioned above), has an insufficient amount of financial income coming from public funds devoted to the national sports federations and sport in general (Radjo, Drid, Sadzak, and Sadzak, 2013). The general income of the Olympic Sport Federations from Bosnia and Herzegovina includes several sources of income among which the most important are marketing, state funding and International Federations.

The percentage would seem to depend on various factors and the most important one is the ability of the people in charge of leading the federation to attract funds either by lobbying at all state levels or through marketing. Furthermore, some external factors such as the tradition and attractiveness of the sport significantly contribute to the general position of the given sport within the country and the marketing income (Radjo, Drid, Sadzak, and Sadzak, 2013).

The aim of this paper is to undertake a critical evaluation concerning the aspects of financial management procedures pertaining to the National Sport Federations in Bosnia and Herzegovina by analysing the data and comparing it with the above-mentioned countries from the West Balkan region. This could serve as a reference for a strategic plan to develop an effective system by adapting the existing knowledge regarding the systems, which leads to success in other nations. The research primarily attempts to synthesise the obtained findings and compare it with the results of other countries in order to contribute to the financial management development of the Sport Federations in Bosnia and Herzegovina.

METHODS

The research design emerged from the ultimate goal of the study, which primarily attempted to increase the knowledge about the financial management procedures in Bosnia and Herzegovina Olympic Sport Federations. The analytical model of the International Olympic Committee (Robinson, and Minikin, 2011) UMAP tool provided the basis for the research protocol and its simplified analytical framework with changes specific to the research and our nation's context. The questions were meticulously structured and addressed all relevant aspects of financial resources in the organisations.

RESULTS

Six different components of financial management were computed for each of the 77 Sport Federations in order to determine the potential differences in financial management procedures between Bosnia and Herzegovina and the above-mentioned countries. Having in mind Camy and Robinson's statement (2007) that "good financial management can be defined as monitoring and communicating an organization's cash flow prudently and in marketing, state funding and International Federations. The percentage would seem to depend on various factors and the most important one is the ability of the people in charge of leading the federation to attract funds either by lobbying at all state levels or through marketing. Furthermore, some external factors such as the tradition and attractiveness of the sport significantly contribute to the general position of the given sport within the country and the marketing income (Radjo, Drid, Sadzak, and Sadzak, 2013). The aim of this paper is to undertake a critical evaluation

concerning the aspects of financial management procedures pertaining to the National Sport Federations in Bosnia and Herzegovina by analysing the data and comparing it with the above-mentioned countries from the West Balkan region. This could serve as a reference for a strategic plan to develop an effective system by adapting the existing knowledge regarding the systems, which leads to success in other nations. The research primarily attempts to synthesise the obtained findings and compare it with the results of other countries in order to contribute to the financial management development of the Sport Federations in Bosnia and Herzegovina.

A total of 25 National Sport Federations from Bosnia and Herzegovina have been assessed thorough a questionnaire addressing the financial management, followed by a comparison with the Sport Federations from the region (52 Sport Federations from Slovenia, Serbia, Croatia and Montenegro). These countries have been used as the sport industry benchmark given the fact that they have better sporting results and are considered to be more successful. After the collection phase, the obtained data have been systematically sorted and synthesised to provide an easy and understandable analysis. The significance of differences and examinations have been determined using the chi-square test (χ^2). accordance with the law. It requires both a broad strategy form a planning perspective and articulate implementation and recording." the results the authors gained in this research could be used as recommendations for improving the financial management of the above-mentioned National Federations. Table 1 shows the annual income of the Olympic Sport Federations of Bosnia and Herzegovina, Montenegro, Croatia, Slovenia and Serbia.

Table 1: Average annual income

	BiH	MNG	Croatia	Slovenia	Serbia	Total
	0	17	13	13	14	57
Did not answer	0.0%	29.8%	22.8%	22.8%	24.6%	100.0%
	-4.9	2.5	.7	.5	1.1	
	3	0	0	0	0	3
No income	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	3.6	-.9	-.9	-.9	-.9	
	14	5	1	3	1	24
Up to EUR 50.000	58.3%	20.8%	4.2%	12.5%	4.2%	100.0%
	5.4	.1	-2.1	-1.1	-2.1	

	5	2	2	4	4	17
Up to EUR 250.000	29.4%	11.8%	11.8%	23.5%	23.5%	100.0%
	1.1	-.9	-.9	.3	.4	
	2	1	6	4	5	18
Up to EUR 1.000.000	11.1%	5.6%	33.3%	22.2%	27.8%	100.0%
	-.9	-1.7	1.5	.2	.9	
	1	1	4	3	2	11
More than EUR 1.000.000	9.1%	9.1%	36.4%	27.3%	18.2%	100.0%
	-.9	-.9	1.4	.6	-.2	
$\chi^2 = 62.99; p < 0.001$						

The result of the analysis conducted on the observed frequencies, calculated according to the standardised adjusted residuals, indicates that there is a statistically significant difference between the results ($\chi^2 = 62.99; p < 0.001$). One can notice the following: The most frequent answer "up to EUR 50.000" statistically significantly dominates for the Federations from Bosnia and Herzegovina with the frequency of 14 answers (ASR = 5.4, 58.3%), in comparison to the Federations from the other countries. Only one federation from Croatia has the average annual income up to EUR 50.000 (ASR = -2.1, 20.8%). The answer "No income" is statistically significantly different for the Federations from Bosnia and Herzegovina (most answers ASR = 3.6; 100%) and the other countries which did not have Federations without an income. These results indicate that there are significant differences in the

amounts of annual incomes between the Federations from the observed countries. Unlike the Federations from the other countries, most of the Federations from Bosnia and Herzegovina have an annual income up to EUR 50.000. The given results, along with the fact that there is only one federation in Bosnia and Herzegovina with the annual turnover that exceeds the sum of EUR 1.000.000 (in Croatia there are 4 Federations that exceed this sum), indicate that the Federations from Bosnia and Herzegovina have lower incomes and therefore lower financial management performance leading to their activities being less developed. The reasons are related to the fact that Federations from Bosnia and Herzegovina did not manage to create mechanisms, which would allow them to be less dependent on public funding, and, unlike the other countries, they don't have an adequate financial support from the state that would stimulate sport development.

Table 2: A description of the financial planning process in the National Federation

	BiH	MNG	Croatia	Slovenia	Serbia	Total
Did not answer	0	17	12	12	14	55
	0.0%	30.9%	21.8%	21.8%	25.5%	100.0%
	-4.8	2.7	.4	.3	1.3	
No plan	1	0	0	0	0	1
	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	2.1	-.5	-.5	-.5	-.5	
We don't have a formal process of planning, the Federation acts according to the possibilities	10	4	0	1	0	15
	66.7%	26.7%	0.0%	6.7%	0.0%	100.0%
	5.0	.7	-2.1	-1.4	-2.1	
The Federation has a simple planning process that suggests where the funds can be allocated	4	3	5	1	3	16
	25.0%	18.8%	31.3%	6.3%	18.8%	100.0%
	.6	-.1	1.2	-1.5	-.1	
The Federation has a clear planning procedure in accordance with the organisation's needs and available funds	7	1	2	4	3	17
	41.2%	5.9%	11.8%	23.5%	17.6%	100.0%
	2.5	-1.6	-.9	.3	-.3	
The Federation has a well-structured financial planning procedure which is in accordance with the strategic plan	3	1	7	9	6	26
	11.5%	3.8%	26.9%	34.6%	23.1%	100.0%
	-1.1	-2.3	1.0	1.9	.4	
$\chi^2 = 61.22; p < 0.001$						

Financial planning is a process that helps the organisation to get a better control of the financial resources by doing an estimation of the financial situation. If we take into consideration the analysis indicated in Table 2, we can deduce that there is a statistically significant difference between the answers of the Federations from the countries taken in consideration ($\chi^2 = 61.22$; $p < 0.001$). The most frequent answer among all Federations is "The Federation has a well-structured financial planning procedure which is in accordance with the strategic plan", with a total of 26 responses. The answer "We don't have a formal process of planning, the Federation reacts according to the possibilities" is significantly different for the Federations from Bosnia and Herzegovina in comparison to the other countries (most answers ASR = 5.0; 66.7%). The answer "The Federation has a clear planning procedure in accordance with the organisation's needs and available funds" has a higher value for the Federations from Bosnia and Herzegovina (ASR = 2.5, 41.2%). The results indicate that, unlike the Federations

from Croatia, Serbia and Slovenia, the highest number of Federations from Bosnia and Herzegovina does not have a formal planning procedure, the highest number of Federations acts according to the possibilities. This fact is most certainly related to the instability in the public funds availability and the inexistence of a permanent financing system, which could cover the basic needs of the federation. This instability is one of the reasons why the Federations have to focus on the way to attract resources by reinforcing the fundraising and their own commercial activities. In any case, a thorough financial planning with the adequate risk assessment management would most certainly affect the development of Bosnian Sport Federations, therefore, the practice of financial planning needs to be enhanced in order to improve the financial performance and the ability to obtain income, which is highly correlated with the success of the organisation (Koski, 1995) and the development of the organisation itself.

Table 3: Persons responsible for managing finances in the National Federation

	BiH	MNG	Croatia	Slovenia	Serbia	Total
	0	17	13	12	14	56
Did not answer	0.0%	30.4%	23.2%	21.4%	25.0%	100.0%
	-4.8	2.6	.8	.2	1.2	
	1	0	0	0	0	1
Anyone who receives the money	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	2.1	-.5	-.5	-.5	-.5	
	6	2	2	4	2	16
The volunteer treasurer	37.5%	12.5%	12.5%	25.0%	12.5%	100.0%
	2.0	-.8	-.8	.4	-.8	
	14	5	4	1	3	27
Secretary General	51.9%	18.5%	14.8%	3.7%	11.1%	100.0%
	4.8	-.2	-.8	-2.5	-1.3	
	3	0	3	0	2	8
The Federation has a financial department, with an employee treasurer, which reports to the Executive Board	37.5%	0.0%	37.5%	0.0%	25.0%	100.0%
	1.4	-1.5	1.3	-1.5	.4	
	1	2	4	10	5	22
Besides the financial department, the Federation has several employees with the responsibility of financial management	4.5%	9.1%	18.2%	45.5%	22.7%	100.0%
	-1.9	-1.4	-.2	3.1	.4	

$$\chi^2 = 59.74; p < 0.001$$

Table 3 treats the responsibility for the financial management in the Federations. Based on the analysis of the differences in frequencies computed according to the adjusted standardised residuals, we can also notice that there is a statistically significant difference between the answers ($\chi^2 = 59.74$; $p < 0.001$). The most common answer "Secretary General", with the frequency of 14 answers (ASR = 4.8, 51.9%), statistically dominates for the Sport Federations from Bosnia and Herzegovina in comparison to the other countries taken into consideration in this research. The answer "Besides the financial department, the Federation has several employees with the responsibility of financial management" is statistically

different for the Sport Federations of Slovenia (most answers ASR = 3.1; 45.5%) and the other countries. The frequency of the answers to this question indicated that, in most National Sport Federations in Bosnia and Herzegovina, the person responsible for the financial management is the Secretary General, which is not the case for the other countries in the region. This is understandable if we take into consideration that in most of the Sport Federations from Bosnia and Herzegovina, the Secretary General is the only employee and as such is responsible for the management of all the resources and the Federation's activities.

Table 4: Financial policies and procedures in the National Federation

	BiH	MNG	Croatia	Slovenia	Serbia	Total
Did not answer	0	17	12	12	14	55
	0.0%	30.9%	21.8%	21.8%	25.5%	100.0%
	-4.8	2.7	.4	.3	1.3	
No procedures in place	4	1	1	0	0	6
	66.7%	16.7%	16.7%	0.0%	0.0%	100.0%
	3.0	-.2	-.2	-1.3	-1.3	
The Federation has some universal procedures	8	3	2	1	0	14
	57.1%	21.4%	14.3%	7.1%	0.0%	100.0%
	3.8	.1	-.6	-1.3	-2.0	
The Federation has guidelines which cover some aspects related to the financial procedures and cash management	4	0	2	2	0	8
	50.0%	0.0%	25.0%	25.0%	0.0%	100.0%
	2.3	-1.5	.4	.3	-1.5	
The Federation has adopted a financial management manual	4	4	0	1	5	14
	28.6%	28.6%	0.0%	7.1%	35.7%	100.0%
	.9	.8	-2.0	-1.3	1.6	
The Federation has a financial policy which covers all the financial issues, planning, budgeting and accounting	5	1	9	11	7	33
	15.2%	3.0%	27.3%	33.3%	21.2%	100.0%
	-.7	-2.8	1.2	2.1	.2	

$$\chi^2 = 61.76; p < 0.001$$

The Table 4 represents the analysis of the differences regarding the federations' financial policies and procedures. According to the results, we can deduce that there is a statistically significant difference between the answers ($\chi^2 = 61.76$; $p < 0.001$). The differences calculated according to the adjusted standardised residuals have been noted for the following answers: The most frequent answer with 33 responses "The Federation has a financial policy which covers all the financial issues, planning, budgeting and accounting" statistically dominates for the NOCs of Slovenia (ASR = 2.1, 33.3%). The answer "No procedures in place" is statistically different for the Federations of Bosnia and Herzegovina with most answers (ASR = 3.0; 66.7%) in comparison to the other NOCs. The answer "The Federation has some universal procedures" also differentiates the NOCs of Bosnia and Herzegovina in comparison to the other countries (ASR = 3.8, 57.1%) which is also the case with the answer "The Federation has guidelines which cover some aspects related to the financial procedures and cash management" (BiH – ASR = 2.3, 50%).

According to the results, we can deduce that there is a significant difference in the structure and type of financial procedures that the Federations from the countries taken into consideration in this study have in place. The results also indicate that the Federations from Bosnia and Herzegovina have less developed financial procedures in comparison to the Federations from Serbia, Slovenia and Croatia. Taking into consideration this deviation and the fact that the establishment of financial policies and procedures is a crucial element of good financial management no matter the size of the federation, it is evident that the Bosnian

Sport Federations need to implement the necessary changes which would include the adoption of a proper financial policy which covers all the financial issues, planning, budgeting and accounting in order to improve their financial performance. The results comparison of the question related to the type of financial control that the Federations have in place indicates that there is a statistically significant difference between the answers of the Federations from different countries ($\chi^2 = 69.19$; $p < 0.001$) (Table 5). The most frequent answer is "The Federation has formal procedures of financial monitoring which include approval, monitoring of the budget and accounting" with 33 frequencies and is noted for Federations from Croatia, Slovenia and Serbia. The answer "The Federation has formal procedures of costs approval which need to be approved in advance" statistically significantly dominates for the Federations from Bosnia and Herzegovina with a frequency of 11 answers (ASR = 3.7, 45.8%).

The answer "We have more than one signature on the payments" is statistically significantly dominant for the Federations from Bosnia and Herzegovina (most answers ASR = 4.7; 100%). This is also the case for the answer "The costs need to be justified and explained to the Executive Board, sometimes even after the activities/project" where Bosnian Sport Federations have the highest number of answers (ASR = 2.3, 45.5%). The results indicate a significant difference in the types of financial control pertaining to the Federations from the observed countries. The results also indicate that the level of control in the Federations from Bosnia and Herzegovina is significantly different from the Federations from Serbia, Slovenia and Croatia, which in most cases have structured financial control that includes formal procedures of financial monitoring with approval, monitoring of the budget and accounting.

Table 5: The type of control over payments in the National Federation

	BiH	MNG	Croatia	Slovenia	Serbia	Total
Did not answer	0	17	12	12	14	55
	0.0%	30.9%	21.8%	21.8%	25.5%	100.0%
	-4.8	2.7	.4	.3	1.3	
No control in place	0	0	0	1	0	1
	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
	-.5	-.5	-.5	2.0	-.5	
The General Assembly adopts the final reports	22	7	7	10	2	48
	45.8%	14.6%	14.6%	20.8%	4.2%	100.0%
	5.9	-1.2	-1.2	.0	-3.5	
Donors of grants provide financial control for the designated funds	2	0	0	0	0	2
	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	2.9	-.7	-.7	-.7	-.7	
We have external audit for the funds that we receive (example from the Government or local sponsors)	1	1	4	0	10	16
	6.3%	6.3%	25.0%	0.0%	62.5%	100.0%
	-1.4	-1.5	.5	-2.2	4.5	
Financial statements are audited by an independent external and qualified auditor	0	1	3	4	0	8
	0.0%	12.5%	37.5%	50.0%	0.0%	100.0%
	-1.4	-.5	1.3	2.1	-1.5	

$$\chi^2 = 80.86; p < 0.001$$

The results of the observed frequencies related to the question "What kind of financial report control does the Federation have in place?" indicate that there is a statistically significant difference between the answers ($\chi^2 = 80.86$; $p < 0.001$). The most common answer with 48 responses "The General Assembly adopts the final reports" statistically significantly dominates for the Federations from Bosnia and Herzegovina (22 answers ASR = 5.9, 45.8%).

The answer "We have external audit for the funds we receive (example from the Government or local sponsors)" statistically differentiates the Federations from Serbia (most answers ASR = 4.5; 62.5%). The answer "Financial statements are audited by an independent external and internationally recognised auditor" is the most frequent response for the Federations from Slovenia (ASR = 2.1, 50%). Taking this into account, the results indicate that a higher number of Federations from Serbia, Slovenia and Croatia have more developed procedures of financial report control in comparison to the Federations from Bosnia and Herzegovina.

We also noted that there is one federation, which has an external audit for the funds they receive and there is no federation whose financial statements are audited by an independent external and internationally recognised auditor. This is certainly an important part of financial procedures that the Federations need to improve because many sponsors and International Federations demand the application of assessment and control systems (Madella, Bayle, and Tome, 2005) such as conducting audits on a yearly basis by an independent external auditor in order to apply for funding and projects. The results comparison of the question related to the type of financial control that the Federations have in place indicates that there is a statistically

significant difference between the answers of the Federations from different countries ($\chi^2 = 69.19$; $p < 0.001$) (Table 5). The most frequent answer is "The Federation has formal procedures of financial monitoring which include approval, monitoring of the budget and accounting" with 33 frequencies and is noted for Federations from Croatia, Slovenia and Serbia.

The answer "The Federation has formal procedures of costs approval which need to be approved in advance" statistically significantly dominates for the Federations from Bosnia and Herzegovina with a frequency of 11 answers (ASR = 3.7, 45.8%).

The answer "We have more than one signature on the payments" is statistically significantly dominant for the Federations from Bosnia and Herzegovina (most answers ASR = 4.7; 100%).

This is also the case for the answer "The costs need to be justified and explained to the Executive Board, sometimes even after the activities/project" where Bosnian Sport Federations have the highest number of answers (ASR = 2.3, 45.5%).

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	BiH	MNG	Croatia	Slovenia	Serbia	Total
Did not answer	0	17	12	12	14	55
	0.0%	30.9%	21.8%	21.8%	25.5%	100.0%
	-4.8	2.7	.4	.3	1.3	
No control in place	0	0	0	1	0	1
	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
	-5	-5	-5	2.0	-5	
The General Assembly adopts the final reports	22	7	7	10	2	48
	45.8%	14.6%	14.6%	20.8%	4.2%	100.0%
	5.9	-1.2	-1.2	.0	-3.5	
Donors of grants provide financial control for the designated funds	2	0	0	0	0	2
	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	2.9	-.7	-.7	-.7	-.7	
We have external audit for the funds that we receive (example from the Government or local sponsors)	1	1	4	0	10	16
	6.3%	6.3%	25.0%	0.0%	62.5%	100.0%
	-1.4	-1.5	.5	-2.2	4.5	
Financial statements are audited by an independent external and qualified auditor	0	1	3	4	0	8
	0.0%	12.5%	37.5%	50.0%	0.0%	100.0%
	-1.4	-.5	1.3	2.1	-1.5	

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DISCUSSION

Financial resources are crucial to each organisation's good performance. According to Bayle and Madella (2002), an NSO which is to be categorised as Class 1: The Mighty, must have high scores across all dimensions, among which good media exposure and important financial resources. Having this in mind, it could be concluded that, through improvements made in financial management (policies, programmes with planning and formal rules, regulations, clear decision-making and good communication about financial issues), you are strengthening the capacity of the organisation itself. However, one should keep in mind that analysing the finances in one organisation is not the only parameter in analysing the organisational effectiveness and thus, according to Chelladurai, Szyszlo and Haggerty (1987), different parameters have to be evaluated simultaneously. But, analysing financial procedures is to be regarded as a very important element of the multidimensional approach. For the purpose of evaluation and in order to establish a proper benchmark that the Federations of Bosnia and Herzegovina should reach in order to improve, the analysis of the financial management procedures in National Sport Federations of Slovenia, Croatia, Serbia and Montenegro has been conducted. These countries are evidently much more successful in sport and are considered to be an appropriate benchmark. The main purpose was to use the current state analysis, compare it with countries that are more successful and make practical recommendations in terms of effectiveness and efficiency in order to improve financial management procedures of the Bosnian Sport Federations.

The results of the research, conducted on a representative sample of 25 Olympic Sport Federations, members of the NOC of Bosnia and Herzegovina and 52 Federations from neighbouring countries, have offered an exact insight into the methods potentially leading to the improvement of key performances for enhancing professionalisation of the Federation of Bosnia and Herzegovina, consequently improving the practices and the quality of work. The obtained data confirmed that there is a significant negative deviation for the Sport Federations of Bosnia and Herzegovina in comparison with the used benchmark in the observed pillar of financial resources. It has been clearly defined what is the direction which requires immediate action in order to improve the organisations and create the assumptions for an efficient, perspective and competitive Olympic Sport Federations.

CONCLUSION

The article explored the current level of development and differences of the National Sport Federations of Bosnia and Herzegovina's development in the field of financial management, in comparison with Federations from Serbia, Croatia, Slovenia and Montenegro. Based on the results derived from the field research, the following recommendations should be considered:

- Improvement of financial policies and procedures to include formalisation of financial policies and procedures which cover the financial issues, planning, budgeting and accounting;
- Improvement of financial planning procedures to include the establishment of clear procedures that will be comprehensive, plausible and in accordance with the planned activities in a specific timeframe. This process should include all relevant stakeholders;
- Financial control consisting of approving and monitoring the budget and all payment procedures, introducing interim control of all financial payments in accordance with the approved budget;

- Introducing an annual independent audit to ensure that all the financial procedures are monitored, harmonised and in accordance with the legal framework.

When implementing recommendations, the Board and staff have to work together to run the OSO effectively because the financial management is the responsibility of the entire organisation, although the ultimate responsibility lies in the hands of the treasuries and the finance staff. "Ideally, financial management should be a component of a strategic plan. Managing funds transparently, efficiently and effectively is essential to ensure the continued income and growth of the organization" (Camy, and Robinson, 2007, p. 164). The knowledge on the current level of financial management procedures of the Sport Federations will be of important theoretic and practical significance, because it will serve to improve the current financial practices of the most important actors in sport system – National Sport Federations of Bosnia and Herzegovina. These practices might have positive results in business culture and policies in the long-term perspective.

Although the findings are tentative and are intended to become the subject of further scrutiny, the results of the study depict a rather negative general picture of the current state of financial performance and an absolute requirement for comprehensive planning in order to introduce the possible and realistic sustainable changes. If we recall the primary responsibility of the NOC to develop, promote and protect the Olympic Movement of their own state (IOC, 2015), the need for revising the financial management of the National Olympic Federations is more clear. The results unveiled a need to establish formal procedures which will lead to the systematic improvements as well as clear areas which call for most urgent actions and which should be included in the strategic plans of organisations.

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PROCEDURE FINANSIJSKOG UPRAVLJANJA OLIMPIJSKIH SPORTSKIH FEDERACIJA BOSNE I HERCEGOVINE I OLIMPIJSKIH SPORTSKIH FEDERACIJA SRBIJE, HRVATSKE, SLOVENIJE I CRNE GORE

Ovaj članak istražuje trenutni nivo razvoja i razlike između sportskih saveza u odnosu na finansijsko upravljanje. Rad je dao uvid u finansijske prakse i procedure putem upitnika upućenog sportskim savezima koji su članovi Olimpijskih komiteta Bosne i Hercegovine, Hrvatske, Srbije, Crne Gore i Slovenije. Istraživanje je pokušalo ispitati trenutni nivo razvoja i razlike između sportskih saveza kako bi se dale preporuke koje bi služile za poboljšanje trenutnih praksi sportskih saveza Bosne i Hercegovine.

Ključne riječi: Olimpijske sportske organizacije, finansijska izvedba, finansijsko planiranje

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THE EFFECT OF ANKLE KINESIO TAPING ON THE EXPLOSIVE POWER OF LOWER LIMBS IN FLAT-FOOTED VOLLEYBALL PLAYERS

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ABSTRACT

In this study, we aimed to examine flat-footed volleyball players to answer the question of whether or not ankle Kinesio taping (KT) can increase explosive power in these players. A total of 60 male volleyball players were selected according to the study inclusion and exclusion criteria and randomly assigned to either the experimental group (KT with tension) or the control group (KT without tension). The flatness of the samples' feet was measured using the Navicular Drop Test and the explosive power of their lower limbs was examined using the Sargent Vertical Jump Test. The Mixed Repeated Measures ANOVA was conducted in order to identify the differences between the experimental and the control group multiple times. The analysis of the data showed significant differences in the lower limbs explosive power over time between the two groups ($P \leq 0.05$), suggesting that KT has significantly increased the explosive power in the experimental group. It can be concluded that the use of KT in flat-footed people can increase the explosive power of their lower limbs and significantly improve their vertical jump test scores. Flat-footed volleyball players are thus recommended to use ankle KT to improve their explosive power in the performance of vertical jumps.

Keywords: Kinesio tape, flat feet, power, volleyball

INTRODUCTION

Flexible flatfoot is a condition in which the longitudinal plantar arch reduces or diminishes when the foot is bearing weight [1]. Considering that the main function of the longitudinal plantar arch is to absorb and distribute the applied forces, the reduction or loss of this arch can hinder the distribution of plantar pressure and change the path of the transfer of muscle forces to the surrounding tissues [1]. In line with this study, Ledoux et al. (2002) also examined the distribution of pressure on different plantar parts in flat-footed

people using a force plate. Their results showed that flat-footed people experience an increased force under the heel, the thumb and the tip of the first to fifth metatarsal bones compared to normal people [2]. Queen et al. (2009) also showed that surface contact and maximum force are higher in the middle part of the foot in flat-footed people compared to the people with a normal plantar arch [3].

Considering the significance of the medial longitudinal arch and its function in human mobility, the differences in size in the medial longitudinal arch appear to have an undeniable effect on physical and mobility fitness

[4]. Several studies have, so far, reported difficulties in walking, running, jumping and some other motor skills in those affected by this abnormality [5]. Studies conducted on this subject also suggest that the size of the medial longitudinal arch can affect different factors such as ground reaction, forward moving forces and other performance capabilities in athletes. For instance, a study conducted by Arnold et al. (1997) showed that the smaller the plantar arch, the greater the reduction in certain physical fitness capabilities of athletes, such as strength and explosive power [4]. A study conducted by Simpson et al. (2000) showed that ground reaction forces in forward movements are lower in flat-footed people compared to normal people [6].

Given that even a minor improvement can mean the difference between a gold medal and a silver medal in professional athletes, every physical problem needs to be addressed in this group, and eliminating the problem or improving the condition can significantly contribute to the future success of the athlete [7]. In certain sports such as volleyball which involves activities such as frequent jumps, spikes and sudden change of direction, explosive muscle power can have a decisive role in the success of players [8]. Explosive power is defined as the maximum capacity of the neuromuscular system for producing the maximum force in the shortest possible time, which, in a way, reflects the muscle stretch-shortening cycle at maximum speed [9-11]. Factors that play a pivotal role in performing power movements include muscle myofibrils and the combination of elastic components, the connective tissue and the intracellular components (due to their reactive and elastic properties) [12-14]. Certain postural abnormalities, including flatfoot, can adversely affect this physical fitness factor by changing the path of force transfer [4].

Reports indicate that taping can improve the explosive power of the muscles by increasing sensory inputs as well as sensory-motor reflexes; sports taping has, therefore, always been recommended as a performance-improving intervention for athletes in different fields requiring explosive muscle power [15]. This tool is also used to improve proprioception, stability, performance and muscle length in the ankle, knee, neck, shoulder girdle, upper limbs and the trunk [7]. Results show that, unlike other types of taping, which lose their structural support within 20 minutes of training [16], the Kinesio tape has more efficient mechanical properties and can be used from 24 hours a day, up to four days [7]. Other advantages of the Kinesio tape compared to other tapes include the ability to increase its length by up to 130%-140% of the original length [17]. Kinesio tape is also used by athletes to increase the use of muscle spindles and improve muscle tone [18].

Although rehabilitation studies have recognized the advantages of Kinesio tape, its role in improving the performance capabilities of people with physical abnormalities has not yet been investigated. Given the relatively high prevalence of flatfoot as a plantar

abnormality in elite athletes, including volleyball players [19], and considering the effect of this abnormality on the path of muscle force transfer and the subsequent reduction in explosive power [1-4], the present study was conducted to assess the effect of Kinesio taping on the explosive power of lower limbs in flat-footed volleyball players so as to answer the question of whether or not Kinesio taping can increase explosive power in these people.

METHODS

The present quasi-experimental study was conducted on 60 male volleyball players with a mean age of 20.1 ± 1.3 years, height of 179.4 ± 4.5 cm and weight of 70.2 ± 2.8 kg who were selected according to the study inclusion and exclusion criteria and were randomized into the real KT ($n = 30$) and the sham KT ($n = 30$) intervention. The study sample size of 60 was determined based on previous studies [7]. To eliminate any potential confounding variables, attempts were made to select the participants of matching age, height and weight with a BMI in the normal range ($18 < \text{BMI} < 25$). The other selection criteria used included having flat feet, no history of surgeries, fractures or major traumas in the lower limbs and no history of neurologic, joint and musculoskeletal disorders [7, 20]. The participants were asked to avoid any intense physical activities involving the lower limbs a day before their tests. They underwent further assessments after submitting written consent forms for participation in the study. Ethical approval for this study has been granted by the Ethics Committee of the Kerman University of Medical Sciences.

Prior to the beginning the study, the process of conducting the tests was fully explained to the participants and their height and weight were measured using a stadiometer and a digital scale with a precision of 0.1 kg [7]. After the preliminary assessments were made through observation and using a Podoscope, the navicular drop test using Brody's descriptive method was used to determine the exact amount of flatness in the participants' feet [21]. The participants were thus asked to sit bare-footed on a chair and to place their feet on a 20-cm-high box. The height of the chair was adjusted so that the thigh and the knee made a 90-degree angle. The thigh joint had no abduction or adduction in this position and the ankle joint was placed in a neutral position [22]. The navicular prominence was identified and marked in this position and its distance from the box surface was measured and recorded using a ruler. Next, the participants were asked to stand in a way that would put all

their weight on the foot being tested and to use their other foot only for support and stability while keeping their ankle in the same position. The distance between the navicular prominence and the box surface was also measured and recorded in this position. The difference between the values obtained from the two measurements was recorded as the navicular drop (Figure 1). If the navicular drop was 10 mm or higher, the participant was identified as having a case of flatfoot [22, 23].

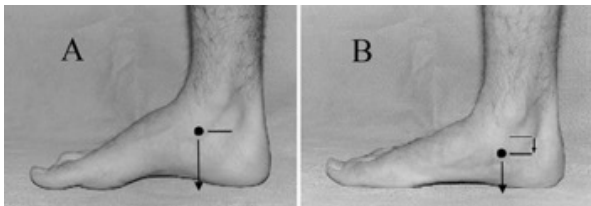


Figure 1: Measuring the navicular drop

The Sargent vertical jump test was then used to measure the explosive power of the participants' lower limbs. The subjects were thus asked to stand sideways against a wall and to raise one of their hands as high as possible.

Their fingers were dipped in chalk powder and so the point on which they touched the graded board (in cm) was recorded and the participants were then asked to return to their initial position and to try to jump vertically at maximum power and no run-ups. The height of the jump was recorded and it was deducted from the height of the standing position, and the figure obtained was recorded as the vertical jump value. This test was repeated three times and the best result was taken as the subject's explosive power [24].

Following baseline examination, the subjects were randomly assigned to either the KT group (experimental group) or the sham-KT group (control group). The experimental group was taped by the KT with tension, while the sham-KT group was taped with KT without any tension. For this purpose, the tibialis posterior muscle was taped to improve the muscle function in order to examine the effect of KT on explosive power.

As per previous reports on the subject, this muscle appears to be weakened and stretched in flat feet, which may be part of the reason explosive power is reduced in people with this abnormality [25]. This muscle was taped in the participants in both legs between its fixed end (in the upper third of the shin) and moving end (the navicular surface); (Figure 2).

For the experimental group, the first strip was placed onto the fixed end of the posterior shin muscle without tension and with the tibiotalar joint in a 90-degree position and with the leg in maximum eversion; then the KT stretched approximately 140% of its maximal length and was placed on the tibialis posterior muscle.

The control group received the same KT application, but without applying any tension to its structure [25]. Once the participants were ready, all the stages of the Sargent test, which had been performed on them once before, were carried out two more times –one immediately after the Kinesio taping and another one 30 minutes later.

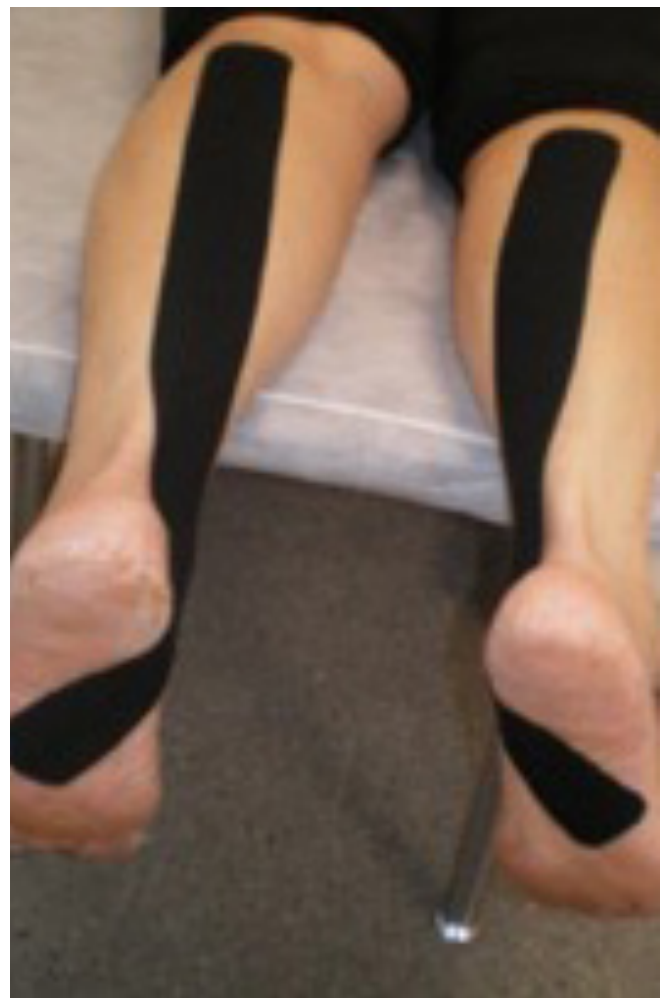


Figure 2: Kinesio taping of the posterior shin muscle

The data obtained were analysed in SPSS-20. The Shapiro-Wilk test showed that the data were normally distributed; the Mixed Repeated Measures ANOVA and Bonferroni's post-hoc test were therefore used for the analysis of the data.

RESULTS

Table 1 presents the demographic details of the participants. Table 2 and Figure 3 also present the results of the Sargent vertical jump test to assess the explosive power of the lower limbs in the participants.

