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BOOK OF ABSTRACTS

Sport and Quality of Life  
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*"Sport and Quality of Life"*

Faculty of Sports Studies  
Masaryk University

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## ANALYSIS OF HUMAN MOVEMENT

### SAFE AND EFFECTIVE RETURN TO SPORT AFTER INJURIES

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Unfortunately, injuries regularly accompany sports on all levels and determine the successes and longevity of a sports career and life of active athletes. Epidemiological data and the data on the success rate of rehabilitation or return to sport are extremely difficult to compare, mostly due to non-uniform definitions. However, we can conclude with great certainty that the incidence of sport injuries is increasing and that some sports are more exposed to injuries (football, hockey, gymnastics) than others. Not only the results of athletes and their teams are connected to sport injuries, but also their long-term health, quality of life, socio-economic status and consequently, the general financial burden on the society. Sport injuries are often strongly connected with previous injuries and often repeat because of several simultaneous injuries (de Visser et al., 2012) or due to maximum burden after a previous injury (Creighton et al., 2012). The absence of pain may in no case be the only factor on deciding on the return of an athlete to training or competition, which is often the reality. Therefore, the decisions about the right moment and method of return to sport are very important, but the information on this are difficult to obtain with currently available methods. It is necessary to search for and eliminate the reason for the injury, which is often excessive burden, muscle fatigue, muscular imbalance, insufficient force, weakened part of the body due to preliminary injuries etc. Opar et al. (2012) used the example of injuries of posterior thigh muscle, i.e. that there are several factors for a repeated injury and many arise from the same skeletal muscle (muscle structure and architecture) or with related functionality (running technique, flexibility).

The research project "The Development of Sport Injury Model for Effective Prevention and Rehabilitation" (in football, basketball and gymnastics) to develop a standardised information system for registering readiness of athletes and their sport injuries was designed. As a recommendation from former experiences and studies the research base decision making on the grounds of tensiomyographic method on the point of safe return to sport. Confidential document of FC Barcelona football club medical team explicitly emphasizes the use of tensiomyography for the follow-up of functional recovery of muscle and to help decide the return to play.

Our main aims are related to safe return to sport after injury and construction of a test battery for preventive assessment of athletes. Forward of we will construct an experimental 2-year study of safe return focusing on hamstring injuries and design and validate sport specific battery of test for sport injury prevention. The selection of tests will be formed on the grounds of scientific literature review, later with an international Delphi analysis that will include athletes, coaches, kinesiologists, other experts, scientists and Expert Centre of Slovenian Olympic Committee. Basic outcome of the proposed project - information system will be available to scientists and expert from different fields (epidemiologists, doctors, kinesiologists, dietitians, coaches, etc.) for safe and ethically acceptable access to data with the goals to discovering new knowledge, risk factors, international comparability and transfer of best practices.

## THE EFFECT OF BABYWEARING ON MATERNAL GAIT: A CASE STUDY

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*Purpose:* Babywearing is getting popular among the parents and caregivers as it provides a close physical contact and stimulations for interaction with the baby. Changes in gait kinematics of the female carrier were described previously; however, the number of studies is limited. Therefore, the aim of this study was to compare the longitudinal maternal gait changes during pregnancy, postpartum period and postpartum during the front wrap and back wrap babywearing condition.

*Methods:* One pregnant woman was measured longitudinally. She participated at the data collection at the 16 and 38 weeks of gestation and 8 months after delivery. Additionally, at the last data collection session a front wrap and back wrap babywearing were used. At each data collection, the participant was asked to walk barefoot through a 7 meters long pathway in a space captured by Simi Motion system at her preferred speed wearing retro-reflexive markers. Following variables were analysed: step width, step length; maximal hip extension; maximal hip flexion; knee joint height, maximal knee extension; maximal knee flexion, trunk left-right motion and trunk anterior-posterior motion.

*Results:* For purpose of this study, the 16 gestational week simulated the pre-pregnancy gait pattern. In the last trimester of pregnancy, increased hip flexion and lateral and antero-posterior shifting of the body and decreased knee flexion and stride length were observed, confirming findings of previous studies. Six months postpartum spatio-temporal and most of the kinematic gait characteristics returned to pre-pregnancy values. Changes in the gait pattern induced by the front wrap babywearing were similar like the 38 g.w. of pregnancy condition. However, a decrease in the maximal knee flexion and lateral trunk motion and increase in step length were observed during the front wrap compared to the advanced pregnancy. During the back wrap babywearing condition compared to the advanced pregnancy data collection session an increase in maximal knee flexion, maximal knee high and step length and decrease in maximal antero-posterior trunk motion, step width and maximal hip flexion were observed.

*Conclusion:* Results from this study confirm that most of the changes in the gait during pregnancy return back to the pre-pregnancy levels postpartum. Changes of the maternal gait induced by both, the frontal and back wrap babywearing were described in this study.

*Keywords:* Babywearing, Gait, Kinematics, Pregnancy, Front Wrap, BackWrap

## COMPARISON OF PHYSICAL PREPAREDNESS OF FOOTBALL REFEREES OF DIFFERENT COMPETITION LEVELS

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*Purpose:* The aim of the research is to compare physical preparedness of football referees of different competition levels. General physical preparedness makes an important part of motor performance. Coping with the physical loading in games, and thus being able to get close to individual game situations, can be seen as a precondition to judge the game correctly. The objective is to find out if the physical preparedness of football referees increases with the higher level of competitions.

*Methods:* 42 football referees participated in the study. There were two groups of different competition levels. The first group (n = 17) comprised 3<sup>rd</sup> league and professional competitions, the other group (n = 25) comprised regional competitions of 1.B and 1.A class. The indicators of physical preparedness were maximal aerobic capacity (VO<sub>2</sub>max) and shuttle run test. The participants had to run repeatedly 20 metres distance in the given pace. The score is the number of sections run in the given pace, to exhaustion. The maximal aerobic capacity was measured and processed by means of sport tester of Polar RS800CX and ProTrainersoftware. The two independent groups were compared concerning the cardiorespiratory endurance indicated by the shuttle run test and VO<sub>2</sub>max. Statistical significance of difference was evaluated by independent Mann-Whitney U-test (p < 0,05).

*Results:* A significant difference (p < 0,05) was found out in both selected indicators of physical preparedness, which suggests that the performance of referees differed between the selected groups. With regard to different level of football competitions, the referees from 3<sup>rd</sup> league and professional competitions had both higher maximal aerobic capacity and better performance in the shuttle run test compared to the referees from 1.B and 1.A class. The performance in the shuttle run test was better on average by 1 time segment and the VO<sub>2</sub>max was better on average by 3 ml/kg.min.

*Conclusion:* The research results support the assumption that the football referees of higher competition levels need to have better level of general physical preparedness. Physical factor is one of the components of motor performance. However, to get a complex idea of factors influencing motor performance, further analysis is recommended in terms of psychological, technical and tactical factors.

*Keywords:* general physical preparedness, VO<sub>2</sub>max, shuttle run, football competition, performance.

## THE RELATIONSHIP BETWEEN OBJECTIVELY MEASURED PHYSICAL ACTIVITY AND FUNDAMENTAL MOTOR SKILLS IN 8 TO 11 YEARS OLD CHILDREN

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*Purpose:* The aim of the research was to explore the relationship between an objectively measured physical activity and fundamental motor skills in children 8 to 11 years old from the Czech Republic.

*Methods:* The research sample was consisted of 201 children (108 boys and 93 girls) aged 8-11 from city Olomouc, Czech Republic. The Test of Gross Motor Development 2 was used to assess the level of children's fundamental motor skills. Furthermore, device accelerometer ActiGraph GTX3 was used for objective measuring of physical activity level.

*Results:* Results have shown a low to a medium correlation between moderate to vigorous physical activity and locomotor motor skills and between vigorous physical activity and object control skills among total sample and boys' only sample respectively.

*Conclusions:* Fundamental motor skills are important factors for children's participation in organized and free time physical activities. There is a commitment to develop fundamental motor skills in children especially object control motor skills in girls.

*Keywords:* motor development, accelerometers, primary school children.

## BIOMECHANICAL FIELD STUDY OF SLALOM TURN DURING SECOND RUN SNOW QUEEN TROPHY RACE

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Slalom is a challenging alpine ski discipline from both tactical and technical perspective. Biomechanical factors influence the tactics employed during the race and can affect success. We performed biomechanical field study investigating velocity at different sections of slalom turn, angles of lower extremity during turn performance and their relation to projection of centre of mass during FIS World Cup Race Snow Queen Trophy. Kinematic analysis of slalom turn was performed to compare the correlations between angles in joints of lower extremities, distance of centre of mass during different segments of turn and velocity of skiing during turn in competitor level skiers. The Ariel Performance Analysis System was used to calculate the 3D kinematic data for 30 elite alpine skiers participating in the second run. Results suggest highest variability between competitors in velocities achieved during turn initiation. Moreover, we found correlation between competitors' velocity during turn initiation and angle in the knee joint ( $r=0,56$ ). Additionally, velocity during initial phases of turn correlated with centre of mass with respect to inner ankle joint ( $r=0,63$ ), as well as with outer ankle joint ( $r=0,58$ ). Moreover, angles between upper and lower leg correlated significantly with velocity during all phases of slalom turn, while we found no correlation whatsoever between competitors' upper leg and core and velocity. Significant correlation was also seen between velocity during all three phases of ski turn and centre of mass during middle part of the turn in relation to both inner and outer ankle joint. Our data suggest that competitors with lower velocity at the beginning of the turn opted for a less direct trajectory. But due to configurational differences and different ways gates are positioned through entire race, competitor is not able to use the same tactics through an entire slalom race, so velocity over one turn might not have an overwhelming influence on the velocity of the race in a whole. To conclude, many different biomechanical factors influence the performance during slalom race and competitor must take into account intricate interactions between them under different conditions to minimize the descent time.

*Keywords:* slalom, kinematic, velocity of skiing, line of skiing, skiing technic

## ANALYSIS OF THE ONE-HANDED OVERHEAD THROW IN STUDENTS OF THE 2<sup>ND</sup> GRADE OF FACULTY OF PHYSICAL EDUCATION AND SPORT CHARLES UNIVERSITY

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*Introduction:* Overhead throwing is a basic skill for many sports games. This is a natural skill based on human phylogenesis. Mastering this skill is a prerequisite for learning handball and softball that are included in the school curriculum of the primary and secondary schools and therefore they are also the content of the education of future teachers.

*Purpose:* The aim is to compare the performance of the one-handed overhead throw with a softball and handball ball at the group of the Faculty of Physical Education and Sport Charles University students; and determine whether there is a relationship between selected anthropometric data (arm span and forearm length) and the overhead throw velocity.

*Methods:* The participants were students of the 2<sup>nd</sup> grade of the Faculty of Physical Education and Sport at Charles University (25 women, 78 men) who were deliberately divided into 4 groups based on whether they were sport games players (volleyball, handball, tennis) or not. The attempts were recorded by the video camera with the frequency of 50 Hz and the velocity was measured with the radar. Software DARTFISH 7 TEAM PRO was used to evaluate the kinematic data using image decomposition at 100 Hz. Significance was evaluated using ANOVA at the 0.005 level of significance and the Bland-Altman diagram. The relationship between anthropometric data and throwing velocity was evaluated using the Pearson correlation coefficient.

*Results:* The results of the comparison of the performance of the overhead throw showed statistically and practically significant differences in the velocity of the ball with the softball and handball ball in all groups except for the group of women who did not play selected sports games. The relationship between the arms span (forearm length, size to wrist) and the throwing velocity of the handball and softball ball has not been demonstrated. The results of the comparison of throw technique have shown high variability in performance and mistakes during the throw in groups that did not have previous experience with selected sports games.

*Conclusion:* The results of the study show the unsatisfactory performance of the monitored skills. The cause may be the insufficient amount of hours of exercises spent on these games in the Faculty of Physical Education and Sport curriculum.

*Keywords:* overhead throw, softball, baseball, velocity, anthropometric data

## DIFFERENCES IN THE TIMING OF BASEBALL SWING IN DIFFERENT CONDITIONS FOR HITTING OF ELITE BASEBALL PLAYERS IN THE CZECH REPUBLIC

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*Purpose:* The aim is to compare the timing of the baseball swing phases during the hitting against the pitcher, the pitching machine and the batting tee.

*Methods:* This is an experimental study in which we change the conditions for a baseball hitting (pitcher, pitching machine, tee). We analysed 5 elite baseball players in the Czech Republic. The monitored variables are the duration of selected phases of the swing. A high-speed camcorder (400Hz) was used to record the participants' action and their motion was analysed in 2D.

*Results:* When hitting from the batting tee, phase of the leg kick 0.118-0.128s longer and upper body load (backswing) 0.082-0.115s respectively. This can be caused by absence of variable of moving ball. Therefore players are not limited by timing of the hitting motion directly dependent to a moving ball. When hitting against pitching machine the time of player's upper body load is 0.03s longer compared to pitcher.

*Conclusion:* The differences in the duration of the different phases in the different hitting conditions can be caused by the absence of information sources from the pitchers motion, on which the batter responds. For practice during the hitting from batting tee, it is advisable to shorten phase of the leg kick and upper body load. And during the all designs it is advisable to put emphasis on the powerful bat-swing in training.

*Keywords:* Anticipation, pitcher, pitching machine, batting tee, visual perception.



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Alpine skiing as a winter sport is limited by the specific conditions in which it can be performed. Due to mentioned, athletes and recreational skiers are trying to find alternative activities that can replace snow conditions but are biomechanically similar. Moreover, it is desirable that during mentioned activities, like in alpine skiing, muscles are predominantly eccentrically activated. The PRO SKI SIMULATOR is a possible alternative. It is an exercise machine on which an athlete is able to perform specific motion biomechanically similar to carving turn performed on an actual ski slope along with predominantly eccentrically activated muscles. The purpose of this study is to measure the kinematic parameters and describe biomechanical model using the MVN BIOMECH XSENS inertial suit while participant performs simulation of the carving turn on the simulator. Participant is a male ski instructor. Kinematic variables that were used are joint angles (ankle, knee, hip, shoulder, elbow), measured in degrees (°), and height of center of mass measured in centimeters (cm). MVN BIOMECH XSENS inertial suit consists of seventeen wireless motion trackers. It ensures real-time human motion analysis. After adjusting the suit and calibration of the system, participant performs sixteen cycles of turn in each side. PRO SKI SIMULATOR has option of adjusting the resistance by using six springs. Adding each spring resistance increases matching the weight interval of an athlete. In this case resistance of three springs was used. Basic descriptive parameters were calculated for all variables. Data necessary to point out is value of the standard deviation of variable shoulder angle of flexion of left hand in right turn which is high (SD=3.5). Moreover standard deviation of the variable elbow angle of flexion of left hand in right turn is high (SD=4.8). Also noticed was high value of standard deviation of the variable shoulder angle of flexion of right arm in right turn (SD=8.7). Values of the right hip angle of abduction in left turn varies between 162° -169°. Values of the left hip angle of abduction in right turn varies between 166° -173°. A possible cause of high values of the SD in mentioned variables is an attempt to maintain central balance position and optimal dynamic balance using upper body and hands. At the same time participant tried to keep the lower body steady not to lose rhythm of the turns. Moreover, range of the values in hip angles mentioned earlier were similar to those measured in previous studies (Hraski and Hraski, 2007). The future studies should concentrate on using an inertial suit but on an actual slope and compare that parameters with ones measured in this study in laboratory conditions.

*Keywords:* biomechanics, ski turn, alpine skiing

## COMPARING THE QUALITY OF STEREOPSIS IN HANDBALL PLAYERS AND SWIMMERS AT THE AGE OF 5-10 YEARS

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The level of stereoscopic vision is a fundamental prerequisite for the ability to distinguish details of viewed objects, especially with regard to space/depth perception. This ability plays an important role both in day-to-day life, and also in educational activities aiming at the integration of pupils into the learning process, as well as in high-performance and peak sports. Thus, the quality of received visual information can be considered a dominant factor for the successful execution or learning of sensomotor tasks.

The aim of this study is to assess the quality of stereoscopic vision in children of younger school age ( $n = 60$ ) with regard to sports activities (handball, swimming), regularly performed by these children. In order to determine the level of stereopsis, the standardized test "Titmus stereo test" was used. At the same time, the initial history of sports-physical activities was carried out to receive more objective interpretation of the results. For the statistical processing of the gained data (Statistica 8.0), the non-parametric method - Mann-Whitney U test - was used. Other parameters were expressed by means of frequency, averages, and percentage representation in charts.

The data were processed using the Mann-Whitney U test. The following values were calculated:  $Z = -1.97$ ;  $p = 0.05$ . The observed data support our hypothesis that physical activity connected with a strong activation of visual and brain functions could affect the quality of individual elements of visual space depth perception, such as stereopsis or myopia. The median values of stereoscopic vision levels in handball players (9) and swimmers (7) are demonstrably given in favour of handball players. Handball players clearly dominate also in the frequency of excellent results achieved in the test of stereoscopic vision (values 9 and 10).

On the basis of the statistical results, we can accept the determined hypothesis validated by the "Titmus stereo test" test of stereopsis, and we can state that the quality of stereopsis in handball players is higher than in swimmers. It seems that children who pursue sports intensively from a very early age (4-5 years), but in a discipline that physiologically does not support the development of visual functions (swimming in this case) may have a reduced quality of spatial vision. Based on the results of the research, we believe that a teacher/ trainer who is aware of this issue might be able to identify a malfunction of spatial vision at the primary level, and, especially, alert parents, recommending a preventative visit to a children's ophthalmologist.

*Keywords:* stereopsis, stereopsis test, younger school age, educational activities, prevention, handball, swimming, ophthalmology

## RELATION BETWEEN THE SPEED OF FRONT CRAWL SWIMMING WITH EITHER THE ARMS ONLY OR FLUTTER-KICKING IN GROUP OF JUNIOR CATEGORY MALE SWIMMERS

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*Purpose:* The results of the researches aimed to assess the impact of flutter-kicking (FK) and swimming with the arms only (SAO) on front crawl swimming (FCS) speeds often differ in their results. They agree with the fact that FK is an important part of FCS, but they differ in the proportion at propulsion forces of swimming and the impact of speed on swimming. With the help of the Tachograph measurement system, we verified the possibility of evaluating their relation on the sample of junior category male swimmers.

*Methods:* For our evaluation, we have chosen data of 10 swimmers who reached the age of 16 years by the date of measurements. We used the Tachograph measuring system. The swimmers were asked to swim 50 metres, initially only with the help of FK, subsequently using their arms only, and finally FCS. We used data from the first 25 meters of the track for evaluation, so we eliminated the effect of push off and turn.

*Results:* At the measured section swimmers reached mean speed of  $1,637 \pm 0,079 \text{ m}\cdot\text{s}^{-1}$  during swimming with FCS, it was  $1,399 \pm 0,0603 \text{ m}\cdot\text{s}^{-1}$  when they SAO, and with FK their mean speed was  $1,082 \pm 0,067 \text{ m}\cdot\text{s}^{-1}$ . We found out that swimming velocity when moving without FK is lower by  $0,238 \text{ m}\cdot\text{s}^{-1} \pm 0,049 \text{ m}\cdot\text{s}^{-1}$  compared to FCS.

*Conclusion:* We focused on the relation between the speed of front crawl swimming with either the arms only or flutter-kicking. The results of our measurements showed that front crawl swimming speed highly correlates with swimming with the arms only ( $r = 0.83$ ). We did not find any statistically significant relation between the results of flutter-kicking and front crawl swimming ( $r = 0.15$ ). However, flutter-kicking contributes to higher speed during front crawl swimming at least by reducing the drag forces of water of the swimmer because the measured speed of front crawl swimming is higher than the swimming speed reached with the arms only.

*Keywords:* swimming; speed; front crawl; arms only; flutter-kick, tachograph

## MOBAK 3 - PRESENTATION OF A TEST BATTERY OF BASIC MOTOR COMPETENCIES AND SELECTED RESULTS OF THE CZECH REPUBLIC AND SWITZERLAND.

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*Purpose:* The aim of the paper is to introduce the MOBAK 3 basic motor competence test battery. We present selected data measured by pupils of third grade at the available primary schools within the Czech Republic in Brno and its surroundings compared to Switzerland. The results obtained are interpreted using a unified methodology published in the pilot measurement of pupils in Switzerland (Herrmann, C., & Seelig, H., 2016).

*Methods:* Basic used method for this measurement was test battery MOBAK 3. Seven elementary schools from Brno and its surrounding agreed to cooperate. Sixteen third classes took part in the measurement. In the Czech Republic, the total amount of students was 302 (n=302, 133 boys and 169 girls) in all disciplines. In Switzerland the number of measured students reached the number 323. The same statistical methods were used to express the results.

*Results:* In most cases, there is a strong correlation between the Czech and Swiss results. We can say, that the chosen disciplines are similarly challenging between both countries. According to the measurements, the Swiss students turned out to be better in the area of Object-movement than the students from the Czech Republic. The most difficult discipline for students from both countries was the „Throw on the target“. The students from Switzerland achieved significantly greater results in the discipline „Bouncing the basketball“. In most cases, students from the Czech Republic finished with better results from area Self-movement items.

*Conclusion:* In both states the results have been similar in most items. Students in both countries achieved bad results in items „Throwing at the target“ and „Rope skipping“. We recommend simplifying these disciplines. Students from both states finished with results that were significantly above the average. It was at the discipline „Moving variably“. The items from the area Object-movement are for third-grade students more difficult, and they finish with worse results. The area Self-movements are easier and students are more successful. Altogether, we can say that the test battery MOBAK 3 is useful in both areas. We think that it would be great to discuss certain adjustments of some tests.

*Keywords:* MOBAK 3, Object-movement, Self-movement, locomotion, basic motor competencies, basic motor qualifications, third grade

## PERFORMANCE ANALYSIS OF WOMEN'S YOUTH BEACH HANDBALL WORLD CHAMPIONSHIP 2017

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In 2017, the World Handball Federation (IHF) for the first time organized a beach handball competition for younger age categories (i.e. under age 17) as a qualifying tournament for the Young Olympic Games to be held in Buenos Aires, 2018. The aim of this study was to determine performance indicators of the winning and defeated teams of the Women's Youth Beach Handball World Championship 2017 in Mauritius. The sample of entities consisted of 56 games played during the competition i.e. 112 opponents from fourteen different national teams (Argentina, American Samoa, Australia, Chinese Taipei, China, Croatia, Hungary, Mauritius, Netherlands, Paraguay, Portugal, Spain, Thailand and Venezuela). The sample of variables consisted of the completed and unsuccessfully executed technical and tactical handball elements in attacking and defensive actions during beach handball matches (12 variables describing performance in attack - *completed/unsuccessfully inflight shots, spin shots, specialist shots, direct goals, one-point shots, 6m shots* and three variables related to play in defence - *completed/unsuccessfully goalkeeper saves and blocks*). The differences between the winning and defeated teams in performance variables were determined using the Mann-Whitney U-test. The results showed statistically significant differences between the winning and defeated teams in the following variables: successful inflight shots ( $0.98 \pm 1.17$  vs.  $2.95 \pm 3.08$ ), successful spin shots ( $7.50 \pm 5.73$  vs.  $11.16 \pm 6.21$ ), successful specialist shots ( $3.09 \pm 2.55$  vs.  $4.79 \pm 2.75$ ), successful direct goals ( $0.43 \pm 0.74$  vs.  $0.75 \pm 0.86$ ), and goalkeepers effectiveness). The winning teams were better in the variables defining offensive performance effectiveness, especially with regard to successful performance of different shots, specially counting according the roles of beach handball, with two points; they also had higher efficiency of goalkeeper's saves. An effective way of playing beach handball for young female handball players is created in accordance with the specific and attractive requirements of the beach handball as well as the requirements of classical team handball. Successful spin shots, followed by efficient performance of classic jump shots of different marked players (specialist), were obtained as key factors in creating the performance of winning teams.

*Keywords:* technical-tactical elements, beach handball, women, performance analysis

## GENDER DIFFERENCES IN THE BALL THROWING TECHNIQUE IN PRESCHOOL CHILDREN

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*Purpose:* Although gender differences have been noted in many motor tasks, differences are minimal during early childhood. In the pre-school period the differences start to increase. Throwing is one of the most useful basic motor skills and is included in various sports such as baseball, softball, basketball, handball, soccer and cricket (Gallahue, Ozmun & Goodway, 2012). The aim of this study was to determine the differences in the technique of ball throwing and its structural elements in preschool children.

*Methods:* The sample consisted of 229 preschool children aged 3 to 7 enrolled in three kindergarten in capital of Croatia. Measurement of the ball throwing technique is part of the Test of Gross Motor Development - 2 testing kit (Ulrich, 2000). Analysis of variance (ANOVA) and Bonferroni post-hoc test were used to determine differences in throwing technique between boys and girls, as well in four technique elements.

*Results:* The main results of this study show that significant differences exist between boys and girls in the ball throwing ( $p < 0.05$ ). The Bonferroni post hoc test shows that boys are significantly better (2.32) in ball throw score than girls (1.20). Furthermore, the results show that boys are better at all ball throwing performance criteria ( $p < 0.05$ ) (body rotation, opposite leg transferring weight, diagonal arm swing after throw), except in the first – preparatory arm swing.

*Conclusions:* Previous research was not consistent regarding gender differences in motor skills. Pennington (2002) determined no differences in motor skills of children while Junaid and Fellowes (2006) determined gender differences in motor skills of children: boys were better in ball manipulation while girls were better in fine motor tasks. Practical application of our research would imply modifications of preschool physical education classes and organized games containing ball throw when girls and boys exercise together.

*Keywords:* motor skills, gender, overarm throw

## BUTTERFLY SWIMMING TECHNIQUE VARIATIONS DURING AN EXHAUSTIVE SWIM EXERCISE

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*Purpose:* Fatigue significantly influences not only physiological parameters during swimming, but also the technique of swimming stroke. Fatigue, therefore, affects also swimmer's performance. This study aims to find out to what extent fatigue influences the technical execution of the butterfly stroke with and without breathing.

*Method:* This work is structured as a case study. The participant was one of the best Czech and European swimmers, a 50 m butterfly Czech record holder. The swimmer performed a standardized lactate test - 8 x 50 metres butterfly swim. In selected moments his heart frequency was measured using a sport tester Polar and a blood sample was taken for lactate level test using Lactate scout+ device. A speedometer "Swim-Speedo-Meter" fixed on the belt and a video record was used for the stroke technique analysis. Temporal, spatial and speed characteristics were evaluated from the acquired curve of the swimmer's speed.

*Results:* Maximum heart frequency (172 bpm) as well as blood lactate level ( $14.2 \text{ mmol}\cdot\text{l}^{-1}$ ) was reached after fifth 50m track. There was a huge increase in stroke frequency with increasing fatigue. This fact resulted in the decrease in stroke duration from initial 1.37 s to 1.09 s in stroke with breathing and from 1.29 s to 1.06 s in a stroke without breathing. Significant changes during the transition phase from "insweep" to "upsweep" were observed, with a huge decrease in speed. Furthermore, accumulated fatigue caused that the speed developed during "insweep" phase was smaller in the second part of lactate test compared to the previous parts. These major differences in technique negatively influence stroke effectiveness.

*Conclusion:* The core importance lies in between relations of measured variables that show changes of butterfly stroke technique as swimmer fatigue increased. We recommend to focus on strength and dynamic preparation during training, mainly leg movement during the second kick. We also recommend regular speedometer measurements which can help control changes in technique caused by factors such as fatigue, injury, different period of training annual cycle, etc.

*Keywords:* speedometry, fatigue, lactate test, stroke technique

## KINEMATIC ANALYSIS OF MOZNIK ELEMENT ON HIGH BAR

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In men artistic gymnastics high bar is often described as the most exiting discipline for spectators. Since generation of gymnasts like Tkatchev, Ginger and Delthcev, who created own flight elements on high bar, routines became very attractive as gymnasts started to include more and more flight elements into their routines. Today contemporary high bar routine can include up to five flight elements. As the elements have to be different, also search for new elements is important. Flight element Tkachev (from front swing, backward hecht with split legs to hang) have been developed in last forty years in different ways. Gymnasts performed up to now piked Tkatchev, straight Tkatchev, straight Tkatchev with 360° turn, and all variations of Tkatchev from back circles. Last version of Tkatchev in Code of Points is since 2009 under Marijo Možnik name as in 2007 at World Championship he performed straight Tkatchev with 180° degrees turn into mixed grip. With Možnik carrier end for the purposes of original inventor biomechanic characteristics of Možnik element we did kinematic analysis of Možnik element performed by element author. We measured the movement with Qualisys measuring system. Over 70 reflecting markers were attached to specific anthropometrical locations on the athletes body. Their location was then calculated using 12 synchronised QTM cameras set at maximum of 178Hz and Qualisys software. Marker location was exported to Visual 3D software where with additional athletes weight and height skeletal model was build. From these model trajectories, velocities, angles, angular velocities, angular acceleration were computed for every joint. Experiment was held at Faculty of Sport, University of Ljubljana in controled conditions. The element was divided into following phases: preparation phase (from handstand to front swing), release phase, flight phase and regrasp phase. For determination of each phase temporal and kinematic values were calculated. According to results difficulty of element is properly set as E value in Code of Points.



## FUNCTIONAL ASSESSMENT OF MOVEMENT WITH THE AIM OF ESTABLISHING ASYMMETRY IN THE RANGE AND QUALITY OF MOTION IN VOLLEYBALL PLAYERS „HAOK MLADOST“

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*Purpose:* The main goal of this study is to determine possible asymmetry in the range and quality of movement in senior volleyball players.

*Methods:* Respondents were nineteen (n=19) male volleyball players, all right handed, healthy and members of „HAOK Mladost“. The testing was conducted during the second week of the preparation period. We used five tests which can indicate asymmetry, all five part of standard FMS protocol (Hurdle Step – HS, In-Line Lunge – ILL, Shoulder Mobility – SM, Active Straight Leg Raise – ASLR, Rotary stability – RS). Educated staff at the Faculty of Kinesiology, University of Zagreb conducted the testing. The examination of significance of the differences between the left and right side of the body was conducted by using the nonparametric **WilcoxonSigned Rank**.

*Results:* Statistical analysis showed significant difference only in one test: hurdle step (HS),  $z = -2,12$ ,  $p = 0,03$ , with moderate effect size ( $r = 0,34$ ). The results clearly point to the problem of reduced stability of the right leg, reduced mobility of the left leg, and reduced mobility in the left hip joint.

*Conclusion:* The cause of asymmetry could be the unilateral technique of landing after offensive and defensive jumps (predominantly left leg for right handed players) which can cause loads that lead to micro traumas, and ultimately, to lower stability and mobility of the entire kinetic chain on the left side of the body. Consecutive single leg landings may occur due to the wrong motion pattern caused by the poor strength of an athlete's body, inadequate spiking technique (non-symmetric hand swing during the preparation phase of the spike) or inaccurate setting. Considering the obtained results, corrective exercises should be carried out in two directions. The first relates to the development of stability of the right leg and the second to the development of mobility of the left leg and left hip. Adoption and stabilization of proper spiking and setting techniques are implied.

*Keywords:* volleyball, stability, mobility, FMS

## KINEMATIC CHARACTERISTICS OF SIDE SOMERSAULT ON THE BEAM

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The lack of evidence of biomechanics studies in women artistic gymnastics was the reason why we choose this topic. The aim of our research was to analyse and compare the kinematic characteristics of the side somersault on the beam. We concerned on time characteristics of side somersault. The research sample was represented by two female junior (BH=161 cm, BW=48 kg, BMI=18,5 kg.m<sup>-2</sup>) and senior (BH=168 cm, BW=56 kg, BMI=20 kg.m<sup>-2</sup>) Slovak national team members in artistic gymnastics. In our ex post facto research we applied a three-dimensional kinematic analyse used by SIMI Motion 3D. We focused on time characteristics in the key phases of the specific difficulty element on the beam. The element was performed by both gymnasts separately. We assumed the rebound phase is the most important as gymnasts affects the final shape of the element. Results: We found out that at the rebound stage of side somersault only the senior gymnast used the ankle joint force properly. Paradoxically, the length of rebound phase was longer performed by junior gymnast (0,15 s) in comparison with the length of senior gymnast (0,13 s). The flying phase was 0,35 s for senior gymnast and 0,32 s for junior gymnast.

Conclusion: As this was a pilot study supported by KEGA No. 036PU-4/2016 and VEGA No.1/0954/16 projects and the other research trace areas will be done in the future.

## SPORT PERFORMANCE STRUCTURE IN FEMALE POLE VAULT FROM THE POINT OF VIEW OF PHYSICAL ACTIVITY KINEMATIC PARAMETERS

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This research is oriented at explanation of sport performance by angle, speed, time and space characteristics of centre of gravity, positions of body, extremities and pole during approach, take-off and jump realization in female pole vault. Kinematic parameters were gained by two-dimension analyser Conspont Motion Analysis System (CMAS). There are involved 19 female pole vault jumpers with sport performance 408.1 – 490.5cm (average result 431.2cm). From the point of biomechanical movement activity analyse we consider as a more objective performance criterion (dependent variable) maximal centre of gravity height that were reached at valid attempts by female pole vault jumpers. . By two-dimension (2-D) analyse of group of female pole vault jumpers there were revealed 76 independent variables that entered into process of multiple correlation and regression analysis.

On 1<sup>st</sup> sport structure performance factor level we isolated two complex parameters absolute grip and standing over by which we can explain dependent variable maximal centre of gravity height on 100%. With stated proceeding we could separate seven factors on 2<sup>nd</sup> level. Three of the parameters horizontal speed of centre of gravity at moment of take-off end, centre of gravity height at moment of take-off end and operating angle during take-off are bound with explanation of absolute grip variable. Four others parameters vertical speed of centre of gravity at the end of pull with turn, centre of gravity height at moment of end of lifting, time duration of take-off and climb angle explain standing over. 14 more factors are found on 3<sup>rd</sup> sport structure performance level. Thus we succeeded in this process to reduce number of decisive variables with their mutual relationships and hierarchy.

Transparent and simplified model of female pole vault sport performance structure enables to coaches and jumpers improve technical training.

*Keywords:* female pole vault, kinematic parameters, sport performance structure

## INTERNATIONAL COMPARATIVE ANALYSIS OF THE QUALITY OF STEREOPSIS AND CO-ORDINATION OF UPPER EXTREMITIES IN CHILDREN OF YOUNGER SCHOOL AGE IN THE CZECH REPUBLIC AND SPAIN

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The goal of the presented research project is to compare the quality of stereoscopic vision and the quality of co-ordination abilities of upper extremities in children of younger school age in the Czech Republic and Spain. This work summarizes the existing knowledge related to these points in question. For testing the quality of stereopsis, the “FLY Stereo Acuity Test” (Vision Assessment Corporation 2012) was used. The quality of co-ordination of upper extremity was tested using the “Ball Tossing and Catching in the Lying Position” modified test (Měkota, Blahuš 1983). The research sample consisted of 153 probands in the ages of 9-12 years, of which 59 children from the Czech Republic and 94 children from Spain. For the statistical processing of variables, the Statistica 6.0 program was used. Mutual differences between the groups were calculated using the Mann-Whitney U test. On the basis of the evaluation of the obtained data, the team of authors came to the following conclusions. There is a difference in the quality of stereoscopic vision ( $p = 0 \leq \alpha = 0.05$ ) between Czech and Spanish children, and, at the same time, there is no difference in the quality of co-ordination of upper extremities ( $p = 0.89 \geq \alpha = 0.05$ ) between Czech and Spanish children of younger school age.

