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CONFERENCE ON  
KINANTHROPOLOGY**



**Sport and Quality of Life**  
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# **BOOK OF ABSTRACTS**

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# **13th INTERNATIONAL CONFERENCE ON KINANTHROPOLOGY “Sport and Quality of Life”**

**FACULTY OF SPORTS STUDIES  
MASARYK UNIVERSITY**

**IN COLLABORATION WITH**

**FACULTY OF KINESIOLOGY  
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# ANALYSIS OF HUMAN MOVEMENT

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# Centre of pressure changes during stance and gait after alcohol intoxication in relationship with habitual alcohol use in young women

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Marta Gimunová<sup>1\*</sup>, Michal Bozděch<sup>1</sup>, Jan Novák<sup>2</sup>

<sup>1</sup> Department of Kinesiology, Faculty of Sport Studies, Masaryk University

<sup>2</sup> Department of Gymnastics and Combatives, Faculty of Sport Studies, Masaryk University

*\*Corresponding author: Marta Gimunová, Department of Kinesiology, Faculty of Sport Studies, Masaryk University, Kamenice 5, Brno 625 00, gimunova@fsps.muni.cz*

**Purpose:** Women are underrepresented in research focused on alcohol despite the changing patterns of alcohol consumption which has been increasing in women in past decades. The purpose of this study was to analyse the relationship between habitual alcohol use screened by AUDIT questionnaire and centre of pressure (CoP) parameters of stance and gait when intoxicated by alcohol in young women. **Participants and methods:** Thirty young women participated in this study. All participants were asked to answer the AUDIT questionnaire. Stance and gait analysis were repeated at two conditions on the Zebris platform (FDM; GmbH, Munich, Germany): when the participants were sober (0.00% BrAC, breath alcohol concentration) and at 0.11% BrAC. By the AUDIT score, participants were divided into a low-risk alcohol consumption group (n=15; AUDIT score: 3 to 6) and hazardous alcohol consumption group (n=15; AUDIT score: 7 to 13). **Results:** When comparing the low risk and hazardous groups at 0.00% BrAC and 0.11% BrAC conditions, no statistical difference was observed in stance and gait parameters. When comparing 0.00% BrAC and 0.11% BrAC condition within each group, in both groups statistically significant difference was observed in CoP path length and CoP average velocity. Additionally, in low-risk group, a statistically significant difference in stride length was observed. **Conclusions:** The alcohol intoxication has a greater impact on CoP parameters during the stance compared to gait in young women.

**Keywords:** gait, stance, alcohol intoxication, female, AUDIT score

# Performance analysis of various features and functions settings on the neural network accuracy

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Michal Bozděch\*

Department of Kinesiology, Masaryk University, Faculty of Sports Studies

*\*michal.bozdech@fsps.muni.cz*

Artificial intelligence with machine learning (more precisely neural network) is one of the most used types of an algorithm, in sports but also in general. In the past, only wealthier sports clubs could afford to use her potential. With the development of affordable software, the situation changes and every club can use it to their advantage, but there is a problem with how to prepare data and how to set up the algorithm. For these reasons, this study aims to determine whether features or function settings have a greater effect on model accuracy. An initial feature dataset ( $n = 18,882$ ; 1,929 players, 8 variables) was created from publicly available sources. Each of the 6 feature settings consisted of 96 independent models. A total of 384 models were created, in which their accuracy (in the training and testing phases) and the percentage difference between the training and testing phases were further analysed. No statistically significant differences were found between the accuracy of the function's settings, but statistically significant differences were confirmed between the features settings, of which 14 models with 100% accuracy and 1.00 AUC. From this study, it is clear that feature settings, especially the reduction of the number of outputs, are a more important factor in increasing the accuracy of the artificial intelligence model and that variables Weight, Height, and Age had the highest frequency of occurrences of normalized importance and can therefore be identified as one of the most important features for prediction of final rank.

**Keywords:** ANN; DNN, inputs and outputs selection and extraction; hidden/output layer activation function; optimization algorithm

# Construction and Validation of Newly Developed Triangle Test of Reactive Agility in School Children

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Vladimir Pavlinović, Željko Cota, Ante Mandić, Jakov Škomrlj, Nikola Foretić

Faculty of Kinesiology, University of Split, Split, Croatia

**PURPOSE:** Agility is described as a rapid whole-body movement with change of velocity or direction in response to the different stimuli. Scientific research identified two independent types of agility performances: pre-planned agility (CODS) and non-planned agility (RAG). CODS represent generic movement patterns. They can mimic the demands of a sport but all of the movements are pre-planned. In CODS there is no response to a stimulus like in RAG where movements are in response to cues such as the movements of the ball or actions of the opposition players. Literature review show lack of studies that assessed CODS and RAG in children, most probably due to insufficiency in quality testing protocols. Hence, the purpose of this study was construction and validation of newly developed agility test that measures RAG performances in children. **METHODS:** For this purpose, the Blaze Pod system (BP) was used. Three lighting pods were mounted on three 50 cm cones in triangle formation with 4.5 meters distance between cones (TRGA). Results were collected via BP app. Four movement patterns were used to test RAG. Start and finish of the tests were conducted with the tap on BP pods. The sample comprised of 80 elementary school children (boys;  $n=39$ , age= $14.88\pm0.36$  yrs, height= $174.3\pm7.46$  cm, mass= $67.86\pm16.78$  kg, and girls;  $n=41$ , age= $14.85\pm0.31$  yrs, height= $167.49\pm5.72$  cm, mass= $59.34\pm10.54$  kg). Statistical analysis included calculation of normality of distribution, reliability coefficients, correlations and analysis of variance. **RESULTS:** Tests showed acceptable reliability with CA=0.58, ICC=0.32 for boys and CA=0.78, ICC=0.55 for girls. Inter-item correlations were higher in girls' sample ( $r=0.49-0.64$ ) than in boys ( $r=0.27-0.41$ ). Also, test showed good sensitivity, normal data distribution and good homogeneity with no differences between items (boys;  $F=0.07$ ,  $p=0.93$ ; girls;  $F=0.13$ ,  $p=0.88$ ). Better reliability of TRAG test for girls is most probably caused by gender morphological differences. Namely, we observed greater standard deviations (SD) of height (BH) and mass (BM) in boys (boys; BH=7.37, BM=16.97; girls; BH=5.68, BM=9.7) and scientific research confirmed negative influence of BM and BH on reactive agility performance. **CONCLUSION:** Altogether, newly constructed TRGA test seems to be reliable instrument for measuring reactive agility in pubescent boys and girls.

**Keywords:** non-planned agility, metric characteristics, pubescents, gender

# Foot deformities in boys athletes and non-athletes aged 14 to 18 years

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Ante Burger<sup>1</sup>, Vladimir Pavlinović<sup>2</sup>, Ivana Klarić Kukuz<sup>1</sup>, Luka Bjelanović<sup>2</sup>, Sanja Bajgorić<sup>3</sup>

<sup>1</sup> University Department of Health Studies, University of Split, Croatia

<sup>2</sup> Faculty of Kinesiology, University of Split, Croatia

<sup>3</sup> University “Džemal Bijedić”, Health care department, Mostar, Bosnia and Herzegovina

**Purpose:** the structure of the foot has important role in human population because it carries the entire weight of the body. Function of the foot has a static and dynamic role during the movement. Healthy foot has an important role in everyday activities. Disturbance in the development of the foot may cause large risk of injuries while performing sport activity further in future. Each foot is consisted of 107 ligaments, 19 muscles and 33 joints. Such complex bone and joint structure is extremely important for the normal function of overall locomotor system for human population. Therefore, the aim of this study is to determinate and compare the number and type of deformities related to the feet in male athletes and non-athletes aged 14 to 18 year using the foot scanner device.

**Methods:** The sample group of this study consisted of 468 respondents, males aged 14–18 years who were divided into two qualitative groups: group consisting of respondents that are athletes who trained basketball, football, swimming and group consisted of respondents that did not play any sport. Respondents who trained some of the observed sports had a minimum of 7 hours of training per week.

**Results:** The results of this study indicate that 35.05% of respondents had a pes planus (slightly lowered foot). Only 14.52% of respondents had a neat foot without deformities. By comparing the differences between observed groups with and without deformities, it is noticed that there is a statistically significant difference between the observed and expected frequencies (Chi-Square = 282.1890 df = 3 p = 0.00).

**Conclusion:** Healthy foot has an important role in everyday activities. Results have showed that footballers have the biggest deformities of the feet, which is expected considering that football has such structure of the game that accelerates the achievement of a certain level of deformity, due to the changes of the playing surface and often wearing inadequate footwear. Children that are not training any sport are on second place in terms of the frequency of some feet deformities due to poor movement and lack of physical activity. The foot structure of the swimmers who participated in this study has the smallest incidence of foot deformity, which can be related to the fact that their activity takes place in the

hydrostatic position and in the aqueous medium where is no large contact with hard surfaces. Most of the movements that swimmers have around the pool area are often without shoes, which enhances normal development and health of the whole foot. This research contributes to the general understanding of the impact that feet have on the whole body observed through the deformities detected in the male population aged 14–18 years that participated in this study.

**Keywords:** foot, deformities, athletes, function, stability

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# **S P O R T   A N D   S O C I A L S C I E N C E S**

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# The effect of practice schedule on retention in motor learning of children and youth and older adults – is it biased? The meta-analytic preliminary results

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Aleksandra M. Wójcik<sup>1</sup>, Stanisław H. Czyż<sup>1,2,3</sup>, Petra Solarska<sup>2</sup>, Paweł Kiper<sup>4</sup>

<sup>1</sup> Faculty of Physical Education and Sports, Wrocław University of Health and Sport Sciences, Wrocław, Poland

<sup>2</sup> Faculty of Sport Studies, Masaryk University, Brno, Czechia

<sup>3</sup> Physical Activity, Sport and Recreation (PhASRec), Faculty of Health Sciences, North-West University, South Africa

<sup>4</sup> Physical medicine and rehabilitation unit, Azienda ULSS 3 Serenissima, Venezia, Italia

**Objectives:** For many years, motor learning practitioners have been trying to facilitate the retention process of the motor skill. Battig (1966) discovered that the retention of acquired skills could be influenced by the practice organization. He described this phenomenon as the *contextual interference* (CI) effect. Following his publication, the results of many studies confirmed the positive effect of random (high CI) schedules on retention. However, debate still exists on the real magnitude of CI. Brady published a meta-analysis of the CI effect on retention and transfer of motor skills in 2004. According to present guidelines, systematic reviews and meta-analyses should be updated every two up to five years. Given the broad interest in CI effect, including but not limited to behavioral and neurosciences, we aim to update the somewhat obsolete Brady's meta-analysis and re-analyze the results of independent studies on the CI effect, aiming to determine its magnitude. **Method:** Searching of the following databases: Scopus, EBSCO, Web of Science, PsycINFO, and ScienceDirect, supplemented by searching via search engine Google Scholar, resulted in 1255 articles. We chose to include 54 primary articles in our meta-analysis based on PICO criteria. Brady (2004) used the general term “adults” to describe the group of participants college-aged and beyond. To further explore the CI effect magnitude in the retention process, in our meta-analysis, we divided adults into two categories: adults (18 up to 59 years old) and older adults (60 years old and above). Participants aged up to 18 years were included in the young category. Other determinants were related to the setting: laboratory vs. applied. We evaluated the quality of included studies with the *Quality Assessment Tool for Quantitative Studies*. **Results:** Our results did not confirm CI's effect on retention in the general population (with ages ranging from 6 to 82 years old). However, differences in the CI effect among the three age groups were substantial. Dividing adult participants into two categories brought our attention to the fact that all primary studies with participation of older adults, were conducted



in a laboratory setting. A random schedule was more beneficial ( $p = 0.0002$ ) for the retention in this group, with the effect size of the CI effect close to large: 0.74 SMD (95% CI 0.35 to 1.13). Heterogeneity was substantial ( $I^2 = 83\%$ ). On the contrary, almost all included studies with young participants were performed in an applied setting. In this group applying the blocked schedule in motor learning was significantly more efficient ( $p < 0.00001$ ) than practicing in random order. The effect size for this group in favor of blocked practice was large indicating -1.24 SMD (95% CI -1.60 to -0.89). Heterogeneity was considerable ( $I^2 = 92\%$ ). Results related to the CI effect in both settings: blocked and applied, differed significantly ( $p < 0.00001$ ). The efficiency of random practice was significant ( $p < 0.00001$ ) in the laboratory setting with medium effect size of 0.50 SMD (95% CI 0.32 to 0.67), showing substantial ( $I^2 = 77\%$ ) heterogeneity. A blocked practice schedule was more effective ( $p < 0.00001$ ) in the applied setting with a moderate effect size of -0.52 SMD (95% CI -0.73 to -0.32), showing substantial ( $I^2 = 88\%$ ) heterogeneity. Conclusion: Due to our study's high level of heterogeneity, it is essential to apply these recommendations with caution. It isn't easy to differentiate whether the age of participants or the study setting plays a crucial role in the CI effect – we recommend future research in the motor learning domain with the participation of older adults in an applied setting and young participants in a laboratory setting.

# Socio-culturally different motor skills of Czech children with asd aged 7–10 years assessed by the test TGMD-3

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Tereza Možná<sup>1</sup>, Hana Válková<sup>1</sup>, Hana Podhorná<sup>2</sup>

<sup>1</sup> Department of Social Sciences and Sport Management, Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

<sup>2</sup> Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Background:** Autism spectrum disorders (ASD) are associated with gross motor development delays and a limited ability to imitate human movements. Early intervention in the field of motor skills is crucial both from the point of view of the need for comprehensive care for these children and to increase their quality of life. Diagnostic evaluation tools for use in practice are a necessary prerequisite for targeted intervention programs. The Test of Gross Motor Development–Third Edition (TGMD-3) is declared for use in children with ASD (Ulrich, 2019). The TGMD-3 was developed in the USA and consists of two subtests – Locomotor and Ball skills. The Ball skills subtest contains culturally different elements such as strike stationary ball and underhand throw, performed according to US practice. For these reasons, modifications have been made in some countries in the European socio-cultural environment (Wagner et al., 2017) that do not include these elements, typical of the US environment. The aim of this study was 1) to record and describe the reactions of children with ASD to culturally different elements in the ball skills subtest in the TGMD-3 motor test and 2) to compare their evaluation with other items of this subtest. **Methods:** This pilot study included 16 children with ASD aged 7–10 years. A total of 1 girl and 15 boys were evaluated by the TGMD-3 motor test using visual support. (Allen et al., 2017) Participants' physical performance was assessed by following the instructions of the Examiner's Manual Test TGMD-3 3 by four independent examiners. **Results:** The results of the study are presented in the form of case studies of individual participants, which allow for further research in this heterogeneous population of children with ASD with better descriptive and comparative possibilities than statistical numerical expression. The limited ability to imitate, which is characteristic of children with ASD, is likely to have a significant effect on culturally dissimilar designs, especially the Underhand throw. The culturally different skill of the Two-hand strike of a stationary ball inflicted very motivating for children with ASD aged 7–10.

**Conclusion:** The limiting factor for generalization to the entire population of children with ASD aged 7–10 in the Czech socio-cultural environment is their small number and heterogeneity, which were affected by restrictive measures during the Covid-19 pandemic. Further research using the TGMD-3 instrument in the Czech population has the potential to expand diagnostic methods in the field of motor skills and contribute to the possibilities of early physical intervention in children with ASD.

**Keywords:** autism spectrum disorders, ASD, motor, TGMD-3, Socio-culturally different skills

# **Mapping the needs of different groups of athletes of the City of Zagreb and the Republic of Croatia during crisis situations (Covid-19 and earthquake) – athlete perspective**

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**Anja Topolovec, Ana Žnidarec Čučković**

This paper was created as part of the project “Trešnjevka Wrestlers for Civil Society Sports Organizations (SOCD) in Crisis Situations.” with a specific ambition - to pursue improving the capacity of civil society organizations to respond to the needs of the local community in crisis situations. For this purpose and as one of the project activities, the mapping of the needs of different groups of athletes and sports workers of the City of Zagreb and the Republic of Croatia during the crises of Covid-19 and the earthquake is carried out. This research used a qualitative approach that includes focus group pre-research. To ensure broad coverage of the researched topic and for the purpose of heterogeneity, research deliberately focused on 17 different groups of sport. The structure of pre-research participants who were selected intentionally from 17 sports resulted in a total of 17 athletes. All respondents are athletes and adults who have consented to participate in the survey. Qualitative research was conducted through pre-questionnaires and semi-structured interviews and the survey was guided from February to April 2022. Each athlete belonging to a defined sports community (club or federation) was examined separately. Respondents were introduced to the aim of the research and general questions asked and were also informed about the confidentiality of the answers. Collected data materials were processed by comparative analysis. Alternate observation of the responses, similarities and differences among them, and according to the superior aspect of the research (improving the capacity of civil society organizations to provide an effective response to the needs of the local community in crisis situations) along with the intensity of life quality for athletes managing sport during the pandemic, led to the following question: What needs have been identified by different groups of athletes of the City of Zagreb and the Republic of Croatia during crises (Covid-19 and earthquakes)? The most frequent declarations are associated with impaired training continuity or suspension of training due to epidemiological measures and earthquake-damaged infrastructure, cancellation of the competitions and a decrease in motivation.

**Keywords:** crisis situations, athletes, needs, quality of life

# **The absurdity of current yoga trends as an impact of the lack of knowledge of its history**

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**Lucie Chocholová**

**Faculty of Sports Studies, Masaryk University, Brno, Czech republic**

The current generation of yoga instructors are educated in a globalized, marketing-successful forms of postural fitness yoga that is built almost entirely on physical exercise and health effects. However, this modern yoga was originated and popularized in India and the West in the early 1920s. Later, the performance and demonstration of yoga postures, which had been largely neglected until then, become the main feature of modern yoga practice.

The goal of my work is to map and analyze the development of yoga from the beginning of the 20th century to the present, based on literary sources. Furthermore, to offer a way how to approach the claim that yoga is an ancient tradition of the East and at the same time fully legitimize its modern physical form. How to define against the absurdities that are called yoga, but completely lack a parallel to the yoga tradition? I want to propose a way, how to reject yoga styles based on misinterpretation of original texts as a way of spreading personalized ideas about the world and opinion about health.

**Key words:** yoga, history, asana, Krishnamacharya

# **A Subjective Experience of Athlete Quality of Life After Retiring From a Sports Career**

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**Damir Labaš**

**Faculty of Kinesiology, University of Zagreb**

The subject of this research is the quality of life of top Croatian athletes in the post-career period of life. The connection between the subjective experience of satisfaction and the meaning of life in the post-career period with the duration of a competitive sports career, the willfulness of ending a competitive sports career, satisfaction with career results, sports category (team or individual), and satisfaction with economic status. Five hypotheses have been set: H1: The duration of a competitive sports career creates a higher level of satisfaction and meaning in life in the post-career period; H2: The arbitrary end of a competitive career creates a higher level of satisfaction and meaning in life in the post-career period; H3: Greater satisfaction with career results creates a higher level of satisfaction and meaning in life in the post-career period; H4: Team sports athletes have a higher level of satisfaction and meaning in life in the post-career period compared to individual sports athletes; H5: Higher economic status of athletes ensures a higher level of satisfaction and meaning in life in the post-career period.

The structure of the sample of respondents included a total of 62 former top athletes, of whom 24 were female athletes and 38 male athletes; 32 from individual and 30 were from team sports. All athletes have won medals for the Republic of Croatia in the team and individual sports at the Olympic Games, World Championships and Cups, European Championships and Cups, and the Mediterranean Games in the period from 1990 (Olympic Games in Barcelona) to 2012.

Five questionnaires were used for the paper: General Data Questionnaire, Independent Variables Questionnaire, Life Satisfaction Questionnaire, Meaning of Life Scale, and Temporal Life Satisfaction Scale. The Kruskal Wallis test and the Mann-Whitney U-test were used to analyze the results of the questionnaires because the groups of participants were significantly different in size. Distribution normality testing was performed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The correlation of the observed groups of variables was examined with Spearman's correlation coefficient.

The results of the analysis showed that greater satisfaction with the results achieved in their careers and higher economic status of athletes ensure a higher level of satisfaction and meaning in life in the post-career period. Economic status during and after a competitive career are factors that provide athletes with a higher level of satisfaction and meaning in life in the post-career period. A positive subjective assessment of satisfaction with the current standard of living compared to the general living conditions in the Republic of Croatia for athletes is related to past life satisfaction and has a positive effect on the projection of future life satisfaction and family and social relations. Likewise, higher economic status during a competitive sports career has a significant positive effect on the current subjective assessment of the meaning of life and temporal satisfaction with a past life. Athletes who believe that they will be satisfied with their economic status in the future experience the meaning of life and life satisfaction in the future more positively. A significant connection between the duration of a competitive sports career, the willfulness of completion, and the type of sport with the satisfaction and meaning of life in the post-career period have not been established.

# Sport and Physical Activity of Prague's Inhabitants

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Kamil Kotlík

Department of Pedagogy, Psychology and Didactics of Physical Education and Sport,  
Faculty of Physical Education and Sport, Charles University

**Basic Characteristic:** The paper occupies with two tightly connected topics. One of them is the attitude and relationship of Prague's inhabitants towards sport and physical activity, the second is real practise of sport and physical activity by these people. The connection of two above mentioned topics allows on one side verify answers of respondents, on the other side it deepens the analysis.

**Goals:** The main goal of the paper is to mention basic description of practising sport and physical activity of Prague's inhabitants. The other goal is to find out the attitude of Prague's inhabitants towards sport and physical activity.

**Methods:** As the research instrument, we use questionnaire SFSPA (Social Function of Sport and Physical Activity). The questionnaire is not standardized, but the reliability was found out through Cronbach's  $\alpha$  (0,77) and Guttman's Split-Half Coefficient (0,84). The questionnaire has 3 main theoretical constructs, in this paper, 2 of them are reflected. Research sample was chosen by a quota choice and consists of 54 men and 63 women. All respondents were questioned personally, their participation was strictly voluntary and all data are anonymous. The data collection was take place in the autumn of the year 2019. The data was processed by SPSS and MS Excel. We used a data sorting of the second grade, namely pivot tables, correlation coefficient and statistical significance of variance ( $\chi$ ).

**Results:** There are not significant differences between men and women in their declared attitude and relationship towards sport and physical activity, but the situation among particular age groups is different. Other general finding is that even Prague is the capital (and biggest) city in Czech Republic with the largest offer of various sport facilities, most of questioned inhabitants use a nature or their home for their sport or other physical practise.

**Keywords:** Sport, Physical Activity, Attitude, Relationship, Metropolis



# The Effect of Physical Activities on Somatic Parameters of Masaryk University Students – Some Selected Results

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Milan Šipl, Emanuel Hurych

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Purpose:** The current trend is an increasing sedentary lifestyle in all age categories. Among university students, there is an alarming decline in physical activity while increasing the percentage of total body fat compared to high school students. The main goal of the study is to describe the current state of body composition of university students and to assess the impact of physical activity / inactivity in this specific age group, which has changed very dynamically in recent years due to the coronavirus pandemic.