Table 1: Participants' demographic details (Mean $\pm$ SD)

P value	Control Group	Experimental Group	
0.731	20.35 $\pm$ 2.44	20.07 $\pm$ 1.26	Age (year)
0.608	176.82 $\pm$ 3.93	179.43 $\pm$ 4.59	Height (cm)
0.654	68.20 $\pm$ 2.61	70.20 $\pm$ 2.83	Weight (kg)
0.915	21.92 $\pm$ 0.83	21.81 $\pm$ 0.75	BMI (kg/m ²)
0.562	12.75 $\pm$ 2.34	13.23 $\pm$ 2.02	Navicular Drop (mm)

Table 2: The results of the Sargent jump test (Mean $\pm$ SD)

Control Group (cm)	Experimental Group (cm)	
40.75 $\pm$ 4.68	40.13 $\pm$ 4.84	Baseline
41.89 $\pm$ 3.91	44.37 $\pm$ 4.75	Immediately after intervention
41.58 $\pm$ 4.12	43.82 $\pm$ 4.20	30 min after intervention

Figure 3: The results of the Sargent vertical jump test (cm)

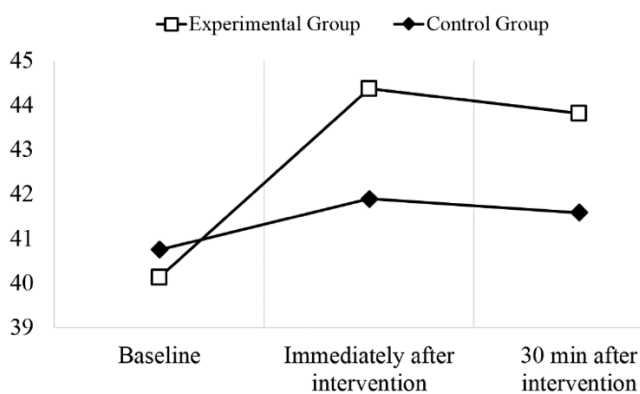


Table 3: The results of the Sargent jump test (Mean $\pm$ SD)

P-value	SE	Mean difference between time points (cm)	
0/001*	0.447	2.690	Immediately after intervention – Baseline
0/001*	0.530	2.260	30 min after intervention – Baseline
0.782	0.386	0.430	Immediately after intervention – 30 min after intervention

Legend: SE = standard error; * = significant differences ($p < 0.05$)

The Mixed Repeated Measures ANOVA test was used to determine the differences between the lower limbs explosive power in the groups. Data analysis revealed that there was a significant main effect ($F_{2, 58} = 14.102$; $p < 0.001$; $\eta = 0.196$) of time, which demonstrated that there were significant increases in the Sargent jump test scores over time. Moreover the main effect of the group (difference in the Sargent jump test scores between groups) was significant ($F_{2, 58} = 5.394$; $p = 0.045$; $\eta = 0.142$). There was also an interaction effect between the time and group ($F_{1, 58} = 13.937$; $p < 0.001$; $\eta = 0.194$), indicating that the Sargent jump test scores of the control group did not change over time while the mean scores of the intervention group significantly increased. Table 3 presents the results of Bonferroni's post-hoc test, which suggest significant differences between the Sargent jump test scores obtained on different test occasions. Significant differences were thus observed between the Sargent test scores before and immediately after taping as well as before and 30 minutes after the taping of groups; however, no significant differences were observed in the explosive power of the lower limbs immediately after and 30 minutes after the Kinesio taping.

DISCUSSION

The present study was conducted to assess the effect of ankle Kinesio taping on the explosive power of the lower limbs in flat-footed volleyball players. Previous studies suggest a weakening and stretching of the posterior shin muscle due to flat feet, which appears to be one of the main factors involved in the reduced explosive power of the lower limbs in flat-footed people [26]. The present study thus used Kinesio taping of the posterior shin muscle to help improve its function and then measured the explosive power of the lower limbs upon the intervention. Overall, the obtained results showed that Kinesio taping according to the given instructions significantly increases the explosive power of the lower limbs in flat-footed people ($P \leq 0.05$).

These results are somehow consistent with the results obtained in previous studies, which showed that taping can improve power performance in the subjects. In one study, Mostert-Wentzel (2012) reported that Kinesio taping of the gluteus maximus muscle can significantly increase the explosive power of the lower limbs in male athletes and improve their vertical jump test scores [8] due to the resultant increase in central mechanoreceptor activity [7].

In another study, Slupik et al. (2007) found that Kinesio taping even without the application of any particular tension can have a significant facilitating role in the skin mechanoreceptors and subsequently stimulate motor reflexes in people [26]. Gilleard et al. (1998) also found that Kinesio taping can facilitate muscle contractions through the stimulation of the skin mechanoreceptors and the subsequent increase in sensory feedback in the taped area and thus enable an increased muscle power in the area [27]. In two separate studies, Slupik (2007) and Donce (2012) found that Kinesio taping can significantly increase muscle power in the flexor muscles of the wrist and quadriceps of the thigh [26, 28].

The pressure and tension applied by the Kinesio tape in the present study therefore appear to have stimulated the skin mechanoreceptors and to have thus improved motor performance in the participants by sending sensory and movement information to the joint. These factors have in fact increased the volume of information sent by the receptors to the central nervous system and have thus enabled the precise regulation of the joint movements [27]. It can therefore be argued that Kinesio taping can improve the factors affecting muscle strength by increasing skin inputs and activating the central mechanoreceptors; and since muscle strength is among the factors that affect explosive power [7], its improvement can lead to an increased explosive power in the participants.

Previous studies also suggest that explosive moves are somehow caused by the stretch-shortening cycle of the muscles, upon which the muscles are first placed under eccentric pressure, and then immediately under concentric contractions. These changes, which ultimately lead to a powerful muscle contraction, originate from muscle contractile myofibrils and also non-contractile proteins, including a combination of elastic components, the connective tissue and intracellular components.

These factors act similarly to the tensile energy dormant in an extended spring and releasing this energy can have a major role in muscle power movements [12-14]. In the present study, Kinesio taping appears to have acted as a facilitator of the

explosive power of the muscles and to have created a kind of convergence in the production of energy by combining the contractile and non-contractile elements. Ankle Kinesio taping in the present study may have therefore improved the elastic behaviour of the posterior shin muscle in flat-footed people, and may have thus somehow improved the results of the Sargent vertical jump test by compensating for this muscle's weakness in performing explosive movements.

Nevertheless, the present findings are inconsistent with some of the results reported in previous studies. For instance, Fu et al. (2008) examined the effect of the Kinesio taping of the anterior surface of the thigh on the power of the quadriceps and hamstring muscles in athletes and reported no significant differences in the power of these muscles following taping [29].

It should be noted that all the athletes in the cited study had favourable levels of muscle function and had perfect physical health and no abnormalities to affect the results; therefore, small measurable changes cannot be expected to have been discernible in them (such as increased muscle power due to Kinesio taping) [29].

In the present study, however, all the participants had flat feet, and as noted earlier, flat feet can attenuate the performance of certain muscles such as the posterior shin muscle [25] and thus adversely affect the explosive power of the lower limbs [4]. With the improvement in the performance of the weakened muscles due to taping, increased muscle power is expected to be more accentuated in the participants of the present study.

A closer look at the results presented in Table 2 and Figure 3 shows that, although the Sargent vertical jump test scores were slightly reduced 30 minutes after the Kinesio taping, there was still a significant difference between the pre-intervention and the 30 minutes post-intervention scores of this test ($P \leq 0.05$). These results are in line with some of the results reported in previous studies, which show that, unlike other types of taping that lose their structural support within 20 minutes of training [16], the Kinesio tape has more efficient mechanical properties and can be used from 24 hours up to four days [7].

CONCLUSION

As a conclusion, we have found that the use of ankle Kinesio taping in flat-footed people can enhance the performance of their posterior shin muscle and thus increase the explosive power of their lower limbs and result in a significant increase in the Sargent jump test scores. Flat-footed volleyball players are therefore recommended to Kinesio tape their posterior shin muscle in order to increase their explosive power during vertical jumps.

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EFEKAT PRIMJENE KINESIO TAPING METODE ZA GLEŽANJ NA EKSPLOZIVNU SNAGU DONJIH EKSTREMITETA KOD IGRAČA ODBOJKE KOJI IMAJU SPUŠTENNA STOPALA

Cilj ove studije je bio ispitati igrače odbojke koji imaju spuštenu stopala kako bismo odgovorili na pitanje da li Kinesio Taping (KT) metoda može povećati eksplozivnu snagu ovih igrača. Ukupno 60 igrača odbojke je odabrano u skladu sa kriterijima za učestvovanje u studiji ili izuzimanje iz iste, te je nasumično podijeljeno u eksperimentalnu (KT metoda sa zatezanjem) ili kontrolnu grupu (KT metoda bez zatezanja). Step en spuštenosti stopala ispitanika je mjer en korištenjem Navicular Drop Testa, a eksplozivna snaga donjih ekstremiteta je ispitana korištenjem testa skoka u vis (Sargent testa). Mješovita ANOVA za ponovljena mjerenja je provedena kako bi se više puta utvrdile razlike između eksperimentalne i kontrolne grupe. Analiza podataka je ukazala na postojanje značajnih razlika između eksplozivne snage donjih ekstremiteta ove dvije grupe ($P \leq 0,05$), a što se pokazalo tokom vremena, te je upućivala na činjenicu da je KT metoda značajno poboljšala eksplozivnu snagu u eksperimentalnoj grupi. Možemo zaključiti da je korištenje KT metode kod osoba sa spuštenim stopalima povećalo eksplozivnu snagu donjih ekstremiteta, te značajno poboljšalo rezultate testa skoka u vis. Korištenje KT metode za gležanj se preporučuje igračima odbojke koji imaju spuštenu stopala kako bi poboljšali svoju eksplozivnu snagu tokom izvođenja skokova u vis.

Ključne riječi: kineziološka traka, spuštenu stopala, snaga, odbojka

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THE LEGAL NATURE AND BASIS OF CIVIL LIABILITY IN SPORTS

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ABSTRACT

Sports Law is largely defined and regulates many issues related to sports, such as the rights and obligations of athletes, sports organisations and other persons in the sports system, thus specifying the range of actions for all participants. However, the exercise of rights, especially when it comes to damages, is not specified in all cases, because engaging in and using sports is, to a large extent, accompanied by increased risk. The main issue arising in this paper is the management of the matter related to the basic determinants, i.e., the exclusion of liability for certain activities concerning sports or other persons participating in the sports system. Analysing the bases, i.e., the diversity of liabilities, the authors point out certain specifics and the legal nature of civil liability in sports.

Keywords: sports law, civil liability, compensation for damage in sports, legal nature of liability

INTRODUCTION

Entering into the world of sports, practising and training it implies, at the same time, entering into the area of a risky activity which, as a consequence, can carry with it certain accompanying injuries, harmful consequences and other detriments. The danger, challenges and extremes are often the main motives of practising certain sports which, as such, carry an enhanced risk, even though practising any sport carries with it a certain degree of risk in and of itself. Legal liability in sports as well as the preconditions for accidents occurring in sports have been dealt with by Dr Đurđević in his major works. Day after day, the number of accidents in sports is increasing since the desire for achieving the best possible score carries with it a greater risk due to the massiveness of sports and insufficiently developed measures for preventing sports accidents and injuries. The causes of injuries can not only be seen in acting and improper behaviour of the athletes towards the opponent, but they can also arise as a consequence of acting and oversights pertaining to a significantly larger group of people who participate in sports events, competitions and manifestations in different ways, whether as teammates, coaches, spectators, organisers, judges, managers, sports professionals,

doctors or as persons who participate in sports in a certain manner. Likewise, athletes are not the only ones exposed to the stated risk, but all the mentioned actors can succumb to the damage and be exposed to it. In addition to the standard and usual risks related to sports activities and professions, unfortunately, there are also risks which have nothing to do with sports. Violence, conflicts and fan fights, throwing different objects into the playing field and a series of numerous destructive acts and behaviours have become a negative accompanying occurrence of modern sports, burdening it with such diverse misuse. Top and recreational sports encounter serious threats such as doping, violence and commercial misuse which oppose moral values, sports image and reputation and deform its nature and role in promoting health and education. The consequence of sports events, that is, sports competitions and sports activities is the emergence of certain accompanying harmful effects. Such consequences are manifested in inflicting physical injuries, i.e., causing damage to the participants (personal and social property) of sports competitions resulting in the basis for different civil liability claims. Civil liability claims are most frequently related to the issue of compensation for the damage caused at a specific sports manifestation. When such a situation is accompanied by physical injuries, it is justified to question the conditions and manner of exercising

the rights arising from the damage. According to the work of Eichenberger et al., there are accidents which occur during general sports activities and those which can occur during sports competitions. Such grounds arise from the manner in which a sports event manifests, bringing with it a larger number of participants and the audience in and of itself. Exercising rights cannot be identical for each case. Injuries sustained by the opponent in a sports contest represent a different case requiring a proper application of law in relation to exercising the rights in a situation when, for example, a spectator or some other actor of the sports competition is injured. The primary question posed is whether the damage arising during a sports activity, competition and the like is borne by the injured party or by another party who would compensate the damage.

The second indispensable question is precisely the one related to the basis of liability, that is, exclusion of liability on the grounds and assumption that the injuries were inflicted during the competition in sports which are recognised and legal and that they were inflicted exclusively due to inattention and without malicious intent. In order for the party, who inflicted the damage on another person during the competition, to be exonerated, it is necessary to meet three fundamental conditions:

1. That the sports competition is conducted according to the basic rules of the sports discipline;
2. That the sports competition participants compete within the limits not surpassing the norms of an average attentive competition;
3. That the injured party legitimately accepted the risks of the game.

However, if only one of the stated conditions has not been met, all the reasons for the sports liability to give way to the civil or, depending on the case, even criminal liability, that is, liability on some other legal grounds emerge. The injuries resulting from engaging in professional sports do not usually lead to civil litigation. For the most part, the governing league imposes internal sanctions, such as penalties, fines and/or suspensions for injuries caused by the misconduct of a professional athlete in the heat of competition.

This paper emphasises the damage caused among athletes, suffered by other athletes or sports actors, that is, the damage borne by the athlete due to damaging actions of others. However, sports activities which are, due to the specificities of participation, unique in cases regarding martial arts where inflicting physical injuries is allowed, with previously determined rules, have to be taken into account when regulating the athletes' responsibility and inevitably require establishing a specific regime of liability deviating from the rules determining the damages according to the rules of the Law on Obligatory Relations. If we take into account the "diversity" of sports disciplines by clearly distinguishing the rules of sports competitions such as golf, boxing or football, finding a single standard of liability in tort law that is appropriate to all sports represents a challenge

for sports law.

LEGAL NATURE AND SPORTS REGULATIONS

Each exclusion of civil liability for physical injuries inflicted on other athletes during sports events and competitions is founded on the assumption that one inflicting and causing the damage adapted his or her activity in line with the rules of the sports discipline in which the damage occurred. Only the damage caused within sports regulations will not provide the option for submitting a damage claim. This represents a basic requirement for excluding civil liability for damage inflicted during engagement in sports and as such, it is generally accepted in legal theory and practice.

The significance of sports regulations results from the above-mentioned reasons since they form the legal framework and limits of attentiveness related to participants in sports.

Based upon that, each participant of the sports event and competition knows and clearly expects that all the other participants will act and behave according to the previously stipulated rules. The stated reasons are precisely those responsible for the fact that the degree of damage suffered by the athlete, which is not in line with the rules of the given competition, represents the foundation and provides a possibility to issue a compensation claim for the damage caused by the inflictor. Nevertheless, the injured athlete is not immediately given the right to claim civil liability from the inflictor, but it ensues from possible court proceedings when, apart from breaking sports rules, all other specific circumstances leading to the damage are examined. "Sport is a social activity which is standardised, and the validity of the compensation claim for the damage incurred in sports will be assessed in accordance with the accepted standards. Standardisation of sports is, from the state's point of view, a subsidiary activity since the state generally leaves the standardisation of a sport to the corresponding sports organisations, and the general rules of the legal order are applied on a subsidiary basis".

SOURCES OF LAW FOR SPORT INJURY LIABILITY

The fundamental regulation which, in our country's legal order, regulates damage liability is the Law on Obligatory Relations. This law prescribes the assumptions of liability, defines damage and guilt, certain cases in which one is liable regardless of their guilt, cases where the inflictor is exonerated, liability for others as well as the forms of damages. The rules of the Law on Obligatory Relations are applied to all cases where damage occurred, except in cases where there are special rules in certain regulations prescribing specific legal relations.

Legal regulations determining the content of sports as well as all important issues related to sports constitute the Law on Sports.

Considering that the Law on Sports is a rather general law regulating sports, it does not contain special provisions on damage liability, so the general regulations for damage liability from the Law on Obligatory Relations are applied for sports. Certain issues related to liability for damage incurred in sports are regulated by special regulations containing provisions on a certain segment of sports activity or specifically for a particular sports discipline. Certain sports have special regulations determining the rules of conduct in particular situations occurring in sports. They are most frequently bylaws – rulebooks. Legal customs and judicial practice are most frequently listed in our literature as supplementary sources of law. Additionally, there are autonomous sources of law. They are the sources of law intended for a limited group of people who self-regulate certain relations. Autonomous sources of law appear in the form of a contract, a rule related to a certain society, and the like.

The Rules of Sports Competitions

Sports rules are one of the most significant factors in assessing liability for damage incurred during a sports competition and that is why it is necessary to point out their division. In and of itself, sports represents a specific degree of danger for all who engage in it, and for those who, in a way, partake in the "sports scene" (the audience, spectators). The rules of sports competitions are primarily divided into:

- a) Those related to the organisation of a sports competition;
- b) Those regulating the manner and conditions for conducting the sports competition itself.

This divides the responsibility of participants in a sports event. According to the opinion of prof. Salma, the responsibility of athletes and sports organisations is classified into specific cases of professional liability since it depends on the situation whether it is a contractual or tort liability, that is, a liability for one's own actions or the actions of another, as well as the liability based on guilt or independent of guilt. The circumstances, causality in particular, dictate who will be liable.

The Rules of Organising Sports Competitions

In order to maintain a regular sports competition, it is necessary to primarily apply the proper rights of organising sports competitions. The rules of organising sports competitions have to be in accordance with the Law on Sports of the Republic of Serbia and bylaws which closely describe the actions that have to be performed when

organising sports competitions, and the specific rules for each branch and sports discipline are adopted by the competent national sports federation related to a particular sports branch.

The national sports federations related to a particular sports branch adopt rulebooks on organising competitions with all the specificities of the sport and discipline. In terms of organising the competition itself, a rulebook which closely describes the requirements which have to be met in order to hold the sports competition is adopted. These rules determine who can participate in a specific sports activity and what are the conditions and circumstances for participation. At the same time, they determine the safety of athletes as active participants and all other passive actors in the sports manifestation, as well as the criteria for organising sports arenas, playing fields and the like during the sports competition.

The rules regulating the manner and requirements for holding sports competitions

The rules regulating the manner and requirements for holding sports competitions determine the manner and course of the competition itself, as well as specify the procedures which have to be undertaken by the participants. These rules individualise a specific sports discipline in relation to other sports branches while determining and defining the allowed actions leading towards success and victory of an athlete. Additionally, these rules determine the unauthorised actions which are sanctioned through disciplinary regulations. All unauthorised actions aggravate the position of the competitor who committed them and, if they are frequent or specifically and particularly break the rules, they lead to disqualification of such an athlete. A special type of these sports rules are those aiming at specifically securing the safety of the competitors (boxing forbids hitting below the belt, fencing allows hitting only the protected body parts, etc.). If the competitors do not obey these rules, they are sanctioned. It is necessary to emphasise that the cause of an accident and damage can also be unfamiliarity or insufficient knowledge regarding the sports rules related to that sports discipline.

In the Republic of Serbia, many rulebooks regulating this area have been adopted. One in a series of rulebooks is The Rulebook on Sports Branches and Fields in RS and Sports Disciplines Within the Sports Branches and Fields, stating all sports disciplines where it is possible to organise an official sports competition. All disciplines have, as such, been recognised by the national sports federations related to a particular sports branch. A Rulebook on Amending the Rulebook on Sports Branches and Fields in the Republic of Serbia and Sports Disciplines Within the Sports Branches and Fields has been adopted in Belgrade on 14/09/2017 and it is still in force. Additionally, the rulebook determining sports branches of particular importance for the Republic of Serbia

- the Rulebook on Sports Branches of Particular Importance for RS was also adopted by the Minister of Youth and Sports alongside the Rulebook on the Competent National Sports Federations for Sports Branches and Fields in the Republic of Serbia. In this way, many general principles of civil liability have been accepted and contained in sports rules. This is how a double relationship is created between the general legal rules and the rules adopted by sports organisations: the general rules of civil liability become specified through sports rules, while in return, these rules serve judges as an element of assessing and applying general rules.

CAUSES OF LIABILITY FOR DAMAGE INCURRED AT SPORTS COMPETITIONS

Notwithstanding the damage, liability does not have to arise. In order for the liability to arise, is necessary to file a compensation claim based upon which it has been determined that all the liability assumptions have been met and that there are no specific reasons for excluding liability. There is a vast number of cases in which damage has been incurred but nobody was liable because the authorised party did not file a compensation claim (which is common in sports) due to the fact that all the liability assumptions have not been met, that is, there was no reason for excluding liability. The general liability assumptions for the incurred damage which are sought for any form of liability and which have to be cumulatively met are: inflictor and the injured party, detrimental act, causal relationship between the detrimental act and damage, as well as infringement. If one of the above is missing, damage liability will not exist. All the damage incurred during or due to a certain sports event raises the question of whether it is necessary for the injured party to bear the harmful consequences or they can claim compensation or the possibility to mitigate the harmful consequences from the organiser. If the injured party has the right to claim compensation from the liable person, it is followed by a determination of the per-existing state and the cost is charged to the inflictor's property. "Specific reasons" have to exist so as to, from the overall society point of view, justify the expenses which the inflictor has to pay with the goal to indemnify the injured party. Such reasons exist only if a party can be found liable for the incurred damage. In practice, there are two possible reasons for material damage liability arising during sports competitions: guilt and generated risk. Subjective liability - liability of the inflictor represents the strongest grounds for material liability. In a multitude of countries, it is considered necessary for the injured party to prove that the person inflicting the damage is guilty for the damage they incurred in case of a non-contractual infringement. The Law on Obligatory Relations does not follow such a position. Proving guilt is a long and strenuous process. This law determines the assumption of guilt regardless of whether it represents a contractual or non-contractual infringement. Pursuant

to Article 154, paragraph 1, of the Law on Obligatory Relations, it is assumed that the party inflicting the damage is guilty. The principled position of the Federal Court, the Supreme Court-Martial and Supreme Courts of the republics and provinces point out what constitutes the assumption of guilt as well as what has to be proved.

Explaining the grounds of liability, Dr Đurđević points out that, in contemporary law, liability for damage incurred at sports competitions on the grounds of guilt is a rule, and that objective liability is an exception. If a legal standard protecting material interests of all actors in a sports event has been broken, material liability ensues. A financial penalty protects non-material interests. According to Eichenberger, injunctions can result from general principles and individual legal regulations; they do not have to be presented in direct form.

Any type of behaviour affecting the breach of sports principles constitutes an infringement, especially when it leads to an increase of risks which are characteristic of the sport in question. Infringement is implied if one is denied their absolute right, that is, their personality right. Infringing behaviour is construed as an act causing physical injury, but at the same time, it can be noted that the physical injury itself is not tortious, as is explained in the work of Erwin Deutsch. An example of an athlete who injures another athlete during a sports event (*lege artis*) cannot be considered as infringing behaviour. This does not mean that, for the situation involving damage, there is no assumption of infringement. Among other things, Article 16 of the Law on Obligatory Relations prescribes this. The offending act of an athlete is expressed in situations where he or she allowed themselves to behave in such a way that should have been avoided in the given situation. The aforementioned behaviour implies a physical relationship towards the infringing act and damage incurred as its consequence. We differentiate between two forms of guilt: premeditation and negligence depending on the athlete's behaviour and conduct. "An athlete will rarely be liable based on premeditation". In order for the intentional injuring of an opposing player to exist, it is necessary for the athlete to have enough time to think about his or her actions. The possibility of manoeuvring in this rule is seen in the fact that the sports game is most frequently carried out quickly and rashly so that the conscious and willing movements are hardly discerned from the reflexive ones. Intentional damage is most pronouncedly and most frequently manifested in martial arts. The game rules are crucial here, dictating the authority for determining the act of inflicting damage so that it can be easily concluded whether the behaviour was correct and allowed, that is, inadmissible and punishable. If an infringement of the game rules also results in injury of another athlete, it is

necessary to make compensation for the damage. The sports organisation of the athlete responsible for the newly incurred damage is not devoid of liability if the injury was inflicted without compliance with the rules. Depending on the nature of the game in certain sports, we encounter a situation of minor deviations from the game rules caused by the athlete's lack of attention, which is a common occurrence characteristic for all the participants. They can be tolerated to the extent that the behaviour of actors in a sports competition cannot be characterised as infringement. Due to the stated reasons, if all other requirements are also met, the participant of a sports game is liable only for the damage he or she inflicted on another participant through physical injury as a result of an intentional or severe injury of the rules of conduct in the playing field.

Where does the limit of the rules of a sports game lie and where are the authorised and unauthorised behaviours of an athlete confronted? The athlete is liable for damages for the unauthorised behaviour which constitutes an infringing act as well as for the incurred damage. In specific cases, as a consequence of different sports competitions and their risk, there is a possibility for the liability to result from objective terms: damage and causality. Such liability is called objective liability and its essence is reflected in the fact that the party in question is liable regardless of guilt.

The Republic of Serbia has thoroughly described the liability for damage caused by dangerous things or activities in the Law on Obligatory Relations where it is stated that the inflictor is liable for damage caused by dangerous things or activities regardless of guilt on the basis of an objective fact that the damage was incurred. The parties dealing with dangerous activities are liable for the damage occurring as a consequence of dangerous activities since it is considered that the damage itself resulted as a product of the dangerous activity. The inflictor's liability can be absolved if it is proved that the activities did not cause the damage, that is, through evidence confirming that the damage was incurred as a consequence of the injured party's activities or those conducted by third parties, or as a consequence of some force majeure which the inflictor could not avoid or remedy in some way. The liable parties are partially exonerated if the injured party has participated in some way and contributed to the incurred damage. The grounds for exoneration from objective liability for damage are based on the fact that the damage was incurred through infringing acts conducted by third parties which are not related to the dangerous activities due to which such liability is stipulated. Depending on the sport they engage in, the athletes also use different sports equipment in sports competitions. Some of them can have "dangerous

properties". According to the Law on Obligatory Relations, liability for damage incurred by a dangerous thing is based on a generated risk and not on guilt. In order to exercise the right to claim compensation, it is enough for the injured party to prove that they have suffered damage and that it is caused by the thing. If it participated in a detrimental event, it is assumed that the damage originated from the thing.

The proprietor of the dangerous thing is exclusively responsible and liable for the damage caused by a dangerous thing. Depending on whether it is a thing that can be private or state-owned, the legal authority of the proprietor can consist of propriety or the right of disposal.

Compensation for the damage

The aim of compensation for the damage is precisely the one attempting to establish the state existing before the damage was incurred. An ideal situation would be to, upon compensating for the damage, create a state where it would seem that the damage had not existed at all. Unfortunately, such an ideal is not always possible to achieve: the athlete who has been seriously injured in such a way will not be able to engage in this sports discipline as he or she used to; upon someone's death, this person can never return; after damaging a unique thing different from all other (species), it cannot be achieved for the owner to have even something similar again. In such instances where the pre-damage state cannot be reinstated, it is aimed to get as close as possible to the pre-existing state through mitigating the consequences of the detrimental act or making compensations by any other suitable way.

Legally speaking, there is no irreparable damage since any damage can legally be remedied by some form of compensation - natural restitution, damages, settlement, agreement and the like. Material damage is repaired by reinstating the pre-damage state - natural restitution, and if it is not possible, the damage will be repaired with a cash-equivalent compensation - damages. The damage caused to the athlete by damaging his or her sports equipment (vehicle, bicycle, sailboat, skis, racket, etc.) can be repaired by removing the damage, paying to remove the damage, providing them with new equipment which is of an appropriate type and adequate quality or making compensations in the form of a pecuniary amount equal to the value of the destroyed equipment.

The Law on Sports of the Republic of Serbia defines the parties who have the right to compensation for the damage suffered, explains the jurisdiction of those liable for the compensation, defines the application of general rules related to liability, explains solidary liability for the incurred damage, describes the procedure for filing a claim (the parliament, representative), defines the sports facilities and taking measures to eliminate the risk, providing consent for participation in international competitions, etc.

CONCLUSION

The fundamental and simultaneously the most significant element of each sport is its proper regulation. As one of the recent legal disciplines, sports law occupies a special place in the study of legal branches. This paper emphasises the significance, requirement and necessity to completely regulate the issue of civil liability through special legislation, along with the desire to thus provide a contribution to study and further affirm liability for damage in sports law, simultaneously deterring the athletes from excessive violent behaviour in the "arena". Legal rules have greatly regulated, defined and governed many issues, rights and responsibilities of the athletes, organisations and other parties in the sports system, simultaneously building a special legal area resulting in the athletes' limited

liability and limited possibility for the injured party to claim compensation. Each engagement and participation in sports is, to a degree, accompanied by a certain risk. Analysing the grounds, that is, the reasons for liability, points to certain specific solutions since the athletes voluntarily participate in sports events which undoubtedly involve an increased risk of incurring damage. Civil liability is an inextricable part of legal regulations in sports and therefore, proper application of rules in civil liability is both desirable and necessary, and since sport functions in a highly complex environment which changes on a daily basis and opens up many possibilities and changes, in order to successfully implement civil liability in sports, it is necessary to clearly recognise the challenges and define the methods of legal regulation.

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PRAVNA PRIRODA I OSNOV GRAĐANSKO – PRAVNE ODGOVORNOSTI U SPORTU

Sportsko pravo je u velikoj mjeri definisano i regulira mnoga pitanja vezana uz sport, poput prava i obveza sportista, sportskih organizacija i drugih lica u sistemu sporta, precizirajući tako opseg aktivnosti za sve učesnike. Međutim, ostvarivanje prava, posebno kada je u pitanju naknada štete, nije određeno u svim slučajevima jer bavljenje i učestvovanje u sportu u velikoj mjeri prati povećani rizik. Primarno pitanje koje se postavlja u ovom radu jeste upravljanje pitanjem vezanim za osnovne determinante, odnosno isključenjem odgovornosti za određene aktivnosti koje se tiču sporta ili drugih lica koja učestvuju u sistemu sporta. Analizirajući osnove, odnosno raznolikost odgovornosti, autori ukazuju na određene specifičnosti i pravnu prirodu građansko-pravne odgovornosti u sportu

Ključne riječi: sportsko pravo, građansko-pravna odgovornost, naknada za štetu u sportu, pravna priroda odgovornosti

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DIFFERENCES BETWEEN 13-YEAR-OLD BOYS AND GIRLS IN THE DIMENSION OF SPEED, EXPLOSIVE STRENGTH AND SOME BODY VOLUME PARAMETERS

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ABSTRACT

The research aimed to verify the differences of some anthropometric characteristics and motor abilities between boys and girls, 13-year-old pupils. Methods: The sample was comprised of 180 pupils (90 M and 90 F) aged 13, who are students of primary schools in Lipjan municipality. Measurements were conducted in the spring of 2019. In order to accomplish the tasks set out in this work and confirm the hypotheses raised, this research used methods to determine the central tendency parameters and the t-test methods for verifying the changes between the genders. The results were processed through the computer programme SPSS 20.0. Results: In the anthropometric space, important statistical changes were determined. Important changes appeared in the variability of the body height, weight and length of the foot. In the motoric space, changes appeared in all the tests included in this research, and these changes were in favour of the boys' group. Conclusion: Based on the results, a hypothesis was raised, assuming the differences between the sexes, especially in the motoric space. It can be concluded that the group consisting of boys has shown better results in the area of motor variables.

Keywords: boys, girls, anthropometric, motor skills, differences, t-test

INTRODUCTION

The participants' age in this research related to both genders belongs to the stage of adolescence. Adolescence takes its starting point to be the period of puberty marking a period of rapid physical growth under the influence of hormones, which begins, in girls around the age of 11, and in boys around the age of 13 (Bogin, 2011). The motor development of children and adolescents, manifested by their physical fitness, is a complex of genetic, somatic, motor and behavioural components. These components are also affected by such social and family factors as income and education level, parents' occupation, place of residence, family size or ethnicity.

These factors can also indirectly – in combination with socio-economic conditions and lifestyles – modify the motor development of youth (Bouchard et al., 1994, Suliga, 2009). The relationship between motor competence and physical activity clearly is complex. It is quite likely that the relationship is dynamic and that motor competence increases the likelihood of participating in physical activity while at the same time engaging in physical activity provides opportunities to develop motor competence (Stodden et al., 2008). The development of motor skills plays an important role for children's involvement in daily life, social activities and being successful in academic achievement (Haapala, 2013). During adolescence, and especially between the ages of 10 and 15,

girls and boys are significantly different. There are differences in anthropometric characteristics, functional and motor abilities as well as in psychological and social terms (Despot, Viskić-Štalec, 1983; Paish, 2000). Boys achieve better results in the explosive power test (standing long jump) and the agility test (figure-of-eight test), while girls perform better in the rhythm coordination test (Kraljević, Gadžić and Vučković, 2013). This paper includes the explosive strength and the speed of moving frequencies as very important components for the fulfilment of many movement tasks. Explosive force represents the athletes' ability to reach the maximum load during the shortest possible time interval. It manifests itself in cases where great force is required and the time available is as short as possible (Čoh, 2004). Speed, muscle power, agility, and balance (static and dynamic) are aspects of performance-related fitness that change during body development in predictable ways associated with the development of tissues and systems discussed above (Malina et al., 2004). Running speed and muscle power are related, and both depend on full development of the neuromuscular system. Running speed and muscle power are similar for boys and girls during childhood (Haubenströckes and Seefeldt, 1986). After puberty, largely because of differences in muscle mass and muscle strength, males continue to make significant annual gains, while females tend to plateau during the adolescent years. Sociocultural factors and increasing inactivity among girls relative to boys, along with changes in body proportion and a lowering of the centre of gravity, may also contribute to gender differences (Malina et al., 2004).

METHOD

The sample of respondents was comprised of 90 boys and 90 girls aged 13, attendants of the primary school in Lipjan municipality. The measurements were taken during the spring of 2019 and managed by the experienced professionals' group comprised of Physical Education students. In compliance with the aim of this study, a sample of 6 anthropometric variables was chosen, which were measured according to the International Biologic Programme (IBP): Body Height (ABHI); Body Weight (ABWEH); Upper Arm Circumference (AUAC); Thigh Circumference (ATHC); Leg Circumference (ALC); Foot Length (AFL). Additionally, the sample of motor abilities consisted of 6 variables: Foot Tapping (MFTAP); Hand Tapping (MHTAP); 20m Run (M20mR); Standing Long Jump (MSLJ); Vertical Jump (MVJ); 30m Run (M30mR). Motor skills were tested according to the test description (Kurelić et al., 1975).
Data Processing Method
The data obtained through the research were processed by descriptive and comparative

statistical procedures SPSS 20.0, adjusted for use on personal computers. For each variable, central and dispersion parameters have been processed. Differences in anthropometric characteristics and motor variables were determined by using a discriminatory parametric procedure alongside a t-test for small independent samples, with a statistical significance of $p < 0.05$.

Hypothesis

H1: Significant differences are expected between boys and girls in anthropometric and motor variables.

RESULTS

Table 1 shows the values of the difference between the arithmetic means of groups for each variable, the value of the t-test and the level of significance between the anthropometric variables. Based on the results obtained through this method, it can be concluded that from a total of six anthropometric dimensions, statistically significant differences have been realized in only three of them. In these variables, the value of the t-test and the level of significance meet the criteria of statistical validity. Significant differences are presented in the body height variable where the difference between boys and girls is about 3 cm. This difference is statistically significant and is in favour of boys.

Also, statistically significant differences are presented in the body weight variable with a difference of 6 cm. This difference is in favour of boys. Even in the dimension of the foot length, the change is in favour of boys with a difference of 3 cm. No statistically significant changes were observed in the dimensions of the arm, thigh and leg circumference. Analysing the anthropometric space in general, we can see that we have significant changes in this age when it comes to the longitudinal dimension of the body and that the dimensions of the body volume do not differ much from each other. This is a normal picture which is characteristic for this age and belongs to the stage of early adolescence for both genders. Table 2 shows the values of the difference between the arithmetic means of groups for each variable, the value of the t-test and the level of significance between the motor variables.

In the motor variable, the differences presented in all the tests are in the favour of the group comprising boys. This overview shows that, at this stage of growth and development, there is a higher level of motor abilities in the group of boys, compared to the category of girls. In the explosive strength test, boys jumped 6 cm longer than girls, which indicates a higher level of explosive leg strength. The difference in the vertical jump test is 4 cm, and it is statistically significant. Even in the 20 m run test, boys achieved a better time of 0.41 sec. and in the 30 m run test, they were faster by 0.65sec. This indicates a higher level of explosive power in boys compared to the group of girls. This test measures the running speed where the starting force and the ability of individuals to accelerate are measured. The same picture is shown in

tests that measure the speed of the moving frequencies related to feet and hands. In the foot tapping results, boys performed two kicks to the wall with their feet more

than girls. In the moving frequencies of the arms, the difference has been greater in favour of boys, reaching 4 more touches during the limited time.