*Keywords:* stereopsis, co-ordination abilities, motor skills, younger school age, physical education, Czech Republic, Spain.

## SPORT MEDICINE

### HEALTH BENEFITS OF RESISTANCE TRAINING IN CHILDREN

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Almost one decade ago European Union (EU Guidelines on Physical Activity, 2008), highlight that the decline in physical activity identified problem of sedentary behavior and physical epidemic in youth in Europe like in the rest of the developed world. EU official bodies recognized **enormous treat** with their guidelines and position statement (EC Expert Group, 2015) but situation is getting worse every year! Constant rate of physical inactivity inevitably leads to increase of several physical, metabolic and mental disorders in childhood or later in life. Recognition is there but problem remained unsolved, even worse its keep escalating. With latest obesity trends (Lancet, 2017) the importance of increased physical activity level is becoming top priority.

One of the most effective strategy for P.A. level increase is participation of youth in organized resistance training program. This idea has not always been encouraged, but the positive results of the numerous studies in scientific literature over the past decade have clearly stated the benefits. Also, position stands of leading world fitness organizations (American Academy of Pediatrics 2001; American College of Sports Medicine 2006; British Association of Sport and Exercise Science 2004; Canadian Society for Exercise Physiology) all state that resistance training can be very beneficial for children and adolescents.

Although there is not a single chronological age at which it is deemed acceptable for youth to formally start training, recent guidelines recommended that any child engaging in a form of resistance training is emotionally mature enough to accept and follow directions and possesses competent levels of balance and postural control (approximately 6-7 years of age). Additionally, some kinds of resistance training activities should be engaged even from early childhood.

Muscle strength is considered as a powerful marker of health in children and adolescents. For long term physical development of children it's recommended that neuromuscular training that enhances both muscular strength and motor skill should be prioritized. In addition to enhancing muscular strength, power and local muscular endurance, regular participation in a youth resistance training program has the potential to influence several other aspects of health. It may result in improvement of body composition, increased bone mineral density, increased cardio-respiratory fitness, enhanced mental health and well-being and a more positive attitude towards lifetime physical activity.

## THE IMPLICATIONS OF RESPIRATORY MUSCLE TRAINING IN PROFESSIONAL ATHLETES

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*Introduction:* Lately, the practical use of the respiratory muscle training (RMT) within specific sports or other therapeutical interventions is on a rise, however, sometimes it might not get used correctly and purposefully in practice. Incorrect use of the breathing devices could lead into development of a functional impairment of the movement system or to a build-up of further problems onto a present one. Human body works as a single unit and therefore the breathing retraining should not be impacted on separately or just with an aim to improve lung functions. Respiratory muscles have the same physiology like any other peripheral muscles. The effect of the RMT impacts on muscle fatiguereduction, which is a frequently discussed topic among doctors specializing in respiratory medicine, allergology and sports medicine as well as among physiotherapists. The main reasons favouring implementation of the RMT intervention into athlete's training are improved exercise tolerance, reduction in exertional breathlessness, reduction of fatigue and therefore an overall enhancement of athlete's performance. Respiratory muscle strength (MIP and MEP), lung function testing (VC, PEF and FEV1) and cardiopulmonary exercise testing (VO<sub>2</sub>max) are the most commonly tested parameters. The RMT could be included into athlete's training to improve the general fitness, but also to increase the performance during sports-specific physical tasks. The RMT usually starts with an optimization of the breathing pattern that can be achieved with the use of soft-tissue techniques. The common clinical findings at baseline are hyperinflated chest due to accessory breathing muscle overuse and restricted chest expansions mainly over the lower part of the rib cage (over xyphoidprocessus). Although inspiratory muscle training (IMT) could result in significant improvements of the lung functions, the expiratory muscle training (EMT) should not be omitted. Focus on the expiratory muscles will help to achieve the ideal position of chest before the inspiration is initiated and therefore the use of accessory breathing muscles for inspiration will be minimized. The RMT is beneficial not only in individuals with chronic respiratory condition, but also in professional athletes. Approximately 7% athletes suffer on bronchial asthma or allergy-related breathing problems. Therefore an individually tailored treatment plan should be agreed on and incorporated into athlete's training routine by a multidisciplinary team involving the respiratory specialist, physiotherapist, athlete's coach, clinical psychologist and dietitian.

*Methods and Results:* Case study: professional athlete in artistic gymnastics (age 19) underwent RMT 5 times a week over a period of 5 months. Treatment plan included IMT and EMT implemented into various postural-demanding positions. The treatment objective wasn't just an increase in exercise tolerance, but also a correction of muscle imbalances and further prevention of a chronic muscle overload due to sport-related activities. In our case study, the intervention led to gradual pain relief in shoulder girdle and sacroiliac joint dysfunction. Cardiorespiratory exercise testing showed increased exercised tolerance (VO<sub>2</sub>max) from 33 ml/kg/min at the baseline to 41.3 ml/kg/min at the discharge and increased power output from 3.5 W/kg at the baseline to 4.36 W/kg at the discharge.

*Keywords:* respiratory training, athletes, weak of respiratory muscles, postural training, sport equipment

## EFFECT OF HORMONE YOGA THERAPY ON SYMPTOMATIC MANIFESTATIONS OF DYSFUNCTIONS IN THE ENDOCRINE AND REPRODUCTIVE SYSTEMS

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*Purpose:* The current research study was conducted to assess the effect of the application of the licenced motion intervention programme called Hormone Yoga Therapy (HYT) on 30 selected symptomatic manifestations of selected dysfunctions of the endocrine and reproductive system.

*Methods:* Czech women of different age groups with different symptomatic manifestations and dysfunctions, who completed the HYT seminar in the authorised HYT centres, were randomly addressed to answer the online questionnaire. 135 respondents completed the questionnaire, but 19 of them had to be excluded, because they did not exercise long or frequently enough. The questionnaire included 37 closed questions and the survey took two months, March – April 2017. To process the obtained data, the descriptive analysis and the inferential statistical method of chi-squared distribution were applied.

*Results:* The results show that the intervention HYT programme had the greatest effect on the following manifestations: mood changes (85.51%), physical exhaustion (79.52%), anger (77.78%) and hot flushes (77.78%), constipation (76.92%), premenstrual syndrome (75.81%), anxiety and misery flushes (75.47%), back pain (75.32%), carpal tunnel syndrome (71.43%) and libido decrease (70.13%). The results also show that the intervention programme was effective in the field of fertility. 16 respondents (27.12%) out of 59 who exercised and completed the programme got pregnant.

*Conclusions:* Based on the research findings, we conclude that the results of the study suggest that the HYT programme can have a positive impact on different negative symptomatic manifestations related to selected insufficiencies or dysfunctions of the endocrine and reproductive system. As not many research studies have been conducted dealing with the influence of the HYT programme so far, there are many areas, such as infertility or menopause and its related problems, which the research should focus on in depth.

*Keywords:* Hormone yoga therapy, symptoms, exercise, improvement, endocrine system, female reproductive system, infertility, menopause



## ANTHROPOMETRY, BODY COMPOSITION AND ACE GENOTYPE OF ELITE FEMALE COMPETITIVE SWIMMERS AND SYNCHRONISED SWIMMERS

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**Purpose:** This study aimed to evidence characteristics and possible differences in anthropometric – body build indices (ABB), and Angiotensin Converting Enzyme (ACE) genotype among female synchronized swimmers (SYN), competitive sport-swimmers (CSS) and age-matching non-athletic control group (CON).

**Methods:** The sample comprised 59 females (SYN: N=14; 15±1.5; CSS: N=12; 16.1±0.6; CON: N=33, 16.0±0.6 years of age). The subjects involved in SYN and CSS groups were current members of Slovak National teams. Anthropometrics were measured by standard techniques, while body composition was analyzed by bioelectrical impedance. Genomic DNA was extracted from the buccal swabs, and the Polymerase chain reaction of the polymorphic region of the ACE gene containing either the insertion I or deletion D fragment was performed (ACE I/D). Kolmogorov Smirnov test showed normality of the distributions, and homoscedasticity of the variance was proven by Levene's test for all ABB variables. Therefore, analysis of the variance with consecutive Scheffe's post-hoc was calculated to establish differences among groups in ABB. The ACE I/D variation differences between groups were identified by Chi-Square test. Statistical significance of  $p < 0.05$  was applied.

**Results:** The ANOVA identified significant differences among groups for all ABB variables. Specifically, SYN weighted less than other groups, had lower BMI and body-fat-percentage than CON. The CON had lowest percentage of muscle-mass, and had shortest forearm-length. The CSS had longest upper-limb length, and were taller than SYN. The ACE I/D genotype frequencies met Hardy-Weinberg expectations in all three groups. The ACE I/D genotype distribution and allele frequencies did not differ significantly among groups.

**Conclusion:** Differences in anthropometrics between SYN and CSS are clearly connected to specific sport-tasks and requirements. The sport of synchronized swimming requires low body weight associated with a lower percentage of body fat and longer forearm. Meanwhile, the body height and arm length are essential for sport swimming, as the basic factors determining the competitive performance in this sport. We did not provide evidence for significant differences of variation of the ACE I/D polymorphism between observed groups.

**Keywords:** synchronized swimming, competitive sport-swimming, anthropometry, body composition, ACE I/D polymorphism

## POSTURE ANALYSIS OF FEMALE STUDENTS OF THE SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

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The paper aims to evaluate body postures of female students of the Slovak University of Technology in Bratislava (STU).

*Method:* The somatoscopic method of the posture evaluation according to Klein and Thomas, as modified by Mayer (1978), was applied. In particular, the methodology focuses on somatotype identification. Consequently, the 5 basic human body parts were evaluated. Head posture, chest shape, abdomen shape, head declination, pelvic inclination, spine curvature, shoulder height and shoulder blade posture. Each of the measurements applies a 4-grade scale. The total score shows the evaluation of the human body posture. Female students (n=32) at the age of 22±0.5 on average took part in the measurements.

*Result:* According to the test, tested subject achieved good, almost excellent body posture- that means 8.094 points on average. A minimum value was 5 points, which refers to an excellent posture and a maximum value was 11 points indicating fatigue posture. The best results were achieved by the students in their head posture 82% (1.188 points on average), 18% of the female students achieved 2<sup>nd</sup> degree of evaluation. Unfavourable state was found in abdomen shape and pelvic inclination too, and only 53% of the female students achieved the correct state. 62% of the female students had obvious or slightly flattened spine curvature. The worst results were found in the shoulder and shoulder blade postures (2.344 points on average). Only 16% of the female students were included in the scale of 1.37% and the scale 2 and even 47% in the scale 3.

*Conclusion:* All students (100%) represented a mesomorph body type. Shortened and weakened muscles of the female students were evaluated according to Janda (1982) for our purposes, modified by Thurzova (1992) for the purposes of the physical education practice. They correspond closely with the body posture. 18% of the female students had the shortened pectoralis major muscle, 26% of them trapezius muscle, parssuperior and 24% of them had shortened tensor fasciae late muscle. The most weakened muscles were the lower shoulder blade fixators up to 33% of the female students and abdominal muscles on the second position represented by 29% of the students. The questionnaires showed that 63% of the female students have never felt spine pain and 21% of them have experienced lumbar spine pain.

*Keywords:* posture, Klein and Thomas test modified by Mayer, spine pain, postural muscle

## OVERUSE INJURIES AMONG ELITE MALE ORIENTEERS IN ADOLESCENT CATEGORIES IN THE CZECH REPUBLIC

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Orienteering is an endurance discipline where athletes run in the rough terrain from 30 to 60 minutes according to the racing discipline. Racing demands on performance have increased training load in children and adolescents in orienteering over the last decades. Children and adolescents differ from adults in many aspects, while the body size and body proportions change noticeably. Overuse injuries have become more frequent in this age group. The aim of this research was to determine the prevalence of injuries resulting from congestion of the locomotor system in elite orienteering runners in the youth and junior categories (M18 and M20) in the Czech Republic. The survey was carried out in August 2017. The participants were elite male orienteers aged 16-20. It was assumed that in the Czech Republic there is a high incidence of locomotor injuries in adolescent orienteering categories, the majority of which can be classified as overuse injuries. The results of the research showed that in all diagnosed cases, knee or ankle were injured. The acute injuries were mainly direct traumas and ankle distortions and the incidence of overuse injuries was mainly in the knee. The research also monitored possible causes of the mentioned problems. The questionnaire survey confirmed the hypothesis and partly showed a relation to an early specialization. Other possible factors influencing the occurrence of injuries may be insufficient system of training methods in children, adolescents and junior categories in the Czech Republic and too long competition distances for boys aged 13-18. This research did not examine an influence of inadequate footwear or paved training terrain. It is apparent that many of the overuse injuries in adolescent orienteers are preventable. It should be the responsibility of coaches to become involved in their early diagnosis, treatment and prevention. The results support the author's recommendation to change the system of competition distances in the M16 categories in the Czech Republic.

*Keywords:* overuse injuries, orienteering, adolescent, training

## EFFECTS OF COMPRESSION CALF SLEEVES ON FORCE PRODUCTION DURING CONCENTRIC AND ECCENTRIC MUSCLE TESTING

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*Purpose:* Muscle strength is one of the key components in almost every sports performance. There are methods which can objectively quantify the actual status of athletes. A considerable amount of research papers has been published. They are focused on torque, position and time parameters with using isokinetic strength testing but often without any practical usage in real conditions. These studies often only describe and compare the sports disciplines or they try to evaluate concentric peak torque changes in time after selected interventions. On the other hand, too little attention is paid to eccentric strength and strength ratio between plantar and dorsiflexion of ankle joint. Strength ratio is well discussed especially for concentric flexion with concentric extension knee muscle strength within the same leg or combination of eccentric flexion and concentric extension. However, questions have been raised about using strength ratio in regards to predicting muscle regeneration or injury's prevention as well. The objective of presented research is to purpose the effect of different pressure levels of compression calf sleeves used during uphill running on selected isokinetic parameters.

*Methods:* The study was designed as a double-blind controlled laboratory study because of the elimination of researcher bias. Ten endurance-trained male athletes (age  $24.8 \pm 3.45$  years; body weight  $74.11 \pm 8.63$  kg; body height  $1.81 \pm 0.08$  m; weekly running distance  $43.0 \pm 5.4$  km; 10 km best time  $38.0 \pm 1.5$  min) performed three 8 km treadmill runs at 75%  $VO_{2max}$  with 6% incline while wearing compression calf sleeves (two types of graduated compression calf sleeves and one type inversely graduated compression). Maximal voluntary isokinetic concentric contraction and maximal voluntary isokinetic eccentric contraction of plantar flexors and dorsiflexors were recorded at 60°/sec and 120°/sec over 6 contractions with a Human Norm dynamometer.

*Results:* No significant differences were found between graduated compression calf sleeves in peak torque of plantar flexors and dorsiflexors during isokinetic concentric and eccentric contraction (60°/s, 120°/s) in pre-test, 24 and 48 hours after the running protocol. Interestingly, analyses showed the significant difference in increasing peak torque of plantar flexors and dorsiflexors (60°/s, 120°/s) for inversely graduated compression calf sleeves during the isokinetic eccentric contraction. A difference between pre-test and 48 hours post run ( $p = 0.04123$ ) was found.

*Conclusion:* The obtained data indicate that inversely graduated compression calf sleeves (a higher pressure over the calf than over the ankle) may be much more practical during running especially in hilly mountainous terrain not only for running performance but also for reducing delayed onset muscle soreness.

*Keywords:* dynamometer, exercise, pressure, running, strength ratio

## BREATHING PATTERN OF RESTFUL AND DEEP BREATHING

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*Purpose:* Respiration is a central aspect of our entire being. We know that every activity of the body is closely connected with breathing and the quality of breathing functions is decisive for our health. Current unnatural way of life leads to a reduction in natural physical activity and together with sedentary occupation and passive leisure it results in the fact that today's civilization cannot breathe correctly. Respiratory stereotype disorder is encountered very often despite the fact that proper breathing is a prerequisite for optimal functioning of the musculoskeletal system, correct posture and mental well-being. The aim of this work was to investigate the course of breathing waves during restful and deep breathing in healthy individuals aged 19-25 who regularly engage in some sort of sports activity.

*Methods:* To test breathing stereotype in 163 research participants, we used a muscle dynamometer to monitor the dynamics of breathing activity. During analysis of the respiratory movements was based on the concept of three sectors of the chest. In the lower chest sector, the first muscular dynamometer probe was located. The second probe was placed in the middle chest sector and the third probe was placed in the upper chest sector. The breathing dynamometry test was performed in the upright position. With the probes we recorded individual segment movements for one minute during restful breathing and for one minute during deep breathing. In this way, 600 values were recorded for each person on the sensor for each breathing cycle. The time series thus obtained were then smoothed by the robust locally weighted regression method. Separate ranges and minima (local extrema) were subsequently identified in the evened series. From the values thus obtained, the average of the maximum and minimum for each individual was determined, depending on the location of the sensor and the type of breathing. From these values, the "average difference" for each sensor location and respiration type was determined for each individual. To test normality, the Shapiro-Wilk's normality test was used for each variable. Results are interpreted with 95% confidence. Due to the rejection of the zero hypotheses on data normality, Wilcoxon's pairing tests were used for individual variables in case of verifying the hypothesis of median compliance (or compliance of distribution functions). Numerical results were obtained through MS Excel and R 3.3.0 software.

*Results:* The values for restful breathing were statistically significantly lower on all sensors than those for deep breathing. During comparison of the percentage involvement of individual chest sectors the activity of breathing waves predominates in the middle and upper chest sections over the activity of the lower chest section. During deep breathing the activity is reduced by nearly 10%.

*Conclusion:* On the basis of the results it can be concluded that the test individuals suffer from respiratory stereotype disorder.

*Keywords:* breathing waves, breathing sectors, diaphragm, respiratory stereotype disorder.

## THE ASSOCIATION OF ACE POLYMORPHISM WITH EXPLOSIVE LEG-MUSCLE POWER IN ELITE VOLLEYBALL PLAYERS

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**Purpose:** The aim of this study was to determine the association of the Angiotensin Converting Enzyme gene variants (*ACE* I/D) with explosive leg-muscle power in elite volleyball players (VOP) and non-athletic controls (CON).

**Methods:** The study involved 124 participants consisting of elite VOP group, N=61 (males N=31, age 26.5±5.8; females N=30, age 21.8±4.3) and CON group, N=63 (males N=32, age 20.8±0.9; females N=31, age 20.1±0.9). Genotyping for *ACE* I/D was performed using a polymerase chain reaction on DNA extracted from buccal swabs. The leg-muscle power performance was assessed by means of a vertical jump (VJ) test. The distribution of *ACE* I/D genotype between the groups was identified by Chi-Square and Fisher's exact tests. Association between genotype and VJ performance was tested using two-way ANOVA at  $p < 0.05$ . Analyses were performed separately in males and females because gender-specific influences of *ACE* polymorphism on phenotypic traits were observed.

**Results:** Genotype distribution of all control and athletic groups met the Hardy–Weinberg equilibrium (all  $p > 0.05$ ). Genotype distribution did not differ significantly between groups (VOP: 34.4% (DD), 45.9% (ID) and 19.7% (II); CON: 25.4% (DD), 61.9% (ID) and 12.7% (II);  $p = 0.179$ ), even when analysis was carried out separately between males and females.

Considering the results for athletic and non-athletic groups, VJ performance was significantly better in the VOP compared to the CON, in both, males ( $p < 0.001$ ) and females ( $p < 0.001$ ). According to the *ACE* I/D polymorphism, two-way Anova did not observe any effect of genotype on VJ performance in males. However, the genotype by group interaction ( $p = 0.043$ ) was detected in females. Female VOP with DD genotype have a higher VJ performance than ID and II carriers. No association between *ACE* I/D genotype and VJ performance was observed in non-athletic females.

**Conclusion:** Our study showed no differences in *ACE* genotype distribution in the elite VOP compared to the CON group. The D allele of *ACE* gene is usually associated with a higher proportion of fast, glycolytic muscle fibers and could favour power oriented performance. We have found gender-specific association of DD genotype with explosive leg-muscle power in female elite VOP. Results need to be confirmed in a larger sample.

**Keywords:** *ACE* I/D polymorphism, volleyball, vertical jump

## ULTRASOUND DIAGNOSTICS OF LATERAL ANKLE INSTABILITY

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*Introduction:* Ankle injuries involving the lateral ankle ligaments are among the most common injuries of the musculoskeletal system. Ankle ligament injuries are collectively known as ankle sprains, which refer to the mechanism of the injury rather than the degree of the injury. Diagnostic accuracy of complete lateral ligaments rupture with an acute instability of the ankle joint (grade III) and ligaments laxity in adults with the chronic ankle instability is problematic. Stress ultrasonography can image the lateral talocrural joint and evaluate acute or chronic lateral ankle instability.

*Purpose:* The aim of this study was to investigate the result of ultrasound diagnostics of lateral ankle instability in held-forced positions (anterior drawer test).

*Methods:* 20 patients were examined after acute lateral ankle sprain (grade III) under local anesthesia. 20 patients were examined with chronic ankle instability symptoms. Diagnosis of acute ankle instability and chronic ankle instability was based on musculoskeletal ultrasound examinations. The distance between the posterior rim of the tibia and talus was measured for each ankle. Then the distance was measured between the apex fibula and the edge of the calcaneus for each ankle. To diagnose the ligament tear as being a complete tear, the difference between the injured and uninjured ankle had to be greater than 3 mm in dorsal cuts (Ernst approach to identify talocrural instability).

*Results:* Ultrasound examinations performed under local anesthesia with ankles in held-forced positions (anterior drawer test) demonstrated significant differences in talocrural joint laxity between limbs. The difference between the injured and uninjured ankle was greater than 3 mm in dorsal cuts.

*Conclusion:* Stress ultrasonography in acute and chronic ankle instability identified significant differences in non-stress (basic neutral position) and stress position (anterior drawer test). Incomplete healing of the ligament tissue results in post-traumatic ligament laxity, predisposing the joint to further injury. Ultrasound imaging represents an effective, non-invasive and relatively low-cost method without negative side effects, which makes the ultrasound scanner a practical tool in the clinical setting.

*Keywords:* lateral ankle instability, post-traumatic talocrural joint laxity, stress ultrasonography, anterior drawer test

## THE DIFFERENCE BETWEEN TYPE OF PHYSICAL ACTIVITY ON THE VALUES OF BLOOD PRESSURE IN THE GROUP OF YOUNG WOMEN

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**Purpose:** Treatment guidelines for primary and secondary prevention of prehypertension and hypertension confirm the positive effect of no pharmacological lifestyle modifications like weight, sodium, alcohol intake reduction and increasing of regular physical activity. Recently, researchers have shown an increased interest in the relationship between health benefits of regular physical activity (>150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity) and maintenance of normotension. It is interesting to note, that the type of exercise has a significant effect in case of lower blood pressure (BP). Research has consistently shown that these positive changes are connected with aerobic or endurance exercise training. Besides that, the similar effect of resistance exercise training can be observed. The aim of this study is to investigate the differences between 3 months of regular aerobic and resistance exercise training in the group of prehypertension young women.

**Methods:** Twelve prehypertension women (age  $21.5 \pm 1.05$  years; body weight  $55.21 \pm 5.79$  kg; body height  $1.63 \pm 0.12$  m; resting systolic blood pressure (SBP)  $124.0 \pm 6.0$  mmHg; resting diastolic blood pressure (DBP)  $85 \pm 5.0$  mmHg) were randomly assigned to two groups (endurance (EG) and resistance group (RG)). Before the study, a ramp test was performed on a standard bicycle ergometer (Ergoline ergoselect 200). Measuring of BP was conducted with digital tonometer (Omron M3) 10 minutes before, 10 and 30 minutes after the each exercise in both groups. The exercise regimen was set up 2 times weekly (exercise programme lasted 50 minutes).

**Results:** The significant decrease were found between pre-test and post-test in the value of SBP and DBP in RG (SBP<sub>30min</sub>,  $p= 0.0332$ ; DBP<sub>30min</sub>,  $p= 0.0472$ ). The average decrease between pre-test and post-test was for SBP  $6.0 \pm 1.0$  mmHg and DBP  $3.0 \pm 1.0$  mmHg). The similar results (10 minutes before vs 30 minutes after exercise) have been found in EG (SBP  $3.0 \pm 1.0$  mmHg and DBP  $2.0 \pm 1.0$  mmHg).

**Conclusion:** From the outcome of our investigation, it is possible to conclude that regular and controlled resistance exercise training is also beneficial for improving the values of BP as regular aerobic activity.

**Keywords:** benefits, diastolic blood pressure, exercise, resistance, systolic blood pressure



## RESPIRATORY TRAINING COMBINED WITH AEROBIC TRAINING IN PATIENT WITH DILATED CARDIOMYOPATHY – A CASE STUDY

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**Purpose:** This case study demonstrates the benefit of expiratory muscle training with the Threshold PEP® combined with aerobic training in a patient suffering from chronic systolic heart failure (CSHF) based on diagnosis dilatation cardiomyopathy. CSHF is a serious disease with very bad prognosis. Cardiovascular rehabilitation (CR) reduces the symptoms of CSHF and thus improves the quality of life. The main symptom presented by the patients with CSHF is exercise-induced dyspnea and fatigue, which limits their ability to perform activities of daily life. Respiratory muscles function can be affected by heart diseases when the patients display weakness and respiratory muscle deterioration. A specific respiratory muscles training program improves muscle strength, functional capacity and quality of life for CSHF patients with weakened inspiratory and expiratory muscles. Improvement in cardiorespiratory indicators and indicators of exercise tolerance after completing CR reinforces the crucial role of physical activity too.

**Methods:** 44-year old patient with dilatation cardiomyopathy was assessed: resting echocardiography with left ventricular ejection fraction (LVEF) 16%, spirometry, mouth inspiratory and expiratory pressures measuring, 6-minutes walking testing (6MWT), measuring elasticity of the chest and also completed a modified Medical Research Council Dyspnea Questionnaire and Minnesota Living with Heart Failure Questionnaire. The respiratory training with Threshold PEP® methodology: in accordance with the discovered occlusion expiratory pressure, an expiratory resistance in centimeters of water column was precisely set to meet the patient's needs. Aerobic training complied with the criteria recommended for rehabilitation of patients with cardiovascular diseases issued by the Czech Society of Cardiology. The duration of the program was set to 10 weeks in total with a frequency of training 2 units per week.

**Results:** After 10 weeks long training with Threshold PEP® combined with aerobic training, a significant change in cardiorespiratory parameters, questionnaires and elasticity of the chest has occurred.

**Conclusion:** On the basis of positive results, we can indicate that applied respiratory and aerobic training is suitable and practicable for the patient. It positively influences the quality of life of patients with dilatation cardiomyopathy, improves cardiorespiratory indicators, reduces effortless breathlessness, and returns to the patient's self-confidence in activities of daily living. However, it is necessary to focus on these problems in more detail in the future.

## TYPES OF INJURIES OCCURRING WHILE USING RESTRAINT DEVICES IN POLICE WORK

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From the kinanthropological point of view, restraint devices represent an application level of combatives. It is a utilitarian use of combatives for the purpose of professional self-defense, the primary aim of which is to protect lives and health of citizens through developing physical abilities and skills, tactical thinking, psychical resistance etc.

Restraint devices are used in case of physical conflict between the Police and a citizen according to paragraph Sec. 52 of Act no. 273/2008 Coll. on the Police of the Czech Republic, Sec. 45 of Act No. 300/2013 Coll., on the Military Police of the Czech Republic and Sec. 18 of Act No. 553/199 Coll. on Municipal police of the Czech Republic. They can also be used when a citizen refuses to cooperate with the Police.

In this study, we have focused on mapping particular types of injuries occurring while using restraint devices. This research is based on a pilot study intitled *Identity of Police Organizations: Resolving Conflict Situations*, which was mapping types of injuries with the Municipal Police. The research methodology is the same, but this time we have focused on all kinds of police forces in the Czech Republic (the Police of the Czech Republic, the Municipal Police and the Military Police).

**Keywords:** Security forces, police, physical attack, violence on police, physical aggression, injuries, restraint devices, conflict situation, handling physical attack, solutions

## SPORT TRAINING

### DIFFERENCES IN AGILITY TESTS IN MALE AND FEMALE U16 AND U18 BASKETBALL PLAYERS

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The aim of this study is to determine and analyze differences in agility tests in both male and female U16 and U18 national basketball team. For this purpose, 30 male and 22 female national level basketball players were tested. Both genders were divided into U16 and U18 groups. U16 male players had an average  $15,27 \pm 0,67$  year, body height of  $192,41 \pm 6,22$  cm, body weight of  $79,80 \pm 9,57$  kg, U16 female were average  $15,45 \pm 0,93$  year, body height of  $179,63 \pm 4,89$  cm, body weight of  $69,39 \pm 8,92$ . U18 male players were  $16,66 \pm 0,78$  year, body height  $192,35 \pm 7,27$  cm, body weight of  $84,23 \pm 8,10$  and U18 female players had  $17,09 \pm 0,7$  year, body height of  $176,94 \pm 6,36$  cm, body weight of  $70,86 \pm 8,66$  kg. Testing was conducted of 3 agility tests: 20 yard test (frontal agility with  $180^\circ$  turn), side steps test (lateral agility) and T-drill test (combined frontal-lateral agility). Variable that was observed in each test was time from start to end of test that was measured with photocells. The collected data were processed with Statistica v12. Descriptive parameters showed better results of U18 players in all 3 agility tests. T- test for independent samples were used to determine significant differences between groups. The results of this study indicate that there were significant difference in 20 yard ( $F=1.28$ ,  $p<0.00$ ) and T-drill ( $F=1.71$ ,  $p<0.00$ ) test performed by male basketball player. Results between male U16 and U18 youth athletes in side steps test showed no significant difference. Furthermore, female groups did not have significant difference in any of three agility tests. The assumption is that the difference in tests is mostly caused by differences in physical growth and development between two groups. In future research one should observe level of running and direction change technique parameters on time values of each agility test.

*Keywords:* basketball, agility, youth national team

## THE EFFICIENCY OF VARIOUS RECOVERY STRATEGIES AFTER SPECIFIC ENDURANCE PHYSICAL LOAD AMONG SOCCER PLAYERS

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*Purpose:* The study deals with evaluation of the lactate response and recovery processes among soccer players after specific endurance physical load using the selected recovery strategies.

*Methods:* The screened sample consisted of 28 soccer players of U17 and U19 categories, who competed in the top national league (average decimal age  $17.0 \pm 0.9$  years; body height  $178.2 \pm 4.7$  cm; body weight  $69.3 \pm 6.7$  kg; body fat  $11.3 \pm 4.5$  %).

The effect of the selected recovery strategies (sport massage, local cryotherapy of a lower limb, whole-body stretching, active movement and passive recovery) on the level of recovery processes was evaluated on the basis of the lactate produced during the 20-minute period after physical load. Participants underwent specific endurance physical load using a Yo-Yo intermittent recovery test, level 2. The level of lactate was detected from capillary blood taken from the fingertips and recorded in the interval of 3, 5, 7, 15 and 20 minutes after physical load. The baseline was the level of lactate recorded before physical load. The study is the part of VEGA 1/0622/15 scientific project titled „The effect of regeneration on recovery of the body after aerobic and anaerobic load in sport “.

*Result:* In terms of metabolism, if compared between the 5<sup>th</sup> and 15<sup>th</sup> minute, the greatest decrease of the lactate level was found in participants with active movement recovery (decrease by 50.2 %), followed by massage (49.3 %), local cryotherapy of a lower limb (45.1 %), stretching (43.8 %) and passive recovery (42.4 %). In case of monitoring the entire rest phase, similar results were found, when the greatest decrease of the lactate level was observed in participants with active movement (decrease by 64.1 %), followed by stretching (55.3 %), massage (54.6 %), local cryotherapy of lower limb (54.3 %) and, finally, participants with passive recovery (53.1 %). Concerning statistics, Kruskal-Wallis ANOVA was applied; however, no statistical differences were found at the level of  $\alpha = 0.05$ .

*Conclusion:* As indicated by the results, the use of active movement recovery strategy appears to be the most efficient after aerobic-anaerobic load.

*Keywords:* Yo-Yo intermittent recovery test, recovery phase, lactate metabolism, massage, local cryotherapy, stretching, active movement recovery.

## THE RELATIVE AGE EFFECT IN THE WORLD JUNIOR TENNIS FINALS 2012-2016 (MALE)

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The issue of the Relative Age Effect (RAE) deals with the differences between the chronological age and the degree of the biological development of individuals. Mainly in the period of pubescence, big differences have been noticed in various areas (mental, anthropometric, strength, etc.) between individuals born in the beginning and in the end of the year/season. Biological acceleration resulting from an earlier birth date tends to be confused with sports talent; the influence of RAE shows itself most often in junior categories. This fact has been confirmed by research in a number of collective and individual sports, especially in soccer, ice hockey and tennis. The results of research studies of RAE in tennis have shown that the influence of RAE is more evident in boys than in girls. The aim of the study was to verify the influence of RAE in players of the World Junior Tennis Finals (WJTF) in 2012-2016 (n=240). They were grouped in three-member teams of individual countries, which means 48 players in the age 13-14 years took part each year. The research data (birth dates, results of WJTF matches) has been taken from the official tournament materials of the ITF. The data has been analyzed according to selected criteria (the whole observed period, individual years, semi-final matches, and ranking of players in team nominations). Verification of specific distribution was done by means of the Kolmogorov-Smirnov test (variations on goodness-of-fit) and the chi-squared test (variations on goodness-of-fit). A significant influence of RAE has been statistically proven in the whole sample (n=240) in the observed period 2012-2016 ( $\chi^2=108.6$ ,  $p=0.00$ ) and in individual years too. A significant influence of RAE has been proven in the players of the semi-final matches ( $\chi^2=42.06$ ,  $p=0.00$ ) in the whole observed period (2012–2016), however, it was lower than in the players of the whole observed sample. The influence of RAE has been proven in years 2012 ( $D_{\max}=0.51$ ,  $CV=0.375$ ) and 2016 ( $D_{\max}=0.59$ ,  $CV=0.375$ ) of semi-final matches in individual years. The influence of RAE has been proven according to the criterion 'ranking of players in team nominations' (1<sup>st</sup>, 2<sup>nd</sup> or 3<sup>rd</sup> player); the higher influence of RAE was observed in the first nominated players ( $\chi^2=44.68$ ,  $p=0.00$ ) than in the second nominated players ( $\chi^2=38.14$ ,  $p=0.00$ ) or the third ones ( $\chi^2=29.37$ ,  $p=0.00$ ). It can be stated that in the observed sample of tennis players, the influence of RAE has been confirmed in the whole observed period; a lower influence has been found in the players of semi-final matches. Further, it has been found that the influence of RAE shows itself also in players' nominations of individual national teams. The mentioned conclusions can be considered important for sports practice, especially for coaches, athletes and also parents.

*Keywords:* talent, pubescence, sport, biological age, chronological age

## THE COMPARISON OF THE INFLUENCE OF THE AGE EFFECT BETWEEN ELITE JUNIOR MALE AND FEMALE TENNIS PLAYERS

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The Age Effect theory is based on the assumption that the athletes born in the beginning of the calendar year are more successful than the athletes born in the end of the year. This “success” comes from the different stage of biological development especially in the junior age. The developmental lead, even just a few months, is often mistaken for a talent.

Several studies have shown that the Age Effect is not as strong in girls’ categories. One of the main reasons is that the strength abilities doesn’t play such an important role in girls’ case as they play in the case of boys - especially during the time when biological development is not over yet, which makes the differences between individuals even more obvious.