**Methods:** A total of 358 probands with a mean age of  $20.87 \pm 1.43$  years were involved in the research, of which 234 women (65.4%) had a height of  $167.9 \pm 6.3$  cm and a body weight of  $61.3 \pm 10.0$  kg, BMI  $21.7 \pm 3.2$ , body fat  $25.9 \pm 6.4\%$ , skeletal muscle mass  $24.7 \pm 3.3\%$  and 124 men (34.6%) with body height  $180.9 \pm 6.3$  cm, body weight  $77.6 \pm 12.4$  kg, BMI  $23.6 \pm 2.8$ , body fat  $15.8 \pm 5.4\%$ , skeletal muscle mass  $37.0 \pm 5.6\%$ . For the purposes of valid categorization into very active, active, and inactive probands, the International Standardized Physical Activity Questionnaire (IPAQ) was used, which monitors physical activity in the last 7 days. The questionnaire includes questions regarding the frequency and time spent in each intensity of physical activity, as well as the time spent sitting. The non-invasive method of bioelectric tetrapolar impedance using the InBody 230 device was used for the analysis of somatic parameters. The Takei hand dynamometer was used for the diagnosis of muscle strength. **Some selected results:** According to IPAQ, probands were classified as inactive (16%), active (58%) and very active (25%), the analysis of selected aspects of physical activity shows that men are more active than women, but both sexes spend more than 5.5 hours a day sitting on average. A total of 39% of probands have higher levels of total body fat than the recommended norms. **Conclusion:** The study showed that lower levels of physical activity are associated with higher values of total body fat in university students. At the same time, within our sample both sexes out of 84% comply with general recommendations regarding the volume and intensity of physical activity.

**Keywords:** physical activity, body composition, IPAQ, body fat, skeletal muscle mass, university students

## **Development of a questionnaire focused on sports coaches learning**

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**Michal Roček, Vladimír Jůva, Kateřina Jakubcová**

**Faculty of Sports Studies, Masaryk University, Brno, Czech Republic**

*Contact information: Mgr. Michal Roček, [michal.rocek@fsps.muni.cz](mailto:michal.rocek@fsps.muni.cz)*

Coaching is one of the most demanding social, helping and pedagogical professions. Therefore, research attention is rightly paid mainly to formal coach education aiming at adequate preparation for the practice of this profession. In recent years, however, many empirical studies have demonstrated that non-formal coach education is playing an increasingly important role in coach development in addition to formal coach education. At the same time, research findings show that it is not only the completed “official” coach education that is crucial for the professional development of each coach, but above all, it is the complex results of their lifelong learning. Therefore, it is essential for various sports institutions, for sports educational facilities, especially for coach educators, to have information about the course, features, and potential problems related to lifelong learning of specific sports coaches. Therefore, our paper aims to create a research tool – a questionnaire that identifies the essential circumstances of lifelong coach learning. The design of the questionnaire builds on our previous research on formal, non-formal and informal coach education and, in particular, on the results of many analogous international empirical studies on coach learning. These starting points show that the following areas play an essential role in the lifelong learning process of coaches: (1) personal sports and coaching experience, (2) reflection (self-reflection) of this experience, (3) professional sharing of coach experience, (4) mentoring and (5) accessible and understandable coach learning information resources. We prepared a working version of the questionnaire based on the above principles. This research tool aims to identify sports coaches’ learning and education processes. We designed the questionnaire containing 66 items (closed, open, semi-closed, and scales) to suit various respondents – coaches (multiple types of sports, competitive and recreational sports, different age groups, beginners and experienced coaches, etc.). The first stage of verifying the draft version of the questionnaire consisted of an expert assessment. A total of 6 active coaches (three male

coaches and three female coaches from the environment of top, competitive and hobby sports), who were acquainted with the theoretical basis of the questionnaire, recommended minor corrections to the questionnaire. The second stage of the questionnaire verification took place in interviews with six coaches (again working in competitive and leisure sports) who were not acquainted with the theoretical basis of the questionnaire. This stage focused on the clarity and unambiguity of individual items. The revised questionnaire was subsequently converted into an electronic form. The functionality of the final electronic version of the questionnaire was verified within a pilot study ( $n = 18$ ).

**Keywords:** coaching knowledge transfer; informal coach education; peer-to-peer learning; mentoring; professional sharing.

# **The analysis of students and lectures' attitudes towards online streamed sports courses within the compulsory physical education at Masaryk University during the COVID-19 pandemic**

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**Alena Pokorná, Renáta Vychodilová, Zora Svobodová, Marek Dubčák**

**Faculty of Sports Studies, Masaryk University, Brno, Czech Republic**

Today's developed society is highly aware of the importance of physical activities. Therefore, the students at Masaryk University are obliged to complete two sports courses during their full-time Bachelor studies. They can choose from a wide offer of different sports courses provided by the lectures of the University Sports Centre (USC) at the Faculty of Sports Studies. The pandemic situation associated with the SARS-CoV2 disease significantly changed many aspects of our lives. It also influenced the offer of sports courses at the University and the way they were implemented because they had to be transferred to the online streamed format, and the offer of the courses had to be decreased. The aim of the study was to explore the attitudes of the USC lecturers and students of Masaryk University towards online lecturing of the compulsory physical education provided by the department of the University Sports Centre during the COVID-19 pandemic situation. To find out the attitudes of the lecturers at the USC and university students towards online lecturing of sports courses, the research method of the questionnaire survey was used. The research group consisted of 564 full-time university students, participating in the compulsory sports courses during the pandemic situation, and fourteen lecturers of the USC department. In the survey, the students evaluated the offer of the provided sports courses that were divided into two main categories: fitness and "body and mind". Next, the organization, implementation and educational content of the online streamed courses, as well as students' motivation to their active participation in the courses was examined. Regarding the lecturers, their satisfaction with their own lecturing and cueing of the online courses was assessed. The questionnaire survey showed that most students were sufficiently informed and satisfied with the offer. The students evaluated the quality of the online sports courses positively, considering the commitment and positive attitude of the lecturers. Since the majority of the lecturers

has a very positive attitude towards sport and the sports courses provided by the Centre, they evaluated positively that the courses were not cancelled during the pandemic. The pandemic experience also brought an impulse to keep some online courses in the offer even after the situation returned to normal. The lectures further appreciated that the continuity of the PE education was kept, and the number of participated students could be increased. Finally, the lectures assessed positively that the recorded lectures could be reused, and the students could exercise repeatedly. Regarding negative aspects, the lecturers named the lack of feedback and no possibility to observe the performed movements and correct them eventually. Next, they mentioned the absence of communication and interaction with the students, and the limitation of the course content, as well as more demanding preparation of the lectures.

**Keywords:** attitudes, COVID-19, distance education, compulsory physical education, sports courses

# Social Behavior in Participants of Special Olympics and Non-sporty Children with Intellectual Disability

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Jitka Kampasová, Hana Válková, Oldřich Racek

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Introduction:** There is a lack of longitudinal research in the field of social behavior in children with intellectual disability (ID). The first goal of the research was to find out and compare the social behavior of children who regularly participating in Special Olympics (SO) competitions with non-sporty children. The second goal was to show the trend in the development of children's social behavior and to find out whether summer holidays have any effect on children's behavior. **Methods:** The Reiss Screen Behavior questionnaire was used to determine social behavior. Participants were children with ID aged 6–20 years. A total of 4 measurements were performed over a two year period (the number of SO participants was  $n = 14$ ,  $n = 18$ ,  $n = 18$ ,  $n = 13$  and the number of non-sporty children was  $n = 42$ ,  $n = 40$ ,  $n = 39$ ,  $n = 40$ ). **Results:** Participants in SO have better social behavior by up to 16 % compared to non-sporty children. The trend of development in social behavior is unbalanced among SO participants, and summer holidays cause improvements in their behavior. Non-sporty children have a convex trend in social behavior and summer holidays have no effect on their behavior. **Conclusion:** In SO participants, social behavior differs by 0–9 % from the norm of ideal social behavior. In non-sporty children, social behavior differs by 5–25 % from the norm. Overall, the behavior of children with ID is very good, as it differs very little from the norm of ideal social behavior. In the Czech Republic, children with ID (participants in SO and non-sporty children) have much better social behavior than children with ID abroad.

**Keywords:** questionnaire Reiss Screen Behavior, social behavior, intellectual disability, participants in SO, non-sporty children, trends.

# Examination of opinions, attitudes of students of the Police College on the values of judo sport

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Marijan Jozić<sup>1</sup>, Hrvoje Sertić<sup>2</sup>, Miroslav Zečić<sup>2</sup>

<sup>1</sup> Police College, Ministry of the Interior of the Republic of Croatia,

<sup>2</sup> Faculty of Kinesiology, Zagreb, Croatia

Given the specificity of the specialised training program generally saturated with several martial arts techniques (karate, judo, aikido, boxing, police self-defense) and specially designed for police officers, an assessment of the attitudes of full-time and part-time students of the Police College will be made. The attitudes of students, future police officers are crucial because they are able to qualitatively identify elements that can predict and explain different types of behavior in stressful police actions, usually of the highest level of complexity. The aim of this paper was to assess the attitudes of Police College students and to determine the differences in attitudes about the elements of judo (Mann-Whitney U test), that are ordinarily integrated into the official self-defense program for students of the Police College, between full-time and part-time criminology students. The paper used a five-point Likert scale that sublimates the positive and negative evaluation of a student of the Police College. The assessment of students' attitudes towards judo was carried out in May 2022 on 178 students of Police College (89 full-time students and 89 part-time students of Police College). The analyses show that elements of judo sport have crucial position in police self-defense and contribute a lot to required, desired type of police self-defense as a martial art. All mentioned is significant because many self-defense elements are dangerous and demand professional approach. Police officers are expected to be familiar with laws and specific police tactics, police integral training and police authorities. They also should know which element is appropriate and which type of self-defense to use in stressful situational procedures, individual or group tactical proceedings.

**Keywords:** judo sport, specialised training, police officers, students' attitudes, martial arts

# Termination of Sports Career

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Klára Kuníková<sup>1</sup>, Renáta Vychodilová<sup>2</sup>, Zora Svobodová<sup>2</sup>

<sup>1</sup> Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

<sup>2</sup> Department of University Sports Center, Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Purpose:** Professional sport is a very hard and demanding job that needs a lot of determination, purposefulness and energy. Thus, many professional athletes dedicate a great deal of their life effort to the sport mainly, not becoming aware of the fact that their retirement age in the sports field is limited, and that after the sports career termination, the start of a new career is inevitable as well as desirable. Depending on many factors, the transition can be stressful, difficult to realize, but also challenging. The goal of the paper was to examine if there is a difference between the preparation to their new future career between the male and female professional volleyball players, the members of the Czech elite volleyball clubs. Further, the differences in the preparation were researched in connection with the age, and next, the support by the clubs the athletes play in was aimed to be assessed. **Methods:** to accomplish the assignment, the method of non-standardized, semi-structured questionnaire to collect data was employed, and both the descriptive and mathematical statistics methods were used to analyse and assess the results.

**Results:** regarding the differences the between male and female players, the analysis of the research results showed that in the Czech professional volleyball, the male players prepare for their new future career more than the female players, but the difference is not significant. Next, the research revealed that the players older than 26 prepare for the career transition more than the younger volleyball players, regardless of the gender. The results further showed that the support by the sports clubs does not have any significant impact on the athletes' preparation to the career change.

**Conclusions:** Based on the results, it can be stated that more than half of the respondents do not prepare to the transition in the research group. Simultaneously, the majority of the participants confirmed that the club supports them in the effort to their new future career inclusion. The lack of interest in the preparation for the career transition can be caused by various intrinsic and extrinsic factors, such as the sports strain, the lack of interest, and the unawareness of the importance of the future transition, or the age. Besides, some athletes may prepare to their new career, but when terminating it, the field they educated themselves can turn out not to be the one they would finally like to work in. Eventually, it can be concluded that in the field of professional volleyball, the problem of the dual career is still necessary to get into a wider awareness.

**Keywords:** sports career termination, transition, volleyball players, sports clubs, club support



# Strategy for Change – How to Move forward after the Sports Career Termination

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Zora Svobodová, Renata Vychodilová

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Purpose:** the constrained or planned sports retirement, the termination of a sports career, is a very important life milestone for professional athletes. The aim of the paper is to probe the way professional athletes prepare their strategy for the transition from the sports to working career. When preparing the strategy, two approaches need to be taken into consideration: the normative and non-normative termination of the sports career. From this point of view, athletes should formulate the long-term strategy defined as a plan for the coherent and planned career termination where the reason for the termination can be the athlete's age, planned maternity, or the achievement of appointed goals, or of the apex of the sports career. Next, the short-term strategy defined as a plan for the acute career termination caused by an injury, the non-renewal of the contract or the collapse of the sports club should be developed. **Methods:** to achieve the goal, the method of the semi-structured interview that involved the topics and questions related to the sports career and athlete's personality was used (e.g. the self-perception, self-identity, self-esteem, dual career solutions, relationships and financial competencies were questioned). **Results:** the research revealed that athletes' knowledge about the formulation of both the short-term and long-term strategy for the transition from the sports to working career is limited and incomplete. Based on the findings obtained in the semi-structured interview, the objective of the research was to create "clues" for the normative and non-normative career termination, to formulate athlete's short-term and long-term life goals (at the moment, now and here), and to change athlete's motivation and attitudes towards their formulation of the strategy and plans, all which may change in connection with the following development processes. **Conclusions:** The study provided a description of the ups and downs elite athletes may face in their sports careers. It further brought questions and answers on how to influence the athlete's psyche and behaviour so that they can actively prepare to leave the sports environment. The findings of the study concluded that when preparing athletes for the sports career termination, the interactive nature of all areas of the athlete's life and the very specific nature of the preparation of the short-term and long-term transition strategy should be taken into account.

**Keywords:** dual career, long-term strategy, short-term strategy, career termination, life goals

# Qualitative Analysis of The Attendees of the Road Cycling Event „La Vuelta“

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Sanela Škorić<sup>1</sup>, José María López-Gullón<sup>2</sup>, Salvador Angosto<sup>2</sup>, Jose Miguel Vegara-Ferri<sup>2</sup>

<sup>1</sup>Faculty of Kinesiology, University of Zagreb, Croatia

<sup>2</sup>Faculty of Sport Sciences, University of Murcia, Spain

**Purpose:** The objective of this study is to carry out a qualitative analysis of the ratings of tourists and residents attending the road cycling sporting event „La Vuelta“ held in Spain in the 2019, 2020 and 2021 editions. **Methods:** The sample consisted of 1203 comments/observations from tourists and residents in the in situ and post-event phase of each edition. For this qualitative analysis, an open question was used at the end of a quantitative questionnaire on social and tourism impact inviting interviewees to comment on any aspect of the event (positive or negative). The responses to the open question were categorised into a total of 16 boxes according to the main theme of the comment (accessibility, environment, traffic and parking, waste, advertising caravan and lap park, COVID-19 pandemic, enjoyment and emotion, unusual experience, socialisation, future intentions, promotion of the locality, promotion among young people, organisation, event information, promotion of sport and tourism) following the criteria of homogeneity, completeness, mutual exclusion, objectivity, relevance and productivity. Once each comment had been categorised, a summary was made of the responses and frequencies of each idea according to each category, positive and negative comments and the words most used in each type of comment. Nvivo v.10 software (QSR International, Burlington, MA 01803, USA) was used to analyse the comments and frequencies of each idea. **Results:** Most of the positive comments focus on the positive feelings and emotions generated by attending the event (excitement or enjoyment; 12.4%), great experience (14.8%), atmosphere of the event (10.4%), good organisation of the event (12.1%) and future intentions to return and recommend the event (7.4%). Negative comments mainly refer to the COVID-19 pandemic (11.8%), the advertising caravan (7.4%) and traffic and parking problems (5.9% of comments). Among the words associated with negative comments, the word „advertising caravan“ stands out, while the most used words in positive reviews were „experience“ and „excitement“. **Conclusion:** The qualitative results obtained are in accordance with the quantitative data from the closed questions of the questionnaire, where emotion and enjoyment are among the most highly rated items. In the 2020 edition, the COVID-19 pandemic negatively affected the event, although parking problems and traffic congestion are the worst rated categories both qualitatively and quantitatively.

**Keywords:** residents; tourists; impacts; perception; sport event

# **Olympic Versus Sokol Movement**

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**Milena Strachová, Aleš Sekot**

**Faculty of Sports Studies, Masaryk University, Brno, Czech Republic**

At the contemporary time of postmodern society, the Olympic Games are the most unique and most watched two-week sporting event of the best athletes in an ever-expanding range of traditional and new sports in the world. In the context of the growing commercialization and scientification of sport, it is worthwhile to confront the ideological emphases and ethos of both the founders of the modern Olympic Games and the founders of the unique physical education movement Sokol. Miroslav Tyrš and his followers at the time (Kožišek) rejected competitive sports. Competitive performance sports and participation in the Olympic Games were not in the spectrum of Sokol's interest. The Sokol values principles rejected the one-sidedness of the sports specialization with the pursuit of performances and victories. However, the later development of Sokol agreed with Coubertin's principle that Olympism is not a formal system, but a state of mind, a certain conception of life, a unique philosophy of life, a balance of physical fitness, will and spirit. Thus, in the development of Sokol and Olympism, there were culturally different emphasis on values, which today took the position of discussions about the meaning and mission of the top media-attractive elite sport, embodied primarily by the Olympic Games on the one hand and the movement for higher mass of sport in the sense of principle Sport for all on the other hand.

# Physical activity of persons with intellectual disability: a comparison of the capacity of activities during the outdoor camp and on the days of everyday life

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Hana Válková<sup>1</sup>, Jitka Kampasová<sup>1</sup>, František Chmelík<sup>2</sup>

<sup>1</sup> Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

<sup>2</sup> Faculty of Physical Culture, Palacký University Olomouc

The presentation follows up on the research of the capacity and intensity of physical activities of the persons with intellectual disability during 2 weeks outdoor camp. The result was that participants achieved higher values in the amount of daily steps and intensity than he general intact population, even in the age cohort of 35-60 years. The results have been published (Válková, Králíková, Dygrýn, 2018, p.538-549. *Proceedings of the 11th International Conference on Kinanthropology*, 2017). The results provoked a challenge: of what values the same people can achieve in the “home” social environment in everyday life. The aim of the follow up research was to compare the capacity and intensity of physical activities in persons with intellectual disability which the participants achieved during the week with a habitual lifestyle with the results achieved in the outdoor camp. After mastering the GDPR requirements a total of 33 participants (16 M, 17) participated in the follow-up survey (47 – 21 M, 26 F during outdoor camp). Age spectrum 16–52 years. The methodology was identical to the camp conditions: weekly recording of physical activities using the GT3X Actigrafaph, written recording of activity log in special form. The identical period for recording was saved (May – June). The survey process was realized in 12 localities in the East and North Bohemian region (Czech Republic). At recorded time the participants were living either in all days in families, or daily/week centers or in transformed sheltered housing. Although the processing the results of the complete participants was statistical by pair differences comparison, due to the heterogeneity of the sample it was necessary to apply a case study approach, too. The results showed that the indicators of capacity and intensity are significantly linked to the social conditions of everyday life, which reflect the age of the participants. In the institutions some attention is paid to physical activities, worse situation was find with participants living in families far from urban centers and persons living in transformed sheltered housing the movement activities were less affected. The conclusion should serve to discuss more intensive support for families, for inhabitants living in transformed housing, namely from the point of view more accessible and consistent physical activities.

**Keywords:** intellectual disability, research with pedometer, Actigraph, living conditions, social environment of persons with intellectual disability

# The role of a forensic expert in the field of self-defense under current legislation and beyond

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Michal Vít<sup>1</sup>, Jan Novák<sup>1</sup>, Zdeněk Maláník<sup>2</sup>, Jaroslav Matoušek<sup>3</sup>, Libor Bílý

<sup>1</sup> Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

<sup>2</sup> Faculty of applied informatics, Tomas Bata University in Zlin, Czech Republic

<sup>3</sup> Police of the Czech Republic, Regional Police Directorate of the Hradec Králové Region

A forensic expert in the field of self-defense is a specialist with extensive knowledge in the methods of defense, close combat, the use of defensive means, or coercive means. The core of the forensic expert's work in this field is the assessment of the facts of conflict situations in which physical violence between two or more persons has been used. The role of a forensic expert is to answer questions related to the roles of the parties involved in the conflict, factors that influenced the conduct of the fight, the course of the fight and the possibility of resolving the conflict situation, etc. Self-defense expertise is sometimes associated or confused with expertise in martial arts or combat sports. This judgment is based on the assumption that most forensic experts in the field of self-defense also have knowledge of martial arts and combat sports. This knowledge is an advantage for the profession of forensic expert in the field of self-defense, similar to knowledge in the field of weapons and ammunition, but it is not the same area as expertise in the field of self-defense or a condition for this function. The new Act No. 254/2019 Coll., on forensic experts, expert offices and expert institutes, faces professional criticism in a number of areas (expert duties, sanctions, division of specializations, etc.) and is likely to lead to pressure for further amendments. The article deals with these changes and the perspective in the coming years with the expert opinion of current forensic experts on the field of self-defense on the appropriate inclusion of this specialization in the future categorization of specializations.

**Keywords:** forensic expert, self-defense, necessary defense, combat, martial arts, combat sports, weapons, legislation

# Using the authors' keywords to map the scientific field of Sport Sciences

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Ivan Čolakovac, *ivan.colakovac@kif.hr*

Iva Barković, *iva.barovic@kif.hr*

Nikolina Bestić, *nikolina.bestic@kif.hr*

Given that scientific communication has grown significantly in recent years, it is necessary to find methodological strategies for understanding and reviewing key research trends developed in certain areas of science. Data mining can be used as an extremely useful technique to assist in finding the solution of this issue. The results of our research demonstrate the information generated in Web of Science Core Collection database, category Sport Sciences. An analysis of the frequency of appearance and the dynamics of the authors' keywords was made for the articles published in top three journals with journal impact factor (JIF) higher than 10 according to Journal Citation Report in the span of three years (2019–2021). The network of co-occurrences established between words was analyzed by using VOSviewer. The aim of this paper was to identify thematic clusters in recent research in top quality journals and to specify which terms coexist and have a high frequency of appearance. The results of this study show a multidisciplinary perspective within the field of Sport Sciences.

**Keywords:** Sport Sciences, knowledge mapping, network analysis, authors' keywords, co-word analysis

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# SPORT TRAINING

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# **Influence of 3 different rest pauses between series in strength training on changes in bone density in strength athletes**

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**Jan Caha**

**Faculty of Sports Studies, Masaryk University, Brno, Czech Republic**

A bone mineral density (BMD) test can provide a snapshot of your bone health. The test can identify osteoporosis, determine your risk for fractures (broken bones), and measure your response to osteoporosis treatment. At the same time, we can perceive bone density as a qualitatively measurable element of the impact of strength training, variably depending on individual training variables. Optimal bone density is also an important factor in quality strength training and a product of adaptation to well-adjusted strength training. The aim of this research is to find out different effects of three different types of rest periods (30, 60, 120 sec.) as a variable factor of strength hypertrophic training on selected indicators of total bone density. In this way, we want to determine whether rest breaks in strength training have a significant effect on changes in bone density or not, and whether bone density in experienced athletes continues to respond to changes in training systematics. This research can be classified as an interindividual research strategy of an experimental base. We have a four-group experiment, with three experimental groups and one control group. Each group containing 5 persons. Study participants can be characterized as athletes with strength training experience longer than 3 years, with sufficient experience and technical equipment to master the prescribed training units. Men 18-35 years of age were included in the study. ( $n = 20$ ). To evaluate the effect of rest pauses in strength training on bone density, we used a comparison of the state before the intervention and after the intervention in individual groups. The groups were compared with each other and with the control group. We used BMD index ( $\text{g} / \text{cm}^2$ ), T-score, Z-score for evaluation. At a statistical significance level of 5%, there was no significant difference in bone density between the groups with different rest pauses. But, we find interesting we found interesting result in different groups, that we can discuss and implicate to the training methods and recommendations about useful rest periods for better results in change of bone density.