Table 1: Differences between groups: t-test in the anthropometric dimensions

		Levene's Test for Equality of Variances		T-Test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error of Difference	95% Confidence Interval of the Difference	
									Lower	Upper
AUAC	Equal variances assumed	.620	.434	-1.380	58	.173	-1.13	0.82	-2.76	0.51
ATHC	Equal variances assumed	.900	.347	-.358	58	.722	-0.50	1.40	-3.30	2.30
ALC	Equal variances assumed	4.905	.031	-.998	58	.322	-0.84	0.84	-2.52	0.84
ABWEH	Equal variances assumed	3.216	.078	-2.331	58	.023	-5.77	2.47	-10.71	-0.82
ABHI	Equal variances assumed	5.135	.027	-2.681	58	.010	-4.30	1.61	-7.52	-1.09
AFL	Equal variances assumed	.780	.381	-5.640	58	.000	-2.02	0.36	-2.74	-1.30

Table 2: Differences between groups: t-test in the fundamental motor skills

		Levene's Test for Equality of Variances		T-Test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error of Difference	95% Confidence Interval of the Difference	
									Lower	Upper
MFTAP	Equal variances assumed	1.786	.187	-3.311	58	.002	-2.07	0.62	-3.32	-0.82
MHTAP	Equal variances assumed	.134	.716	-4.451	58	.000	-3.80	0.85	-5.51	-2.09
MVJ	Equal variances assumed	.053	.819	-3.820	58	.000	-4.80	1.26	-7.31	-2.29
MSLJ	Equal variances assumed	.947	.335	-3.501	58	.001	-19.80	5.66	-31.13	-8.48
M20mR	Equal variances assumed	3.938	.052	5.738	58	.000	0.41	0.07	0.26	0.55
M30mR	Equal variances assumed	1.827	.182	6.471	58	.000	0.65	0.10	0.45	0.85

Table 3: Differences in mean values

Group Statistics					
	Sex	N	Mean	Std. Deviation	Std. Error Mean
AUAC	Girls	90	22.83	2.83	0.52
	Boys	90	23.95	3.46	0.63
ATHC	Girls	90	46.77	5.01	0.91
	Boys	90	47.27	5.79	1.06
ALC	Girls	90	32.12	2.62	0.48
	Boys	90	32.96	3.80	0.69
ABWEH	Girls	90	47.24	7.62	1.39
	Boys	90	53.00	11.20	2.04
ABHI	Girls	90	157.35	4.67	0.85
	Boys	90	161.65	7.45	1.36
AFL	Girls	90	23.58	1.30	0.24
	Boys	90	25.60	1.47	0.27
MFTAP	Girls	90	22.43	2.67	0.49
	Boys	90	24.50	2.13	0.39
MHTAP	Girls	90	26.53	3.33	0.61
	Boys	90	30.33	3.28	0.60
MVJ	Girls	90	28.47	4.94	0.90
	Boys	90	33.27	4.79	0.87
MSLJ	Girls	90	140.31	23.61	4.31
	Boys	90	160.11	20.06	3.66
M20mR	Girls	90	3.96	0.33	0.06
	Boys	90	3.55	0.21	0.04
M30mR	Girls	90	6.89	0.37	0.07
	Boys	90	6.24	0.41	0.08

CONCLUSION

Based on the results obtained by the t-test method, which investigated the differences between groups, we can conclude that the group comprising boys has shown better results in the space of motor variables. In the research conducted by other authors, similar differences have been found when dealing with the comparison between groups comprising girls and boys, with different ages and categories. Analysing the anthropometric space

in general, we can see that we have significant changes in this age when it comes to the longitudinal dimension of the body and that the dimensions of the body volume do not differ much from each other. This once again emphasises the importance of sports activity at a young age, in order not only to ensure a better development and growth, but also to influence young people to a better development of motor skills which will play an important role, not only in the fulfilment of sports tasks but also in the performance of daily life activities.

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RAZLIKE IZMEĐU DJEČAKA I DJEVOJČICA DOBI OD 13 GODINA U DIMENZIJI BRZINE, EKSPLOZIVNE SNAGE I NEKIH PARAMETARA VOLUMENA TIJELA

Svrha: Istraživanje je imalo za cilj provjeriti razlike nekih antropometrijskih karakteristika i motoričkih sposobnosti između dječaka i djevojčica, učenika u dobi od 13 godina.

Metode: Uzorak je obuhvatio 180 učenika (90M i 90 F) u dobi od 13 godina, učenika osnovnih škola opštine Lipjan. Mjerenja su provedena u proljeće 2019. Kako bi se izvršili zadaci iz ovog rada i potvrdile postavljene hipoteze, koriste se metode za određivanje parametara središnje tendencije i metode t-testa za provjeru promjena između spolova. Rezultati se obrađuju putem računalnog programa SPSS 20.0.

Rezultati: U antropometrijskom prostoru pojavile su se važne statističke promjene. Važne promjene pojavile su se u varijablama visine tijela, težini i dužini stopala. U motoričkom prostoru pojavile su se promjene u svim testovima koji su uključeni u istraživanje, a ove promjene idu u korist grupe dječaka.

Zaključak: Na osnovu rezultata postavljena je hipoteza koja pretpostavlja razlike među polovima, posebno u motoričkom prostoru. Može se zaključiti da je grupa dječaka pokazala bolje rezultate u prostoru motoričkih varijabli.

Ključne riječi: dječaci, djevojčice, antropometrijske, motoričke sposobnosti, razlike, t-test

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RESPIRATORY PARAMETERS AND GLUCOSE METABOLISM PARAMETERS AFTER THE SWIMMING LOAD – WATER POLO CRAWL TECHNIQUE

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ABSTRACT

The main goal of this research is to determine respiratory parameters and glucose metabolism parameters after the swimming load – water polo crawl technique. Swimming is realized on a 200 m length. The examinees were students of the Faculty of Sports and Physical Education, University of Sarajevo. $N = 26$ male examinees in the age of 21 were tested. Measurements were done before and after the swimming load. T-test results and calculated eta coefficient have shown the differences for: air flow in the sixth second – standing position – SPIR6SS ($p < .01$ and $\eta^2 = .22$), air flow in the sixth second – lying position – SPIR6SL ($p < .00$ and $\eta^2 = .67$), overall air flow in the standing position – PROTOKS ($p < .00$ and $\eta^2 = .55$), overall air flow in the lying position – PROTOKL ($p < .00$ and $\eta^2 = .41$), no load after 1 h in glucose metabolism – BEZOPT1H ($p < .00$ and $\eta^2 = .49$), no load after 2 h in glucose metabolism – SAOPT2H ($p < .00$ and $\eta^2 = .41$), glucose metabolism differences before and after the load at the end of 2 hours – RAZL2H ($p < .00$ and $\eta^2 = .38$). It can be stated that the research goal has been achieved and respiratory parameters were determined as well as the parameters for glucose metabolism after the 200m swimming load – water polo crawl technique. Research with the same or similar variables can be organized and conducted on different age categories. Recommendation: additional training should be done with students and water polo players to increase respiratory endurance.

Keywords: respiratory capacity, tiredness, glucose overdose, students, t-test

INTRODUCTION

Modern water polo characteristics consist of a fast and attractive game with counter attacks, strong and precise goal shots as well as contact during the game which requires players to have motor and energy capabilities on a high level. Apart from the ball and counter players, a water polo player is distracted by hydrostatic pressure in the water. Hydrostatic pressure makes breathing harder and the player soon gets tired. The function of chest and abdominal muscles (Druz et al., 1981; Withers and Hamdorf, 1989) as well as the diaphragm function

while breathing (Hadžović – Džuvo and Kapur, 2011; Frangolias and Rhodes, 1995) is more difficult.

The specific body position of water polo crawl players also affects heavier breathing. The head position is above water which is opposite to the classic crawl technique (Mirvic et al., 2018), so it seems easier to realize this swimming technique. However, the body position in the water is under higher pitch in comparison to the classic crawl, so it is not so convenient for swimming. All this triggers more energy consumption and the players get tired faster. Tiredness affects the time spent in water for working, exercising, and training. That is why it is important to maintain the function of respiratory organs and the working capacity of lungs with maximum

inhalation and exhalation, as long as possible (Cohen, 1988, Henke et al., 1988; Ray et al., 2008). Spirometry is an important test used to determine the state of the respiratory system, enabling us to see its functional capabilities. In addition, a water polo player should be properly energetically equipped so he/she can endure the pressure and water temperature easily. Swimming under pressure triggers a physiological defence mechanism known as "exhaustion or muscle fatigue" (Secher et al., 2006) when players have to consummate energy drinks to fill up their energy (Legović et al., 2007). To keep the player in the aerobic work phase for as long as possible, air respiration should be eliminated from all troublesome factors (Francolins and Rhodes, 1996). Experienced and trained swimmer adapts to pressure, lowers the breathing frequency and increases respiratory volume and inner breathing quality (Maglischo, 2003; Dicker et al., 1980). Correct breathing enhances the swimming techniques and decreases water pressure (Rodriguez, 2000; Holmer and Gullstrand, 1980; Hsieh and Hermiston, 1983; Lerda et al., 2001). In accordance with the above mentioned, the goal of this research is set to determine respiratory parameters and glucose metabolism parameters after the swimming pressure on 200 m – water polo crawl technique. The research will show how tiredness affects the decreased working capacity of lungs and glucose waste after 200m swimming using the water polo crawl technique.

METHOD

Sample characteristics

The examinee sample was made out of students attending the Faculty of Sports and Physical Education, University of Sarajevo. The average age of students was 21 +/- 11 months, the average height of students was 1.73±0.08 m, and their weight was 70.5±10.8 kg. The research included 26 male students. No examinee has had a history of cardiorespiratory diseases or diabetes. All students are non-smokers. The examinees were free to leave the research regardless of its phase. The testing was conducted at the Olympic Swimming Pool in Sarajevo.

Physical activity measurement

Before testing and measuring, the students were prepared for the pressure. Body musculature was prepared by 200m swimming using the water polo crawl technique which is suitable up to +/- 80% of the control test tempo. Additional inspiratory – expiratory warm-up was done with the transferable device POWERbreathe®, Leisure Systems International Ltd, UK. The warm-up was conducted according to Pedersen and Kjendile (2003) in order to introduce overall testing and prevent injuries. After the implemented research preparation and research agenda, it can be stated that the examinees were adequately prepared for testing

since no one gave up or had any kind of health issue during the process. The measurement was conducted in the swimming pool, with their body in the water. The temperature of the pool was +27C °, the space humidity was 58.70%, air temperature was +29.64 C ° and the chlorine level was 0.5 mg/L. The examinees did maximum inspiratory and expiratory warm-up while standing in the pool, leaning on the wall and while lying in the pool with their head above the water. When they were in a lying position, their feet were placed up against the pool to lower body movements. The variables used for checking the breathing capacity were gathered by applying a portable device Micro Medical Ltd, Kent, UK. Variable measuring to determine glucose metabolism was conducted after the preparation for swimming pressure. The examinees consummated glucose in a ratio of 1.75g by one kilogram of body weight, up to a maximum of 75g. After 5 minutes, the mixture was ingested. The variables were gathered by using the finger-stick procedure and the "Abbott Precision Xceed" measuring device with biosensor technology (5 seconds, 0.6 microlitres of blood). Blood glucose was initially controlled one hour after ingestion and two hours after glucose ingestion. The research which verified respiratory tiredness used the following variables:

- Air flow in the first second - standing position before and after pressure (SPIR1SS)
 - Air flow in the first second - lying position before and after pressure (SPIR1SL)
 - Air flow in the sixth second - standing position before and after pressure (SPIR6SS)
 - Air flow in the sixth second - lying position before and after pressure (SPIR6LS)
 - Overall air flow - standing position before and after pressure (PROTOKS)
 - Overall air flow - lying position before and after pressure (PROTOKL)
- The research which verified glucose metabolism used the following variables:
- Glucose metabolism with no pressure after 1h (BEZOPT1H)
 - Glucose metabolism with no pressure after 2h (BEZOPT2H)
 - Glucose metabolism with pressure after 1h (SAOPT1H)
 - Glucose metabolism with pressure after 2h (SAOPT2H)
 - Differences in glucose metabolism with and without pressure in 1h (RAZL1H)
 - Differences in glucose metabolism with and without pressure in 2h (RAZL2H)

Statistical analysis

The gathered data was analysed in SPSS 22 programme with the licence of the Faculty of Sports and Physical Education, University of Sarajevo. The difference between the groups

was determined with a t-test for independent and dependent samples on a level of statistical significance ($p < .05$). The values above this one were not treated as significant. The variables with significant difference had results and were additionally calculated with eta coefficient (η^2) which shows the data on variant coverage of the initial and final testing results. Calculation and analysis of the eta coefficient (η^2) was done according to (Cohen, 1988; Kolesarić and Tomašić-Humer, 2016): .01 – high coverage, .06 – medium coverage, .13 – low coverage of variants.

METHOD

The respiratory variable SPIR6SS has values in the standard deviation .3497/.5916 (Table 1) and does not exceed the ratio of 1:1.5 between the two measuring results. The value Sig2 is .01 (Table 2) and it shows a statistically significant difference between the initial and final measuring results. The calculated eta coefficient is .02 (Table 2) and it confirms a low variant coverage. The measurement results are different.

The results of the respiratory variable SPIR6SL in standard deviation .7724/.9504 do not exceed the ratio of 1:1.5. The Sig2 value for the t-test is .00. After checking the level of coverage by calculating the eta coefficient $\eta^2 = .67$, it is stated that there is a low coverage of variants and that there is a significant difference between the final and initial measurements. The glucose metabolism variable BEZOPT1H has standard deviation result relations 1.356/5.049 (Table 3) exceeding the ratio of 1:1.5 and it indicates that the results were not in groups. The Sig2 value is .00 (Table 4) and it shows a statistically significant difference between the results. The calculated eta coefficient ($\eta^2 = .49$ Table 4) confirms the low variant coverage.

The measurement results are different. The glucose metabolism variable BEZOPT2H has standard deviation result relations 1.356/2.751 (Table 3) exceeding the ratio of 1:1.5 and it indicates that the results were not in groups. The Sig2 value is .00 (Table 4) and it shows a statistically significant difference between the results.

The calculated eta coefficient ($\eta^2 = .33$ Table 4) confirms the low variant coverage. The initial and final measurement results are different. The glucose metabolism variable SAOPT1H has

VAR	N	Valid N	Mean	Std. Dev.
SPIR1SS	1	26	5.288	.4471
	2	26	5.379	.6801
SPIR1SL	1	26	4.997	.4097
	2	26	4.658	.0803
SPIR 6SS	1	26	6.652	.3497
	2	26	6.185	.5916
SPIR6S L	1	26	6.223	.9504
	2	26	5.653	.7724
PROTOKS	1	26	.704	.1064
	2	26	.873	.1029
PROTOKL	1	26	.731	.0418
	2	26	.651	.0909

standard deviation result relations 1.356/1.979 (Table 3) exceeding the ratio of 1:1.5 and it indicates that separate results were homogenous. The Sig2 value is identical to the previous variable (Table 4) and it shows a statistically significant difference in the results.

The glucose metabolism variable SAOPT2H has standard deviation result relations 1.356/.940 (Table 3) exceeding the ratio of 1:1.5 and it indicates that separate results were homogenous. The Sig2 value is .00 (Table 4) and it shows a statistically significant difference in the results. The eta coefficient is $\eta^2 = .41$ and it confirms the difference between group results.

The glucose metabolism variable RAZL1H has standard deviation result relations 4.048/1.879 (Table 3). The result distribution exceeds the ratio of 1:1.5 and it indicates that the results are spread. The Sig2 value is .00 (table 4) and it shows statistical difference between initial and final measuring. The calculated eta coefficient ($\eta^2 = .30$ Table 4) confirms the low variant coverage. The results are different.

The glucose metabolism variable RAZL2H has standard deviation result relations 2.759/1.940 (Table 3). The result distribution exceeds the ratio of 1:1.5 and it indicates that the group results are not homogenous. The Sig2 value is .00 (Table 4) and it shows a statistical difference between the results. The calculated eta coefficient ($\eta^2 = .38$ Table 4) confirms the low variant coverage. The initial and final results are different.

VAR	Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference Lower/Upper		t	df	Sig. 2	η^2
SPIR1SS	-.091	.685	.134	-.368	.185	-.678	25	.504	/
SPIR1SL	.338	.991	.194	-.062	.739	1.740	25	.094	/
SPIR 6SS	.466	.891	.174	.106	.827	2.671	25	.013	.22
SPIR6SL	.570	.403	.079	.407	.733	7.215	25	.000	.67
PROTOKS	-.169	.154	.030	-.231	-.106	-5.59	25	.000	.55
PROTOKL	.080	.096	.018	.040	.119	4.215	25	.000	.41

Table 3 Descriptive Statistical Data for Glucose Metabolism

VAR	N	Valid N	Mean	Std. Dev.
BEZOPT1H	1	26	4.993	1.356
	2	26	9.600	5.049
BEZOPT2H	1	26	4.993	1.356
	2	26	7.140	2.751
SAOPT1H	1	26	4.993	1.356
	2	26	6.673	1.979
SAOPT2H	1	26	4.993	1.356
	2	26	5.033	.940
RAZL1H	1	26	9.600	4.048
	2	26	6.673	1.879
RAZL2H	1	26	7.140	2.751
	2	26	5.033	1.940

Table 4 T-test Results for Glucose Metabolism

VAR	Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference Lower/Upper		t	df	Sig. 2	η^2
BEZOPT1H	-4.606	4.758	.86875	-6.383	-2.829	-5.303	25	.000	.49
BEZOPT2H	-2.146	3.098	.56572	-3.303	-.989	-3.795	25	.001	.33
SAOPT1H	-1.680	2.417	.44133	-2.582	-.777	-3.807	25	.001	.33
SAOPT2H	-.040	1.621	.29601	-.645	.565	-.135	25	.003	.41
RAZL1H	2.926	4.552	.83124	1.226	4.626	3.521	25	.001	.30
RAZL2H	2.106	2.703	.49361	1.097	3.116	4.268	25	.000	.38

METHOD

The initial and final measurements in the respiratory space included six variables. Therefore, the results of the t-test did not detect statistically significant difference for expirium variable in the first second of the implemented standing position before and after pressure (SPIR1SS). Difference was not determined in the initial/final measurement for the variable – air flow – first second of lying position measurement (SPIR1SL). It can be assumed that the time of the test measurement consisting of one second is too short to register the differences in the breathing capacity before and after pressure regardless of the measuring position. Such indicators are possible because of the good preparation students had before this research, and are not in accordance with the tiredness results that Aujouannet et al. (2006) stated in their research. For the next variable (SPIR6SS) which shows air flow in a standing position before and

after pressure within six seconds, a t-test provided statistically significant difference in the measured capacities. The results match the ones that the authors Figueirredo et al. (2013) gathered showing an increased anaerobic work and tiredness after 200m swimming. The eta coefficient calculation of the variant coverage confirmed the differences so we can state that 200m swimming caused tiredness based on the decreased air flow. The air flow variables before and after pressure within six minutes in a lying position have differences in the decreased expirium and are more visible than the measurements done in the standing position (Pelayo et al., 1996). The calculated eta coefficient shows extremely low coverage of the variant and justifies the given statement that tiredness caused a decreased working capacity. The variable (PROTOKS) indicating overall air flow in a standing position before and after pressure had a t-test confirming statistically significant difference between the initial and final measurements. The calculation of the eta coefficient for both variables confirmed the given statistical difference between the measurements which is low coverage of the variant results. Since PROTOKS and PROTOKL measure overall

air flow or working capacity of the respiratory organs, it is stated that 200m swimming using the water polo crawl technique with maximum speed caused a decreased working capacity of lungs. The initial and final glucose testing had six indicators. The t-test results have shown significant statistical difference for all considered variables. This proves that the indicators were compatible since there were no examinees with diabetes history and confirms the fall of glucose concentration that follows time limits. For variables that had glucose measured after pressure (SAOPT1H and SAOPT2H), we can state with more certainty that there will be difference in the measurements – glucose metabolism is increased with physical pressure. The most interesting fact for this research is the difference between glucose metabolism with and without pressure (RAZL1H and RAZL2H). The difference in the glucose level was determined by this. These variables had the initial measurement showing a higher dispersion than the variables which define the areas of spirometry. The same indicators are not visible in the measurement after pressure. There is a difference in the mean values which is higher in both measurements done without pressure in swimming. So, glucose metabolism is different and faster in variables with pressure than those without it. All of this confirms the statement that pressure in the water polo crawl technique causes a glucose metabolism increase.

To sum up the indicators of both areas, one can state that the research goal was finalized. Respiratory parameters and glucose metabolism parameters were determined – water polo crawl technique. It is also confirmed that 200m swimming using the crawl technique causes acute tiredness visible in the decreased lung capacity and increased glucose. (Engstrom et al., 1971). To postpone tiredness during swimming, it is recommended to coaches and teachers of water polo to especially train their players so

that they can learn the techniques and tactics of breathing (Mirvić et al., 2012; Mirvić and Rašidagić, 2017). More breaths can give the player an advantage during long swims and postpone tiredness. Besides techniques and tactics of swimming, it is also necessary to develop muscle strength which contributes to breathing since it is not possible to determine the active part of lungs or residual volume with this procedure (Gattinoni et al., 1987). The recommendations are based on conclusions after training with swimmers (Hill et al., 1991) who conducted the 50m and 200m swimming where there was noticed that decreased lung capacity is postponed.

There is an assumption that training increased the muscle strength included in breathing which caused chest wideness and oxygen breathing and so prolonged the aerobic work phase. When it comes to the process of a low glucose level, it is necessary to monitor the blood glucose level during and after pressure and not have it lower than 3.9 mmol/l – hypoglycaemia (Pitzer et al., 2001). This means that energy drinks should be ingested to fill-up energy – glucose spent in the work process (Maughan, 2003).

CONCLUSION

The recommendation could also state that research with the same pressure should be done on different age categories. Additionally, there could be research on the same age category but with different pressures such as 30m or 50m swimming which is more suitable for water polo, or including swimming techniques with ball handling. The given data could be compared with these parameters.

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RESPIRATORNI PARAMETRI I PARAMETRI METABOLIZMA GLUKOZE NAKON OPTEREĆENJA PLIVANJEM - TEHNIKA VATEPOLO KRAUL

Osnovni cilj ovog istraživanja je utvrditi respiratorne parametre i parametre metabolizma glukoze nakon opterećenja plivanjem - tehnika vatepolo kraul. Plivanje je realizovano na dužini od 200 m. Ispitanici su bili studenti Fakulteta sporta i tjelesnog odgoja Univerziteta u Sarajevu. Testirano je N = 26 ispitanika, muškog spola, životne dobi 21 godinu. Mjerenja su izvršena prije i poslije opterećenja. Rezultati t-testa i izračunatog eta koeficijenta su pokazali razlike za: protok zraka u šestoj sekundi - stojeći stav - SPIR6SS ($p < ,01$ i $\eta^2 = ,22$), protok zraka u šestoj sekundi - ležeći položaj - SPIR6SL ($p < ,00$ i $\eta^2 = ,67$), ukupni protok zraka u stojećem stavu - PROTOKS ($p < ,00$ i $\eta^2 = ,55$), ukupni protok zraka u ležećem položaju - PROTOKL ($p < ,00$ i $\eta^2 = ,41$), metabolizam glukoze bez opterećenja po isteku 1 h - BEZOPT1H ($p < ,00$ i $\eta^2 = ,49$), metabolizam glukoze bez opterećenja po isteku 2 h - BEZOPT2H ($p < ,00$ i $\eta^2 = ,33$), metabolizam glukoze nakon opterećenja po isteku 1 h - SAOPT1H ($p < ,00$ i $\eta^2 = ,33$), metabolizam glukoze nakon opterećenja po isteku 2 h - SAOPT2H ($p < ,00$ i $\eta^2 = ,41$), razlika u metabolizmu glukoze prije i poslije opterećenja po isteku 1 h - RAZL1H ($p < ,00$ i $\eta^2 = ,30$) i razlika u metabolizmu glukoze prije i poslije opterećenja po isteku 2 h - RAZL2H ($p < ,00$ i $\eta^2 = ,38$). Može se konstatovati da je ostvaren cilj istraživanja i da su utvrđeni respiratorni parametri i parametri metabolizma glukoze nakon opterećenja plivanjem na 200 m - tehnika vatepolo kraul. Istraživanja sa istim ili sličnim varijablama mogu se organizovati i provesti sa različitim uzrasnim kategorijama. Preporuka: sa studentima i vaterpolistima je potreban dodatni rad na povećanju respiratorne izdržljivosti.

Ključne riječi: respiratorni kapacitet, zamor, opterećenje glukozom, studenti, t-test

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THE EFFECTS OF L2-L3-L4 HIGH VELOCITY LOW AMPLITUDE MANIPULATION ON TONUS, STIFFNESS AND ELASTICITY OF THE RECTUS FEMORIS MUSCLE

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ABSTRACT

Chiropractic treatments on lumbar vertebrae, which play a critical role in terms of lower extremity functions, are similarly effective in the treatment of functional deficiencies in lower extremity muscles such as rectus femoris, and on muscle tone, elasticity and stiffness. HVLA manipulation was applied to the L2-L3-L4 segments of 39 athletes between the ages of 18 and 60. Muscle tone, elasticity and stiffness were measured on the rectus femoris muscle, before and after the manipulation, using the MyotonPRO device. The measured values were compared in statistical terms. The evaluations were undertaken separately for the right leg and the left leg, and the p value indicating statistical significance was taken as p 0.05. According to the research findings from this study, HVLA manipulation therapy applied to the lumbar region does not cause any significant change in tonus, elasticity and stiffness values of the rectus femoris muscle. There is also no statistically significant difference between the measured values obtained from the right leg and the left leg. HVLA manipulation is known to have successful results in the treatment of many musculoskeletal problems. However, according to the results of our study, there is no statistically significant effect on tonus, elasticity and stiffness in the rectus femoris muscle.

Keywords: lumbar vertebrae, rectus femoris, chiropractic treatment, HVLA

INTRODUCTION

The basic structure of the spine, the vertebral column, is composed of sequential vertebrae and fibrocartilaginous intervertebral discs. A total of 33 vertebrae form the vertebral column include 7 cervical, 12 dorsal, 5 lumbar, 5 sacral and 4 coccygeal vertebrae. However, sacral and coccygeal vertebrae in adults are fused to form the

sacrum and coccyx (1).

Formed by various compounds including the vertebrae, ligaments and muscle tissues, the spine represents how the body is carried and ensures the realization of the most basic functions. The shape and mobility of the spine significantly depend on the structure of the discs, since they constitute the basic structure of the spine. Thus, any possible pathology in the discs will lead to

functional disorders including, in the first instance, spinal disorders. There are many reasons behind vertebrae pathologies that disrupt the function of the spine including degeneration, infections, malignancies, and trauma. Degeneration is one of the most common vertebrae pathologies that may result from a variety of reasons, while it may not be limited only to the vertebrae, but may spread to other parts (2).

Health problems related to the discs in the lumbar region are commonly observed in athletes. The incidence of this problem is rare in adolescent (10-18 years of age) athletes; however, it exceeds an occurrence rate of 48% in adult athletes. Spondylolisthesis is the most common disc problem in adult athletes, while lumbar Scheuermann's disease, scoliosis, transverse or spinous dislocations are also observed. Conservative treatments are recommended at the initial stages of these problems, which usually occur as herniation, while the need for surgical intervention increases with severity (3).

Utilising an elastic structure, muscles support mechanical movements and store elastic energy resulting from these movements. They have a flexible structure that allows tonus, hardness and elasticity in interaction with the nervous system (4, 5). Defined as the muscle's resistance to passive stretch, muscle tone depends on the internal stiffness of the muscle and the feedback loop of the stretch reflex. An increase in muscle tone usually causes spasticity in the muscle and resistance develops against the tonic stretch reflex. Although methods, such as the Ashworth scale and the Tardieu scale, were commonly used in the past to measure the tonus in muscles, new methods such as electromyogram (EMG) and myonometry have been developed in recent years (6).

Measurement of muscle tone and stiffness, based on objective criteria, is of significant importance, particularly in terms of monitoring the effects of trauma and injuries on athletes. There are various methods, supported by suitable devices, to measure and test the tonus and other mechanical features of the skeletal muscle. In addition, clinical studies have shown that some methods are more useful than others (7). These methods and devices are used to determine the mechanical features such as muscle tone and stiffness in addition to muscle activity by means of electrical stimulation. Methods such as electromyography measure intramuscular pressure and tonus through a certain correlation. Myotonometers and devices developed in accordance with electromyography are widely preferred today as a more practical method of measurement (8).

Since the main elements of the lower extremity, such as muscles and joints, are under the effect

of the neural tissues originating from the vertebrae of the lumbar region, any problem in the lumbar region is likely to affect the muscles of the lower extremity. The rectus femoris muscle is in the quadriceps muscle group and its innervation is provided through the nerves originating from the vertebral discs in the lumbar region (L2-L3-L4). Therefore, pathologies in these discs and disc elements affect the functionality of the rectus femoris. According to this correlation, therapeutic applications on the lumbar region, where neural structures originate, can have a positive effect on the functionality of the rectus femoris muscle. Therefore, manual therapies on various sections of the spine have been commonly used for a long time to treat the muscles in both the lower extremity and other regions of the body.

Manipulation applications on the spine and spinal region have been used for over 2000 years. Nonetheless, modern methods such as the high-velocity low-amplitude (HVLA) thrust are applied today and scientific research studies are conducted to identify the effectiveness and mechanism of this treatment modality in addition to clinical applications (9).

Proven to be successful in a substantial number of clinical investigations, high-velocity low-amplitude (HVLA) thrust has emerged as a treatment modality that relieves spinal pain and decreases functional loss (9). HVLA produces a cavitation by direction towards synovial joints. While improving the range of motion in short and thick paraspinal soft tissues, it also changes the pain modulation. Additionally, this method also reduces muscle spasm by decreasing motor neuron stimulability and muscle tonus, ensuring the production of proprioceptive responses. Research indicates that this method affects spinal mobility segments and muscles in addition to the thoracic region, while there are also various studies assessing its effectiveness (10). Furthermore, studies on the effect of manipulation on muscle strength indicate that this treatment significantly increases the level of muscle strength (11).

Clinical effectiveness of manipulation therapies is known and recommended by chiropractic physicians for treatment of spinal problems. Although it is a method used on many spinal regions, HVLA is particularly recommended for the thoracic region, lumbus, cervical region and pelvic joints (12).

As discussed in a number of scientific research studies on muscle and joint problems in various parts of the spine, HVLA is widely recommended for clinical use. However, its effectiveness must be tested by empirical studies, since such studies will identify the health issues and pathologies for which this method produces meaningful results, while also forming a consistent basis for clinical applications.

Athletes are one of the population groups that face the highest risk of disablement and injury in the lumbar spinal region. In this regard, manipulative therapies

are frequently used on athletes to regulate tonus and stiffness in the lumbar region. Within this framework, this study investigated the effectiveness of HVLA in relieving tonus and stiffness in the L2-L3-L4 vertebrae. It is believed that the findings will empirically demonstrate the effectiveness of HVLA in the regulation of muscle tone and stiffness affected by L2, L3, L4 discs.

MATERIALS AND METHODOLOGY

The study was planned on asymptomatic healthy professional athletes between the ages of 18 and 60 in Acibadem Sports Fifa Medical Center of Excellence. A certain point for tonus measurement was determined on both rectus femoris muscles and evaluated using the MyotonPRO. Later, HVLA manipulation was applied just one time on the L2, L3 or L4 segments. The segments to manipulate were found referring to Maigne's method (15). Those segments innervate the biceps femoris muscle, which is why they were selected.

The determined points on both rectus femoris muscles were re-evaluated immediately after the application. The initial and final evaluations were compared in terms of tonus, stiffness and elasticity. The evaluation was performed separately for the right and left legs. The subjects included in the study were selected according to certain criteria:

Criteria for inclusion in the study:

- a) Aged between 18 and 60 years
- b) Literacy
- c) Volunteering to participate in the study
- d) Being a professional athlete

Criteria for exclusion from the study:

- a) Lumbar disc herniation, radiculopathy or myelopathy
- b) Tumor, infectious, psychiatric or systemic disease and bleeding diathesis
- c) No history of lower back pain in the last six months
- d) No contraindication to HVLA manipulation
- e) Unwillingness to cooperate

This study is designed to analyse the effect of L2-L3-L4 HVLA manipulation on the tonus, elasticity and stiffness of rectus femoris in healthy athletes.

In the second phase of the study, data obtained from 39 healthy volunteers was analysed using SPSS software which enabled numerical measurement of the effect of HVLA manipulation application on lumbar discs, tonus, elasticity and stiffness of the rectus femoris. Firstly, demographic information (name, surname, age, occupation, gender) of the participants was collected. Subsequently, they were questioned to determine whether they had experienced low back pain in the last six months. The general evaluation included investigating patient history to determine whether they

had past trauma, comorbidities, used prescription medication, had undergone surgical operations, ascertained if pregnant or smoked.

After examinations by a physiotherapist, a designated point of the rectus femoris was marked. Myotone measurement on the rectus femoris muscle commences with the placement of the electromagnet part of the device on the projection of superficial muscle on the skin.

During the measurement, 5-15 milliseconds and 0.4-Newton stimulation is applied to the skin by the device probe and this stimulation creates 2-3 millimetres of deformation on the skin. Muscle tone, a graph of muscle oscillation, elasticity and stiffness were analysed in numerical values as a result of this deformation.

Stiffness (Newton/meter) refers to the resistance of the muscle to the applied force. An increase in muscle stiffness means an increase in the strength necessary for antagonist muscle movement and it is not economical for movement.

HVLA manipulations were applied to L2 or L3 or L4 vertebrae once for each participant. A physiotherapist determined which vertebra to manipulate by means of the palpation method. Maigne also described signs found in the skin (cellulalgia), in the muscles (myalgic bands) and in the bony insertions of tendons (tenalgia). We also used the Maigne's method to find which vertebra to manipulate (15).

From this perspective, palpation is the oldest evaluation method used by chiropractors in determining subluxation or dysfunctions. One of the indicators related to the sequence disorder/dysfunction of vertebrae is muscle and bone sensitivity in palpation (13, 14, 15).

The statistical analysis undertaken in this study consists of pre- and post-application results data. Tonus, elasticity and stiffness values obtained from right and left leg measurements before HVLA spinal manipulation were recorded and the same measurements were repeated and recorded after HVLA manipulation. The values obtained before and after HVLA manipulation were statistically analysed for the right and left leg separately in order to investigate whether there was any significant change in measurements.

The significance level was accepted as $p < 0.05$ in measurements. Statistical Package for the Social Sciences (SPSS) 22.0 Package Programme was used to analyse the data obtained from measurements; mean deviation, standard deviation, t and p values were calculated separately and the significance of change in mean values was investigated by the t-test.

FINDINGS

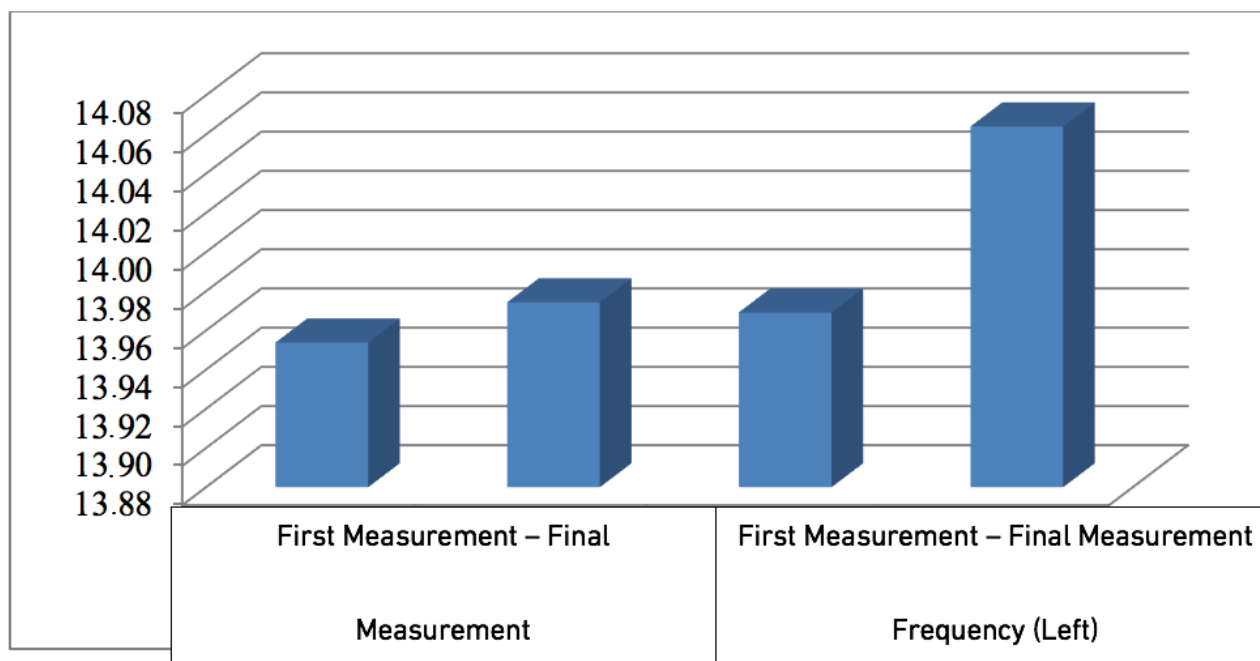
The results of the t-test applied to dependent groups, in order to determine whether there was a significant difference between the mean values of the first and second measurement in the right and left leg, are given below (Table 1). Analysis

of the first and second measurements in the right leg shows that the pre-HVLA measurement frequency was 13.95 and post-HVLA was 13.97. While the mean value in the first measurement was 13.97 for the left leg, the second measurement produced a mean value of 14.06. No significant difference was found between the mean frequency values in the first and second measurements in the right and left leg ($p > 0.05$). (Figure 1).