The first aim of this study was to compare the influence of the Age Effect between elite junior male (n=239) and female (n=240) tennis players, participant of World Junior Tennis Finals (WJTF) in 2007 – 2011. The second aim was to compare the influence of the Age Effect between the males (n=60) and females (n=60) players in the groups of semifinalists and finalists. The analyses were based on a comparison of the same quarters and same semesters (half-years) of the year between males and females (Q1 males and Q1 females, Q2 male and Q2 female, etc.). We’ve used a Shapiro-Wilk test for normality verification and the data was analyzed by the T-Test in IBM SPSS software. *The results of all players showed, that there were no significant differences between the quarters* ( $-0,37 < 1,96 = t_{Tab\ 0,05}$  resp.  $2,58 = t_{Tab\ 0,01}$ ;  $0,43 < 1,96 = t_{Tab\ 0,05}$  resp.  $2,58 = t_{Tab\ 0,01}$ ;  $-0,83 < 1,96 = t_{Tab\ 0,05}$  resp.  $2,58 = t_{Tab\ 0,01}$ ;  $0,01 < 1,96 = t_{Tab\ 0,05}$  resp.  $2,58 = t_{Tab\ 0,01}$ ). *The second comparison, based on individual semesters also didn’t confirm any statistically significant differences* ( $1,58 < 1,96 = t_{Tab\ 0,05}$  resp.  $2,58 = t_{Tab\ 0,01}$ ;  $-1,03 < 1,96 = t_{Tab\ 0,05}$  resp.  $2,58 = t_{Tab\ 0,01}$ ), *neither did the results of semifinalists and finalists* ( $0,2 < 1,96 = t_{Tab\ 0,05}$  resp.  $2,58 = t_{Tab\ 0,01}$ ;  $-0,2 < 1,96 = t_{Tab\ 0,05}$  resp.  $2,58 = t_{Tab\ 0,01}$ ) in individual semesters (no analysis between the quarters was made, because of low number of players in these groups). Although our previous studies confirmed the impact of the Age Effect on the groups of males and females, the comparison of individual quarters and semesters based on genders did not show any significant differences. Because of that, it is possible to conclude that there is no dominant component of performance in junior tennis players which would significantly differentiate males and females.

**Keywords:** birth date, talent, tennis, sport performance, gender differences

## EFFECTS OF RunningMax® GEL IN SKIN TEMPERATURE VALUES AND TRAINING RECOVERY

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*Purpose:* Implementation of quality methods of rest can help athletes and amateurs reduce recovery time and by that improve their working abilities. In later years an increment in usage of additional supplements was evident, as the trend is to use as many accessories in training, both professional and recreational. Sometimes it is not easy to determine the quality of some products. In this study, the effects of a RunningMax gel made of natural ingredients was monitored by taking thermal images with thermal camera FLIR E60 and by monitoring the level of blood flow on applied area.

*Methods:* Study consisted of 22 grown (age =  $25,0 \pm 4,6$  years, height =  $181,5 \pm 6,8$  cm, weight  $84,0 \pm 10,7$  kg), physically active males and females from Faculty of kinesiology University of Zagreb. The tests were performed at Sports diagnostics center at Faculty of kinesiology. Protocol was consisted of 5' rest to ensure normal skin temperatures, and then the RunningMax gel was applied on the area of m. soleus and m. gastrocnemius on right leg. Three thermal images were taken in the space of 5'. Left leg was also monitored and considered as the control sample. Data was statistically processed in Student's T-test for dependent samples and ANOVA, and with some basic descriptive statistics.

*Results:* Statistically significant differences in skin temperatures were found on all three spots on lower leg. It was found that the skin temperature was the lowest after the first thermal image measurement ( $1,08 \pm 0,07$  °C), or after 5' of the first RunningMax gel application. Slight increase of temperature was found after 10' and 15', which can be explained due to evaporation of gel, however the skin temperature was still significantly lower than on the control sample. All participants reported significant cooling sense on the applied leg. In unpublished preliminary study at Faculty of medicine in Osijek, significant increase in blood flow in upper arm was found after the application of RunningMax gel.

*Conclusion:* All these evidences confirm usage of RunningMax gel as an recovery tool, or method which can improve the quality of recovery. It delivers best effects after five minutes, but it is recommendable that further investigation should be aimed towards the repeated application of cooling gel, and possible prolonged cooling effects.

*Keywords:* thermal imaging, natural ingredients, cooling, sport, recreation

## CONTEMPORARY TREND IN TRAVELLING OF ELITE SPORT CLIMBERS

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The aim of the paper is to monitor the contemporary trend in travelling of elite sport climbers and use of the potential of climbing areas for the most difficult ascents. Travelling climbers become a part of a specific form of sport tourism that can be called climbing sport tourism. The analysis covered data of the realized most difficult ascents of the top thirty sport climbers (according to the ranking of 8a.nu) within the time span of one year. The source for the ascent evidence were climbing logbooks and the records in the season of 2016-2017. There are over 65 000 climbers from all over the world registered in the database. The ranking covers the best 2000 climbers and it is based on the evidence of the following factors: 10 best rated realized ascents within the last 12 months according to the numerical value of their difficulty, style of ascent and number of attempts. The analysis concerned 212 climbing areas where the selected elite climbers carried out their most difficult ascents, and 371 travels of the climbers in the mentioned areas. Most travels were recorded in the region of Margalef (14), Oliana (12) and Siurana (12) in Spain. They are followed by other Spanish regions of Cuenca, Rodellar and French St. Léger (8), Spanish Bielsa, and Santa Linya (7). Arco in Italy and Frankenjura in Germany (6) are also worth mentioning. The biggest numbers of the visited climbing areas (within one country) were recorded in Spain (146), followed by France (94) and Italy (48). It is necessary to emphasize that the selected respondents belong to the top level in sport climbing and the conclusions cannot be generalized in terms of all climbers. Differences in the style of travelling in the climbing areas can be found in the countries with a high climbing potential, such as Spain, France, Italy, compared to other European countries.

*Keywords:* climbing, geography of tourism, rock climbing, sport, sport tourism.



## SHOULD WE OBSERVE STANDING- AND RUNNING-VERTICAL-JUMPS AS UNIQUE OR SEPARATED QUALITIES FOR HIGH LEVEL BASKETBALL PLAYERS?

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**Purpose:** Vertical jumping is important capacity in basketball, but studies mostly observed jumps performed from standing position (STAND-VJ). Meanwhile, running-vertical jumps (RUN-VJ) are rarely examined, and there is no study which systematically observed associations between STAND-VJ and RUN-VJ in basketball. The aim of this study was to evidence associations which may exist between STAND-VJ and RUN-VJ in high-level basketball players, according to their position played in game.

**Methods:** The sample of subjects included 93 basketball players (age: 21.8±3.9 years; body mass: 89.1±11.1; body height: 194.4±8.1 cm), involved at highest national competitive levels (1<sup>st</sup> and 2<sup>nd</sup> Division). Players were divided into three playing positions: guards (N = 43), forwards (N = 19), and centers (N = 31). The variables included three STAND-VJ performances: countermovement jump (CMJ), drop-jump (DROPJ), and 6-consecutive-vertical-jumps; and four RUN-VJ performances: lay-up-shot-jumps from dominant leg (LUP-D), and non-dominant leg (LUP-ND), maximal running vertical jump from dominant leg (MAXR-D), and non-dominant leg (MAXR-ND). The Pearson's correlation, and factor analysis with subsequent Varimax rotation were calculated to determine associations between jumping tests. Analyses were stratified by playing position.

**Results:** Reliability of all tests was appropriate to high, with ICC values ranging from 0.80 (for LUP-ND), up to 0.92 (for CMJ and MAXR-D). Pearson's correlation coefficients among STAND-VJ and RUN-VJ were lowest in guards (r: 0.34-0.44), followed by forwards (r: 0.21-0.75), and centers (r: 0.54-0.69). Factor analysis calculated for guards identified two independent latent dimensions of (i) standing- and (ii) running-jump-capacity (Factor Variance: 3.4 and 2.1, respectively). For Forwards, two factors were also identified, the first-one was correlated with CMJ, DROPJ, MAXR-D and LUP-D (Factor Variance: 2.9), while the second-one was correlated to MAX-ND and LUP-ND (Factor Variance: 2.5). For centers, one significant latent dimension was extracted, with similar correlations of all jumping tests with factor component (Factor Variance: 5.0).

**Conclusion:** Results indicate necessity of differential approach in conditioning of standing- and running-vertical- jumping-performances for playing positions in basketball. For guards and forwards separated conditioning of standing- and running-jumps is needed. Meanwhile, standing- and running-jumping-performances for centers may be developed simultaneously.

**Keyword:** testing, conditioning, jumping abilities, basketball

## METHODICAL MODEL FOR CORRECTION OF COMMON MISTAKE IN THE BASIC SKI TURN PERFORMANCE

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Handling of characteristic errors is an integral part of the process of adoption of skiing techniques. The expert instructions help alpine skiers to train, so it is important to form and refine expert models for teaching and correction of characteristic mistakes. The aim of this research was to define the methodical exercises for correcting the error interfering with performance of basic ski turn. The respondent sample consisted of 20 skiing experts aged 25 to 45 years. They were interviewed by email on the typical errors which most often occur during performance of basic ski turn and then asked to select three most important ones on a scale ranging from 1 to 3. Following, the experts defined the methodical model of exercises for correcting the error leaning back forced turn (LBFT), which according to their opinion, interferes the most with performance of basic ski turn. Moreover, on a scale ranging from 1 to 5, they graded methodical exercises with potential to be used for correction of this error. In accordance with the objective set by the study a nonparametric chi - square test ( $\chi^2$ ) was used. Tested was statistical significance of the differences ( $p$ ) in the frequency of the expert evaluation of the three errors interfering the most with proper performance, and in the evaluation of the five methodical exercises which, in the formed expert model, have the highest significance in the correction of the LBFT error. There was statistically significant difference between the most efficient methodical exercises for correcting the LBFT error during basic ski turn ( $\chi^2 = 14$ ;  $p = 0,12$ ). Obtained results help in defining fundamental methodology of perfecting basic ski turn. Future research should concentrate on application of defined model during different conditions and its improvement.

**Keywords:** Expert evaluation, alpine skiing, methodical exercises, basic ski school.

## THE IMPACT OF EXERCISES WITH THE USE OF A REACTION BALL ON THE EYE-HAND COORDINATION OF BASKETBALL PLAYERS

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*Purpose:* The eye-hand coordination plays a meaningful role in performing the combination of movements. In basketball, this is the combination of dribbling and passing. The aim of this study was to analyze the impact of movement exercises with the use of a reaction ball on the level of selected coordination skills among men, who practice basketball.

*Methods:* The research was carried out on a group of 13 basketball players - aged  $20 \pm 0,9$  (height:  $185 \pm 6,1$  cm, weight:  $81,8 \pm 9,6$  kg), who were randomly divided into two groups. The first group (6) was performing specialized exercises with the use of a reaction ball, while the second group (7) was realizing the standard basketball training. The experiment lasted nine weeks and it was carried out twice a week – at the beginning of the initial training part. These exercises were not preceded by a warm-up. Each set of exercises lasted no longer than 8 minutes and it was carried out with a moderate intensity. The reaction ball was used in this experiment (weight – 5,6oz, dimensions: 3 x 3 x 3 inches). The exercises were connected with the performance of passes and catches realized between two players with the use of a reaction ball with one dribble. The players made a set of 3 exercises, in which they had to initially grab the ball with both hands, then grab it with the right hand and finally grab the ball with the left hand. During this exercise (maximum time: 8 minutes), each of the players always performed 90 repetitions. In the next weeks of this experiment, the distance between participants was increased (1, 3, 5 meters), and the number of repetitions was decreased (30 repetitions in 1-3 week, 15 repetitions in 4-6 week and 10 repetitions in 7-9 week). In both groups, two measurements of the eye-hand coordination (at the beginning and at the end of the experiment) were carried out with the use of the SPANT test (Spatial Anticipation Test) – Text2Drive computer system.

*Results:* The analysis demonstrated that in the group, where the specialized training technique was used, decreases in both reaction times and times of motor skills were observed. Additionally, the percentage of correct reactions was increased, and the percentage of out-of-range responses was decreased. Tests with a reaction ball showed that after the training based on this ball, the average level of successful attempts to grip the ball was increased, while reducing the time of individual attempts.

*Conclusions:* The obtained results show that exercises can significantly help to shape the eye-hand coordination. This directly translates into technical excellence and efficiency of movement. Due to the fact that basketball, in terms of coordination requirements, is included in a group of very difficult sports disciplines, the coordination preparation should be treated as a separate module in the substantive structure of training. The practice improves the process of control and regulation of movements what can lead to a shorter reaction time.

*Keywords:* Reaction time, basketball, reaction ball, Spatial Anticipation Test

## INTRODUCING AN INERTIAL MEASURING METHOD WITH SYNCHRONOUS VIDEO RECORDING BASED ON THE CASE STUDY ANALYSING THE FRONT CRAWL, BACK STROKE, BREAST STROKE AND BUTTERFLY STROKE

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Top level swimming has seen a significant growth in performance over the past twenty years. The cause of this rise can be found not only in the great amount and intensity of swimming training, but also in science and research investigations in this sport. The aim of this paper is to present our new measurement method for inertial sensors and synchronous video recording used for the analysis of swimming techniques. Since 2009, we have been using two tachographs to measure swimming speed and to carry out its analysis. Results of tachograph measurements were published previously. In addition to tachographs, since the beginning of 2017, we have been using an inertial measurement unit to measure the acceleration of swimming. This unit contains sensors of inertial variables in the MicroElectroMechanical System (MEMS) technology. Specifically, it is a triaxial accelerometer and a triaxial gyroscope. Unit control and transmission of measured data are wireless via Wi-Fi interface. Motion of the swimmers being measured is graphically and numerically evaluated, along with synchronous recordings from three underwater camcorders. In the present article, we will focus only on measurements with the inertial measuring unit where we will introduce our new measuring method for the qualitative evaluation of front crawl, back stroke, breast stroke and butterfly technique of selected probands. For the measurement, probands swam their entire distance with an accelerometer mounted on a belt above their pelvic bone. When measuring with the accelerometer unit on 8 March, 26 April, 31 May, 18 September 2017, the national team of OLYMP Sport Centre of the Ministry of the Interior was measured, of which we selected for our case study: M.J. (year 1997) - front crawl. On the 100-metre track, in the first twenty-five metres, the proband reached the swimming efficiency of 98.4% with a coefficient of variation of 0.074% and swam at a mean speed of 2.29 m.s<sup>-2</sup>. The proband K.D. (1993) reached, on the 100-meter track, in the first twenty-five metres, the swimming efficiency of 98.7%, with the coefficient of variation of 6.74% and the mean speed of 1.93 m.s<sup>-2</sup>. The proband T. J. (1995) swam the 100-metre track of breast stroke and reached the swimming efficiency of 84% with the coefficient of variation of 25.63% and the mean swimming speed of 1.39 m.s<sup>-2</sup>. The proband J. B. (2000) swam the 50-metre track of butterfly stroke in the first twenty-five metres with the swimming efficiency of 90.22%, the coefficient of variation 18.88% and the mean speed of 1.51 m.s<sup>-2</sup>. The conducted research measurements have confirmed the ability of the new inertial unit with synchronous video recording to deliver reliable results from the speed and acceleration recording; this allows us to accurately and, in greater detail, analyse the respective swimming cycles. Thanks to these results, we can advise the coaches to correct the errors in the swimming technique and thereby to improve their swimming performance.

**Keywords:** Swimming speed, acceleration, inertial measuring unit, accelerometer, efficiency of swimming technique.

## FACTORS INFLUENCING PASSING SKILLS DURING COMPETITIVE BASKETBALL GAMES

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Basketball is a team sport and thus passing in basketball is a very important offensive skill—it can lead, simply put, to assist or to turnover. The precise pass can create an advantage for the offensive team; for example, it can lead to an open shooting position. On the other hand, the inaccurate pass may create a disadvantage for the offensive team and can help the defending team. The aim of this study was to identify factors which may affect the passing skills in competitive games of women's basketball. 10 female semi-professional basketball players of the 2<sup>nd</sup> division senior team participated in this study. They were, in average,  $20.4 \pm 2.8$  years old, with a body height of  $178.5 \pm 5.2$ , and body weight of  $65.4 \pm 5.7$ . Passing skills were assessed during 5 competitive games. During all games, the heart rate and its development were monitored by the telemetric device. 451 overall passes were evaluated in detail and they were categorized as accurate and inaccurate. Based on the previous research, the four factors, which could be the main influence on the effectiveness (intensity of load, defensive pressure, ball possession duration, and game periods), were set as independent variables. Passing effectiveness was set as a dependent variable. Each of four factors was categorized (independent variables). Intensity of load was divided into 3 categories (<85%, 85-95%, and >95% of  $HR_{max}$ ); defensive pressure had 3 categories (low, medium, and high); ball possession duration was divided also into 3 categories (0-8 s, 9-16 s, and 17-24 s); and game periods had 4 categories (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup>). The influence of independent variables on dependent variable was expressed by binary logistic regression. Method of backward stepwise selection was used to find the best model. Only one regression coefficient included in the final model was statistically significant – the defensive pressure of the opponent. In conclusion, the chances for the bad pass are higher when the level of defensive pressure increased. Coaches should include these findings into team practices.

*Keywords:* heart rate, defensive pressure, logistic regression

## THE PHYSIQUE OF NATIONAL OLYMPIC TEAMS AND IMPLICATIONS FOR TALENT SELECTION

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The aim of this study was to compare body dimensions (height, weight, body mass index/BMI) of national male Olympic teams at the Summer Olympic Games 2000-2016. The results show that the national averages of height and BMI from the same regions are mutually similar. The mean height of Olympic teams is highly correlated with the mean height of young men in their native countries, and inter-ethnic differences in the BMI (which, in the case of trained Olympians, reflects primarily differences in muscle development) also agree very well with the documented inter-ethnic differences in lean body mass/BMI ratio. These data indicate that average physical characteristics of national Olympic teams reflect the body type prevalent in their native populations, which may have very important practical implications for talent selection strategies. A specific case is that of nations of the former Yugoslavia that have the tallest means of height among all the Olympic teams and whose physical characteristics have been investigated within a separate anthropometric project.

## A TOTAL SAMPLE VS. PLAYING-POSITION APPROACH TO IDENTIFYING RELATIONSHIPS BETWEEN DIFFERENT AGILITY COMPONENTS IN BASKETBALL

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**Purpose:** Non-planned agility (reactive agility - RAG), and pre-planned agility (change of direction speed - CODS) are important determinants of success in basketball. However, the association between these two conditioning capacities in high-level basketball players is rarely evidenced. The aim of this investigation was to evaluate the relationship between basketball-specific CODS and RAG in the total sample, and separately for three main playing positions in the game of basketball (i.e. guards, forwards and centers).

**Methods:** The sample comprised 106 national/international-level male basketball players (age: 21.9±3.5 years; body height: 195.1±7.9 cm; body mass: 90.1±10.0 kg), divided according to their playing positions in game (guards, N = 49; forwards, N = 22; centers, N = 35). The variables included body mass, body height, and body fat percentage; as well as basketball-specific CODS and -RAG. The reliability of CODS and RAG was evidenced by intra-class-coefficients (ICC). Differences among positions were established by one-way analysis of variance, consecutive post-hoc analyses, and effect size differences ( $\eta^2$ ). Finally, the relationship between variables was established by means of Pearson's moment correlation coefficient ( $r$ ), which was calculated for the total sample, and then separately for each playing position.

**Results:** The intra-session reliability was somewhat higher for CODS, than for RAG (ICC: 0.81 and 0.76, respectively). The centers were tallest (F: 67.75,  $p < 0.01$ ;  $\eta^2$ : 0.57), and heaviest (F: 39.01,  $p < 0.01$ ,  $\eta^2$ : 0.44), followed by forwards. The guards and forwards achieved better results than centers in CODS (F: 5.19,  $p < 0.01$ ;  $\eta^2$ : 0.09), and RAG (F: 3.85,  $p < 0.05$ ;  $\eta^2$ : 0.07). When observed for the total sample, the CODS and RAG shared 49% of common variance ( $r$ : 0.70). When calculated for playing positions, the highest correlation between CODS and RAG was evidenced for centers ( $r$ : 0.81), then for forwards ( $r$ : 0.71), and guards ( $r$ : 0.51).

**Conclusion:** Relatively strong correlations between CODS and RAG among forwards and centers implies the possibility of simultaneous strength and conditioning of these capacities for these two playing positions. Meanwhile, because of the small common variance, separate training for RAG and CODS is warranted for guards. The study highlights the necessity of a position-specific approach to evidencing determinants of sport-specific conditioning qualities for high-level players.

**Keywords:** pre-planned agility, non-planned agility, team sports, sport-specific test

## SPORT AND SOCIAL SCIENCES

### REIMAGINING TOPICAL CHALLENGES WITHIN THE KINANTHROPOLOGICAL FRAME

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This paper traces some topics which to may become urgent in the few next years for all those who are engaged in kinanthropology within the Euro-American cultural zone. We selected three topics which should be seriously considered as influential processes in the field of sportification, technologization and physical inactivity.

Within the theoretical frame of this paper we describe a core of these three phenomena and their ambivalent effects on modern human society. We argue a conceptual schema in which these processes are interconnected in some way and in which they influence each other in quite a multiple pattern. Some aspects of these processes can be understood as problems to be solved, despite their positive and negative effects in the social field. In our opinion, some conventional methods how to solve the negative effects of these processes often fail because they are based on a unilateral approach coming from a specific branch of study.

We propose a more multiple approach established on the specific interconnection of the philosophical, sociological and psychological perspectives. In the synergy of these perspectives we can find some new possibilities for a deeper understanding of the causes and consequences of sportification, technologization and physical inactivity in the kinanthropological frame.

In this way, we can transform these processes (including some problems which they bring) into urgent challenges for social studies in kinanthropology. The necessity to reconstruct a traditional portfolio of the most important kinanthropological issues comes from the rapid development of our society at the end of the 2010s.

Reimagining this portfolio also supports the role of social studies in sport, which has been somewhat suppressed recently in scientific research, because of the rapid development of the exact outputs provided by sciences, sport medicine and economic studies in kinanthropology.

*Keywords:* sportification, technologization, physical inactivity, synergistic approach



## THE EDUCATION OF SOCIAL SKILLS AMONG SENIOR HIGH SCHOOL AGE STUDENTS IN PHYSICAL EDUCATION CLASSES

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The purpose of this study was to reveal the peculiarities of the education of social skills among senior high school age students in physical education classes. Study hypothesis – the application of education programme would allow expecting more developed social skills among senior high school age students in physical education classes. Participants in the study were 51 pupils of the ninth grade ( $15.15 \pm 0.36$ ). Experimental group consisted of 25 and the control group of 26 senior high school age students. Tromso Social Intelligence Scale (TSIS), Problem Solving Inventory (PSI), Jusupov's questionnaire of empathy level diagnostics, and General Trust Scale (GTS) were used. Repeated measures (RM) multivariate analysis of variance ( $2 \times 2$  (Group  $\times$  Time) MANOVA) was used in order to analyse the effects of the educational program. It was found that during the educational experiment the applied measures of educational impact had a statistically significant effect on the components of experimental group senior high school age students' social awareness, empathy, problem solving, and trust in others skills in physical education classes.

*Keywords:* social skills, educational program, physical education classes, senior high school age.

## CROATIAN BASKETBALL IN CONTEMPORARY SOCIETY - WHERE HAS NATIONAL IDENTITY DISAPPEARED?

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Sports sociologists claim that general societal changes are also deeply connected with the world of sport. This claim can also be applied in the field of Croatian basketball. States that have undergone significant socio-political changes, such as Croatia, are fertile ground for research of national identity and its connection with sports. This article will deal with what has changed in Croatian sport and society since Croatian basketball's greatest success – a silver medal at the Olympic games in Barcelona – with an accent on the significance of national identity.

Through a qualitative discourse and content analysis of Croatian daily newspapers (Sportskenovosti, Jutarnji list, Večernji list), we shall attempt to explain how two large sporting events (the 1992 Olympic Games and the EuroBasket 2017) in which the Croatian national basketball team competed affected the structure of national identity in different ways. Taking into account the period of 25 years that marked the transition from a post-socialist society into a “crony capitalist” society, we suppose that changes have also taken place regarding the perception of the role of sport in creating national identity. Players in the 1990s who refused to play for the national team would be labelled traitors to the nation. We examine what is happening a quarter of a century later – do refusal to play for the national team, victory, and defeat carry the same weight? How connected is the relationship between basketball and Croatian society with media constructions versus real events in society as a whole? Based on a discourse analysis and a qualitative content analysis, we shall examine this case on three levels: media discourse, political discourse, and the discourse of the key players themselves – top athletes.

*Keywords:* national identity, basketball, content analysis

## PSYCHOLOGICAL CHARACTERISTICS IN SPORT TALENT DEVELOPMENT

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*Purpose:* Numerous studies identify and investigate psychological characteristics of elite athletes. They compare elite and the less successful athletes with the intention to reveal the reasons behind excellence of some athletes. These attributes, often termed Psychological Characteristics of Developing Excellence, also comprise several mental skills. They underpin quality and development of talent. These psychological characteristics are trainable and their improvement in sport leads to better performance in both long and short term perspective. Clear distinction of the key psychological characteristics is still missing in sport psychology literature. The purpose of this study is thus to identify the main mental skills connected with sport talent development. This will serve as a stepping stone for future creation of a diagnostic tool to measure their quality which may be utilized in sports talent identification.

*Methods:* Problem analysis and conceptual analysis based on 4 different approaches are used in order to identify the key psychological characteristics.

*Results:* Based on the extensive literature review, the following psychological characteristics and mental skills were identified: Self-efficacy, commitment, imagery, attentional control, coping with pressure, realistic performance and skill evaluation, goal setting, mental toughness, self-awareness

*Conclusion:* Psychological characteristics developing excellence and mental skills associated with talent development in sport were identified. They serve as a solid base for future creation of diagnostic tool development.

*Keywords:* mental skills, psychological characteristics of developing excellence, peak performance, sports talent, mental training

## PARENT–ATHLETE INTERPERSONAL RELATIONSHIP IN SPORT: THE IMPORTANCE OF ATTACHMENT

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The purpose of this qualitative interpretative phenomenological analysis was to examine parent–athlete interpersonal relationships in youth sport. The second aim was to gain an understanding about the importance of the athlete attachment to parents in youth sport. Interpretative Phenomenological Analysis method (IPA) (Smith, Larkin, Flowers, 2009) was selected. Eight youth sport parents participated in one in depth semi–structured interview (total of eight interviews). The data were analyzed using interpretative phenomenological analysis. Three key themes were identified: Parent–athlete attachment; Secure athlete attachment to parents; Insecure athlete attachment to parents. The phenomenological interpretative analysis has revealed the importance of athlete attachment to parents in youth sport. Interviews with athlete parents revealed that involvement into children’s sport is more important in the early period of youth sporting experience and become less appreciable or unwelcome when children gain sporting experience. Parents–child attachment in early childhood has an affect in youth sport participation. Secure attachment ensures a positive and safe development in children's sports: the child becomes confident, independent, goal–seeking, result oriented, able to regulate emotions in sport and easily integrates into a sporting environment. In contrast, insecure parent–child attachment leads to a athlete demotivation, disability to survive in a competitive environment which in tern can lead to a drop out of sport phenomenon.

*Keywords:* Parent, athlete, attachment, sport.

## THE ROLE OF SOME MODERATING VARIABLES THAT WE SHOULD NOT IGNORE IN ORGANISED PHYSICAL EDUCATION, SPORTS AND IN ADOLESCENCE MOTIVATION.

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We live in an eminently sedentary society, which causes a lot of physical and mental problems while increasing health costs. In addition, adolescence is considered to be the stage where more people decline the physical activity levels, most of this abandon is related with the Importance and Utility of Physical Education Perception (IUPEP) on school. Literature suggests that IUPEP could be explained through Sport Motivation (SM). Although many studies had analyzed this relation, no research considers the moderating effect that Teacher Learning Climate (TLC) and Student Learning Orientation (SLO) could have simultaneously on this relation on adolescents. Therefore, the aims of the present research are both to analyze the impact of Sport Motivation on the Importance and Utility of Physical Education Perception, and to analyze the moderator effect of Professor Learning Climate and Student Learning Orientation on that relation. This analyses was performed using the PROCESS macro (Hayes, 2013), designed for testing the moderation by directly assessing the significance of the indirect effect of the independent variable (X; SM) on the dependent variable (Y; IUPEP) through two moderators: TLC (M) and SLO (W). Participants were 267 adolescents from 8 classes of a public school on Valencia, aged between 11 to 18 years old (Mean=14.04 ± 1.64), 52.8 % boys. Results suggest that Sport Motivation explains 21% of the Importance and Utility of Physical Education Perception. In addition, a moderating effect of both Teacher Learning Climate and Student Learning Orientation is observed.

*Keywords:* Sport Motivation, Dropout , Importance and Utility of Physical Education Perception, Teacher Learning Climate.

## PHYSICAL EDUCATION OF STUDENTS WITH VISUAL IMPAIRMENT IN CZECH SCHOOLS

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Over the last twenty five years, the inclusion of pupils and students with visual impairment has been possible in the Czech Republic. It is necessary to find actual situation in practice to evaluate the benefits and risks of current methods and supportive strategies. The aim of this paper is focused on charting the actual level of inclusion of pupils/students with visual impairment aged 7 to 18 years in physical education. This data is important to upgrade the quality of inclusion in Czech schools.

A quan/qual research design was used in research surveys. The research group consists of experts - special education teachers and advisers and physical education teachers at primary and secondary schools in the Czech Republic, who teach pupils with visual impairment. We concentrate on the assessment of teachers' competence in support strategies and in the quality of environmental conditions; assessment of the level of use of support aids and strategies for the education; assessment of the level of teachers' experience and regarding the subject of PE and level of support from experts from regional support center for pupils/students with visual impairment.

The results show that the level of education and provision of support measures is still unsatisfactory in a large number of schools. Based on the results, the following recommendations are formulated: To improve the awareness of schools about the possibilities of education and to support the motivation of teachers for their completion. It is also necessary to increase the number of teaching assistants for the subject of PE and/or reduce the number of pupils in PE lessons. It is also important to ensure control activity in schools concerning the provision of support measures, including aids and environmental adaptations for which schools annually receive finances.

Education of primary school pupils in the area of locomotor development should be regarded essential for future exercise regimen and prevention of lifestyle diseases. Pupils with visual impairment belong to the risk group of persons with lack of movement. But majority of pupils with visual impairment are educated inclusively; however, researches focused on the quality of physical education lessons in the Czech Rep. have not been implemented yet. The research results will become the basis for monitoring the development of quality of education following the new legislative norms of the Education Act. The basic anticipated reflection of the new legal system is an increase in the number of pupils with VI participating in PE and introduction of further support measures into PE lessons. Moreover, the results will help create special means of support for teachers at mainstream schools to educate pupils with visual impairment.

*Keywords:* adults, low vision, visual rehabilitation, reading performance, adaptation of external conditions, research.

## OLYMPIC VERSUS OLYMPIC GAMES

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To discuss any problem relating to broadly understood phenomenon of sport, means to respect the fact, that sport reflects its relevant social background. Olympic culture is defined as everything that has origins in the ideas, activities and realities that surround it. This embraces past and present, strengths and weakness, successes and failures, virtues and vices. And specific aspect or manifestation of olympic cultures. Olympism as a philosophy of life, exalting and combining in balanced whole the qualities of body, will and mind. The fundamental principles as stated in the Olympic Charter are accenting Olympism as a philosophy of life, exalting and combining in balanced whole the qualities of body, will and mind. And more visible and tangible of the culture of Olympism are Olympic games. The fundamental and main objective of establishing of modern Olympic games was rooted in intention to be a means by which to create a modern global „festival“ of sports. At the time of being the escalation in the cost of staging the Games requires justification: Winning the Games functions to enable a whole range of giant infrastructural projects that would otherwise struggle to win support „Legacy“ has become justification in the rhetoric of people and institutions being from various reasons and aspirations involved in Games.

*Keyword:* Sport, Culture, Olympism, Olympic games.

## SOCIAL DEMOGRAPHIC FACTORS AND DOPING OF CZECH ADOLESCENTS

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International research shows that performance enhancing drugs represent a serious problem both in competitive and leisure sports, affecting not only adults but adolescent athletes as well (Ntoumais et al., 2014; Kindlundh et al., 2008; Lucidi et al., 2008). We realized research project focused on doping in Czech adolescents (Doping in the Czech adolescents: Prevalence, correlates and experiences) granted by WADA. We hypothesized that some demographical variables (gender, socioeconomic background, type of school), and the motivational orientation towards sport involvement (such as goal orientation, intrinsic/extrinsic motivation, sources of sport confidence), are related to doping behaviour. The main goal of the project was to bridge this gap and conduct a systematic comprehensive research on doping in the Czech adolescents involved in sports both on elite and recreational level. The project was conducted in two stages when a large scale quantitative survey was complemented by qualitative in-depth interviews. In total, we collected fully completed questionnaires from 2851 respondents (mean age 16.2 years, SD=1.84).

Here presented results concern quantitative part of the project, especially demographical data and prevalence of doping. The results show that use of doping was related to gender, age, level of sport participation, and family economic status. Doping was reported significantly more frequently by men, students of vocational schools, and students of sport schools, coming from families of more educated and physically active parents. We assessed also the attitudes of Czech adolescents toward doping (by Performance Enhancement Attitude Scale, Petroczi, Aidman, 2009). Negative attitudes towards various aspects of doping reported 53.3-90 % of the sample. After conducting a correlational analysis (Spearman correlational coefficient) we found a significant relationship between the use of doping and gender, age, economic background of the family, level of sport participation and intention to doping use.



INTEGRATING PHYSICAL EDUCATION AND GEOGRAPHY IN THE REALISED CURRICULUM – A QUESTIONNAIRE SURVEY IN THE CZECH REPUBLIC, THE REPUBLIC OF SLOVENIA AND DENMARK

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*This work was supported by a MU - Faculty of Education Grant ("Curriculum Research Physical Education and Health Education", MUNI/A/0994/2016).*

*Purpose:* This paper aims to address the lack of international knowledge and research in interdisciplinary curriculum development and teaching in the subjects of Physical Education and Geography. The aim of this international study, between universities from the Czech Republic, Denmark, and the Republic of Slovenia, focuses on a comparison of questionnaire survey outcomes among teachers in these subjects. The main problem focuses on how Physical Education and Geography is integrated and combined in the real school life.

*Methods:* A questionnaire survey which was carried out in the school year 2015/2016, in order to determine how experts (teachers in lower and higher primary classes, university experts, or other specialists) perceive the integration of physical education and geography. The questionnaire survey was developed using Google Docs forms and completed on-line by participants.

*Results:* The results of the questionnaire survey showed that while interdisciplinary integration is often mentioned and encouraged in the curricula documents and most teachers believe that the integration of PE and Geography is important, the subjects have not been integrated sufficiently.

*Conclusion:* The type of learning experience we have while in school underpins how we integrate everything we learn, as well as how we transfer knowledge and skills from one experience to another.

*Keywords:* physical education, geography, curriculum, cross-curricular interdisciplinarity, integration, comparison

## THE VOLUME AND INTENSITY OF MOTORIC LOAD OF PRIMARY SCHOOL CHILDREN IN THE IMPLEMENTATION OF INTEGRATED FIELD WORK EDUCATION.