**Keywords:** bone density, strength, strength training, muscle mass, hypertrophy



# Use of rate of force development in field testing of ice-hockey players

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Jakub Krajňák, Michal Kumstát

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Introduction:** Ice hockey is a power-speed sport played on ice. The surface specification is very different from a normal surface, so it is important to look for the most appropriate measurements and specific off-ice tests that would better define ice-hockey performance. Therefore, the main purpose of this research was to determine the relationship of rate of force development (RFD) in back squat with commonly used off-ice and on-ice tests. **Methods:** The research involved 15 junior ice-hockey players ( $181.8 \pm 4.1$  cm;  $80.7 \pm 8.8$  kg;  $18.4 \pm 0.9$  yrs) playing in the highest competition of Czech hockey. Players performed all tests in one day divided into 2 blocks - off-ice block (OFF) in the morning and on-ice block (ON) in the afternoon, respectively. The OFF contained 30 m sprint test with 15 m split (SP15; SP30), plyometric tests (broad jump - BJ; countermovement jump - CMJ), and a velocity squat protocol (VSP). Finally, in the ON was performed speed and coordination tests - 30 m forward skating with 15 m split (FW15 and FW30); 30 m backward skating with 15 m split (BW15 and BW30); Weave agility test (WAT); Transition test (TT) and Pro-agility test (PAT). **Results:** No significant results were found between RFD and coordination tests (TT, WAT, PAT) and CMJ. The significant correlations were found between RFD40kg and SP30 ( $r = -.865$ ;  $p < .01$ ) and BJ and RFD40kg, respectively ( $r = .649$ ;  $p < .05$ ). However, as the back squat loads increase, the correlation strength decreases between RFD and SP30 ( $r = -.677$ ;  $p < .01$  for RFD50kg and  $r = -.560$ ;  $p < .05$  for RFD60kg). Moreover, the strong degree of correlation were observed between RFD40kg and FW15 ( $r = -.699$ ;  $p < .05$ ) and also FW30 ( $r = -.705$ ;  $p < .05$ ). **Conclusion:** The results of the study show a significant relationship between the RFD and commonly used off-ice and on-ice tests.

**Keywords:** Ice-hockey; field testing; rate of force development; RFD

# Effect of 10 weeks of rhythmic gymnastics training on physical abilities performance in novice Brazilian group

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Shauane Emanuela Fornaciari Silva<sup>1</sup>, Helio Serassuelo Junior<sup>1</sup>, Marta Gimunová<sup>2</sup>,  
Martina Bernaciková<sup>2</sup>, Ana Carolina Paludo<sup>3</sup>

<sup>1</sup> Postgraduate Program in Physical Education, State University of Londrina, Londrina, Brazil

<sup>2</sup> Department of Kinesiology, Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

<sup>3</sup> Incubator of Kinanthropology, Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

Rhythmic gymnastics is characterized by well-executed technical elements, which require a good physical ability to execute the movements that compose the routine. For novices gymnasts, the training process needs to focus on learning and improving the ability to perform the basic physical elements of the modality. Therefore, the aim of the study was to analyze the effect of 10 weeks of a rhythmic gymnastics training program on the physical abilities performance of a novice Brazilian group. Sixteen Brazilian novice gymnastics (age:  $11.6 \pm 1.3$  years; body mass:  $45.5 \pm 10.6$  kg; height  $152.3 \pm 10$  cm) underwent 10 weeks of a training program. Before starting, the training (T1) and after the competition period (T2) the gymnasts performed a battery of rhythmic gymnastics physical ability testing including flexibility, coordination/balance, jump, sprint and muscle resistance tests. Each test was performed according to the protocol established, with the results ranging from the Likert scale ranging from 1 to 10 points. Paired t-test and the effect size (ES) test were used to analyze pre-post outcomes, with significance set at  $p < 0.05$ . As the main results, it was observed a significant increase in flexibility ( $1.25 \pm 0.36$  to  $1.66 \pm 0.35$  cm,  $ES = 1.08$ ); coordination/balance ( $6.13 \pm 2.22$  to  $6.88 \pm 2.25$ ;  $ES = 0.6$ ); sprint ( $1.38 \pm 1.02$  to  $2.94 \pm 1.23$ ;  $ES = 1.35$ ) and resistance ( $5.25 \pm 3.15$  to  $6.38 \pm 3.22$ ;  $ES = 0.51$ ). No significant difference was found on the jump test ( $1 \pm 0$  to  $1 \pm 0$ ). The results of the study suggest that the training program executed for 10 weeks for rhythmic gymnastics novices had a positive effect and significantly improve the majority of physical ability components. An increase in the training stimulus related to the power component is suggested to promote an improvement in the jump test. Overall, the improvement of physical ability components promoted by the program can increase gymnastic performance.

**Keywords:** training; young athletes; performance; rhythmic gymnastics.

# The Relative Age Effect in World Junior Tennis Finals: A 5-Year Longitudinal Study

Adrián Agrícola<sup>1</sup>, Michal Bozděch<sup>2</sup>, Tomáš Válek<sup>2</sup>, Jiří Nykodým<sup>2</sup>, Jiří Zháňel<sup>2</sup>

<sup>1</sup> Faculty of Education, University of Hradec Králové, Hradec Králové, Czech Republic

<sup>2</sup> Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

The Relative Age Effect (RAE) is now a well-established phenomenon in research studies, but opinions on its effects in different sports or age categories often differ. The main aim of the present research was to verify the impact of RAE between female junior tennis players in the age category U14 ( $n = 240$ ). All these female players were participants of international tournaments World Junior Tennis Finals (WJTF) held in Prostějov, Czech Republic in 2012–2016. The secondary aim was to verify the impact of RAE on the order of nomination of female players to each national team (1st, 2nd and 3rd player respectively) and then verify the impact of RAE on the final ranking of the teams in the whole tournament. The third aim of the research was to compare the impact of RAE between junior female tennis players and the world's best senior female players according to the WTA Rankings. All junior female tennis players were categorized by date of birth into four quarters: Q1 (January–March); Q2 (April–June); Q3 (July–September); Q4 (October–December). Chi-square test and Effect Size (ES) index  $w$  were used for statistical data analysis (using Microsoft Excel and STATISTICA 10 software). Statistically significant RAE was found in each of the years 2012–2016 ( $p < 0.05$ ) for all subgroups, effect size index  $w$  ranged between medium and large (0.32–0.63). Statistical significant RAE was found for all female players over the entire five-year period ( $p < 0.01$ ), ES  $w$  was medium (0.44). Statistically significant RAE ( $p < 0.01$  and  $p < 0.05$ , respectively) was found in all cases for nominations of female players to teams (1st, 2nd and 3rd rank), ES ranged between 0.38–0.54 (medium and large, respectively). In all four performance groups of teams (ranked 1st–4th, 5th–8th, 9th–12th, 13th–16th) the impact of RAE was statistically significant ( $p < 0.01$  and  $p < 0.05$ , respectively), ES was 0.43–0.52 (medium and large, respectively). Comparison of RAE between the groups of junior female tennis players (WJTF) and the world's best female players (WTA Rankings, TOP 48) showed statistical significant differences ( $p > 0.05$ ), the ES index  $w$  was small (0.10). The findings about the existence and impact of RAE in junior tennis should be reflected by tennis coaches: their consideration in practice can contribute to the improvement of the selection and training of young talents.

**Keywords:** date of birth; chronological age; age distribution; youth sports; sports talent

# **Influence of match fatigue on countermovement jump performance of women basketball players**

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**Martina Barthová, Andrea Izáková, Dávid Líška**

**Faculty of Arts, Department of Physical Education and Sports, Matej Bel University, Slovakia**

*Corresponding author: Martina Barthová email: barthova.martina@gmail.com*

Fatigue of the central nervous system in a match leads to the influence of several motor skills. However, information about the effect of match fatigue on post-match countermovement jump performance of female basketball players is very limited. The aim of our study was to determine the effect of central nervous system fatigue caused by post-match fatigue on the rebound abilities of female basketball players. The research was carried out on 12 players from extra-league team UMB Banská Bystrica. The mean age of the group was  $23 \pm 2.69$  years. The mean weight was 65 kilograms  $\pm 9.14$  kilograms and the mean height of the basketball players was 174.69 centimeters  $\pm 2.69$  centimeters. Vertical jump of women basketball players were tested before and immediately after the match. For testing of lower limb explosive power was used one of the most widely used test- countermovement jump (CMJ). Countermovement jump is a valid, practical and reliable method for measuring the explosive power of the lower body. Performance of CMJ is associated with maximum strength, maximum speed and explosive power. The countermovement jump was tested using OptoJump. The mean result of countermovement jump before the match was 28.14 centimeters  $\pm 4.55$  centimeters. The mean result after the match was 30.2 centimeters  $\pm 5.50$  centimeters. There was a significant difference after the match in favor of post-match performance testing ( $p=0.03$ ). Better countermovement jump performance was recorded after the match. Fatigue of the central nervous system during the match did not lead to a negative effect on the performance of the countermovement jump.

**Keywords:** fatigue, countermovement jump, basketball

# Specific wrestling fitness test: differences according to wrestler's quality and weight category in elite youth wrestlers

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Krešo Škugor<sup>1</sup>, Valdemar Štajer<sup>2</sup>, Barbara Gilić<sup>1,3</sup>, Nenad Žugaj<sup>3</sup>, Hrvoje Karninčić<sup>1</sup>

<sup>1</sup> Faculty of Kinesiology, University of Split, Croatia

<sup>2</sup> Faculty of Sport and Physical Education, University of Novi Sad, Serbia

<sup>3</sup> Faculty of Kinesiology, University of Zagreb, Croatia

**Purpose:** Wrestling is a demanding sport that relies mainly on anaerobic energy pathways. Specific anaerobic wrestling tests have been introduced, but there is a lack of studies that detailly investigated their effectiveness. The aim of this research was to examine whether youth wrestlers differ in the performance of one wrestling-specific test according to quality and weight category.

**Methods:** This research included 21 youth elite Greco-Roman wrestlers aged 16–20 years. They underwent an anthropometric assessment (body height, body mass, body fat percentage) and performed the Specific Wrestling Fitness Test (SWFT), consisting of 3×30 seconds of suplex throwing the dummy with load relativized according to weight category. The result was displayed as the total number of throws, and SWFT index was calculated as heart rate change/total number of throws. Wrestlers were divided into two categories according to their quality (national team members, non-members) and two weight categories (55–67kg, 72–87kg). ANCOVA with body mass as a covariate was used for determining the differences in all variables between team members and non-members and between two weight categories.

**Results:** Team members and non-members did not differ in the total number of throws nor SWFT index. Further, no significant differences were found in the total number of throws and SWFT index when comparing weight categories.

**Conclusions:** SWFT did not differentiate team members and non-team members, which could imply that the test is not sensitive enough for this specific sample. Also, another possible explanation is that we included top-level athletes and that even non-team members are close to entering the team. Thus, future studies should include wrestlers of lower quality (e.g., club-level wrestlers). Weight categories did not differ in the SWFT, which could be explained by the fact that the test was performed with a dummy with a specifically determined weight according to the weight category.

**Keywords:** combat sports, young athlete, fitness assessment, metabolic demand

# Forearm muscle sport-specific performances in elite youth sport climbers; gender, age, and maturity specifics

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Barbara Gilic<sup>1,2</sup>, Dario Vrdoljak<sup>1</sup>, Damir Sekulic<sup>1</sup>

<sup>1</sup> Faculty of Kinesiology, University of Split, Croatia

<sup>2</sup> Faculty of Kinesiology, University of Zagreb, Croatia

**Purpose:** Sport climbing is a sport where athletes have to move their whole bodies, meaning that almost all muscles are involved in the movement. However, one of the most important success factors is the strength and endurance of the forearm muscles. This research aimed to investigate the forearm muscle strength in youth sport climbers and determine the gender, age, and maturity status as factors of influence on forearm muscle performance in elite youth climbers, which is a significant predictor of forearm muscle strength. **Methods:** This research included 18 elite sport climbers aged 13–18 years (Croatian National team members). They were divided into two age groups: younger (aged 13–15 years) and older (aged 16–18 years). Variables included anthropometric/body built indices (body mass, body height, body fat percentage, ape index (ratio between height and arm span), handgrip strength (measured by hand dynamometer), and climbing-specific forearm strength (measured on the smart hangboard with integrated force sensors in standing and sitting positions). Forearm performance variables were reported as absolute values and were relativized according to climbers' body mass. **Results:** Mann Whitney test did not reveal differences in studied variables between age groups. Spearman's correlations confirmed such findings, as no significant correlations were found among anthropometric/body built indices, forearm muscle performances, with age and maturity offset. However, when gender stratified, there were associations between forearm capacity in standing position and age in boys (Spearman  $R=0.68-0.78$ ) but not in girls. **Conclusion:** The results could be explained by the specificity of sports selection in sports climbing. Namely, each subsequent generation is better than the previous one as sports climbing expands and provides an additional possibility for development. Also, in this study, we observed top-level climbers who were at similar performance levels, regardless of age and maturity stage. The lack of associations between performance variables and age in girls is probably related to their earlier maturation.

**Keywords:** athlete, muscle capacity, fitness profile

# Human Performance Program in the Czech Army

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**Martin Bugala**

**Faculty of Sports Studies, Masaryk University, Brno, Czech Republic**

The constant development and advancement of military technology helps to advance combat competencies. This progress is often evolutionary in certain military areas. However, if we look at the progress in the development of the human performance of professional soldiers and their training, we do not see the same development as in the military technology. At the same time, all the military technology and equipment is controlled by people and they are always more important than hardware. Thanks to these facts, the US Army changed the attitude to soldiers and understanding of who soldiers really are and the result is that soldiers are now considered professional athletes called TACTICAL / COMBAT ATHLETES. The HP program is not just a theoretical framework or a philosophical approach to professional soldiers, but a functional evidence-based system. The HP program has created a new direction in soldier care through the application of scientific foundations, measurements, and training and regeneration techniques. The main reason for creating this direction was that the functional characteristics, metabolic coverage, biomechanics of movement, nutrition, compensation, mental strain, etc. are different from sports performance. In the Czech Army, the partly HP program began to appear in 2020 when the individual elements of the HP program were gradually incorporated into the process of fitness training of special forces soldiers. Masaryk University Faculty of Sports Studies, thanks to the fields of Special Education of Security Forces SESF, Applied Sports Education of Security Forces ASESF and Fitness trainer and research activities in the field of security and armed forces significantly contributes to the development of HP program for the Czech Army. This study points to a new scientific trend and the connection of kinanthropology with military issues.

# Determinants of reactive agility performance in table tennis players

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Henrieta Horníková

Department of Track and Field, Faculty of Physical Education and Sport, Comenius University in Bratislava

**Background:** Table tennis is considered as a reaction sport, in which reaction speed is the key factor of sports performance. However, in addition to the quality of sensory (or cognitive) functions, it also requires a rapid motor response. Reactive agility is one of the most important qualities of table tennis performance. It comprises both sensory and motor components. Therefore, the aim of this study was to find the relationship between reactive agility performance and reaction speed (sensory part), sprint and change of direction speed, and muscle strength parameters (motor part) and thus to identify determinants of reactive agility in table tennis players. **Methods:** Fifteen male competitive table tennis players ( $26.3 \pm 4.0$  years,  $179.4 \pm 6.0$  cm,  $77.2 \pm 6.4$  kg) performed the Reactive Agility Test (RAT), three reaction time tests (simple and choice reaction, reaction to four visual stimuli), sprint for 5 m, 505 Agility test, countermovement and drop jumps. **Results:** Pearson correlation coefficient revealed a significant relationship between RAT performance and reaction time to four visual stimuli ( $r = 0.801$ ,  $p < 0.001$ ). Nonsignificant, but the medium correlation was found between RAT performance and choice reaction time ( $r = 0.404$ ) and decision-making time, which was calculated as a difference between choice and simple reaction time ( $r = 0.410$ ). These results showed that reactive agility is determined by the cognitive component (reflected by the reaction time) in table tennis players. **Conclusion:** It seems that fast reactions associated with hand movements are more important than explosive strength and speed abilities in table tennis performance. Therefore, the trainers should focus primarily on the development of reaction-speed abilities in their training program. Secondary, they should focus on more specific movements (e.g., lateral change of direction or speed of first steps) rather than linear sprint speed or changing of direction under angles higher than  $90^\circ$ . Additionally, it seems that explosive strength training has only supportive character in relationship to the sports performance.

**Keywords:** motor component, racquet sports, reaction time, sensory component



# **Influence of situational technical-tactical parameters on success in female basketball**

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**Mario Jeličić<sup>1</sup>, Šime Veršić<sup>1</sup>, Campaz Xavier Mansa<sup>2</sup>**

**<sup>1</sup>Faculty of Kinesiology, University of Split**

**<sup>2</sup> Lithuanian Sports University, International joint master in basketball coaching and management**

Basketball is dynamic team sport game played by two teams with 5 players on the court with 28×15 dimensions. It is characterized by the performance of technical and tactical elements in defensive and offensive actions. The main aim of this study was to investigate differences in situational efficiency parameters between successful and unsuccessful female basketball teams in EuroLeague Women 2018/2019. Sample consisted of total 124 games (112 group and 12 elimination games) in which 248 team performances were analysed. Situational technical-tactical parameters included: 2-point field goal made (2FGM), 2-point field goal attempt (2FGA), free throw made (FTM), free throw attempt (FTA), 3-point field goal made (3FGM), 3-point field goal attempt (3FGA), offensive rebound (OREB), defensive rebound (DREB), assists (AST), steals (STL), turnovers (TO), blocks (BLK) and personal fouls (PF). Success was determined with final outcome of the match and was observed as binomial criterion (win/lose). To establish differences between observed groups logistic regression was used. First, all predictors were used in univariate analysis and additionally, all significant predictors were simultaneously included in the multivariate calculation. Univariate logistic regression showed significant association between match outcome and all observed predictors except OREB. Multivariate model identified higher values 2FGM (OR = 1.524, 95%CI: 1.252–1.855), 3FGM (OR = 2.762, 95%CI: 1.864–4.091), DREB (OR = 1.615, 95%CI: 1.359–1.919) and STL (OR = 1.863, 95%CI: 1.456–2.385) in winning teams while losing teams had significantly more 2FGA (OR = 0.794, 95%CI: 0.705–0.894), 3FGM (OR = 0.711, 95%CI: 0.594–0.851), TO (OR = 0.662, 95%CI: 0.549–0.797) and STL (OR = 1.863, 95%CI: 1.456–2.385). These results suggest that field shooting accuracy, both for two and three points, in the attack phase and number of rebounded and stolen balls from the opponent in the defence, represent most significant parameters that will contribute to winning in the female basketball. On the other hand, number of field goal attempts, lost balls and fouls are significantly higher in the losing teams. These findings can help basketball coaches and practitioners in training process and technical-tactical analysis and preparation for the game.

# **Temporal interconnectedness of handball players' activities in the context of accelerating their movements: Preliminary study**

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**Martin Kovář, Roman Cuberek**

**Institute of Active Lifestyle, Faculty of Physical Culture, Palacký University in Olomouc**

Background: Handball is, among other things, defined as an indoor team sport with many actions, such as body collisions, fast stop and go movements, accelerations, and decelerations in all directions. The players' movements are initiated to achieve some goals or as a reaction to the opponent's action also all of the actions precede another one. The use of units that involve accelerometers appears very advantageous for the analysis of sports performance. These units are valid and suitable for use in team sports. Our goal was therefore an investigation of the causality of the next movement on the previous one using features on raw accelerations data and to assess the temporal interconnectedness of handball players' activities based on their player's position. Methods: The study involved 11 handball players (men; mean age  $29.0 \pm 6.21$  years; mean body mass index  $28.45 \pm 3.0$  kg/m<sup>2</sup>), where goalkeeper (GK), line player (LP), wing player (WP), and back player (BP) positions were distinguished. During two 10-minute training matches, the acceleration (AC) of the players was measured using a triaxial Axivity device (AX6, Axivity, UK) containing an accelerometer sensor (located between the players' shoulder blades). Vector magnitude values were calculated for AC each time the triaxial data was recorded. For study purposes, two autocorrelation time series (the first and second half of the match) were calculated for each player based on a series of lags from 1 to 200. These time series allowed us to assess the dependence of a particular AC value on the previous set. Furthermore, biserial correlations were calculated to assess the similarity of trends within four groups of player positions. Results: In the three groups of player positions, the observed time series of autocorrelation values can be characterized as a periodical trendline with positive as well as negative correlation values, peak-to-peak distances around 1/3 second, and decreasing peaks of periods. The trends of the time series can be well described using a 6th-order polynomial trendline in all LP, WP, and BP groups. In the GK group, the character of time series differs significantly – their trendline is not periodical and from the lag of 20 the values are close to zero. These trends were similar in both parts of the match. The observed biserial correlations between all pairs of autocorrelation time series indicate a significant difference between the GK group and other groups of player positions (correlations between time series of GKs and other players ranged from 0.118 to 0.722 while from 0.788 to 0.996 in pairs of other player positions). Conclusion: Following the results, we assume that the dynamic nature of the player's movement during a particular task is slightly dependent on the specific stages of a player's previous behavior. These associations vary according to player positions.

**Keywords:** accelerometry; analysis; movement task; sports game

# **High-intensity functional training in pregnancy: a case study**

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**Petr Schlegel**

**Department of Physical Education and Sports, Faculty of Education,  
University of Hradec Králové**

High-intensity functional training (HIFT) is a popular activity that combines high effort and compound exercises. Many women aged 20-40 who are expected to become pregnant are also involved in it. HIFT is an activity in which the heart rate increases significantly, there is an increase in intra-abdominal pressure, free weights are also used. There is poor evidence of HIFT and its effect on pregnancy or childbirth. The case was a healthy woman (31 years old) who has long term experience with HIFT. The aim of the study was to analyze training regime (length, intensity, heart rate) and number of steps in the period from the 4th to the 38th week. The effect on the health of the mother and the fetus, the delivery and the birth weight were monitored. The findings show that with an optimally set training program, HIFT can be a safe activity that has no adverse effect on pregnancy, fetal health, or childbirth. This is the first such study, so further research is needed.