Table 1: Tonus Findings

		N	Mean	Standard Deviation	t	p
Frequency (Right)	First Measurement	39	13.95	1.46	-0.070	0.944
	Final Measurement	39	13.97	1.74		
Frequency (Left)	First Measurement	39	13.97	1.54	-0.330	0.743

Figure 1: Tonus Findings

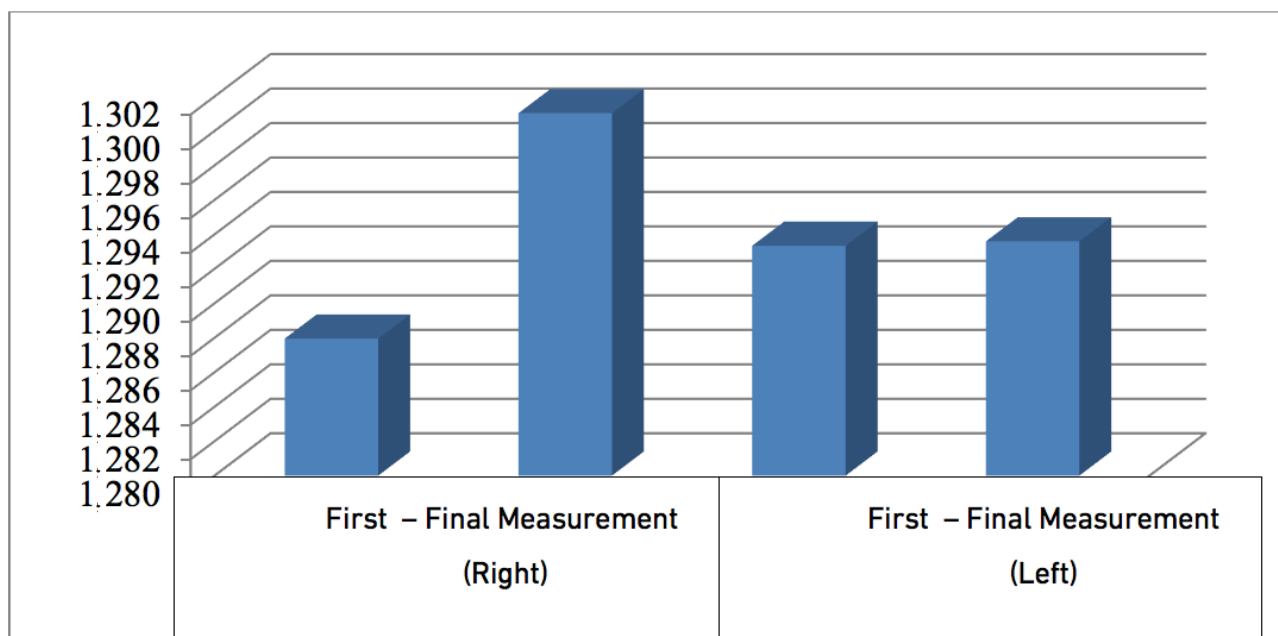


While the mean logarithmic decrement of the right leg was 1.29 in the first measurement, the mean value was 1.30 in the second measurement. Conversely, the mean logarithmic decrement of the left leg was 1.29 in the first measurement, and

it remained the same for the second measurement. No significant difference was found between the mean logarithmic decrement values in the first and second measurements on the right and left leg ($p > 0.05$). (Table 2 and Figure 2).

Table 2: Elasticity Findings

		N	Mean	Standard Deviation	t	p
Logarithmic Decrement (Right)	First Measurement	39	1.29	0,22	-0.160	0.874
	Final Measurement	39	1.30	0,47		
Logarithmic Decrement (Left)	First Measurement	39	1.29	0.22	-0.004	0.997
	Final Measurement	39	1.29	0.40		

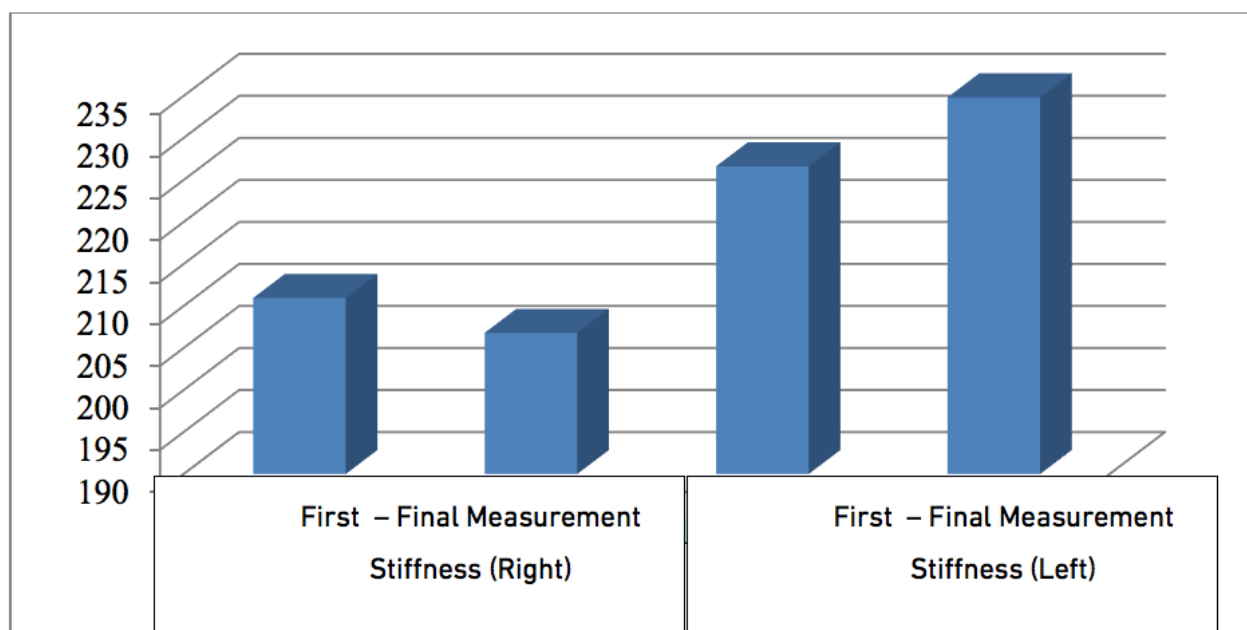
Figure 2: Elasticity Findings

In the first measurement, the mean stiffness value in the right leg was 210.95, while it was 206.79 in the final measurement. In the first measurement, the mean logarithmic decrement in the left leg was 226.62,

and it amounted to 234.82 in the second measurement. No significant difference was found between the mean stiffness values in the first and final measurements in the right and left leg ($p > 0.05$). (Table 3 and Figure 3)

Table 3: Stiffness Findings

		N	Mean	Standard Deviation	t	p
Stiffness (Right)	First Measurement	39	210.95	43.67	0.444	0.660
	Final Measurement	39	206.79	60.61		
Stiffness (Left)	First Measurement	39	226.62	43.67	-0.629	0.533
	Final Measurement	39	234.82	65.25		

Figure 3: Stiffness Findings

The results of the t-test applied to dependent groups, in order to determine whether there was a significant difference between the mean values of the first and second measurement in the right and left leg, are shown below. (Table 4) In analysing the t-test results it was clear there was no significant difference between the right and left leg mean values of frequency,

logarithmic decrement and stiffness in the first and final measurements ($p > 0.05$).

In analysing the findings obtained from the statistical analysis of MyotonPRO measurements performed before and after HVLA manipulation, the manipulation was not found to have any significant effect on the tonus, elasticity or stiffness parameters of the rectus femoris muscle.

Table 4: Comparison of Right and Left Leg Measurements

		N	Mean	Standard Deviation	t	p
First Measurement	Frequency	Right	39	13.95	-0.045	0.964
		Left	39	13.97		
	Logarithmic Decrement	Right	39	1.29	-0.109	0.914
		Left	39	1.29		
	Stiffness	Right	39	210.95	-1.584	0.117
		Left	39	226.62		
Final Measurement	Frequency	Right	39	13.97	-0.236	0.814
		Left	39	14.06		
	Logarithmic Decrement	Right	39	1.30	0.075	0.940
		Left	39	1.29		
	Stiffness	Right	39	206.79	-1.965	0.053
		Left	39	234.82		

DISCUSSION AND RESULTS

Analysis of the study findings demonstrates that HVLA manipulation treatment applied on the lumbar region (L2-L3-L4) does not create any significant change in the tonus, elasticity and stiffness levels. Additionally, there is no statistically significant difference between the measurements of the rectus femoris on the right leg and on the left leg.

It was not possible to directly compare the results of the study with other research outputs as no other research could be located in the literature which measures the effectiveness of the HVLA manipulation on the basis of similar parameters. Nevertheless, there is research in the literature which tests the effectiveness of HVLA spinal manipulations in terms of various physiological problems. Furthermore, there are other studies that directly consider muscle parameters. The findings of such studies are briefly shared below, and their similarities are compared with our study.

HVLA is effective in relieving lumbar pain. In a study measuring the effectiveness of HVLA spinal manipulation in the treatment of acute non-specific pain, HVLA provided a significant level of improvement, while also ensuring more improvement compared to the use of diclofenac which was also investigated in the study (16). HVLA affects sensorimotor function in low back pain. According to a study examining the postural release of HVLA in patients with low back pain, HVLA manipulation significantly increases postural release (17). Additionally, Hondras et al. (18) examined the effectiveness of HVLA manipulation in low back pain experienced by patients over 55 years of age. The findings suggest that HVLA is an effective method for the treatment of low back pain.

Injury and disablement are mostly observed in rotator cuffs of the upper extremity and a study analysing muscle and joint disorders in this region demonstrated that manipulation provided significant improvement in these disorders (19).

According to the study of Hillermann et al. (10), evaluating the effect of manipulative therapy on the quadriceps muscle strength in the spinal region, the manipulation therapy resulted in a significant increase in muscle strength. In an experimental study, Dunning and Rushton (20) found that HVLA spinal manipulation led to changes in EMG activity of the right and left biceps muscles. It is observed that HVLA increases hip extension and angle of pitch when applied as a treatment in order to increase the performance of muscles with limited function (21).

Analysing the myoelectric activity of lower trapezius and posterior deltoid muscles after HVLA manipulation applied on the thoracic spine, McChesny et al. (9) revealed that myoelectric activity reduces via manipulation. However, this change is not at a statistically significant level. Thomson (22), however, scrutinized the effect of HVLA manipulation and mobilization therapies on the pain threshold in the lumbar region, suggesting that there is a change in the pain threshold although not at a statistically significant level.

In general, studies in the literature have investigated the effect of HVLA manipulation on lumbar region pain, functional disorders in the upper extremity and functions of the lower extremity. However, there are no studies focusing directly on the effect of HVLA

manipulation on the tonus, elasticity and stiffness of the rectus femoris muscle. Nevertheless, research findings suggest that, generally, HVLA manipulation is a useful treatment modality for muscle and joint functions. Certain studies, however, highlight the fact that HVLA manipulation does not provide expected pain relief or functional improvement (24).

Manipulation therapies, known since the time of Hippocrates, have become diversified and more

widespread as technology develops.

HVLA spinal manipulation therapy has been commonly used in recent years as a chiropractic treatment. Despite clinical applications, the number of research studies investigating the effect of manipulation on lumbar discs as well as related muscles and joints in neural and functional relationship is very limited. There is a need for further research in order to understand the action mechanism of this therapy and determine its healing effect.

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EFEKTI BRZIH I KRATKIH MANIPULACIJA LUMBALNIH PRŠLJENOVA L2, L3 I L4 NA TONUS, KRUTOST I ELASTIČNOST RECTUS FEMORIS MIŠIĆA

Kiropraktički tretmani lumbalnih pršljenova, a koji igraju važnu ulogu kada je u pitanju funkcija donjih ekstremiteta, su jednako efektivni u tretmanu funkcionalnih nedostataka mišića donjih ekstremiteta poput rectus femoris mišića, te mišićnog tonusa, njegove elastičnosti i krutosti. HVLA manipulacije su primjenjene na L2, L3 i L4 pršljenove 39 sportista između 18 i 60 godina starosti. Mišićni tonus, elastičnost i krutost su mjereni na rectus femoris mišiću prije i poslije manipulacije koristeći uređaj MyotonPRO. Izmjerene vrijednosti su poredene koristeći statističke metode. Mjerenja su provedena odvojeno za desnu i lijevu nogu, a p vrijednost koja ukazuje na statistički značaj je postavljena na nivo $p=0,05$. U skladu sa pronalascima ovog istraživanja, HVLA manipulacija primjenjena na lumbalnu regiju ne uzrokuje značajne promjene vrijednosti tonusa, elastičnosti i krutosti rectus femoris mišića. Također, nije pronađena statistički značajna razlika između mjerenih vrijednosti dobivenih za desnu i lijevu nogu. Poznato je da HVLA manipulacija daje uspješne rezultate u tretmanu bilo kojih mišićno-koštanih problema. Međutim, prema rezultatima ove studije, nije utvrđen statistički značajan efekat na tonus, elastičnost i krutost rectus femoris mišića.

Ključne riječi: lumbalni kralješci, rectus femoris, kiropraktički tretman, HVLA

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THE IMPACT OF SPECIAL PHYSICAL EDUCATION TEACHING ON THE DEVELOPMENT OF REPETITIVE FORCE IN FEMALE STUDENTS' HAND EXTENSOR MUSCLES

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ABSTRACT

The goal of this research was to determine the differences between the results obtained at the entrance exam and at the end of the freshman year of studies at the University of Criminal Investigation and Police Studies regarding the female student's hand extensor muscles force. The sample of 39 female students aged 19 to 21 was monitored with regard to the changes in hand extensor muscles repetitive force, shaped by the impact of the Special Physical Education 1 (SPE 1) teaching which is taking place during the freshman year of undergraduate academic studies at the University of Criminal Investigation and Police Studies in Belgrade. For determining the significance of differences pertaining to the observed variable at the initial and final measurements, the Student's t-test is used for dependent samples. The results obtained in this research on the sample of female students ($N = 39$) had shown that, after the subject Special Physical Education 1 was taught, statistically significant changes of absolute values pertaining to the repetitive force of hand extensor muscles were found at the final measurement ($M = 8.2$; $SD = 1.91$; $t = -4.218$; $p < 0.000$; in relation to the initial measurement $M = 6.4$; $SD = 2.92$).

Keywords: muscle strength, hand extensors, female students, special physical education

INTRODUCTION

Together with other subjects, students attending the University of Criminal Investigation and Police Studies in Belgrade take classes from the subject titled Special Physical Education 1 - general course. The Special Physical Education 1 (hereafter referred to as SPE 1) subject teaching is implemented at the study programme of undergraduate academic studies during the second

semester as a mandatory subject. For admission at the University of Criminal Investigation and Police Studies (hereafter referred to as UCIPS), during the procedure of selecting candidates for job posts in the Serbia Ministry of Internal Affairs, one of basic criteria is quantitative qualification of motor abilities and morphologic features of candidates (Milošević, Stojčić, Blagojević et al., 1994; Božić, 1995; Amanović, Mudrić, Jovanović, 1999; Mudrić, Jovanović, 2000; Dopsaj, Milošević, Blagojević,

2002; Amanović, Milošević, Mudrić, 2004; Milošević, Mudrić, Jovanović, Amanović, Dopsaj, 2005; Dopsaj, Vučković, Blagojević, 2007; Amanović, Mašić, Kostovski, Ljubisavljević, 2015). At the entrance exam as well as for the Special Physical Education 1 subject taught at the University of Criminal Investigation and Police Studies, one of the tests is the basic motor skills test (hereafter referred to as BMS) within which the repetitive force of hand extensor muscles is measured.

One of basic tasks of Special Physical Education is also the development of basic motor skills (BMS), and that, alongside others, implies the development of hand extensor muscles repetitive force in female students at the University of Criminal Investigation and Police Studies. A certain level of rendering repetitive force has great impact on the successful and efficient execution of professional police duties (Milošević, 1985; Vučković, Dopsaj, Blagojević, 2001; Amanović, 2003; Vučković and Dopsaj, 2007; Amanović, 2013; Amanović, Baić, Nikač, Ljubisavljević, 2015). Strength is a capability of an organism, especially muscles (within the moving activities) to significantly and efficiently resist greater efforts (Kurelić, 1967). Opavsky (Opavsky, 1975) defines force as the capability of muscle strain contained within motor units transformed into kinetic and a potential form of mechanical energy. Strength is the capability of a human to overwhelm outside resistance or to oppose it by muscular strain (Zatsiorsky, 1995). Bomp (Bompa, 2005) defines strength as the capability of using a force to overwhelm resistance. Strength is the capability of muscles to act with relatively high forces, where small outside resistance is present in addition to the high velocities of muscle contractions (Kukulj, 2006). Repetitive force is defined as the capability of performing individual simple movements as well as whole body repetitions.

This capability can be highly developed, considering that the congenital coefficient is very low and amounts 50 (Vukadinović, 2015). Repetitive force signifies the most frequently implied capability of working out based on alternating contractions and relaxations of muscles pertaining to the hands, legs, and torso or a long execution of a certain movement without diminishing its efficiency (Kurelić et al., 1975; Pržulj, 2006). Due to the ease of their applicability and reliability, tests for estimating the hand extensor muscles repetitive force are often an integral part of policemen's physical capabilities examinations (Milošević, 1985; Dopsaj et al., 2002; Milošević et al., 2005; Milošević and Milošević, 2014).

The subject of this research is the selected motor ability of female students – hand extensor muscles repetitive force expressed by the number of push-ups performed over the 10-second period. The goal of the research was to determine the changes in the

results obtained at the entrance exam and at the end of the freshman year of studies regarding the University of Criminal Investigation and Police Studies female student's hand extensor muscles force formed under the influence of the subject titled Special Physical Education 1 - general course.

METHODS

Distribution of educational treatments

Special Physical Education 1 – general course is a mandatory subject and, according to the actual teaching plan, students are pursuing this subject at the freshman year of studies, during the second semester. The scheduled teaching encompasses 45 hours of lectures and 35 hours of exercises. In this phase, educational content comprised 60%, while 40% is taken by motor contents. The tasks related to this phase of training are mastering basic techniques and creating motor programmes such as: falls, posturing, moving, stance, stifling, throwing, punching, blocking and using leverages and grips. During the introductory part of each lesson, standard warming-up is performed for the duration of 10-15 minutes, while the final 10-minute part is reserved for relaxing and stretching workouts.

Sample

The sample consisted of 39 female students attending the University of Criminal Investigation and Police Studies in Belgrade, aged 19-21, who went through the process of selection – passed the entrance exam and enrolled at the freshman year of undergraduate academic studies ($BH = 169.34 \pm 6.17$ cm, $BW = 65.89 \pm 10.18$ kg, $BMI = 22.98 \pm 4.78$ kg/m²). It should be pointed out that all instances of previous success in passing medical check-ups and psychological tests tell about their capability for performing the job and executing work tasks within the Ministry of Internal Affairs of the Republic of Serbia.

Measurement methods

Female students are tested in the Special Physical Education gymnasium at the University of Criminal Investigation and Police Studies in Belgrade. Testing is performed by teachers of the Special Physical Education subject. Initial measurement of hand extensor muscles repetitive force has been performed at the entrance exam, while retesting has been performed within the exam tasks given to female students attending the freshman year of undergraduate academic studies. In this research, the test for estimating the maximum value of hand extensor muscles repetitive force is expressed by the number of push-ups performed over the 10-second period. The above mentioned variable is an integral part of a battery of tests for estimating basic motor abilities of the students attending the University of

Criminal Investigation and Police Studies: (PUSH-UP 10s) – hand extensor muscles repetitive force – the number of push-ups performed over the 10-second period. The procedure related to the number of push-ups performed within the 10-second period (PUSH-UP 10s) – hand extensor muscles repetitive force had been conducted using the standardized protocol (Milošević, 1985; Amanović et al., 2004; Milošević et al., 2005; Milošević and Milošević, 2014).

Statistical data processing methods

The obtained results have been analysed by the following tools of descriptive statistics: for calculating the basic parameters of central tendency, the arithmetical mean (Mean), coefficient of variation (cV%), standard deviation (SD), minimum and maximum value of each variable observed (Min, Max), indicator of result skewness – the coefficient of asymmetry (Skew) and the indicator of the degree of curvature – the coefficient of flattening (Kurtosis) had been used.

A significant difference among the observed variables, created under the influence of the Special Physical Education 1 teaching, was determined by using the Student's t-test for dependent samples. Statistical significance is defined at the level of 95% of probability or $p > 0.05$. The analysis was determined by using the statistical package for data processing (SPSS 20.0).

RESULTS

According to the research goal, the differences present in the results of the selected motor abilities in female students attending the University of Criminal Investigation and Police Studies – hand extensor muscles repetitive force – the number of push-ups done over the 10-second period (PUSH-UP 10s) at the entrance exam testing the basic motor abilities and at the initial measurement and the test results obtained within the

basic motor abilities' tests for the subject Special Physical Education – general course were used as the control measurement for teaching. Table 1 illustrates the values of basic descriptive indicators related to the hand extensor muscles repetitive force expressed by the number of push-ups done over the 10-second period (PUSH-UP 10s). The coefficient of variation for the variable observed at the initial measurement indicates an immoderate degree of homogeneity related to average values (cV% = 45.85) while the control measurements for the degree of homogeneity related to the average values are significantly lower (cV% = 23.46).

At the initial measurement, the value of standard deviation (SD) is around 2.92 with regard to the observed variable, namely 3% less than the average value, while the control measurement is at the level of 1.91, which points out that the sample followed-up in this research solidly represents the population of female students attending the University of Criminal Investigation and Police Studies in Belgrade. The average number of push-ups done over the 10-second period at the entrance exam amounts to 6.4 with a standard deviation of 2.92, and the coefficient of variation in the amount of 45.85%. The minimum value recorded amounts to 0, while the maximum recorded value is 14 repeats. The average number of push-ups done over the 10-second period during tests conducted within the measurements of basic motor abilities for the SPE 1 subject amounts to 8.2 with the standard deviation of 1.91, and the coefficient of variation in the amount of 23.46%. The minimum value amounts to 5 repeats, while maximum value is 14 repeats. The results obtained for determining the significance of difference in the observed variable are presented in Table 2, the final related to the initial measurements, created under the impact of teaching the SPE 1 subject content, with the use of Student's t-test for dependent samples.

Table 1: Basic descriptive indicators, I and II measurement (female students N = 39)

	I measurement	II measurement
Mean	6.4	8.2
SD	2.92	1.91
cV%	45.85	23.46
Min	0	5.0
Max	14	14
Skew	0.027	0.672
Kurt	0.442	0.926

Based on the data contained within Table 2, the results related to the Student's t-test for dependent samples had shown a statistically significant impact of SPE 1 teaching on the change in hand extensor muscles repetitive force expressed by the number of push-ups done over the 10-second period at the end of the freshman year for female students attending UCIPS ($t = -4.218$; Sig. = 0.000). The repetitive force of hand extensor muscles expressed by the number

of push-ups done over the 10-second period during the initial measurement of female students had shown, on average, a lower result ($M = 6.4$; $SD = 2.92$) than at the final measurement ($M = 8.2$; $SD = 1.91$), which means that female students, after taking part in the programme activities of the SPE 1 subject teaching, had a statistically significant improvement of these motor abilities, along with the statistical values of $t = -4.218$, at the level of significance of $p > 0.000$.

Table 2: Results of the t-test for dependent samples – initial and final measurement (female students $N = 39$)

Variable	Mean	Mean	df	t-value	Sig.
	Initial	Initial			
PUSH-UP 10s – female students	6.4	8.2	38	-4.218	0.00

DISCUSSION

In order to perform police work, muscle force is one of the most significant physical abilities, which is why determining its level is often present in examinations of motor abilities development and the selection processes (Anderson et al., 2001). Repetitive force implies the ability to perform multiple fast and powerful movements within the time intervals between 15 seconds and 2 minutes, which are being performed within the suboptimal intensity zone (Milošević, 1985; Dopsaj et al., 2002).

As the ability of the muscular apparatus to perform consecutive muscular contractions with maximum intensity, repetitive force is one of the most important motor features which statistically describes the specific motor space of policemen (Milošević, 1985; Milošević and Gavrilović, 1985; Dopsaj et al., 2002; Amanović et al., 2004; Milošević et al., 2005).

In the areas of selecting and diagnosing the level of certain physical features, special physical education is also used as a test for assessing the repetitive force of muscles related to different body segments (Milošević, 1985; Milošević and Gavrilović, 1985; Blagojević, 1996; Dopsaj et al., 2002; Amanović et al., 2004). Repetitive force can be expressed in absolute values (for example, the number of repetitions for the given task or the time needed for performing it) or in relative values (for example, the number of repetitions of for the given task per second of activity or the time needed for performing one attempt of the given workout). In this research, the repetitive force of hand extensor muscles in the population of female students who have already been tested

was estimated in absolute values as the time period necessary for execution of a given task (the number of push-ups done within a 10-second period). The results obtained in the research conducted on a sample of students during the first three years of attending the Academy of Criminalistic and Police Studies for the 2006/2007 generation (Janković, 2009), within which the repetitive force of hand extensor muscles was assessed as the time needed to perform 15 push-ups, had shown that the average value of a PUSH-UP increased by 0.29 seconds, i.e. for 2.45 seconds during the first three years of study. The defined model of the trend change has shown that, in the function of one year of studies, there is an increase of the PUSH-UP value by 0.145 seconds.

Based on the results of research conducted on well-trained persons according to the type of strength training (students of the Academy of Criminalist and Police Studies as well as well-trained persons), it is determined that the time period necessary to perform 15 push-ups, namely the value of a PUSH-UP, amounts to 11.04 ± 0.57 seconds (Koropanovski and Janković, 2007). The results of research conducted on categorized karate athletes (Vučković and Koropanovski, 2007) have determined that the value of a PUSH-UP (the time needed to perform 15 push-ups) amounts to 12.11 ± 1.51 seconds.

In the research conducted by Dopsaj et al. (Dopsaj, Blagojević, Marinković, Miljuš, Vučković et al., 2010), performed on a sample of 1579 respondents aged 18 to 24 (1233 male students and 356 female students, out of which the highest number were from the freshman year of studies at the Academy of Criminalist and Police Studies, while a small number of respondents attended the Sport Academy and the Faculty of Sport and Physical Education), the yielded results were as follows: for the tested female respondents, the

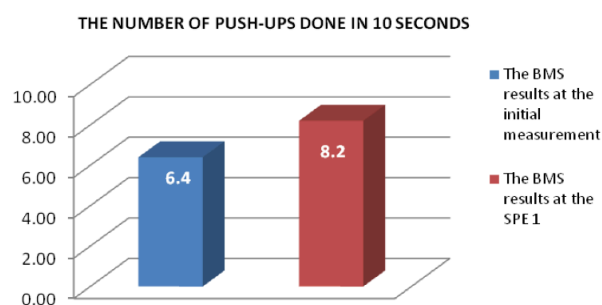
maximum repetitive force of hand extensor muscles expressed by the number of push-ups performed over the 10-second period amounts to $M = 6.2$; $SD = 3.40$. The results of our research on a sample of female students ($N = 39$), ($M = 6.4$; $SD = 2.92$; at the initial in relation to the final measurement amounts to $M = 8.2$; $SD = 1.91$; $t = -4.218$; $p < 0.000$), in relation to the results of the above mentioned project, with the goal of obtaining actual descriptive, classification, and normative criteria for evaluating the state of basic morphological features and basic motor abilities of healthy active young individuals, both genders aged 18 to 26, point out a satisfactory level of the measured values related to the female students' hand extensor muscles repetitive force.

At the initial measurement, the number of push-ups performed over the 10-second period ($M = 6.4$; $SD = 2.92$) was at the same level as the number of push-ups performed over the 10-second period by benchmark respondents ($M = 6.2$; $SD = 3.40$), while at the final measurement ($M = 8.2$; $SD = 1.91$), as the result of the effect of SPE 1 subject teaching, the value recorded for hand extensor muscles repetitive force, expressed by the number of push-ups performed over the 10-second period, is at a higher level than the value of benchmark respondents' hand extensor muscles repetitive force by 2, and has 32.5% in relative amount.

The results of measuring the values for the number of push-ups performed over the 10-second period obtained in this research on a sample of female students ($N = 39$) have shown that, after taking part in programme activities of the SPE 1 subject teaching, a statistically significant change of the absolute value at the final measurement had occurred $M = 8.2$; $SD = 1.91$; $t = -4.218$; $p < 0.000$ in relation to the initial measurement $M = 6.4$; $SD = 2.92$. The absolute value change amounts to 1.8, while the relative value change amounts to 27.4% (median value is higher by 27.4% at the final measurement in relation to the initial one).

CONCLUSION

In this research, the change of hand extensor muscles repetitive force occurred under the impact of the Special Physical Education 1 – general course subject teaching, on a sample consisting of 39 female students from the freshman year of undergraduate studies at the University of Criminal Investigation and Police Studies in Belgrade. The results of the rendered hand extensor muscles repetitive force, expressed by the number of push-ups performed over the 10-second period on a sample of female students ($N = 39$), had shown that, after taking part in programme activities of the SPE 1 subject teaching, statistically significant change occurred at the final measurement (at the end of the academic year) in relation to the values registered at the initial measurement (entrance exam). Therefore, it can be concluded that Special Physical Education 1 – general course subject teaching, which is performed at the freshman year of undergraduate academic studies at the University of Criminal Investigation and Police Studies in Belgrade, does contribute to the improvement of hand extensor muscles repetitive force expressed by the number of push-ups performed over the 10-second period for the population of female students.



Graph 1 - The differences between medium values for the sample of female students $N = 39$ (the initial and final measurement)

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UTICAJ POSEBNE NASTAVE IZ FIZIČKOG OBRAZOVANJA NA RAZVOJ REPETITIVNE SILE MIŠIĆA EKSTENZORA RUKU STUDENTICA

Cilj ovog istraživanja je bio utvrditi razlike između rezultata dobivenih na prijemnom ispitu i na kraju brucške godine studija na Kriminalističko-policijskom univerzitetu, a u vezi sa snagom mišića ekstenzora ruku studentica. Uzorak od 39 studentica uzrasta od 19 do 21 godine je praćen po pitanju promjena repetitivne sile mišića ekstenzora ruku, oblikovanih uticajem nastave Specijalnog fizičkog obrazovanja 1 (SPE 1) koja se održava na brucškoj godini dodiplomskog akademskog studija na Kriminalističko-policijskom univerzitetu u Beogradu. Za određivanje značaja razlika posmatrane varijable na početnom i završnom mjerenju koristi se Studentov t-test za zavisne uzorke. Rezultati dobiveni u ovom istraživanju na uzorku studentica ($N = 39$) su pokazali da su, nakon realizovane nastave iz predmeta Specijalno fizičko obrazovanje 1, statistički značajne promjene apsolutnih vrijednosti repetitivne sile mišića ekstenzora ruku uočene na završnom mjerenju ($M = 8,2$; $SD = 1,91$; $t = -4,218$; $p < 0,000$; a u odnosu na početno mjerenje $M = 6,4$; $SD = 2,92$).

Ključne riječi: mišićna snaga, ekstenzori ruku, studentice, specijalno fizičko obrazovanje.

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THE EFFECTS OF SPORTS AND PHYSICAL EDUCATION TEACHING ON IMPROVING CHILDREN'S MOTOR ABILITIES

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ABSTRACT

Aim: The main goal of the whole research procedure is to determine the effects of different sports teaching and physical education programmes, and what are the effects of the implementation of the elementary and team sports programmes in teaching, on the motor abilities of elementary school students. **Methods:** The examination was conducted on a model of 60 students aged 10 years (± 6 months) and it included testing, measurement, and comparison within the motor abilities space. The students were divided into two groups, control (30) and experimental (30). The experimental programme included content from sports games, with the implementation of supplementary exercises under the supervision and guidance of a professor of sports and physical education. The control group worked according to the existing curriculum (athletics, rhythmic and dance, exercise machines and exercises on the floor), and the teachers of elementary school education worked with them. The programme for both groups was implemented over a period of 16 working weeks or 32 teaching hours. **Results:** The result of the t-test indicates a statistically significant difference observed for all variables according to the most stringent level of statistical inference ($p = 0.01$) except for the variable - standing long jump, where we do not have statistical significance of differences between the experimental and control groups. **Conclusion:** One of the primary preconditions for a more effective and appropriate impact of sports and physical education on the anthropological status of the child is certainly an increase in the volume of teaching in terms of daily physical activities. Insufficient exercise, and especially inappropriately conducted and directed exercise, do not provide the expected effects.

Keywords: effects, teaching, sport, physical education, motor skills, children

INTRODUCTION

Sports and physical education teaching, viewed as a process, has its content (kinesiological operators in the function of the goal) and methods that are realised at a series of time points, with the appropriate volume of kinesiological activity (duration, rhythm), and the appropriate quantity and quality of available information in accordance with the complexity of the recipient's motor task or the

ability to decode it in a timely manner (Zeng et al., 2017). Motor abilities are conditionally defined as latent motor structures which are responsible for a practically infinite number of manifest reactions and can be measured and described (Bala, Jakšić, & Popović, 2009). The essence of a programmed teaching activity, besides determining the goal and a specific programme, is reflected in the existence of quality feedback, which is in the function of taking measures in a timely manner to adapt the process of pedagogical activity to the individualised needs of students (Budimlić, 2016).

Physical exercise can significantly affect the development and maintenance of the achieved level of individual motor abilities (Gašparić, 2015). Exercise can have some effect on coordination, explosive power, balance, flexibility, and especially repetitive and static power. (Antolović, 2017). Psychomotor abilities can be developed by different training methods and modalities, and can be tested by motor abilities tests (e.g. long jump, crunches, obstacle course, etc.) (D. Milanović, Jukić, & Šimek, 2003). The methods and exercises we use in properly programmed physical exercise differ as we develop different abilities. Motor abilities are more important to a child's development than motor skills (L. Milanović, Jukić, Nakić, & Čustonja, 2003). Motor abilities are the abilities of a person who participates in solving motor tasks and they condition successful movement, whether acquired by training or not. They are manifested through manifest and latent space (Malacko & Rađo, 2004).

METHODS

The main goal of the whole research procedure is to determine the effects of different sports teaching and physical education programmes, and what are the effects of the implementation of the elementary and team sports programmes in teaching, on the motor abilities of elementary school students. In this research, the examination was conducted on a model of 60 students aged 10 years (± 6 months) and it included testing, measurement, and comparison within the motor abilities space.

The students were divided into two groups, control (30) and experimental (30). The experimental programme included content from sports games, with the implementation of supplementary exercises under the supervision and guidance of a professor of sports and physical education.

The control group worked according to the existing curriculum (athletics, rhythmic and dance, exercise machines and exercises on the floor), and the teachers of elementary school education worked with them. The model of variables for the assessment of motor abilities in this research constitutes the EUROFIT battery test group, which is mandatory and is implemented throughout the school system, i.e., the teaching process (Hadzikadunić, Rađo, Grozdanić, and Turković, 2000) as follows: Flamingo Balance Test; Plate Tapping; Sit-and-Reach; Standing Broad Jump; Sit-Ups; Bent-Arm Hang; 10 × 5 metre Shuttle Run. The programme for both groups was implemented over a period of 16 working weeks or 32 teaching hours.

RESULTS

By analysing the test results using parametric statistics, based on the results of the t-test (Table 1), in order to determine the differences in the arithmetic means of the results pertaining to the control and experimental groups, it is observed that there are no statistically significant differences between the experimental and control groups in the initial measurement, for all tested motor abilities.

By analysing the test results in the final measurement (Table 2), using parametric statistics, based on the results of the t-test, in order to determine the differences in the arithmetic means of the results pertaining to the control and experimental groups, a statistically significant difference is observed for all variables according to the most stringent level of statistical inference ($p = 0.01$) except for the variable - standing long jump, where we do not have statistical significance of differences between the experimental and control groups. Statistical significance is at the level of 0.58.

Table 1: T-test for independent samples - experimental and control group initial measurement

	AS Experimental	AS Control	t-value	df	p
Flamingo Balance Test	11.26	7.27	4.11	51.00	0.00
Plate Tapping	14.89	16.77	-2.92	51.00	0.01
Sit-and-Reach	25.30	18.58	4.12	51.00	0.00
Standing Broad Jump	125.63	128.50	-0.56	51.00	0.58
Sit-Ups	20.33	12.58	7.01	51.00	0.00
Bent-Arm Hang	40.22	23.29	2.66	51.00	0.01
10 × 5 metre Shuttle Run	22.49	24.01	-3.18	51.00	0.00

Table 2: T-test for independent samples - experimental and control group final measurement

	AS Experimental	AS Control	t-value	df	p
Flamingo Balance Test	11.26	7.27	4.11	51.00	0.00
Plate Tapping	14.89	16.77	-2.92	51.00	0.01
Sit-and-Reach	25.30	18.58	4.12	51.00	0.00
Standing Broad Jump	125.63	128.50	-0.56	51.00	0.58
Sit-Ups	20.33	12.58	7.01	51.00	0.00
Bent-Arm Hang	40.22	23.29	2.66	51.00	0.01
10 × 5 metre Shuttle Run	22.49	24.01	-3.18	51.00	0.00

DISCUSSION

It is a wide known fact that the current movement mode with the majority of the school children does not satisfy even the minimum hygiene norm. According to some research, motor activity of the students attending elementary schools, in the traditional movement regime, satisfies only 50% to 60% of natural needs for movement. Children lack motor activity which prevents them from establishing a regular shift of mental and physical labour (Skender, 2004). Motor abilities cannot be effectively described with one, general dimension.