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*This work was supported by a Faculty of Education Grant ("Curriculum Research Physical Education and Health Education", MUNI/A/0994/2016).*

*Purpose:* This paper focuses on children's physical activity during the school day. It also deals with the integrated field work as one of the forms of teaching and its possible influence on the children's physical activity throughout a school day at primary schools. In the research we analysed each method of teaching in terms of the amount of steps the pupils reached and their metabolic rate. The minor aim is to verify the use of ActiGraph accelerometers by teachers at schools and to provide basic information about the devices to the potential users.

*Methods:* The paper compares three types of a school day. First a day of frontal teaching, then a day with a physical education lesson and finally a day where integrated fieldwork education is implemented. Each type of the day is analysed in terms of the amount of steps the pupils reached and the metabolic rate in MET units.

*Results:* The Physical Education class had the highest volume of movement - 1,202 steps in 45 minutes. However, integrated fieldwork education with 1,118 steps in 45 minutes may be comparable to a class of physical education in terms of the number of steps. The Weakest in terms of steps and the amount of physical activity was a habitual education class, where students walked an average of 218 steps in 45 minutes. We also tried to find out the intensity of the physical load of pupils at the school age. The physically most demanding form of teaching was once again a physical education lesson, during which pupils achieved a medium physical load, above 3 MET. For integrated fieldwork education the metabolic output was below 3 MET, namely, 2.63. The lesson of habitual teaching is characterized by a low intensity movement load, 1.81 MET.

*Conclusion:* The research results in integrated fieldwork education being significantly more physically active than a habitual class and being comparable with a physical education class.

*Keywords:* ActiGraph, accelerometer, children physical activity, metabolic rate, school day, fieldwork, integrated fieldwork education

## MEDICAL AND BEHAVIOURAL CHARACTERISTICS OF THE SECONDARY SCHOOL TEACHERS OF PHYSICAL EDUCATION

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In paper we mention chosen secondary school teachers (with PE teaching qualification) opinions and attitudes to a day mode and regimen. Further, we focus on a psychosocial function of motion activities and sport. This paper is a part of a wider research and follows the part dedicated to teachers with other qualifications.

The research survey was implemented by a method of questionnaire in different types of secondary school (grammar school and vocational school with GCSE exam). The total number of respondents was 461 individuals (262 men and 199 women). For the purpose of a graphical and statistical data processing SPSS and Excel programmes were used. The results we present from the view point of gender.

We consider as a positive findings that a big majority of teachers supports adequate motion activities and sport. Majority of them also takes their meals regularly and a strong majority is constituted from non-smokers. The negative finding is mainly the fact that the majority of research sample get stressed because of their work very often. In total, teachers with PE teaching qualification reaches lightly positive results than their colleagues without this qualification as well as than common Czech population.

*Keywords:* teacher, secondary school, daily regime, regimen, physical education, sport

## ETHICAL PROBLEMS OF SPORT

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Sport as a social and cultural phenomenon reflects contemporary highly competitive and medially influenced society. In this context traditional accent on fair play in the field of sport is relativized in context of sports ethics as asset of norms generally accepted in the top level performance-oriented sport as means for achieving maximum success and as an expression of identification of the top level athlete who is fully devoted to the values of performance, victory and reward. Top level sport contributes, in a specific and relativized manner, to the creation of the social criteria of success, wealth and prestige. The risks of negative effects of sport are necessarily considered also in connection with the process of commercialization of sport. As the respond therefore public recognition and political support should only be given to an attractive and demanding sport fair in every respect, satisfying individual as well as collective interests of democratic society.

*Keyword:* sport; fair play; ethics; mass media

## PHYSICAL ACTIVITY OF SPECIAL OLYMPIANS DURING A SUMMER OUTDOOR CAMP

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The goals of the Special Olympics Healthy Athletes program is to assess the level of physical activities of individuals with mental disability. Studies indicate that people with a mental disability are less engaged in physical activity than their peers. The published data was mainly collected from oral feedback. The intention of this study was to assess physical loading during one week summer outdoor camp. The objective of the project was to assess the physical activity of Special Olympians during one week summer outdoor camp using an accelerometer and to analyze their level of physical activity of in relation to gender and age cohort of the camp participants. Forty-seven participants (21 males, 26 females) at the age from 14 to 52 wore a GT3X ActiGraph to record their physical activity levels for 7 days during the outdoor camp from 7 a.m. to 10 p.m. Every day their activity was recorded by trained volunteers (camp leaders). The content of activities was based on the principle of E.K. Shriver camp and consisted of walking, hiking, easy team outdoor plays, table tennis, cycling. Participants realized the exercises in co-educated groups (males and females together) with respect to their age, physical and intellectual capacity. The physical activity levels of participants were higher than published guidelines.

Average items: males 4,943 steps per day, 68 min of moderate activity/day; females 3,727 steps per day, 49min of moderate activity/day. Our sample was 1.7 times more active than an ordinary population. These findings disagree with the previous published results even if we respect that they were at an outdoor physical activity camp. In spite of the fact the guided program was similar for both genders: the males were more active than females, which is relevant with findings in the general population. The analyses of the achievements of the age cohort older than 35 years showed the daily results: 13 males - 4,056 steps and 32.5 min of moderate activity; 13 females - 2,881 steps and 26.5 min of moderate activity. Regarding the level of physical activity we can conclude the persons with intellectual disability (Special Olympians) can realize a higher level of physical activities under a guided program. The local Special Olympics initiatives are beneficial for people with intellectual disability. The project should be repeated with the same participants during their regular week and in relations to their BMI, fitness variables, etc

*Keywords:* Intellectual Disability, Eunice Kennedy-Shriver Camp, Steps, Accelerometer

## SELECTED VIEWS OF STUDENTS TO THE STUDENT EVALUATION OF SPORTS TEACHING

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In relation to requirements for quality of university education, the importance of student evaluation of teaching (SET) also increases. The paper is specifically focused on SET at the Faculty of Sports Studies Masaryk University (FSpS MU). The introduction briefly characterizes the concept and significance of SET, it deals with some specifics of the university sports teaching and the related requirements of the SET. In addition, it gives some experience with previously used tools of SET at FSpS MU. The empirical part of this text deals with selected views of the students themselves to the SET. The aim of the qualitative research was to find out the opinions regarding the SET of the selected FSpS MU students. On the basis of the research carried out, the conclusion of the paper presents some suggestions that can contribute to a more efficient use of student evaluation of university sports teaching.

*Keywords:* quality of teaching, student evaluation of teaching (SET), university sports teaching

## HEALTHY COMMUNITIES - RESEARCH PROOF OF WELLNESS PROGRAMS AT THE SPECIAL OLYMPICS MOVEMENT

Milada Krejčí, Jiří Kajzar, Jitka Gigalová

The Special Olympics has been focusing in the long term perspective on the health support of athletes with mental disabilities in the past 15 years. The intent is to realize the maximum individual potential of each individual on the basis of an integrative educational effect so as to achieve the best performances in sports facilities and in daily life activities. The aim of the presented study is to optimize circadian habits, including movement interventions, with regard to age, current status and needs of the individual with mental disability. The methodological basis of the research is an investigative pentagram and an intervention aimed at verifying simple, affordable educational wellness programs for people with mental disability in the sense of the WHO's current definition of Wellness. The results are used in practice by trainers to improve health prevention of mentally handicapped people and can also be used as a tool for saving the cost of expensive medical treatment of chronic illnesses resulting from an improper lifestyle. The research is carried out within the framework of the three-years project "Healthy Communities", ID No. ZAS Y1 16-600-14 (April 2016 - March 2019) with competence for the Prague region.

*Keywords:* sport, health, people with mental disabilities, sleep, endurance

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### *Introduction:*

Sport policies play an important role in achieving the recommended levels of physical activity for health and physical fitness. Although written sport policy documents reflect political commitment to take action and are important measures of accountability (Bull et al., 2004; Schmid et al., 2006) there is a lack of research of how these sport policies are addressing the issue of physical fitness. So far there have been conducted analyses of policies promoting physical activity but only at EU and national level (Bull et al., 2004; Daugbjerg et al., 2009, Christiansen et al., 2014). Therefore this article aimed at reviewing and analysing recent regional sport policies in Czech Republic with a focus on the measures that are suggested to support the fitness -enhancing physical activities.

*Methods:* Desk research method has been used for identifying the relevant policy documents on sport and physical activity in 14 Czech regions. Systematic content analysis of all documents has been conducted. Categories suggested by Christiansen et al. (2014) were used for the content analysis of the policies. Thematic coding (Strauss a Corbin, 1998) and the Atlas .ti software have been utilized so to categorize, summarize and present the main output as the Network Views.

*Results and conclusions:* The preliminary results of the study showed that sport strategies in Czech regions differ significantly in terms of general information, the formulation, content, implementation, evaluation, and clear allocation of resources. In general they contain aggregate goals that address physical activities and health on an overall level by recognizing the importance of Sport for All approach. Few also focus on various target groups specifying time frame and responsible body for implementation. However, in almost all strategies, there is a lack of measurable targets, specified budgets, and indicators that would enable the evaluation of the regional development in the physical activity, physical fitness and health. Cooperation with other sectors such as health and education is envisaged, but strategies lack identifying the areas where this could take place.

*Please note:* Full results are not available at the time of abstract submission, but will be presented at the conference

*Keywords:* regional sport policies, physical fitness- enhancing activities, indicators of physical activity, indicators, resources



## SPORT MANAGEMENT

### THE YIN AND THE YANG

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The presentation attempts to build a case for a fundamental change to the way we view sport management from both an academic and practitioner's viewpoint, by accepting the fundamental tenet that sport has a simultaneously positive and negative impact on our lives. If we accept this we are then in a position to understand the impact that sport has on our quality of life and ensure that our sport management practice considers both the positive and negative impacts in equal measure when making recommendations for improving our lives through sport.

In broad terms, examples of how the impact of sport have both positive in negative consequences to the quality of life, arguably in equal measure, although this has never really been either quantified or qualified. Anecdotal evidence suggests that while we may rationalise our sport policies and our decisions to fund and actively participate in sport through the benefits and the positive impacts that it has, or is assumed to have, we must always be aware of the potential risks and negative impact that sport may have. The accepted approach that is taken to developing objectives and their accompanying KPI's is used to illustrate the need for us to move beyond the simplicity of SMART objectives towards a more holistic view of sport and the impact that it has on both society at large as well as the individuals who live within its confines.

Sport has an important part to play in the development of society and the people within it. Our justification for being involved in sport depends upon our belief that it is only good for us. However for sport to truly have a positive impact on our quality of life, we must also understand the negative influences that are inherent to life itself. By developing our monitoring and evaluation framework more broadly and comprehensively, we have a better chance of preventing, detecting and dealing with negative impacts before they become problematic enough to negate the positive.

This address raises important questions about the appropriateness of the contemporary approach to sport management that on occasion, blindly embraces the positive benefits of sport without properly evaluating the alternatives.

This address may provide a basis for informed critical approaches to evaluating the impact of sport on the quality of life, the main theme for this conference.

*Keywords:* Sport organisations, quality of life.

## ECONOMIC INDICATORS AND THEIR IMPACT ON ATTENDANCE

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The paper deals with the economic indicators and their impact on attendance. It focuses on the comparison of the average gross monthly wage and unemployed rate with average attendance. The aim of the paper is to try to find out if there is any connection or dependence between those economic indicators and attendance over the years. Also there is a comparison of outcomes from the Czech Republic with Germany and England for better picture.

*Keywords:* Economic indicators, average gross monthly wage, unemployed rate, attendance, sport

## AUDIT OF CORPORATE CLIMATE IN SPORT RELATED ORGANIZATIONS

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Competitive advantage of sport related organizations heavily depends on what is the state of organizational climate and ability to increase effectiveness and efficiency. It is already a tradition to analyze this in business corporations and herewith an effort is made to discover differences and similarities of diagnosing/auditing sport related organizations.

It is proposed and understood by the author of this paper that classification of sport related organizations is to be viewed from the model proposed in the paper published in 2015 based on a presentation at this very conference in 2014. (Sport Sector and its Sources Of Sustainable Competitive Advantage). As a consequence different category organizations and their key elements are discussed here.

An audit has been conducted in more than two dozen of sport clubs and associations in Hungary base on a set of upto 10 dimensions characterizing the state of the climate in the organization. The major findings will also be presented to demonstrate the challenges faced and propose alternative sets of solutions.

*Keywords:* competitiveness, organizational climate and culture, audit

## GYMNASTICS AND CROATIAN SOCIETY – WHAT HAS THE MEDIA GOT TO DO WITH IT?

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Croatia has attained its best gymnastics results in the past three Olympic cycles, mostly at world cup events. When gymnast Filip Ude won a silver medal in the pommel horse at the Olympic Games in Beijing in 2008, gymnastics entered the Croatian media space through the “back door”. Until then, despite tradition, gymnastics had held the status of a “small sport” in Croatian society. Shortly before the Olympic Games in 2008, Ude was not mentioned as a potential Olympic medal winner. In fact, the newspapers wrote nearly nothing about gymnastics. “Big” sports took the foreground, such as handball or athletics. After successes at the Olympic Games in Beijing, the status of gymnastics in the Croatian media changed, however, what happens with media interpretations when results begin to flounder?

From a sociological perspective, an analysis of media discourse related to gymnastics is noteworthy because it enables us to understand the relationship between “small” sports and society. The goal of this research is to answer three questions: how does the Croatian print media perceive Filip Ude as an athlete, how did the media discourse change in three Olympic cycles according to sporting successes or “failures”, and how does media discourse affect the perception of gymnastics in Croatian society?

Different qualitative methods were used – an interview with Filip Ude and his coaches, as well as a content and discourse analysis of print media and documents. The analysis was performed on all texts concerning this topic published in three high-circulation Croatian daily newspapers – Jutarnji list, Večernji list, and Sportske novosti, three days before tournaments, during tournaments, and three days after tournaments. We analysed three sporting events – the 2008 Olympics, the 2012 Olympics and the 2016 Olympics.

## THE EFFECTS OF SPORT INVOLVEMENT IN A CORPORATE STRATEGY ON EMPLOYEE LOYALTY – FOCUS ON YOUNG GRADUATES IN ECONOMICS

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Very low unemployment, prosperous economy and a high number of free work positions create appropriate conditions for young absolvents in the Czech Republic. They take advantage from the situation and do not hesitate to change jobs in order to find better one. They are characterized with high fluctuation and low loyalty. As hiring and training processes are very costly, the employers need to think about a way how to make their new joiners want to stay longer. This paper investigates whether including sport in the company's strategy can cause higher loyalty of its employees. The paper focuses on young graduates in economics as they have a wide range of possibilities on the labour market. The 85 respondents completed the online questionnaire where they answered questions related to the satisfaction and loyalty. The 72 respondents matched with the target group of the survey. There were three hypothesis on employee loyalty stated and tested through chi-square test on a significance level of 5 %. The research results shows association between the employee loyalty and sport involvement in corporate strategy. The relation between attitude to sport of the employees and the evaluation of this strategy was not proved. What can affect the employee loyalty is their satisfaction.

*Keywords:* employee loyalty, employee satisfaction, sport, strategy

## RUNNING RACES IN HRADEC KRÁLOVÉ AND THEIR INFLUENCE ON TOURISM DEVELOPMENT

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*Purpose:* The aim of the research is to describe and analyse an influence of running races held in Hradec Králové and its close surroundings (Hradecko) and to evaluate their influence on tourism development. The emphasis was laid on the biggest running event in Hradec Králové in the last years, OlfinCar Half Marathon and ČSOB Marathon of Hradec Králové 2016. The event belongs to the top ten running races in the Czech Republic.

*Methods:* An outline of all the running races held in Hradec Králové in 2016 was made in content analysis of relevant sources. The total number was 30 races. Their attendance was examined in the period of 2013 – 2016. The influence on tourism was evaluated by means of the use of basic tourist services – catering, accommodation and transport, and also the attendance of local tourist attractions and tourist information centres in Hradec Králové. The research comprised a questionnaire survey (n = 308) and structured interviews (n = 52). The questionnaire survey was carried out among the OlfinCar Half Marathon of Hradec Králové and ČSOB Marathon of Hradec Králové 2016 runners. The second part for data collection were structured interviews (n = 52) among employees in tourist services - catering (n = 25) and accommodation (n = 15), tourist attractions (n = 9) and tourist information centres (n = 3).

*Results:* As a result of the analysis an overview of 30 running races held in Hradecko was compiled. In the years 2013 – 2016 there was an increase of the overall attendance of running events, the biggest of which was between the years 2013 and 2014 (by 73%). The attendance of individual races was fluctuating, however, in 2 races (OlfinCar Half Marathon of Hradec Králové and Run Tour) the increase was continuous in all the analysed years. The biggest impact of running events on the selected tourism services was found in catering, followed by accommodation and transport services. Research showed that the organization of running racing events had no significant influence on attendance of the selected tourist attractions in Hradec Králové.

*Conclusion:* Increasing in popularity of running can be supported by the evidence of continuous increase in attendance of running races in Hradecko in the years 2013 – 2016. Running events have potential to support the development of tourism, which was applied in this research. However, the results suggest that the proportion of influence on tourism does not correspond to the size and regional significance of the selected sport event, OlfinCar Half Marathon of Hradec Králové and ČSOB Marathon of Hradec Králové 2016. Accommodation, transport services and attendance of tourist attractions were not significantly influenced. A positive economic influence was found out primarily on catering services, especially in the facilities situated close to the historical city centre.

*Keywords:* running race, sport event, sport tourism, tourism services, half marathon.

POSTMODERNISM IN SPORT MANAGEMENT AND SPORT DEVELOPMENT IN IRAN:  
REQUIREMENTS, PROCEEDINGS

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Developing sport nationally, is a significant part of national economic and social development of any country. Sport promotion in all aspects of a nation identity will lead to the incensement of social pleasure and national productivity. Promotion of Championship sports in a nation will cause them to be known all around the world. Achieving place and getting national credit and honor is one of the stimulus factors among nations. Sport managers though should consider a horizon beyond short term obstacles and temporary issues of their organizations. They should respect the ideas of their staff and persuade the staff to foster creative, self-controlled, self-organized and co-creative human resources as well as being creative themselves. All these words mean that it is necessary to be a postmodern manager. Moreover complex conditions of today's life make it necessary for managers to be updated with modern management methods and processes more than before. Therefore, the purpose of the present study was to study the role of postmodern approach in management and its role in sport development in Iran. The present study was a field research using correlation test. The population were all the experts and stakeholders of Sport and management of Iran. Theoretical sampling method was used according to the population size (N=160) and 112 questionnaires remained eventually. To collect data two researcher-made questionnaires including "postmodern management questionnaire" and " sport development questionnaire" were used after reliability and validity confirmation. For Inferential statistics, Kolmogorov-Smirnov and Spearman correlation tests were used by 22nd version of SPSS. Also the 8.8th version of Lisrel software was used to test the construct validity and structural equation modeling. The researchers did their best to collect and analyze the questionnaires as confidential as possible. The results showed that there is relation between postmodern management and sport development and its components. Also surveying regression coefficients of research structural model showed that postmodern management has positive impact on sport development. Also servant leadership and development of educational sport are the two variables which have the most impact in this area. Regarding to the research results managers creativity on paying more attention to promote the culture of debate among staff, staff cooperation in problem solving, motivating staff to have common values on sport and their own organization, promoting criticism and being criticizable, propagating team research activities among staff, positioning Human Resources based on organizational place instead of social place, behaving based on rule, decision making according to knowledge and truth, limiting latitudes and specializing the tasks due to achieve maximum efficiency are fundamental solutions in order to develop sport in country.

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<sup>1</sup> - *Assistant professor of sport science research institute*

*Keywords:* championship sport, professional sport, public sport, educational sport, postmodern management.



## PERCEPTION OF STAKEHOLDERS IN NON-PROFIT SPORT ORGANIZATIONS

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*Purpose:* The purpose of this qualitative research is to identify important stakeholders' groups in the Czech sport environment perceived by managers of non-profit sport clubs. Managers are usually enthusiastic sportsmen without managerial education and knowledge of stakeholder management theory. The goal of this paper is to investigate how the managers perceive stakeholders, how they work with them within the strategy formulation and implementation.

*Methods:* The research sample was composed by eleven managers who were selected by cluster analysis from previous quantitative part of research. The non-profit sport organizations in the research sample have different purposes and offer different sports at all competition levels. The phenomenology approach was chosen for the qualitative research. The data were collected using semi-structured interviews, later verbatim transcribed. The data analysis was based on open coding, three levels of codes were created. Presentation of results was based on a model of stakeholder prioritization – power, legitimacy and urgency attributes.

*Results:* Managers perceive stakeholder management differently, most of them do not analyse stakeholders' requirements regularly, systematically and do not use some of stakeholder analysis approaches. Some of them perceive stakeholders as an insignificant part of management activities. Nevertheless, the deep analysis of stakeholder groups identified parents of youth sportsmen as the main stakeholder group which are definitive stakeholders for most of clubs. Parents often perceive sport club as cheap kind of babysitting. The competitive clubs are perceived not within the same kind of sport, but in other sport clubs offering different sports. The competitive fight is in gaining members or funds acquisition. The main competitive advantage is perceived in internal stakeholders – staff and trainers who built the club atmosphere.

*Conclusion:* The results present interesting knowledge about stakeholder management in non-profit sport organizations. The knowledge can be used not only for sport management education, but also for managers in praxis, how to manage relationships with stakeholders within strategy formulation and implementation.

*Keywords:* Stakeholders, competitors, strategy formulation

## SELECTED CONDITIONS OF THE SENIOR TOURISM FUNCTIONING ON THE EXAMPLE OF LOWER SILESIA

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The article presents selected conditions of the senior tourism on the basis of a study carried out among a group of Wrocław seniors. The theoretical introduction defines key tourism functions, with particular emphasis on the educational, cognitive, and social ones. Both the senior group and senior tourism were defined in the context of their participants, motivations, needs, season, etc. The empirical part presents the group of seniors who underwent the tests. The majority of participants were aged 60–79 years. The authors indicated the preferred forms of tourist recreation, and characterized the main motivations stressing the influence of the professional suggestion of the doctors, ways of traveling, length of the journey itself, and major goals. Attention was drawn to the economic situation of seniors and their personal judgment on the influence of the recreational activity on their health conditions.

*Keywords:* senior tourism, tourist functions, travel, tourist motivations, health conditions

## LEAVING COMPETITIVE SPORT IN THE CZECH CONTEXT

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*Purpose:* What happens to athletes when they end their active participation in the top-level competition?

This contribution focuses on career transition as a phase of a breakthrough in professional development. Successful handling of transitions, both within and outside the sport, allows a greater opportunity for athletes to live a long and successful life in sport as well as the ability to effectively adapt to post-career.

An unmanaged or unmanageable involution brings about personal problems of a different character making up for the athlete's loss of a social economic, psychosocial, and economic capital including loss of sport environment experience for the next generations

*Methods:* The group watched the top athletes from various sports (football, hockey, basketball, volleyball, athletics, swimming) and consists of 71 women and men. Reported athletes are former (already inactive) and active athletes from national top competitions in the Czech Republic. The means of collecting data was a semi-structured interview in which we formulated thematic areas on the development and course of sports careers, family backgrounds, life or sports links, lifestyle, needs, goals and ability to solve problems related to sports career and involution. Data analysis was performed using categorical data sorting followed on by an observation of categorical clusters, and the development and trajectory of an individual athlete's life story.

*Results:* In the Czech Republic still lacks a systematic strategy at national, regional or local level in the field of dual careers. There is only the Dual Career Program of the Olympic Committee for Olympians, services for other athletes are still missing.

*Conclusion:* The results of our research will serve as a basis for the training program for athletes, Coaches, Assistants and Mentors of sports careers.

*Keywords:* athletic career, transition, socio-cultural context.

## BEHAVIOR OF SLAVIA PRAGUE FOOTBALL FANS: SOME SELECTED ETHICAL ASPECTS

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The purpose of this research deals with the fact that football (soccer) is one of the most popular sports all over the world but this beautiful game has its dark side, as well: corruption, homophobia, violence, and racism. Within our research we focused on one specific category of visitors – football fans. We divided fans into five types according to their motivation and differences in their behavior. This kind of division was based on the theoretical and practical studies which have been published mostly in the last two decades.

Our empirical research was focused on the fans of Slavia Prague (a Czech football club). Within the survey we obtained and analyzed data about relationship between fans' verbal and other expression and about their violent behavior.

Primary data were collected by a questionnaire survey mainly at the Eden stadium in 2015 and 2016. A total of 462 respondents (aged  $26.29 \pm 10.19$  years old) participated in this research and all the respondents were attending in a stand of home team supporters.

In our research, we found that expressions of demolishing the stadium and other disturbances are considered the most serious expression of violent behavior by 79.22% of the fans. On the other hand, 77.06% of the fans stated that boo is the least serious problem.

The final aim of this paper is to consider and discuss some concrete outputs coming from the empirical research within the ethical discourse. While the utilitarian position presents one possible viewpoint for the ethical approach, the deontic position provides a bit different ethical platform. Because of the limited space for this complex issue we focused on defining the main structure of different kinds of behavior and their ethical consequences in both the deontic and utilitarian perspectives.

*Keywords:* aggression, deontic position, football club, utilitarian way of thinking, violence

## HEALTHY LIFESTYLE, ACTIVE AGING

### MOVEMENT ACTIVITIES AS A PREREQUISITE FOR QUALITY LIFESTYLE AND ACTIVE AGING.

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At present, the volume of the regularly performed physical load is still decreasing in virtually all age groups of the population. In the last two decades, the volume of regularly implemented physical activities in the Czech Republic has decreased by about 30%. The result is an increase in overweight, overweight and obesity, which has already exceeded 50% in the adult population, 32% in children, with over 30% of adults being obese and 10-12% of children in obese children. Decline in fitness is another accompanying phenomenon, along with an increase in cardiovascular disease, type 2 diabetes, an increase in mental illness, a deterioration in lifestyle.

The benefit of regularly practiced physical activities as a preventive tool to reduce the impact of current lifestyle is documented in a number of epidemiological studies. This has been demonstrated in both child, middle and senior age. A substantial part of these studies is concerned with reducing the risk of acute medical failures such as myocardial infarction, obesity, diabetes observed in people with higher levels of physical activity and hence physical fitness. It is interesting to recall that the first work on the benefits of physical activity dates back to 1953 - a study carried out on London postmen and bus drivers - (Morris et al., 1953) and then the most famous study of Harvard dock workers and graduates in 1986 (Paffenbarger et al. 1986).

For seniors, a higher level of physical activity and thus increased physical fitness significantly affect the quality and progression of aging - the anti aging effect. The basis of all regime measures that use movement is to influence the quality of lifestyle, to change sedentary to active lifestyle, where the essential component is adequate physical activity. The sedentary lifestyle is currently found in more than 80% of the Czech population. Sedentary lifestyle induces mechanisms that lead to increased risk factors for chronic diseases of the noninfectious type and ultimately to premature death. This can be referred to as a sedentary lifestyle syndrome.

Movement on walk based interventions with an energy content of 2000 kcal in children, 1500 kcal in adults and 950 kcal in seniors, lasting at least 7 weeks can significantly reduce body mass (about 10%), improve aerobic fitness by about 17% and motor performance by about 15%, regardless of gender, starting mass and age. It is also possible to significantly affect the amount of muscle mass (about 8%) and thus the assumptions for movement load. If weight reduction and increased fitness are achieved, this may lead to a prolonged life expectancy of about 7 years. In the case of seniors, movement interventions can greatly influence their aging - a functional shift to a lower age of about 5 years. In conclusion, reasonable physical activity is a prerequisite for quality lifestyle and active aging.

## ASSOCIATION BETWEEN THE FEAR OF FALLING AND THE LEVEL OF PHYSICAL ACTIVITY IN OLDER ADULTS

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*Purpose:* We live in the era of aging population. According to statistical forecasts by 2030 the proportion of people aged 65 and older will increase up to 25%, it means almost up to twice as much as in these days. It is necessary to focus not only on the length of life but also on its quality. Many studies are already dealing with determinants related to the quality of life. One of the limiting factors is inherently the level of physical activity. This study investigated the association between habitual physical activity and perception of fear of falling (FOF) in older adults.

*Methods:* To measure the level of fear of fall, we used a standardized questionnaire. The Falls Efficacy Scale-International (FES-I) is a short, easy to administer tool that measures the level of concern about falling during social and physical activities inside and outside home whether or not the person actually does the activity. The level of physical activity was evaluated by answering questions about the type, length and intensity of physical activity. The number of 206 older adults were grouped according to METs (METs are calculated from their physical activities), gender and age. For differences between groups we used statistical methods: nonparametric t-test and nonparametric analysis of variance (ANOVA). Statistical significance is calculated on  $\alpha=0.05$ , for effect size we used Cohen's  $d$  and  $\eta^2$ .

*Results:* We have found differences among age groups in perception of fear of falling ( $p=0.000$ ,  $d=0.67$ ). There are not differences between gender ( $p=0.727$ ,  $d=0.13$ ). We revealed differences among level of METs ( $p=0.000$ ,  $\eta^2=0.093$ ).

*Conclusion:* Our study contributes to the statement which says that the level of physical activity can have an influence on quality of life in older adults in association with fear of falling.

*Keywords:* Fear of falling, perception, older adults, physical activity, MET

## PHYSICAL ACTIVITY AND SOCIO-ECONOMIC STATUS

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Today's time is characterized by a high degree of civilization, by the development of modern technologies and, to a large extent, leads to stress. We are increasingly experiencing civilization diseases, and it is alarming that also in young people or even children. Hendl and Dobrý (2011) report that 70% of the European and American population lead sedentary lifestyle, these people perform no or very little physical activity (PA). However, even a slight increase in regular physical activity can lead to improvement of health and quality of life. Regular, appropriate and long-term PA has a beneficial effect on morphological and functional adaptation changes of individual body systems and whole body as well.

The aim of the survey was to determine the PA condition of pupils of the 2<sup>nd</sup> grade of basic schools (ZŠ) depending on the socio-economic status. This was deduced from completed questionnaires focused on room equipment, the amount of electronic equipment, social networks, own sports equipment, and the amount of means of transport in the family.

Two primary schools in Hradec Králové (HK) were deliberately included in the research project. At the first school, designed as ZŠ A, one class was followed. At the second school, designed as ZŠ B, three classes were followed. All students were aged 13-15. The presented results were processed with a set of 108 respondents. After getting the respondents acquainted with the measurement procedure, explaining the use of mechanical pedometers and transferring the data to the form, the pupils registered in the INDARES internet system, where they completed an electronic questionnaire. After the briefing, PA monitoring was performed using pedometers in one calendar week.

The results have shown that PA reduces children's room facilities such as television, video or DVD players, music players, computers, gaming devices. At the same time, children are less active if they have an Internet connection and a social network profile. On the other hand, PA increases affordable equipment, but also financially demanding equipment and the sporting equipment around home residence. The monitored group of pupils showed a greater number of steps per working day, with more time being organized than at a weekend when pupils decide alone about spending their time. When choosing between passive and active leisure time spending, passive leisure time spending prevails, even when they have ideal conditions for PA. However, a significant correlation between room equipment and PA was not found.

PA monitoring was part of the nationwide measurement of the Center for Kinanthropological Research at the Faculty of Physical Culture of the Palacký University in Olomouc

*Keywords:* active lifestyle of pupils, health, pedometer, walking, pubescence

## MOTOR AND COGNITIVE DEVELOPMENT IN EARLY CHILDHOOD: THE IMPORTANCE OF BEING PHYSICALLY ACTIVE FOR LATER ACHIEVEMENTS (RESULTS OF A PILOT STUDY)

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*Introduction:* The assumption that there is a relationship between motor and cognitive development exist more than 5 decades. Piaget (1953) proposed that activity and sensorimotor experience are important for the development of cognitive ability. But the debate about a possible relationship between motor abilities with cognitive development has re-emerged, because of an increasing media-consume and a decrease in physical activity in childhood. Especially in pre-schoolers working memory and attention seem to be important predictors of later academic achievement (Silverman, Davids & Andrew, 1963; Alloway & Alloway, 2010). Hence, it is necessary to assess the cognitive and motor competence of pre-schoolers in context of the increasing media-consume.

*Methods:* We recruited 20 children (10 male and 10 female) of a communal kindergarten in Magdeburg at the age ranging from 3 years until 6 years. We used the Wiener Entwicklungstest (WET) by Deimann and Kastner-Koller (2012) to assesses gross motor and fine motorskills. To assess visual working memory performance and perception speed we used the Matrix Film Battery Test (MFBT) by Pittorf, Lehmann and Huckauf (2013). This test consists of a 4 x 4-matrix with an increasing number of items which need to be memorized. For attention and memory we used an interactive movie called Teddy Tom Test (Pittorf, Huckauf and Lehmann, 2010). Furthermore, we provided the parents with a comprehensive questionnaire to monitor media-consume and assess the parental background.

*Results:* First, our results reveal positive correlations ( $r = .80$ ;  $p > .001$ ) between increasing performances in cognitive and motor abilities with age. Second, there is a strong correlation between visual memory and motor competence ( $r = 0.76$ ;  $p > .001$ ). Furthermore the level of education of the mother seems to be an important predictor for the media-consume of children and cognitive competence, whereas the educational level of the father plays an important role for motor development.

*Conclusions:* A physical active lifestyle is not only important to be healthy, but also to emerge important cognitive and motor competence for later life achievements. Especially the promotion of cognitive and motor abilities in pre-schoolers extremely matters for school achievements. A lack of a sensorimotor enriched environment and missing stimuli have an irreversible impact on the cognitive development of children. In context of an increasing media-consume, more investigations need to be done in this field of research.



## BODY HEIGHT, BODY COMPOSITION AND LIFESTYLE OF CZECH HIGH SCHOOL STUDENTS

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The purpose of this anthropometric research, which took place in Moravian high schools between 2015-2017, was to examine the relationship between body height, body composition (measured via bioelectric impedance on the device InBody 720) and some aspects of lifestyle (surveyed via a questionnaire). The target group was high school students aged 17-20 years, from a full range of secondary schools. The research specifically focused on factors that correlated most strongly with body weight and obesity prevalence, which may potentially have very important implications for the preparation of nutritional recommendations in the school catering system.

## NEIGHBORHOOD WALKABILITY AND PHYSICAL ACTIVITY IN CZECH ADOLESCENTS NATIONAL STUDY

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*Supported by the research project of Czech Science Foundation “Multifactorial research on built environment, active lifestyle and physical fitness in Czech adolescents” (No. 14-26896S).*

**Background:** Prevalence of obesity and unhealthy health behavior are increasing in Czech adolescents. The aim of this study was to find out how the type of neighborhood environment influence the level of physical activity in Czech adolescents.

**Methods:** Standardized method using the IPEN adolescent protocol was used to describe the subjective and objective measures on physical activity (PA) and neighborhood environments across Czech regional cities. The research was running from 2014 to 2016. Total of 1772 adolescent respondents participated in the study. Current results include sample of 558 respondents who met the including criteria (wearing pedometer for objective measures of physical activity and fulfilled the IPEN questionnaire for the neighborhood characteristics).

**Results:** Meeting the level of 10000 steps/day was not suitable for 36 % of Czech adolescents with more than 13 % not reaching the level of 7500 steps/day. Variety of neighborhood walkability indicates different level of adolescent's PA. In high walkable areas (the city center and surrounding neighborhoods) reported adolescents significantly more steps (average 15454 steps/day for boys and 13838 steps/day for girls) than those living in low walkable neighborhoods (average 11353 steps/day for boys and 10748 steps/day for girls) on the outskirts of the cities ( $p \leq 0.00$ ). This neighborhood variety influence on physical activity is also consistent in school and weekend days for both boys and girls.