# Kata selection, successfulness and scoring at the senior Karate 1 events in 2021

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Radovan Hadža, Dušana Augustovičová

Faculty of Physical Education and Sport, Comenius University, Bratislava, Slovakia

**Introduction:** To succeed at the most significant Karate 1 events under World Karate Federation (WKF), kata competitors must show their best performance. Karatekas perform prepared katas, which possibly elevate their strengths. We recognize 102 katas from the official WKF list of katas. The various katas have different duration and fast to slow moves ratios. The competitor performs one kata in each round, which he/she cannot repeat during the competition. The selection of kata for each round, considering the level of opponents and difficulty of kata, can be crucial to obtaining the highest possible score. **Methods:** Our sample consisted of 460 senior kata athletes (225 males, 235 females) who competed in monitored tournaments. All 876 performed katas were recorded (413 male, 463 female) and obtained from the website of Sportdata – World Karate Federation section [<http://www.sportdata.org>]. The statistical analyses were carried out using the SPSS 21.0 program for Windows (SPSS, Inc., Chicago, IL, USA). We evaluated the proportion of used katas using the Chi-square Goodness-of-fit Test. Determination of the most successful kata we achieved, expressing the success ratio (promote/did not promote karateka) of selected kata. To compare mean score values Mann-Whitney U-test was conducted. The significance level of  $p < 0.05$  was used. **RESULTS:** The most often used kata at 2021 Karate 1 events was Papuren (141), Anan Dai (97) and Gojushiho Sho (88). Most often used kata in females were Papuren (117), Chatanyara Kushanku (53) and Anan Dai (47), and in males, Gojushiho Sho (63), Anan Dai (50) and Unsu (47). The Chi-square test revealed a significant difference in proportions of used katas ( $P < 0.001$ , for all). The most successful katas were Kururunfa (4.11), Chibana No Kushanku (2.40), which karatekas used only 46- and 17-times, respectively, mainly in 1st round. The ratio of most often used katas were as follows: Papuren (1.27), Anan Dai (1.26), Unsu (1.03), Gojushiho Sho (0.73), Chatanyara Kushanku (0.68). Mean score values for females were  $16.62 \pm 1.22$ ,  $7.10 \pm 0.52$ , and  $23.69 \pm 1.71$ , for males  $16.70 \pm 1.27$ ,  $7.19 \pm 0.57$ , and  $23.88 \pm 1.81$ , technical, athletic, and total, respectively. Man-Whitney U-test revealed a non-statistical difference in mean technical scores ( $P=0.175$ ) but revealed a statistical difference in mean athletic and total score values between male and female karatekas ( $P=0.003$ , and  $P=0.046$ , respectively). **Conclusion:** Our study provides the information about kata selection of top karate kata competitors. The content of these katas justifiably describes the current requirements of this sport to date, which success ratios confirm. A statistically significant difference in mean athletic score values between genders reflects in the total score too, which confirms the higher level of physical fitness of male compared to female athletes. These results can help karatekas in a strategy of kata selection and allow them to compare their results with top-level competitors.

**Keywords:** World Karate Federation, performance, success ratio

# Differences in a dynamic load of handball players during the game in the context of player positions: Preliminary study

Roman Cuberek, Martin Kovář

Institute of Active Lifestyle, Faculty of Physical Culture, Palacký University in Olomouc

**Background:** In handball as well as in other sports games, the training requires a high level of individualization. From this point of view, a broad knowledge base is needed about the specifics of each player's performance. Due to the specifics of handball, the dynamic nature of a player's movement is an important factor contributing to a player's overall performance during the game. High individual variations of specific tasks are a natural part of the game in handball players. At present, however, little is known about differences in dynamic load (DL) on different player positions, the trends in DL during the match, or some DL details in specific handball tasks (overall size, variability, extremes, etc.). In addition, validated methods for evaluating the DL characteristics are missing. Therefore, the study aimed to assess the differences in the DL of handball players during the game depending on the player positions. **Methods:** The study involved 11 handball players (men; mean age  $29.0 \pm 6.21$  years), where 4 player positions were distinguished: goalkeepers (GKs), line players (LPs), wing players (WPs), and back players (BPs). During the two 10-minute training matches, the acceleration (AC) and an angular velocity (AV) of the players were measured using a triaxial Axivity device (AX6, Axivity, UK) containing accelerometer and gyroscope sensors (located between the players' shoulder blades). Vector magnitude values were calculated for both AC and AV each time the triaxial data was recorded. The DL was expressed by a set of 44 parameters – 36 statistics of AC and AV recordings along with the magnitude of acceleration, deceleration, and increase and decrease of AV. Heatmaps, based on the correlation matrix, were used to explore group similarities visually. In addition, the differences in the increase (the same in decrease) in overall acceleration during the match between the different player positions were examined to see if the player positions differed in any way (in both halves separately; the same in AV). **Results:** Two main clusters were observed in player positions, where GKs differed from other player positions. In the deeper structure of clusters, three sub-clusters were found, where LPs represent the first and BPs the second sub-cluster. The third cluster is represented by players from various player positions. The total sum of accelerations (decelerations) in the first half of the 10-minute match ranged from 301 (337) to 344 (389) g and the total sum of increasing (decreasing) angular velocity ranged from 15,323 (14,454) to 36,519 (35,464) radians per sec. The values, their range, and the respective order of the players were the same or similar in both halves. The lowest DL was observed in GKs compared to other players, which was to be expected and can be practically explained. The second-lowest DL was observed for LPs and, conversely, the highest for WPs. **Conclusion:** The proposed AC and AV parameters seem to be suitable for expressing and assessing the DL of players during a handball match. The presented procedure makes it possible to distinguish between the different player positions to varying degrees.

**Keywords:** accelerometry, angular velocity, heatmap, data models, signal processing

# Effects of 4-week Olympic weightlifting training on speed and power performance in recreational athletes

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Šime Veršić

Faculty of Kinesiology, University of Split, Croatia

Olympic weightlifting (OW) is sport with high strength and power demands where athletes need to explosively lift heavy weights. It is consisted of barbell lifting snatch and clean and jerk disciplines. In the strength and conditioning training, OW techniques are often used as a method for speed and power development. The aim of this study was to determine effects of 4-week OW training intervention on speed, agility and power performance among young recreational athletes. The sample of participants consisted of 12 Kinesiology students (average 23 years old). They attended the Olympic Weightlifting course. The training intervention lasted 4 weeks and with 3 training sessions per week in which participants practiced OW training based on learning OW techniques and auxiliary lifts execution. Before and after the intervention, measurement was conducted and included power, speed and agility tests. Squat jump (SJ), countermovement jump (CMJ) and drop jump (DJ) were used to estimated lower body power and medicine ball throw (MBT) for upper body power. Sprinting on 5 meters (S5) and 15 meters (S15) were conducted as power and speed tests, while 20 yards test (20Y) measured nonreactive agility performance. All variables were descriptively analysed and ANOVA for repeated measures was used to determine possible effects of training intervention. Results showed improvement in jumping capacities, with statistically significant difference noted only for CMJ ( $p > 0.01$ ). Upper body power and agility performance did not show any significant changes, while a decline in sprinting performance was found for both S5 ( $p > 0.01$ ) and S15 ( $p > 0.01$ ). While the results in jumping variables are expected and in accordance with current scientific knowledge, the results in sprint tests are somewhat confusing. Possible explanation for this can be found in the fact that the participants worked for four weeks the tasks that biomechanically are not similar to the structure of sprinting movement. This could suggest that athletes who want to improve their explosive speed capacities should include specific sprint stimuli in their training program in addition to OW training program. In the future, more variables and longer treatment duration need to be applied.

# Angular differences in major joints of the playing limb between short and long serve in table tennis

Sławomir Winiarski<sup>1</sup>, Ziemowit Bańkosz<sup>1</sup>, Ivan Malagoli Lanzoni<sup>2</sup>

<sup>1</sup> Division of Biomechanics, Wrocław University of Health and Sport Sciences, Wrocław, Poland

<sup>2</sup> Department of Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy

Table tennis serve is the only stroke performed during the game, which the opponent does not directly influence. Therefore, the role of the serve in the game is fundamental. A short serve (SS) is a serve that (if allowed) would bounce twice on the far side of the table. Long serve (LS) bounces once on the opponent's side of the table, typically within 10 cm of the endline. Therefore, this study aimed to evaluate the changes in angular movement in the joints of the playing limb between SS and LS serve in players of high sporting level. The study involved 6 male table tennis players (mean  $\pm$  SD; age:  $25.0 \pm 7.1$  years, body height:  $177.2 \pm 6.0$  cm, body weight:  $72.6 \pm 7.7$  kg). The players belong to the top 50 in the Italian table tennis association (FITeT) ranking. Each player performed two tasks presenting a forehand serve with back-sidespin rotation: SS, in such a way that the second bounce of the ball on the opponent's half was placed in the rectangle designated at the right corner of the table; and LS, so that the first bounce of the ball was placed in the designated corner. Each serve type was performed with up to 10 hits in the designated field. Each player's movements were registered using the MR3 myoMuscle Master Edition system consisting of 16 inertial motion units. The differences between SS and LS serve types in the angular course of the movement were evaluated separately for each subject for the: upper thoracic rotation, shoulder flexion, abduction and rotation, elbow flexion, wrist flexion, supination and radial abduction against specific events: ready position, backswing and forward phase. SPM1D statistical testing was conducted in two stages between the same movement type of the angular course. Firstly, the test statistic was computed using the one-sample t-test SPM{t}. Secondly, statistical information was transferred to the angular graphs in statistical bar representation. The research carried out in this study indicates the presence of the biomechanical principle of proximal-to-distal sequencing in the serving technique. The differences between SS and LS serves concern mainly the range of movement and the movement speed, which have higher values during the impact for long serves. The most important joints in which these differences are the most pronounced are the elbow (flexion-extension) and the wrist joint (mainly the flexion-extension). The study of serve kinematics in table tennis can bring beneficial and new knowledge for coaches, players and researchers. It may concern coordinating movement when using multiple types of serves, comparing kinematics values in athletes of different levels, creating performance models by evaluating high-level athletes, or comparing kinematics of different types of serves and finding the most beneficial in terms of tactics and match strategy.

# The role of the verification phase for determination of maximal aerobic capacity

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Ivan Struhár<sup>1</sup>, Vojtěch Grün<sup>2</sup>, Lucie Lipková<sup>1</sup>, Michal Kumstát<sup>1</sup>, Kateřina Kapounková<sup>1</sup>

<sup>1</sup> Faculty of Sports Studies, Department of Health Promotion, Masaryk University

<sup>2</sup> Faculty of Sports Studies, MUNI SPORT Laboratory, Masaryk University

**Purpose:** One of the key signs of the achievement of maximum oxygen uptake is the flattening the oxygen uptake at gradually incremental load protocol. On the other hand, that is necessary to mention that not all athletes are able to achieve  $\text{VO}_2$  plateau at the end of testing the maximum aerobic capacity. The aim of the study was to compare the incidence of the  $\text{VO}_2$  plateau during the verification phase of two different types maximal oxygen uptake testing protocols. **Methods:** The data was collected from twenty-one physically active male participants (age  $26.18 \pm 2.53$  years; body mass  $75.81 \pm 4.22$  kg; body height  $1.80 \pm 0.04$  m). The participants visited the laboratory two times, separated by at least 7-days. The testing protocol started with a randomly chosen testing protocol (Self-paced  $\text{VO}_2$ max test 5x2min;  $\text{VO}_2$ max test 0.3W/kg, 1 min). **Results:** The study proved the statistically significant incidence of  $\text{VO}_2$  plateau for Self-paced  $\text{VO}_2$ max test 5x2min comparing with the Stepwise Graded Protocol-  $\text{VO}_2$ max test 0.3W/kg, 1 min. **Conclusion:** The study has shown that the using the verification phase for determination of the incidence of the  $\text{VO}_2$  plateau can be useful tool for approving the maximum aerobic capacity.

**Keywords:** exercise, plateau in oxygen consumption, ratings of perceived exertion, testing



# **Characteristics of different shots on goal considering the outcomes of the matches of one soccer team during half-season**

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**Tihana Nemčić**

**Faculty of Kinesiology, University of Zagreb**

The aim of this research was to determine the differences in performance indicators of one team in matches that they won, lost and played uneven. The sample was consisted of 13 matches of one soccer team competing in third rank of Croatian football (soccer). The variables tracked were shots on the goal saved by the goalkeeper, shots on goal outside the goal, shots on goal blocked by the opponent and scored goals. The methods used were descriptive analysis and MANOVA. Results showed that football team in matches won scored the highest number of goals on average (3), comparing to matches lost (1) and played uneven (2). In all three matches type team performed equal number of shots outside the goal (6). Four (4) shots were blocked by the opponent and saved by the goalkeeper in matches both won and played uneven while in matches lost there were 3 shots blocked by the opponent and saved by the goalkeeper. No statistically significant differences between three groups of matches were found. Conclusion: in matches won team scored highest number of goals comparing with matches lost and played uneven. Differences were not found for other types of shots outcomes, from which we can conclude the efficiency is the most relevant factor influencing result. Further study comparing performance indicators between different competitive level in football would be of interest and would provide useful information to determine characteristics and structure of different ranked teams in football.

**Keywords:** performance indicators, shots on goal, football, efficiency

# Match outcome and running performance among UEFA Champions league soccer players

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Toni Modric\*, Goran Gabrilo, Mia Peric

Faculty of Kinesiology, University of Split, Split, Croatia

\* Correspondence: [toni.modric@yahoo.com](mailto:toni.modric@yahoo.com)

This study aimed to examine position-specific differences in running performance (RP) according to the match outcome in UEFA Champions League (UCL). The players' RPs (n=244) were collected during UCL group stage matches (n=20) in the 2020/21 season using semiautomatic optical system InStat Fitness, and classified according to their playing positions as: central defenders (CD; n=79), fullbacks (FB; n=65), central midfielders (CM; n=55), wide midfielders (WM; n=28) and forward (FW; n=17). The RP variables included: total distance covered, low-intensity (LIR) (<14.3km/h), running (14.4–19.7 km/h), high-speed running (HSR) (19.8–25.1 km/h), and sprinting (>25.2 km/h). Match outcome was observed as win, draw and loss. One-way analysis of variance (ANOVA) was used to examine differences in RP according to the match outcome. Significant differences in TD (F-test = 4.16,  $p = 0.02$ ) and LIR (F-test = 4.51,  $p = 0.01$ ) among match outcomes were observed for FBs. Specifically, FBs covered significantly greater TD when their team won than when lost ( $p = 0.03$ ,  $d = 0.79$ ). In addition, FBs' LIR was significantly greater in won matches than in draw ( $p = 0.04$ ,  $d = 0.92$ ) and lost matches ( $p = 0.03$ ,  $d = 0.77$ ). The RP of players on all other playing position were similar irrespective to the match outcome (F-test = 0.08 to 2.84, all  $p > 0.05$ ). These results indicated that winning UCL matches is not strongly influenced by players' physical performance, except for FBs who tended to covered greater total- and low- distance when their teams won. This study indicated limited overall influence of RP on success in matches at elite-level soccer. The findings from this study may help soccer coaches to ensure optimal physical preparation of players in elite soccer.

**Keywords:** physical performance, winning, elite soccer, playing positions

## **Pilot study: Specificity of PAPE effect using explosive and maximal isometric stimuli on anaerobic cycling tests**

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**Zdeněk Morávek, Tereza Králová, Jan Cacek, Jan Ondráček**

**Faculty of Sports Studies, Masaryk University, Brno, Czech Republic**

**Purpose:** This pilot study is about the opportunity of involvement of power training for the acute improvement of anaerobic performance in cycling. This study's main aim was to determine whether it could improve power output performance through two different strength training stimuli (explosive; maximal isometric) conducted 30 or 60 minutes before anaerobic power output tests.

**Methods:** 6 athletes took part in the test (3 ice hockey players and 3 cyclists), aged 23–28 years, weight  $75 \pm 23$  kg, and were  $182 \pm 5$  cm tall. As explosive stimuli, we used 3 sets of 5 repetitions of countermovement jump (CMJ), 4 sets of 10 repetitions of dead-lift on trap bar (TDL) and 4 sets of 10 repetitions of unilateral hip flexion on the lower pulley (HF). As maximal isometric stimuli (MIS) were used, 4 sets of 5-second maximal isometric TDL and 4 sets of 5-second maximal HF.

**Results:** The cycling group showed positive changes in peak and mean power during 5 seconds all-out test after both types of intervention (EXS and MIS) and both pauses (30 and 60 minutes). The most positive change was an increase in mean power output during 5 seconds of the all-out test 60 minutes after EXS by  $+2,04$  W/kg ( $+14,5$  %). The ice hockey players group showed a decrease in all measured variables, except for the 30seconds peak power output 30 minutes after EXS. The highest reduction was measured during 30 seconds mean power output 60 minutes after MIS by  $-1,09$  W/kg ( $-13,1$  %).

**Conclusion:** Cycling group achieved positive changes during maximal and submaximal efforts 30 minutes after both types of strength stimulus (EXS and MIS) and were also positive in maximal efforts after 60 minutes after MIS or EXS. On the other side, the ice hockey players group showed predominantly negative changes in peak and mean power output during both tests. Results of this pilot study suggest a potential use in cycling thanks to specific kinds of exercises during postactivation (or PAPE). For more convincing results from using these methods, it is necessary to expand the sample.

**Keywords:** maximal effort, submaximal effort, postactivation, PAP, power output, strength training, relative power output

# Differences in the situational parameters of tennis matches between winners and losers in the women's main draw competition at Roland Garros 2022

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Zlatan Bilić<sup>1\*</sup>, Petar Barbaros, Stipe Čubrić

Faculty of Kinesiology, University of Zagreb, Croatia

*\*Correspondence: zlatan.bilic@kif.hr*

Several studies investigated the situational efficiency parameters at tennis matches in the men's and women's competition at previous Rolland Garros tournaments. The aim of this study was to determine if there are differences in the situational efficiency parameters between winners and losers in the women's main draw competition at Roland Garros 2022. This study included 125 main draw matches. Differences in performance were analyzed across 7 situational efficiency variables: aces, double faults, 1st serve average speed, 2nd serve average speed, winners, unforced errors and forced errors. The results showed significant differences between winners and losers with the following parameters on the winners' side: number of aces per match (2.40/1.63;  $p = 0.03$ ), winners (24.83/19.37;  $p = 0.00$ ), unforced errors (23.80/29.13;  $p = 0.00$ ) and forced errors (19.71/23.64;  $p = 0.00$ ). The results demonstrated that there were no significant differences in double faults, 1st serve average speed and 2nd serve average speed. More aces of winners can indicate better service accuracy and variability, as there is no significant difference in service speed. Also, a more successful start of a point can positively affect the early dominance in the point rally and easier achieving of winners. In addition to all the above, it is notable that more successful tennis players, as well as having more winners, record less unforced and forced errors. The information obtained should be used by tennis coaches in planning trainings and preparing matches in order for their tennis players to achieve maximum results.

**Keywords:** tennis, efficiency, match statistics

# The selfish gene as a possible driving force behind HIIT

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Jan Florian, Emanuel Hurych

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Purpose:** High-Intensity Interval Training (HIIT) is a training method aimed at increasing the fitness of individuals. It is based on a combination of periods in which high-intensity alternate with low-intensity exercise or passive rest. The topic of this paper is a reflection on the benefits and risks of HIIT health use in recreational athletes. We investigate humans' conscious and unconscious motivations for choosing this specific method in the philosophical discourse. **Problem:** HIIT is a method that, in some ways and with particular approaches, strongly reflects the imperative of the postmodern age - to get as much as possible, as quickly as possible, and with as little effort as possible. Martin Heidegger perceives three fundamental existentials in the context of temporality – historicity, everydayness, and within-time-ness. Here conscious motivation may be linked to the temporal characteristic of the human being. Unconscious motivation may be related to the application of the selfish gene theory, as it is presented by Richard Dawkins. The philosophical approach to the problem: The Heideggerian concept of temporality leads us to research the authenticity and inauthenticity of the Dasein phenomenon. Some features of motivation for applying HIIT can be examined as inauthentic forms of being. In focusing on possible elements of unconscious motivation, the concept of evolutionary biology, namely Dawkins's theory of the selfish gene, provides a unique platform. It is primarily (a human) effort to spread genes. Here, in connection with HIIT, we build on the concepts of replicator and vehicle and deal with the basic selection unit of evolution and its form. **Conclusions:** HIIT presents an exciting training method that is examined in the context of effectivity of sports training, social benefits, or health aspects. Here we would like to offer the HIIT concept as the reflection of philosophical (mainly ontological, partly ethical) discourse.

**Keywords:** selfish gene, High-intensity interval training, replicators, vehicles

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HEALTHY LIFESTYLE,  
ACTIVE AGING,  
NUTRITION AND  
REGENERATION  
IN SPORT

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# Impact of whole-body electromyostimulation and resistance training programme on strength parameters and body composition in group of elderly women at risk of sarcopenia

Michaela Kotková<sup>\*1</sup>, Pavlína Vaculíková<sup>2</sup>, Ivan Struhár<sup>3</sup>, Dominika Balousová<sup>2</sup>, Andrea Potůčková<sup>2</sup>

<sup>1</sup> Department of Sports, Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

<sup>2</sup> Department of Gymnastics and Combatives, Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

<sup>3</sup> Department of Health Promotion, Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

*\*Corresponding author: (ORCID 0000-0002-3540-887X), e-mail: 429889@mail.muni.cz*

**Objective:** The purpose of the study is to compare the effect of 10 weeks of WB-EMS and the circuit resistance training programme on body composition and strength parameters in women at risk of sarcopenia.

**Methods:** The WB-EMS program was carried out once a week and included 10 exercise sessions, the resistance training program was carried out twice a week and included 20 sessions. 17 elderly women participated in the study, 9 in a WB-EMS intervention group (age:  $63.11 \pm 1.52$  years; weight:  $70.07 \pm 9.07$  kg; height:  $165.11 \pm 6.4$  cm; BMI  $25.81 \pm 3.96$  kg/m<sup>2</sup>), 8 in a resistant training group (age:  $62.13 \pm 1.69$  years; weight:  $73.58 \pm 3.87$  kg; BMI  $27.34 \pm 2.58$  kg/m<sup>2</sup>). To assess body composition, dual-energy X-ray absorptiometry (DEXA) was used. To determine the level of strength parameters, hand dynamometry and isokinetic dynamometry of knee flexors and knee extensors were used.

**Results:** Body composition assessment was performed by dual energy X-ray absorptiometry and strength parameters were evaluated using isometric dynamometry (knee flexors and extensors strength). After completing 10 weeks of intervention, significant differences were observed for lean muscle mass (resistance training group,  $\text{Leanmass}_{\text{pre-test}} 43316.91 \pm 1856.77$  vs.  $\text{Leanmass}_{\text{post-test}} 43939.56 \pm 1869.84$ ,  $p = 0.0307$ ). No significant differences were found between the pre test and post test in the whole body electromyostimulation group ( $\text{Leanmass}_{\text{pre-test}} 39472.56 \pm 3370.04$  vs.  $\text{Leanmass}_{\text{post-test}} 38835.56 \pm 3306.84$ ,  $p = 0.5995$ ). The isokinetic dynamometry analysis showed significant differences for the extensors and the peak torque on the right side in the resistance training group (Extensors Peak Torque  $\text{pre-test} 98.00 \pm 13.55$  vs.  $\text{Extensors Peak Torque}_{\text{post-test}} 38835.56 \pm 3306.84$ ,  $p = 0.0160$ ; Flexors Peak Torque  $\text{pre-test} 54.25 \pm 11.14$  vs.  $\text{Flexors Peak Torque}_{\text{post-test}} 59.75 \pm 11.13$ ,  $p = 0.0059$ ).

**Conclusions:** The most obvious finding that emerges from this study is that resistance training has shown a greater effect than whole-body electromyostimulation.