The description of human motor abilities requires a partition into more quantitative (strength, speed, stamina and flexibility) and qualitative (coordination, agility, balance, precision) motor abilities (Gajski, 2017). Physical exercise can significantly influence the development and maintenance of the achieved level of specific motor abilities (Mikelić and Morović, 2011). Certain abilities can be influenced more than others, and that depends on how much certain abilities are congenital and the level of exercise in the optimal life age.

The methods and exercise which we use in an adequately programmed physical exercise differ during the development of different abilities. The results of the conducted research show that the programme of team sports, characteristic for a number movement structures which change depending on the situation and consist of a number of movement structures exercised in cooperation with other members of the team in the game, has shown better effects in relation to the control group. The results of a research (Lazarević & Milosavljević) on the connection between anthropomorphic characteristics and balance of younger-school-age children point to a need for a higher level of attention being

paid to training and specialisation of basic motor abilities (walking, crawling, standing on one foot, etc.) in balancing positions and without visual control, so that the general motoric factor, coordination abilities and balance can be improved as a condition for a good postural status of children, which is of fundamental significance in this age and in the sports and physical education classes intended for younger-school-age children in the phase of intensive growth. Implementation of the sports games programme in regular teaching of sports and physical education for younger-school-age children is harder to conduct in comparison to the majority of other programmes and content of physical exercise because of the lack of material and spatial requirements needed for adequate implementation of these classes.

The content of sports and physical education classes needs to be set so that it includes specific requests which are set for the students during their execution, all with the goal of reaching the most efficient results of these classes (Milenković, Pelemiš, Veličković, & Stamenković, 2011).

A sample of 64 students (Batričević, 2008) divided into two subsamples (students who are active and inactive in sports) has shown that the students who are active in sports perform better in tests of explosive strength, segmented speed, vital lung capacity and systolic and diastolic blood pressure.

The consequences of a modern lifestyle can be substantively compensated with kinesiological programmes. It is necessary to accept the fact that one of the main tasks of the school is creating a habit of physical exercise, which should become a foundation for a lifelong positive habit of everyday exercise.

The research (Prskalo, 2013) shows a worryingly low frequency of individuals who put the subject of physical and health culture in the first place when it comes to the importance for future life, with 13% in 2007, and 18% in 2012.

CONCLUSION

Physical growth and development, or ontogeny itself, as well as the development and improvement of motor abilities, are very important components that we can act on with well-organised physical activity, regardless of the limits given to each person by hereditary factors. One of the primary preconditions for a more effective and appropriate impact of sports and physical education on the anthropological status of the child is certainly an increase in the volume of teaching in terms of daily physical activities. Such a modern perception and understanding of the importance of sports and physical education is already being implemented in schools throughout many countries. On the other hand, in the structure of the necessary modernisation and modification of the teaching process, the intensification of work in accordance with the objectively determined needs of homogeneous groups is essential. In addition to all the kinesiological and biological influences, from the point of view of pedagogical activity, for the purpose of personality socialisation, alienation and maladaptation, as well as successful channelling of aggressive behaviour, physical education and sport generally play a key role.

The current problems of today, such as the increased number of locomotor deformities, obesity and high frequency of cardiovascular and respiratory diseases, which occur as a result of new living conditions caused by urbanisation of settlements and technical progress, can be averted by preventive measures where physical activity plays a key role. Insufficient exercise, and especially inappropriately conducted and directed exercise, do not provide the expected effects. In order to optimise work, to implement reforms that will significantly increase the effects of physical and health education of children, it is not enough only to increase the volume and intensity of exercise and to improve the material base and human resources.

One of the crucial tasks is certainly a need to define the structure of the anthropological status pertaining to our school population, extracting latent dimensions which are invaluable for planning, programming and objective control of physical and health education teaching. Furthermore, it is necessary to determine valid measuring instruments that will be able to monitor the state and changes that we want to achieve through systematic exercise.

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EFEKTI NASTAVE SPORTA I TJELESNOG ODGOJA NA POBOLJŠANJE MOTORIČKIH SPOSOBNOSTI KOD DJECE

Cilj: Glavni cilj čitave istraživačke procedure jeste utvrditi efekte različitih programa nastave sporta i tjelesnog odgoja, odnosno kakvi su i koliki efekti primjene osnovnog i programa timskih sportova u nastavi, na motoričke sposobnosti učenika osnovnih škola. Metode: U ovom istraživanju, ispitivanje je sprovedeno na uzorku od 60 učenika uzrasta 10 godina (± 6 mjeseci) i obuhvatalo je testiranje, mjerenje i komparaciju u okviru prostora motoričkih sposobnosti. Učenici su podijeljeni u dvije grupe, kontrolnu (30) i eksperimentalnu (30). Eksperimentalni program je obuhvatio sadržaje iz sportskih igara, uz primenu dopunskih vježbi pod nadzorom i rukovodstvom profesora sporta i tjelesnog odgoja. Kontrolna grupa radila je po postojećem nastavnom planu i programu (atletika, ritmika i ples, vežbe na spravama i tlu), a sa njima su radili profesori razredne nastave. Program kod obje grupe je sproveden u trajanju od 16 radnih sedmica odnosno 32 nastavna sata. Rezultati: Rezultat t-testa pokazuje statistički značajne razlike kod svih varijabli po najoštrijem nivou statističkog zaključivanja ($p = 0,01$) izuzev kod varijable – skok u dalj iz mjesta gdje nemamo statističku značajnost razlika između eksperimentalne i kontrolne grupe. Zaključak: Jedan od osnovnih preduvjeta za učinkovitiji i primjereniji utjecaj sporta i tjelesnog odgoja na antropološki status djeteta zasigurno je povećanje volumena nastave u pogledu svakodnevnih tjelesnih aktivnosti. Nedovoljno vježbanje, a posebno neprimjereno izvedena i usmjerena tjelovježba, ne daju očekivane učinke.

Ključne riječi: učinci, nastava, sport, tjelesni odgoj, motoričke sposobnosti, djeca

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THE INFLUENCE OF EXPLOSIVE LEG STRENGTH ON THE REALISATION OF SPECIFIC TASKS IN BASKETBALL

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ABSTRACT

The study included a total of 85 11-year-olds who attend regular exercises at a basketball school. The sample was treated with 4 basic motor skills tests, and 3 situational basketball motor skills tests. The purpose of the paper is to prove that the system of predictor variables will obtain significant values in predicting the criteria variables.

Keywords: correlations, regression, basketball players

INTRODUCTION

The growing popularity of the basketball game, an increase in the quality of the game, as well as the involvement of a large number of our young people in basketball raise the need to organise work with young people to approach it seriously. The application of new programmes for processing results gives us even more precise information regarding the development of the most complex movements and specifics in the sport of basketball. A large number of authors have addressed topics similar to the one expressed in the present study. Basketball is a physically demanding sport and has developed a hugely competitive nature (Jack, 2017). The sport of basketball requires specific skills that can be completed under dynamic conditions, in most cases while moving at a high speed or while changing directions (Ransone, 2016). In basketball, the ability to generate maximal strength levels in the shortest period of time (muscular power) has been considered as essential to obtain high sport performance levels (Eduardo et al., 2008). To reach the goal, we need to consider the multi-

dimensional status of humans as well as the complexity of correlations among dimensions, especially in the research sample, which is at the most critical phase of growth and development. (Pireva, 2015). There have been a number of studies investigating jump performance in a range of players; often with the aim of distinguishing between males and females, those from a range of abilities, and for the purpose of assessing different training interventions (Balciunas et al., 2006; Matavulj et al. 2006) Otherwise, plyometrics is closely related to speed and strength, which is ultimately the result of force. Regarding plyometric exercises, we can consider the possibility of muscles which express the maximum strength for a short time used in basketball (Matavulj, et al., 2003). Explosive strength, take-off power, speed, and agility are abilities that make an important contribution to the efficient movement with and without the ball, thus playing an important role in basketball technique and tactics (Erculj et al., 2010). Physical training is a prerequisite for learning the technique and tactics of the game of basketball and their application in the game. (Iulian Ghițescu et al., 2013). In basketball, the ability to generate maximal strength levels in the shortest period of time (muscular power) has been considered as essential to obtain high sport performance levels.

METHODS

The research included 85 players of the basketball school "PROBASKET" from Prishtina, aged 11. These players are in the final stages of the regular basketball school curriculum for beginners. In order to carry out this research and verify the hypotheses presented, the results are processed with the statistical program SPSS 20.0 and the appropriate methods. Correlation and Regression

Research sample

The sample is included in two spaces: basic motor skills, and situational motor skills.

Basic motor skills variables. 1. MSLJ-Standing long jump 2. MHJ - High jump 3. MR20m - 20 meters running 4.

MBTH 1kg - 1kg medicine ball throw

Situational motor skills variables. 1. MR3X10m - 3X10m forward-backward running 2. MSBD- slalom ball dribbling with 5 obstacles in a straight line 3. MSBDZ5- slalom ball dribbling with 5 zigzag obstacles

Hypothesis

H1: Significant correlation values will be obtained between the basic and situational motor tests.

H2: The system of predictor variables will obtain significant values in predicting the criteria variables.

RESULTS AND DISCUSSION

From the results obtained in Table 1, it can be seen that in most cases high statistical values were obtained at the level of 0.01, except for the medicine ball throw test, the standing high jump test and 20m run which are normal.

From the results obtained in Table 1, it can be seen that in most cases high statistical values were obtained at the level of 0.01, except for the medicine ball throw test, the standing high jump test and 20m run which are normal. Table 3 presents the results of the interrelationships between the basic motor and situational variables.

From the obtained values, it can be seen that the variable medicine ball throw with all other variables (except for the variable jump from place to place) presented low statistically insignificant values. While in other variables we have valuable and high statistical values.

Table 1: Correlation coefficients of basic motor variables

	MKVGJ	MKVL	MV20m	MHMB1kg
MSLJ	1			
MHJ	.598**	1		
MR20m	-.658**	-.504**	1	
MBTH 1kg	-.319**	.155	.107	1

** The correlation is valid at the 0.01 (1-star) level.

Table 2: Correlation coefficients of situational motor variables

	MV3x10m	MVSLLD	MSLL5PZZ
MR3X10m	1		
MSBD	.435**	1	
MSBDZ5	.669**	.640**	1

** The correlation is valid at the level of 0.01 (1-star).

Table 3: Correlation of basic motor and situational motor skills

	MR3X10m	MSBD	MSBDZ5	MSLJ	MHJ	MR20m	MBTH 1kg
MR3X10m	1						
MSBD	.435**	1					
MSBDZ5	.669**	.640**	1				
MSLJ	-.644**	-.348**	-.533**	1			
MHJ	-.452**	-.461**	-.497**	.598**	1		
MR20m	.718**	.533**	.557**	-.658**	-.504**	1	
MBTH 1kg	.087	-.172	.109	-.319**	.155	.107	1

REGRESSION ANALYSIS

The regression analysis in this research was conducted to show what the characteristics of the basic and situational motor skills included in the paper are. Namely, to what extent the result in situational mobility tests can be predicted from the results of basic mobility tests.

Consistent with the purpose of the research, regression analysis was applied to show what relationships they have with the basic and situational motor skills included in the research.

At the same time, it was applied in order to determine the impact of basic motor skills as a system of predictors on the level of manifestation and prediction of the result in situational skills characteristic of the game of basketball.

The first tables present the main elements of regression analysis such as: multiple correlation (R) which represents the value of the correlation between all predictor variables and the criterion variable, adjusted coefficient (Adjusted R square) which represents the percentage of common variance between predictor variables and criterion variable and validity (Sig F change), representing statistical validity at the level of reliability .01.

Table 4: Influence of predictor variables on the criterion variable 3x10m Run

Model	R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.757(a)	.573	.539	.43420	.573	16.791	4	50	.000

a Predictors: (Constant), MBTH 1kg, MR20m, MHJ, MSLJ

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.663	4	3.166	16.791	.000(a)
	Residual	9.427	50	.189		
	Total	22.089	54			

a Predictors: (Constant), MBTH 1kg, MR20m, MHJ, MSLJ

b Dependent Variable: MR3X10m

Coefficients (a)

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	7.331	1.593		4.601	.000			
	MSLJ	-.011	.005	-.354	-2.299	.026	-.644	-.309	-.212
	MHJ	.003	.013	.029	.225	.823	-.452	.032	.021
	MR20m	1.023	.251	.509	4.072	.000	.718	.499	.376
	MBTH 1kg	.000	.000	-.085	-.774	.442	.087	-.109	-.072

a Dependent Variable: MR3X10m

Based on the values obtained in the above tables, it can be concluded that the system of basic motor variables included in the research serves as an important predictor in the realisation of the test 3x10 meters run. This conclusion is based on the significant value of $F = 16.80$ which is significant at the level 0.00. The magnitude of the multiple correlation is $R = .757$, while the delta value is $\Delta = .539$ which means that 54% of the common predictor and criterion variability is explained.

In Table No. 4 which presents the values of beta coefficients and partial correlations of each variable with the criterion, we notice that only the variables Standing long jump and 20 meters run have shown significant values in predicting the result in the criterion variable. This can be justified by the high connection of explosive force and speed of the legs with the results achieved in situational running in basketball.

Table 5: The influence of basic motor skills on the criterion variable Slalom running

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.606(a)	.367	.316	.31649	.367	7.250	4	50	.000

ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.905	4	.726	7.250	.000(a)
	Residual	5.008	50	.100		
	Total	7.913	54			

a Predictors: (Constant), MBTH 1kg, MR20m, MHJ, MSLJ

b Dependent Variable: MSBD

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.544	1.162		1.329	.190			
	MSLJ	.001	.004	.028	.148	.883	-.348	.021	.017
	MHJ	-.013	.010	-.217	-1.365	.178	-.461	-.189	-.154
	MR20m	.555	.183	.461	3.029	.004	.533	.394	.341
	MBTH 1kg	.000	.000	-.179	-1.339	.187	-.172	-.186	-.151

Based on the values obtained in the above tables, it can be concluded that the system of basic motor variables included in the research represents an important predictor in the realisation of the test slalom ball dribbling with 5 obstacles in a straight line. We support this conclusion with the significant value of $F = 7.25$ which is significant at the level of 0.00. The magnitude of the multiple correlation is $R = .606$, while the delta value is $\Delta = .316$ which means that 32% of the common

predictor and criterion variability is explained. In Table No. 3 which presents the values of beta coefficients and partial correlations of each variable with the criterion, we notice that only the variables standing long jump and medicine ball throw have shown significant values in predicting the result in the criterion variable.

This can be justified by the high connection of explosive force and speed of the legs with the results achieved in situational running in basketball.

Table 6: The influence of basic motor skills on the zigzag slalom ball dribbling tes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.627(a)	.393	.345	.35998	.393	8.104	4	50	.000

a Predictors: (Constant), MBTH 1kg, MR20m, MHJ, MSLJ

ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.201	4	1.050	8.104	.000(a)
	Residual	6.479	50	.130		
	Total	10.680	54			

a Predictors: (Constant), MBTH 1kg, MR20m, MHJ, MSLJ

b Dependent Variable: MSBDZ5

Coefficients (a)

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	4.177	1.321		3.161	.003			
	MSLJ	-.003	.004	-.143	-.777	.441	-.533	-.109	-.086
	MHJ	-.018	.011	-.259	-1.661	.103	-.497	-.229	-.183
	MR20m	.455	.208	.325	2.182	.034	.557	.295	.240
	MBTH 1kg	.000	.000	.069	.527	.600	.109	.074	.058

a. Dependent Variable: MSBDZ5

Based on the values obtained in the above tables, it can be concluded that the system of basic motor variables included in the research serves as an important predictor in the realisation of the test 3x10 meters run. We support this conclusion with the significant value of $F = 16.80$ which is significant at the level of 0.00. The magnitude of the multiple correlation is $R = .757$, while the delta value is $\Delta = .539$ which means that 54% of the common predictor and criterion variability is explained.

In Table No. 3 which presents the values of beta coefficients and partial correlations of each variable with the criterion, we notice that only the variables standing long jump and 20 metres run have shown significant values in predicting the result in the criterion variable. This can be justified by the high connection of explosive force and speed of the legs with the results achieved in situational running in basketball.

CONCLUSION

The value of the research lies in the possibility of applying the knowledge gained in the process related to the selection and orientation of young talents in basketball.

This paper also provides assistance in the continuation of numerous efforts to find the most effective modalities of kinesiological treatments, as well as to better understand the magnitude of the impact various factors have in the rise and formation of quality basketball players. All these are important, especially when we are dealing with athletes of a young age and taking into account the ever-increasing level of basketball in the Kosovo area. We can conclude that, based on the achieved results, the hypotheses have been verified: The first H1 hypothesis has been fully realised because important correlation values have been obtained between the basic and situational motor tests.

The second H2 hypothesis has been validated because the predictor system has realised significant values in predicting the variable criteria. Explosive force ability is the most important special quality of basketball players. It is closely linked with the explosive force and is one of the aims of the training. The player jumps to shoot, jumps to intercept the ball and jumps to recover it. It is known that the team which controls the recoveries wins the game, because their attacks multiply and minimise those of the opponent (Iulian Gabriel Ghițescua, Virgil Tudora, Alina Daniela Moanță 2013).

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UTICAJ EKSPLOZIVNE SNAGE NOGU NA IZVEDBU POSEBNIH ZADATAKA U KOŠARCI

S tudija je obuhvatila ukupno 85 jedanaestogodišnjaka koji pohađaju redovne treninge u školi košarke. Uzorak je obrađen korištenjem 4 testa osnovnih motoričkih sposobnosti i 3 testa situacijskih motoričkih sposobnosti u košarci. Svrha rada je dokazati da će sistem prediktivnih varijabli ostvariti značajne vrijednosti u predviđanju kriterijskih varijabli.

Ključne riječi: korelacije, regresija, košarkaši

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THE EVALUATION OF BIH OLYMPIC SPORT FEDERATIONS FROM THE ASPECT OF MARKETING PLANNING, BRANDS AND SPONSORSHIP

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ABSTRACT

The aim of this paper is explore the current level of development and differences between the National Olympic Sport Federations of Bosnia and Herzegovina with regard to marketing planning, existence of trademarks (products or brands) and sponsorship. The paper provided an insight into the evaluated area through a questionnaire addressed to the National Olympic Sport Federations (NF) which are members of the National Olympic Committee of Bosnia and Herzegovina (N = 25 NFs). A Chi-square test (χ^2) was used in order to precisely determine the differences between the answers frequency. The result analysis procedure was performed by software (SPSS ver. 22.0). The research attempted to inspect the current level of development and differences between the NFs in order to provide recommendations that will serve to improve the current practices of the National Olympic Federations of Bosnia and Herzegovina.

Keywords: National Sport Federations, marketing plan, fundraising, merchandising, sport product

INTRODUCTION

National Sport Federations represent major players in the sport landscape within today's contemporary sport environment (Pedras, L., Taylor, T., Farwley, S. 2019). Because of the changes in modern sport and society, they have to deal with substantial complexity and face a variety of challenges such as: major growth of international competitions in elite sports; increase of sport for all activities; professionalization - the organizational services can no longer be carried out by volunteers, but to a certain extent, by paid employees; increase of quality management which

becomes an important instrument for the performance; use of modern forms of communication and media, increased cooperation with new partners, public and private institutions, and a greater range of stakeholders in order to obtain new funding (Nagel, S., Schlesinger, T., Bayle, E., Giauque, D. 2015). One of the new and significant stakeholders which provides substantial resources are the sponsors.

They are especially important in developing countries such as Bosnia and Herzegovina which has an insufficient amount of financial income from public funds devoted to the national sports federations and sport in general (Radjo, I., Drid, P., Sadzak, M., Sadzak, D., 2013).

The findings of this study indicate that, in the general income of the Olympic Sport Federations from Bosnia and Herzegovina, substantial funds come from marketing. External factors such as the tradition and attractiveness of the sport significantly contribute to the general position of the given sport within the country and the marketing income. Besides marketing, the other important sources of income are state funding and International Federations.

The percentage would seem to depend on various factors and the most important one is the ability of the people in charge of leading the federation to attract funds either by lobbying at all state levels or through marketing. (Radjo, I., Drid, P., Sadzak, M., Sadzak, D., 2013). The competition on the sport market has become quite big and the consumers of sport products are becoming more demanding, due to the way of life, their aims and top achievements. Each BiH Sport Federation, i.e., Olympic Sport Organisation must be aware of these facts, so as to design its activities and politics according to the following: "Marketing is not everything, but everything without marketing is nothing" (Hindle, 2006).

Having this in mind, the development of marketing activities in the Olympic Sport Organizations in Bosnia becomes an innovative response to the competitive position of the organization. They compete at the national level for financial support as well as international sport results which are the most important factor in the increase of funding. In order to attract resources, they need to acquire skills in order to be able to attract sponsorship revenues and be able to better serve the sponsors' interest.

This paper explores marketing planning, brand and sponsorship in the National Sport Federations of Bosnia and Herzegovina. If one takes into consideration the process of marketing planning, it is important to highlight that the process itself is comprehensive, thorough and based on the market needs, the products being presented and the facts about the end consumers. Babić V., Domazet A., Kurtović E. (2012) consider that each process of organisational governance must contain three phases: planning, organisation and control. Marketing is a MANAGEMENT CHARACTERISTICS skill which requires specific tools in order to be proactive and successful. Marketing plan is a tool which is used to determine what, how and why something needs to be done, and to act proactively. Each vision demands a specific strategy, and it is not possible to come up with any kind of strategy without a good plan which is directly connected to efficiency of the Olympic Sport Organisation, i.e., BiH Sport Federation. Administrative marketing entails the capacity to write and implement a marketing plan. Such marketing plan contains all the strategies and tactics of a single organisation, which are assumed by the organisation, or its governing body to be conducted effectively. A marketing plan can be the best in its branch, or even wider, but without adequately educated employees and tools for its implementation, it is just a nicely written document.

METHODOLOGY

The research design emerged from the ultimate goal of the study, which primarily attempted to increase the knowledge about marketing planning, the existence of brands – products and sponsorship in the National Olympic Sport Federations of Bosnia and Herzegovina. In order to perform the results analysis, adequate quantitative and qualitative methods were used, while the analytical model of the International Olympic Committee UMAP (Robinson, L., Minkin, B., 2011) provided the basis for the research protocol and its simplified analytical framework with changes specific to the research and our nation's context.

The questions were meticulously structured and addressed all relevant aspects of marketing planning, brand development and sponsorship in the organizations and the answer to each question provided the position of the Federation against standards which included 5 levels of development from 0 to 4 (nothing in place, emerging, developing, established, embedded). 0 represents no development while 4 represents a professional and specialised level of development.

The survey was performed in one week, assessing 5 Federations per day. All the representatives of Sport Federations were present at the meeting where they were given directions from a competent person (and assisted by a number of trained assistants) in regards to how to fill out the questionnaire with a possibility to ask questions and to sort out any misunderstandings during the survey.

Data, statistical analysis and presentation of results were performed with regard to methodological principles and data scale, and directed towards the research purpose. All the data come from a nominal scale defined by the ranking quality. It is precisely because of this that the Chi-square test method (χ^2) was used, so as to precisely determine the differences between the observed results. The procedure of data analysis was performed with regard to the highest methodological standards in the field of scientific work, and by the use of software (SPSS ver. 22.0). The level of statistical conclusion was set the conventional 95% ($p < 0.05$).

THE RESEARCH RESULTS AND DISCUSSION

Based on surveys completed by NOC of BiH on 25 Olympic Sport Federations coming from Olympic sports, the following results have been gathered:

How would you describe the processes of marketing planning in your Federation?

	Frequencies	%	Residuals
We do not have a plan	3	12.0	-0.6
We plan our marketing activities AD-HOC (based on the situation and the moment)	19	76.0	-11.3
Our marketing plan is implemented by external agencies, potential sponsors or the government	0	0	0
A marketing plan is developed on a four-year-long basis	3	12.0	-0.6
A marketing plan is a long-term plan, and developed for a period of over four years	0	0	0
$\chi^2 = 28.7; p < 0.001$			

The structure of the responses to the question "How would you describe the processes of marketing planning in your Federation?" is the following: Most Sport Federations, 19 out of 25 (76%), responded that "We plan our marketing activities AD-HOC (based on the situation and the moment)". The response "Marketing plan is developed on a four-year-long basis" was given

by 3 Federations (12%), which is the same for the answer "We do not have a plan" when it comes to frequency. The responses "Our marketing plan is implemented by external agencies, potential sponsors or the government", and the "Marketing plan is a long-term plan, and developed for a period of over four years" were not among the answers given by the Federations (0%).

How would you describe your approach to merchandising (brands)

	Frequencies	%	Residuals
We have never considered the possibility of setting up a brand	10	40.0	8.3
We have considered this possibility, but we are not in a position to establish a brand	11	44.0	7.7
We sell our products at special events, like t-shirts during competitions, etc.	2	8.0	-3
We have few products with our brand which we sell (t-shirts, pins, presents, etc.)	1	4.0	-7.3
We have branded merchandise which includes a wide variety of products (sport uniforms, equipment, presents, etc.)	1	4.0	-5.7
$\chi^2 = 72.37; p < 0.001$			

The structure of the answers given to the question "How would you describe your approach to merchandising (brands)?" is as follows: The greatest number of Federations, 11 out of 25 (44%), responded by "We have considered this possibility, but we are not in a position to establish a brand". The answer "We have never considered the possibility of setting up a brand" was given by 10 Federations (40%), which is the second most

represented answer. The answer "We sell our products at special events, like t-shirts during competitions, etc.", was awarded by 2 Federations (8%), which is the third most represented answer. The answers "We have branded merchandise which includes a wide variety of products (sport uniforms, equipment, presents, etc.)" and "We have few products with our brand which we sell (t-shirts, pins, presents, etc.)" were each awarded by one Federation (each 4%).

What type of sponsorship do you have?

	Frequencies	%	Residuals
We get Value in Kind, as supplies from certain sponsors (Coca-Cola, etc.)	3	12.0	-0.3
We get financial means from certain sponsors without having big obligations towards them	11	44.0	6
We have sponsorship agreements with different sponsors for different activity groups (for example championships, tournaments, promotional activities, etc.)	4	16.0	-2,7
We have an official and binding sponsorship contract and programme	2	8.0	-6,3
We do not have sponsors	5	20.0	3.3

The structure of answers to the question "What type of sponsorship do you have", is the following: The greatest number of Federations, 11 out of 25 (44%), responded that "We get financial means from certain sponsors without having big obligations towards them". The answer „We do not have sponsors", was given by 5 Federations (20%), which is the second most represented answer. The answer "We have sponsorship agreements with different sponsors for different activity groups (for

example championships, tournaments, promotional activities, etc.)" was circled by 4 Federations (16%), which is the third most represented answer. The answer "We get Value in Kind, as supplies from certain sponsors (Coca-Cola, etc.)", was the fourth most represented answer, circled by 3 Federations (12%), and the answer "We have an official and binding sponsorship contract and programme" was circled by two Federations (8%).

Which possibilities of "activation" do you offer to your sponsors (logo of your Federation on a telecom card, television broadcasting and sponsors, etc.)?

	Frequencies	%	Residuals
We do not have anything to offer to our sponsors	2	8.0	0.3
We do not have regular activities which we can offer to our sponsors	1	4.0	-2.3
We have some activities which we could offer to our sponsors, like state championship, etc.	14	56.0	9
We have different activities and opportunities which we can offer in a context of sponsorship	7	28.0	0.3
Sponsors are fully connected to the activities of the organisation	1	4.0	-7.3
$\chi^2 = 24.37; p < 0.001$			

The structure of the answers to the question "Which possibilities of "activation" do you offer to your sponsors (logo of your Federation on a telecom card, television broadcasting and sponsors, etc.)?" is: The greatest number of Federations, 14 out of 25 (56%), responded that "We have some activities which we could offer to our sponsors, like state championship, etc.". The response "We have different activities and opportunities which we can offer in a context of sponsorship", was circled by 7 Federations

(28%), which is the second most represented answer. The answer "We do not have anything to offer to our sponsors", was circled by 2 Federations (8%), which is the third most represented answer. The answers "We do not have regular activities which we can offer to our sponsors", and "Sponsors are fully connected to the activities of the organisation", was circled by one Federation each (4% each), which is the fourth most represented answer.

How well is the brand of your Federation developed?

	Frequencies	%	Residuals
We do not have a brand	1	4.0	-1.3
We have a logo	20	80.0	15.5
We have created the brand of our organisation	2	8.0	-9.4
We have several registered "trademarks" (mascot, tournaments, etc.)	0	0	0
We have a developed, and legally protected brand which includes the sign, motto and trademark	2	8.0	-4.8
$\chi^2 = 64.23; p < 0.001$			

The structure of answers to the question "How well is the brand of your Federation developed?" is as follows: The greatest number of Federations, 20 out of 25 (80%), responded with "We have a logo". The responses "We have a developed, and legally protected brand which includes the sign, motto and trademark", and

"We have created the brand of our organisation" was circled by two Federations each (8% each), which are the second most represented answers. The answer "We have several registered "trademarks" (mascot, tournaments, etc.)" was not circled.

Who is responsible for "servicing" your sponsors?

	Frequencies	%	Residuals
We do not have sponsors	4	16.0	0.0
No one in the Federation is responsible for "servicing" the sponsors	13	52.0	7.2
The Executive Board is responsible for sponsors and the protection of their rights	5	20.0	1.0
We have a professional person who is in charge of working with the sponsors	2	8.0	-3.0
Servicing sponsors is done by a sector along with a team which only works on these activities	1	4.0	-4.5
$\chi^2 = 41.02; p < 0.001$			

The structure of the answers to the question "Who is responsible for "servicing" your sponsors?" is the following: The greatest number of Federations, 13 out of 25 (52%), responded with "No one in the Federation is responsible for "servicing" the sponsors". The answer "The Executive Board is responsible for sponsors and the protection of their rights", was circled by 5 Federations (20%), which is the second most represented answer.

The answer "We do not have sponsors", was awarded by 4 Federations (16%), which is the third most represented answer. The answer "We have a professional person who is in charge for working with the sponsors" was circled by 2 Federations (8%), which is the fourth most represented answer, while the answer "Servicing sponsors is done by a sector along with a team which only works on these activities" was circled by only one Federation (4%).

DISCUSSION

Based on the results of the research, one can conclude that BiH Sport Federations do not possess a developed system of marketing planning, brands and sponsorship. Strategic planning at the level of a company as a whole always tries to align its own human and material resources with market opportunities. Most of the BiH Sport Federations (76%) plan their marketing on an "ad hoc" basis, which puts them on a low level in the domain of marketing planning. It is clear that not a single serious process can be successful without a detailed plan, and therefore OSO cannot expect quality final marketing results at the end of an edition, not without a quality plan. Looking at the results, as much as 84% of the Federations did not even take into consideration establishing a trademark (brand or a good product), which indicates that they do not have anything to promote or offer to the market, and one of the four elements of the marketing mix, based on which marketing and the entire marketing economy exist, is precisely a quality product. This notion is in synergy with the definition of the authors Rađo, I., Mujkić, D., Ajdinović, A. (2017) who define marketing in

sport as "an activity which is in indirect production and placement of sport products and services into the sports market". Based on the results and presented answers, an encouraging fact is that over 80% of the Federations do have products to offer as a basic precondition to establishing sponsorship relations, but what is questionable here is the quality and the verity of these products, because 56% of the Federations offers state championship as a product organised on its most basic level. Brand is closely connected to the notion of an image and sports brand, with an aim to have that specific brand identified in the mind of its consumers and to be differentiated from the competition. Most Sport Federations (80%) consider their logo a brand, which is not enough. Brand is presented by a product which holds an additional value, resulting in increased value of the product or service, and the consumers are willing to pay more in regard to its real value (FC Barcelona uniform). A brand is sold "on its own", with minimum or even no promotion, which is a rare circumstance in BiH Sport Federations. Activation is a type of activity which creates opportunities within which a sponsor will be allowed to represent itself and relate to the brand or a positive message, with an aim to better present and sell sponsored products.

Sponsorship presents a measurable value of the marketing activity of OSO, and, in that regard, the notion that even 5 Federations, or 20% of the sample, do not have a sponsor is a concern. Even though many companies, especially media companies never reject sport organisations and try to find a symbolic way to develop a sponsorship relationship. This indicates multiple structural marketing disadvantages in these Federations, whether talking about planning, involvement, product, promotion, distribution or implementation of plans. Based on the results and the answers given, only two BiH Federations have the highest level of marketing sponsorship. The analysis of the answers provided and their frequency can lead to the conclusion that BiH Sport Federations are at a low level of development in regard to sponsorship, and it is necessary to make significant advancement in this segment.

The term servicing sponsors is related to all the activities which contribute to better communication between donors and sponsors of a federation, as well as

individual sponsors who support the work of federations, the organisations of individual sport competitions and personal sponsorships to athletes on an individual level. This is also related to servicing of contracts and their implementation.

Communication is connected to the preparation of the necessary material, promotional and marketing reports for those activities which promote sponsors on a wide market, and also introduce sponsors to the market opportunities.

In ideal circumstances, all employees must do marketing because it is an essential part of the entire sport organisation. Looking at the data gathered, 52% of the Federations do not have a single person who is to be in charge of servicing sponsors, which is an alarming fact, because not a single person in the Federation works with sponsors who are looking for "feedback" from the Federation for their investments defined in the contract. Sponsors do not renew or break contracts with these Federations. The results, unlike this information and Federations, indicate that two Federations in this segment differ in their quality, adequate work and sponsor relations.

CONCLUSION

The results of this research suggest that most BiH Sport Federations do not have a marketing strategy, nor even a plan, and that some have never even considered this possibility. Most BiH Federations have never even established, nor considered establishing a brand or a products, which is considered as a basis for marketing and commercial identity of a Federation. For most Federations, apart from the rare ones, the basic marketing product is a logo, or a state championship, which is organised on an amateur level without any

possibility and a wish to enrich it with new content or products, and also to enrich the product itself with additional product values. In this kind of a relationship it is not possible to set up a brand of a product or a service, nor to attract consumers or sponsors. The results indicate that as much as 84% of the Federations did not even consider establishing or even having a trademark (brand or a good product), which indicates that they have nothing to promote or offer to the market, and one of the four elements of the marketing mix, which defines marketing and a complex economy, is a quality product. Most Sport Federations (80%) consider the logo as their brand, which is not enough.

Sponsorship presents a measurable value of the marketing activity of OSO, and, in that regard, the notion that even 5 Federations, or 20 %, do not have sponsors is a concern. Even though many companies, especially media companies never reject sport organisations and try to find symbolic ways to develop a sponsorship relationship. The analysis that 52% do not even have one person assigned to service the sponsors is alarming, and is inadequate for the operations of that specific Sport Federation.

The results of this research indicate the nonexistence of a systematic approach towards marketing activities, but great opportunities for improving the sport system in the field of marketing and BiH Sport Federation's communication is possible, especially in the field of marketing planning, brands and sponsorship. According to all of the above stated in this paper, it is necessary to highlight the fact that most Federations neither have a planned sponsorship and marketing offer, nor a quality marketing relationship towards sponsors and sponsorship.

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PROCJENA SPORTSKIH SAVEZA OLIMPIJSKIH SPORTOVA BIH SA ASPEKTA MARKETING PLANIRANJA, BRENDOVA I SPONZORSTVA

Cilj ovog rada je istražiti trenutni nivo razvoja i razlike između nacionalnih sportskih saveza olimpijskih sportova Bosne i Hercegovine u odnosu na marketing planiranje, postojanje zaštitnog znaka (proizvoda ili brendova), te sponzorstvo. Ovaj rad je dao uvid u istraživano područje putem upitnika koji je upućen nacionalnim sportskim savezima olimpijskih sportova (SS), a koji su članovi Olimpijskog komiteta Bosne i Hercegovine (N = 25 SS). Hi-kvadrat test (χ^2) je korišten kako bi se precizno utvrdile razlike između frekvencije odgovora. Procedura analize rezultata je izvršena korištenjem softwera (SPSS verzija 22.0). Istraživanje je pokušalo ispitati trenutni nivo razvoja i razlike između SS-a kako bi se dale preporuke koje bi služile za poboljšanje trenutnih praksi nacionalnih sportskih saveza olimpijskih sportova Bosne i Hercegovine.