**Conclusions:** Environmental influence on the level of physical activity was verified in both adults and adolescents. It also has implications for understanding ways in which transport, workplace and recreation policies, and urban planning may be used to influence MVPA. The policy and school authorities should reflect these indicators in creation supportive environments to deal with epidemics of obesity and unhealthy lifestyle especially in youths.

**Keywords:** built environment, school, leisure time, pedometer, IPEN

## THE LEVEL OF PHYSICAL ABILITIES OF HEALTHY SENIORS AND PATIENTS WITH MILD COGNITIVE IMPAIRMENT

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*Purpose:* Alzheimer's disease (AD) is the major cause of dementia in seniors. Pharmacological disease as a modifying treatment is not available and increasing attention is thus being given to non-pharmacological approaches. The aim of this article was to compare the results of measurement Senior Fitness Test of two groups – healthy seniors (HS) and patients with mild cognitive impairment (MCI) in AD.

*Methods:* 60 subjects were included in the study, randomized group attended a 6 months dance-exercise intervention with 50 training units. Initial and output examination included chair stand test, 8 foot test, 6 minutes' walk.

*Results:* The difference between MCI group and HS group was not significant. Groups achieved similar results in three seniors test.

*Conclusion:* Findings confirmed the similarity of the two groups.

## “COMPARATIVE STUDY OF CORTICAL ACTIVITY BETWEEN YOUNG AND SENIOR PEOPLE UNDERGOING THE SENSORY ORGANIZATION TEST (SOT) FOR POSTURAL BALANCE

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*Introduction:* Postural control is achieved and maintained by a complex set of sensory-motor control system which receives the sensory inputs from somatosensory, visual and vestibular systems (Manchester et al. 1989). Postural control becomes very crucial with seniors as the dis-balance is the fifth biggest cause of death of adults over 65 year of age (Gorina et al. 2006). The aim of this study is to find the effect of aging on cortical response under individual contribution on somatosensory, visual and vestibular response during postural control.

*Method:* Sensory organisation test was performed on 20 young students aged 25±2.5 years and 20 seniors aged 68±5 years in this study with Balance Master NeuroCom®. Also 32 channel wireless MOVE EEG 10/20 system was used to measure the EEG activity during test. IIR filter low cutoff: 0.1 Hz, time constant 1.591549, 24 dB/oct high cutoff: 70 Hz, 24dB/oct were applied to the EEG data along with the semiautomatic artifact rejection method. The ocular correction with independent component analysis was applied to blink marker channel. The average of segments in each trail was used to apply Fast Fourier Transformation (FFT) and data was exported to SPSS 22.

*Results:* Overall equilibrium score of seniors has been found significant lower than young participants ( $p < 0.05$ ). Young participants have the significant lower equilibrium score ( $p < 0.05$ ) during vestibular input. During somatosensory and visual input significant high gamma frequency in occipital lobe has been found. The equilibrium score of seniors are respectively significantly lower ( $p < 0.05$ ) during somatosensory, visual and vestibular input and gamma frequency in parietal lobe is significantly higher ( $p < 0.05$ ) during visual and vestibular input as compare to young participants.

*Discussion and conclusion:* Gamma activity is found to be higher during challenging balance task. According to results, the young people maintain balance equally to the somatosensory input and visual input condition but they show the high gamma activity in occipital lobe in visual condition. The seniors showed high gamma activity during visual and vestibular input as compare to young participants in parietal lobe with less postural control. This could be due to the difficulty in controlling posture under these conditions. The outcome of this study will help to understand the effect of aging on cortical response during sensory integration for postural control and to plan training which could improve the postural control abilities.

## FREE-TIME ACTIVITIES OF CHILDREN OF YOUNGER AND OLDER SCHOOL AGE

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In the contribution we deal with the involvement of children of younger and older school age in selected leisure activities. We focused on sports activities, spending time with friends, spend time with your computer and watching TV. Research data were collected by using the non-standardized author's questionnaire. Of the total number of 1489 questionnaires, 618 were usable. The sample was a random sample of children parents from three selected primary and secondary schools in Ruzomberok. The obtained data was processed using descriptive and inferential statistics in SPSS.

The results show that majority of children need to perform physical movement more than once a week; but there were also found relatively enough children who do not need any physical movement at all. The most frequented leisure activities of children are watching TV along with computer play. However, in these primary and secondary school children is still a strong need for social contact with their peers.

*Keywords:* Free-time activities, school children

## NUTRITION AND REGENERATION IN SPORT

### WHY MATHEMATICAL MODELING OF NUTRITION DOES NOT ALWAYS WORK FOR ATHLETES?

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According literature, nutrition was believed to be a corner-stone for improving performance in the ancient Greece. Since those times we have reports about food composition of ancient athletes which is not meaningfully changing to satisfy current recommendations. Notwithstanding the attempts of “modern” dietary concept like low carb high fat diet, there is strong scientific evidence of failure to better clear performance. Nutrition and metabolism is not black or white. The diet of elite athletes does not always meet recommendations for macronutrient intake and caloric value. Recently emerged field of microbiome study uncover principles how gut bacteria may beneficially or harmfully influence the metabolic efficiency and health of an athlete. There is a need for better recognition of healthy nutrition with limited processing and change of chemical and physical properties of consumed food.

*Keywords:* metabolism, microbiome, food, health, performance

## EXAMINATION OF AUTONOMIC NERVOUS SYSTEM ACTIVITY IN HEMATOONCOLOGICAL PATIENTS

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*Purpose:* The aim of this study was to obtain information on the autonomic nervous system (ANS) activity in haematological patients in remission before and after an interventional motion programme using the spectral analysis of the heart rate variability (HRV). Haematological diseases and their treatment create a number of side effects that aggravate the quality of patients' lives. The most common side effect is enormous fatigue that accompanies the patient's subjective state not only during the therapy but it may persist for months or years after the termination of the therapy. This fatigue is a state of the organism that is characterized by extreme exhaustion and a reduced capacity for a physical and a mental work. The patients are often unable to undertake basic daily activities. Physical activity may be safe and well tolerated in patients with haematological diseases and demonstrates a great potential for reducing fatigue.

*Methods:* The spectral analysis of the heart rate variability is a non-invasive method that is used to assess the ANS functional status through heart rate changes using a simple orthostatic test. The heart rate is influenced by a number of stimuli of both internal and external environments, with age and some chronic illnesses being the most significant. It appears that fatigue associated with cancer treatment has a negative relationship with the overall ANS activity due to its dysfunction. It is known that the autonomic dysfunction in haematological patients is associated with a higher mortality rate in a cardiovascular disease and a sudden death based on cardiac arrhythmias. However, the basic question is whether it is a paraneoplastic manifestation or the consequence of chemotherapy. Recent studies have shown that the autonomic function disorder in haematological patients is unlikely to be the result of chemotherapy, but a direct consequence of the disease or other, to this point, unrecognized factors. Regular exercise improves physical fitness and triggers positive changes in the ANS, both in patients and healthy people. The interventional motion programme ran for 3 months. The programme took place three times a week and lasted 60 minutes. The programme included cardio training, strength training and breathing exercises. The exercise intensity was set individually by each patient based on the input stress test.

*Results:* The research file consisted of 10 persons of age 57,2 with  $\pm 10,12$ . The spectral analysis of the heart rate variability was monitored in the tested patients before and after the three-month interventional motion programme. The results of the spectral analysis of the heart rate variability demonstrated significant positive changes in the autonomic nervous system of the group of patients that underwent the interventional motion programme in comparison to the group of patients that did not participate in the programme.

*Keywords:* Hematooncological diseases, autonomic nervous system, heart rate variability, physical activity

## HYDRATION FOR BETTER PERFORMANCE - AUTONOMOUS OR PRESCRIBED DRINKING REGIME?

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The amount and way of fluid administration during exercise and consequent changes in body weight are currently being challenged in scientific literature. Presently accepted recommendations, based on the fact that the level of ~ 2% of dehydration negatively influences sports performance are being criticized for overestimating the adverse effects of exercise induced hypo-hydration. Furthermore, a contrasting debate between scientists supporting either the autonomous or prescribed model of fluid intake is escalating. Current recommendations are based on the latest consensual statements provided by the American College of Sports Medicine and acknowledged by International Olympic Committee favor an individually prescribed fluid intake regime with the aim of maximally eliminating the negative effects of hypo-hydration on the performance and health of the athlete. The use of the prescribed regime assumes the knowledge of the body weight losses resulting in an estimation of the sweating rate. Contrasting to the theoretical postulation, however, athletes typically follow an autonomous fluid intake which is either controlled by physiological signals (e.g. thirst) or an athlete ingests fluids ad libitum (at any time and in any quantity). Based on the growing scientific evidence, ad libitum fluid intake or thirst-controlled intake are hydration strategies that do not adversely affect performance, even endurance-based in warm environment. Therefore autonomous drinking strategies may be used alternatively to the formally recommended prescribed regime. The aim of the theoretical review is to discuss in-exercise fluid intake strategies in relation to the athlete's performance. The original studies, review, and meta-analysis were searched using the PubMed, Google Scholar and Sport Discuss.

*Keywords:* dehydration, endurance, physical activity



## VERIFICATION OF LAG-TIME OF PELLETS WITH CONTROLLED RELEASE OF GLUCOSE DURING VARIOUS PHYSICAL ACTIVITIES

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**Purpose:** Hypoglycemia is a serious medical risk resulting from physical activities of people with Type 1 Diabetes Mellitus (T1D). Various strategies are used to solve this problem, mainly reduction and alternative distribution of insulin or extra meals. In a previous work, pellets with sequential release of glucose (Grant Project of IGA NT14479/2013, Veterinary and Pharmaceutical University Brno, CZ) were constructed to enable to 'eat a saccharide snack in advance' before a motion to prevent harmful need to eat in the course of physical exercise. The aim of the work was to verify the stability of 240minute lag-time before glucose release from the pellets under the conditions of varied long-lasting physical activity of adolescents and young adults with T1D. The programme was part of the second step of research to bring the unique form of glucose with a postponed release into clinical life (Pre-seed Project 2015 'Verification of lag-time of pellets with controlled release of glucose', TG02010020-1, University Hospital Hradec Kralove).

**Methods:** Our aim was to create a programme of specific physical activity to verify an impact of physical load and of aerobic/anaerobic and mixed exercise on the lag-time of pellets in real life. We designed a protocol of various forms and courses of motion within 3 consecutive days. The intensity of physical activity as well as the response of the studied subjects and individual glucose metabolism were monitored by simple (heart rate) and sophisticated (continuous glucose monitoring and <sup>13</sup>C-breath test) methods. Eight boys with T1D aged 13 to 20 years had following somatic parameters: weight 68.8±16.3 kg, height 173.5±11.5 cm, BMI 22.25±4.55 kg/m<sup>2</sup>. Ruffier fitness test and selected Unifittest 6-60 (Cooper run, standing long jump and sit-ups) determined physical readiness. Three-day programme of varied physical activities with graded intensity consisted of initial real-life testing using atypical sports, activities with the involvement of cognitive processes in the performance, followed by speed-endurance motion with high physical and mental demands and with accented fluctuations in heart rate.

**Results:** The results have shown the stability of the lag-time of the designed pellets under various physical activities and proved the expected independency of designed 'functional food'.

**Conclusion:** The programme of physical activity well traced the needs and accents of the research project. It enabled the verification of stability of 240minute lag-time of glucose release in the conditions of varied all-day motion and exercise of adolescents and young adults with T1D.

**Keywords:** Diabetes mellitus Type 1; physical activities; special needs; pellets with controlled release of glucose.

## GYMNASTICS AND DANCE

### THE PERFORMANCE PROFILE OF DANCE AND EFFECTS ON THE BRAIN

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Dancing combines cognitive, motor and social skills and therefore it can be assumed to have great potential in inducing neuronal plasticity in the grey and white matter of the brain. Research has to clarify what kind of movement has the highest effects on the brain. The aim of this work was to study the network mechanism in the brain during practicing cyclic and a-cyclic dancing movements and to find out effects on the brain after 15 month of cyclic and a-cyclic training with elderly people.

*Methods:* For the intervention study were used typical non-cyclic movement (NCM) combination program focused on movement sequence learning (Dance, Gymnastics) and on the other side repetitive cyclic movements CM (walking, cycling and repetitive gymnastics). Both intervention programs were performed in a group context using music to control for psychological influence. The experiment was designed as a 15-month controlled intervention. Fourteen members of the dance ( $67.21 \pm 3.78$  years, 50 % females), and 12 members of the fitness group ( $68.67 \pm 2.57$  years, 42 % females) completed the whole study. Independent Components Analysis (ICA) has enabled studies of electrocortical activity during locomotion. 12 healthy young students of sport science were randomized to practice a diagonal step using a ski roller as a type of cyclic movement, and one dance movement combination as an example of a-cyclic movement. Also, a 32-channel wireless MOVE EEG 10/20 system was used to measure the EEG activity during the activity. MRI and neuropsychological tests were performed at baseline, after 6 and after 15 months of interventions. Postural control was assessed with the Sensory Organization Test (SOT) implemented in the Balance Master System (Neurocom International, Inc., USA)

*Results:* Cyclic movement shows very clear structure of activities in the area of the motor cortex. The brain network during a-cyclic movement looks much more complicated and involves different brain areas for practicing the movement combination. These findings support the idea that cortical involvements during a-cyclic movement combination are greater than during cyclic movements. The dance group showed a larger increase in grey matter volumes in multiple frontal and temporal regions dedicated to working memory, attention and multisensory integration. These regions are usually prone to atrophy and synaptic dysfunction in aging. Compared to dancers the sportspersons demonstrated grey matter increases only in occipital areas and the cerebellum, the latter presumably reflecting the repetitive nature of their motor exercises. The largest white matter volume change was observed in the corpus callosum of the dancers. This finding probably resulted from strengthened interhemispherical communication induced by the combination of different physical and cognitive challenges inherent in dancing.

*Conclusion:* The results of our study suggest that practicing different types of movement with distinguished movement structures demanded more brain activity in different areas. For this reason, it should be encouraged to offer physical activities with sensory enrichment and high coordination demand in schools and in sports clubs or sport association for child development over all ages. This is

also true for people in higher age; constant cognitive and motor learning is superior to engaging in repetitive physical exercises in inducing neuroplasticity in the brain, and, therefore, has a very promising potential to counteract age-related physical decline and prevent neurodegenerative diseases.

## THE LEVEL OF SELECTED GYMNASTIC ABILITIES IN ELEMENTARY SCHOOL PUPILS

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*Purpose:* Gymnastics positively influences the condition of locomotion system, increases muscular as well as functional fitness and cultivates movement performance. According to the Framework Educational Programme Ministry of Education, Youth and Artistic gymnastics should form one of the basic parts of physical education content on elementary and secondary schools. The aim of the work was to evaluate the level of selected gymnastics abilities in pupils of selected elementary schools in the Czech Republic.

*Methods:* The group consisted of 351 pupils of 8th Year of elementary school in the Czech Republic, 198 boys and 153 girls. Basic gymnastic movement elements were selected: forward roll, backward roll, handstand, cartwheel, pullover, squat vault and straddle vault. The level of performance was evaluated by observation. The quality of performance was evaluated by 4 - level scale. Interviews with individual teachers were held in order to acquire information on number of lessons per week, content of lessons and material equipment of gymnasiums.

*Results:* We found out that more boys than girls train gymnastic during the compulsory lessons of physical education. Girls, however, try more different types of gymnastic exercises. When comparing exercises on different equipment, both boys and girls performed best at forward roll and straddle vault. Boys performed worse in handstand and cartwheel, girls performed worse in handstand and squat vault. We also found out that at some schools not all the selected elements were trained and practised.

*Conclusions:* A positive fact is artistic gymnastic is trained in boys at all selected schools, in girls at 13 out of 14 schools. Almost all teachers had a positive relationship with gymnastics, however, lessons spent training gymnastics at some school was not sufficient for mastering of the selected elements. Another factor affecting the level of performance of gymnastic elements was poor equipment of gymnasiums and low functional awareness in mainly girls, as stated by teachers.

*Keywords:* artistic gymnastics, evaluation, scale, education

## PARAMETERS OF POSTURAL SWAY AFTER SPECIFIC EXERCISES AND GYMNASTICS PERFORMANCE

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The aim of the study was to analyze the relationship between the parameters of postural sway and gymnastics performance in all-around competition and on selected individual apparatuses (balance beam and uneven bars). Twenty female gymnasts (mean age  $15.3 \pm 3.8$  years, mean height  $156.2 \pm 8.7$  cm and mean weight  $46.2 \pm 7.6$  kg) competing at national level underwent stabilographic tests in standard upright stand, special heel rise stand (releve), one leg stand, handstand as well as in standard stand immediately after specific gymnastic elements namely 5x flick-flack on floor, 5x giant swings on highbar, 10x turn hanging upside down. The results showed that gymnastic performance was more closely correlated to stabilographic parameters obtained immediately after gymnastics elements (10x turn hanging upside down,  $r = 0.827$ ) or further specific positions (heel rise stand - releve,  $r = 0.825$ ; handstand,  $r = 0.810$ ) than those measured under general conditions without preceding exercise ( $r = 0.634$ ). While correlating results on individual apparatuses the highest correlations were found between balance beam performance and mean velocity of center of pressure (COP) in the heel raise test ( $r = 0.866$ ), as well as between uneven bars performance and mean velocity of COP in handstand test. Results of present study indicate that parameters of postural sway measured immediately after specific gymnastics elements or inspecific static gymnastic positions can be used to monitor the efficiency of gymnastic training. In addition they can also provide useful hints for the further specialization of gymnasts.

**Keywords:** postural sway, artistic gymnastics, sport performance

## PHYSIOLOGICAL ASPECTS OF MUSCULOSKELETAL SYSTEM IN CLASSICAL DANCE

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*Purpose:* Classical dance at a professional level is comparable to top sport. In sport, it is a trend today to work with a physiotherapist. The reason is not only the therapy of the already existing problems, but also the prevention resulting from the knowledge of basic elements of musculoskeletal system physiology. Applying these elements to training leads to more economical movement.

In practice, we often encounter strict adherence to the rules of the ballet schools. Prescribed positions are performed at the expense of the movement stereotypes quality. A balance must be struck between the aesthetic and the health aspects. By compensating for the dysbalance of the dancer's musculoskeletal system, the minimization of the consequences in this system and long-term retention in the professional sphere can be achieved.

*Methods:* In the case study was evaluated the quality of the technical skills of ballet female proband L.Z. (female sex, 23 years old, height: 165 cm, weight: 46 kg, right upper extremity and left lower extremity are dominant). The physiological aspects of the musculoskeletal system were monitored. In this article we will focus on examinations in selected basic positions of classical dance, which was part of the incoming and outgoing examinations. The test was completed by an intra-abdominal pressure test. There were 8 therapies at a frequency of 1 - 2 times per week between the examinations. Therapies were focused on the perception of body details according to different concepts and their application to the classical dance trainings.

*Results:* The proband after therapies gives a feeling of greater certainty in individual positions. Objectively in the first position there is no longer a hyperpronation of feet, nor excessive external rotation of the hips and anteversion of the pelvis. In a grand plié, the proband is capable of correction for achieving a greater degree of physiology. In positions of grand battement jeté the proband is able to partially center the hip joint of the training leg. The extension at the lower range of motion can handle no problem. Higher range of motion leadsto significant development in one segment of the spine and the syndrome of open scissors. There is slight improvement in the intra-abdominal pressure test.

*Conclusions:* The conscious work on adjusting the technique of individual classical dancing positions has led to the improvement of the subjective feelings of the proband (the feeling of certainty and stability). Work in individual therapies was predominantly in the first and second phases of motor learning. These are characterized by high mental activity. Therefore, there was probably no significant change in intra-abdominal pressure. It is necessary to respect the long duration of the changes in order not to forcibly remove the compensatory mechanisms of the proband.

*Keywords:* physiological aspects, musculoskeletal system, muscle imbalance, motor control, classical dance

## THE EFFECT OF DANCE INTERVENTIONS ON THE LEVEL OF CHOSEN PHYSICAL ABILITIES IN ELDERLY PEOPLE. REVIEW

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Physical activity has undoubtedly a lot of physical and mental health outcomes. Dance has the big potential to be an attractive physical activity. Also it can be adjusted to meet the needs of the elderly. In this article, we systematically reviewed the scientific literature to identify the effects of different dancing intervention programs on the level of movement abilities like balance, endurance and leg strength in the elderly.

We examined the Web of science database focusing on different dance interventions in elderly people. For this article, the final selection of 25 articles published between 2000 and 2017 was used. All of the studies met the inclusion and exclusion criteria. We analyzed the type of intervention, study design, demographics of participants, and results.

This review includes studies concerning dance programs performed around the world. Many different dance styles were used as intervention programs - creative dance, social dance, ballroom dance, salsa, country dance and also using a dance pad. In nine articles, the authors confirmed the positive effect of dance intervention on the level of balance, including three studies using dance pads. In three studies, dance was confirmed as more suitable for their targeted group than other physical activities.

Conclusions of three articles show the positive influence of the dance on the level of endurance ability, two articles confirmed the positive effect of dance programs on the level of leg strength.

Previous studies have dealt with issues related to the quality of life in the elderly in the association with the growing number of the elderly in the society. This process leads to the need and thus a need further investigation arises. Findings indicate the dance interventions have the positive effect on the level of chosen physical abilities which are also very important limiting factors influencing the quality of lives of elderly. The results demonstrate that dance provides not only physical but also many psychological benefits, and should be promoted as one of the most appropriate form of leisure activities for the elderly.

*Keywords:* Dance, elderly, balance, endurance, leg strength

## CROSS-SECTIONAL PLANTOGRAPHIC STUDY IN MEN AND WOMEN ARTISTIC GYMNASTS

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*Purpose:* Artistic gymnastics is a sport which positively affects human locomotion system on one hand, on the other hand at a professional level the early specialisation has negative effects. A long-lasting specialised gymnastic training may result in permanent changes in the structure of musculoskeletal system. Due to specific load, mainly landings, the changes are expected in lower extremities and feet. The aim of this work was to examine the condition of longitudinal plantar arch in artistic gymnasts and find differences in the condition between men and women as well as among different age categories.

*Methods:* The group consisted of 84 probands, 52 girls and 32 boys aged 6 - 25 years, all at higher performance levels. After documenting the basic anthropometric data, we examined the condition of longitudinal plantar arch using sensor platform Emed and the acquired data were processed using Novel software. The acquired plantogram data were evaluated using Chippaux-Šmiřák method. To evaluate the observed relations we used non-parametric tests, Mann-Whitney U test and Spearman Correlation, at 5 % level of significance.

*Results:* In most of the tested persons one of the stages of high arch was diagnosed, concretely in 87.5%. We found out no statistically significant difference in condition of foot arch between men and women of matched age groups. When comparing longitudinal foot arch among different age categories, a tendency of foot arch to lower with increasing age was observed.

*Conclusion:* We assume that higher longitudinal foot arch in gymnasts may be one of the causes of frequent injuries of ankle and foot. We recommend to add more compensatory exercises focusing on plantar flexors stretching into the training process.

*Keywords:* foot arch, Chippaux-Šmiřák, gymnastics, plantogram



## PH.D. SECTION

### THE ROLE OF GENERAL MOTOR COORDINATION IN TALENT IDENTIFICATION AND DEVELOPMENT IN SPORT

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*Introduction:* Traditional talent identification programs focus on a combination of anthropometric, physical performance, and sport-specific tests to evaluate the potential of an individual to achieve the ultimate level of performance. The preponderance of sport-specific skills in selection procedures is however problematic for several reasons. First, results of a sport-specific test can seriously be contaminated by differences in training history between two athletes, providing an advantage to the athlete with the longest history of deliberate practice. Second, and related to the first limitation, any test should only be incorporated in such programs if the predictive value of it has been demonstrated. The latter is at least questionable in sport-specific tests.

*Results:* Starting from the idea that general motor coordination, as an underlying construct for the learning of sport-specific skills, might be a candidate-predictor of future success in sport, this contribution reviews the evidence supporting this claim. A first cluster of studies is discussed, in which the superiority of elite athletes over sub-elite counterparts with respect to general motor coordination is demonstrated. This has been the case in female artistic gymnastics (Vandorpe et al., 2011), soccer, (Deprez et al., 2015) and figure skating (Mostaert et al., 2016). While the cross-sectional design of these studies might prevent us from making conclusions with respect to the causal relationship between motor coordination and future performance, a second group of studies has done so. Pion et al (2015) showed that future performance of elite female volleyball players is better predicted by motor coordination than by any other anthropometric, physical or sport-specific test over a period of five years. Similarly, a simple motor coordination test enabled to predict 40% of the variance in performance at national championships in female gymnastics two years after the baseline measurement (Vandorpe, 2012).

*Keywords:* expertise, talent, elite sports performance, coordination

## TASK AND EGO GOAL ORIENTATIONS ACROSS THE YOUTH SPORTS EXPERIENCE

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Since the late 1980s, Achievement Goal Theory (AGT) has flourished in the competitive sports research across all age groups. One central proposition is the undifferentiated conception of ability exist until approximately 12 years of age. Given the volume of AGT age-specific studies, quantitative analysis of available youth studies allows for examining whether the goal orientations (i.e., task and ego) scores change based on age (i.e., undifferentiated to the differentiated conception of ability). Hence, the purpose of this quantitative based review was to determine whether task and ego orientation values differ based on age. To achieve our objective, we conducted a meta-analysis with 16 studies meeting specified inclusion criteria one being the use of Perceptions of Success in Sport Questionnaire (POSQ) resulting in 19 samples. The total sample size was 5,679 with 14 studies with mean samples greater than 13-years of age and five equal to or under 12-years of age. The articles came from seven different countries with the USA and Norway accounting exactly half of all represented countries. There was a mix of sports played. Results demonstrated that ego orientation scores did not differ by age category. Initially, task orientation scores appeared to decrease after the age of 12. However, with one outlier removed, a lack of statistical significance ( $p > .05$ ) resulted. Theoretically, children move in youth to a differentiated conception of ability. It appears even though ability becomes not equal to effort in the minds of youth that self-reported goal orientation values as measured by the POSQ are stable. The implication of such results are many. One being children in competitive sports seemingly have a stable ego orientation score. A critical future research question concerns goal orientation differences among recreational youth sports participation as well as youth who discontinue both competitive and recreational sports participation. The role of goal orientations across these groupings and influence on participation rates is unknown.

*Keywords:* motivation, competitive sports, meta-analysis, Achievement Goal Theory

## NUMBER OF STEPS AND SEDENTARY TIME DURING TWO WEEKDAYS AND TWO WEEKEND DAYS IN 7-10 YEARS OLD CHILDREN WHO DID NOT MEET STEPS/DAY RECOMMENDATION

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*Purpose:* In recent years, children spend most of their waking hours in a sedentary state or in a low level of physical activity (PA), and that might put them at risk of many non communicable diseases. Identifying the specific time segment in the week when children show a lack of physical activity and knowledge about proportion of time children spend sedentary is crucial and helpful in organizing and developing public health intervention strategies. The aim of this study was to assess the difference between two weekdays and two weekend days in regard to the number of steps and percentage of time children spent sedentary during waking hours. Further, we investigated the level of correlation between steps/day and sedentary time.

*Methods:* One hundred and ninety-seven 7-10 years old children, from four elementary school located in Olomouc, Czech Republic, who did not meet steps/day recommendation, were enrolled in this study. The number of steps and time spent sedentary were monitored for four consecutive days including two weekend days by ActiGraph accelerometers (GT3X, GT3X+). Paired *t*-test was used to assess differences in steps/day and sedentary time between two weekdays and two weekend days and between Sunday and Saturday. Pearson correlation coefficient was used to assess association between steps/day and percentage of time children spent sedentary.

*Results:* Both, boys and girls were significantly more active and took on average two thousand more steps on weekdays compared to weekend. Children from both genders took significantly less steps ( $p < .001$ ) on Sunday than on Saturday. While there was no significant difference between weekdays and weekend days in percentage of time girls spent sedentary, boys spent a slightly larger percentage of time in sedentary behavior during weekdays ( $p = .009$ ). Both, boys ( $p = .005$ ) and girls ( $p < .001$ ) spent a significantly larger percent of their waking time in sedentary activity on Sunday compared to Saturday. Time spent sedentary is negatively related to steps/day during both time sequences, weekdays and weekend, in both genders. The strongest correlation coefficient was found in girls during weekend ( $r = -.73$ ).

*Conclusion:* Based on the findings in this study, there is no big differences between two weekdays and two weekend days in percentage of time children spent sedentary. Children from the current study were less physically active and took less steps during the weekend, while Sunday was the most inactive day. Percentage of time children spent sedentary during waking hours is negatively related to steps/day during both time sequences, weekdays and weekend, in both genders. These findings suggest that the weekend is a crucial time in planning additional activities for increasing PA, while there is a need for decreasing the time children spent in sedentary activity during every day of week.

**Keywords:** Physical activity, Middle childhood, ActiGraph, Noncommunicable diseases

## DIFFERENCES IN TESTING THE ASSESSMENT OF MAXIMUM OXYGEN UPTAKE AND SPRINT OF YOUNG VOLLEYBALL AND HANDBALL PLAYERS

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**Purpose:** The main objective of the study is to compare the estimated maximum oxygen uptake results based on the BEEP test in handball and volleyball players aged 15-17, the SPRINT 20m speed explosion test results, and to establish the correlation between maximum oxygen uptake at performance and results at 5, 10 and 20 meters of sprint.

**Methods:** The sample of examinees in this study was divided into two groups according to the affiliation of the sports branch, namely 13 volleyball players and 13 handball players aged 15-17. Aerobic energy capacity has been evaluated at examinees by a BEEP test, whereby the parameters of maximum reach in the test (RBEEP) and the total exceeded distance (RBEEP-m) have been measured, with the aid of an estimated algorithm value  $VO_{2max}$ . The explosive power of the speed type s was measured by a 20 meter sprint test with a passage measurement at 5 and 10 m (MES5m, MES10m and MES20m). To compare two groups of examinees, ANOVA was used to compare the individual difference in the tests performed. The results correlation between the variables was calculated by the Pearson correlation coefficient.

**Results:** It can be confirmed that the differences between handball and volleyball players are statistically significant in sprint results of 10m and 20m. In the FTBEEP aerobic endurance test, there were no statistically significant differences between these two groups although this ratio may be expected to change in favor of handball players as they are younger in the research and it is expected that specific training operators shall have a positive effect.

**Conclusions:** The data processed in this study does not confirm the differences in energy capacity and the correlation between FTBEEP and MES5m, MES10m and MES20m. Estimated  $VO_{2max}$  is not related to results at 10m and 20m although there should be a link between BEEP test and running speed (although we do not expect high correlation values) because it is anticipated that athletes who are quick and have a greater ability to accelerate the body to show that speed multiple times and maximally, they tend to be less tired during the acceleration of the body, to delay fatigue and thus endure longer in the test and achieve significantly higher running speeds.

**Keywords:** maximum oxygen uptake, physical fitness, athletic performance, Léger test

## FOSTERING INTRINSIC MOTIVATION AND SATISFACTION WITH TRAINING SESSIONS AMONG SPORTING CHILDREN AND YOUTH

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The contribution deals with a creation of a motivational climate from a point of view of children and young adult's category members coach and which should result both in the fostering of intrinsic motivation and enhancing of satisfaction with training sessions. Children and youth athletes require a different approach than adults in a matter of motivation as well as a matter of satisfaction and this is the reason why some trainers tend to fail in the preparation of training unit.

There is a number of studies about these topics, but there are basically a little bit of comprehensive materials that can be used in practice. So this contribution therefore has a review character with the review question: Are there communication techniques and techniques for preparation of training unit that enhances satisfaction and intrinsic motivation among sporting children and youth?

Data will be extracted from studies that include areas of pedagogy, psychology, management and environment of sport by following keywords: motivation, intrinsic motivation, external motives, satisfaction, children, youth and physical activities. Data will be synthesized by a narrative summary.

Parts of the output are also practical examples of how psychologically affect children and young adults in sport. So this paper details techniques of creating exercises from psychological point of view, including the use of external and internal motives, as well as communication techniques that have an impact both on intrinsic motivation and satisfaction with training sessions. The basics of these techniques should know every trainer because psychological component plays a crucial role not only in sport performance but can also have far-reaching consequences for the future career of an athlete.

*Keywords:* Motivation, intrinsic motivation, external motives, satisfaction, children and youth, preparation of training unit, physical activities

## RELATIONSHIP BETWEEN MAXIMUM LEG CURL/KNEE EXTENSION PERFORMANCE AND 10M SPRINT PERFORMANCE OF AMATEUR SOCCER PLAYERS

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Speed is an inherent component of the overall players' performance in soccer, where acceleration speed is one of the most abundant types of speed skills used in the game. When sprinting, whole set of muscles is employed. Quadriceps muscles functioning as a knee extensors play fundamental role during the acceleration phase of a run, particularly in the support and driving phase of the movement. Previous findings suggest that there is a positive relationship between maximum strength level of lower extremities and sprint performance. Nevertheless, these studies used multi joint exercises when measuring the maximum strength level. In contrast, our study focused on single joint exercises engaging predominantly hamstring and quadriceps muscle groups. This study comprised 31 amateur soccer players (mean (SD) age 22.2 ( $\pm$  2.2) years, height 180.9 ( $\pm$  6.7) cm, weight 76.9 ( $\pm$  7.6) kg) who were assessed for maximum knee extension, maximum leg curl and 10m sprint test. Maximum bilateral strength was measured according to Baechle's protocol, using Grün sport workout machines. The 10m sprint test was conducted indoors, using Brower Timing TC-System. We found no significant linear correlation ( $p < 0.05$ ), between the maximum knee extension performance and 10m sprint performance ( $r = 0.08321$ ), as well as between the maximum leg curl performance and 10m sprint performance ( $r = 0.2945$ ) of the soccer players. This result is contradictory to the previous findings which observed correlation between maximal strength and speed performance. We assume that knee extension and leg curl exercises are very specific, single joint exercises, and as such, recruit only a limited number of structures. Hence, we do not recommend to use solely knee flexion/extension strength tests to predict the level of speed skills. We suggest that more complex testing and training exercises should be utilized for strength evaluation when working with soccer players.

*Keywords:* soccer, maximum strength, leg curl, knee extension, acceleration, 10m sprint

## SENSORIMOTOR SKILLS AND SPECIFIC TIMING IN ADOLESCENT POPULATION 6-18 YEARS

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Following the number of studies dealing with the timing of the movement, focusing on the adult population and the population with cerebellar symptoms such as a Parkinson disease or essential tremor, (Bareš, 2014, p.67), we try to look at the timing from other point of view. After effort to explain the causes of slowness and their relationship with age or stage of a disease, now this study tried to determine the dynamics and the accuracy of sensorimotor skills, which is responsible for the adolescent brain during ontogenesis and puberty. Only boys from each age 6 to 18 were tested. Subjects perform a special test on a PC with a length of about 45 minutes to test their response and timing of movement with number of tests in which they try to hit a moving target, which appear on the screen at 3 different angles (0°, 15° and 30°) and at different speeds (accelerating, decelerating, constant). This whole happened at unpredictable intervals by rotation for 45 minutes. We are expanding the own results from last year in specific timing hits and miss shots in terms of age and frequency of PC gaming. Test data was evaluated from used program. Predictive motor timing suggests that the cerebellum plays an essential role in integrating incoming visual information with the motor output in a timely manner.