**Keywords:** ageing; dynamometry; health; strength; physical activity

# Walking speed: a factor in the physical fitness of the elderly

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Andro Štefan, Lovro Štefan, Mario Kasović

The main purpose of the study was to explore whether gait velocity predicts the level of separate and overall physical fitness. In this study, we asked one hundred and twenty older adults over the age of 60 (mean  $\pm$  SD age  $71 \pm 7$  38 years, height  $159 \pm 21$  cm, weight  $70 \pm 13$  kg) to complete a Senior Fitness Test battery to assess the level of physical fitness and walked across the Zebris pressure platform (Munich, Germany) to measure gait velocity. To calculate overall physical fitness, we summed z-score values of each physical fitness test. Pearson's coefficient ( $r$ ) was used to determine the level of correlation and coefficient of determination ( $r^2$ ) for variance explained between gait velocity and physical fitness. Respondents conducted a battery of six tests: "chair stand in 30 s", "arm curl in 30 s", "2-minute step test", "chair sit-and-reach test", "back scratch test" and "8-feet up-and-go test". Gait velocity was significantly correlated with chair stand in 30 sec ( $r=0.45$ ,  $r^2=20\%$ ,  $p<0.001$ ), arm curl in 30 sec ( $r=0.56$ ,  $r^2=31\%$ ,  $p<0.001$ ), 2-minute step test ( $r=0.44$ ,  $r^2=19\%$ ,  $p<0.001$ ), chair sit-and-reach test ( $r=0.46$ ,  $r^2=21\%$ ,  $p<0.001$ ), back scratch test ( $r=0.30$ ,  $r^2=9\%$ ,  $p<0.001$ ) and 8-feet up-and-go test ( $r=-0.23$ ,  $r^2=5\%$ ,  $p=0.011$ ). Gait velocity was not significantly correlated with waist circumference ( $r=0.12$ ,  $r^2=1\%$ ,  $p=0.189$ ). Overall physical fitness was strongly correlated with gait velocity ( $r=0.75$ ,  $r^2=56\%$ ,  $p<0.001$ ). In conclusion this study shows that gait velocity may be an easy and quick screening tool to predict the level of separate and overall physical fitness in a sample of older adults.

**Keywords:** elderly, speed, performance, correlation, tool



# Reasons for an early career termination: a case study of female runners from Slovakia national team

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Martina Bernaciková, Radka Škovranová, Ana Carolina Paludo, Marta Gimunová,  
Michal Kumstát, Kristýna Dvořáková

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Purpose:** The early drop-out in professional youth athletes is a complex and multi factors process and seems to be more common in individual sports with higher physical demands, such as the running disciplines. Also, it has previously been reported that youth female athletes presented a higher drop-out rate compared with males. The present study, therefore, investigated the causes of early-career termination and possible association with wellness and low energy availability in youth female runners.

**Methods:** Data from four female runners (aged from 22 to 24 years) from the Slovakian national team in running disciplines who have ended their careers early were collected. A semi-structured interview was performed to explore multiple factors (advent athletics, training, regeneration, sleep, diet, health, emotions, motivation, communication, environmental pressure, coach, habits, reasons for ending an athletic career and a better relationship with the sport) and the questionnaire about wellness and low energy availability in females (LEAF-Q).

**Results:** The interview shows that the most common factors of early-career termination of a former runner were: an early specialization in the discipline, inadequate training dose-response (e.g., high intensity and insufficient recovery), pathological nutritional behaviour, health problems, psychological factors, and loss of motivation. The factors reported during the interview were associated with negative results of the wellness questionnaire (high level of fatigue: score 4–8) and with LEAF-Q (high risk: score  $\geq 8$ ).

**Conclusion:** The study highlights the multi factors involved in early career termination. Based on the athletes' reports, was possible to notice that the early sports specialization in running disciplines affected negatively their health, nutrition and psychological aspects, and could be triggered by higher training loads and insufficient recovery. Caution should be taken by coaches and professionals involved during the sports specialization, in order to minimize the negative impact of training routine on youth athletes and consequently avoid an early drop-out.

**Keywords:** early specialization, overtraining syndrome, female and male athletic triads, relative energy deficiency, eating disorders, athletes

# Age-related changes in older adults' gait pattern

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Denisa Nohelova<sup>\*1,2,3</sup>, Lucia Bizovska<sup>1</sup>, Zdenek Svoboda<sup>1</sup>, Nicolas Vuillerme<sup>2,3,4</sup>

<sup>1</sup>Faculty of Physical Culture, Department of Natural Sciences in Kinanthropology, Palacký University Olomouc, Olomouc, Czech Republic

<sup>2</sup>University Grenoble Alpes, AGEIS, Grenoble, France

<sup>3</sup>LabCom Telecom4Health, Orange Labs & University Grenoble Alpes, CNRS, Inria, Grenoble INP-UGA, Grenoble, France

<sup>4</sup>Institut Universitaire de France, Paris, France

*\*Correspondence: denisa.nohelova01@upol.cz*

**Purpose:** Aging is characterized by progressive system degradation, therefore at an advanced age, gait alterations are a common occurrence, which significantly affect well-being and independence of older adults. The aim of this study was to assess age-related changes in older adults' gait pattern after 5 years.

**Material & Methods:** Gait pattern of 23 older adults aged  $65.7 \pm 4.0$  years (17 females, 6 males) was assessed at baseline measurement and after a 5-years period. Participants were asked to walk in an indoor corridor at their preferred walking speed for 5 minutes. They were equipped with a triaxial inertial sensor (Trigno wireless system, Delsys Inc., Natick, MA, USA) attached to the lower trunk. Linear and nonlinear characteristics from trunk acceleration in vertical (V), mediolateral (ML) and anteroposterior (AP) direction obtained during gait were calculated. Stride time and gait speed were used as basic characteristics. Multiscale entropy (MSE), short-term Lyapunov exponent (LE), harmonic ratio (HR) and root mean square (RMS) were used as an indicators of gait complexity, gait stability, gait symmetry and gait variability, respectively.

**Results:** Gait speed significantly decreased ( $P = 0.033$ ), while no significant change was observed in HR and stride time during the follow-up measurement compared to the baseline. MSE from trunk accelerations significantly increased in V and ML directions and decreased in AP direction ( $P < 0.05$  in all cases) during the follow-up measurement compared to the baseline. Opposite results were observed for RMS and LE, for which a significant decrease was found in V direction ( $P = 0.048$  and  $P = 0.016$ , respectively) and a significant increase in AP direction ( $P < 0.001$  and  $P = 0.039$ , respectively) during the follow-up measurement compared to the baseline.

**Conclusion:** The findings confirmed that linear and nonlinear characteristics of gait pattern changed during the 5-years period. In contrast to prevalent expectations, the changes are not the same in all directions. This result supports the statement that process of aging represents the transition to possibilities for adaptation, not an inevitable journey to "frailty" and that the human body systems organize solutions with different levels of complexity.

**Keywords:** aging, gait speed, complexity, stability, symmetry, variability, entropy, Lyapunov exponent, harmonic ratio, root mean square

# Correlation Between the Results of Crofit Norms and the Performance of Dances of the 8<sup>th</sup> Grade Pupils of Elementary School

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Jadranka Vlašić<sup>1</sup>, Lea Burcar<sup>2</sup>, Maja Horvatin<sup>1</sup>

<sup>1</sup>Faculty of Kinesiology, Univesity of Zagreb

<sup>2</sup>Elementary school „Sesvetska sela“, Zagreb

The aim of this study was to determine the correlation/s between some basic motor and functional abilities and anthropological characteristics of 8<sup>th</sup> grade elementary school pupils with the obtained results of the adoption of performance in dances Vienna Waltz and Cha-cha, which according to the plan and programme are carried out in the teaching of physical education. The assessment of basic motor abilities was carried out by some tests of the CROFIT NORMS. The question arises, whether the defined tests for the assessment of motor abilities cover a sufficient spectrum of abilities and characteristics important for the successful performance of dance structures.

The study included 30 participants (N=30), 8<sup>th</sup> grade elementary school pupils, 14 years of age ( $\pm 6$  months), 15 male and 15 female. The sample of variables consisted of three tests for the evaluation of basic motor abilities and one test for the assessment of functional abilities, and two variables for the assessment of morphological characteristics. In addition to the primary objective of the study the aim was also to determine, based on the results obtained, whether there are differences between male and female pupils in the performances of the observed dances. The results were processed by standard descriptive statistics procedures, correlative analysis and Mann Whitney U test. The obtained results indicate that there is a statistically significant correlation between Cha-cha dance results in relation to the tests for evaluation: agility (MAGPRP), flexibility (MFLPRU) and functional abilities of F600/800 in female pupils, and that they are statistically more successful, significantly so, in the performances of the observed dances than the male pupils.

**Keywords:** CROFIT NORMS, Vienna Waltz, Cha-cha, students of 8<sup>th</sup> grades of elementary

# **The difference in the quality of life and selected parameters of the body composition of physically active and inactive middle-aged women**

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**Gabriela Kavalířová, Věra Knappová, Ladislav Čepička, Lucie Marešová**

**University of West Bohemia, Pilsen, Czech Republic**

The issue of lack of physical activity is a very current and discussed topic across all age categories. Due to the development of a sedentary lifestyle and rise of modern technologies regular physical activity disappears from human life. Lack of exercise combined with excessive energy intake and increased stress leads to number of diseases of civilization, such as overweight or obesity, diabetes, heart disease and others. This is connected with reduction in the overall quality of life. The lack or complete absence of physical activity is a common problem in the middle age and leads to a negative change in body composition associated with a number of physical or health problems and mental discomfort. Thus, our research study is focused on physical and mental changes in middle-aged women. The aim of the study was to compare differences in body composition and quality of life of physically active and inactive middle-aged women. The study involved 38 women aged 35-55. The sample was divided into a group of physically active ( $n=21$ ) and inactive ( $n=17$ ) women according to a set criterion on the basis of a weekly record of physical activity. Women recorded minutes for each physical activity and number of steps every day. Body composition was diagnosed using the InBody370 bioimpedance device. Specifically, body fat percentage, skeletal muscle percentage, visceral fat and body mass index were evaluated. The quality of life assessment was performed on the basis of a standardized WHOQOL-BREF questionnaire. We assumed that 75 % of subjects from the group of physically active women will be within the recommended standard for body fat percentage (18–30 % of the total body weight). The results showed that 76.2 % of physically active probands were in the norm of an acceptable amount of body fat. We also assumed that 50 % of probands from the group of physically inactive women will be above the recommended standard for the percentage of body fat. The assumption was confirmed, 52.9 % of probands were above the upper limit (30 % of the total body weight). Overall more optimal values of the total body composition in all examined parameters were measured to group of physically active women. Last we assumed that the physically active women will demonstrate a higher perceived quality of life in all evaluated areas than physically inactive women. If we focused on the results of each proband separately, this tendency did not appear by 100 % of examined women. But if we compare the average values, the group of physically active women achieved better values in all areas of quality of life than the group of inactive women. In conclusion the amount of physical activity has a positive effect on the perception of overall quality of life and overall body composition.

**Keywords:** quality of life, body composition, middle-aged women, physical activity

# Nutrition periodization in recreational endurance athletes during training camp – case study

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Michal Kumstát, Tomáš Hlinský

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

Both training and dietary periodicities used by athletes greatly vary. Current sports nutrition guidelines promote dietary manipulation of energy-yielding nutrients specific to the period of training. The study explores the ad libitum nutrition practices of four healthy adult recreational athletes during a 2-week cycling training camp ( $\sim 100 \text{ km}\cdot\text{d}^{-1}$ ,  $\sim 240 \text{ min}\cdot\text{d}^{-1}$ ) with particular attention to the current sports nutrition recommendations. Based on evidence-based guidelines, peri-exercise carbohydrate (CHO) and protein (PRO) intake periodization cut-off levels were set for athletes. Training days were categorized as hard (HARD, two training units/day), middle (MID, one training unit/day), and easy (LOW, no training). Fourteen-day diet records were used and analyzed by nutritional software for energy intake (EI), carbohydrate (CHO), and protein (PRO) intake. Relative daily EI of  $78.6\pm 4.5$ ,  $73.3\pm 6.4$ ,  $75.4\pm 8.2 \text{ kcal}\cdot\text{kg}\cdot\text{d}^{-1}$  and CHO  $8.9\pm 0.8$ ,  $7.8\pm 1.0$ ,  $8.2\pm 1.5 \text{ g}\cdot\text{kg}^{-1}$  intakes were not different in HARD, MID and LOW days, respectively. The mean daily EI was  $1.3\times$  higher than the predicted total daily energy expenditure, irrespective of the training day category, resulting in  $\sim 500 \text{ kcal}\cdot\text{d}^{-1}$  energy surplus. In the 2h post-exercise period, PRO intake exceeded the current recommendations 4.6 fold, and CHO intake was significantly lower after a second training session on HARD days ( $0.7 \text{ g}\cdot\text{kg}\cdot\text{h}^{-1}$ ) than a recommendation ( $1.2 \text{ g}\cdot\text{kg}\cdot\text{h}^{-1}$ ). Mean in-exercise CHO intake ( $\sim 11.5 \text{ g}\cdot\text{h}^{-1}$ ) was significantly under the moderate  $30 \text{ g}\cdot\text{h}^{-1}$  recommendation. In conclusion, the dietary behaviours of recreational athletes are not consistent with current sports nutrition periodization guidelines. Energy intake throughout the training camp led to positive energy balance being highest on non-training days. Daily or during, and post-exercise CHO and PRO intakes were not adjusted to the number of training sessions, intensity or duration.

**Keywords:** Nutrient timing; energy intake; carbohydrates

# Health literacy, physical literacy, and body composition; gender-specific associations among Croatian adolescents

Marijana Geets Kesic <sup>1\*</sup>, Barbara Gilic <sup>1,2</sup>, Mia Peric <sup>1</sup>

<sup>1</sup> Faculty of Kinesiology, University of Split, Split, Croatia

<sup>2</sup> Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia

\* Correspondence: markes@kifst.hr

**Purpose:** Health literacy (HL) and physical literacy (PL) are important abilities related to overall health and well-being. However, interrelationships between HL and PL are rarely reported, while to the best of our knowledge, there is an evident lack of knowledge on associations that may exist between HL and PL, and body composition as another important determinant of health status in adolescence. The aim of this research was to explore gender-specific associations among PL, HL, and body composition in Croatian adolescents.

**Methods:** Participants were 253 adolescents from Split-Dalmatia county ( $16.9 \pm 1.4$  years of age, 181 girls). The HL was evidenced by European-Health-Literacy-Survey-Questionnaire (HLSEU), the PL was evaluated by PLAYSelf questionnaire, while body built was measured by Tanita BC 418 scale. Descriptive statistics included means and standard deviations, t-test was used to compare genders in PL and HL, while the gender-specific associations between variables were identified by Spearman's correlation.

**Results:** Boys and girls did not differ neither in PL (t-test = 0.01,  $p = 0.99$ ) nor in HL (t-test = 0.21,  $p = 0.83$ ). For boys, HL, PL and body composition were not significantly intercorrelated with negligible correlations (ranging from 0.05 to 0.14, all  $p > 0.05$ ). Meanwhile in girls PL and HL were positively intercorrelated ( $r = 0.31$ ,  $p < 0.01$ ).

**Conclusion:** The lack of differences in PL and HL between genders actually confirmed the validity of the applied questionnaires in the sample of Croatian adolescents. However, the lack of associations between body composition indices with PL and HL highlighted the poor applicability of the used questionnaires in the prediction of anthropometric/body built status in studied adolescents. Finally, low associations between HL and PL highlight the necessity of independent evaluation of these important abilities in the period of adolescence.

**Keywords:** health literacy, physical literacy, correlations, differences, adolescence

# Dance against dementia (DiADEM): effects of a sportive dance training on cardiorespiratory fitness (and cognition) in seniors with mild cognitive impairment (MCI)

Marvin Stiebler<sup>1,2</sup>, <sup>6</sup>Patrick Müller<sup>1,2</sup>, Ulrich Thiel<sup>6</sup>, Corinna Langhans<sup>6</sup>, Berit Labott<sup>3</sup>, Nicole Halfpaap<sup>6</sup>, Stefanie Schreiber<sup>1,3,4</sup>, Notger Müller<sup>6</sup>, Rüdiger Braun-Dullaes<sup>2</sup>, Anita Hökelmann<sup>6</sup>

<sup>1</sup> Deutsches Zentrum für Neurodegenerative Erkrankungen (DZNE), Magdeburg

<sup>2</sup> Klinik für Kardiologie und Angiologie, Otto-von-Guericke Universität Magdeburg

<sup>3</sup> Klinik für Neurologie, Otto-von-Guericke Universität Magdeburg

<sup>4</sup> Center for Behavioral Brain Sciences (CBBS), Otto-von-Guericke Universität Magdeburg

<sup>5</sup> Degenerative und chronische Erkrankungen, Universität Potsdam

<sup>6</sup> Bereich Sportwissenschaft, Otto-von-Guericke Universität Magdeburg

**Introduction:** Current research indicates that lifestyle factors, especially physical activity, could play a key role in healthy ageing and prevention of neurodegenerative diseases. Dance training in healthy older adults has been shown to be superior to repetitive physical exercise in inducing brain plasticity as it poses demands on both physical and cognitive functions. However, studies on the effects of motor-cognitive training in older adults with MCI are still lacking. **Methods:** A total of 51 older adults with MCI were recruited and randomly assigned to either inactive control (N=20; age = 67 ± 6.6; female = 10) or intervention group (N=25; age = 70 ± 5.5; female = 16). The dance intervention consisted of a six-month long program with two dance interventions per week lasting up to 90 minutes and increasingly difficult choreographies. An extensive pre/post-assessment was performed at baseline and post-intervention including cognition, MRI, blood analysis, and spiroergometry. Here we focus on our preliminary results for cardiopulmonary exercise testing (CPET). Spiroergometry was done pre- and post-intervention on a cycle ergometer with gas exchange analysis (ramp protocol, beginning 25 W, increase 25 W all 3 minutes) in accordance with current safety recommendations. Furthermore, lactate levels and rate of perceived exertion (BORG-Scale) were assessed. **Results:** Average training load (% of maximal heart rate (HR<sub>max</sub> = 220 – age) during dance training was 65% of maximum heart rate. Pre/post analysis of spiroergometry demonstrated a (statistically not significant) increase of cardiorespiratory fitness (VO<sub>2</sub>max) in the dance group (pre= 25.2±6.3; post= 25.7±7.1; p=.708) while the inactive control group showed a statistically significant decrease (pre= 27.3±7.4; post= 25.0±6.8; p=.007). Analysis of other parameters (e.g. heart rate, lactate levels, perceived exertion using BORG-Scale) revealed no significant changes. **Discussion:** Our results demonstrate that sportive dancing training can improve and/or stabilize cardiorespiratory fitness in older patients with MCI. Because cardiorespiratory fitness is a predictor of quality of life, these results could impact autonomy and independence of patients with MCI.

**Keywords:** Spiroergometry, MCI, Dementia, Sports medicine

# Attitudes toward doping in high level team-sport coaches; Gender specific correlates of doping intentions

Natasa Zenic <sup>1\*</sup>, Jelena Rodek <sup>1</sup>, Enver Tahiraj <sup>3</sup>

<sup>1</sup> Faculty of Kinesiology, University of Split, Split, Croatia

<sup>2</sup> University for Business and Technology, Prishtina, Kosovo

\* *Correspondence:* natasazenic@gmail.com

**Purpose:** Doping behavior is one of the most important problems in sport, while coaches' attitudes toward doping (doping attitudes – DA) are known as one of the most influential factors on doping behavior of the athletes. However, studies rarely examined coaches' DA. This study examined DA in high-level coaches involved in team sports, and correlates of DA, considering gender-specifics. **Methods:** Study involved 113 coaches (15 females) from Kosovo, involved in four Olympic team sports (volleyball, basketball, soccer, handball) who were examined by previously validated questionnaires on DA (dependent variable), sociodemographic variables, sport factors, doping-related factors (i.e. opinions about doping presence in sport, opinion about doping penalties), and doping knowledge (all independent variables). Statistics included descriptive statistics, differences between genders, and analyses of associations between independent and dependent variables. **Results:** Coaches engaged in handball and volleyball are less confident in doping behavior in their sports, than their peers who work in soccer and basketball (Kruskal Wallis ANOVA (KW) = 10.44,  $p = 0.02$ ). Similarly, basketball- and soccer-coaches lean to less rigid penalties for doping offenders (KW = 11.01,  $p < 0.01$ ). Volleyball- and basketball-coaches have substantially better knowledge on doping than handball- and soccer-coaches (F-test = 5.80,  $p < 0.001$ ). No significant differences between genders were evidenced in any of the studied variables. Longer coaching experience was correlated with more rigid penalties for doping offenders (Pearson's correlation = 0.51,  $p < 0.05$ ). Logistic regression evidenced association between opinion about doping presence in sport and positive DA, with higher likelihood for positive doping intention in those coaches who perceive their sport as being doping contaminated (Odds Ratio: 6.63, 95%CI: 2.21-19.95). **Conclusion:** Results evidenced that sport coaches involved in team sports should be observed as homogenous sample with regard to doping factors, irrespective of gender. However, since coaches with longer coaching experience had evidently more negative opinions about doping practice of the athletes, special attention with regard to doping should be placed on younger and less experienced coaches. The results should be incorporated into specific and targeted anti-doping campaign in competitive team sports. Further studies in other types of sports (i.e. martial arts, aesthetic sports) are warranted.

**Keywords:** doping behavior, factors of influence, gender specifics, associations, differences



# The effect of parkour concept on functional mobility in older adults

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Lenka Svobodová, Antonín Tomáš, Martin Sebera

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Introduction:** One of the limiting factors in the quality of life of seniors is the increased risk of falls. According to the The National Institute of Public Health (NIPH), falls naturally occur most often in everyday activities. Many types of physical activity have already been tested in connection with fall prevention. We come up with a new type of exercise - modified parkour for older adults.

**Objective:** The aim of the study was to determine the effect of the Parkour concept on functional mobility in older adults.

**Patients and Methods:** Twenty older adults without cognitive or neurological deficits (> 26 points in MoCa Test) completed a ten-week exercise program. The program included practice of overcoming obstacles of various shapes and sizes and practice of fall techniques under the guidance of an instructor.

The level of functional mobility was assessed using the TUG test and the modified TUG before and after completing the exercise program.

**Results:** The effect of parkour concept is not statistically significant on functional mobility. The difference is small by Cohen's effect size ( $d = 0.22$  and  $d = 0.26$ ). There was a slight improvement in the functional mobility test without another task (TUG1) and in the modified test with another movement task (TUG3). There was no significant change in the modified test with cognitive test (TUG2).

**Conclusion:** Modified parkour is a new activity that requires research that is more scientific. For this age group, we consider a positive improvement of any partial part of physical fitness.