Ključne riječi: nacionalni sportski savezi, marketing plan, prikupljanje finansijskih sredstava, promocija proizvoda, sportski proizvod

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THE USE OF LIFE KINETIC EXERCISE FOR INCREASING ATHLETES' CONFIDENCE IN TEAM AND INDIVIDUAL SPORTS

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ABSTRACT

The confident athlete has a strong faith in his ability. The less confident athlete often doubts his ability to show his best performance. To boost confidence, it is necessary to practice by using the right methods; one of them is Life Kinetic exercise. This study aims to examine the differences in the effect of Life Kinetic exercise on improving athletes' confidence in team and individual sports. The method applied is the experimental method with the pretest-posttest control group design. The population is comprised of male athletes in the Student Sports Activity Unit at one of the universities in Indonesia. The sample comprises active 17-19-year-old male athletes and competition in team and individual sports taken with non-probability sampling technique, resulting in 34 athletes from team sports and 32 athletes participating in individual sports. The samples from two groups of sport were divided into two groups through random assignment in order to obtain two sample groups: experimental and control group. The experimental group is the group which was given treatment in the form of Life Kinetic training for the duration of 11 meetings, twice a week. The data analysis technique used in this study was the MANOVA test. The results showed that there was a difference in the effect of Life Kinetic training on the increase of athletes' confidence in team and individual sports.

Keywords: Life Kinetic exercise, self-confident, team and individual training

INTRODUCTION

Self-confidence is one's belief in one's own ability that he or she is capable of doing a good job (Whiteman, 2016). Believing it is a performance-related variable, confidence is correlated with the success and performance of athletes in sports (Hays, 2009). The results show that there is a significant relationship between the confidence level and team success (Benjiman, 2013), when it comes to pre-competition and stress at the end of the competition (Jose, 2001; Cecchini, 2010). The high level of self-confidence relates to the self-perception of their ability (Martens et al., 1990; Robazza and Bortoli, 2007), that is: athletes have the ability to manage emotions, and they are able to control negative emotions more effectively (Besharat and Pourbohloul, 2011). Thus, self-controlled athletes are

able to control themselves and their environment (Burton, 1998; Martens et al., 1990; Woodman and Hardy, 2001), so the athlete feels safe and unresponsive, nervous, assertive in action and confident in his ability to do his job well (Mowlaie, 2011). This ability must be possessed by athletes in the sport, so that the tasks provided by the trainer can be completed properly.

Athletes who are lacking confidence in the world of sports will always doubt their ability, they will feel hesitant, tense, afraid, and even experience feelings of anxiety in displaying their duties, resulting in adverse performance (Mowlaie, 2011). The case which occurred at the SEA Games XXIX 2017 in Kuala Lumpur, Malaysia, with Indonesia's medal contest has been the worst in the history of the Sea Games. From 55 to 59 targeted medals, Indonesia

won 38 gold medals, which is far from the number won by Malaysia amounting to 145 gold medals, with Thailand winning 72 gold medals and Vietnam 58 gold medals (Rahmat, 2017, Setyawatie, 2017). This is because Indonesian athletes are less mature in preparing for the exercise. Other factors which determine the failure of the Indonesian contingent are the policy holders who are too confident with the athletes' ability, and are less sensitive in evaluating the opponent's strength so that determining the target the medal count is often wrong. In addition, non-technical issues also affect the team's pre-match preparation. Sandra (2003), associated with the issue, confirms that confidence is very influential on one's behaviour in sports activities. Therefore, confidence should get attention and needs to be improved by the trainer through continuous training and appropriate methods, one of which is Life Kinetic training.

Some of the previous research conducted in developed countries and related to this problem has been done by many experts such as the research conducted by Duda (2015) indicating that Life Kinetic exercise gives effect to the cortical part in the human brain so as to improve the more efficient thinking process. The research conducted by Whiteman (2016) explains that one's self-confidence can be predicted from the pattern of brain activity. Bherer's research (2013) revealed that regular physical activity exercise affects the physical and mental conditions of a person regardless of their age. One of the mental aspects in the study is self-confidence. Self-confidence has three important aspects (physical skills and training, cognitive efficiency, and resilience); these three aspects are crucial to the success of athletes in sport (Machida, 2016). Thus, self-confidence is the determining factor of performance for quality athletes in sport (Evrensel, 2014). The study has confirmed that Life Kinetic training needs to be mastered by everyone, including athletes and even professional athletes (Duda, 2015), as it has a positive effect on improving the physical, mental, and athletic performance.

In Indonesia, Life Kinetic research has not been done much, while in the European countries, this exercise has become an exercise that must be done by athletes in every training session, both during physical training and in the context of playing (games). This exercise is given on the grounds that athletes must have excellent physical condition and an intelligent brain to overcome various problems in the field. Considering the many benefits of this exercise, it is well-founded that Life Kinetic practice is applied in sports in Indonesia, and it is reviewed comprehensively through various studies. It is this condition that attracts researchers to review Life Kinetic training to increase athletes' confidence in team and individual sports. The problem that needs to be studied is whether Life Kinetic exercise can

improve athletes' confidence? Is there a difference in the effect of Life Kinetic training and conventional exercise on improving athletes' confidence in team and individual sports?

Life Kinetic exercise is a cognitive motor coordination training (CMCT) method, which is very popular in Western Europe such as Germany, the Netherlands, France and Spain. Life Kinetics is a motion program with motion cognition and coordination tasks (Pietsch, Bottcher and Jansen, 2017). Life Kinetic exercise is a combination of three aspects of exercise which are motion activity, cognitive challenge, and visual perception, combined in a pattern of body movements, such as capturing and throwing objects, as well as eye and limb coordination (Demirakca, 2016). The combination of motion and coordination skills between the eyes and hands and other body parts is very important (Schmid and Wrisberg, 2008) to cope with the challenges in life (Uttal, et al., 2013), and especially in sports. Life Kinetic exercise aims to reduce tension, increase relaxation, improve concentration and memory, improve the quality of skill learning processes, improve physical, mental and performance quality, and enhance athlete confidence (Lutz, 2017). Considering that the exercise is a complex activity, "the perception of one's own body and thereby the kinaesthetic and vestibular system is trained, which enables athletes in using specific cognitive procedures." (Goldstein, 2011; Pietsch, et al., 2017). Therefore, Life Kinetic exercise is very appropriate to be given in every training process to improve athlete performance.

METHODOLOGY

The design used in this research is experimental, with the pretest-posttest control group design. Subjects in the study amounted to 160 athletes obtained from two sports, namely team and individual sports. The team sports branches in this research are basketball, soccer, and volleyball, while the individual sports are karate, archery, and badminton. The subjects are athletes of the Student Sports Activity Unit from one of the universities in Indonesia, who are members of the team and individual sports. 90 people participate in team sports, while 70 people participate in individual ones. The selected subjects are only male athletes aged between 17 and 19 who actively practice and regularly follow the competition in accordance with the sport that they do. Subjects were selected by using a non-probability sampling techniques to obtain 34 athletes from team sports and 32 athletes who participate in individual sports.

The subject groups from the two sports were divided into two groups by means of random assignment techniques, which resulted in two sample groups: the experimental group and the control group. The experimental group was given the Life Kinetic training exercise, while the control group was given a conventional exercise which is the usual practice given during each exercise in the

Student Sports Activity Unit. Before the experiments were performed, both groups performed a pretest (O1) on the dependent variable, i.e., self-confident athletes from the team sports (PD-B) and self-confident athletes from individual sports (PD-P). The purpose of the pretest is to investigate the initial condition of the athletes' confidence level before being given the treatment. After conducting the pretest, the treatment process is performed, that is, the experimental group is given the Life Kinetic training practice, while the control group does the usual practice according to the exercise programme of the sport in the activity unit. After completing the treatment, the posttest (O2) is performed on confidently bound variables of athletes from the team sports (PD-B) and self-confident athletes from the individual sports (PD-P). The goal is to see an increased level of the athletes' self-confidence as a result of the treatment provided.

There are two variables in this study, namely, the independent variable of Life Kinetics (X1) and conventional exercise (X2). The dependent variable is the confidence level of the athlete (Y), the level of athletes' confidence in team sports (Y1) and level of athletes' confidence in individual sports (Y2). The treatment in the experimental group (Life Kinetic training) was given for 11 meetings, twice a week. The sum of these meetings refers to the research (Demirakca, 2016). Life Kinetic training programme given to the experimental group consists of eight Life Kinetic training modules.

The training module consists of several varied forms of practice and needs to be given an explanation in such a way as to be easily understood by trainers and athletes. More details about some Life Kinetic training modules can be seen in the following explanation:

Module 1: Ladder Exercises. Ladder exercises are exercises of different foot movement patterns performed by using the ladder box on the floor. The athlete moves forward, jumps, moves straight ahead, left, right, which is done according to the athlete's ability to start slowly. The motion patterns in ladder exercises are cyclic and acyclic movements. Module 1 is ladder training A divided into some form of training, that is: (1) Ladder A1 is performed by stepping with one foot (single) on the ladder box; (2) Ladder A2 is performed by stepping with both feet (doubles) on the ladder box; (3) Ladder A3 is a stepping combination of singles and doubles; and (4) Ladder A4 is performed by stepping in with both feet and stepping out with one foot (double-doubles out).

Module 2: Ladder Exercise B is divided into several forms of training: (1) Ladder B1 is zigzag stepping with one leg; (2) Ladder B2 is zigzag stepping with both legs; (3) Ladder B3 is cross stepping; and (4) Ladder B4 is reverse cross stepping.

Module 3: Ladder C training is divided into several forms of training, namely: (1) Ladder C1 is performed by stepping forwards and backwards; (2) Ladder C2 is

performed by stepping forwards and backwards beyond the ladder; (3) Ladder C3 is sideways stepping; and (4) Ladder C4 is alternate stepping.

Module 4: Line Jump Training. Line jump exercise is an exercise consisting of jumping forward, left, and right by passing the stretched strap. The line jump exercise is divided into several forms of training: (1) Line Jump A consists of jumping left and right over the line; (2) Line Jump A2 is performed by jumping left and right with both legs (doubles) over the line; (3) Line Jump A3 is a combination of the jumping motions as described in line jump A1 and A2; (4) Line Jump A4 is a combination of the jumping motions as described in line jump A1 and A2 while tapping the limbs; and (5) Line Jump A5 represents the same movement as the one in line jump A4 while tapping the opposite leg. Line Jump B is divided into: (1) Line Jump B1 consists of jumping left and right with both legs (doubles) across the line and to the back; (2) Line Jump B2 is performed by jumping left and right with both legs (doubles) past the line and to the back; (3) Line Jump B3 consists of jumping over the rope on one foot and landing on both feet; (4) Line Jump B4 is performed by jumping over the rope and tapping the limb with one hand; and (5) Line Jump B5 consists of jumping over the rope and tapping the limb with both hands.

Module 5: Reaction-Cognition Exercise (RC). Reaction-Cognition Exercise is a ball-throwing exercise performed by throwing a ball from the bottom by giving an instruction, for example, saying right means the receiver of the ball catches the ball with the right hand while moving the left foot forward, otherwise, if the instruction is left, the receiver receives the ball with his left hand while leading with the right foot. This exercise is divided into several types of exercises, namely: (1) RC1 practice which consists of throwing the ball with the instruction as mentioned above; (2) RC2 training implies throwing the ball with the back of the thrower and the instructions as mentioned above; (3) RC3 practice is performed by throwing the ball while moving other limbs; and (4) RC4 exercise which consists of throwing the ball while twisting the arm.

Module 6: Cross Jump (CJ) Exercise. This exercise is done by cross-stepping combined with the movement of the foot forwards, sideways and backwards. This exercise is divided into several parts: (1) CJ1 exercise is a step through the cross jump; (2) Exercise CJ2 is a both-feet step; and (3) The CJ3 exercise is a cross-legged step.

Module 7: Juggling Exercise (JUG). This exercise is a ball-throwing exercise performed by throwing the ball up and catching it with the palm up and the arms straight ahead, the palm up facing one arm which is placed across the right or left arm, palms down with straight arms, and palms down

with crossed arms. The exercises are divided into sections: (1) JUG 1 training implies throwing the ball up with both hands and with palms facing upwards; (2) JUG2 practice is performed by throwing the ball and catching it with the left arm crossed under the right arm; (3) JUG3 practice consists of throwing the ball and catching it with the right arm crossed under the left arm; (4) Exercise JUG 4 implies throwing the ball and catching it from above; (5) JUG5 practice implies catching with a combination of other motion patterns.

Module 8: Rainbow Run (RR) Training. This exercise is a combination of movements from single out and back doubles with the addition of a colour or a sign (cones) placed next to the ladder. This exercise is a combination of ladder exercises ranging from simple movements to complex movements, coupled with arm movements using the ball. The exercises are divided into several parts: (1) Exercise RR1 is a single out and back doubles movements with the addition of various colours (cones) in addition to the ladder; (2) RR2 exercises are single out and back doubles movements with the addition of various colours placed next to the ladder; and (3) RR3 exercises imply performing single out and back doubles movements combined with various colours in addition to the ladder which accompanies the movement of the ball around the waist (Kuswari, 2014).

Life Kinetic exercise is combined with some forms of exercise which use ladders, balls, ropes, cones, and other limb movements, including arm movements, with the goal of providing a cognitive challenge to the athlete in the coordinating motion. Therefore, the equipment required for Life Kinetic training is a 6-metre or 9-metre ladder adapted to a state, tennis ball, or balloon containing fine sand so that if they fall, they will not be far from the athlete, the strap which is 6 metres long, the string which is 1.20 metres long, the cones which are of different colours, and the doubles tip to give the sign.

In this study, the data collected are in the form of quantitative data obtained from the measuring the confidence level of athletes who take part in the team and individual sports. The data obtained from the measurement results were collected before the treatment through a pretest, and the data obtained after the treatment were collected by means of a posttest in the two experimental and control groups. Data were obtained by using a questionnaire in the form of a Self-Confidence Scale Instrument (Hidayat, 2015). This instrument has a validity level of 0.68 and a reliability of 0.76, so that it is suitable as a measuring tool. The data analysis technique used in this study is the MANOVA test. The test results will refer to several tests which exist in it, i.e., Pillai's Trace test, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root, taking into account

the significance and alpha level received (i.e.: 0.05). To facilitate the implementation of test calculations, researchers use computer assistance with SPSS version 21 for Windows (Santoso, 2013).

RESULTS

The results obtained in this study are shown in the form of data descriptions pertaining to the mean and standard deviation values of each pretest and posttest result on the confidence level of the athlete taking part in the team and individual sports. The result of data calculation is as shown in Table 1. Based on Table 1, in the experimental group, the mean pretest score of self-confidence in team sports is 55.765 and standard deviation is 3.308, while the mean posttest score is 75.529 and the standard deviation is 5.444. The mean pretest score of self-confidence in individual sports is 54.438 and standard deviation is 3.723. Meanwhile, the mean posttest score is 69.250 and standard deviation is 3.154. In the control group, the mean pretest of team sports is 56.824 and standard deviation is 3.695, while the mean posttest score is 70.353 and standard deviation 3.200. The mean pretest score of self-confidence in individual sports is 53.938 and standard deviation is 3.872. Meanwhile, the mean posttest score is 66.813 and standard deviation is 3.936.

The difference in experimental group scores between the pretest and posttest results of the confidence level in team sports is 19.764, while in individual sports, it is 14.812. The difference between the confidence level score in team sports of the control group is 13.529, with in individual sports, it is 12.875. Obtaining a confidence score difference in the experimental group, in both the group sport and the individual sport, is better than the score difference in the control group sports. These data show that the results of the Life Kinetic exercise treatment can increase the athletes' self-confidence compared to conventional exercise.

Before the data were analysed using the relevant statistical tests, the data obtained from the initial and final tests were tested for normality and homogeneity which turned out to be in the normal and homogeneous category. Furthermore, the data can be analysed using parametric statistics, namely the MANOVA test. The calculation results are shown in Table 2. Based on the calculation results in Table 2, the significance score is 0.000 (< 0.05) which means that H_0 is rejected, so it can be concluded that there is a difference of confidence levels in the team and individual sports athletes between those who were treated by Life Kinetic exercise and conventional exercise. Furthermore, the Table Tests of Between-Subjects Effects shows that the relationship between Life Kinetic exercise with increased confidence in the team sports has a significance value of 0.000 (< 0.05) which indicates that there is a difference in the confidence level of athletes caused by differences in the

given exercise treatment. Furthermore, the relationship between Life Kinetic exercise and self-confidence improvement in individual sports has a significance value of 0.013 (< 0.05). This indicates that there is

a difference of the confidence level due to the different exercise treatment given. The result of the Test of Between-Subjects Effects is shown in Table 3.

Table 1: Pretest, posttest, and standard deviation level of athletes' self-confidence in experimental and control groups

Variables	Pretest		Posttest	
	M	SD	M	SD
EXPERIMENTAL				
Self-confidence of team sports	55.765	3.308	75.529	5.444
Self-confidence of individual sports	54.438	3.723	69.250	3.154
CONTROL				
Self-confidence of team sports	56.824	3.695	70.353	3.200
Self-confidence of individual sports	53.938	3.872	66.813	3.936

Table 2: MANOVA Result

Multivariate Tests						
	Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.990	1390.664 ^b	2.000	29.000	.000
	Wilks' Lambda	.010	1390.664 ^b	2.000	29.000	.000
	Hotelling's Trace	95.908	1390.664 ^b	2.000	29.000	.000
	Roy's Largest Root	95.908	1390.664 ^b	2.000	29.000	.000
X	Pillai's Trace	.604	22.149 ^b	2.000	29.000	.000
	Wilks' Lambda	.396	22.149 ^b	2.000	29.000	.000
	Hotelling's Trace	1.527	22.149 ^b	2.000	29.000	.000
	Roy's Largest Root	1.527	22.149 ^b	2.000	29.000	.000
a. Design: Intercept + X						
b. Exact statistics						

Table 3: The result of the Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	PD-B	351.125 ^a	1	351.125	21.635	.000
	PD-P	36.125 ^b	1	36.125	7.049	.013
Intercept	PD-B	8978.000	1	8978.000	553.202	.000
	PD-P	6216.125	1	6216.125	1212.902	.000
X	PD-B	351.125	1	351.125	21.635	.000
	PD-P	36.125	1	36.125	7.049	.013
Error	PD-B	486.875	30	16.229		
	PD-P	153.750	30	5.125		

Total	PD-B	9816.000	32
	PD-P	6406.000	32
Corrected Total	PD-B	838.000	31
	PD-P	189.875	31
a. R Squared = .419 (Adjusted R Squared = .400)			
b. R Squared = .190 (Adjusted R Squared = .163)			

DISCUSSION

The results of this study indicate that there is a significant effect of Life Kinetic exercise on increasing athletes' confidence in both team and individual sport athletes. The findings of this study are in accordance with Lutz's (2017) opinion indicating that, in general, Life Kinetic exercise aims to increase athlete confidence. Life Kinetics is a combination of motor activity and challenges in cognitive and visual perception training, particularly peripheral visual field perception. Training visual perception such as moving limbs in different and unusual ways is actually a basic characteristic of training (Demirakca et al., 2016). According to the concept, Life Kinetic exercise is a combination of motion activity, cognitive challenges, and visual perception exercises, especially peripheral visual perceptions. The combination of limb motion in the exercise is performed by capturing, throwing, visual perception, eye coordination, and using other limbs, constituting the fundamental characteristics of the Life Kinetic exercise.

Life Kinetic exercise is a part of the Cognitive Motor Coordination Training (CMCT) exercise. This exercise represents "the harmonisation of the nervous and musculoskeletal systems, resulting in a rapid, accurate, and balanced motor response (Corbin et al., 2000; Lopes et al., 2012; Fernandes et al., 2016). The motion pattern of Life Kinetic exercise, according to the above concept, is varied and so complex that it demands ability and motion skills as well as cognitive function to be able to perform the movement well. The opinion is in accordance with the results of research stating that there is a strong relationship with intelligence, whereas fine motor skills are have a moderate one (Van der Fels et al., 2015; Fernandes et al., 2016).

The complexity in Life Kinetic exercise demands a strong perception of the athlete's ability and competence to perform complex motion patterns, thereby impacting engagement in the training process. Bandura (1986) and Chase (2001) related to this opinion stating that athletes, who are not sure, hesitate, and feel inadequate in doing their job, will avoid the practice situation, especially if the exercise does not vary. In addition, the athlete

reports a negative state of his / her feelings about the challenging circumstances and situations in the training process. In Sport Training Advisor (1917), there is an explanation of the "training variation since there are changes in several things. The variation is also believed to be able to promote learning and prevent staleness and plateaus". Therefore, the varied and complex physical activity exercises, including the Life Kinetic exercise, make the athlete confident and believe that he or she is capable of doing the exercises. The level of confidence will determine how much effort the athlete is investing and how long the athlete is able to participate in the physical activity. The athlete's perception of his abilities and skills has an important role to produce the athlete's confidence before the activity and during the training process (Tompsonowski; McCullick; Pesce, 2015).

In Life Kinetic exercise, the process will encourage athletes to see themselves as competent athletes, athletes who are trying and able to describe Life Kinetic exercise form as a challenging activity filled with fun and excitement. All forms of exercise with a combination and variation of complex motion is a blend of some form of ladder movement, which is very challenging for athletes to do well. But in the process, not all athletes can directly master the form of Life Kinetic training well; motion perfection and mastery of motion patterns in Life Kinetics is not a demand, but the most important thing is that the athletes are happy in doing the motion activity in Life Kinetic exercise. In line with this statement, Demirakca (2016) explains that "it's not only fun, but it's the perfect way to improve your performance. An essential aspect of this combined training is that the exercises are not trained until automatised. As soon as the participant's performance reaches about 60% of correct trials, the movements are introduced."

Furthermore, to reinforce the findings in this study, Hays et al. (2009) explain in their research that self-confidence is strongly associated with cognitive, affective, and behavioural responses. This is a confident construct in exercise which affects the performance of athletes (Lane, 2008). In the study, it was explained that there is a positive correlation between high self-confidence and the success of the athlete. The results of interviews conducted with 63 athletes turned out that all athletes stated that the high success of athletes in the sport is 90% determined by the high level of confidence (Weinberg and Gould, 2007), whereas

failure occurs when the confidence level is low. This opinion also corresponds with Jones and Hardy's research, 1990; Vealey, 2005; Weinberg and Gould, 2007, indicating that "the athletes are confident." The performance of athletes in sports is determined by the athletes' high self-esteem. The high level of confidence is synonymous with the positive affect statement, effective competition behaviours, and effective competition focus. Conversely, the low self-confidence of athletes is synonymous with the negative affect statement, ineffective competition behaviour, and an inability to maintain an effective competition focus (Lane, 2008).

An athlete with high self-confidence has an effective ability to use cognitive resources (Vealey's, 2001; Lane, 2008). Athletes who have confidence have positive emotions such as excitement and happiness, so they are able to focus on performing the tasks provided by the trainer which are included in the Life Kinetic training process, while less confident athletes tend to be emotionally disturbed so that they feel anxiety, worry, and depression (Hays, et al, 2009). Athletes who lack the ability to focus on assigned tasks have a decrease in performance (Jones and Hanton, 2001).

The data collected from interviews with athletes indicate that athletes are able to maintain concentration on the task they do when they have high confidence, whereas athletes have low self-confidence when they are not focused, being unable to control the feelings of stress, anxiety and depression, and unable to think positively during the activity on a regular basis (Cresswell and Hodge, 2004; Hays, 2009). Thus, confidence has an influence on the athlete in overcoming various challenges, because the athlete has the power and confidence in himself so as to display optimum performance under pressure.

In addition, Evrensel's (2014) study indicated that "confident athletes have a high perceived strength of adequacy related to physical fitness and their perceived strength has high goal-oriented grades." The presence of strong perceptions regarding oneself presents the ability of a prime physical condition as well as a clear purpose, and the goal will challenge the athlete to complete and achieve it well. Confident athletes have to do with productive behaviour (behavioural behaviours) such as increased effort and athlete motivation. The theory of self-efficacy explained that the decline in the athletes' performance efficiency was caused by anxiety (Eysenck and Calvo, 1992; Hays, 2009). Therefore, the strength of self-confidence is related to challenging goal setting and investing a maximum effort and persistence to achieve that goal (Bandura, 1986). In Life Kinetic exercise, the motion task which the athlete must perform is very complex, challenging for the athlete and systematically arranged, thus demanding good motion coordination and high motivation in order for the athlete to be able to perform the movement. The challenging moves in Life Kinetic training are very

interesting for athletes who, through the process of repetition in each exercise, try to make every move until they are able to perform each motion task successfully.

Life Kinetic Exercise is one of the physical and psychological training programmes deliberately designed in such a way as to improve athlete performance, especially with regard to self-confidence (Machida, 2016). This exercise provides many benefits for athletes to reduce tension, improve relaxation, improve concentration and memory, improve the quality of skill learning, improve physical, mental and performance quality, and improve athlete confidence (Lutz, 2017). In addition, Life Kinetic training aims to "improve your mental and physical performance in all areas of life" (Demirakca, 2016). Athletes who practice Life Kinetics are able to improve their physical condition, mental, cognition, and visual perception better, it is "a good foundation in sport, respect for one's competence, adequate preparation, and good physical conditions" (Roxel, 2005). Good physical condition training and continuous training represent one method which can improve an athlete's confidence (Weinberg and Gould, 2007).

In this study, it was aimed to explain the differences in the effect of Life Kinetic exercise on team and individual sports athletes. The findings are in line with Lane's (2008) opinion that the athlete's self-confidence level to perform the task is very different, especially in the Life Kinetic training process, which is a relatively consistent finding in the research literature. In relation to this opinion, Vealey (1998) explains that the assessment of individual self-confidence belonging to the athlete group is different, because the difference between individuals at the level of understanding, perspective and self-assessment as well as organisational culture is an aspect that affects the development of confidence in sports. The model is confident in the sport according to both Vealey and Lane (2005), being the primary source of self-confidence in sports, based on athletes' perceptions. The differences in athlete perception are made as a foothold and cannot be generalised to other athletes. Therefore, self-confidence groups of athletes and individual teams are clearly different because the two sports have different characteristics, both in terms of sports and actors involved in it. However, Life Kinetic training can increase the athletes' confidence in both sports.

The Life Kinetic exercise of team sports is very dynamic because the individual in the team tries to perform their ability competitively as if the individual does not want to lose in performing his ability. The competitive aspect of the training process is the basic capital that is expected to

arise and occur from every individual in the team; it aims to increase motivation and develop a sense of individual pride in the team in completing their tasks for the benefit of the team. In individual sports, athletes show their duties in accordance with their abilities and beliefs without being influenced by others in performing their duties. The point in the Life Kinetic training process is that the athlete is able to perform some combination of motion patterns caused by the athlete feeling confident in his ability, so that the athlete can succeed in performing the pattern of motion. Successful sportsmen have a higher level of self-confidence than less successful ones. The other explanation is that highly confident sportsmen believe in their abilities to win and be successful or to perform better (Hazril, 2016).

Some of the weaknesses in this study need to be considered for the next study related to Life Kinetic exercise because the motion pattern is very complex and demands a high coordination ability as well as high cognition challenges. In the use of research subjects, it is better to note other aspects such as the ability and quality their motion. The next researcher should categorise the subjects' capabilities related to the motor skills of educability and cognitive function (concentration and intelligence level) of the athlete so that the researchers will get a clear picture of how the athlete's confidence increases in the athlete group who have high and low educational motor skills and how the confidence level in the concentration group becomes high and low as the result of Life Kinetic practice training. In addition, the methodology used in this study does not use a randomisation design so that it is difficult to generalise in this research. Therefore, we recommend that sampling techniques in subsequent research be done through random techniques in groups of athletes capable of homogeneity on the team and individual sports.

Some of these weaknesses are expected to be a reference for future researchers to conduct research on issues and topics which are similar to this one.

DISCUSSION

This study can conclude that well-provided Life Kinetic exercise gives a significant effect on the improvement of athletes' self-confidence. This is because Life Kinetic exercise can motivate athletes to try some form of exercise with a pleasant situation, and have confidence to succeed in doing every motion pattern in the Life Kinetic practice. In addition, there are significant differences in the effect of Life Kinetic exercise on increasing the confidence of athletes in the team and individual sports. The difference in the effect of the results obtained in this study is due to differences in individual perceptions in interpreting their own ability to display tasks in the Life Kinetic exercise. Life Kinetic exercise is one of the methods of psychological practice. It is expected to be one of the training methods that can add to the treasury of psychological training methods for trainers. This exercise method is expected to improve the psychological ability of athletes, both for the team and individual sports, having a positive impact on the athletes' performance improvement. This exercise is expected to be integrated into a period of practice, so that the psychological training method with a step-by-step training programme becomes clearer and easier to implement by the trainer. Based on the findings of this study, Life Kinetic exercise can improve the performance of athletes, especially in the aspect of confidence. Therefore, it is suggested to the sports coaches of both team and individual sports to use Life Kinetic training methods if they want to train athletes to increase their self-confidence. It is suggested to the next researcher who is interested in doing research on same problem and topic to add a moderator variable.

One of them is the motor educability level and concentration level because, in Life Kinetic exercise, the movement is complex and has a high cognitive challenge which has to be overcome by the athlete. The subjects' ability in subsequent research can be categorised into high and low groups, so that the results of Life Kinetic practice treatments really reflect the results of the treatment accurately and in accordance with the treatment programme given to each group.

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KORIŠTENJE LIFE KINETIC VJEŽBI ZA POVEĆANJE SAMOPOUZDANJA SPORTISTA U TIMSKIM I INDIVIDUALNIM SPORTOVIMA

Samopouzdan sportista iznimno vjeruje u svoju sposobnost. Manje samopouzdan sportista često sumnja u vlastitu sposobnost pokazivanja svog najboljeg učinka. Kako bi povećali samopouzdanje, potrebno je koristiti prave metode prilikom vježbanja. Jedna od njih je Life Kinetic vježba. Cilj ove studije je ispitati razlike efekata Life Kinetic vježbi na poboljšanje samopouzdanja sportista u timskim i individualnim sportovima. Primijenjena metoda je eksperimentalna metoda sa pretestiranjem i posttestiranjem kontrolne grupe. Populaciju čine muškarci, sportisti Sekcije za sportsku aktivnost studenata na jednom od univerziteta u Indoneziji. Uzorak se sastoji od aktivnih sportista u dobi između 17 i 19 godina, te takmičenja u timskim i individualnim sportovima, koji su odabrani korištenjem neprobabilističke metode uzorkovanja, što je dovelo do uzorka od 34 sportista iz timskih i 32 sportista iz individualnih sportova. Uzorci iz ove dvije grupe sportova su podijeljeni u dvije grupe putem nasumičnog odabira kako bi dobili dvije grupe uzoraka: eksperimentalnu i kontrolnu grupu. Eksperimentalna grupa je ona koja je podvrgnuta 11 Life Kinetic treninga koji su se odvijali dva puta sedmično. Tehnika analize podataka u ovoj studiji je bio MANOVA test. Rezultati su pokazali da postoji razlika u efektu Life Kinetic treninga na povećanje samopouzdanja sportista u timskim i individualnim sportovima.

Ključne riječi: Life Kinetic vježbe, samopouzdanje, timski i individualni trening

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PERCEIVING MANAGEMENT CHARACTERISTICS IN TEACHING STAFF WITH REGARD TO SUCCESSFUL MANAGEMENT IN EDUCATIONAL INSTITUTIONS

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ABSTRACT

When it comes to analysing the predispositions for successful management in educational institutions, this paper will strive to indicate the key predispositions in successful management with regard to age. This research aimed at examining which characteristics are necessary to successfully manage an educational institution, considering that it is expected of modern school principals to have them, while also possessing the ability to successfully react to the goals and tasks set for the school. The results of this research indicate that teachers have identified two traits as the most important ones for successful management in education. The traits are: morality and integrity as well as psychological stability. On the other hand, two traits which are considered to be the least important for successful management in schools have also been identified, namely: sightliness and self-initiative. The respondents' age is not a factor which affects how they perceive the importance of possessing certain traits for successful management and work in educational institutions. This paper provides an overview of the factors for successful management in educational institutions and the respondent's personal insights regarding the importance of age in management. Additionally, it should be mentioned that all the characteristics, i.e., individual factors representing the segment of predispositions are of utmost importance for the principal and the educational institution itself.

Keywords: management, educational institution, teaching staff

INTRODUCTION

Avdagić E., "translates" the definition of management into the field of education, indicating that it represents coordination of human and material potentials in order to achieve the goals set (both explicitly and implicitly) in the concepts, strategies and projections of education. Therefore, it is emphasised that the application of educational management is operationalised through managing, directing and steering the education system as well as its subsystems (Staničić, 2011).

Alongside the affirmation of management in education, there has been an emergence of disputes based on the claim that management and education are two incompatible phenomena or processes. The term management in education consists of two central terms, namely, education which aims towards autonomy and freedom of mind, and the term management, with its origin coming from economy, which is the synonym for the "dominion of money" (Pigisch, 2010: 12). This precisely illustrates the accentuated disconnection between the two phenomena. In favour of this, Avdagić emphasises

that "managership" is not in accordance with the educational (school) values and contents, that the manner in which the power relations are created in education is not in accordance with democratic principles expected in education, that the activities in educational organisations are significantly different than those present in market-oriented organisations, that the idea of a market, which is the cornerstone of management, is foreign and damaging for the understanding of education, that managers usually enjoy their power, neglecting moral principles, which is not in accordance with educational values, and that vertical responsibility of school employees creates distrust and dissatisfaction. Avdagić deems that these are the reasons why principals must be the first among equals, and not managers at all (Everard, Morris, according to: Staničić, 2011).

In spite of disputes and evident differences between educational and economic activities, it is not possible to deny the capability and need for management in education since it is important for an educational institution to plan, organise, connect and coordinate as well as develop and value human potential and material resources in order to improve performance and the total contribution of the educational activity and organisation. "The success and competitiveness of an organisation as well as the productivity and innovative strength of a society depend on good management, especially in today's uncertain times" (Zech, 2010: 12). Opponents of management in education have based their criticism mostly upon the incompatibility of the nature and essence of management (oriented towards the economy and business) with a centralised educational policy, which is only directed towards the system of formal/school education, within which a school is a strictly controlled institution without much room for innovative steering and management.

Additionally, Avdagić points out that the characteristics of an educational environment certainly determine the properties of management in an organisation. As the main "reform issues" in transition economies, decentralisation and liberalisation in education create such an environment where the effect of many types of regulations - administrative, professional and market-oriented can be assessed. It is to be expected that a market-oriented approach is present in adult education (but it is all the more present in the education of children and youth). In order for the "educational market" not to become chaotic (which would signify a transformation of the system into its opposite), it is necessary to adequately define the relations among all structural elements of the system (the relations between formal and informal education as well as private and public ones, the relations between education

and the labour market, etc.), so that the process of competitiveness in the field of educational offer is based upon the principles of standardisation, accreditation and certification (Alibabić, 2002).

The required individual characteristics of managers Horonitz M. (2013) points out that the individual characteristics of managers required for performing managerial activities, where the characteristics imply the knowledge, skills and competences in general, abilities and personality traits, are a step towards establishing a manager identification and selection system. Horonitz classifies the required characteristics of managers into three fundamental categories:

MANAGERS' ABILITIES AND SKILLS

The notion of skills in managerial literature signifies a transformation of abilities and knowledge into certain forms of behaviours and activities. Those are: technical, interpersonal, strategic or conceptual, diagnostic and analytical, communication, political and administrative skills. These skills are divided into certain skill categories. Presumptions related to managerial effectiveness in terms of abilities: intelligence, imagination, intellectual fluency and flexibility, divergent opinions, ability of logical thinking, creativity, social intelligence, analytical skills, verbal comprehension and fluency, perceptive and specific intellectual abilities. Specific meaning is attributed to particular characteristics, i.e., personality traits. Personality is actually a factor of managerial effectiveness.

MANAGERS' PERSONALITY TRAITS

Personality traits are relatively permanent characteristics of humans which explain behaviour and enable its prediction. Personality traits distinguish a leader from a follower, and a successful from an unsuccessful manager. Self-evaluation of top managers identified the most important factors of their success: ability to work with a multitude of different people, the need to achieve a result and success, total responsibility for important tasks obtained early, experience in leading obtained early, the width of experience in many functions before the age of 35. The research conducted on 45 top managers from British companies, which have over a thousand employees, has shown that their common traits are: achievement and ambition, ability to learn from adversity, a high level of dedication to their work and work energy, great analytical skills in solving problems, exceptional ability to work with people and a high level of inventiveness. With the help provided by external experts, some companies attempt to create programmes for identifying managers. Considering that the known-groups method is the most suitable one, the existing managers were subjected to a series of tests in order to determine the traits which distinguish the successful from the unsuccessful ones. The research conducted on a random sample of 2000 managers from Sears, Roebuck & Co. The research conducted by the company "Sears, Roebuck & Co" on a random sample of 2000 managers resulted in two groups of managers being distinguished in interpersonal skills.