*Keywords:* Sensorimotor skills, anticipation, timing of hits, adolescent, ontogenesis

## ANALYSIS OF THE GAME CHARACTERISTICS OF A FINAL JUNIORS MATCH U14 AT WORLD JUNIOR TENNIS FINALS (WJTF) IN 2014

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Analysis of the course of a match serves as a feedback tool in many sports (e.g. football, basketball, volleyball, tennis), the results of which are subsequently used in the training process. In tennis, the most common method is analysis of the game characteristics, which is being used before the match as well as during the post-match analysis. Currently a specialized computer software is being used which replaces previously used manual analysis methods. The advantage of using the software is less time-consuming, immediate data processing and gaining results. Analysis results of game characteristics from major tennis tournaments are commonly available online in electronic form, even several years back. When selecting the analyzed game characteristics, we used the IBM Slam Tracker software which is used in all Grand Slam tournaments.

The aim of the research was to analyse the game characteristics of the participants of World Junior Tennis Finals (WJTF) in 2014 in Prostějov. Based on the research data analysis, we wanted to find out the differences in the level of 13 chosen game characteristics of the winners and defeated junior finalists (n=4) and also to verify whether there are significant differences between the junior and adult players' results at Roland Garros 2014. From the recorded video of the final matches of Canada (CA) and Germany (DE), the game characteristics were analyzed using the Dartfish 9.0 software. The results of the WJTF 2014 finalists' analysis showed that in the first match (NK vs. FA) the winning FA tennis player presented himself with the more aggressive concept of the game. Player FA scored 3 aces, 17 winners (16 of which were from forehand) and 11 successful actions on the net. The equilibrium of the opponents shows a small difference in the total number of points gained (NK88; FA 96). In the second match (RM vs. NM players), the defeated NM player made a total of 7 doubles, his success rate of first serve was only 56%, also the NM player also scored 18 unforced errors, and gained only 26 points (comparing to 55 points of the winner). While in the first match a total of 184 points were scored, only 81 points were scored in the 2nd match, which is indicating the unequivocal course of the 2nd match.

The comparison of the game characteristics of the two junior finals showed that the difference between the winners and defeated players was mainly the number of aces, points scored after the 1st and 2nd serves and total number of points scored. Based on a comparison of the level of game characteristics of Junior (WJTF) and adult finalists (Roland Garros) in 2014, it can be noted that adult players have been able to benefit more from their first serve and also gain more points after the second serve of their rival than juniors. Also, breaking the opponent's serve was more important factor and in this case the decisive one.

*Keywords:* game analysis, match statistics, sports performance, software, tennis, comparison



## LATERAL DIFFERENCE IN THE LEVEL OF THE 9-10 YEARS OLD CZECH FEMALE TENNIS PLAYERS' HAND STRENGTH IN THE CONTEXT OF INJURY PREVENTION

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From the general viewpoint, the notion of laterality relates to the preference or dominance as to the side asymmetry of the human body. Preference means that the surer, more accurate, coordinated, and often also stronger side is chosen from the viewpoint of motor manifestations. The stated percentage of the left-handed preference is 10-13%, in some sports (e.g. boxing, hockey, tennis), the proportion of left-handers is higher and the percentage of left-handers among the top female players is higher (16%). The one-sided load in tennis can result in an overload of certain muscle groups of the playing hand and in development of muscular dysbalances, which can lead to injury. The research objective was to find out the level of somatic and strength characteristics and to assess lateral differences in the maximum hand strength of the top Czech female tennis players. The research population was composed of female tennis players in the age of 9-10.9 years ( $n=65$ , body height:  $H=145.30\pm 7.50$  cm, body weight:  $W=36.76\pm 6.10$  kg) who took part in the regular testing of the Czech Tennis Association in 2000-2015. The basic anthropometric characteristics were measured (height and weight) and also the maximum hand strength using the hand dynamometer (Grip D, Takei). The basic statistical characteristics of anthropometric and strength variables were calculated ( $n=65$ , strength of right hand:  $M_{SR}=18.90\pm 4.82$ , strength of left hand:  $M_{SL}=16.70\pm 5.03$ ). It was found that 89% of female players ( $n=58$ ) used their right hand and 11% their left hand ( $n=7$ ) as their playing hand. Thus, the percentage of right-handed players was substantially higher than that of left-handed players. The assessment of importance of differences in the level of strength between right-handed (RH) and left-handed (LH) players (Cohen's  $d$ ) proved objectively significant differences in favor of LH players ( $M_{RH}=18.90\pm 4.60$  kp,  $M_{LH}=24.40\pm 8.40$  kp;  $d=1.07$ , large). In RH players, an objectively significant difference in the level of strength between the dominant (RH/R) and non-dominant (RH/L) hands was found ( $M_{RHR}=18.90\pm 4.60$  kp,  $M_{RHL}=15.70\pm 3.40$  kp,  $d=0.70$ , medium). Also in LH players, an objectively significant difference in the level of strength between the RHL and RHR was found ( $M_{LHL}=24.40\pm 8.40$  kp,  $M_{LHR}=19.10\pm 6.20$  kp,  $d=0.81$ , large). The difference between the strength of the dominant and non-dominant hands higher than 15% was found in most female players (51.7% in right-handed players and 85.7% in left-handed players). In conclusion, it may be stated that objectively significant differences between the level of strength of RH and LH players were found in the examined female players aged 9-10.9 years. The significant differences between the level of strength of the DH and NDH in the population of female players may be a potential cause of injury and it is necessary to pay attention to this fact in training.

*Keywords:* hand dynamometry, laterality, muscular dysbalances, tennis, training

## COMPARISON OF RESPONSE CAPABILITIES AMONG STUDENTS OF SPECIAL EDUCATION OF SECURITY SECTIONS STUDY PROGRAMME, COMBAT SPORTS ATHLETES AND PHYSICALLY INACTIVE PERSONS

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*Purpose:* The aim of the study was to determine the level of response capabilities among students of Special Education of Security Sections study programme (SEBS), physically inactive persons and to provide comparison with results of combat sports athletes based on literature research.

*Methods:* Students of SEBS were tested in June 2017 by the Vienna Testing System. The data were processed by the Vienna Testing System and followed by descriptive statistics using excel. Data interpretation was performed by comparing with available literature, especially with the available standards of the Vienna Testing System -results of normal population and the professional athletes of combat sports. Reaction test (version S1) standards is based on a sample of 139 people of normal population (no significant differences between males and females or education level), the sample was divided only by age - 16-50 years (N = 67), over 50 years (N = 72) (Neuwirth, Benesch & Hoskovcová, 2007). According to the manual the main determinant test variable is the number of correct responses to the stimuli. Standards for Reaction test version S1 of the determination test are obtained on a sample of 1179 persons. They are normal adults whose data was collected between 1996 - 2001 (Neuwirth, Benesch & Hoskovcová, 2007).

*Results:* The mean reaction time for the reaction test was 261,20ms. According to the standards of a representative sample SEBS in the group the average percentile was 72.60 and compared with a standard based on the age of the average the result was 62.13 percentile. The average time for motor response SEBS was 118.47 ms. The average percentile compared with a representative sample was 78.40 and compared with standards based on age was 61.73 percentile value. For determination test, the number of correct answers for SEBS reached the average of 251.13 and compared with the standard based on a representative sample the average percentile was 64.67. In comparison with the standard based on age the average percentile was 39.20.

*Conclusions:* In reaction test the average reaction time differed only in values between 10ms between tested groups. Group "medal Taekwon-do" achieved the best results. Time average and motor reactions differed only in the range 10ms and SEBS group achieved the best time. In the determination test group "nomedal Taekwon-do" achieved the highest average number of correct answers. Group SEBS was second and group "medal Taekwon-do" was third. Group SEBS reached lower average median reaction time.

*Keywords:* Stress, Reaction time, Determination test, Reaction test, SEBS, motoric reaction

## EVALUATION OF ANAEROBIC THRESHOLD IN ELITE HANDBALL PLAYERS ON DIFFERENT PLAYING POSITIONS USING RATING OF PERCEIVED EXERTION

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Team handball (TH) is a physically demanding sport in which anaerobic threshold (AT) plays a significant role. Although the AT estimation tests are mainly performed in laboratory conditions, assessment of AT in TH is possible in the field, too, using only rating of perceived exertion (RPE). The aim of this paper is to determine possible differences in the determination of AT underpinned by the *V-slope* method and AT estimated with RPE at the treadmill progressive test in handball players (HP) on different playing positions. The sample included 17 elite HP, members of the *Croatian Senior Handball Team*. A sample of 12 variables was obtained using a treadmill spiroergometric test, and on the basis of RPE assessment by the respondents during the test. The absence of a statistically significant difference ( $P = 0.59$ ) in the variables *running speed at the ventilation threshold* (km/h) and *running speed at RPE7* (km/h) between the HP, confirmed the hypothesis of this work - HP on different playing positions estimate their AT based on their RPE equally well.

*Keywords:* handball, top players, functional test, endurance, playing positions, analysis

## INFLUENCE OF DIFFERENT AEROBIC PROGRAMS ON STABILITY PARAMETERS IN WOMEN

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In the study we observed and evaluated parameters of stability in adult healthy women, participated in 8-weeks aerobic programs: TABATA (TAB) and JUMPING (JUMP). Women's basic somatometric data were observed: body height (BH), body weight (BW), body fat percentage (%BF) body mass index (BMI). The postural stability were registered by the FITRO Sway Check System at the beginning and after the application of two different aerobic programs. 19 healthy adult, college students, who are not professionals in any sports were involved in the study. They were randomly divided in two groups: TAB (n = 8; age = 25.5 ± 4.75 years; BW = 63.14 ± 7.96 kg; BH = 167 ± 6.32 cm; BMI = 22.59 ± 2.44 [kg/m<sup>2</sup>] and %BF = 31.8 ± 4.71 %) and JUMP (n = 11; age = 25.00 ± 3.46 years; BW = 60.75 ± 9.46 kg; BH = 167.64 ± 7.97 cm; BMI = 21.55 ± 2.19 [kg/m<sup>2</sup>] and %BF 29.47 ± 5.18 %). Both groups were practising twice per week, with duration of 60 minutes per workout, and intensity of 60 – 90 % HRmax.

*Methods:* the stability parameters were indicated by 30-second static balance test on stabilographic device. The test case comprises of two tests of stability: stand upright without visual control and tandem stance without visual control. Measured data: velocity of the CoM, velocity of the CoM in the direction antero-posterior and medio-lateral, mean distance from the middle of the CoM. To process and evaluate the data basic statistical characteristics were obtained. Additionally, the Wilcoxon T-test and Mann Whitney U-test were used for comparative analysis. According to a statistical significance we compare the results with a table of critical values ( $p \leq 0.5$ ).

*Results:* Stand upright without eyes control the velocity of the CoM in antero-posterior direction were 39.28 ± 26.39 [mm] in TAB and 51.22 ± 53.39 [mm] in JUMP. In medio-lateral the values were 41.28 ± 25.82 [mm] in TAB and 30.65 ± 35.84 [mm] in JUMP. Statistically significant changes were confirmed between input and output measurements in each group. Despite this we did not find statistically significant differences between the groups.

*Conclusion:* We note that both of aerobic programs are beneficial for improving level of postural parameters.

*Keywords:* velocity of the CoM, CoM length, Tabata, Jumping, college students.

## INFLUENCE OF PHYSICAL ACTIVITY ON EXECUTIVE FUNCTIONS IN CHILDREN WITH INTELLECTUAL DISABILITIES

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*Purpose:* Children with intellectual disabilities (ID) usually show impairments in executive functions (EF). Most of the studies with children of typical development evidenced positive influence of physical activity and exercise on executive functioning. Therefore, objective of the study was to determine relationship between physical activity (PA) and EF in children with mild and moderate ID. We wanted to find out are those that are more physically active also better in scores of EF, respectively does PA predict scores of EF.

*Methods:* One hundred and four children (62 boys and 42 girls) with ID from 7 to 18 years of age that attend 7 Special schools and 2 special classes in 6 cities of Bosnia and Herzegovina (B&H). There were 49 children with mild ID and 44 with moderate ID. For assessment of EF, we used BRIEF - Behavior Rating Inventory of Executive Functions -teacher version that was completed by 15 teachers of children participating in the study. Physical Activity in terms of sedentary, light, moderate, vigorous and moderate to vigorous physical activity (MVPA) was assessed with GT3X Actigraph accelerometer during 7 consecutive days.

*Results:* There was significant relationship between PA and EF in 4 out of 8 BRIEF scales for certain type of PA. The most statistically significant correlations were between Initiate, Working Memory and Plan/Organize scale of EF and Moderate PA, Vigorous PA and MVPA. In addition, regression analysis have shown that moderate PA was most significant predictor of scores for initiate, working memory plan/organize scales, as well as for metacognition index (MI) and global executive composite scores (GEC).

*Conclusion:* PA and EF are related to each other in children with ID but not for all BRIEF scales and not for each PA intensity. Our study confirmed some of the results from previous studies that PA positively influences EF. So, future research may focus on determining appropriate PA and exercise intervention that would influence development of EF.

*Keywords:* Executive functions, physical activity, exercise, intellectual disability, actigraph, accelerometer, BRIEF

## PERCEPTION OF FACIAL ATTRACTIVITY OF NON-CONTACT AND COMBATIVE ATHLETES

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Female partner preferences may change over the time. They are influenced by many factors. The key determinants in sexual strategies and perception of attractiveness include fertility and preferences of either a long-term or a short-term relationship. The main differences are in perceptions of male masculinity and the ability to provide and raise offspring. This paper aims to describe changes in the perception of the attractiveness of photographs of male faces of elite golfers (non-contact sport) and MMA fighters (combative sport). The data was collected through anonymous questionnaires from 400 women over the age of 15. Questionnaire included photos of athletes in random order and 1-10 scale rating (10 for the most attractive ones). In this research, the following factors were observed: Age, sexual activity/passivity, use of hormonal contraceptives, duration of actual relationship and number of children. For data analysis, the effect size was calculated by using Cohen's D between the mean mark of contact and non-contact athletes. The greatest differences in the perception of facial attractiveness among the women in the research sample were caused by age and the number of children. This can be explained by the low fertility of older women and by lower needs for more offspring in women with more children. In both cases, strong masculine indicators which are typical for contact athletes are no longer so important to women. On the contrary, it can be assumed that most of the Czech women of lower age (15-20 years) do not look for a father of their children and a lifelong partner yet, and non-contact athletes are therefore not so preferred. An active sexual life and the use of hormonal contraception show only a small change in the preferences. In both of these cases in which women are expected to have a higher fertility, the perception of combative athlete's attractiveness has grown slightly.

*Keywords:* Mating strategy, masculinity, sexual attractiveness, athletes

## THE INFLUENCE OF TRAINING ON AUTONOMIC NERVOUS SYSTEM CARDIAC MODULATION

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Heart rate variability (HRV) is a degree of fluctuation in the interval length between successive heart beats. The cardiovascular system is mostly controlled by autonomic regulation through the activity of sympathetic and parasympathetic pathways of the autonomic nervous system. Analysis of HRV permits insight in this control mechanism. Research has shown that HRV is a very accurate, reliable, noninvasive and easy to apply method for diagnostics of the autonomic nervous system state. The variations in heart rate may be evaluated by a number of methods. The time domain (RR, NN, SDNN; rMSSD), frequency domain (HF, LF, LF/HF) and non linear methods standardized by TaskForce are used to determine HRV indices. It has been reported that increase and decrease in HRV indices are associated with positive<sup>(1)(2)(3)(4)(5)</sup> and negative<sup>(6)(7)(8)</sup> training adaptations. The results of the mentioned findings, the different methods of measuring HRV makes it difficult to conclude how HRV indices respond to different training types, training load and which method is desirable for measuring and monitoring ANS modulation of the heart (HRV). The purpose of this short review is to systematize and examine the influence of different training types, training load on HRV indices, or the ANS activity in athletes. The study examines different training types, such as high and low training intervention, aerobic and anaerobic training types, overload training types and resistance training types and their influence on ANS cardiac modulation. The literature search was carried out in the Web of science (WOS), Medline and Ebsco bibliographic bases. We only included studies which examine the influence of different training types on autonomic nervous system cardiac modulation in athletes.

*Keywords:* HRV, ANS, sympathetic activity, parasympathetic, training, performance, training load, overtraining, athletes

## BILATERAL KINEMATIC INDICATORS OF THE SPECIFIC HIP AND KNEE POSTURAL ADAPTATION OF HANDBALL PLAYERS

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*Purpose:* Considering the everyday training, handball players promote specific postural adaptation. Determining of postural and functional unilateral sports inherent asymmetry could improve the performance and provide injury prevention. The aim of this study was to examine whether there were significant differences in hip and knee ROM, in all planes, between stance and dominant leg of handball players.

*Methods:* Research was conducted in the Laboratory for biomechanics of the Institute of Kinesiology at the Faculty of Kinesiology, University of Zagreb, during May 2016. Assessment was performed in 2 stages, on a randomized sample comprised of 25 male subjects, age ranging from 19 to 24 years with a mean 21.8. Participants were recruited from the population of students who train handball  $10.44 \pm 3$  years. Based on the IPAQ, a high level of physical activity of the participants was determined. Kinematic measurements were performed through the Modified Thomas Test, which is standard for sagittal evaluation of the passive hip extension and knee flexion, giving the information on the flexibility of monoarticular and biarticular hip flexors, whose segmental postural adaptation can generate end movements in other planes. Therefore, the sample of variables were 4 angles: knee flexion and hip extension, rotation and abduction, all bilaterally. The research was performed using automatized optoelectronic kinematic measurement system ELITE 2002 (BTS Bioengineering Corp., Milano) with 8 cameras, frequency 100 Hz and 9 passive markers placed at bony prominences. Data processing was done using the Smart Analyzer software package. Since distribution showed normality, the t-test for independent samples was used. Calculations were performed using Statistica 12 software.

*Results:* Dominant leg was more mobile in the hip, through the extension ROM ( $2.36^\circ$ ,  $p=0.18$ ), and especially in the frontal plane where significantly higher abduction angle was found ( $2.55^\circ$ ,  $p=0.03$ ). Knee ROM was greater for the stance leg, although no significance was found ( $1.56^\circ$ ,  $p=0.45$ ). Posture in the horizontal plane was neutral for both legs.

*Conclusions:* Handball players are characterized by greater mobility of the dominant leg in the hip. With the exception of hip abduction, this study has not found that multi-year handball training forms a postural adaptation of the lower extremities with significant bilateral asymmetries. Bilateral kinematic indicators determined in this study could contribute to a better understanding of the role of segmental hip and knee movements in posture, postural adaptation and locomotion of handball players, and provide guidelines for the prevention and rehabilitation of neuromuscular deficits and their consequences.

*Keywords:* unilaterality, stance leg, dominant leg, ROM, Modified Thomas Test, optoelectronic kinematic measurement



## ONE WAY PROCEEDING OF LEARNING BASIC GYMNASTIC ELEMENTS

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The aim of this manuscript was to determine the difference between initial and final stage of basic acrobatic elements: forward roll, backward roll, backward roll with extended legs, candlestick, cartwheel, in left and right side and handstand. The research was conducted on a sample of 101 regular students of second year of the Faculty of Kinesiology, University of Zagreb. Initial test of motor skills was performed before listening the artistic gymnastics, and finally, after three months proceeding of learning. The evaluation of the performance technique was performed by three gymnastics experts. Differences between the initial and the final stage were determined by the t-test for independent samples with Levene's test. The obtained results show that in all tests of motor knowledge, students improved grades with statistical significance  $p < 0.05$ . Statistica 12 was used for data analysis. The results of this study indicate that the methodological learning process has significantly contributed to improving the performance of basic acrobatic elements. Therefore, the application of particular teaching methods can be applied to the beginner population.

*Keywords:* artistic gymnastics, basic elements, teaching methods, learning

## PHYSICAL INACTIVITY – A GREAT HEALTHCARE EXPENSE IN THE REPUBLIC OF CROATIA

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*Purpose:* The purpose of this study is to examine the fluctuation of total number of insured persons in Croatia and total costs of public health insurance in Croatia in the last 15 years.

*Methods:* In this paper, we have comprised secondary – financial data about the total expenditure of CHIF and an average number of insured persons in Croatia for the period from 2002 and 2016 and the structure of the most significant expenditures of CHIF by groups for 2002 and 2016 and the determined differences (increase / decrease) for the above mentioned data are displayed in the form of an amount and percentage (%).

*Results:* Research results have shown that the number of insured persons has not changed from 2002 to 2016, while the costs of public health insurance have increased by 66%.

*Conclusion:* Considering the unsatisfying physical activity level of the general population of Croatia and continuous increase in costs of public health insurance, it is essential to come up with a National strategy for physical activity improvement. The development of this strategy would gather experts from fields such as: Kinesiology, Medicine, Psychology, Sociology, Economics, etc.

*Keywords:* health, physical inactivity, healthcare expenses, Republic of Croatia

## DIFFERENCES IN PHYSICAL ACTIVITY LEVEL, ESTIMATED BY QUESTIONNAIRE, BETWEEN 3TH AND 4TH GRADE PUPILS OF ELEMENTARY SCHOOL

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*Purpose:* The aim of this research is to determine differences in physical activity (PA) level, estimated by questionnaire, between 3th grade pupils and 4th grade pupils of elementary school. School curriculum enacts 3 lessons of Physical Education (PE) per week for 3th grade and 2 lessons of PE per week for 4th grade of elementary school. Partial aims are referring to determining gender differences (3th and 4th grade separately) and also which gender contributes more to the possible differences between 3th and 4th grade pupils.

*Methods:* The set of entities included 400 3th and 4th grade pupils of elementary school. In the 3th grade participated 200 pupils, 93 girls and 107 boys and in the 4th grade 200 pupils participated in the research, of which 102 girls and 98 boys. PA level was estimated by the croatian version of PAQ-C (Physical Activity Questionnaire for Children) which estimates overall weekly PA by summarising nine partial parameters of PA and PA occurring during PE lesson is one of them. The questionnaire has determined appropriate validity and reliability.

*Results:* Differences in level of overall PA estimated by questionnaire between 3th grade pupils and 4th grade pupils of elementary school are not determined. Also gender differences in level of overall PA (3th or 4th grade pupils) are not determined. Only determined gender differences are the ones in some partial parameters of PA. According to the pupil's average result in item referring to Physical Education lessons (4,60), it can be concluded that pupils were active often or every time, whereby the purpose of the PE lesson is in large scale fulfilled.

*Conclusion:* The future research need to upgrade questionnaires for estimation of physical activity level based on self-evaluation, also need to determine reasons of pupil's insufficient levels of PA in some partial parameters of PA in order to improve them and by that to raise level of overall PA of younger school-aged children.

*Keywords:* physical activity, PAQ – C, young school age, gender differences, Physical Education.

## RELATIVE-AGE-EFFECT-FORCED DROPOUT OF SPORTS: A STUDY OF SIX BASIC SCHOOLS IN OLOMOUC, CZECH REPUBLIC

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Dropout of sports, and/or any kind of discontinuation of regular organized physical activities (OPA) in school children mark the onset of potential future difficulties directly, or indirectly linked to a lack of physical activities. Early-leaving OPA within our country in this age segment has not been documented and researched enough yet.

This paper aims to give evidence on the relative age effect (RAE), presuming that an athlete born in the last quarters of the respective year has lower chances to engage, and/or keep to a given OPA over the time.

RAE appears to be one of the gravest co-factors which affected sport careers of 421 girls, former participants of basketball prep schools aged 6-10 at six basic schools in the regional town of Olomouc, Czech Republic. The data was obtained ex post facto via interviews with their parents, and additionally with the girls after 4-10 years they had left their prep schools for a chosen sport. More than 55 % of the participants who dropped out of basketball, or other regular sports within three years after the end of their prep schools, were born in the late months of the given year. However, other strong related motives were found, too. Examples of communicating reasons for dropouts of sport activities were presented.

*Keywords:* dropout, physical activities, relative age, girls, early school age

## HOW ONE-YEAR OF SYSTEMATIC TRAINING CHANGES THE SHOOTING PERFORMANCE IN A GROUP OF YOUNG BIATHLETES?

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*Purpose:* Performance of biathletes depends on many factors (for example wind speed, lighting conditions, air temperature, athlete's concentration, shooting accuracy and time and many others). The previous findings of our research proved a relationship between exercise intensity and athlete's postural stability (centre of pressure area and anterior-posterior movement of the centre of pressure) during shooting at a standing position. Moreover, it is important to mention that not only postural balance plays a role in shooting accuracy. The objective of this paper is to evaluate a one-year progress in shooting skills of young biathletes during a systematic training. The training process of participants was mostly focused on their shooting skills, balance abilities and the development of strength-endurance abilities.

*Methods:* Twelve healthy, well-trained biathletes (5 girls, 7 boys) volunteered to participate in the study (Girls: age  $15.8 \pm 0.74$  years, body weight  $55.20 \pm 5.70$  kg, body height  $1.65 \pm 0.03$  m,  $VO_{2max}$   $54.62 \pm 3.29$  ml.kg<sup>-1</sup>.min<sup>-1</sup>,  $W_{max}/kg$   $4.8 \pm 0.39$ ; Boys: age  $15.0 \pm 0.75$  years, body weight  $57.42 \pm 6.47$  kg, body height  $1.71 \pm 0.07$  m,  $VO_{2max}$   $65.3 \pm 2.85$  ml.kg<sup>-1</sup>.min<sup>-1</sup>,  $W_{max}/kg$   $4.9 \pm 0.22$ ). The centre of pressure area and anterior-posterior sway were measured by a foot pressure scan (FootWork Pro). Shooting performance and rifle stability were measured by SCATT Shooter Training System. All of these parameters were measured in rest and after a physical load (skating on roller skis) expressed by the percentage of maximum heart rate ( $HR_{max}$ ) (5 minutes, 65-75% of  $HR_{max}$ ; 5 minutes, 75-85% of  $HR_{max}$ ; 5 minutes, 85-95% of  $HR_{max}$ ). This paper presents the changes over a period of one year.

*Results:* The stability of the rifle (the length trajectory of a motion of the barrel in the last second before a shot) during the testing in rest and after physical load was improved for all participants. The rifle stability in the standing shooting position improved: in rest – boys (24.3%), girls (6.2%); Intensity 165-75% of  $HR_{max}$  – boys (19.5%), girls (13.9%); Intensity 275-85% of  $HR_{max}$  – boys (1.8%), girls (13.0%); Intensity 385-95% of  $HR_{max}$  – boys (16.1%), girls (17.1%). The improvement of anterior-posterior sway was found after the systematic one-year training for all biathletes.

*Conclusion:* The results of our study showed the improvement of young novice biathletes in their shooting skills. It can be assumed that the athlete's progress should continue during the next year if the same training concept is continued. To conclude, these results suggest not only progress of biathletes but also the importance of evidence for predicting the performance in a future sport career.

*Keywords:* anterior-posterior movement, biathlon, centre of pressure, heart rate, training

## RUNNING DYNAMICS IN 400M SPRINT EVENT

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The main goal of this research study was to determine running dynamics in 400m sprint event for women. The research was carried out on female sprinters of final races at four World Championships in Athletics: Stuttgart (1993), Athens (1997), Seville (1999) and Berlin (2009).

Data needed for this research study were obtained from official results and published results of biomechanical analyses. This research study analyzed competitive activity referring to running rhythm and running dynamics. This study shows different examples of competitive activity structure which differ according to results' achievements. These examples vividly show the miniscule differences which make for the better running placement of female finalists of these World Championships in Athletics, based on successful realization of running dynamics.

*Keywords:* athletics, sprint, 400m, running dynamics, female sprinters

## HOW HARD IS WORK WITH PERSONAL COMPUTER AND HOW TO MEASURE IT-THERMOGRAPHIC METHODS. NOT NEW, BUT STILL JUST PROMISING

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*Purpose:* In medicine and affiliate scientific disciplines we have gotten used to many diagnostic tools measuring or displaying mostly structural changes (X-ray, ultrasound, CT etc.). It's pity, that even when we have a tool displaying functional changes, thermography, we are still after some decades not able to use it properly. Despite the fact personal computers are used to "make work easier" for about thirty years, there is still not much scientific work done on this topic. Especially not on the field of thermography where we could use this not really young method to enhance our knowledge of how hard the work with personal computer really is and what are dynamics of this workload. This paper presents a comparison between the methods used over the last twenty years for studying the thermal changes in hands while the subject is working on a personal computer and Horacek's newly developed method. In doing so, it sets up the best-known methodology for the next few years in which anticipated "bigger research" should be done. All of this is done in a real environment where office workers are doing their job – at their workplace.

*Methods:* In this study, ten office workers were studied using a thermographic camera, and then the results of two methodologies were compared. Another two methodologies already used to describe thermal changes in hands were also considered.

*Results:* The results showed us similarities at 84% with the already used methodology developed by Gold, but 75% higher sensitivity with a mean difference of 1.6°C.

*Conclusions:* It was found that Horacek's methodology, when compared to Gold's methodology, has not only comparable specificity but even higher sensitivity. This method is also easier and faster. Thus, taking into account the lack of current scientific knowledge, it is probably appropriate method for observing thermal changes in hands. These results encourage us to carry on next researches which are desperately needed.

*Keywords:* hand, methods, thermography, workload

## THE PERCEPTION OF SPORT MANAGEMENT STUDENTS TOWARDS THE COMPETENCY OF SPORT ORGANIZATIONS MANAGERS

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*Introduction:* With the expansion in the scope of the sports and athletic club manager's job, one needs to question how an individual becomes adequately prepared to meet the challenges and complex role of the club manager. Management competency is the characteristics that is associate with superior or effective performance. The purpose of this study was to evaluate perception of sport management students towards the competency of sport organizations managers.

*Methods:* The statistical population was 500 sport management Ph. D. students of Iranian universities out of which 200 samples were chosen randomly according to Morgan sampling table. The questionnaire sent to them via email or filled in person. The number of 167 questionnaire was eligible to be analyzed. The method of this research was descriptive survey. The instrument came from 17 interview with sport management experts in a qualitative research. The reliability of the questionnaire was ( $\alpha = 0.943$ ) in a pilot study. Responses included the range of 1-9 and one sample T test and SPSS22 were used for analyzing data.

*Results:* The results showed that all component including Technical ability, scientific ability, Personality empowerment, Perceptual-emotional empowerment, Relationship management, Globalization ability and Competitive ability had significant difference. The amount of test value was 5.

*Conclusion:* Sport management students believed that a competent manager of sport organization must have abilities such as Technical ability, scientific ability, Personality empowerment, Perceptual-emotional empowerment, Relationship management, Globalization ability and Competitive ability.

*Keywords:* Sport, Competency, Manager, Student



## THE INFLUENCE OF SOCIAL INTERACTION: MOTIVATION GAIN OF GROUP TRAINING IN CHILDREN

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It could be assumed that an exercise motivation is influenced by many psychological factors, including enjoyment, social influence and self-efficacy. Effect of group exercise is sometimes neglected factor although it was shown that it leads to higher performance, especially with a more capable partners. Objective of this study was to report on the effect of social-comparative feedback to physical performance of children in age of nine to eleven years. The study involved young elite synchronized swimmers from Czech Olympic club who compete at an international level (n=14, age M=10.02±0.66). This research was conducted in an experimental design. Two girls didn't finish research protocol. The influence of social interaction was examined in the two different physical performances (isometric strength, dynamic strength) in two separately measured rounds, i.e. as individuals and as the group. There was a week interval between the rounds. In first test girls were required to hold a wall seat position as long as possible and the second test was maximum vertical jump. The sample was randomly split into two groups, one started with an individual and the other with the group exercise for both testing methods. The mean performance in individual try for vertical jump was M=15.63±4.59 and M=17.19±4.61 for the group one. In the wall seat test it was M=107.07±72.18 (individual) and M=216.21±140.47 (group). The influence of social interaction was evaluated by Cohen's d which showed high substantive differences (dynamic strength d=0.33, small effect; isometric strength endurance d=0.99, large effect). Wilcoxon matched pair test was used for data analysis (results was significant, P< 0.05). Result showed that exercising in the groups caused an improvement in performing vertical jump and wall sit exercise. To sum up, we found out that children physical performance could be affected by social interaction, i.e. mutual encouragement in the group. However, the effect fluctuated in the sample. It could be assumed that group exercise is beneficial for the children training as well as other factors like positive verbal motivation, constructive feedback and appraisal.

Ethics: consent forms were signed by parents before it started.

*Keywords:* Self-motivation, group cohesion, sport performance, youth athletes, mutual encouragement, synchronized swimming.

## ANALYSIS OF THE LEVEL OF ANTHROPOMETRIC AND SPEED AGILITY CHARACTERISTICS OF MALE AND FEMALE PLAYERS AGED 11-12

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A high level of fitness skills has been a sign of successful tennis players in recent years and its systematic training has become an integral part of the training process. Speed and its manifestations in modern tennis, where the trend is towards fast and powerful game, are the inherent attributes of successful tennis performance. The aim of this paper is to analyse the level of basic anthropometric and speed characteristics among young Czech tennis players, to assess inter-gender differences and to determine the correlation between individual variables. The research sample consists of Czech junior male tennis players ( $n=221$ ) and female players ( $n=193$ ) between the ages of 11.0 and 12.9 years. The data for this research was gathered specific agility speed test within a Czech tennis association project during the period of 2000-2015. Analysis of the acquired data shows normal distribution characteristics (verified by Chi-square test). The anthropometric and speed variables were characterized by the basic statistical variables of the TEN-M set (male,  $n=221$ , body height:  $H=155,10\pm 7,62$  cm, body weight:  $W=43,50\pm 6,68$  kg, speed agility:  $SA=14,90\pm 0,77$  sec) and the TEN-F set (female,  $n=193$ , body height:  $H=154,60\pm 6,94$  cm, weight:  $W=43.49\pm 17.17$  kg, speed agility:  $SA=15.23\pm 0.78$  sec). Substantive significance assessment of differences between male and female tennis players using Cohen's  $d$  values showed a factually insignificant difference in basic anthropometric features (height,  $d=0.07$ , weight,  $d=0.00$ ). A small level of substantive significance of the inter-gender difference, in favour of male tennis players, was found in the speed agility test ( $d=0.42$ , small). A sizeable substantive significance dependence between body height and weight was demonstrated for the TEN-M (male,  $r=0.71$ , large), the substantive significance of the dependence between speed agility, and height and weight, respectively, is small ( $r=0.15$  or  $r=0.06$ , small), which means insignificant. In the case of the TEN-F there was again large substantive significance (female,  $r=0.75$ , large) between body height and weight, the relative significance of the relationship between speed agility and body height is medium ( $r=0.33$ , medium), between speed agility and weight is small ( $r=0.29$ , small) but, in both cases, it is higher than among the set of male tennis players. Among male tennis players and female tennis players between the ages of 11 and 12 years, the inherently insignificant inter-gender differences of anthropometric characters and better results of the male tennis players in the speed agility test have been demonstrated. Substantive dependencies between body height and weight were established for both male and female tennis players, the dependence between the results of the speed agility test and the anthropometric features are insignificant in both sets (except for the dependence between speed agility and tennis height).

*Keywords:* anthropometry, inter-gender differences, speed, tennis, motoric test

## PARENTS' EDUCATION LEVEL AND HOUSEHOLD INCOME IS NOT RELATED TO MOTOR SKILLS OF PRESCHOOL CHILDREN

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*Purpose:* Motor development of preschool children is influenced by different environmental factors. Among them, home and family are the most important during early childhood. The review of the literature revealed that family features, such as socioeconomic status, mother's educational level, and the existence of siblings can affect children's motor competence. The aim of this research was to determine the influence of some environmental factors on the motor skills of preschool children in capital of Croatia.