**Keywords:** older adults, parkour, mobility, age, obstacles,

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# **S P O R T S   M E D I C I N E**

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# Impact of cancer and 12 weeks of chemotherapy on the balance of the autonomic nervous system in cancer patients

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Pavĺina Bazalov, Kateřina Kapounkov

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

Cancer and its treatment itself (especially chemotherapy) is associated with number of negative effects on the human body. These include mainly cardiac toxicity, peripheral neuropathy, bone loss, depression, anxiety, nausea, pain, cognitive changes, fatigue, fitness reduction and more. Fatigue is one of the most common negative effects, often persists long after treatment and is described as insurmountable and is associated with lower parasympathetic activity. The autonomic nervous system (ANS) is the main homeostatic regulatory system of the body, it regulates involuntary physiological processes. We believe that this part of the peripheral nervous system can be negatively affected by cancer and chemotherapy, which can have a negative impact on all the processes that control this system. Most drugs used in oncology lead to chemotherapy-induced peripheral neuropathy and are expected to have an influence on the autonomic nervous system. Activity and balance of the autonomic nervous system depend on a range of dynamically changing and quantitatively different conditions such as age, stress, physical activity, sleep, illness, fatigue and more. Methods: To evaluate ANS activity, spectral analysis of heart rate variability (HRV) was assessed. During treatment, 19 oncological patients with prescribed adjuvant chemotherapy measured HRV 3 times a week using a chest strap with a HRV monitor mySASY and mySASY software. Parasympathetic activity (PA), sympathetic activity (S), total score (TS) and total power (TP) were selected as indicators of ANS activity. The patients were women aged  $50.38 \pm 10.29$  with BMI  $25.72 \pm 4.16$ . The mean values for the first 14 days of treatment and then for 14 days after 12 weeks of treatment were compared. Data normality was verified by Kolmogorov-Smirnov test (K-S) and static significance was calculated by t-test. All statistical tests were performed at a significance level of 5%. Results: There was a significant decrease in values for three parameters. The PA decreased from  $3.80 \pm 1.56$  to  $3.14 \pm 1.67$  ( $p = .03$ ), TP decreased from  $3.65 \pm 1.87$  to  $2.82 \pm 2.08$  ( $p = .04$ ), TS decreased from  $3.40 \pm 1.67$  to  $2.67 \pm 1.73$  ( $p = .01$ ). Sympathetic activity was somewhat but not significantly higher, increased from  $6.74 \pm 1.22$  to  $6.80 \pm 1.44$  ( $p = .83$ ). Conclusion: During the 12 weeks of treatment with adjuvant chemotherapy, there was a significant reduction in parasympathetic activity, total score, and total power. A decrease in PA is usually associated with lower regenerative abilities of the organism, a decrease in TP is associated with a decrease in the activity of the entire ANS. TS evaluates the total power and balance of both ANS branches. The higher the values, the more the body is regenerated and ready for further stress and response to stress.

**Key words:** heart rate variability, oncology, neoplasm, tumors

# Lateral differences in handgrip strength in Czech U14 male tennis players in the context of injury prevention

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Tomáš Válek<sup>1</sup>, Adrián Agricola<sup>2</sup>, Tomáš Vespalec<sup>1</sup>, Jiří Zháněl<sup>1</sup>

<sup>1</sup>Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

<sup>2</sup>Faculty of Education, University of Hradec Králové, Hradec Králové, Czech Republic

The term laterality refers to the preference or dominance of the lateral asymmetry of the human body. The prevalence of left-handedness is reported to be 10–13%, but in some sports (e.g. boxing, ice hockey, tennis), the proportion of left-handers is higher. The left-handedness is considered an advantage in tennis; however, the one-sided load can cause muscular dysbalances leading to injuries. The research aim was to assess bilateral differences in handgrip strength in top Czech U14 male tennis players as to injury prevention. The participants were tennis players ( $n = 232$ ) aged 13.0–14.9 taking part in the regular testing by the Czech Tennis Association using the TENDIAG1 test battery between 2000 and 2019. 87.5% of all players were right-handed (RH) and 12.5% left-handed (LH). The Effect Size Index  $d$  was used, which can be interpreted as a small ( $d = .20$ ), medium ( $d = .50$ ) or large effect ( $d = .80$ ). Bilateral differences between the right- and left-hand strength of all players were medium significant ( $d = .52$ ) in favor of the right hand, probably because of more RH players ( $n = 203$ ) than LH players ( $n = 29$ ). The assessment of differences between the right hand of RH and the left hand of LH players showed lower than small differences ( $d = .13$ ) in favor of RH players. There was a medium significant ( $d = .62$ ) difference among all players in favor of the dominant hand (DH) over the non-dominant one (NDH). Regarding injury prevention, a difference between DH and NDH force of  $>15\%$  was found in 5.6% of players ( $n = 13$ ), which means a high risk in terms of potential injury and  $>20\%$  (very high risk) in 1.3% of players ( $n = 3$ ) according to the Bilateral Asymmetry Index 1 (BAI-1). This predicts an increased risk of injury, so it is desirable to pay attention to both sides of the training load and to include compensatory or strengthening exercises.

**Keywords:** bilateral asymmetry, dynamometer, handedness, isometric strength, laterality

# Efficient Deep Neural Networks for Classification of Mild Cognitive Impairment from Scalp EEG Recordings

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Abdelaziz Triki, Anita Hökelmann

Department of Sport Science, Otto-von-Guericke University Magdeburg

*anita.hoekelmann@ovgu.de, abdelaziz.triki@ovgu.de*

**Introduction:** Aging, a highly complex biological process, is inexorably associated with a more severe age-related health decline and frailty. This affects several aspects of cognitive and motor functioning and increases the number of inactive people with a high risk of neuro-degenerative disorders. Dementia is a common and feared geriatric condition that includes both a random loss of brain function and a number of different syndromes with different emotional, cognitive, and behavioral changes that lead to a long-lasting loss of the ability to think and remember. This may have a substantial influence on a person's day-to-day functioning and, in turn, their quality of life in general. Mild cognitive impairment (MCI) is a neurological impairment that is often thought to represent a transitional stage between aging and dementia. For several years, electroencephalogram (EEG) signals were presented as one of the most important sources of information by recording the electrical activity of the brain. Furthermore, the EEG provides a reliable and low-cost method to explore different patterns between amnesic mild cognitive impairment (aMCI) and non-aMCI (naMCI). An accurate classification of subjects into healthy, aMCI, and naMCI in its early stages plays a vital role in intercepting the progression of memory disorders and contributing to ameliorating the quality of life of elderly patients with MCI disorders. **Methods:** To facilitate standardization, the EEG data is collected with a high-density stationary EEG system (Nihon Kohden Neurofax EEG-1200) using 32 active electrodes and a sampling rate of 1000 Hz. The data is preprocessed prior to model fit, including an IIR filter that manages an impulsive signal within the time and frequency domains. In addition, we employed an independent component analysis (ICA) for artifact detection and removal. To extract discriminative features and perform classification accurately, five convolutional neural networks (CNN) and one maxpooling layer were employed, respectively. Furthermore, we used seven batch-normalization and one fully connected layer as well as a rectified linear unit (ReLU), which is used as an activation function. **Results:** Deep neural networks, including convolutional neural

networks, are able to provide significant information that may be used in the diagnostic process of MCI. The main objective of this method is to classify subjects into three groups: healthy, aMCI, and naMCI. The proposed method can lead to several benefits for potential MCI individuals and can also lead to an early diagnosis of Alzheimer. The experimental results on the collected database showed that the suggested approach for subject classification offered high accuracy for the healthy, aMCI, and naMCI groups. The proposed method achieved a classification accuracy of 96% and 95.3% for aMCI and naMCI, respectively.

**Keywords:** Mild cognitive impairment; classification; EEG signals; convolutional neural networks

# Musculoskeletal injury risk based on static balance and movement quality in physically active women

Dawid Koźlenia\*, Jarosław Domaradzki

Unit of Biostructure, Faculty of Physical Education and Sport, Wrocław University of Health and Sport Sciences, Wrocław, Poland

\* Correspondence: [dawid.kozlenia@awf.wroc.pl](mailto:dawid.kozlenia@awf.wroc.pl)

Static balance is a valuable indicator of the musculoskeletal and nervous system state and stands a basis for developing movement stabilization. The disorders in this area may increase musculoskeletal injury risk (IR). Therefore, this study aimed to investigate the musculoskeletal injury risk due to static balance and movement quality in physically active women. Specifically, we aimed to establish 1) which parameters values are different in injured and uninjured subjects; 2) which measured static balance parameters and movement patterns scores predict injury; 3) and the possibility of creating a two-factor prediction model in injury risk based on static balance and movement patterns quality. The study sample was 88 physically active women aged  $21.48 \pm 1.56$ ; body height  $1.68 \pm 0.06$ cm; body weight  $60.5 \pm 9.00$ kg; BMI  $21.48 \pm 2.52$ kg/m<sup>2</sup>; physical activity level  $4535.36 \pm 2897.91$  MET. Injured were 40.90% women. The injury data were obtained with the Injury History Questionnaire. The questions considered musculoskeletal injuries associated with physical activity from the last 12 months. The International Physical Activity Questionnaire was used to determine the physical activity level. Static balance was measured using the balance platform (ACCU SWAY, Newton, MA, USA). The measured parameters were the center of pressure area circle (AC) and path length (PL) with open (OE) and closed eyes (CE). Two lasting 30s attempts were made for every test, separated by a 60s break. The better results were included in the analysis. The module tests of Functional Movement Screen: Deep Squat (DS), In-line lunge (IL), and Hurdle Step (HS) tests were conducted to assess stability during body movement required standing position. It was made 3 trails for every movement test and body side in case of unilateral tests (HS & IL). The best result was considered in the case of OHS and the worse from body sides in HS and IL. The adopted scale was: 0-pain reported during the movement; 1-lack ability to move; 2-movement with compensation; 3-proper movement ability. The T-test comparison reveals a statistically significant worse ability to maintain static balance in injured females when AC-CE was measured ( $t=-3.18$ ;  $p<0.01$ ). The U Mann-Whitney test also showed lower scores of IL in injured subjects ( $z=2.86$ ;  $p<0.01$ ).

The logistic regression models were built to assess IR. It was revealed that alone, AC-CE predicts injury occurrence (OR=0.70;  $p=0.03$ ) and IL (OR=0.49;  $p=0.03$ ). The two-factor model, including AC-CE and IL, also predicts injury occurrence (OR=1.40;  $p<0.01$ ). The better static balance expressed in AC-CE and higher movement pattern quality in the IL are associated with lower musculoskeletal injury risk. Using both quantitative (balance platform tests) and qualitative (movement patterns screening) measurements could be helpful in IR prediction. In a further study, there is a need to verify the efficiency of indicated factors in the prospective terms.

**Keywords:** static balance; stability; injury risk; movement; women; physical activity



# A Cross-sectional Study: Correlation of Static Joint Angles and Balance Performance in Elderly with Mild Cognitive Impairment

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Niharika Bandaru, Anita Hökelmann

Otto-Von-Guericke Universität of Magdeburg, Sport Science Department

**Introduction:** Evidence shows balance impairment in the elderly with Mild Cognitive Impairment (MCI). Nevertheless, no studies have proved the effect of MCI on Static Joint Angles (SJA). However, the current research aimed to find the relationship between the changes in static joint angles and Balance Performance (BP); to detect compensatory movements that enhance balance performance in MCI.

**Methods:** The present research is a lab-based, cross-sectional study among the participants (n=24) aged 60–79 (67.5 mean age  $\pm$  4.8 years) with MCI. The participant's body posture and Trendelenburg test in three anatomical views (Anterior, Posterior and Lateral) are recorded and examined. In addition, direction control, movement velocity, endpoint excursion, maximum excursion, and reaction time on limits of stability test are measured, and sensory organisation test conditions are tested using Balance Master. SJA is calculated using the Kinovea software tool in two views, mediolateral and anteroposterior. Correlational statistical analysis is performed between SJA and BP.

**Results:** There are 14 correlations between balance performance on limits of stability test and SJA. For the sensory organisation test, SJA correlated to 2nd and 6th conditions. Additionally, Trendelenburg angle positively correlates to vestibular ratio, and pelvic tilt relates to somatosensory ratio.

**Discussion:** Results of the current study indicate that BP on one side is higher than on the other with a change in SJAangles in the mediolateral view in MCI. Furthermore, results suggest that the balance performance in the forward direction exceeds the backward direction in the elderly, with MCI representing motor control abnormalities on the posterior side of the body. However, the compensatory movements help in the decreased balance performance of the elderly with MCI.

**Keywords:** Static Joint Angle, Mild Cognitive Impairment, Balance Master, Compensatory Movements, and Kinovea Software

# Injury prevalence in amateur lacrosse players; gender difference

Sebastian Vračar<sup>1,2</sup>, Dora Marić<sup>1,3</sup>, Vladimir Pavlinović<sup>1</sup>, Mia Perić<sup>1</sup>, Nikola Foretić<sup>1</sup>, Ante Burger<sup>4</sup>

<sup>1</sup> Faculty of Kinesiology, University of Split, Croatia

<sup>2</sup> Lacrosse club Legion, Split, Croatia

<sup>3</sup> Sport and Exercise Research Unit, Department of Psychological, Pedagogical and Education Sciences, University of Palermo, Italy

<sup>4</sup> University Department of Health Studies, University of Split, Croatia

**Purpose:** The lacrosse game for both males and females is a combination of unique physical challenges such as the use of sticks, high ball velocity, change of direction, and fast pace, which can result in acute and overuse injuries. However, even though both females' and males' lacrosse matches include high-speed movements and changes of direction, there are several procedural differences between them, including the greater amount of stick-to-player and player-to-player contact allowed in male players. Accordingly, this study aimed to identify gender differences in the prevalence of sports-related injuries during training and competition in lacrosse players.

**Methods:** The study included 145 (51 females,  $26.2 \pm 6.2$  years) amateur lacrosse players practicing lacrosse for  $8.9 \pm 5.7$  years on average from multiple countries. Variables were collected by previously validated questionnaires. Statistical procedures included the calculation of means and standard deviations for age and experience in lacrosse, while frequency (F) and percentages (%) were calculated for the remaining variables. The differences between injury prevalence in groups (sex) were calculated by the Chi-square test.

**Results:** According to calculated frequencies and percentages most common injuries in males that happened during training were knee-related injuries (27.5%), followed by ankle injuries (12.1%) and wrist injuries (7.7%), while in females most common injuries were ankle injuries (27.8%), followed by knee injuries (13%). The incidence of injuries during the competition is somewhat lower. In both male and female lacrosse players, the most common injuries are related to the lower back (9.9% males, 16.7% females). Gender differences were detected only between prevalence in the knee ( $p=0.04$ ) and ankle ( $p=0.02$ ) related injuries during training, while no differences were detected when examining differences in injuries prevalence in competition.

**Conclusion:** This study found some similarities in the injury prevalence among male and female lacrosse athletes, with a higher prevalence of knee injuries in males and a higher prevalence of ankle injuries in female athletes. A higher rate of injuries happening during training was found both in males and females, suggesting a need for more extensive research into training modalities/protocols to optimize the training and reduce injury risk.

# The cardiorespiratory parameter in ice hockey players diagnosed with COVID-19 after the 2020 competitive season: a case study

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Vojtěch Grün, Ana Carolina Paludo

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Introduction:** In sports settings, after the lockdown caused by the SARS-CoV-2 virus (COVID-19), a special attention was given during the return-to-play with those athletes that were infected by the virus due to a possible impact on cardiorespiratory system, which cooperate to produce an exercise effort. The effect of the virus in players' cardiorespiratory performance still has been explored by the literature.

**Aim:** The study described the cardiorespiratory performance in ice hockey players diagnosed with COVID-19 and compared with those without the positive diagnosis, after the 2020 competition season.

**Methods:** It was a retrospective data from eleven professional ice hockey players ( $27 \pm 5.16$  years; body mass  $88.2 \pm 9.03$ ; height  $183 \pm 7.46$  cm) belonging to the same team from Brno city. After the competitive season, the players performed a maximum cardiopulmonary exercise test protocol designed as an incremental ramp test on a bicycle ergometer (Lode Excalibur). During the test, oxygen consumption was analyzed using the Cortex METALYZER® 3B device (Germany) and data was processed using MetaSoft®Studio software. Maximal consumption of oxygen ( $\text{VO}_{2\text{max}}$ ), maximal heart rate ( $\text{HR}_{\text{max}}$ ), respiratory exchange ratio (RER) and ventilation per minute (VE) were compared between players with and without diagnosis of COVID-19 infection. Non-paired t test was used, with significance set at  $p < 0.05$ .

**Results:** Before the competition season in 2020 (September), all players reported not be infected by the virus. After the competition and before start the 2021 season, 4 players described not be infected and 7 players were positively diagnosed. No significant difference was found between the  $\text{VO}_{2\text{max}}$  outcome between players (Non-COVID-19:  $44.2 \pm 3.98$  mL/kg/min versus COVID-19 diagnosed:  $45.4 \pm 3.73$  mL/kg/min), HR (Non-COVID-19:  $186 \pm 2.16$  bpm versus COVID-19 diagnosed:  $191 \pm 8.22$  bpm), RER (Non-COVID-19:  $1.26 \pm 0.01$  versus COVID-19 diagnosed:  $1.26 \pm 0.05$ ) and VE (Non-COVID-19:  $178 \pm 14.2$  versus COVID-19 diagnosed:  $164 \pm 28.7$ )

**Conclusion:** During the competitive season in 2020, the ice hockey team increased the number of players diagnosed with COVID-19. Despite the infection from the virus during the competition, no negative effect was observed in cardiorespiratory parameters, demonstrating players that had the virus can perform similarly to those who was not diagnosed with it. However, a monitoring on cardiorespiratory parameters in those players is recommended, due to the uncertainty consequence of the virus from long-term.

# Menstrual cycle and reproductive health in the training process of Croatian athletes according to sports groups

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<sup>1,2</sup> Snježana Schuster,<sup>2</sup> Lana Palijan<sup>2</sup>, Tatjana Trošt Bobić

<sup>1</sup> Department of Physiotherapy, University of Applied Health Sciences, Zagreb, Croatia

<sup>2</sup> Faculty of Kinesiology, University of Zagreb, Croatia

*Correspondence author: snjezana.schuster@zvu.hr*

Monitoring the menstrual cycle in athletes of younger age categories affects sports results and reproductive health. The aim of this study was to determine the differences in the frequency and duration of training, regularity and changes in the menstrual cycle in female athletes ( $n = 143$ ) from Croatian sports clubs. Athletes are divided into three different groups of sports: sports games, martial arts and aesthetic sports. The results were processed in IBM SPSS, v.26. Comparisons by sports categories were made by Chi-squared test for categorical variables and Kruskal - Wallis analysis of variance for quantitative variables. For significant differences obtained by Kruskal - Wallis analysis, Dunn-Bonferroni post hoc test was performed to determine which groups there is a difference. Logistic regression analysis was performed to predict the regularity of the menstrual cycle by age, length and duration of training in this category of sport. The obtained results show that the frequency of training is the same in all three groups of sports, while martial arts have slightly shorter trainings from the group of sports ( $p = 0.003$ ) and from training of aesthetic sports ( $p = 0.000$ ). Aesthetic sports have longer training sessions than sports games ( $p = 0.000$ ). The groups of sports do not differ from each other with regard to the regular cycle ( $p = 0.088$ ), although it is suggested that the share of athletes with irregular cycles is slightly higher in martial arts, but this difference is not statistically significant at 5%. Regarding the existence of changes in the cycle, there is no difference between the group of sports ( $p = 0.935$ ) or the difference in duration ( $p = 0.883$ ) and the ability to bleed ( $p = 0.700$ ). Logistic regression showed that there are no significant predictors for predicting the regularity of the cycle by age, sports group, and the frequency and duration of training that would predict the regularity of the menstrual cycle.

**Keywords:** menstrual cycle, sports, women

# Heightened tone and stiffness with concurrent lowered elasticity of peroneus longus and tibialis anterior muscles in athletes with chronic ankle instability as measured by myotonometry

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Wojciech Stefaniak<sup>1\*</sup>, Jarosław Marusiak<sup>2</sup>, Dawid Bączkowicz<sup>1</sup>

<sup>1</sup> Faculty of Physical Education and Physiotherapy, Opole University of Technology, Opole, Poland;

<sup>2</sup> Department of Kinesiology, Faculty of Physiotherapy, Wrocław University of Health and Sport Science, Wrocław, Poland;

*\* Corresponding author at: Faculty of Physical Education and Physiotherapy, Opole University of Technology, ul. Prószkowska 76, 45-758 Opole, Poland; telephone: +48 77 449 8279; fax number: +48 77 449 8279; e-mail address: w.stefaniak@po.edu.pl*

In a recent study, myotonometry revealed adverse alterations in the mechanical properties of ankle periarticular muscles in soldiers reporting previous lateral ankle sprain (LAS) incidents. This knowledge, if confirmed in athletes with developed chronic ankle instability (CAI), may have important diagnostic and therapeutic implications in sports medicine and rehabilitation. Consequently, the purpose of the study was to explore mechanical properties of the peroneus longus (PL), tibialis anterior (TA), and the lateral and medial gastrocnemius (LG and MG, respectively) muscles in athletes suffering CAI. Fourteen adult male athletes with developed CAI (International Ankle Consortium selection criteria) and 15 healthy male athletes without any LAS incidence as the control group (CO) participated in the study. The CAI and CO groups were characterized by similar anthropometric parameters and weekly training volume. In both the groups of athletes, we performed resting state (controlled with electromyographic recordings) myotonometric measurements (using a MyotonPRO® device) in the PL, TA, LG and MG muscles and calculated the following five myotonometric parameters: frequency (F-MYO), stiffness (S-MYO), decrement (D-MYO), relaxation time (R-MYO) and creep (C-MYO). Athletes from the CAI group (compared to the CO group) exhibited significantly higher values of F-MYO and S-MYO as well as lower values of R-MYO and C-MYO in the PL and TA muscles. No significant inter-group differences were found in the remaining myotonometric parameters. Using myotonometry, our study is the first to reveal that athletes with developed CAI are characterized by heightened tone and stiffness with concurrent lowered elasticity of the PL and TA muscles.

**Keywords:** chronic ankle instability, lateral ankle sprain, athletes, myotonometry, muscle mechanical properties

# First Aid Teaching and First Aid Instructions for Teachers

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**Martina Hrušková<sup>1</sup>, Marek Slabý<sup>2</sup>, Radim Viochna<sup>2</sup>, Alena Čermáková<sup>1</sup>, Ladislava Ondříčková<sup>1</sup>,  
Kristýna Shonová<sup>1</sup>**

<sup>1</sup> Faculty of Education, University of South Bohemia, České Budějovice, Czech Republic

<sup>2</sup> Medical Rescue Service, Czech Republic

The contribution deals with basic first aid and the importance of its inclusion in education of teachers of pre-primary, primary, lower and higher secondary schools (N=382), in connection with statistical data of Medical Rescue Service in the same region of the Czech Republic (6 % of the CR population). Through the most common first aid instruction scenarios and a questionnaire survey were found non-significant differences in the impact of teaching experience, but significant differences in the level of knowledge of traumatic and non-traumatic acute conditions ( $p \leq 0.05$  in the favour of the traumatic acute conditions, except nosebleeds). But overall, the level of knowledge was insufficient (means between 63 and 76 % in basic first aid questionnaire). It is advisable to train first aid using both traumatic and non-traumatic acute conditions once every two years using simulations. The first aid training should be completed by all those who come into contact with pupils, i.e. teachers and non-teachers, and not just for signing on the list of first aid course participants, but practically. Towards the end of the contribution, is presented further recommendations concerning first aid teaching and first aid instructions for teachers.

# Pilot study: Effect of Developmental Dysplasia of the Hip on the gait and feet posture

Veronika Vasilcová <sup>1,2 \*</sup>, Moqfa AlHarthi <sup>2</sup>, Nadrah AlAmri <sup>2</sup>, Ayman H. Jawadi <sup>3</sup> and Martin Zvonář <sup>4</sup>

<sup>1</sup> Department of Kinantropology, Faculty of Sport Science, Masaryk University, Brno,

<sup>2</sup> Pediatric Rehabilitation Department, King Abdullah Specialized Children Hospital, moqfa2012@gmail.com (M.A.), Nadrah.alamri@gmail.com (N.A)

<sup>3</sup> Department of Surgery, College of Medicine, King Saud bin Abdul-Aziz University for Health Sciences, dr.aymanjawadi@gmail.com

<sup>4</sup> Division of Sport Motoric and Methodology in Kinantropology, Department of Kinesiology, zvonar@fsps.muni.cz

\* Correspondence: veronika.vasilcova@gmail.com; Tel.: +421 908 688 180, +966 55 743 9506.