The traits of unsuccessful managers are: insensitivity, unreliability, aloofness, unfriendliness, arrogance, overambition, ill temper, levity under pressure and other traits, with successful managers behaving exactly opposite to them. The same research indicated that common traits of managers are: achievement and ambition, ability to learn from adversity, a high level of dedication to their work and work energy, analytical skills in solving problems, exceptional ability to work with people and inventiveness. With the help provided by experts, some companies attempt to create programmes for identifying managers. Considering that the known-groups method is the most suitable one, managers are subjected to a series of tests with the goal to determine the traits which distinguish the successful from the unsuccessful ones.

By applying special batteries of tests, the following traits of successful managers were revealed: a high level of intelligence, a high level of social leadership and social stability, a high level of confidence, objectivity in perceiving themselves and others, a high degree of tolerance towards others, great interest in recognition and economic advantage, and high goal orientation. The identified work values are: significant focus on the possibility of being promoted, high identification with the organisation, interest in salary, status and recognition. The key differences between the successful and unsuccessful managers are: intelligence, sociability, optimism, social leadership, self-confidence, dominance, motivation and objectivity. All research point at the importance of personality traits, so the focus in identifying and selecting managers is placed precisely on personality traits. In the United Kingdom, the typical list of individual traits during the selection of managers is: vigour, ambition, intelligence, creativity, business orientation, self-confidence, communicativeness, analyticity, decisiveness, credibility, and incisiveness. Those are the combinations of intellectual abilities and personality traits. (M. Horonitz, 2013)

One becomes a successful and quality manager if they satisfy the stated factors. It is necessary to place an imperative and an emphasis on each factor and thereby "strengthen" the areas and tasks performed by the manager. A manager has verbal and written communication skills, he is able and decisive in making the right decisions at the right time, and he is flexible. It is through fast acquisition of knowledge and skills alongside personal creativity that one becomes a successful manager. (Horonitz, M., 2011)

MANAGERIAL MOTIVATION

Managerial motivation is as important as the abilities and knowledge. The first attempt to define managerial motivation is provided by McClelland who pointed out the motive for achievement, the need for power in the sense to be strong and influential. Based upon this, we can distinguish three types of managers: affiliative managers, managers motivated by their own power, and institutional managers.

The optimal and desirable combination of these needs is situationally conditioned. By measuring and researching managerial motivation, it has been revealed that the following attitudes and motives contribute to the success in one's career as a manager: a positive attitude towards authority, the need for competing, the need to prove and affirm oneself, the need to display power, the need to have a distinguished position and behaviour, the need for responsibility and a sense of responsibility. (Horonitz, M. Psihologija ekonomskog ponašanja. 2013. pp. 83-84)

The word strategy is derived from the Ancient Greek word *strategos* consisting of the terms *stratos* (meaning army), and *ago* (meaning one who leads), while it signified a military commander during the period of Athenian democracy.

In order to better understand the philosophy of strategic management, it is necessary to provide an explanation of the key strategic terms.

Strategies are means to ends and the way to achieve purpose, vision and goals, a clear direction to strive towards, a determination of paths and decision making in order to reach a certain place or achieve a certain value (added value) and record the degree of success. Strategies are specific actions and activities rather than plans laid on paper or abstract ones.

Tactics represents shorter, frequently changed plans for the existence of mission, vision and goals. Strategic thinking is the ability to understand the present moment in relation to the past and future events, it is a synthetic ability of finding paths towards an imaginary future, it means thinking forward, anticipating.

Strategic awareness is the recognition that strategies are not fixed and uniform plans, but temporary roads, bridges or scaffolding we build, demolish and rebuild, anticipating the future relevant factors. In order to achieve a better position, it is necessary to conduct manoeuvres. Strategic management is the art and science of formulating, implementing and evaluating interfunctional decisions, enabling the school to determine its course in achieving the tasks set. It is a technique which helps in predicting the future so that the principal can direct and plan a more economical, efficient and effective school operations. The English term is "3E's" (three words beginning with the letter e): economic, efficient and effective, determined by the EU as the norm for its members!

A competent principal must know how to predict the future and formulate the school development vision, all in the interest of improving the learning and teaching processes. The principal's vision should be accepted by most students, teachers and parents,

as well as other school stakeholders as their own. It is understandable that formulating a good vision is a difficult job.

Glatter and Weindling's (1993) discussion, drawing on Bolam et al.'s (1993) research on effective schools, takes a sceptical view that principals can formulate a good vision and that it will be accepted by all school participants: "All twelve heads said they had a vision, but in the majority of cases these lacked specific detail and tended to reflect the broad aims of British education... Few could be said to be genuinely inspiring...there was little evidence that teachers had played a significant part in shaping them...teachers generally were obliged to infer what the vision was about."

RESEARCH METHODS

The following research methods were used in this study:

- survey method
- theoretical analysis method

Statistical techniques

- a questionnaire related to predispositions for successful management in educational institutions
- descriptive statistics
- content analysis
- survey technique

Measuring instruments

- socio-demographic questionnaire
- questionnaire

Research sample

The sample was formed based on the convenience sampling method due to the specificity of the population. During the first step, we determined the number of teachers who properly filled in the questionnaires. The sample of respondents was formed based on the convenience sampling method due to the specificity of the population. With the goal to achieve greater representativeness, it was planned to form the sample from this population by using the convenience sampling method. The research was conducted at the Public Institution Primary School "6. Mart", Hadžići, the Public Institution Primary School "Meša Selimović", the Public Institution Primary School "Čamil Sijarić", the Public Institution Primary School "Aleksa Šantić", during the school year 2017/2018, on a total of $N = 100$. The obtained results are presented below, with the implementation of the corresponding statistical analyses related to predispositions for successful

managing in educational institutions.
The sample variables

The dependent variables are: management, analysis of predispositions for successful management in educational institutions.
The independent variables are: age.

RESEARCH RESULTS

Differences in perceptions depending on the employees' age

In order to verify whether there are statistically significant differences in perceiving the importance of traits for successful management in teaching, we have divided the respondents in two groups based upon their age: 25-50 years of age and 51-60 years of age (Table 1). This distribution was conducted considering the age structure and sample size, obtaining two groups which are approximately the same in size, i.e., there were 46% of respondents in the 25-50 years-of-age group, and 54% of respondents in the 51-60 years-of-age group.

Table 2 illustrates the descriptive values of assessing the traits considering the respondents' age. We can see that both groups of respondents did not evaluate a single trait with a grade lower than the average one $M = 4.0$, while the highest grade was $M = 4.9$.

Considering that the distribution of results is not normal, we illustrated the ranks of arithmetic means between the younger and older respondents (Table 3).

The effect of education on successful management in educational institutions

The results illustrated in Table 4 indicate that there is a statistically significant difference ($p < 0.05$) between the older and younger respondents when it comes to perceiving the importance of possessing the education trait for successful management in teaching. In this regard, older respondents consider the possession of this trait to be more important in relation to the opinion of the younger respondents. Considering that the distribution of results is not normal, we illustrated the ranks of arithmetic means between the younger and older respondents (Table 5).

Differences in perceiving the importance of integrity, independence, reliability, resourcefulness and courage between the younger and older teachers:

Moreover, we investigated whether there are statistically significant differences in perceiving the importance of possessing the following traits between the younger and older teachers: integrity, independence, reliability, resourcefulness and courage.

Table 1: The respondents' age distribution

		N	%
Age	25-50 years of age	46	46%
	51-60 years of age	54	54%
	Total	100	100%

Table 2: Descriptive values of the measured traits according to the respondents' gender

	Age			
	25-50 years of age		51-60 years of age	
	M	SD	M	SD
Education	4.6	.7	4.9	.4
Intelligence	4.6	.6	4.6	.5
Creativity	4.4	.7	4.7	.5
Systemisation	4.4	.7	4.4	.7
Self-initiative	4.2	.9	4.3	.8
Integrity	4.3	1.0	4.5	.7
Independence	4.3	1.0	4.5	.6
Reliability	4.7	.5	4.7	.6
Resourcefulness	4.6	.5	4.6	.6
Courage (audacity)	4.4	.8	4.5	.7
Perspicacity	4.5	.7	4.4	.7
Degree of culture	4.6	.6	4.6	.7
Sociability	4.4	.7	4.6	.6
Psychological stability	4.7	.6	4.8	.5
Behaviour and stability	4.7	.6	4.7	.7
Rationality and equity	4.7	.5	4.7	.6
Morality and integrity	4.7	.6	4.8	.5
Willingness, persistence and incisiveness	4.6	.6	4.5	.7
Diligence and industriousness	4.5	.7	4.5	.7
Sightliness	4.1	.9	4.0	.9

Table 3: Ranks of arithmetic means for the measured traits according to the respondents' age

	Age	N	Rank M	Sum of ranks
Education	25-50 years of age	46	45.35	2086.00
	51-60 years of age	54	54.89	2964.00
	Total	100		
Wisdom (knowledge and intelligence)	25-50 years of age	46	49.22	2264.00
	51-60 years of age	54	51.59	2786.00
	Total	100		
Creativity	25-50 years of age	46	45.76	2105.00
	51-60 years of age	54	54.54	2945.00
	Total	100		
Systemisation	25-50 years of age	46	50.90	2341.50
	51-60 years of age	54	50.16	2708.50
	Total	100		
Self-initiative	25-50 years of age	46	49.42	2273.50
	51-60 years of age	54	51.42	2776.50
	Total	100		

Table 4: Statistically significant differences of the measured traits according to the respondents' age

	Education	Intelligence	Creativity	Systemisation	Self-initiative
Mann-Whitney U	1005.000	1183.000	1024.000	1223.500	1192.500
Wilcoxon W	2086.000	2264.000	2105.000	2708.500	2273.500
Z	-2.238	-.484	-1.774	-.143	-.373
P	.025	.628	.076	.886	.709

The results illustrated in Table 6 indicate that none of the listed traits had statistically significant differences between the younger and older respondents. Considering that the distribution of results is not normal, we illustrated the ranks of arithmetic means between the younger and

older respondents (Table 7). The difference between the younger and older respondents for the perspicacity, degree of culture, sociability, psychological stability as well as behaviour and stability traits. Subsequently, we have investigated the existence of statistically significant differences between the younger and older respondents

for the following traits: perspicacity, degree of culture, sociability, psychological stability as well as behaviour and stability. Even in this set of measured traits, we have not obtained statistically significant differences between the older and younger respondents which can be seen in the illustration of results from Table 8. Considering that the distribution of results is not normal, we illustrated the ranks of arithmetic means between the younger and older respondents (Table 9). Lastly, we have measured whether there are statistically significant differences according to the respondents' age regarding the importance of possessing the following traits for successful management in teaching: rationality

and equity, morality and integrity, willingness, persistence and incisiveness, diligence and industriousness and sightliness. Just as in previous situations, the results indicate that there are no statistically significant differences for the measured traits considering the respondents' age. Based upon the results illustrated in Table 10, we can conclude that, when it comes to their gender, teachers differ in five of the twenty measured traits required for successful management in teaching. Considering the teachers' age, we have obtained a statistically significant difference for only one of the two measured traits.

Table 5: Ranks of arithmetic means for the measured traits according to the respondents' age

	Age	N	Rank M	Sum of ranks
Integrity	25-50 years of age	46	47.15	2169.00
	51-60 years of age	54	53.35	2881.00
	Total	100		
Independence	25-50 years of age	46	48.79	2244.50
	51-60 years of age	54	51.95	2805.50
	Total	100		
Reliability	25-50 years of age	46	51.17	2354.00
	51-60 years of age	54	49.93	2696.00
	Total	100		
Resourcefulness	25-50 years of age	46	50.50	2323.00
	51-60 years of age	54	50.50	2727.00
	Total	100		
Courage (audacity)	25-50 years of age	46	50.00	2300.00
	51-60 years of age	54	50.93	2750.00
	Total	100		

Table 6: Statistically significant differences of the measured traits according to the respondents' age

	Integrity	Independence	Reliability	Resourcefulness	Courage (audacity)
Mann-Whitney U	1088.000	1163.500	1211.000	1242.000	1219.000
Wilcoxon W	2169.000	2244.500	2696.000	2727.000	2300.000
Z	-1.202	-.612	-.292	.000	-.180
P	.229	.540	.770	1.000	.857

Table 7: Ranks of arithmetic means for the measured traits according to the respondents' age

	Age	N	Rank M	Sum of ranks
Perspicacity	25-50 years of age	46	52.10	2396.50
	51-60 years of age	54	49.14	2653.50
	Total	100		
Degree of culture	25-50 years of age	46	50.47	2321.50
	51-60 years of age	54	50.53	2728.50
	Total	100		
Sociability	25-50 years of age	46	48.54	2233.00
	51-60 years of age	54	52.17	2817.00
	Total	100		
Psychological stability	25-50 years of age	46	49.41	2273.00
	51-60 years of age	54	51.43	2777.00
	Total	100		
Behaviour and stability	25-50 years of age	46	50.20	2309.00
	51-60 years of age	54	50.76	2741.00
	Total	100		

Table 8: Statistically significant differences of the measured traits according to the respondents' age

	Perspicacity	Degree of culture	Sociability	Psychological stability	Behaviour and stability
Mann-Whitney U	1168.500	1240.500	1152.000	1192.000	1228.000
Wilcoxon W	2653.500	2321.500	2233.000	2273.000	2309.000
Z	-.569	-.013	-.713	-.497	-.132
P	.570	.989	.476	.619	.895

Table 9: Ranks of arithmetic means for the measured traits according to the respondents' age

	Age	N	Rank M	Sum of ranks
Rationality and equity	25-50 years of age	46	48.05	2210.50
	51-60 years of age	54	52.58	2839.50
	Total	100		
Morality and integrity	25-50 years of age	46	48.49	2230.50
	51-60 years of age	54	52.21	2819.50
	Total	100		
Willingness, persistence and incisiveness	25-50 years of age	46	53.15	2445.00
	51-60 years of age	54	48.24	2605.00
	Total	100		
Diligence and industriousness	25-50 years of age	46	50.24	2311.00
	51-60 years of age	54	50.72	2739.00
	Total	100		
Sightliness	25-50 years of age	46	52.38	2409.50
	51-60 years of age	54	48.90	2640.50
	Total	100		

Table 10: Statistically significant differences of the measured traits according to the respondents' age

	Rationality and equity	Morality and integrity	Willingness, persistence and incisiveness	Diligence and industriousness	Sightliness
Mann-Whitney U	1129.500	1149.500	1120.000	1230.000	1155.500
Wilcoxon W	2210.500	2230.500	2605.000	2311.000	2640.500
Z	-1.005	-.919	-.991	-.097	-.638
P	.315	.358	.322	.923	.524

CONCLUSION

Based on the tasks set and the research goals as well as the analysed data, we can reach the following conclusions which have been made by researching the topic of predispositions for successful management in educational institutions: possession of all measured traits is important for successful performance and management in educational institutions, but it is especially important to possess the morality and integrity as well as psychological stability traits, while it is of less importance to possess the sightliness and self-initiative traits. The respondents' age is not a factor which affects how they perceive the importance of possessing certain traits for successful management and work in educational institutions. In the end, we can conclude that, when it comes

to their gender, teachers differ in five of the twenty measured traits required for successful management in teaching. Considering the teachers' age, we have obtained a statistically significant difference for only one of the two measured traits. Additionally, the results indicate that there is a statistically significant difference between the older and younger respondents when it comes to perceiving the importance of possessing the education trait for successful management in teaching.

In this regard, older respondents consider the possession of this trait to be more important in relation to the opinion of the younger respondents, while the factors do not indicate that age is important for successful management. Therefore, this paper provides an overview of the factors for successful management in educational institutions and the respondent's personal insights regarding the importance of age in management.

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PERCEPCIJA MENADŽMENT KARAKTERISTIKA KOD NASTAVNOG OSOBLJA ZA USPJEŠNO RUKOVOĐENJE U OBRAZOVNIM INSTITUCIJAMA

Kada je u pitanju analiza predispozicija uspješnog vođenja u obrazovnim institucijama u radu ću nastojati pokazati koje predispozicije se smatraju ključnim u uspješnom vođenju u odnosu na dob. Ovo istraživanje imalo je za cilj ispitati koje su neophodne karakteristike za uspješno vođenje odgojno-obrazovne institucije, s obzirom na to da se navedeno očekuje od direktora savremene škole, koji mora imati i sposobnost uspješnog reagovanja na ciljeve i zadaće koje se postavljaju pred školu. Rezultati ovog istraživanja pokazuju da su nastavnici identificirali dvije osobine kao najvažnije za uspješno vođenje u obrazovanju. To su osobine: moralnost i poštenje i psihološka stabilnost. S druge strane također su identificirane i dvije osobine za koje se smatraju da su najmanje važne za uspješno vođenje u školi, a to su: naočitost i samoinicijativnost. Životna dob ispitanika nije faktor koji utječe na percepciju o važnosti posjedovanja pojedinih osobina za uspješno vođenje i rad u obrazovnim institucijama. Ovaj rad daje presjek stanja faktora za uspješno vođenje u obrazovnim institucijama i pogleda ličnih shvatanja ispitanika na bitnost životne dobi za segment rukovođenja. Također, treba napomenuti da sve karakteristike odnosno faktori pojedinačno, koji predstavljaju segment predispozicija, su najbitniji za direktora a i za samu obrazovnu instituciju.

Ključne riječi: menadžment, obrazovna institucija, nastavno osoblje

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HOW DOES YOGA AFFECT HEALTH? YOGA TEACHERS' EXPERIENCES

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ABSTRACT

The health benefits of yoga for the physical, emotional and spiritual development of an individual have been shown in a great number of international research. Practicing yoga significantly improves the mood, reduces anger, depression and fatigue, increases resilience, and reduces problematic physiological and cognitive patterns of responding to stress, such as rumination, intrusive thoughts, and emotional arousal. Research about yoga is rare in our countries, so we wanted to examine the yoga teachers' opinions on yoga, yoga's health benefits as well as their motives for practicing and teaching yoga. In order to understand their experiences better, we have applied a qualitative methodology. According to the results, yoga teachers chose to practice yoga for different reasons. The most common motives were the need to balance physical and mental functioning, the need for "depth" and meaning in daily life, personal dissatisfaction, pain, and the need to do something useful for themselves. From their answers, it was evident that the role of a yoga teacher brings many benefits such as continuous learning, growth and development, sharing experiences with students, and a better understanding of themselves, others and life. When it comes to the health benefits of yoga, the participants provided similar answers: improved spine and bone health, good circulation, desired weight loss, pressure regulation, vitality, strength, endurance, re-learning proper breathing, etc. According to the findings, we can conclude that the health benefits of practicing yoga are enormous and bring great benefits to both the yoga teachers and their students.

Keywords: yoga, health, yoga teachers, well-being

INTRODUCTION

The World Health Organization (WHO) defined health as "a state of complete physical, mental and social well-being, not just the absence of illness and disability" (WHO, 1948). Research has consistently shown that stress contributes to the aetiology of heart disease (Guddeti, Dang, Williams, and Alla, 2019), cancer (Côté and Daneault, 2012), stroke (Zou et al., 2018), and other chronic conditions and diseases (Cramer et al., 2018). Therefore, it is imperative to place a focus on preventative stress management and the reduction of negative emotional states in order to reduce the burden and cost of illness (Stephens, 2017). Yoga is generally accepted as an ancient tradition consisting

of physical postures, breathing techniques, meditation, and moral and ethical principles. Despite the high popularity of yoga among people of different ages, research on the health benefits of practicing yoga is rare in Bosnia and Herzegovina and Turkey. A great deal of international research has consistently demonstrated the health benefits of yoga for the physical, emotional and spiritual development of an individual. For example, practicing yoga significantly improves mood (Noggle, Steiner, Minami, and Khalsa, 2012), reduces anger, depression, and fatigue (Felver, Butzer, Olson, Smith, and Khalsa, 2010), increases resistance to stress (Ramadoss and Bose, 2010), and reduces problematic physiological

and cognitive patterns of responding to stress, such as rumination, intrusive thoughts, and emotional arousal (Mendelson, Greenberg, Dariotis, Gould Rhoades, and Leaf, 2010). Also, it is shown that yoga practices can have a significant positive impact on many health conditions such as asthma (Mekonnen and Mossie, 2010), Diabetes Mellitus (Malhotra, Singh, Tandon, Madhu, Prasad, and Sharma, 2002), anxiety (da Silva, Ravindran, and Ravindran, 2009), hypertension (Tyagi and Cohen, 2014) and reduced pain in patients with arthritis, carpal tunnel syndrome, back pain, and other chronic conditions (Woodyard, 2011). Since there is not enough research conducted among yoga teachers on this subject, we wanted to examine the yoga teachers' opinions of yoga, the health benefits of yoga, as well as their motives for practicing and teaching yoga. In order to better understand their experiences, we have applied a qualitative methodology.

METHOD

Qualitative methodology

Studies using qualitative methodology are usually descriptive in nature since the focus is on the research process itself and on the meaning and understanding of the statements of research participants (Tkalac Verčič, Sinčić Ćorić, and Pološki Vokić, 2010). The main features of qualitative methodology are that it has a logical and open approach with the primary purpose of gaining a deeper insight and understanding of research issues. For this reason, we decided to use a structured interview with open-ended questions.

In this research, we wanted to answer the following questions:

1. What was the motivation of the participants to start practicing yoga?
2. How do participants perceive their role as a yoga teacher?
3. What are the health benefits of practicing yoga according to the experience of the participants?

Participants

The study involved seven women and two men, with an average age of 34.3. All the participants were yoga teachers of different yogic styles: Hatha, Vinyasa, and Ashtanga yoga. They have been practicing yoga for an average of 7.1 years. They held classes in a private context. For some of them, it was an additional professional activity.

Instruments

We administered a structured questionnaire consisting of 17 questions pertaining to teacher experience, and their perceptions of the health benefits of practicing yoga. The participants completed the questionnaire online.

RESULTS

The personal motives of the yoga teacher

When asked why they started practicing yoga, the participants responded with different answers, outlining the following topics: the need to balance physical and psychological functioning, the need for "depth" and meaning in daily life, personal dissatisfaction, pain, the need to do something useful for themselves, et cetera:

"Yoga has had a positive impact on every aspect of my life because, by working on myself, I have improved my physical and mental health. Perhaps one of the most important elements is discipline. Many years of work involved gradually breaking out of bad habits and embracing some healthier ones. Therefore, my attitude towards life, career, and the people around me have changed. Before I started practicing yoga, a high degree of anxiety and social phobia had so much effect on my daily life and career. I gained more control over my emotions, thoughts and body, and therefore over my fate because the emotions usually brought me into various conflicts and deprived me of energy. Everyone has different reasons. I have two reasons. One is the desire to work on oneself, and the other comes from an inner desire for knowledge. With the first, the biggest role was anxiety and social phobia, which kept me in a cocoon that I couldn't express myself the way I wanted and kept me stuck in my daily life and career. Of course, mental work on oneself is inseparable from the physical. It is commonly said that the mind is an abstraction of the body, and the body a reflection of the mind. Therefore, all the energy nodes in the body correspond to the energy nodes in the mind. Yoga includes both physical and mental work. So, with the desire to work on myself mentally, yoga Asanas also improved my physical health." (Yoga teacher, 33 years old)

Experience of the role of a yoga teacher

The following questions were related to how the participants perceived their role as a yoga teacher. It is evident from their answers that this experience brings them many benefits such as continuous learning, growth, and development, sharing experiences with students, and a better understanding of themselves, others, and life: "The role of the teacher has made it easier for me to understand life and myself. Better acceptance of everything that comes and goes, and generally balance (not continuous, not yet :) at all the levels of being." (Yoga teacher, 39 years old)

"Yoga is a lifestyle for me. It is constant work on oneself. I am pleased to be able to share some of this experience with others, to help all those who

want to work for themselves. "
(Yoga teacher, 33 years old)

"This role allows me to work all the time because, when I have sessions, I cannot say that I am not working today and then quit the session. So, that helped me with discipline. It is also a tremendous experience because of all the students' questions, and another perspective that constantly pushes me to learn. "
(Yoga teacher, 33 years old)

"There is a dose of seriousness and responsibility on my part and great happiness when I see all the people who come to my class."
(Yoga teacher, 33 years old)

Some of the participants stated that their role as a yoga teacher helped them to realize that we are all connected, to become wiser, and they were able to fulfil their life mission:

"I understand that we are all one, I see it clearly; I live a simpler and healthier life, etc."
(Yoga teacher, 40 years old)

"I see myself as a conduit. I do not consider that any of the knowledge I convey belongs to me. Also, I do not consider myself wise, but rather that I am a channel that imparts wisdom and experience to students in the class. "
(Yoga teacher, 39 years old)

The impact of yoga on health

The main topic of interest in this research was the perception of the yoga teachers about the health benefits of practicing yoga. Because health relates to all aspects of human functioning, we assessed the impact of yoga on the physical, emotional and spiritual aspects of the practitioners' lives. Regarding the physical body, the participants provided similar answers: healthy spine and bones, good circulation, weight loss, blood pressure regulation, vitality, strength, endurance, re-learning proper breathing, etc.

One of the participants states:

"The benefits to the body are enormous: spine flexibility, mobility, and flexibility of joints, strengthening and relaxing of muscles, stimulating and obtaining high amounts of oxygen in the blood, bringing the muscles to an optimal size in terms of height and weight, the functions of regulating internal organs and glands, rejuvenation of the lymphatic and metabolic systems, strengthening the immune system, regulation of blood pressure, and regulation of other systems while the whole body is strengthened and brought into balance and harmony. It also enhances motivation, resolves insomnia,

neurosis, poor posture and impairs normal lung function which can lead to depression, weakness and boredom, and also balance of the physical body, leading to physical, emotional, mental and spiritual balance. It improves concentration although the thoughts become more positive due to all the negative energies thrown out of the body and the ability to control poor temperament and anger.

Breathing (Pranayama) techniques help to gain mind control. Rapid and shallow breathing leads to anxiety and fear. Breathing exercises repair this condition, the nervous system calms down, emotions calm down as well as the heartbeat. The parasympathetic nervous system activates. Accordingly, the endocrine system is influenced and the levels of adrenaline decrease. "
(Yoga teacher, 33 years old)

When it comes to the emotional state of the practitioners, the participants agree that yoga helps to control understand and accept emotional states. It helps to achieve emotional peace, release from stress and transform negative emotional states. They also state that practicing yoga is aimed at establishing a life balance: "Doing yoga has a positive effect on emotional health. When all energy centres work at full capacity, the capacity of the brain increases, emotions increase, consciousness is raised. Pratyahara techniques calm the mind and expel negative energies and thoughts. When we get rid of the thoughts of the past and the future, then life begins to come into the present moment, and those thoughts related to the past or the future do not unnecessarily restrain and prevent us. The control of mental energies and mismatched emotions are put in order. Aligning emotions gives you control over your eating habits, etc. Mental and physical work on oneself is inseparable, just as mental and physical benefits are inseparable. They are complementary. "
(Yoga teacher, 33 years old)

Practicing yoga can also affect the spiritual development of the practitioners if they are open to that dimension. From the participants' responses, we can see that yoga helps a person to undergo personal transformation and become a better version of themselves. It also paves the way for a broader realization, a universal state of love, and deep peace and stability:

"Yoga is a great way to open up to new insights, to experience authentic spiritual experiences. In states of deep meditation, we can experience pure spirituality. Those who work long enough, who are dedicated and who do not give up on the first obstacles have a result. Sometimes it is very visible, sometimes it comes a little later, but there is always a result. Yoga works, and if we are honest in our practice, we inevitably transform into a better version of ourselves. When they experience something like that, then people continue to practice. "
(Yoga teacher, 39 years old)

"With all the unmentioned benefits, both physical and mental, with the disappearance of mental stress and

emotional imbalance, the real self is perceived and concentration rises to the inner reality. Internal insight and awareness is awoken. The models of spiritual existence are being developed.”

(Yoga teacher, 33 years old)

“Doing yoga helps us discover the divine spark in us, a sense of purpose and connection.”

(Yoga teacher, 27 years old)

DISCUSSION AND CONCLUSIONS

According to our results, yoga teachers generally refer to the positive impact of yoga on the physical and mental aspects of life. Their motives for practicing yoga are different, from the need for a life balance to the search for the meaning of life. These results are consistent with other studies. For example, Park, Quinker, Dobos, and Cramer (2019) noted that the most common reasons for starting the practice of yoga are the need for relaxation and for preventative reasons. A similar study reported that the most common motives are physical benefits such as increased flexibility, a decrease of low back pain, and for mental reasons such as increased concentration, meditation, and a clearer mind after practice (Mocanu, Mohr, Pouyan, Thuillard, and Dan-Glauser, 2018). A study conducted on 56 women between the ages of 50 and 79 showed that 90 minutes of Hatha yoga performed once a week increased their spine mobility and muscle flexibility, regardless of age (Grabara and Szopa, 2015). It appears that the experiences of the role of a yoga teacher are very rarely examined in the research. To our knowledge, there is no research on this topic. Our results show that the role of a yoga teacher is very supportive of teachers and brings many benefits to them, and is perceived by some participants as a life mission.

The main topic of interest in this research is the perception of the yoga teacher about the health benefits of practicing yoga. Because health relates to all aspects of human functioning, we assessed the impact of yoga on the physical, emotional and spiritual aspects of the practitioners' lives. Regarding the physical aspect, the participants gave similar answers: flexibility of the spine and joints, improvement of circulation and blood pressure, regulation of weight and eating habits, regulation of pressure, vitality, strength, endurance, improvement of sleep and proper breathing. Such observations by yoga teachers are consistent with numerous studies. For example, in the study of Hagins, States, Selfe, and Innes, (2013), many of the effects of yoga on the cardiovascular system were confirmed where yoga, as a complementary therapy, has been studied in numerous randomized controlled trials. On average, the total effect of yoga therapy resulted in a decrease in systolic blood pressure by about 10 mmHg, and approximately 8 mmHg decrease in diastolic blood pressure (Hagins, States, Selfe, and Innes, 2013). One of the possible mechanisms of the influence of yoga

on blood pressure is increased parasympathetic activity with the help of yogic breathing techniques, such as alternating breathing through the left and right nostrils (Telles, Sharma, and Balkrishna, 2014). In addition, the American Heart Association published a study that transcendental meditation can reduce the incidence of heart attacks, strokes, and deaths in patients with cardiovascular disease, and suggested that transcendental meditation techniques be considered in clinical practice with patients with lower blood pressure (Brook et al., 2013).

Yoga teachers have also expressed the view that practicing yoga influences body weight, which is consistent with a randomized controlled study conducted among adult men (Rshikesan, Subramanya, and Nidhi, 2016). In a qualitative study conducted by Ross, Brooks, Touchton-Leonard, and Wallen (2016), the respondents concluded that yoga led to physical and psychological changes which supported weight loss, including increased muscle tone, improved metabolism, decreased stress, as well as increased awareness, better mood, and greater self-acceptance and self-esteem. According to the data collected in our study, the participants reported numerous psychological benefits of yoga.

A large number of studies have confirmed the very significant effects of yoga on mental health. For example, a study conducted by Bonura and Tenenbaum (2014) found that yoga practitioners had better anger control, less anxiety, depression, and greater well-being and general self-efficacy during normal activities compared to the exercise group and the control group of participants. Research has also confirmed that yoga helps bring awareness to cognitive processes (such as thoughts, feelings, beliefs) through increasing meta-awareness and developing self-regulatory techniques such as changing negative thoughts (Cahn and Polich, 2006). In many other studies, yoga has been associated with a general increase in feelings of well-being, quality of life and positive emotions, and a decrease in stress, negative emotions, anxiety symptoms and depression (Pilkington, Kirkwood, Rampes, and Richardson, 2005; Woodyard, 2011).

It has also been shown that practicing yoga can be a potential treatment or additional activity for healing psychiatric disorders such as depression, anxiety, post-traumatic disorder and schizophrenia (Balasubramaniam, Telles, and Doraiswamy, 2012; Cabral, Meyer, and Ames, 2011; Kirkwood, Rampes, Tuffrey, Tuff, Richardson, and Pilkington, 2005; Li and Goldsmith, 2012). Several studies have shown that practicing yoga at least once a week is sufficient for psychological effects such as stress reduction (Banerjee et al., 2007; Cowen and Adams, 2005; Michalsen et al., 2005, 2012).

Our results show that practicing yoga brings numerous health benefits at all the levels of human functioning, both for yoga teachers and their students.

Further research should examine, in more detail, how practitioners are transformed and how they can be further supported in the self-exploration and in improving their own quality of life.

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KAKO JOGA UTIČE NA ZDRAVLJE? ISKUSTVA UČITELJA JOGE

Uticaj joga na fizičko, emocionalno i duhovno razvijanje pojedinca utvrđen je u velikom broju međunarodnih istraživanja. Vježbanje joga značajno poboljšava raspoloženje, smanjuje ljutnju, depresiju i umor, povećava otpornost, i smanjuje kognitivne reakcije na stres, kao što su ruminacija, nametljive misli te emotivno uzbuđenje. Istraživanja o jogi su rijetkost u našim zemljama, stoga smo željeli da ispitamo iskustva učitelja joga o jogi, zdravstvenim uticajima joga na zdravlje i njihovim motivima za vježbanje i podučavanje joga. Da bi shvatili njihova iskustva bolje, primjenili smo kvalitativnu metodologiju. Prema rezultatima, učitelji joga odlučili su vježbati jogu iz različitih razloga. Najčešći motivi su bili potreba za balansiranjem fizičkog i mentalnog funkcioniranja, potreba za "dubinom" i značenjem u svakodnevnom životu, osobno nezadovoljstvo, bol i potreba da se uradi nešto korisno za sebe. Iz njihovih odgovora evidentno je da uloga učitelja joga donosi mnoge pogodnosti, poput kontinuiranog učenja, rasta i razvoja, dijeljenja iskustava sa studentima, boljeg razumijevanja sebe, drugih i generalno života. Kada su u pitanju zdravstvene pogodnosti joga, učesnici su dali slične odgovore: poboljšano stanje kičme i zdravlje kostiju, željeni gubitak težine, regulacija pritiska, vitalnost, snaga, izdržljivost, ponovno učenje ispravnog disanja, itd. Prema ovim rezultatima, možemo zaključiti da su zdravstvene pogodnosti prakticiranja joga ogromne i da donose velike benefite učiteljima joga i njihovim studentima.

Cljučne riječi: joga, zdravlje, učitelji joga, dobrobit

THE RELATION BETWEEN DIFFERENT ALPINE SKI PROGRAMMES AND THE LEVEL OF ACQUIRED ALPINE SKI TECHNIQUE

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ABSTRACT

Alpine skiing is an extremely popular recreational activity in which ski beginners are included through the alpine ski school. The primary aim of this research was to determine the relation between the distance travelled on skis during a 10-day alpine ski programme and the overall level of the acquired ski knowledge. 167 ski beginners of a young adult age (59 women and 108 men) participated in the research. The participants acquired ski knowledge under the same conditions and programme in groups of ten students. During the ski school programme, each ski instructor measured the daily distance travelled on skis in meters by a GPS sports watch. At the end of the ski school programme, all participants demonstrated six elements of ski technique and independent judges graded the level of ski knowledge on a 5-item scale. The grading process enabled the participants' ranking. The results showed a positive correlation between the overall distance travelled on skis and the level of acquired knowledge in all the tested elements of the ski technique except for the basic turn. The highest correlation was determined between the short turn and the distance travelled ($r = 0.47$). The correlation between the average grade for all the elements of the ski technique and the overall distance travelled on skis was statistically significant ($r = 0.36$). A higher level of ski knowledge can be obtained in case of learning skiing dominantly by continuously connecting the ski technique elements. Thereby, the participants will produce higher number of ski turns, which will ultimately lead to better knowledge of alpine skiing

Keywords: alpine skiing, skiing technique, ski school programme

INTRODUCTION

Alpine skiing is a widely spread winter sport, with over 2000 ski areas in a large number of countries and approximately 400 million annual skiers (Burtscher et al., 2019). The majority of research involving alpine skiing includes ski injuries and their prevention, as well as different potential health benefits of skiing (Hébert-Losier, Holmberg, 2013; Burtscher et al., 2013). Alpine skiing, if well accepted, can become a regular physical

activity, contributing to better cardiometabolic health (Thornton et al., 2016; Lo et al., 2013). Additionally, a study conducted by Lee et al. (2014) suggested that skiing-experienced flow led to satisfaction and pleasure. Skiers who crossed longer distances on skis get more pleasure from skiing, which might ultimately lead to acquisition of better ski knowledge and a positive attitude towards skiing, making it a sporting activity that is regularly pursued. Therefore, travelling longer distances on skis might be a potentially more efficacious way of learning alpine skiing than more "static"

learning during which shorter distances on skis are crossed. Studies on the alpine ski learning process answering mentioned questions are scarce. In order to be successful, an alpine ski programme requires adequate ski equipment and terrain which is chosen according to the needs of ski beginners, their motivation and abilities. Moreover, it requires an educated and motivated ski instructor and a validated teaching programme. One of the preconditions to be successful in developing and mastering skiing skills is also a basic level of certain motor abilities.