*Methods:* A sample of subjects were 259 preschool children (boys and girls), included in the kindergarten program, aged 4-7 years. The research was conducted in two parts. In the first part, parents completed a survey questionnaire, and in the second part, motor skills and abilities of preschool children were measured. Measurement of motor skills of preschool children was performed using the Bruininks-Oseretsky Test of Motor Proficiency Second edition. A short version of the BOT-2 battery test was used, which consisted of 14 separate tests. Spearman's rank correlation coefficient was calculated to determine the relation of motor skills and parents' education level and household income. Significance level was set to  $p < 0.05$ .

*Results and Conclusions:* Results show that monthly household income ( $r_s = -0.046$ ) and parents' education (mother  $r_s = -0.053$ , father  $r_s = -0.001$ ) are not related to motor skills of children. Previous research suggested that both mothers' and fathers' education was related to motor performance (Cools et al., 2011). Results identified positive associations of motor performance with parental education, father's physical activity, transport to school by bicycle, and the high value placed by parents high on sport-specific aspects of children's physical activity. This was not found in our study. Furthermore, results of our study suggest that high or low socioeconomic status is not a factor that will influence motor skills of preschool children. This was similar to Cottrell and associates (2015) who investigated families with different socioeconomic status. Their results show that in low-income families, parents play more with their children, while in high-income families children exercise in centers, although level of physical activity of children did not differ.

*Keywords:* socio-economic status, motor proficiency, mother

## COMMON ELEMENTS OF SOCIALIZATION IN SPORT - SUMMARY THROUGH THE CAREER TRANSITION THEORY

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*Purpose:* Socialization in sport is an important aspect of individual stages of career transitions (Stambulova & Alfermann, 2007) recognized by three studies (continuation through bachelor, diploma and dissertation thesis).

*Methods:* The study is of a qualitative nature. The data was collected through semi-structured interviews and the analytical procedure described and established by The Grounded Theory (Strauss & Corbin, 1999). Studies were conducted with different age categories of athletes (15-18; transition from junior to senior stage, 20-30; active athletes, 35 and more - retired). The research was done with team sports as well as individual ones because the participants' opinions do not differ significantly between different type of sports or genders.

*Results:* The common elements of socialization are aspects of the group (acceptance, recognition of different personality types, recognition of self through eyes of the others, communication, cooperation); player intelligence; personality features (decision-making, autonomy, resilience and super vision); social support (friendship in sport and outside of sports); introversion versus extroversion, coach.

*Conclusion:* Positives of socialization in sport - in their own words – prevail; the negatives can be managed with the right approach. Significant and important elements are - approach of coach and close relatives and friends; their ability and interest in helping athletes to adapt to the environment outside of sports professional career.

*Keywords:* social support; player intelligence; career transition theory; acceptance; communication; autonomy; meaning of life; basketball; coach.

## USE OF INTRINSIC MOTORIC IMAGINATION ON THE LEVEL OF MUSCULAR STRENGTH; METHODOLOGICAL STUDY

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This paper attempts to share experience of the process of methodical crystallization in study related to use of intrinsic motoric imagination as a method of increasing level of isometric muscular strength contraction of wrist flexor muscles. This project comes under neuromuscular field of science. Nowadays the influence of mind capabilities such as imagination or concentration is undeniable. Usually most of researches in this field focus on "mind to mind" impact. It means for instance that training of imagination has positive effect on decision-making skills, technique corrections or regulation of stress level. On the other hand, researches dealing with direct "mind to body" impact are fewer and struggling with methodical concepts or interpretation of results very often. In this study I am trying to pass on my experiences gained in the process of formulating methodical procedure. Compared with research findings I summarized aim of project into four main areas.

- 1) Selection of nature of population and form of getting feedback information during research.
- 2) Selection of muscle group corresponding to the aim of study and appropriate measuring instrument such as isometric dynamometer.
- 3) How to explain and teach imagination skills to participants and develop suitable imagination training program.
- 4) Selection of the most appropriate brain activity displaying method such as Electroencephalogram (EEG), Magnetoencephalogram (MEG), Positron Emission Tomography (PET) or Functional magnetic resonance (fMRI). Then develop convenient measuring protocol.

### *Results:*

- 1) I presume that 50 20 to 30 years old men are suitable sample. Each participant should fill imagination training feedback information in special questionnaire every day. Participants will be instructed of emphasis on truthfulness of filled feedback.
- 2) I emphasise the meaning of handgrip muscles group in daily life situations. This group of muscles are used on daily base on certain level of activity. Therefore, I consider handgrip muscles as an appropriate muscle group. If muscle group is trained on the daily base there is assumption that muscle will be more resistant against other influences such as accidental workload impact.
- 3) Firstly, this study suggests organising 1 to 3 common lectures based on free time of participants. Common lecture includes basic information about use of imagination and its limits, explanation how to concentrate on image of working muscle properly and getting familiar with isometric flexor muscle dynamometer.
- 4) I consider fMRI as a most appropriate brain activity displaying method predominantly because of its accurate spatially distinguishing ability. Each Participant takes part in 3 measuring (1 before training program, 1 after 4 weeks and 1 after training program – 8 weeks).

Overall, this paper tries to show an example how to form methodical procedure in little mapped scientific field.

*Keywords:* Intrinsic Motoric Imagination (IMI), Extrinsic Motoric Imagination (EMI), Concentration, Neuromuscular study, Handgripmuscles group, Mind, Imagery training, Muscle contraction, functional magnetic resonance (fMRI)

## ANALYSIS OF PEDAGOGICAL-MATERIAL STANDARD OF WATER SPORTS TEACHING

Oreb, B.1, Prlenda, N.1, Oreb, G.1

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Water sports is regular subject on the Faculty of Kinesiology of the Zagreb University. It comprises four Olympic sports: sailing, windsurfing, rowing and kayaking. Through the analysis of results obtained by anonymous questionnaire researching pedagogical-material standard, it is the aim of this paper to contribute to the quality of Water sports teaching.

The research was conducted in the period from year 2001 to 2015, on the sample of 2400 examinees, regular male and female students of the Kinesiology faculty of the University of Zagreb, between the age of 21 and 25. The program of Water sports teaching was realized in duration of 7 days on the sea (Korčula-Badija), with classes of sailing, windsurfing and rowing (kayak-canoe). On a daily working regime, every aforementioned activity was realized through two school hours.

At the end of the program, students have assessed, through anonymous questionnaire, 12 variables on a five-degree Lickert scale. Variables assessed were traveling, accommodation, food, teachers, assistants, vessels, climate, teaching program of sailing, windsurfing, rowing and kayaking.

Through the analysis of the questionnaire, very high total arithmetic mean was determined for all the variables (4.30) during 14 years, which shows very high degree of contentment of students. Lowest average assessment grade was noted in a variable Traveling (AS 3,23), which is explainable by the long duration of the traveling (10 hours). Low assessment grade in Rowing (AS 3,30) can be assigned to the manner and conditions of realization (Zagreb, rowing track and small number of teaching hours). The highest average assessment grades are registered in variables Climate (AS 4,66) and Assistants (AS 4,59), confirming therefore a good choice of location, considering wind and sea conditions, and quality choice of assistants in realization of teaching. Average results by year also show high average assessment grade for all the observed generations. The highest average grade was given by generations 2013 (AS 4,45) and 2014 (AS 4,44), while the lowest average grade was assigned for generations 2001 (AS 3,53) and 2003 (AS 4,08).

Based on the obtained results it is concluded that student population in years 2001 to 2015 is extremely content with Water sports collegium as a whole.

*Keywords:* students, sailing, windsurfing, rowing, kayaking, teaching

## RELATIONAL STUDY OF DEMOGRAPHIC FACTORS AND ENTREPRENEURSHIP INTENTION IN THE IRANIAN'S SPORTS ACTIVITIES

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As a creative human performance, the entrepreneurship is the process of designing, and conducting a new business through the pursuit of opportunity beyond the resources controlled. Demographics is one of the most important factors affecting entrepreneurship. Due to this, we aimed at conducting relational study of demographic factors and entrepreneurship intention in the Iranian's sport activities. The study sample was selected the individuals involved in sports activities in Iran. According to Morgan table, 240 individuals were selected randomly. The research tool was a structured questionnaire. The risk of data loss led to distribute 260 questionnaires. The tool validity was approved by some management field experts as well as its reliability was assessed using Alpha Cronbach ( $\alpha=0.83$ ) after pilot study. Questionnaire Introductory contained the demographic information (i.e., age, income, education certificate). ANOVA test and t-student were used to test the hypotheses. According to the results, except the variables of experience and age, there was not relationship between nine demographic variables (income, marital status, education certificate, entourage's education, father's education, mother's education, gender, job, residence) and entrepreneurship. In sum, it is important to promote the entrepreneurship concept among the individuals to enrich the national economy.

*Keywords:* Demographic factors, Entrepreneurship intention, Experience



## POSTER SECTION

### MOBILE HEALTH INTERVENTIONS TO SUPPORT BEHAVIORAL HEALTH IN OLDER ADULTS: A SYSTEMATIC LITERATURE REVIEW

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*Purpose:* There have been important gains in life expectancy, but the quality of life of seniors is often hindered by poor behavioral habits such as insufficient amount of physical activity, high levels of sedentary behavior, and insufficient sleep. Although effective intervention strategies exist to improve these behavioral indicators in older adults, traditional intervention (face-to-face) approaches require substantial resources and have limited public health impact. Advances in digital technology have opened up opportunities for scalable solutions with potentially greater reach. Herein, we provide a systematic review of the literature, focusing on intervention studies utilizing mobile technology (i.e., smartphone, tablet) to alter physical activity, sedentary behavior, or sleep among adults aged 50 years and older.

*Methods:* We conducted a systematic search through electronic databases (Web of Science, SCOPUS, PubMed and EBSCO - PsychInfo, PsychArticles) to identify all relevant articles (RCT, quasi-experimental, pre/post single group study design). Total number of 1499 abstracts were identified, of which 117 fulltext articles were screened, resulting in final number of 29 articles included in the final review.

*Results:* Out of 29 studies, the majority provided some evidence supporting the effectiveness of mHealth components for increasing physical activity (8 out of 11 pre/post studies and 10 out of 18 RCTs) as well as sedentary behavior (1 pre/post study and 4 out of 6 RCTs), with text messaging being the most frequently used component but usually used in combination with other components. Intervention design and outcomes demonstrated large variation between studies but more studies with positive effects were guided by theory than those failing to show significant effects.

*Conclusion:* Although some evidence was found supporting the effectiveness of mHealth approaches to enhance behavioral health of seniors, the overall low quality of study designs and inconsistent reporting of outcomes indicates need for higher quality experimental studies and more consistency in reporting of study outcomes.

**Keywords:** Health, mobile, older adults, behavior, physical activity, sedentary behavior, sleep

## IDENTIFYING AND PROMOTING THE PSYCHOLOGICAL CHARACTERISTICS OF TALENTED ADOLESCENT ATHLETES

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The purpose of this qualitative interpretative phenomenological analysis (Smith et al, 2009) was to reveal the psychological characteristics in talented adolescent-athletes identification and development process. By obtaining qualitative phenomenology phase, 7 elite youth sport coaches participated in semi-structured in-depth interviews. In the qualitative study three themes emerged from elite coach perspective: 1) Athlete self motivation; 2) Goal setting and self reinforcement; 3) Confidence under pressure. The lived experience of elite youth sport coaches revealed that athlete psychological and mental strength is associated with effective sport progression and performance. Athlete intrinsic motivation has been linked to goal setting and self reinforcement and associated with athlete confidence under pressure phenomenon.

*Keywords:* Identification, talent, athlete, coach, psychology.

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*Purpose:* Physical education (PE) lessons are the most important organisational form where teachers can influence the attitude of pupils toward physical activity and thus develop their physical literacy journey. The main aim of this study is to describe the differences in assessment of school physical education lesson by pupils in long-term context.

*Methods:* The survey took place within teaching practices of prospective teachers who study master degree programmes between 2002 and 2016. These student teachers attended secondary and high schools (n=919) according their place of living. Altogether 39,054 pupils participated in the survey. Student teachers were instructed to teach one habitual and one PE lesson of the same content but in the second lesson, they had to apply exercises with higher intensity. At the end of these lesson, pupils completed simple anonymous questionnaire that contains 24 yes-no questions. We than analyzed these answers into cognitive, emotional, healthy, social, attitudinal and supplementary dimensions. We used descriptive statistics to analyze the total points as well as two-independent-sample tests for comparison according to years and gender.

*Results:* Girls assessed PE lesson significantly better than boys did. In girls, we recorded significant decline in assessment of PE lesson during observed period in cognitive, emotional, healthy, social, attitudinal, and creative dimension. In boys, we recorded the decline only in cognitive and creative dimensions. Supplementary dimension “pupil’s role” was significantly different in girls as well as in boys within observed period. Younger girls assessed PE lessons significantly better than older girls did while in boys it was vice versa. Despite the deterioration of the relationship towards PE lesson, 63.3% of boys and 67.3% of girls still proved very positive attitude toward PE lesson. More than 72.5% of boys and 79.5% of girls would like to attend the same or similar PE lesson.

*Conclusion:* Negative trend in assessment of PE lessons by girls and boys draws attention to the danger of further deterioration of pupil’s relationship towards PE lesson. The situation requires major changes in school education programs and in the training of prospective PE teachers. Long-term analysis of the pupils' assessment of PE lessons is necessary to promote evidence-based education and physical literacy journey as one of the major aim in school PE programme.

## ATTITUDES TOWARD DANCE AND GENDER DIFFERENCES OF KADETS OF MILITARY COLLEGE

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Dance is often stereotypically categorized as "women's" sports' activity and as such, dance is not a favorite sports' activity among men. In regards to various transformational, educational and nurturing benefits that dance enables, the dance attitude of kadets (N=100) of the Military College was assessed. Kadets' dance attitudes were assessed using dance attitude scale SPP (J. Vlašić, K. Bosnar, 2007; according to J. Vlašić, 2010). The scale consists of 20 items of both directions (positive and negative) with answers containing five grades. The answers are valorized using points from 1 to 5 in such way that the greater result indicates positive dance attitude. The overall, summarized result ranges from 20 to 100 points. To determine differences in dance attitudes between male and female kadets T-test for independent samples was used. Questionnaire showed different dance attitudes among genders. Positive dance attitude is a good prerequisite for dance activities' engagement, especially that of male individuals. Promotion of stereotypical female or male activities should move from examining attitudes towards such activities with a view to changing attitude in a positive direction.

*Keywords:* military kadets, gender differences, dance attitudes.

## DIFFERENCES IN SOME KINEMATIC PARAMETERS DURING SHOOTING FOR TWO AND THREE POINTS IN BASKETBALL UNDER INFLUENCE OF DIFFERENT PHYSIOLOGICAL LOADS

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The aim of this study was to determine whether a progressive physiological load affects changes in certain kinematic parameters when performing a two and three-point jump shot in basketball. The effect of fatigue on jump height, duration of the flight phase, and duration of contact with the ground, amortization angle were observed through the concentric and eccentric contraction phases with respect to the duration of the shot, the shoulder angle and the angle at which the ball enters the basket. In this study, 6 participants were members of the Croatian national basketball team with an average age  $16,46 \pm 0,71$  y, body height of  $188.88 \pm 5.09$  cm, body mass of  $80.71 \pm 2.06$  kg and subcutaneous fat tissue of  $11.96 \pm 2.14\%$ . Descriptive indicators (Min, Max, Mean, Sd) were obtained and the anova for repeated measures showed statistically significant differences in jump height ( $F=10.16$ ,  $p<0,00$ ), duration of the flight phase ( $F=9.53$ ,  $p<0,00$ ), duration of contact with the ground ( $F=15.20$ ,  $p <0.00$ ) and duration of the concentric contraction phase ( $F=20.91$ ,  $p<0.00$ ) under the influence of progressive physiological load for two-points shots. And in the three-points shot the difference in jump height ( $F=9.09$ ,  $p<0,00$ ), duration of the flight phase ( $F=10.29$ ,  $p<0,00$ ), duration of contact with the ground ( $F=15.20$ ,  $p <0.00$ ) and duration of the concentric contraction phase ( $F=11.65$ ,  $p<0.00$ ) and finally with the duration of the eccentric contraction ( $F=5.96$ ,  $p<0.02$ ). Analysing kinematic parameters when performing a two and three-point jump shot under the influence of progressive physiological load we can conclude that certain kinematic parameters changed because of fatigue such as: jump height, duration of the flight phase, duration of contact with the ground and duration of concentric and eccentric contraction phases. Future studies should concentrate on different player positions under the influence of progressive physiological load.

*Keywords:* kinematic analysis, lactate, basketball, jump shot, physiology

## DETERMINING THE GENERAL HEALTH STATUS OF CZECH BOYS BETWEEN THE AGES OF 13 AND 16 YEARS BY USING THE FITNESSGRAM BATTERY TESTS

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How to improve and secure the general wellbeing of children and then adults is a global question of the modern society. A large number of researches are directed towards determining the importance of certain factors on the general health status of an individual with the goal of reducing the number of cases of people with acute and chronic diseases of the vascular, locomotor and other important body systems (WHO, 2016). This study covered 53 students in the 7th (23) and 8th (30) grade of elementary school Sirotkova from Brno. The children were aged  $14\pm 1.5$  years,  $165\pm 3.5$  cm tall and  $56.9\pm 5$  kg weight. The estimate of morphological traits (Body Mass Index), motor (curl up, trunk lift, push up 90°, sit and reach and shoulder stretch) and functioning (PACER test) abilities was conducted with the FitnessGram battery of tests (Cooper institute, 2013), adapted to the school population of Czech boys (Plowman & Meredith, 2013). The aim of this research was to determine if the health status of students significantly differs from the norm of the „Health Fitness Zone“ (President Youth Fitness Program, 2013). Based on the obtained results the majority of students are in the healthy fitness zone, but the more significant deviation happened when the students were put through the back strength and flexibility estimate intrunk lift test. The probable cause for the deviation is the intense growth spurt common for boys in that age range, where the tension of muscles is smaller, weakened (Sekulići Metikoš, 2007) and because of that special attention should be payed to prevention of possible injuries and deformations to the lumbar and sacral part of the back.

## DESIGNING THE STRENGTH TRAINING PROTOCOL THAT MIGHT ELICIT SIMILAR BDNF RESPONSES AS STANDARDLY RECOMMENDED AEROBIC EXERCISE

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*Purpose:* BDNF that increases after aerobic exercise effects cognition, enhances neurogenesis, neuroplasticity and long-term potentiation, and cognitive performance (Leckie *et al.*, 2014). Very much like in metabolic and cardiovascular disorders, the aerobic exercise has been prescribed as golden standard also in psychic disorders (Tsai *et al.*, 2014), though many people avoid aerobic exercise because of the boredom or inability to run or similar. Some suggested that strength training had no influence on peripheral BDNF but in our opinion it is the type of the strength training that is important. So the aim of this study was to design a strength training program that mimics the intensities of aerobic exercise responses that might be an useful stimuli for blood-borne neurotrophic growth factors (NTFs) like brain-derived neurotrophic factor (BDNF) in order to elicit double training benefits.

*Methods:* Eight female subjects, volunteered in the study (age  $38.3 \pm 4.7$ ). In the first trial the subjects performed a classical 30min aerobic exercise (65% of  $VO_{2max}$ , 80% of  $HR_{max}$ ) on cycle-ergometer. The rate of perceived exertion, the lactate levels, the heart rate, as well as cognitive function in remembering the shortly exposed pictures in the last minute of the protocol were monitored. In the next 4 trials (1 week apart from each other) the subjects underwent different strength training regimes. The regimes differed in number of sets, number of repetitions, muscle groups involved and the duration of breaks between the exercises and between the sets.

*Results:* Among the tested protocols we identified that the protocol design that involved exercises for 5 major muscle groups, each exercise repeated 12-14 times with only 30 second break between the sets and 1 min break between the exercises elicited the most similar effect to the desired aerobic training on the parameters monitored. The end lactate levels were  $3.7 \pm 1.2$  mmol/L, mean heart rate 78% of the predicted  $HR_{max}$ , and the rate of perceived exertion mean response was  $10.1 \pm 2.5$  on a 1-20 scale (meaning moderate exertion). None of the values differed significantly from the standard aerobic protocol.

*Conclusions:* The above mentioned training program mimics the aerobic exercise physiological load responses so it might be expected that it would elicit the same BDNF responses like the currently studied aerobic exercise BDNF responses. The benefits might be doubled as it influences the muscle mass as well as it increases cardiovascular response. In the future studies the above mentioned protocol will be used in different populations (especially in depressive patients) in order to evaluate the BDNF strength training dynamics.

*Keywords:* strength training, BDNF, aerobic exercise

## REASONS BEHIND SUCCESS AND FAILURE IN SPORT

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*Introduction:* Attribution theory can help us investigate and understand the reasons or attributes behind peoples' behaviors and different outcomes which can occur in sports settings. Attributions have cognitive, affective and behavioral consequences (Weiner, 1985). Therefore, it is especially important and relevant to investigate how athletes explain the reasons behind their successes and failures in sport. Even though understanding attributions in sports context can be extremely beneficial, there is an evident lack of research in this area conducted on Croatian athletes. Therefore, this study aimed to examine how Croatian student-athletes interpret the reasons behind their most and least successful competition and whether the pattern of their attributes supported attribution theory predictions.

*Methods:* The sample was 65 (40 male and 25 female) student-athletes from the team and individual sports who were in average 20 years old ( $M=19,97$ ;  $SD=.901$ ). At the time of the data collection, all participants were active athletes. To measure the attribution dimensions, we used Weiner's attribution model and Croatian version of the Causal Dimension Scale (CDS-II; McAuley, Duncan, and Russell, 1992).

*Results:* The Cohen's  $d$  coefficient was the statistic utilized to understand differences between attributions for success and failure. The results showed large effect size for stability dimension ( $d=.85$ ), the medium effect size for the locus of causality ( $d=.49$ ) and personal control ( $d=.58$ ) dimensions, and negligible effect size for external control dimension ( $d=.05$ ). These results overall supported attribution theory predictions.

*Conclusion:* These results can help us further understand how athletes explain the reasons behind their successes and failures. The pattern of attributes has significant practical implications, especially for post-competition evaluation. We encourage more study of attribution theory in competitive sports settings.

*Keywords:* attributions, athletes, psychology



## EFFECTS OF PHYSICAL EXERCISE IN ELDERLY PEOPLE WITH DEMENTIA – A REVIEW

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*Purpose:* The concept of dementia includes progressive disorders of cognitive function induced by changes in the central nervous system. One of the basic symptoms is a memory disorder, but it can include cogitation and behaviour disorders, therefore dementia syndrome may greatly interfere with daily functioning of the person. The aim of this paper was to review and show the results of studies in which elderly people with dementia, who are housed in nursing homes, have participated in physical exercise programmes.

*Methods:* The bibliographic database Medline was searched using key words “nursing homes and physical activity and dementia”. The search was limited to clinical trials that included participants aged 65 years and older. The search yielded 40 articles. After the screening of the titles and abstracts, 9 articles were included in the final analysis.

*Results:* Out of eleven intervention groups in the analysed studies, six engaged in an exercise programme consisting of either strength, balance or flexibility exercises. Four interventions included walking, and one included adapted yoga programme. The measured outcomes included the effects of physical activity on balance, functional mobility, walking speed and strength (primarily of lower extremities). In terms of mental health, the effects of intervention programme on cognitive functions were measured. Experimental groups performed significantly better than control groups post-intervention in the balance tests (in three studies), tests of functional mobility and walking speed (in four studies) and lower extremity strength tests (in three studies). Also, there was a significant improvement in agitation symptoms (in one study), symptoms of depression (three studies) and anxiety (one study), mood (one study), and communication skills (one study).

*Conclusion:* Research findings suggest that physical exercise programmes have a potential positive effect on physical abilities and traits and also on the cognitive abilities of the elderly people with dementia, although further quality randomized controlled trials are still needed.

*Keywords:* aging, cognitive abilities, balance, physical activity

## INFLUENCE OF UPPER BODY STRENGTH ON BURPEE30 TEST PERFORMANCE

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The aim of this research was to determine how the results of the tests for the estimation of dynamic and static upper body strength have influenced the burpee30 test performance in the first-year students of the Faculty of Kinesiology at the University of Zagreb. The research was conducted on 391 female students,  $18 \pm 1.6$  years of age, average height  $168.9 \pm 6.26$  cm, average body mass  $60.9 \pm 6.6$  kg. The data were processed by the statistical software package Statistics 13.2.

The results of regression analysis showed that the analyzed variables for assessing abdominal muscular strength (double-leg lift on the floor, double-leg lift on an incline bench, sit-up in 20 second, hanging double-leg lift hold, sit-up without help support) and variables for the evaluation of back muscle strength (back extension, back extension hold) did not have a statistically significant impact on the performance in the burpee30 test. A statistically significant but negative impact on the performance in the burpee30 test was obtained in the test for assessing the static strength of abdominal musculature in the hanging double-leg lift hold.

Therefore, it can be assumed that, apart from the whole body strength, the strength of the arm and shoulder girdles, together with coordination and endurance, have a more significant effect on the performance in the burpee 30 tests.

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**Purpose:** Team handball may be considered as a representative of highly intensive complex activity and sport, with spectrum of maximum exerts of power/force trough unilateral moving patterns. Unilateral load while jumping, shooting (stance-shot/jump-shot, defensive contacts, etc) in terms of take-off and landing forces (Gruić, 2006), concentric, eccentric and elastic component of take-off (Gruić 2014), kinematic parameters of specific take-off (i.e. unilateral jump-shot, e.g. in Pažin et al, 2016), pedobarographic parameters (i.e. plantar pressure distribution in Gruić et al, 2015, 2016), may produce different outcomes (score, scoliosis, injury..), (Gruić, 2017), and alterations in everyday (e.g. gait) patterns. Ankylosing spondylitis (AS) is chronic inflammatory rheumatic disease which predominantly affects sacroiliac joints and spine and, during course of time, may also alter posture, movement patterns and regulation and quality of life (Gruić et al., 2017). Main objective was to compare differences in basic gait patterns between two groups caused by two opposite and continuous sources of transformations and alterations – involvement in unilateral sport activity, i.e., team handball, and chronic inflammatory rheumatic disease, i.e. AS.

**Methods:** Subjects were 24 team handball players - age (Mean±StandardDeviation) 22±4years, Body weight 81,34±9,03kg, Body height 174,97±19,43cm, BMI 26,89±3,07 kg/m<sup>2</sup>, and 10 male patients diagnosed with AS - age 41,6±8,76years, Body weight 76,70±18,29kg, Body height 174,80±9,74cm, BMI 24,91±4,37 kg/m<sup>2</sup>, regularly participating in rehabilitation program. Sample of 8 quantitative variables assessing pedobarographic features of gait within protocol standardized for descriptive and inferential statistical methods (Gruić et al, 2015; FDM1.5, ZEBRIS medical, GmbH), i.e. GSL (Stride length, cm), GSW (Stride width, cm), TST (Stride time, sec), PDSTP (Double stance phase, % of gait cycle), TC (Cadence, steps/min), TV (Velocity, km/h), BAP (Ant/Post position, mm), BLS (Lateral symmetry, mm), were observed. Data was collected out of reports on pedobarographic status of subjects (Zebris Medical FDM software for qualitative and quantitative analysis) within raw gait parameters (geometry, phases, timing). Collected data were processed within descriptive analysis, K-S normality tests, discriminant analysis, and ANOVA, in Statistica for W/12.0

**Results:** General differences between two groups were tested and confirmed by discriminant analysis (Wilks' Lambda =0,46; approx. F (8,25)=3,66; p< ,01). Furthermore, classification matrix revealed that observed classifications were not absolutely in line predicted classifications (91,18 percent correct). Gait cycle of three AS patients were classified under 'handball group'. Statistically significant univariate differences between two groups were found in stride length (GSL:F=10,689, p<0,01) and in percentage of gait cycle in double stance phase (PDSTP: F=5,185, p<0,03).

**Conclusion:** Different long-lasting stimuli usually cause different transformation on different subject. Unilateral stimuli, caused by training or chronic illness, can produce almost similar, usually unwanted, effects. By proper diagnosis, status determination and targeted program it is possible to 'steer' among possible future desirable and undesirable effects caused by systematic handball training or chronic inflammatory rheumatic disease.

*Keywords:* Handball, Ankylosing Spondylitis, unilateral load, differences

## DIFFERENCES IN MORPHOLOGICAL CHARACTERISTICS OF FEMALE ATHLETES - OLYMPIC FINALISTS IN THROWING DISCIPLINES FROM 2000 TO 2016

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The aim of this research was to analyse the differences in morphological characteristics of female athletes-Olympic finalists in throwing disciplines from 2000 to 2016 (discus throwers, hammer throwers, javelin throwers and shot putters). The sample consisted of 160 finalists in throwing disciplines (40 finalists per each discipline), and common parameters such as body height (BH), body weight (BW), body mass index (BMI) and age (AGE) were used in order to determine the morphological differences between the athletes. The collected data were processed using Statistica 12.0 analytics software. The basic descriptive parameters were calculated for the variables in this research and the significance of differences between the subsample regarding the morphological characteristics was tested with the one-way ANOVA. Non-parametric Kruskal-Wallis and Mann-Whitney tests were also used in this research. Statistical significance of differences was tested at the level of significance  $p < 0,05$ . The results indicate that there are statistically significant differences between athletes according to the discipline criterion in variables BH, BW and BMI. It was determined for the body height variable that javelin throwers ( $M=176,08$ ) and hammer throwers ( $M=174,38$ ) are significantly shorter than shot putters ( $M=181,80$ ) and discus throwers ( $M=181,75$ ). For the body weight variable, it was determined by the use of non-parametric tests that there is a statistically significant difference between all combinations of throwing disciplines, and for the BMI variable that there is also a statistically significant difference between all throwing disciplines, except between hammer and discus throwers. Statistically significant difference was not determined for the age variable. The results of this research should undoubtedly help trainers with selection and training of potentially top-level athletes, which can also contribute to the decrease of deficit in the diagnostics of the morphological characteristics against physical abilities

*Keywords:* Olympic Games, thrower disciplines, morphological characteristics

## DIFFERENCES BETWEEN BODY COMPOSITION PARAMETERS IN UNIVERSITY STUDENTS ACCORDING TO SELF RATED HEALTH STATUS

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*Purpose:* The purpose of the present study was to investigate differences between poor and good self-rated group in body composition parameters.

*Methods:* In this cross-sectional study, participants were 73 university students (mean age 19.52, mean height 173.09 yrs, mean weight 70.89 kg, mean body-mass index 23.40 kg/m<sup>2</sup>). Self-rated health was assessed by using single-item question: "How would you rate your health?" with five responses: (1) very poor, (2) poor, (3) fair, (4) good and (5) excellent. We categorized the outcome on "poor" health (responses very poor and poor) and "good" (responses fair, good and very good). Body composition parameters were assessed by using bioelectric impedance analysis. Differences between groups were analyzed by using Student t-test and Man-Whitney U-test. Significance was set up at  $p < 0.05$ .

*Results:* Roughly, 38% of participants reported having poor health. Group reporting poor health had higher % of fat-mass ( $p < 0.001$ ), visceral fat ( $p < 0.001$ ) and body-mass index ( $p < 0.001$ ). Group with good health had higher values in % fat-free mass ( $p < 0.001$ ), but not in blood pressure and heart rate ( $p > 0.05$ ).

*Conclusion:* Our study shows that participants who reported having poor self-rated health had higher values in non-healthy body composition parameters compared with those reporting good health. Special strategies and policies that leverage healthy lifestyle, such as more physical activity balanced diet should be implemented within the university school system, in order to improve health and body composition status.

*Keywords:* young adults, body composition, health, differences

## POTENTIALS OF COMPUTERIZED ADAPTIVE TESTING IN PHYSICAL SELF-CONCEPT ASSESSMENT.

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*Purpose:* Measurement instruments including questionnaires, inventories, test batteries, achievement tests, and surveys commonly used in social and behavioral sciences including Kinanthropology, have traditionally been designed for administration in a linear (fixed-length) format. This conventional measurement approach presents the same set and sequence of test items to each test taker. However the developments of psychometric theory in recent decades allow for efficient implementation and practical use of so-called Computerized Adaptive Testing (CAT). Despite its growing popularity in various disciplines, the same widespread use of CAT has not witnessed similar growth in Kinanthropology (Gershon & Bergstorm, 2006). In this novel approach to the test administration, items (questions) are selected adaptively, based on previous responses of tested individuals in order to maximize the measurement accuracy. Since fewer items (questions) are usually administered in CAT, it offers a possibility of increasing the efficiency of the entire testing process compared to the linear testing format (reducing the test length and thus the testing time, ...).

*Methods:* The aim of this poster was to validate the usefulness of CAT when assessing physical self-concept using the Physical Self-Description Questionnaire (PSDQ) – an instrument widely used in the field of sport and exercise psychology. We conducted a Monte-Carlo simulation of the PSDQ adaptive administration, which utilized a real item pool (N=70) calibrated with a Graded Response Model. The item responses were generated based on item parameters and pre-specified latent values of physical self-concept.

*Results:* Results have shown that when a relatively low but often acceptable measurement accuracy (reliability = 0.8) was required, the average number of administered items from the PSDQ was 5.3 (SD = 4.9), saving more than 90% of all the test items. Physical self-concept estimates based on CAT corresponded highly with physical self-concept estimates obtained using all 70 PSDQ items (Pearson's  $r = 0.94$ ).

*Conclusion:* Our findings indicate that computerized adaptive testing represents a useful way of reducing a test length, when assessing physical self-concept using the PSDQ items. Given the favorable results of the present simulation study, an interesting next step would be to evaluate the usefulness of the PSDQ CAT administration in real testing conditions.

*Keywords:* item response theory, psychometrics, computerized adaptive testing

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## FACTOR STRUCTURE OF INTRINSIC MOTIVATION IN SPORT.

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*Purpose:* The aim of this study was to examine the factor structure of intrinsic motivation (IM) using the Sport motivation scale (SMS) – a well-known assessment tool in sport and exercise psychology – in a sample of Czech University athletes (N = 229, mean age = 22.0 ± 2.1 years).

*Methods:* First, the factor structure of the SMS was examined using exploratory (EFA) and confirmatory factor analysis (CFA) techniques. In addition, we applied a rigorous multiple-indicators multiple-causes (MIMIC) structural modelling approach to evaluate possible group differences in intrinsic motivation by modelling gender, competition level, and frequency of physical activity as predictors.

*Results:* Following exclusion of one problematic item, the EFA and CFA model fit statistics (EFA:  $\chi^2(25) = 37.9$ ,  $p = 0.048$ , RMSEA = 0.05, CFI = 0.99, TLI = 0.97; CFA:  $\chi^2(41) = 73.8$ ,  $p = 0.001$ , RMSEA = 0.06, CFI = 0.99, TLI = 0.98) favored the hypothesized 3-factor solution with subscales: intrinsic motivation to know (IM-K), intrinsic motivation to accomplish (IM-A) and intrinsic motivation to experience stimulation (IM-E). Interestingly, MIMIC modelling revealed no significant differences in intrinsic motivation with regard to gender, both at the latent and manifest indicator level. The same was true for competition level, where highly competitive athletes did not differ in their levels of IM from recreational athletes. Correlations between IM subscales and hypothesized outcome variables highlighted possible convergent validity issues of the three-modal IM delineation

*Conclusion:* While results of this study support construct validity and generic reliability of the IM subscales within the SMS, it is recommended to take an advantage of recent developments in sport motivation assessments, which prefer unitary conceptualization of IM.