**Background:** The objective of this pilot study was to assess the effect of Developmental Dysplasia of the Hip (DDH) on gait, in pediatric participants, between the age of one to four years. Few studies are investigating the effect of DDH on the walking pattern within the pediatric rehabilitation practice. **Methods:** The retrospective review of gait analysis, performed on 410 lower limbs, took place in King Abdullah Specialized Children Hospital (KASCH) in Riyadh, Kingdom of Saudi Arabia, from April 2020 until September 2020. All participants were diagnosed with DDH by pediatric orthopedics physicians in KASCH. Gait analysis was done by a physical therapist twice within three months, using The Wee Glasgow Gait Index and foot assessment was done once using Foot Postural Index. **Results:** From all gait analyses (n=410). We included only 292 (71%) lower limbs with DDH and had to exclude 60 (19%) after hip surgery, 30 (7%) with another diagnosis, 18 (4%) without conservative treatment of DDH and 10 (2%) with age above 48 months. According to the scoring of the Wee Glasgow Gait Index within the optimum/normal limits (score 0- zero), we had 50 (17%), mild deviation (score 1-11) had 236 (81%), and gross deviation (score 12-22) had 6 (2%) limbs within first gait analysis. With second gait analysis, 40% of lower limbs were with optimum/normal limits, 60% with mild deviation in gait, and zero within gross deviation. Every limb assess for gait had the Foot Postural Index as well. Within normal limits (0 till +5) we had 143 (49%) feet, pronation (+6 till +9) was presented in 97 (33%) and high pronation (more then +10) had 52 (18%) pediatric feet. Supination (-1 till -4) or high supination (+5 till -12) was not presented in this sample. **Conclusion:** Pathological gait pattern with DDH was detected in 83% within the first gait analysis, 60% within the second gait analysis, and Foot Postural Index revealed pronation of 51% feet. Among Saudi participants, a relatively high effect of DDH on gait patterns is reported in this pilot study.

Keywords: DDH, gait, FPI-6, physiotherapy, WeeGGI.

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# POSTER SECTION

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# The Test of Sensory Functions in Infants (TSFI) for screening purpose in full term infants

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Andrea Krajačić, Mihaela Grubišić, Lea B.Krišto

Faculty of Kinesiology, University of Zagreb, Croatia

**Purpose:** The purpose of this study was to determine the sensory integration function with the Test of Sensory Functions in Infants (TSFI) of full term infants, between the ages of 4 to 18 months. Some of the infants show problems through feeding difficulties, are crying, or have been assessed due to the recommendations of a specialist. The aim was to confirm the hypothesis that the TSFI test is useful as a screening tool for isolating children with difficulties in sensory processing in which there are no additional indications for such difficulties (premature babies, early neonatal complications, syndromes, etc.).

**Methods:** The test was performed on 10 infants in which there was no direct indication of difficulty in sensory processing. The results were recorded and analyzed.

**Results:** The sensory profile of the participants was established with the TSFI test. According to the authors of TSFI, it can be used to assess infants with difficult temperament or developmental delays and it is also an excellent way to evaluate high-risk premature babies. Our results show that this test is a good screening tool for children who are born at term, and who show problems (feeding difficulties, crying children ...) but also do not directly point to the difficulties of sensory processing.

**Conclusion:** We conclude that this test is a good tool to help assess the sensory processing of infants, but we believe that in addition to conducting the test, the sensory processing of the child must be further assessed. This tool is not the only one in assessing a child. Since the difficulties of sensory processing affect the overall functioning of the child and his development, it is important to identify the difficulties as soon as possible in order to plan early intervention.

**Keywords:** infant, development, TSFI, sensory integration

# Influence of the pull-out technique on start and turn performances in elite male 50 m breaststroke swimmers

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Marek Polách, Tomáš Michalica

Faculty of Physical Culture, Palacký University Olomouc

**Background:** In breaststroke, it is possible to use two types of pull-out techniques during the underwater phase. In TYPE 1 the dolphin kick is performed at the same time as the arm pullout. In TYPE 2 the dolphin kick is finished before arm pull-out. However, it is unclear which technique is more effective.

**Objective:** The aim was to assess two types of pull-out technique and their influence on the time 15 m after the start and turn. Moreover, the relationship of all sub-phases in both techniques during the underwater phases after the start and turn was assessed.

**Methods:** Video footages of all male participants ( $n=59$ , age,  $23.6\pm6.9$ , FINA points  $822\pm95$ ) at the 2019 and 2021 European swimming short-course championships were analyzed.

**Results:** No differences in 15 m after the start and turn were found. Both pull-out techniques seem to be equally effective. Sub-phase 1 and sub-phase 3 strongly correlated with the time of the underwater phase in TYPE 1 ( $r\geq 0.81$ ;  $r\geq 0.71$ ) and TYPE 2 ( $r\geq 0.63$ ;  $r\geq 0.62$ ). After the start and turn a significant difference was found in sub-phase 1 ( $p=0.027$ ).

**Conclusions:** TYPE 2 spent less time gliding after the start and initiated the dolphin kick at a higher speed, which negatively affected the rest of the underwater phase. When optimal timing of the dolphin kick, our results suggest a greater potential for TYPE 2.

**Keywords:** video-analysis, biomechanics, start, turns

# Determination of students and lectures attitudes towards online teaching of compulsory physical education at Masaryk University

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**Alena Pokorná, Marek Dubčák, Zora Svobodová, Renáta Vychodilová**

**Faculty of Sports Studies, Masaryk University, Brno, Czech Republic**

Today's developed society is highly aware of the importance of physical activities. Therefore, the students at Masaryk University are obliged to complete two sports courses during their full-time Bachelor studies. They can choose from a wide offer of different sports courses provided by the lectures of the University Sports Centre (USC) at the Faculty of Sports Studies. The pandemic situation associated with the SARS-CoV2 disease significantly changed many aspects of our lives. It also influenced the offer of sports courses at the University and the way they were implemented because they had to be transferred to the online streamed format, and the offer of the courses had to be decreased. The aim of the study was to explore the attitudes of the USC lecturers and students of Masaryk University towards online lecturing of the compulsory physical education provided by the department of the University Sports Centre during the COVID-19 pandemic situation. To find out the attitudes of the lecturers at the USC and university students towards online lecturing of sports courses, the research method of the questionnaire survey was used. The research group consisted of 564 full-time university students, participating in the compulsory sports courses during the pandemic situation, and fourteen lecturers of the USC department. In the survey, the students evaluated the offer of the provided sports courses that were divided into two main categories: fitness and „body and mind“. Next, the organization, implementation and educational content of the online streamed courses, as well as students' motivation to their active participation in the courses was examined. Regarding the lecturers, their satisfaction with their own lecturing and cueing of the online courses was assessed. The questionnaire survey showed that most students were sufficiently informed and satisfied with the offer. The students evaluated the quality of the online sports courses positively, considering the commitment and positive attitude of the lecturers. Since the majority of the lecturers has a very positive attitude towards sport and the sports courses provided by the Centre, they evaluated positively that the courses were not cancelled during the pandemic. The pandemic experience also brought an impulse to keep some online courses in the offer even after the situation returned to normal. The lectures further appreciated that the continuity of the PE education was kept, and the number of participated students could be increased. Finally, the lectures assessed positively that the recorded lectures could be reused, and the students could exercise repeatedly. Regarding negative aspects, the lecturers named the lack of feedback and no possibility to observe the performed movements and correct them eventually. Next, they mentioned the absence of communication and interaction with the students, and the limitation of the course content, as well as more demanding preparation of the lectures.

**Keywords:** attitudes, COVID-19, distance education, compulsory physical education, sports courses

# Does the number of prescribed medications affect the quite stance in elderly?

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Kateřina Jenčíková, Marta Gimunová, Martin Sebera, Lenka Svobodová, Mario Kasovic, Tomáš Vespalec

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Purpose:** Previous studies show that specific medication use can increase the risk of falls. The aim of this study was to analyze the effect of the number of used medication on the quite stance in the elderly.

**Patients and Methods:** A total of 210 independently living older adults ( $72.84 \pm 6.26$  years old; 156 females, 54 males) participated in this study. To assess the stance parameters, the Zebris FDM platform was used. An additional question about prescribed medications was asked and participants were subsequently classified into three categories of use (none; one medication; two or more medication), which were statistically analyzed using the nonparametric analysis of variance test (Kruskal-Wallis test).

**Results:** Statistical significance has not been confirmed for any of these parameters: COP path length, mm ( $p=0.269$ ); COP average velocity, mm/sec ( $p=0.269$ ); forefoot force (N, left foot  $p=0.597$ ; right foot  $p=0.559$ ); backfoot force (N, left foot  $p=0.597$ ; right foot  $p=0.559$ ); total force (N, left foot  $p=0.152$ ; right foot  $p=0.152$ ).

**Conclusion:** Our study did not confirm the effect of the number of medications on standing parameters in the elderly as all three categories did not show any statistically significant difference from each other. Further studies may require a multi-breakdown analysis of the factors such as age, type of medication or gender that may affect the stance parameters and the risk of falls in elderly.

**Keywords:** medication, stance, seniors, aging, center of pressure

# **Biomechanical analysis of back extension roll and methodical exercises**

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**Kamenka Živčić, Lucija Milčić, Marijo Možnik, Dan Lanc, Marija Milas**

**University of Zagreb, Faculty of Kinesiology, Zagreb, Croatia**

The aim of this paper was to compare the methodical exercises applied to learning the back extension roll in some biomechanical parameters. A sample was conducted of the kinematical parameters of back extension roll and the methodical exercises for learning a certain phase of the technique. The exercises were grouped into four phases of performing the back extension roll: 1st phase - from the upright position to the first contact of the palms with the floor, 2<sup>nd</sup> phase from the last contact of the palms with the floor to the first contact of the shoulders with the floor, 3<sup>rd</sup> phase - from the last contact of the shoulders to the floor to the first contact with palms to the floor, and phase 4: from the last contact of the palms with the floor to the handstand. These are the angles between individual body segments: the angle between the upper arm and torso, the thigh and torso. Kinovea 0.8.15 was used for video analyses of kinematic variables. For data processing used program Statistica. Basic descriptive parameters, K-S test were calculated for all variables. Wilcoxon test was used for comparing kinematic parameters of methodical exercises on the back extension roll at the level of statistical significance of  $p < 0.05$ . The results showed that there is no statistical significance difference between phases of backward roll and certain exercises which means that each exercise is good for learning the element.

**Keywords:** biomechanics, artistic gymnastics, roll, handstand

## **Differences in height and weight in young female gymnasts**

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**Lucija Milčić, Marijo Možnik, Kamenka Živčić, Tomislav Krističević, Marija Milas**

**University of Zagreb, Faculty of Kinesiology, Zagreb, Croatia**

Following the changes in basic anthropological characteristics of the young gymnast can help coaches to recognize how the process of training influence the growth and development of gymnasts. This also can be useful in the specialization of specific apparatus. The aim of this investigation was to find the differences in weight and height between young female gymnasts. The sample consisted of 26 female gymnasts: 10 years old who are competing at different levels – compulsory (16) and free (10) programs. Compulsory program training was three times per week, each lasting two hours. Training in the free program lasted two and a half-hour five times per week. K-S test was used for testing the normality of distribution. Differences between height and weight are calculated by ANOVA at the level of statistical significance of  $p < 0.05$ . Results show that there is a statistically significant difference in height and weight between categories. Girls from the compulsory program are taller and heavier than girls in free program. The free program is the hardest program and physically more demanding for execution than a compulsory program. It seems that the bigger volume of training influences height and weight.

# Differences in body fat and muscle mass in relation to competitive level in male handball players

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Aleksandra Stachoń, Jadwiga Pietraszewska, Anna Burdukiewicz, Marcin Lijewski

University School of Physical Education in Wrocław, Poland

**Purpose:** The body tissue composition has become one of the elements of controlling the athlete's biological condition as well as the effects of training. The direct impact of body muscle or fat content on the effectiveness in handball is not always evident, but the appropriate level of fat and muscle is necessary for the performance of important athlete's functions, especially during intense physical effort. From this perspective, it is valuable to look for the relationship between the sports level and body composition. The aim of the presented study is to assess the differences in the content of tissue elements between handball players presenting different levels of sports competences.

**Methods:** The study involved 70 handball players aged  $23.9 \pm 5.80$  years, presenting different levels of sport competence (Super League clubs  $N=20$ , club teams of 1st League  $N=20$ , academic athletes  $N=30$ ). Basic anthropometric measurements routinely used to monitor athletes were conducted and selected indicators of body proportions were calculated. The thickness of selected skinfolds was measured and the transversal muscular and fat area of limbs segments were also calculated. The body composition was assessed using the BIA analyzer (BIA-101 Anniversary Sport Edition by Akern with BodyGram software). Measurements were taken at the end of the preparatory period, before the start of the competition season. The statistical analysis was performed with the use of Statistica 13 package. Descriptive statistics were applied to quantitatively analyze the collected data. Shapiro–Wilk test was used to examine the distributions in the analyzed characteristics. Variance analysis and Tukey's HSD test were used to assess the inter-group differences in body structure and in the analyzed anthropometric characteristics.

**Results:** The highest values of body height and length's and width's characteristics (upper and lower limbs; shoulder and hip width) were found in elite players while the lowest—among academic players. Competitors representing the highest sports level were characterized by the largest cross-sectional area of the arm, forearm, thigh and lower leg muscles. This confirms the opinions of other researchers that along with perfectly mastered agility-technicaltactical actions, better physical conditions can become an important and even decisive factor for effective playing. There were no significant differences in subcutaneous fatness on the trunk. Skinfolds on the extremities were the thickest among

academic athletes, while the differences between Super League and 1st League players were negligible. However, the analysis of the cross-sectional area of the subcutaneous fat indicates that academic players dominate in this features on the arm, forearm, thigh and lower leg. It confirms the results obtained by other authors who showed that high level of physical activity and sports training are factors that influence the reduction of fatness. Nevertheless, not all regional fat deposits respond in the same way to exercise load.

**Conclusion:** The results show that there is a relationship between different levels of play and morphological structure. Players presenting the highest level dominate by the overall size and massiveness of the body, characteristics ensuring an advantage in direct confrontation. Moreover they were characterized by the largest muscle cross-sectional area of the limbs' segments. Training in handball modifies the fatness of the limbs more strongly than the trunk.

**Keywords:** skinfolds, body composition, limbs' morphological structure, anthropometry

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# **The relationship between selected kinematic parameters and the speed of the jump topspin serve in men's volleyball**

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**Jiří Petrů, Tomáš Vencúrik, Dominik Bokůvka**

**Faculty of Sports Studies, Masaryk University, Brno, Czech Republic**

This article focused on the relation between selected kinematic parameters of jump topspin serve regarding the speed of a flying ball in men's volleyball. 10 players of the elite senior category in real conditions performed one measured jump topspin serve at sub-maximal speed during training. All serves were performed following the rules of volleyball. The average speed of the recorded serves was  $94.7 \pm 5.22$  km/h. 6 high-frequency cameras measured kinematic variables during the measurement of the jump topspin serve in the 100 Hz recording mode (Simi Motion - technology). In this article, we focused on comparing the serve speed with the wrist height of the hitting arm at the time of the strike. Furthermore, to compare the speed of the serve with the height of the centre of gravity of the serving player (calculated according to Gubitz) at the time of the strike. And the last relation we looked for was the serve speed and the length of the serving player's flight phase. This parameter was calculated from the centre of gravity trajectory (according to Gubitz) from the moment of the player's jump from the ground (pad) to the moment of hitting the ball. Pearson's correlation coefficient was used for statistical processing of serve speed and kinematic parameters. The resulting correlation between the serve speed and the wrist height of the hitting arm  $r = 0.03$ , i.e., a very trivial association. The correlation between the serve speed and the height of the centre of gravity at the moment of the strike is large,  $r = 0.5$ . Similarly, the correlation coefficient  $r = 0.52$  was obtained in the case of the relation between the serve speed and the length of the flight phase of the center of gravity, so in this case, it is a large degree of correlation. We presume the data obtained could contribute to volleyball coaches (primarily male category) in developing this complex player skill. Information about the relation between the serve speed and the length of the flight phase of the serving player is beneficial.

**Keywords:** volleyball, speed, kinematic parameters, jump topspin serve

# **Cost-Effectiveness of Preventive Physical Activity Programs in Elderly; theoretical background and methodology**

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**Alexandra Novotná, Ján Cvečka,**

**Faculty of Physical Education and Sport, Comenius University Bratislava, Slovakia**

The European Union has a duty, arising directly from the EU's founding treaty, to ensure the protection of citizens' health and to cooperate with the individual Member States to improve health, prevent diseases in the population and eliminate sources of danger to physical and mental health. The way to improve prevention and ensure the protection of the health of the population is to regularly monitor and examine the health of different population groups (by age, socio-economic status, gender, etc.). An aging population is associated with an increased incidence of disease and chronic illness and is a burden on the health system. Given that resources in the health sector are limited, the design of new policies and decisions on resource allocation should be conditioned by the search for the best value for money. Preventive measures and health promotion could be effective in finding the right value for money. According to the World Health Organization (WHO), physical activity is one of the most affordable and effective means of consolidating human health and preventing diseases of civilization. The research seeks to assess whether the implementation of preventive exercise programs is a cost-effective measure and can have a potentially positive impact on health care expenditures. The research involves 100 probands divided into experimental and control groups. The experimental group consists of 50 participants who will complete a 10-week supervised preventive exercise program, with strength, aerobic and coordination-focused training units and aqua fitness at a frequency of twice a week. Strength training is part of the program every week, with endurance-coordination training and aqua fitness alternating on even and odd-numbered weeks. The time duration of one training unit is 50 minutes. The seniors subsequently perform the physical activity for 42 weeks in their homes. The control group consisted of probands who do not undergo a controlled exercise program. The need for medication intervention and expenditure on medication intervention is monitored in the studied seniors. Subsequently, expenditures on medication intervention are compared with expenditures on preventive movement programs.

**Keywords:** prevention, physical activity for seniors, cost-effectiveness, health care

# Analysis of 24-hour monitoring of physical behavior in girls and boys of school age in the context of after school organized physical activity

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Eliška Materová\*<sup>1</sup>, Jana Pelclová<sup>1</sup>, Aleš Gába<sup>2</sup>, Jan Dygrýn<sup>1</sup>

<sup>1</sup> Institute of Active Lifestyle, Faculty of Physical Culture, Palacký University Olomouc, Czech Republic

<sup>2</sup> Department of Natural Sciences in Kinanthropology, Faculty of Physical Culture, Palacký University Olomouc, Czech Republic

*Correspondence: Institute of Active Lifestyle, Faculty of Physical Culture, Palacký University Olomouc, třída Míru 671/117, 771 11 Olomouc, Czech Republic, email: eliska.materova01@upol.cz*

**Purpose:** After school organized physical activity (OPA) could significantly contribute to meeting physical activity guidelines of children and adolescents. While previous research has largely examined physical activity in isolation, recent studies have adjusted for multiple behaviors. The aim of this study was to examine daily and weekly sedentary behavior (SB), light-intensity physical activity (LPA), moderate-intensity physical activity (MPA), vigorous-intensity physical activity (VPA) and sleep in girls and boys. Further, this study aimed to compare physical behaviors of girls and boys with OPA and without OPA.

**Material & Methods:** Data included 756 children and adolescents (343 boys and 413 girls; mean age 15 years) from 14 primary and secondary school, who were monitored using the wGT3X-BT accelerometer over seven consecutive days. Physical behaviors and sleep were specified for group of participants with OPA ( $n = 413$ ) and without OPA ( $n = 343$ ). Differences between groups of girls and boys with OPA and non-OPA were examined by MANOVA test and Hotelling test for movement behavior composition.

**Results:** There were significant gender differences between the groups with and without OPA ( $F=3.53$ ;  $p=0.007$ ). Boys with OPA showed 33 min/day less SB, 16 min/day more sleep, 11 min/day more MPA and 5 min/day more VPA than boys without OPA. Girls with OPA showed 47 min/day less SB, 17 min/day more sleep, 12 min/day more LPA, 14 min/day more MPA and 3 min/day more VPA than girls without OPA. On weekdays, there were significant gender differences between the group of boys and girls with and without OPA ( $F=2.40$ ;  $p=0.036$ ). There was not found any significant difference for weekends ( $F=0.42$ ;  $p=0.837$ ). Boys and girls with and without OPA spent on average 25 min/day less time sitting and 45 min/day more time sleeping on weekends than on

weekdays. In contrast, both groups spend on average 22 min/day more time LPA on weekdays than on weekends. Relative physical behavior profiles significantly differed between OPA group and non-OPA groups ( $p < 0.001$ ). Based on compositional geometric means, non-OPA group was characterized by a relatively lower amount of VPA (by 36 %) and a relatively higher amount of sitting (by 11 %) compare to OPA group.

**Conclusion:** Our findings suggest that participation in OPA could help to reduce sedentary behavior and increase physical activity and sleep in children and adolescents.

**Keywords:** accelerometer, physical activity, sedentary behavior, children and adolescent, organized physical activity

# The effect of successful team pressing on running and technical performance in elite soccer

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Damir Sekulic\*, Toni Modric, Mario Jelcic

Faculty of Kinesiology, University of Split, Split, Croatia

\* Correspondence: [dado@kifst.hr](mailto:dado@kifst.hr)

Considering that pressing behaviour is seldom investigated in soccer, this study aimed to examine the effect of successful team pressing on team running performance (TRP) and team technical performance (TTP). The TRP and TTP were collected during UEFA Champions League (UCL) group stage matches ( $n=20$ ) in the 2020/21 season using semiautomatic optical system InStat Fitness. Individual performances ( $n=547$ ) of 378 outfield players were jointly evaluated into the teams' performances. The TRP variables included total distance covered, low-intensity running ( $<4$  m/s), running (4–5.5 m/s), high speed running (5.5–7 m/s) and sprinting ( $>7$  m/s). The TTP variables included total actions shots on target, passes, key passes, crosses, dribbles, final third entries and penalty area entries. The effect of successful team pressing on TRP and TTP was examined using linear mixed models, with teams' identities modelled as random effect to account for the repeated measures. Results indicated (i) no significant effect of successful team pressing on TRP ( $t = -0.13$  to  $0.67$ ,  $p < 0.05$ , all trivial to small effects sizes), (ii) significant effect of successful team pressing on all TTP variables ( $t = 2.33$  to  $5.18$ , all  $p < 0.05$ , all large effects sizes). These findings show that TRP was similar irrespective to number of successful pressings, while TTP tend to increase when playing style with high rate of successful team pressings was utilized. Given that TTP is considered as essential for match success in soccer, this study suggests that team pressing may be an effective tool for achieving greater success in elite-level soccer matches. Meanwhile, no association between TRP and successful team pressings emphasize that cooperative and well-organised interaction between players is more important factor of team pressing than pure physical performance.