Ski beginners need to find the proper balance on skis, and those who have better balance will learn skiing more quickly (Staniszewski et al., 2016). Balance is the ability differentiating the faster-learning ski beginners (Loland, 2009). Besides, coordination is the ability that helps in achieving balance on skis as well as on a snow surface, and speeds up the process of learning ski movements (Wojtyczek et al., 2014).

Worldwide, there are numerous programmes adopted for alpine ski beginners, and although different, they all share the same primary goal – inclusion of ski beginners in the alpine ski school. Only then is the aim of each alpine ski school programme to teach ski beginners the specifics of ski movements, enabling them to be independent in mastering different ski terrains (LeMaster, 2010). Skiing knowledge is gradually being adopted at ski schools in a successive way, so that more complex elements of ski technique are added to the basic ones, in order to master different ski turns (Cigrovski and Matković, 2015).

Ski literature usually mentions two mostly used programmes of teaching alpine skiing. One programme relies exclusively on the elements of parallel ski technique. Such an approach forces teaching the parallel turns from the beginning and it is known as a direct way of learning (Murovec, 2006). It is more dynamic and ski beginners spend more time skiing downhill and making continuous turns for mastering the skiing technique. Traditional teaching of alpine skiing combines the elements of snowplough and parallel ski technique (Lešnik and Žvan, 2010). Snowplough is the first element which ski beginners need to master in the traditional method of teaching. Because of its biomechanical characteristics, it requires slower skiing and does not acquire a lot of kilometres of downhill skiing. All the following ski elements learned in a traditional way also require more attention to individual demonstrations of a particular task and correcting mistakes.

Which of the mentioned programmes will be used primarily depends on the ski instructor and is based on the environmental conditions.

In addition to choosing the optimal programme, a ski instructor will also need to determine the tempo of learning, considering the motivation and abilities of ski beginners. Setting the right pace and tempo is extremely important, while it directly affects prevention of potential injuries which could result from inadequate speed. The adaptation of ski beginners to skies and specific ski equipment is an unavoidable phase during the process of learning alpine skiing basics. The years-long experience and some scientific support also suggest the importance of travelling on skis, which brings more pleasure and positive attitude toward skiing, and might help beginners to learn the ski technique (Burtscher et al., 2019). It can be expected for a group of ski beginners, who are going to travel more distance during the 10 days spent in an alpine ski school, to have a higher level of alpine skiing knowledge.

The aim of the research is to determine whether there is a positive correlation between the distance travelled on skis while taking part in an alpine skiing school and the final level of alpine skiing knowledge

METHODS

Participants – 167 students (59 female; 108 male) of the Faculty of Kinesiology, University of Zagreb, entered the study. All participants were ski beginners and they attended a 10-day alpine skiing programme. They reported being free of any health problems and injury. All subjects were provided with a detailed explanation of the study procedures and gave written informed consent prior to data collection.

Variables – The acquired alpine skiing knowledge of all study participants was measured on six representative elements of the ski technique: traversing (both sides), uphill turn (both sides), basic turn, snowplough, parallel turn and short turn. Skiing knowledge was rated by independent experts. Each participant had 8 grades in total for each element of the ski technique and one overall grade (the mean of each grade for the elements). While attending an alpine skiing class, they were divided into smaller groups. Each group had their own ski instructor who measured the cumulative distance travelled (in meters) during the 10 days of skiing class. The distance was measured using a GPS sports watch Suunto Ambit 3 Peak.

Study protocol – All participants were taught alpine skiing for 10 days while participating in the alpine ski school. While in school, they had identical conditions concerning the number of participants per group (10), the number of learning hours per day (4), the number of hours for daily practice (2), the quality and adequacy of skiing equipment, the quality of ski instructors, and the adequacy of ski terrains. Upon finishing the structured programme of the alpine ski school, each participant demonstrated the acquired knowledge of alpine skiing on

six elements, graded by independent experts. According to the grades obtained, each participant's knowledge of alpine skiing was ranked. The grading process followed the five-point scale, where one represented the worst, and five the best knowledge of skiing. Data acquisition followed the standardised procedure of rating ski knowledge (Cigrovski et al., 2008). Statistical methods – Statistical package "Statistica" version 13.5 was used for data analysis.

The distributions were tested by means of a Shapiro-Wilk test. Basic descriptive parameters were calculated for eight tests used to value the acquired alpine ski knowledge. The Spearman's rank-order correlation coefficients (ρ) were used to determine the level of correlation between alpine skiing knowledge and cumulative distance travelled on skis during class. The results were significant with $p < 0.05$.

Table 1: Basic descriptive parameters gathered after a 10-day alpine skiing class

Variable	N	Mean	Min	Max	SD
Total Distance	167	68388.26	43040.00	97170.00	17165.48
Traversing Right	167	4.09	2.00	5.00	0.75
Traversing Left	167	4.02	2.00	5.00	0.78
Uphill Right	167	3.90	2.00	5.00	0.75
Uphill Left	167	3.83	2.00	5.00	0.76
Snowplough	167	3.88	2.00	5.00	0.83
Basic Turn	167	3.68	2.00	5.00	0.87
Parallel Turn	167	3.62	2.00	5.00	0.81
Short Turn	167	3.28	2.00	5.00	1.03
Total grade	167	3.79	2.00	5.00	0.62

The basic descriptive parameters of each measured variable obtained in the research are given in Table 1. Correlations between the cumulative distance travelled and each individual element are given in Table 2. Positive correlation is determined between the cumulative distance travelled and the total grade of

alpine skiing knowledge (0.36). In all the observed alpine skiing elements, a positive significant correlation was determined, excluding the basic turn. The highest correlation with cumulative distance travelled was obtained in mean grades of the short turn (0.47).

Table 2: Spearman's rank-order correlations for the observed variables

Variable	Tot. Dist.	Trav_R	Trav_L	Uphill_R	Uphill_L	Snowpl.	Bas_Turn	Par_Turn	Sh_Turn	Tot_grade
Tot. Dist.	1.00	0.26*	0.18*	0.29*	0.32*	0.29*	0.15	0.25*	0.47*	0.36*
Trav_R		1.00	0.63	0.52	0.46	0.48	0.49	0.50	0.47	0.73
Trav_L			1.00	0.52	0.43	0.35	0.40	0.41	0.39	0.66
Uphill_R				1.00	0.68	0.43	0.53	0.50	0.51	0.75
Uphill_L					1.00	0.45	0.47	0.46	0.54	0.74
Snowpl.						1.00	0.51	0.51	0.47	0.69
Bas_Turn							1.00	0.67	0.62	0.78
Par_Turn								1.00	0.67	0.79
Sh_Turn									1.00	0.81
Tot_grade										1.00

DISCUSSION AND CONCLUSION

The main results of this investigation ($r = 0.36$) support the hypothesis. The results showed a positive correlation between the overall distance travelled while skiing in the ski school and the level of the acquired ski knowledge. It was expected for ski beginners to acquire a higher level of knowledge in less dynamic ski elements, such as snowplough and uphill turn, if the programme was based on the standard "static" method. The mentioned method relies on the individual's repetition and training that include chosen methodical exercises for the element of the ski technique.

On the other hand, the authors assumed there would be higher correlation between the distance travelled and more dynamic ski elements such as short turn and parallel turn. That kind of programme relies on a continuous connection of several turns. The analysis of the graded ski technique elements and the overall distance travelled on skis during the alpine ski school showed positive correlations, and the highest correlation was observed for the short turn element ($r = 0.47$). The particular element of the ski technique is extremely dynamic and performed in the narrow corridor, which eludes the need for fast changes while skiing downhill (Lešnik and Žvan, 2010).

For the ski beginner to master the short turn, many correctly performed repetitions are required and it seems that learning while continuously connecting a large number of parallel turns is the best way. A skier needs to make the specific body movements during the distinct phase of a turn in order to correctly perform the short turn (Loland, 2009). Namely, skis are constructed in the way that, when positioned on the sidecuts and pressured adequately, they bend and make a turn. This is only possible if a skier, in the precise moment when then need occurs, makes the particular movements and leads the skis on their sidecuts (Staniszewski et al., 2016). Unlike all the other turns in the alpine ski school programme, short turn is the only element of ski technique that leaves out the last phase of a turn, needed for speed control. The best way to master the mentioned short turn is by multiple

repetitions of downhill skiing. Although the snowplough is a less dynamic element, it was shown to have positive correlation with the cumulative distance travelled ($r = 0.29$). Moreover, although an uphill turn consists of a single turn, it also showed significant positive correlation with the cumulative distance travelled ($r = 0.29$; $r = 0.32$). All the above points to a greater success of a programme involving longer distance travelled and more turns performed while learning because the mentioned programme resulted in better grades obtained for the elements of the ski technique.

Analysing the alpine ski school programmes, one can conclude that, historically, they aimed to teach alpine ski beginners to ski in the same technical way as their instructors. Today, alpine ski schools look beyond the ski technique. The level of ski knowledge is still determined through the ski technique, but positive effects of ski school programmes are not evaluated only by the level of the acquired ski knowledge. Learning a new motor activity like skiing ideally offers health benefits and pleasure to the ones partaking in it.

According to the review published in 2019 by Burtscher et al., alpine skiing provides favourable health effects as well as emotional and social benefits. They are later related to skiing-generated flow (Lee et al., 2014). Therefore, it seemed interesting to correlate the distance crossed on skis during beginning phases of alpine skiing in ski school to the success of learning alpine skiing. The long-term benefits from our observation might be important for the modern lifestyle where people need constant stimuli to stay interested in an activity and develop the positive attitude towards it (Fromel et al., 2017). Only then can one expect health effects (Muller et al., 2011; Thornton et al., 2016).

The limitation of this study is the selected sample of participants, consisting of young physical education students. It would be interesting to repeat the investigation with a population of different age and abilities, and if the results are confirmed, implement the method in the regular ski school programme.

Namely, it is well known that ski beginners who are more physically fit are better in acquiring ski knowledge since they cope better with physical stress and exercise (Aerenhouts et al., 2015). In the same way, they will probably better adopt a ski programme based on a continuous connection of numerous turns compared to a static programme of learning.

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ODNOS IZMEĐU RAZLIČITIH PROGRAMA UČENJA ALPSKOGA SKIJANJA I RAZINE USVOJENOSTI SKIJAŠKE TEHNIKE

Alpsko skijanje je izrazito popularna rekreativna tjelesna aktivnost u koju se skijaški početnici uključuju putem škole alpskoga skijanja. Glavni cilj ovog istraživanja bio je utvrditi povezanost između udaljenosti koju skijaški početnici tijekom učenja u desetodnevnoj školi prođu na skijama i konačne razine stečenog skijaškog znanja. U istraživanju je sudjelovalo 167 skijaških početnika studentske dobi (59 žena i 108 muškaraca). Ispitanici su usvajali skijaška znanja po istim uvjetima i istom programu u školi alpskoga skijanja u grupama do deset polaznika. Za vrijeme svih dana škole alpskoga skijanja, svaki učitelj je pomoću GPS sportskog sata mjerio put u metrima koji je s grupom ispitanika prošao na skijama. Po završetku škole alpskoga skijanja, svi ispitanici su demonstrirali šest naučenih elemenata skijaške tehnike, a nezavisni ispitivači procjenjivali su razinu skijaškog znanja na skali od 5 stupnjeva. Proces ocjenjivanja stečenog skijaškog znanja omogućio je rangiranje ispitanika. Rezultati su pokazali pozitivnu povezanost između ukupnog prijednog puta na skijama kod ispitanika i razine usvojenog skijaškog znanja kod svih ispitanih elemenata tehnike, osim osnovnog zavoja. Najveća značajna povezanost između demonstriranog skijaškog znanja i ukupnog puta utvrđena je kod elementa vijuganje ($r = 0,47$). Povezanost između prosječne ocjene svih ispitanih elemenata skijaške tehnike i ukupnog puta ispitanika prijednog u školi skijanja također je statistički značajna ($r = 0,36$). Višu razinu skijaškog znanja moguće je postići ako se tijekom učenja dominantno usvajaju elementi tehnike kontinuiranim povezivanjem. Na taj način tijekom učenja alpskoga skijanja ukupno će se savladati veći broj zavoja, što će se u konačnici pozitivno odraziti na količinu naučenog skijaškog znanja.

Ključne riječi: alpsko skijanje, skijaška tehnika, program škole skijanja

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DIFFERENCES IN HIGH-SCHOOL STUDENTS' ATTITUDES TOWARDS A HEALTHY LIFESTYLE

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ABSTRACT

This research aimed at determining the differences in attitudes towards a healthy lifestyle between high-school students attending different classes. The population taken for the sample of 242 respondents was defined as the population of students attending the first, second, third and fourth grade of high schools from Tuzla who are aged between 15 and 18 years $\pm$ 6 months. A survey questionnaire consisting of 25 items specifically valued on a 5-point scale was used for assessing the attitudes towards a healthy lifestyle. With the goal of determining the differences in attitudes towards a healthy lifestyle between students attending different classes, we applied the Kruskal-Wallis test. The obtained results have shown that there are statistically significant differences between the treated groups in 13 items (6 items determining the cognitive, 3 items determining the affective and 4 items determining the behavioural attitude component). The largest number of statistically significant differences in the treated items is seen between the second and third (9), first and second (7) and third and fourth grade (7). The largest differentiation between the groups appeared in two items, namely: "I lead a healthy lifestyle because health is the most important thing in life" and "I think that regular physical exercise would make me healthier and happier".

Keywords: health, high-school students, differentiation, survey

INTRODUCTION

Adolescence or juvenility represents a period of human life which begins with puberty and ends with reaching physical and psychological maturity. It is a period of emotional and social adaptation, development of attitudes, stable interests and a personal worldview. This is where childhood attitudes and behaviours are replaced with the attitudes and behaviours of an adult. Frydenberg and Lewis (1993, according to Anić and Brdar, 2007) emphasise that adolescence can be stressful for young people since they face many important life decisions and changes such as establishing a social role in the society, finishing education and

making decisions related to their future career. Young people see a challenge and attraction in many other things. Smoking and alcohol are increasingly popular among the youth. Most young people start consuming tobacco products in order to be accepted in their social circles. Poor diet, lack of sleep and excessive stress are the factors which, alongside physical inactivity, impact the health of an individual (Gloc, 2017). It is important to point this out and raise awareness on a healthy lifestyle (Kraml, Rendulić Slivar, Vidović, Rendulić, 2017). A healthy lifestyle is expressed through positive health behaviour which is exercised in order to be healthy and prevent diseases. A healthy lifestyle behaviour is an important feature of health promotion which can prevent various diseases. Individuals who have accepted a healthy lifestyle behaviour can resist health

risks related to disability and disease occurring later in life. The World Health Organisation has emphasised that 60% of an individual's quality of life depends on his or her behaviour and lifestyle. That is why developing and promoting a healthy lifestyle behaviour among high-school students is the basis for preventing disease and maintaining a healthy lifestyle. (Lowry et al., 2002; Sawyer et al., 2012).

The primary goal of this research is determining the differences in attitudes towards a healthy lifestyle between students attending the first, second, third and fourth grade of high school.

RESEARCH METHODOLOGY

The sample of respondents

The research was conducted in 3 high schools from Tuzla (High School for Nursing, "Meša Selimović" Grammar School and "Ismet Mujezinović" Grammar School). The population taken for the sample of 242 respondents was defined as the population of students attending the first, second, third and fourth grade of high schools who are aged between 15 and 18 years $\pm$ 6 months.

The sample variables

In order to measure the attitude towards a healthy lifestyle, we consulted the scale used in the research "Everyone dies, so you might as well have fun" Attitudes of Dutch youths about their health lifestyle (van Exel, de Graf and Brouwer, 2006, according to Markuš, 2011). The notion of a healthy lifestyle is defined within the following framework: nutrition, physical activity and exercise, sleep and rest, smoking, alcohol consumption, tension and stress, daily and chronic fatigue, care for personal health and obesity.

The questions used in the questionnaire, i.e., attitude manifestations, were defined as parts of a three-component model of attitudes: cognitive, affective and behavioural component (Hewstone and Stroebe, 2003). The scale consists of 25 items. Questions determining the cognitive component of the attitude are: SZDR03 – I cannot understand those who find something useful in physical exercise; SZDR04 – I do not think about my future health too much; SZDR07 – moving and engaging in physical activity is not important in my life; SZDR08 – for me, everyone who smokes is reckless; SZDR10 – it is important to care for your health; SZDR13 – I do not care much about what is healthy and what is not; SZDR14 – I think one should go to the doctor in time; SZDR15 – daily physical activity is the basis of good health; SZDR16 – I think that a regular sleep schedule is good for my health; SZDR17 – smoking makes people less healthy; SZDR20 – it is risky to drink alcoholic beverages; SZDR21 –

exercise is meant for relaxing and recovering from daily concerns, it is not something that should be easily discarded; SZDR22 – the one who is most responsible for my health is myself; SZDR23 – smoking in public should be forbidden; SZDR25 – those who lead an unhealthy lifestyle will not look good.

Questions determining the affective component of the attitude are: SZDR01 – I hate any form of physical exercise; SZDR12 – I get angry at myself if I do not exercise; SZDR19 – I worry that a lack of movement will harm my health; SZDR24 – I think that regular physical exercise would make me healthier and happier.

Questions determining the behavioural component of the attitude are: SZDR02 – even if someone paid me, I would not engage in physical exercise; SZDR05 – I engage in physical exercise when I have nothing better to do; SZDR06 – I really do not care when I go to bed and how much I exercise; SZDR09 – a sleepless night is not a problem for me; SZDR11 – when I am tense, physical exercise alleviates my concerns; SZDR18 – I lead a healthy lifestyle since health is the most important thing in life.

On a five-point Likert scale, the respondents have a task to determine their level of agreement with a particular claim from the questionnaire. The five-point assessment scale is defined as follows: 1 - completely inaccurate, 2 - mostly inaccurate, 3 I am not sure, 4 - mostly accurate and 5 - completely accurate.

Data processing methods

With the goal of determining the differences in items for assessing attitudes towards a healthy lifestyle between high-school students attending different classes, we applied the Kruskal-Wallis test. In order to determine which of the treated groups statistically differ from one another, we subsequently applied Bonferroni adjusted alpha values in order to avoid type I errors.

RESULTS AND DISCUSSION

With the goal of determining the differences in the treated variables of attitudes towards a healthy lifestyle between the surveyed students attending different classes, we applied the Kruskal-Wallis test. Students were divided into 4 groups according to their class (first, second, third and fourth).

Based upon the results obtained in this test (Table 1a, b, c), we determined a statistically significant difference ($p \leq .05$) between the treated groups

in the following items: SZDR01 (.04), SZDR03 (.03), SZDR04 (.00), SZDR05 (.02), SZDR06 (.02), SZDR07 (.00), SZDR08 (.01), SZDR09 (.00), SZDR13 (.00), SZDR18 (.00), SZDR19 (.00), SZDR20 (.00) and SZDR24 (.00).

In order to determine which of the treated groups statistically differ from one another, we subsequently applied Bonferroni adjusted alpha values in order to avoid type I errors. This would mean dividing the alpha value of .05 by the number of tests we plan to conduct, and then using such a revised alpha level as a criterion for determining the significance. This would signify a more severe alpha level of .01.

The obtained multiple comparisons results related to the examined groups of students (differences between groups) tell us that statistically significant differences exist in:

SZDR01 - between the first (Mean Rank = 135.46; Med. = 1) and second grade (Mean Rank = 109.99; Med. = 1); between the first (Mean Rank = 135.46; Med. = 1) and fourth grade (Mean Rank = 112.98; Med. = 1).

SZDR03 - between the first (Mean Rank = 134.97; Med. = 1) and second grade (Mean Rank = 105.79; Med. = 1).

SZDR04 - between the second (Mean Rank = 109.44; Med. = 1) and third grade (Mean Rank = 142.13; Med. = 2); between the third (Mean Rank = 142.13; Med. = 2) and fourth grade (Mean Rank = 105.48; Med. = 1).

SZDR05 - between the second (Mean Rank = 108.44; Med. = 1) and third grade (Mean Rank = 139.01; Med. = 2).

SZDR06 - between the second (Mean Rank = 109.20; Med. = 1) and third grade (Mean Rank = 142.28; Med. = 2.5).

SZDR07 - between the second (Mean Rank = 112.11; Med. = 1) and third grade (Mean Rank = 143.44; Med. = 2); between the third (Mean Rank = 143.44; Med. = 2) and fourth grade (Mean Rank = 106.38; Med. = 1).

SZDR08 - between the first (Mean Rank = 109.20; Med. = 4) and fourth grade (Mean Rank = 93.84; Med. = 2).

SZDR09 - between the first (Mean Rank = 127.57; Med. = 2) and second grade (Mean Rank = 87.88; Med. = 1); between the second (Mean Rank = 87.88; Med. = 1) and third grade (Mean Rank = 156.03; Med. = 3); between the third (Mean Rank = 156.03; Med. = 3) and fourth grade (Mean Rank = 117.41; Med. = 2).

SZDR13 - between the first (Mean Rank = 126.31; Med. = 2) and second grade (Mean Rank = 90.42; Med. = 1); between the second (Mean Rank = 90.42; Med. = 1) and third grade (Mean Rank = 124.99; Med. = 2); between the second (Mean Rank = 90.42; Med. = 1) and fourth grade (Mean Rank = 160.70; Med. = 3); between the third (Mean Rank = 124.99; Med. = 2)

and fourth grade (Mean Rank = 160.70; Med. = 3).

SZDR18 - between the first (Mean Rank = 167.88; Med. = 5) and second grade (Mean Rank = 78.49; Med. = 1); between the first (Mean Rank = 167.88; Med. = 5) and third grade (Mean Rank = 109.65; Med. = 2.5); between the second (Mean Rank = 78.49; Med. = 1) and third grade (Mean Rank = 109.65; Med. = 2.5); between the second (Mean Rank = 78.49; Med. = 1) and fourth grade (Mean Rank = 153.75; Med. = 4); between the third (Mean Rank = 109.65; Med. = 2.5) and fourth grade (Mean Rank = 153.75; Med. = 4).

SZDR19 - between the first (Mean Rank = 134.30; Med. = 5) and third grade (Mean Rank = 74.40; Med. = 3); between the second (Mean Rank = 136.15; Med. = 2) and third grade (Mean Rank = 74.40; Med. = 3); between the third (Mean Rank = 74.40; Med. = 3) and fourth grade (Mean Rank = 152.53; Med. = 5).

SZDR20 - between the first (Mean Rank = 70.85; Med. = 1) and second grade (Mean Rank = 152.91; Med. = 5); between the first (Mean Rank = 70.85; Med. = 1); and third grade (Mean Rank = 120.80; Med. = 4); between the first (Mean Rank = 70.85; Med. = 1) and fourth grade (Mean Rank = 131.47; Med. = 5).

SZDR24 - between the first (Mean Rank = 134.21; Med. = 5) and second grade (Mean Rank = 161.84; Med. = 5); between the first (Mean Rank = 134.21; Med. = 5) and third grade (Mean Rank = 63.07; Med. = 2); between the second (Mean Rank = 161.84; Med. = 5) and third grade (Mean Rank = 63.07; Med. = 2); between the second (Mean Rank = 161.84; Med. = 5) and fourth grade (Mean Rank = 128.05; Med. = 5); between the third (Mean Rank = 63.07; Med. = 2) and fourth grade (Mean Rank = 128.05; Med. = 5).

The results obtained in this research indicate that the largest differences between the treated groups are present in items determining the cognitive attitude component regarding the subjects' opinions on something (e.g., usefulness) in relation to physical activity and exercise, sleep and rest, smoking, alcohol consumption as well as tension and stress. The differences between the treated groups exist, to a lesser degree, in items determining the behavioural and affective attitude components.

The most important behaviours related to high-school students' health are physical activity, sedentary behaviour, healthy diet and absence of alcohol and tobacco consumption (Brownson, Remington and Wegner, 2010; Liu, Wu and Yao, 2016; Rayner, Wickramasinghe, Williams, McColl and Mendis, 2017). Addiction is considered as an unhealthy lifestyle.

Smoking and the use of other substances can result in various problems, cardiovascular disease, asthma, cancer and brain injuries (Ebadi et al., 2011). Previous research have shown that a healthy lifestyle is connected to the perception of health and the quality of life (Marques, Peralta, Santos, Martins and Gaspar de Matos, 2019; Marques, Bordao, Tesler, Demetriou, Sturm and Gaspar de Matos, 2020). The importance

and duration of sleep, especially for young people, is an important health habit (WHO, 2004). Sleep is one of the fundamentals of a healthy lifestyle. Sleeping cannot be separate from life. Sleeping disorders have several social, psychological, economic and health consequences.

Lifestyle can affect sleep, and sleeping clearly influences mental and physical health (Farhud and Tahavorgar, 2013). High technology makes life easier for people. Misuse of technology can result in unpleasant consequences. For example, using computers and other devices up until midnight can affect the sleeping pattern and disrupt sleep. Mobile phone dependency is connected to sleep disorders and depression symptoms (Thomee, Harenstam and Hagberg, 2011).

Physical activity is important for health because it improves the cardiorespiratory fitness, bone mineral density, blood pressure, and lipids in cholesterol. It also prevents depression, metabolic syndrome and obesity, while being associated with improved immune responses and a lower rate of immune system aging (Janssen and Leblanc, 2010; Marques, Minderico, Martins, Palmeira, Ekelund and Sardinha, 2016; Sardinha, Marques, Minderico and Ekelund, 2016). That is why it is highly important for high-school students to engage in regular physical activity in order to improve their health and use their free time comfortably and actively (WHO, 2010). Research has shown that the time

spent without movement has a detrimental effect on health (Chinapaw, Proper, Brug, van Mechelen and Singh, 2011). Few studies have tried to combine several health habits and create a measure that expresses a healthy lifestyle (Kelly, Melnyk, Jacobson and O'Haver, 2011).

Therefore, young people should be constantly encouraged to avoid unhealthy behaviours and adopt healthy ones, since interventions in this age group can affect healthy behaviour in later stages of life (Landsberg, Plachta-Danielzik, Lange, Johannsen, Seiberl and Muller, 2010; Rendo-Urteaga, de Moraes, Collese, Manios, Hagstromer, Sjostrom, 2015). The cumulative result of a healthy lifestyle was achieved through certain forms of youth behaviour, as used in previous research (Marques, Loureiro, Avelar-Rosa, Naia and Matos, 2018; Marques, Loureiro, Avelar-Rosa, Naia and Matos, 2019).

The results of this research emphasise the need to promote a healthy lifestyle and raise awareness within the key stages on the potential risk of unhealthy behaviour for youth health. Given that health behaviour sets in during this developmental period and tends to decrease with age (Marques et al., 2018), understanding the mechanisms of behavioural change towards a healthy lifestyle is of crucial importance during this life stage.

Table 1a: Differences in attitudes towards a healthy lifestyle between the surveyed students of different grades

Test Statistics - Kruskal Wallis Test								Bonferroni	
Grouping Variable	Chi-Square	df	Asymp. Sig.	Mean Rank	Med.	Min.	Max.	Group (N)	Differences between groups
SZDR01	7.98	3	.04*	135.46	1	1	5	1 (54)	1 ♦
				109.99	1	1	5	2 (74)	2
				128.7	1	1	5	3 (68)	3
				112.98	1	1	5	4 (46)	4 ♦
SZDR02	2.32	3	.51	127.11	1	1	5	1 (54)	
				115.26	1	1	5	2 (74)	
				127.05	1	1	5	3 (68)	
				116.75	1	1	5	4 (46)	
SZDR03	9.27	3	.03*	134.97	1	1	5	1 (54)	1
				105.79	1	1	5	2 (74)	2 ♦
				130.1	1	1	5	3 (68)	3
				118.25	1	1	5	4 (46)	4
				125.7	1	1	5	1 (54)	1
				109.44	1	1	5	2 (74)	2

SZDR04	14.4	3	.00*	142.13	2	1	5	3 (68)	3 [†]
				105.48	1	1	5	4 (46)	4 [‡]
SZDR05	10.38	3	.02*	110.13	1	1	5	1 (54)	1
				108.44	1	1	5	2 (74)	2
				139.01	2	1	5	3 (68)	3 [†]
				129.98	2	1	5	4 (46)	4
SZDR06	10.07	3	.02*	113.81	1	1	5	1 (54)	1
				109.2	1	1	5	2 (74)	2
				142.28	2.5	1	5	3 (68)	3 [†]
				119.6	2	1	5	4 (46)	4
SZDR07	12.95	3	.00*	119.62	1	1	5	1 (54)	1
				112.11	1	1	5	2 (74)	2
				143.44	2	1	5	3 (68)	3 [†]
				106.38	1	1	5	4 (46)	4 [‡]
SZDR08	12.27	3	.01*	140.22	4	1	5	1 (54)	1
				119.26	3	1	5	2 (74)	2
				127.78	3	1	5	3 (68)	3
				93.84	2	1	5	4 (46)	4 [◆]
SZDR09	36.5	3	.00*	127.57	2	1	5	1 (54)	1
				87.88	1	1	5	2 (74)	2 [◆]
				156.03	3	1	5	3 (68)	3 [†]
				117.41	2	1	5	4 (46)	4 [‡]

Table 1b: Differences in attitudes towards a healthy lifestyle between the surveyed students of different grades

Test Statistics - Kruskal Wallis Test									Bonferroni
Grouping Variable	Chi-Square	df	Asymp. Sig.	Mean Rank	Med.	Min.	Max.	Group (N)	Differences between groups
SZDR10	3.72	3	.29	116.73	5	1	5	1 (54)	
				132.51	5	1	5	2 (74)	
				114.79	5	1	5	3 (68)	
				119.32	5	1	5	4 (46)	
SZDR11	3.49	3	.32	106.61	4	1	5	1 (54)	
				127.07	4	1	5	2 (74)	
				123.58	4	1	5	3 (68)	
				126.95	4	1	5	4 (46)	
SZDR12	2.54	3	.47	130.1	4	1	5	1 (54)	
				116.09	3	1	5	2 (74)	
				115.13	3	1	5	3 (68)	

SZDR13	33.65	3	.00*	129.52	4	1	5	4 (46)	
				126.31	2	1	5	1 (54)	1
				90.42	1	1	5	2 (74)	2♦
				124.99	2	1	5	3 (68)	3†
				160.7	3	1	5	4 (46)	4†#
SZDR14	5.09	3	.17	124.65	4.5	1	5	1 (54)	
				133.99	4.5	1	5	2 (74)	
				111.54	4	1	5	3 (68)	
				112.42	4	1	5	4 (46)	
SZDR15	2.71	3	.44	126.63	5	1	5	1 (54)	
				127.77	5	1	5	2 (74)	
				111.85	4	1	5	3 (68)	
				119.66	4.5	1	5	4 (46)	
SZDR16	1.79	3	.62	121.34	5	1	5	1 (54)	
				126.55	5	1	5	2 (74)	
				113.35	4	1	5	3 (68)	
				125.61	5	1	5	4 (46)	
SZDR17	2.66	3	.45	118.97	5	1	5	1 (54)	
				127.72	5	1	5	2 (74)	
				112.56	4	1	5	3 (68)	
				127.67	5	1	5	4 (46)	
SZDR18	66.88	3	.00*	167.88	5	1	5	1 (54)	1
				78.49	1	1	5	2 (74)	2♦
				109.65	2.5	1	5	3 (68)	3♦†
				153.75	4	1	5	4 (46)	4†#

Table 1c: Differences in attitudes towards a healthy lifestyle between the surveyed students of different grades

Test Statistics - Kruskal Wallis Test									Bonferroni
Grouping Variable	Chi-Square	df	Asymp. Sig.	Mean Rank	Med.	Min.	Max.	Group (N)	Differences between groups
SZDR19	50.7	3	.00*	134.3	5	1	5	1 (54)	1
				136.15	5	1	5	2 (74)	2
				74.4	3	1	5	3 (68)	3♦†
				152.53	5	1	5	4 (46)	4#
SZDR20	50.98	3	.00*	70.85	1	1	5	1 (54)	1
				152.91	5	1	5	2 (74)	2♦
				120.8	4	1	5	3 (68)	3♦
				131.47	5	1	5	4 (46)	4♦

SZDR21	2.83	3	.42	118.77	5	1	5	1 (54)	
				131.64	5	1	5	2 (74)	
				115.87	4.5	1	5	3 (68)	
				116.72	5	1	5	4 (46)	
SZDR22	4.01	3	.26	114.83	5	1	5	1 (54)	
				132.99	5	1	5	2 (74)	
				114.65	5	1	5	3 (68)	
				120.98	5	1	5	4 (46)	
SZDR23	1.15	3	.76	125.32	5	1	5	1 (54)	
				118.11	5	1	5	2 (74)	
				117.56	4	1	5	3 (68)	
				128.28	5	1	5	4 (46)	
SZDR24	91.12	3	.00*	134.21	5	1	5	1 (54)	1
				161.84	5	1	5	2 (74)	2♦
				63.07	2	1	5	3 (68)	3♦†
				128.05	5	1	5	4 (46)	4†‡
SZDR25	2.45	3	.48	114.92	4	1	5	1 (54)	
				130.54	4.5	1	5	2 (74)	
				115.7	4	1	5	3 (68)	
				123.26	4	1	5	4 (46)	

♦ STATISTICALLY SIGNIFICANT DIFFERENCES IN RELATION TO 1ST CLASS VALUES; $P \leq .05$

† STATISTICALLY SIGNIFICANT DIFFERENCES IN RELATION TO CLASS 2 VALUES; $P \leq .05$

‡ STATISTICALLY SIGNIFICANT DIFFERENCES IN RELATION TO 3RD CLASS VALUES; $P \leq .05$

CONCLUSION

A healthy lifestyle is increasingly popular. Living healthy means maintaining healthy lifestyle habits which will improve the quality of life and an individual's general health. It is hard for a person to break old habits but there are steps which can be taken in order to be healthier. For the majority of people, a healthy lifestyle implies that physical and mental health are balanced or that they function well within an individual. In many cases, physical and mental health are closely related so that any change, be it good or bad, occurring in one, directly affects the other. Physical fitness is not the only foundation of an individual's good health. The results we obtained show that there are statistically significant differences between the treated groups of respondents in 13 items, namely: 6 items determining the cognitive, 4 items determining the behavioural and 3 items determining the affective attitude component. The largest number of statistically significant differences in the treated items is seen between

the second and third (9), first and second (7) and third and fourth grade (7). The largest differentiation between the groups appeared in two items, namely: "I lead a healthy lifestyle because health is the most important thing in life" and "I think that regular physical exercise would make me healthier and happier". We know that health is the greatest value of every individual and the most important resource in every social community. We cannot choose health, but we can choose a healthy lifestyle. Health and a healthy lifestyle are becoming one of the priorities when it comes to human life goals, and in order to achieve them, it is of great importance to develop an understanding of habits for maintaining and developing health. This implies an active role of each individual in maintaining their own health, and their responsible behaviour first towards themselves and then towards others as well as towards the environment in general. A healthy lifestyle is not something that was given to us at birth but must be learned and patiently developed throughout life. That is why the role of kinesiologists in high schools is multiple, and it aims to prepare students for the active use of free time by promoting regular physical exercise

and a healthy lifestyle. A transformation of a healthy lifestyle behaviour through school programmes is of great importance for maintaining and establishing well-being and overall health among high-school students. It is necessary to encourage them through efficient

health programmes promoting a healthy lifestyle with the goal to acquire knowledge, positive attitudes and health-related behaviours, as well as to prevent them from developing an unhealthy lifestyle or health risk behaviours.

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RAZLIKE U STAVOVIMA UČENIKA SREDNJE ŠKOLE PREMA ZDRAVOM NAČINU ŽIVOTA

Ovo istraživanje imalo je za cilj da utvrdi razlike u stavovima prema zdravom načinu života između učenika različitih razreda srednje škole. Populacija iz koje je uzorak od 242 ispitanika bio uzet definisana je kao populacija učenika I, II, III i IV razreda srednjih škola iz Tuzle, u dobi od 15-18 godina $\pm$ 6 mjeseci. Za procjenu stavova o zdravom načinu života korišten je anketni upitnik, koji se sastojao od 25 čestica posebno vrednovanih na skali od 5 stepeni. U cilju utvrđivanja razlika u stavovima prema zdravom načinu života između učenika različitih razreda primijenjen je Kruskal-Wallisov test. Dobiveni rezultati pokazali su da postoje statistički značajne razlike između tretiranih grupa kod 13 čestica (6 čestica koje određuju kognitivnu, 3 čestice koje određuju afektivnu i 4 čestice koje određuju bihevioralnu komponentu stava. Najveći broj statistički značajnih razlika u tretiranim česticama postoji između drugog i trećeg (9), prvog i drugog (7) te trećeg i četvrtog razreda (7). Najveća diferencijacija između grupa pojavila se kod dvije čestice, i to: "Živim zdravo jer je zdravlje najvažnije u životu" i "Mislim da bi me redovno tjelesno vježbanje učinilo zdravijim i sretnijim".

Ključne riječi: zdravlje, srednjoškolci, diferencijacija, anketa

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