*Keywords:* intrinsic motivation, university athletes, factorial validity, MIMIC

*Acknowledgements:* This study was supported by projects PROGRES Q19,SVV 2017-260446 and GAUK110217.



## THE COMPARISON OF THE LEVEL OF MOVEMENT COORDINATION BY INTACT CHILDREN AND CHILDREN WITH DIFFERENT SPECIAL NEEDS IN YOUNG SCHOOL AGE

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*Purpose:* The quality of movement coordination significantly influences the everyday life of a man and creates preconditions for effective acquiring motor skills. The most important is development of coordination in the field of functional skills that are useful in everyday life and their quality must be cultivated from an early age (Livesey, Coleman, Piek, 2007). Any dyscoordination and inaccuracies in movement significantly correlate with cognitive, language, social and emotional difficulties of children (Pick, Hands, Licari, 2012). We wanted to compare movement coordination by intact children and children with special needs in young school age.

*Methods:* For the evaluation of the level of movement coordination we used the test battery MABC-2. It is designed for diagnostics of developmental coordination disorder that evaluates and describes imperfections of motor performance. The test battery has eight tasks that cover three areas: manual dexterity, aiming and catching, static and dynamic balance.

We tested three different research samples of children pre and post targeted movement intervention. First sample was from Special Elementary School in Pilsen (13 pupils with moderate mental retardation). The second sample was from Elementary School for Children with Hearing Impairment in Pilsen (12 pupils). The third sample was created by children attending sport clubs focused on general motor development (13 pupils).

Every sample participated in one year movement intervention specially adjusted to their needs.

*Results:* According to the results children were divided into the three zones (Red zone - movement difficulties; Amber zone - risk of movement difficulties; Green zone - without movement difficulties). After pre-test 7 children with mental retardation (MR) and 5 children with hearing impairment (HI) belonged to the red zone. The sporting children belonged all to the green zone. The movement intervention had positive effect on all research samples. After that 10 children with MR, 11 children with HI and 7 sporting children improved. The more significant improvement was obvious by children with MR and HI. Sporting children had already high level of movement coordination in pre-test, so there was not such a big chance for improvement. Children with MR and HI experienced some problems during the testing: a) in manual dexterity - posting coins task - it was unknown task, children needed longer concentration; b) in static balance - most of pupils held in position only 0-2 second; c) in dynamic balance - the most difficult task for children was walking heels raised. And it is also difficult to get the best results from these children in one assessment day as it depends on their actual mood and concentration.

*Conclusions:* The test battery MABC-2 is primarily set for intact children. But it seems to be more suitable for diagnostics of developmental coordination disorder by children with special needs. Intact children, specially sporting ones, do not have due to their high level in movement coordination in pre-test significant chance for the improvement. It is convenient that after the diagnostics with MABC-2 we can individually adjust movement intervention according to the findings which area of

coordination (manual dexterity, aiming and catching, static and dynamic balance) should be improved by the individual.

*Keywords:* movement coordination, test battery MABC-2, young school age, children with special needs

## COUNTRIES EFFICIENCY ON WORLD CHAMPIONSHIPS IN ARTISTIC GYMNASTICS

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The purpose of this study was to determine the countries efficiency in World Championship team competition in artistic gymnastics from 1934 to 2015 and differences in won medals between men and women. A sample of variables was made by 23 countries that won one of the first three medals. The data were collected over a number of years from the FIG base. The number of medals per individual country and gender differences was determined by frequency tables. Statistica 12 was used to data analyses. The results showed that the highest number of medals belongs to the Eastern Bloc countries, then Asian countries, European and US. Eastern bloc countries have won more medals in female gymnastics, while in male gymnastics is the dominant Asian countries. The results of this research will give an insight into the distribution of gymnastics and domination of individual countries.

*Keywords:* medals, competition, artistic gymnastics, World Championships

## SPECIAL SECTION: ATLETIKA 2017

### THE UTILIZATION POSSIBILITIES OF OXYGEN CONCENTRATORS' INHALATION IN SPORT

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The aim of research is to analyse the practical utilization possibilities of oxygen concentrators' in a sport. Introduction contains a wide meta analysis of researches realized on sportsmen, where variable methods of oxygen concentrator's usage were used for improving performance and recovery. The main purpose of research is to point on variety of oxygen concentrator's utilization in sport as well as on its limits. There is a presentation of author's team members own researches, which they had realized in the past. Practical part of research is talking about oxygen concentrator' inhalation and its impact to recovery in ice-hockey players. Twenty male players were tested, average age 23.53 years (SD  $\pm$  1,32), average weight was 81.83 kg (SD  $\pm$  10,62), average height 180.55 cm (SD  $\pm$  6,01 cm). Inhalation was realized on a New Life Intensity 2x10 l device, which can produce 90 %  $\pm$  3 % mixture of oxygen concentrator in a volume of 10 l.min<sup>-1</sup>. Blood lactate value was diagnosed on a medical analyser EKF Biosen C line (measurement scale for lactate 0.5 – 40mmol.l<sup>-1</sup>). Statistical analysis was calculated by IBM SPSS® V23 software. The repeated shuttle running test performance (4x10x10m) with different period of oxygen concentrator' inhalation (0 sec. 30 sec., 60 sec., 90 sec. 120 sec.) were compared. We compared tests score, blood lactate concentration and heart rate parameters with using oxygen concentrator's inhalation during test and without oxygen concentrator's inhalation during test. There were significant differences in all periods of inhalation (p<0.01) respectively (30 sec., 60 sec., 90 sec., 120 sec.) compared to placebo control test without inhalation. When it comes about blood-lactate concentration we achieved significant differences (p<0.01) only during 120 seconds' inhalation. In heart rate measurements, we found significant differences during 60 sec., 90 sec. And 120 sec. Inhalation. Based on these findings it is possible to assume that inhalation of oxygen concentrators might have positive impact on sport's performance as well as on recovery processes in sport.

*Keywords:* inhalation, oxygen, performance, recovery.

## COMPARISON OF STRENGTH EXERCISES ON BALANCE AIDS AS STABLE TOOLS

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The issue the strength training effectiveness is getting in the foreground of sport preparation. Recently, the stimulation of strength abilities and deep stabilisation system (DSS) via the balance aids starts to be promoted.

In our work we sought to verify the affecting the efficiency of a Strength programme of exercise on unstable surfaces for stimulation of strength endurance abilities, compared to a similar didactic programme conducted on stable surfaces, thus creating an alternative choice for coaches, teachers, and sports instructors. The research sample consisted of males (non-competitive athletes) aged 21-35 years ( $n = 75$ ). Probandes were randomly assigned to three groups. Experimental factor represented a specific intervention program strength (exercises on unstable surfaces supporting exercises on a stable platform, free exercise program). Intervention Force program lasted 10 weeks and included 22 intervention units.

A major element of the didactic process is the quality of the strength training programme on stable and unstable surfaces. When evaluating the overall results of the tests before and after the experimental programme, we come to be of the opinion that the experimental programme manifested itself positively in effectiveness of stimulating strength abilities. The strength programme had an influence on increasing the persistence of strength in dynamic and static regimens. In the case of a strengthening programme on unstable surfaces there was a tendency towards greater growth in the number of repetitions as opposed to programme on a stable base at the beginning of the programme in the case of exercise in a dynamic regimen.

Next, we study focuses on the comparison of strength training on balance aids and stable surfaces and its impact on the quality of activation DSS. Based on our results we can conclude that both alternatives are similarly effective workout.

Based on our result we found that strength intervention on unstable and stable platforms had positive effect on the duality of DSS activation.

## ATHLETICS PERFORMANCE AND TRAINING FITNESS TRAINING IN ATHLETICS, ATHLETICS IN FITNESS TRAINING

PULSE OXIMETRY AS A TOOL TO ASSESS THE LEVEL OF ACCLIMATISATION AND THE EFFECT OF  
THE TRAINING LOAD ON THE BODY OF AN ELITE FEMALE RUNNER DURING ALTITUDE TRAINING

Pavel Červinka,

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The results of a case study on an elite female runner, participant of the World Championship and European Championship, are presented. We examined the feasibility of using a finger pulse oximeter to follow the acclimatisation process and training stress during mountain training workshops. We measured the subject's blood saturation with oxygen, heart rate and perfusion index levels. The results demonstrated that periodic pulse measurements with a finger pulse oximeter can be used to monitor both the body response to acclimatisation at high altitudes and to the training load and that this is a promising approach to a rapid and reliable assessment of acclimatisation as well as to the monitoring of the body response to load.

## THE EFFECT OF UNILATERAL STRENGTH TRAINING TO THE CROSS-COUNTRY SKIING DOUBLE POLING PERFORMANCE

David Brúnn, Jozef Sýkora, Martin Pupiš

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At the highest level of sport performance the progress is already very limited. Therefore it is very important to implement new training approaches and methods to our training process. The main purpose of our research was to find out, if unilateral strength training is more efficient for developing cross-country skiing double poling performance, than bilateral strength training approach. Our research was based on bilateral limb deficit phenomenon. We focused purely on double poling performance, because in today's world of cross-country skiing this technique is limiting factor of success in races. Our research sample consisted of 8 probands (Age  $17.94 \pm 1.04$ ), national and international level cross-country skiers. After entry test, we divided our sample into two groups. Experimental group realized unilateral strength training program and control group bilateral strength training program within 6 weeks (3 training sessions per week). For tests we used SkiErg machine from Concept 2. The test was designed by performing 30 seconds of double poling at maximum intensity. Experimental group improved in total distance for about 6.66% (9.25 m) and control group 2.69% (3.75 m). Although we did not register statistically significant difference between groups ( $p = 0.724$ ), experimental group improved its performance with medium effect size level ( $p = 0.11$ ,  $r = 0.4$ ) while control group achieved small effect size level only ( $p = 0.19$ ,  $r = 0.17$ ). The gap on finish line where winner and loser is determined is often just few centimeters, so our results (difference almost 6 meters between our groups) would definitely make big difference in real races. In our research we also wanted to come up with an clear answer, if unilateral strength training approach is beneficial and efficient way of training for cross-country skiers. It seems that unilateral strength training approach might be better choice for developing cross-country skiing double poling performance.

*Keywords:* Cross-country skiing, double poling, unilateral strength training

## THE ROLE OF THROWING EVENTS IN DECATHLON – ANALYSIS OF ABSOLUTE AND POINT RESULTS

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*Purpose:* Decathlon is a combined track-and-field event in which an athlete's final result depends on the partial results achieved in each of the ten component events, which include running, jumping and throwing. The aim of this paper was to analyse the significance of throwing events for the final score in decathlon at various stages of development of an athlete's career, taking into account the point score. The analysis was conducted on the basis of data collected on the careers of the world's 25 best athletes active between 1985 and 2015 (282 cases).

*Methods:* The material was divided into the four stages of the career development (S1 - to 19 years of age, S2 - from 19 to 23 years of age, S3 - from 23 to 30 years of age and S4 - from 31 years of age to the end of the career). The study takes advantage of basic descriptive statistics, determines the values of Pearson's linear correlation coefficients, ANOVA variance analysis and post hoc Tukey's test. All analyses were conducted using the Statistica 12 software and the R programming language, along with additional packages.

*Results:* The research shows that there are statistically significant differences between levels achieved in individual throwing competitions in most career stages. In addition, significant relationships between the various competitions at different stages of the ontogenesis of the athletes are observed. The calculations proved the existence of statistically significant correlations between the final score in decathlon and the point scores in throwing events, and of correlations between individual events at various stages of a decathlete's sport development.

*Conclusions:* On the basis of the obtained calculations it was concluded that results achieved in discus throw and shot put events at junior stage have the highest significance for and influence on the final results and the high correlation between shot put and discus throw might be significant in terms of combining training units. Javelin throw should be treated independently – it does not reveal any connection with other throwing events regardless of the career stage.

*Keywords:* decathlon, throwing competitions, sport ontogenesis



## ANTHROPOMETRIC CHARACTERISTICS AND SOMATOTYPES OF MALE AND FEMALE ELITE THROWERS FROM THE CZECH REPUBLIC

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**Purpose:** The purpose of this study was to find out the relationship between elite male and female throwers through the anthropometric characteristics and somatotype depending on each discipline. The sample consists of 28 elite female throwers and of 25 elite male throwers from the Czech Republic.

**Methods:** Anthropometric and somatotype variables were measured according to the Heath-Carter method, except the skinfolds, which were measured on the throwing hand-side. Body composition was measured by BodystatQuadScan 4000. The statistical analysis of differences was tested by Kruskal-Wallis ANOVA, correlations were tested by the Spearman correlation coefficients ( $p < 0.05$ ).

**Results:** The relationship between the waist circumference and competition performance showed stronger correlation ( $r = -0.82$ ) inside the men hammer throw. A positive correlation was found out among body height and performance inside the men javelin throw ( $r = 0.90$ ). Other anthropometric parameters have no statistically significant correlation with performance. Results showed significant differences between female javelin and hammer throwers only, exactly in the body mass index ( $p < 0.01$ ). Significant differences were found between body mass index and waist circumference between male javelin throwers and male shot putters ( $p < 0.01$ ). The average somatotype of female throwers is for the hammer 5.1-5.7-0.7, for the discus 4.1-4.9-1.8, for the shot 5.3-5.3-1.6, and for the javelin 3.7-4.5-1.8 (average performance  $58.13 \pm 6.89$  m). The average somatotype of male throwers is for the hammer, 4.5-7.3-1.1, for the discus 3.5-6.8-1.3, for the shot 6.3-8.4-0.1 with turn technique (average performance  $21.41 \pm 0.68$  m) and for the javelin 3.1-6-1.9 (average performance  $74.95 \pm 8.93$  m).

**Conclusion:** The result of this study indicates the relationship between anthropometric characteristics and performance in the men hammer and javelin throwers. The results show apparent similarities in the somatotype of the group of shot putters, hammer, and discus throwers compared to javelin throwers in both sexes. The anthropometric measures and somatotype are an important factor in the correct determining of throwing talents in these disciplines. These measures can be useful for later comparisons of anthropometric characteristics and somatotype in a long-term context.

**Keywords:** javelin throw, hammer throw, shot put, discus throw, anthropometric, somatotype, male, female, track and field

## INFLUENCE OF INTERVENTION PROGRAMME OF RESPIRATORY EXERCISES ON SELECTED DYNAMIC VENTILATION PARAMETERS

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*Purpose:* Performance in endurance sports is affected by qualities of the breathing stereotype and economical breathing. The aim of the work is to find out the influence of breathing exercises on tidal volume ( $V_T$ ) and minute ventilation volume (VE) in spiroergometry of the test.

*Methods:* The behaviour of a breathing wave may be influenced by targeted respiratory exercises. We have carried out an intentional selection of 36 subjects - middle- and long-distance runners. The research involved nineteen girls at the age of  $16.79 \pm 1.51$ , weight  $58.15 \pm 5.94$  kg, height  $167.53 \pm 4.24$  cm, and seventeen boys  $16.12 \pm 1.64$ , weight  $62.14 \pm 11.54$  kg, height  $176.38 \pm 8.72$  cm. Twenty subjects were trained in respiratory techniques, and sixteen subjects formed a control group. Our aim was to examine the influence of a two- and four-month intervention of respiratory exercises on dynamic ventilation parameters.

*Results:* The subjects conducted respiratory exercises for the first two months in average for  $13.2 \pm 3.87$  minutes on a daily basis, then in average for  $11.3 \pm 4.05$  minutes on a daily basis for the other two months. This procedure resulted in the improvement of  $V_T$  values from  $1.98 \pm 0.40$  l to  $2.07 \pm 0.44$  l, i.e. by 4.5% (2 months), or  $2.20 \pm 0.49$  l, i.e. by 11.21% (4 months). VE values improved from  $112.13 \pm 34.54$  l to  $117.59 \pm 35.30$  l, i.e. by 4.87% (after 2 months), or to  $123.68 \pm 34.28$  l, i.e. by 10.30% (after 4 months). Changes in  $V_T$  are substantively significant, changes in VE are substantively significant only with respect to a four-month intervention, and all changes and statistically significant.

*Conclusion:* Our study confirmed that four-month interventions of respiratory exercises have an influence on an increase in  $V_T$  and VE values, with both substantial and statistical significance. Our assumption is that this change in dynamic ventilation indicators, caused by improved breathing, may enable endurance sportsmen to develop their performance.

*Keywords:* spiroergometry, respiratory volume, ventilation minute volume, respiratory exercises, respiratory muscles.

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In this thesis I demonstrated the importance of testing and scoring fundamental movement patterns and functional movements in athleticism on younger age-group athletes already. Theoretical conclusions were based on two crucial works published by the author of the method, Gray Cook, then on scientific articles and studies found out in foreign databases (23 publications altogether) since no relevant scientific publication in Czech about FMS was available. Key words used for searching in foreign sources were: „Functional movement screening“, „FMS and athletic performance“, „FMS and young population“, FMS in athletics“, „FMS and norming data“, „FMS and scoring system“, „FMS and injury“ and „reliability of FMS“. Later I executed a short testing on a group of randomly selected athletes of category U16 –U19, based on two particular tests of FMS methodology: “deep squat” and “hurdle step”. Junior athletes were selected as described in the article of Polish authors, Paruzel-Dyja and Iskra (2012), then Paruzel-Dyja and Mehlich (2014) that already published studies on FMS testing to score young athletes. Another reason why to focus on these categories was my own belief that a method that evaluates fundamental movement can bring changes and new opportunities to improve trainings so that athletes will be better prepared when moving into the adult category. Each test demonstrated significant differences between individuals, independently on their gender. Only seven of overall 30 examined young athletes achieved the highest score. Most of them achieved score two and only one had visibly worse movements, twice characterised with score one. The most important faults revealed when doing “deep squat” were external or internal rotation of the knee, transfer weight to the outer or inner edges of the feet or loss of stability due to assaults across the toe and the heel, further excessive bend the torso with a protruding head carriage and poorly with stretched arms at the elbows. The biggest deficiencies revealed in “hurdle step” were indirect movement during the stroke of the lower limb in the hip, knee and ankle joints. Other identified faults were compensation diversions torso and head to one side or the other, forward head posture and problems with the correct position of the feet. When staying on one leg, some instability appeared that I detected when an individual completed step behind the hurdle on the outer or inner edge of the the foot.

*Keywords:* athletics, physiotherapy in athletics, FMS, movement patterns, Gray Cook, FMS evaluation, FMS and athletic performance

## CHANGE OF DIRECTION SPEED IMPROVES RAPIDLY COMPARED TO LINEAR SPEED AND EXPLOSIVE STRENGTH IN ADOLESCENT FOOTBALL PLAYERS

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<sup>4</sup> *Department of Kinanthropology*

**Purpose:** The goal of the study was to establish dependence of change of direction speed (CODS), linear speed and explosive strength on age in early adolescent football players.

**Methods:** Forty eight adolescent ( $178,5 \pm 5.8$  cm;  $66.8 \pm 7.3$  kg; 14.90-16.74 years) participated in the study. All subjects underwent the protocol, which consisted of field (CODS and speed) and laboratory measurements (explosive and reactive strength). Group of speed and CODS test were performed on artificial lawn football field indoor. All test were measured by timing gates. Day later, the subjects were tested in the laboratory in explosive and reactive strength using force plate (Kistler, Winterthur, Switzerland). Pearson correlation, ANOVA and Cohen d were used to assess the relationship between CODS and the factors.

**Results:** The most significant relationship was found between age and CODS performance ( $r=0.11-0.51$ ;  $d=0.31-1.20$ ). Improvement in speed and strength was also observed, however the magnitude of change was not so high (trivial in linear speed; trivial-moderate in explosive strength indicators).

**Conclusion:** CODS improvement was rapid in comparison with linear speed and strength. It indicates improved motor control and execution in game specific movement. Further development would be achieved through development of strength capacities.

**Keywords:** CODS – linear speed – explosive strength – reactive strength

## CREATINE KINASE LEVELS AFTER COMPETITION MATCH AND ITS RELATION TO PLAYER'S POSITION IN ELITE SLOVAK SOCCER TEAM

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Regular season in soccer often brings overloading of players therefore it is highly important to implement some fatigue controlling mechanisms for minimizing the risk of injury. Many authors investigated which methods could be used for reliable measurement of fatigue and injury prevention in elite soccer and since technology is always moving forward the necessity of next research is essential. The main purpose of this study was to monitor creatine kinase levels after competition matches on professional Slovak league soccer team and defining differences of CK on player's position. Soccer team consisted of 19 players (Age  $24.4 \pm 4.84$ , Height  $181.75 \pm 3.87$ , Weight  $77.50 \pm 6.16$ ). Two goalkeepers, six defensemen, seven midfielders and four forwards were tested respectively. Players took a part in measuring of creatine kinase 16 hours after competitive match during 6 measurements in regular season. Reflotron Plus device was used for measuring creatine kinase levels via non invasive principle of reflectance photometry. There were increased CK levels in all players average about  $4.62 \pm 1.56 \mu\text{kat.l}^{-1}$  in goalkeepers,  $6.79 \pm 4.29 \mu\text{kat.l}^{-1}$  in defencemen,  $7.56 \pm 5.59 \mu\text{kat.l}^{-1}$  in midfielders and  $7.68 \pm 5.40 \mu\text{kat.l}^{-1}$  in forwards. Globally we achieved increased CK levels during 80% from all measurements compared to reference values of CK for sportsmen. There were significant differences with moderate effect size between CK levels of goalkeepers and defencemen ( $p = 0.05$ ,  $r = 0.32$ ), goalkeepers and midfielders ( $p = 0.05$ ,  $r = 0.34$ ) and goalkeepers and forwards ( $p = 0.05$ ,  $r = 0.36$ ). We found no significant differences between defencemen, midfielders and forwards. We strongly recommend regular measuring of CK levels after every match due to decreasing risk injury and overload in players, since many authors approved significant connection between high CK levels and frequency of injuries.

*Keywords:* elite soccer players, creatine kinase, position, training, match

## RELATIONSHIP BETWEEN THE ISOKINETIC STRENGTH OF THE KNEE FLEXORS, KNEE EXTENSORS AND SPRINT RUNNING PERFORMANCE IN ELITE FOOTBALL PLAYERS.

Zuzana Hlavoňová, Jan Cacek, Tomáš Kalina, Dominik Bokůvka, Tereza Hammerová  
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*Purpose:* Strength is an important component of sporting performances in all branches of sport, including football. To a significant extent the speed of movement is dependent on it, and it greatly influences the movement activity of players requiring skilfulness, endurance and resilience in personal contests. Modern, professional football is a sport in which fast-moving individuals are successful. The largest number of sprints is performed at distances of up to 30 m during a match. Over the last decade, studies emerged documenting the correlation between half squat performance and 10m and 30m running time. Compared to the multi-joint half squat, the aim of our study was to find out whether there is a relationship between the isokinetic strength of the knee flexors or extensors and the 10m or 30m running performance of elite football players in the Czech Republic. The isokinetic testing of knee flexors and extensors is advantageous as compared to the isotonic in terms of gaining information about the H/Q ratio which is a major factor in the prevention of knee injuries.

*Methodology:* The strength of knee flexors and extensors (dominant limb) was tested on an isokinetic dynamometer at angular velocities of 60 and 240°.s<sup>-1</sup> for fourteen football players (excluding goalkeepers) of the highest Czech league at the age of 23.2 (SD 5.3), body height of 182.8 cm (SD 4.2) and body weight of 76.6 kg (SD 5.2). Apart from the strength parameters, the hamstrings-to-quadriceps strength ratio was calculated from the test results. Another tested parameter was the 10m and 30m sprint running performance.

*Conclusion:* The maximum isokinetic strength of the knee flexors is not a determining factor for 10m and 30m running performance for football players. The velocity at which the flexor strength was tested was not decisive, although a significantly higher tendency to limit sprint performance was documented at 240°.s<sup>-1</sup> than at 60°.s<sup>-1</sup>. For the knee extensors, the effect of isokinetic strength at 240°.s<sup>-1</sup> on the 30m running performance was documented, indicating that the strength of the knee extensors positively affects selected velocities at higher speeds. Based on our results, we do not recommend using single-joint, isolated exercises for knee flexors and extensors to increase the pace of running acceleration speed of football players.

## MONITORING OF SELECTED INJURY RISK FACTORS IN THE YOUNG BASKETBALL PLAYERS

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Top level basketball is one of professional sports that puts great demand on the physical fitness of the players. The physical load during the training and competitions is very high and that leads to a large number of injuries. Causes of these injuries are various, however the meta-analysis of fourteen studies concerning sport injuries (McCall et al., 2015) identified muscle fatigue, muscle imbalance and previous injuries as the three most risky factors.

The aim of the study was to verify the effect of muscle imbalances and previous injuries on the incidence of lower leg injuries in 19 young basketball players aged 12-14.

The examination confirmed high incidence of lower limb muscle shortenings, especially of the knee joint long extensor and flexors. On the other hand, the shoulder blade lower fixators were weakened, which is often associated with kyphotic posture in the chest area. Positive correlation between the occurrence of the lower limbs muscle shortenings and the incidence of injury was statistically significant. In agreement with other authors, we found more injuries on the right lower limb (36% of the players) than on the left (21% of the players).

Muscle imbalances are a significant factor in lower leg injuries. For this reason, it is important to include regular compensatory exercises in the training, which can reduce the risk.

*Keywords:* muscle imbalances, injury risk factors, basketball

# ATHLETICS IN SCHOOL PHYSICAL EDUCATION AND RECREATIONAL ATHLETICS

## POSTER SECTION

### EFFECT OF PHYSICAL PROGRAM ON CHOSEN INDICATORS OF PHYSICAL DEVELOPMENT AND PERFORMANCE OF 6 AND 7 YEARS-OLD CHILDREN

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In this contribution we present the changes in the level of physical development and movement performance of 6 - 7 year olds due to the movement program within the IAAF Kids' Athletics project. The monitored period lasted for 5 months, during which the members of the experimental set went through 37 trainings (2 trainings for 60 minutes a week). The motion program consisted of preparatory athletic and gymnastic exercises and movement games. Versatile training was focused on the development of all fitness abilities, coordination abilities and articulated mobility. The experimental group consisted of 24 children (17 boys and 7 girls), at  $6.62 \pm 0.31$  years. The control group had 31 children (22 boys and 9 girls), aged  $6.78 \pm 0.3$  years. We measured body height, body weight, and BMI from physical development indicators. We used the following tests to diagnose fitness abilities: standing long jump, knee throw over a head, 4 x 10 m shuttle run, frequency of lower limbs during 6 s, endurance shuttle run.

In the experimental sample, statistically significant changes ( $p < 0.05$ ) occurred in body mass (body height and body weight) and in all exercise performance tests. In BMI, we recorded a decrease in the experimental group but an increase in the control group. In the control group, we noticed minor changes in physical development and movement performance as in the experimental sample, in terms of statistical significance and effect size. In the experimental sample, we recorded medium effect in the tests: knee throw over a head, 4 x 10 m shuttle run, endurance shuttle run. We recorded small effect on the test: standing long jump and frequency of lower limbs during 6 s. In the control sample, we recorded small effect in the tests: standing long jump, knee throw over a head and endurance shuttle run. In 4 x 10 m shuttle run and frequency of lower limbs during 6 s we did not see any effect size.

The results show that children who have attended the IAAF Kids' Athletics project have achieved more positive changes in physical performance and in BMI.

*This contribution is a part of Grand project VEGA 1/0571/16 The impact of training on physical abilities, physical and functional development of 5 – 6 years old children.*

**Keywords:** Kids' Athletics, somatic parameters, physical development, younger school age



## ATHLETICS IN PHYSICAL EDUCATION FROM THE PERSPECTIVE OF GRAMMAR SCHOOL STUDENTS

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Athletics are perceived as negative by 40.1 % of responding students – with girls prevailing over boys in this group. The perception of athletics is mostly influenced by teachers of physical education, but also depends on the level of physical activity. Classes for the most part emphasize learning skills in various athletic disciplines, but grading still often reflects only the performance. The preferred athletic disciplines include long jump, sprints, cricket ball throw and relays (but in comparison the last two are included in classes minimally). On the other hand the least favorite is long-distance running.

*Keywords:* physical education, athletics, track and field, grammar school, student, physical activity, adolescent, athletic discipline

## PHYSICAL ACTIVITY AS A PREVENTION OF PATHOLOGICAL PHENOMENA IN CHILDREN AT ELEMENTARY SCHOOL

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The main objective of our contribution is to analyze the relationships between the level of physical activity and the occurrence of pathological phenomena (alcohol consumption, tobacco use and marijuana) in pupils at the 2nd level of elementary school.

The International Physical Activity Questionnaire (IPAQ) was used to collect data related to the diagnosis of physical activity frequency, which determines the intensity and duration of physical activity during the previous 7 days. For the purposes of this research, a short version of the IPAQ questionnaire was selected which contains a total of 7 questions.

For the collection of data related to the frequency of occurrence of selected adverse events, an international standardized ESPAD questionnaire was used within the framework of the European School Study on Alcohol and Other Drugs, from which selected questionnaire questions were compiled. The ESPAD International Project is the largest pan-European study on the use of addictive substances in adolescents. For the purpose of this research, 7 questions from this questionnaire were selected.

## PERFORMANCE LEVELS OF FEMALE STUDENTS OF THE FACULTY OF PHYSICAL EDUCATION AND SPORTS (COMENIUS UNIVERSITY) IN COMBINED TRACK-AND-FIELD EVENTS

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The authors have evaluated the combined track-and-field events performed by the female students of the Faculty of Physical Education and Sports of Comenius University in Bratislava (CU FPES) in the years 2013–2017. The combined track-and-field events are an obligatory part of the final Athletics examination in the teacher-training study path. The selected disciplines reflect the first day of the men's decathlon with the exception of the last one, which is replaced by 800 metres. The number of points in the combined event enters into the overall assessment of the subject Didactics of Athletics II together with an oral examination. The authors analysed not only the total number of points in the pentathlon but also in the individual disciplines and their percentage share in the final result. They have discovered that the shot put and high jump are among the most stable disciplines. The greatest variance of the percentage share in the overall number of points was observed in the 100-metre dash, 800 metres, and in the long jump. The performance of a high number of students (almost two-thirds) came below the average performance in the particular year as expressed in points.

*Keywords:* combined track-and-field events, CU FPES female students, physical performance, final athletics examination

## PLYOMETRIC TRAINING (DEPTH JUMP) AND LEG MOTOR FITNESS OF MALE UNIVERSITY STUDENTS IN CZECH REPUBLIC AND NIGERIA

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Leg motor fitness variables are essential parameters for the execution and skills and performances lower body which can effectively achieved the manipulation with right kind of lower body plyometric training. This study investigated the effect of depth jump (DJ) on leg motor fitness on male undergraduates of Czech Republic (CZ) and Nigeria (NG). The leg motor fitness variables selected for this study were leg muscular strength (LMS), leg muscular endurance (LME), leg power (LP) and speed (Sp). Experimental design was adopted for this study. Forty-eight participants were purposively selected from Masaryk University of CZ (n = 24, age = 20.29±1.27, height = 183.29±6.73, weight = 76.45±8.48) and University of Calabar of NG (n = 24, age = 23.56±3.05, height = 173.03±7.48, weight = 63.81±8.83), and randomized separately in each university into DJ (n = 12), and control (n = 12). Training protocol was 4 seconds work, 5 seconds rest between works, 10 repetitions, 8 sets, 2 min between sets at 90% HR<sub>MAX</sub>, totaling 30 min including warm-up and cool-down, twice per week for 8 weeks. Participants in CZ were measured using isokinetic dynamometer for LMS, isometric-squat with weight for LME, Myotest Pro for LP, and 10m dash using timing gate for Sp. While participants in Ng were measured using back and leg dynamometer for LMS, isometric-squat with weight for LME, Sergeant Jump for LP, and 10m dash with stopwatch for Sp. MANCOVA was used to test the hypotheses at p<.05 and multiple bar graph for the research question. The findings showed that CZ DJ had a significant effect on LME and Sp with effect size (ES) 26.4% and 72.4% respectively, and NG DJ had a significant effect on LME and Sp, with ES 32.9% and 64.8% respectively. DJ was effective in both countries, but with higher ES in CZ. Differences in result could be attributed to level of intrinsic motivation, age, and level of physical activity. This study recommends that DJ should be incorporated in the regular routine strength and endurance training.

**Keywords:** depth jump, strength, endurance, speed, power

## THE LEVEL OF ENDURANCE ABILITIES OF PUPILS AT PRIMARY SCHOOLS IN BANSKÁ BYSTRICA

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The aim of this contribution is the diagnosis, analysis and comparison of the level of endurance abilities of the pupils attending the 1<sup>st</sup>, 4<sup>th</sup> and 9<sup>th</sup> grade at primary schools in Banská Bystrica.

Tested pupils were from all 11 public schools, which are in Banská Bystrica. Overall, we tested 492 pupils from the 1<sup>st</sup> grade and this is 252 boys and 240 girls. The average age of tested boys was  $7.39 \pm 0.43$  decimal years and the average age of tested girls was  $7.24 \pm 0.34$  decimal years. We tested 433 pupils from the 4<sup>th</sup> grade and this is 220 boys and 213 girls. The average age of tested boys was  $10.37 \pm 0.44$  decimal years and the average age of tested girls was  $10.21 \pm 0.4$  decimal years. And we tested 301 pupils from the 9<sup>th</sup> grade and this is 164 boys and 137 girls. The average age of tested boys was  $14.88 \pm 0.39$  decimal years and the average age of tested girls was  $14.76 \pm 0.39$  decimal years.

We used endurance shuttle run for testing endurance abilities of pupils. The results were compared according to age, gender, somatic parameters and frequency of after-school sport activities.

To verify the representativeness of files by sex, we used chi-square goodness of fit test. Representativeness was verified by default on 5 % level of significance ( $\alpha = 0.05$ ). To verify the difference in performance of boys and girls, we used the t-test for independent files.

We found out statistically significant differences ( $p < 0.05$ ) between boys and girls in the 4<sup>th</sup> and 9<sup>th</sup> grade as well as among groups according to somatic parameters and after-school activities. The number of excellent performance decreases with increasing age. Groups of boys and girls from the 1<sup>st</sup>, 4<sup>th</sup> and 9<sup>th</sup> grade of Banská Bystrica lagged behind in endurance abilities of boys and girls of the Slovak population.

The most common cause of a very low level of endurance abilities was high body weight, high BMI and absence of after-school sport activities.

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**Keywords:** Banská Bystrica, girls, boys, Physical and Sport Education, endurance shuttle run, 1<sup>st</sup> grade, 4<sup>th</sup> grade, 9<sup>th</sup> grade

## THE RELATION BETWEEN RECREATIONAL RUNNERS' EFFICIENCY AND PARTICULAR PHASES OF THEIR MENSTRUAL CYCLE

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Apart from having an impact on woman's emotions, particular phases of the menstrual cycle influence also her sport performance, as well as her motivation to train. It is caused by the changing level of hormones during the menstrual cycle.

On a selected sample of women, we did a three-month research, observing how the particular phases of the cycle influence the sport efficiency; changing of the emotional mood was taken into consideration, too.

Concerning the sport activity itself, the subject of the research was either medium long or long track running.

Women chosen to the research had to meet the condition of being reproductively active; further, they were divided into groups of those taking hormonal contraception and women without using it. After three months, the results were evaluated and divided according to the relevancy of problems women had experienced during the training. A special category was established for women who were unable to continue with the training in particular days of their menstrual cycle.

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