**Keywords:** pressing behaviour, match performance, physical performance, UEFA Champions League, match analysis

# Does the amount of injuries affect the final ranking at the end of the competitive season in football?

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Alen Marosevic, Ivan Belcic, Cvita Gregov

Faculty of Kinesiology, University of Zagreb

The aim of this research is to determine whether a larger number of injuries in the team affects the final competitive achievement of clubs in the 1st Croatian Football League. Data on injuries in training and matches were collected using UEFA's Injury Study Questionnaire. 340 players (in all 10 clubs) participated in the research. The Chi-square test was used for non-parametric tests while logistic regression analysis was used to correlate the independent and dependent variables. The hypothesis that clubs with lower rankings will have statistically significant more injuries has not been confirmed ( $p < 0.05$ ), but this difference (although not statistically confirmed) still exists between clubs that finished the championship at the top five compared to the low five clubs.

**Keywords:** injury prevention; football injuries; injury occurrence; injury type; specific training

# Relationship between the length of an active wrestling career with selected attitudes and behavior caused by the covid-19 virus pandemic

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Nikola Starcevic<sup>1</sup>, Ivan Belcic<sup>1</sup>, Dubravka Sajkovic<sup>2</sup>

<sup>1</sup> Faculty of Kinesiology, University of Zagreb

<sup>2</sup> University Clinic of Traumatology, Zagreb, Croatia

The main aim of this paper is manifested in the hypothesis that there is a statistically significant correlation between the length of an active wrestling career and selected attitudes and behaviours caused by the COVID-19 virus pandemic. The sample of respondents (N=131) consists of international wrestlers (average age  $22.32 \pm 5.08$  years) from all competition categories (seniors, senior juniors U23, juniors and cadets). The collected survey data were systematized based on obtained answers and numerical values and according to the instructions for interpretation of answers analysed with particle frequencies and descriptive statistics. Correlation analysis proved statistically significant negative association ( $r = -0.19$ ) between the length of an active wrestling career and the behaviour of wearing a protective mask during the COVID-19 virus pandemic. Observing all age groups, attitudes indicate concern about the infection of acquaintances, and the behaviour of wrestlers emphasizes the importance of washing hands, wearing masks, and using disinfectants. Wrestlers are also aware of the dangers of the virus for their careers and are informed and follow the instructions of experts.

**Keywords:** combat sport; sport and COVID-19; pandemic influence

# Analysis of importance of physical preparation for recreational alpine skiers

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Ivan Bon, Mateja Očić, Vjekoslav Cigrovski, Vedran Dukarić, Matija Matić

Faculty of Kinesiology, Laboratory for Sports Games, University of Zagreb

Alpine skiing is demanding physical activity, therefore recreational skiers need to develop a high level of motor (balance, agility, coordination, strength, endurance) and functional (aerobic and anaerobic) abilities. Fitness training directly reduces the risk of injury, delays the reaction to fatigue, speeds up the recovery process and develops motor and functional abilities. Inadequate and poor fitness preparation of recreational skiers weakens the effectiveness of learning skiing technique and maximizes the risk of suffering injuries on the ski slopes. This research aims to determine level of physical preparation of recreational skiers for the upcoming ski season. A total of 207 respondents participated in the anonymous online survey. The conducted research showed contradictions in the respondents' attitudes and actions, i.e., 88.89% believe that fitness preparation is important before going skiing, but at the same time 51.21% do not prepare prior to skiing. Overall, 49.76% respondents consider skiing a very demanding sport and rate the difficulty of skiing with a score of (4) out of (5). In the field of interest in physical activity, 74.88% of alpine recreational-level skiers who participated in the survey stated that they were engaged in physical activity. Almost half of the respondents (47.83%), train as much as 3 to 4 times per week. Also, 28.50% believe that a month before skiing is necessary for adequate fitness preparation. Moreover, 67.15% of respondents consider aerobic exercise necessary, while 59.42% consider strength training extremely necessary. In addition, 51.69% believe that balance is among the most important exercises, and 52.17% of respondents value endurance exercises necessary for the preparation. In addition, respondents find speed and coordination exercises unnecessary in 63.29% and 47.34% of cases respectively, while at the same time rate agility and flexibility in 55.56% and 57.97% of cases as necessary exercises during preparation for skiing. Results of the conducted survey suggest recreational alpine skiers pay very little attention to fitness preparation before going skiing, despite awareness of the importance of physical preparation. The research focusing on preparation for skiing period is promising from several aspects, such as investment in organizing, implementing, and promoting individual and group professional training led by kinesiologists. Also, there is a possibility of conducting various professional research in the field of fitness training of alpine skiers at the recreational level connected with the method of acquiring ski skills, application of different intensities, types of exercises (agility, endurance, flexibility, etc.) and the length and timing of the preparation period. Physical preparation is certainly important from the standpoint of minimizing the risk of injuries and overall prevention of injuries. Also, it has a positive influence on acquiring ski technique for ski novices and overall performance of experienced recreational skiers.

**Keywords:** alpine skiing, fitness training, motor and functional abilities, survey questionnaire



# Morpho-functional changes in young female volleyball players during training cycle

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Jadwiga Pietraszewska, Aleksandra Stachoń, Adrian Sieroń

University School of Physical Education in Wrocław, Poland

**Introduction:** Modern volleyball, due to its rules and speed of game requires a high level of motor preparation, specific body build and optimal body composition. Appropriate training loads result in the improvement of the morpho-functional characteristics of athletes, and therefore in better performance. In order to plan and implement the training load properly for the training periods, the athlete's body reactions should be tested. The consistent tracking of changes in motor fitness throughout changes in tissue may contribute to the improvement of athletes' performance during starts. The continuous assessment of tissue composition and performance can support preparation for major competitions. The aim of this study was to determine and evaluate changes in body build, tissue components and the level of motor skills in young volleyball female players after preparatory and during start phases of training cycle.

**Methods:** The research group was comprised of 36 female volleyball players aged 15–17 years, training in one academic club. Their experience ranged from four to six years. The team was monitored throughout a 20-wk season consisting of the preparatory and starting phases, using a longitudinal study design. Body weight and body height were measured, BMI was calculated. Body composition was estimated by bioelectrical impedance analysis (BIA) using BIA-101 Anniversary Sport Edition and Bodygram 1.3 software. Measurements of body composition were carried out three times: (I) at the beginning of the preparatory period, (II) after its completion, (III) in the middle of the start period. Absolute and percentage values of the following body mass components were used in the analysis: lean mass, total body water, extracellular fluid, intracellular fluid, cell mass, fat mass. Motor fitness was assessed with the following motor tests: standing vertical jump, running vertical jump, zig-zag run, standing long jump, 2-kg medicine ball throw.

**Results:** Analysis of changes after the preparatory period demonstrated a slight decrease in BMI. The loads applied resulted in an increase of lean body mass, body water, especially its extracellular fluid, and a significant decrease in fat. This period also showed a significant improvement in jumping abilities and running.

The start period was characterized by a gradual increase in body weight and height. In this cycle, changes in loads resulted in a significant increase in body cell mass. Analysis

of water fractions confirmed that young female volleyball players were increasing the ratio of intracellular fluid/extracellular fluid over the period of several months in league matches. There were no significant changes found in the absolute lean body mass. However, the percentage values revealed a drop of lean body in body mass related to the accumulation of fat in the athletes' bodies. Analysis of the results of motor tests presented improvement in jumping tests. During this phase of the macrocycle there was improvement in the distance of medicine ball throw.

**Conclusion:** The training loads applied in particular training phases affected basic morphological features, body tissue components and motor fitness of the female volleyball players. The observed changes were favourable for the effectiveness during the competition. Systematic monitoring of these changes in young volleyball players in shorter and longer intervals offers the chance to maintain their optimal sports level.

**Keywords:** body composition, motoric tests, periodisation

*This research was funded by University School of Physical Education in Wrocław, Poland, grant number PN/BK/2020/08.*

# 24 Hours physical behavior monitoring of patients with heart failure: the study design

Jan Vindiš<sup>1,2</sup>, Jana Pelclová<sup>1</sup>, Renata Aiglová<sup>4</sup>, Denisa Nohelová<sup>1,2</sup>, Jakub Flašík<sup>4</sup>, Patrik Kepř<sup>4</sup>, Marcela Škvařilová<sup>3,4</sup>, Miloš Táborský<sup>4</sup>

<sup>1</sup> Faculty of Physical Culture, Institute of Active Lifestyle, Palacký University Olomouc, Olomouc, Czech Republic

<sup>2</sup> Faculty of Physical Culture, Department of Natural Sciences in Kinanthropology, Palacký University Olomouc, Olomouc, Czech Republic

<sup>3</sup> Faculty of Physical Culture, Department of Recreation and Leisure Studies, Palacký University Olomouc, Olomouc, Czech Republic

<sup>4</sup> Department of Medicine I – Cardiology, University Hospital Olomouc, Olomouc, Czech Republic

**Introduction:** Recent studies confirm the benefits of physical activity in reducing the number of hospitalizations, deaths and improvement concerning functional capacity of patients with heart failure (HF). However, there has not yet been a consensus on the most appropriate recommendations of PA for these patients which would lead to the maintenance of these benefits. One of the options is a detailed description of patients' 24-hour physical behavior (PB) and optimizing their daily active living based on their level of physical fitness (PF). **Aims:** The main aim is to analyze the 24-hour PB profile and gait of patients with HF based on accelerometry. Further aims is to optimize PB of patients with HF using feedback based on processed accelerometer data and consulting with their physician in a Heart failure ambulance. **Design and sample:** The study participants will be patients with symptomatic HF. PB will be assessed by sensors located on different body segments for 24 hours seven days a week, allowing a detailed description of PB. Subsequently, a detailed analysis of the raw accelerometer data is going to provide precise feedback for aid in optimizing HF patients' daily behaviors to the European Society of Cardiology physical behavior recommendations. **Measures:** Four accelerometers worn on the waist, non-dominant wrist, front of the right thigh, and the lower back will provide information about posture- and intensity-based PB. The Data obtained from accelerometers will be processed using Acti4 software (posture and type of physical activity) and R-Studio software using the GGIR data package to describe the intensity of physical behavior and sleep.

**Keywords:** Accelerometry, actigraph, activity, heart failure, physical activity, posture, sedentary behavior, sleep.

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# Knowledge of proper physical activities of pregnant women

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Jana Juříková

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

Women, who are regularly physically active before pregnancy, are much more likely to continue to be regularly physically active during pregnancy. There is lack of information on the specific guidelines and real strategies of adaptation of several recreational and sports activities that might be adapted to healthy pregnant women.

The thesis investigates knowledge about suitability of physical activity during gestation in pregnant women. The total complex of examined women was divided into two parts: active (women who do some leisure physical activity while they are pregnant) and inactive (women who do not any leisure physical activities while they are pregnant). Based on questionnaires was found that majority of women who were subject of the research believe their information about the proper nutrition and appropriateness of physical activity within gestation are good enough. They named the internet and television like their prime source of information. However through analysis of the data they have written down in questionnaires was found consumption insufficiency of fish and wholegrain products in general. On the other hand, red meat, poultry, smoked meats and sweetness were overconsumed.

Regarding knowledge of advisability of physical activity during gestation in pregnant women was found out the most of researched women responded right way on surveyed questions.

**Keywords:** pregnant women, physical activity, book, the Internet

# **Biomechanical analysis of back extension roll and methodical exercises**

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**Kamenka Živčić, Lucija Milčić, Marijo Možnik, Dan Lanc, Marija Milas**

**University of Zagreb, Faculty of Kinesiology, Zagreb, Croatia**

The aim of this paper was to compare the methodical exercises applied to learning the back extension roll in some biomechanical parameters. A sample was conducted of the kinematical parameters of back extension roll and the methodical exercises for learning a certain phase of the technique. The exercises were grouped into four phases of performing the back extension roll: 1st phase - from the upright position to the first contact of the palms with the floor, 2<sup>nd</sup> phase from the last contact of the palms with the floor to the first contact of the shoulders with the floor, 3<sup>rd</sup> phase - from the last contact of the shoulders to the floor to the first contact with palms to the floor, and phase 4: from the last contact of the palms with the floor to the handstand. These are the angles between individual body segments: the angle between the upper arm and torso, the thigh and torso. Kinovea 0.8.15 was used for video analyses of kinematic variables. For data processing used program Statistica. Basic descriptive parameters, K-S test were calculated for all variables. Wilcoxon test was used for comparing kinematic parameters of methodical exercises on the back extension roll at the level of statistical significance of  $p < 0.05$ . The results showed that there is no statistical significance difference between phases of backward roll and certain exercises which means that each exercise is good for learning the element.

# Correlation between wrist motor control and throwing velocity in young male handball players

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Luka Galić, Ana Marija Peti, Tatjana Trošt Bobić, Katarina Ohnjec

Faculty of Kinesiology, University of Zagreb

In the handball game, scoring a goal by some way of shooting is concretized by the numerical advantage in the result of one team over another. Shootings as elements of handball technique are the operators represented with the highest frequency in every handball training of young handball players. The aims of this research consist in determining the connection between throwing velocity and wrist motor control of the shooter's hand in young handball players. The measurement was conducted on a sample of forty handball players from handball clubs: age of  $11.23 \pm 0.54$ , body mass of  $45.28 \pm 12.93$  kg, and body height of  $153.32 \pm 8.05$  cm. The following variables were examined: age, body height, body mass, the velocity of movement of the ball under the basic shot from the spot, the velocity of movement under the basic shot of three steps from the ground, the velocity of movement under the jump shot from three steps, maximal strength of wrist palmar flexors, precise movement modulation during plantar and dorsal wrist flexion, precise modulation of submaximal force during plantar and dorsal wrist flexion. Basic descriptive parameters were calculated. Based on the correlation coefficients, the correlation of individual variables of the studied sample was determined. A statistically important correlation between all three manners of shooting was found, as well as between the variables jump shot from three steps and the maximal strength of wrist palmar flexors ( $0.41$   $p < 0.05$ ). According to the obtained results, it can be concluded that for young handball players aged 10–12 years the speed of the ball when shooting depends more on the palmar flexors maximum strength than on their coordinated work in fine movement control tasks.

**Keywords:** handball, throwing velocity, maximal strength, precisely modulation, correlation

# Differences in height and weight in young female gymnasts

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Lucija Milčić, Marijo Možnik, Kamenka Živčić, Tomislav Krističević, Marija Milas

University of Zagreb, Faculty of Kinesiology, Zagreb, Croatia

Following the changes in basic anthropological characteristics of the young gymnast can help coaches to recognize how the process of training influence the growth and development of gymnasts. This also can be useful in the specialization of specific apparatus. The aim of this investigation was to find the differences in weight and height between young female gymnasts. The sample consisted of 26 female gymnasts: 10 years old who are competing at different levels – compulsory (16) and free (10) programs. Compulsory program training was three times per week, each lasting two hours. Training in the free program lasted two and a half-hour five times per week. K-S test was used for testing the normality of distribution. Differences between height and weight are calculated by ANOVA at the level of statistical significance of  $p < 0.05$ . Results show that there is a statistically significant difference in height and weight between categories. Girls from the compulsory program are taller and heavier than girls in free program. The free program is the hardest program and physically more demanding for execution than a compulsory program. It seems that the bigger volume of training influences height and weight.

**Keywords:** artistic gymnastics, anthropological characteristics, children

# Differences between traditional and modern technology in the acquisition of new ski knowledge

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Mladen Marinovic<sup>1,2</sup>, Danijela Kuna<sup>1</sup> and Iva Macan<sup>1,2</sup>

<sup>1</sup> Faculty of Kinesiology Osijek, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia

<sup>2</sup> Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia

**Purpose:** Video materials have been used as teaching tools for many years. With the development of modern technology, new video devices have appeared that have greatly improved the quality and capabilities of video materials. This study was conducted with the purpose of investigating and comparing the current traditional and modern ways of recording ski elements. In the traditional way of recording, the cameraman stands on the ski slope and uses a camera to record a demonstration of the ski element of the skier moving toward him. On the other hand, the modern way of recording was made with the Gopro 360 max, which allows you to record video while skiing.

**Methods:** The sample of respondents who evaluated the quality of the traditional and the Gopro 360 max videos for three skiing elements consisted of 149 students (105 male and 44 female) from the Faculty of Kinesiology Osijek. Prior to the video quality assessment test, the performance of the ski elements was explained to the students using traditional and modern video footage. When solving the ski knowledge test, students had the opportunity to watch and use traditional and/or modern videos.

**Results:** The average score that students achieved on the ski knowledge test was  $8.9 \pm 2.48$  points ( $74.16 \pm 0.21\%$ ). When evaluating the quality and contribution of the videos, students rated the usefulness of the traditional method of video recording with an average score of  $3.01 \pm 1.25$ , while the modern method of video recording received an average usefulness score of  $3.79 \pm 1.07$ . The difference between the traditional and modern video recording was statistically significant at the  $p < 0.01$  level.

**Conclusion:** The obtained results indicate that the way the Gopro360 max records and presents the skiing elements contributes significantly to the quality of the presentation and the acquisition of specific skiing knowledge compared to the traditional recording method.

**Keywords:** Gopro360 max, ski elements, knowledge test



# Kiteboarding injuries

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Mateja Orlović, Mate Maglov, Tomislav Krčelić, Goran Vrgoč, Nikola Prlenda

Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia

*Mateja Orlović – mateja.orlovic@student.kif.hr , Mate Maglov – mate.maglov@kif.unizg.hr ,  
Tomislav Krčelić – tkrcelic@hotmail.com , Goran Vrgoč – goran.vrgoc@kif.unizg.hr , Nikola  
Prlenda - nikola.prlenda@kif.unizg.hr*

**Purpose:** Kiteboarding is classified as one of extreme sports, which often includes performing of different tricks. The aim of this paper was to determine the type and frequency of injuries in kiteboarding, and to define causes of injuries in recreational and professional athletes engaged in kiteboarding. The results received can be used as guidelines in creating of prevention programmes for most frequent injuries.

**Methodology:** The research was conducted on the sample of 93 kiteboarders, of which 74 were male (79.57%) and 19 were female (20.43%). Overall sample of examinees consisted of 2 professional boarders (2.2%), 14 kiteboarding instructors (15.1%), and the rest were recreational athletes (82.8%). Online questionnaire was applied with clearly defined completing instructions. The online questionnaire consisted of several question groups: 1. general questions, 2. questions concerning the method of learning and duration of engagement in this sport, 3. questions concerning injuries resulting from the sport.

**Results:** In overall sample of examinees (93), there were 51 who were injured during kiteboarding. Out of total percentage of injured (54.8%), as many as 30.1% had more than one injury. Average number of injuries per examinee was 0.6129. Depending on the method of initial learning and training, 70% of examinees who were self-taught were injured, among those who were taught by a friend with kiteboarding experience 68.18% were injured, then there were 58.82% of injured among those who passed the kiteboarding course with an instructor without a valid license, and the smallest percentage of injured, 43.18%, among those who took the kiteboarding course with an instructor having a valid license. Having in mind the site of injury, the most frequent are foot and knee injuries (59.65%) and more than half of injuries (57.91%) is related to strains of ligaments and muscles. Most of the injuries happen during the performance of more advanced technical elements, particularly jumps (33.3 %), while the second most frequent cause of injuries is insufficient kite control (23.7%).

**Conclusion:** The largest number of injuries, depending on the site of injury, pertains to foot and knee injuries. During the ride, most of the force affecting the body

is dominantly laying stress on lower extremities, causing greater possibilities of injury in these regions. Such stress is especially evident in jumps, primely in landings. Using boards with footstraps can facilitate the occurrence of such injuries. Because of insufficient control of board during high speed or fall, in many cases one or both feet remain in footstrap, which can cause an injury. Most injuries happen between fourth and sixth year of kiteboarding, due to advanced technique mastering, and most of the examinees believe that the injury happened because of their own mistake. Kiteboarders taught by licensed instructors had the smallest risk of injury, while the greatest risk of injury was for self-taught individuals. Mentioned data clearly suggests how important it is to take a verified course with educated instructors to reduce the risk of injuries to a minimum.

# Anthropometric and somatotype differentiation between elite kyorugi and poomsae competitors

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Matej Babić<sup>1,2</sup>, Dražen Čular<sup>2,3,4</sup>, Danijela Kuna<sup>5</sup>

<sup>1</sup> Faculty of Kinesiology, University of Zagreb, Croatia

<sup>2</sup> Faculty of Kinesiology, University of Split, Croatia

<sup>3</sup> Einsten, Startup for Research, Development, Education, Trade and Services, Split, Croatia

<sup>4</sup> European Institute for Talents, Education, Research & Development, Split, Croatia

<sup>5</sup> Faculty of Kinesiology, University of Osijek, Croatia

Taekwondo, according to World Taekwondo Federation (WTF) has two official competitive disciplines, poomsae and kyorugi (technique and sport combat). Still, there is an insufficient number of studies which considered differences, or similarities between poomsae and kyorugi athletes. Aim of this investigation is to determine the possible difference between samples of taekwondo competitors in terms of somatotype and anthropometric measures. Sample of this research is composed of  $n=39$  taekwondo competitors of cadet, junior and senior age, divided into two subsamples, kyorugi ( $n=27$ ) and poomsae ( $n=12$ ). Ten competitors are the current national champions, while one participant is the European champion. After statistical analysis was conducted between subsamples, somatotype values were turned out to be significantly different. Somatotype of observed kyorugi competitors is composed of endo-  $2.55 \pm 1.17$ , meso-  $3.66 \pm 0.81$  and ecto-  $4.09 \pm 1.22$ , while mean values of poomsae sample are endo-  $4.21 \pm 0.70$ , meso-  $4.25 \pm 0.61$  and ecto-  $2.69 \pm 0.74$ . According to success at national championship, female kyorugi national champions tend to be balanced ectomorphs, males to be ectomesomorphs, while poomsae champions tend to be endomesomorphs with tendency toward centre. Authors suggest that such results were expected due to their different training programs and competition requirements. Future research should include especially male competitors, greater samples and should be conducted on the international level competitors.

**Keywords:** heath, carter, taekwondo, wtf, morphology

# The Effect of Physical Activities on Somatic Parameters of Masaryk University Students – Some Selected Results

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Milan Šipl, Emanuel Hurych

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

**Purpose:** The current trend is an increasing sedentary lifestyle in all age categories. Among university students, there is an alarming decline in physical activity while increasing the percentage of total body fat compared to high school students. The main goal of the study is to describe the current state of body composition of university students and to assess the impact of physical activity / inactivity in this specific age group, which has changed very dynamically in recent years due to the coronavirus pandemic. **Methods:** A total of 358 probands with a mean age of  $20.87 \pm 1.43$  years were involved in the research, of which 234 women (65.4%) had a height of  $167.9 \pm 6.3$  cm and a body weight of  $61.3 \pm 10.0$  kg, BMI  $21.7 \pm 3.2$ , body fat  $25.9 \pm 6.4\%$ , skeletal muscle mass  $24.7 \pm 3.3\%$  and 124 men (34.6%) with body height  $180.9 \pm 6.3$  cm, body weight  $77.6 \pm 12.4$  kg, BMI  $23.6 \pm 2.8$ , body fat  $15.8 \pm 5.4\%$ , skeletal muscle mass  $37.0 \pm 5.6\%$ . For the purposes of valid categorization into very active, active, and inactive probands, the International Standardized Physical Activity Questionnaire (IPAQ) was used, which monitors physical activity in the last 7 days. The questionnaire includes questions regarding the frequency and time spent in each intensity of physical activity, as well as the time spent sitting. The non-invasive method of bioelectric tetrapolar impedance using the InBody 230 device was used for the analysis of somatic parameters. The Takei hand dynamometer was used for the diagnosis of muscle strength. **Some selected results:** According to IPAQ, probands were classified as inactive (16%), active (58%) and very active (25%), the analysis of selected aspects of physical activity shows that men are more active than women, but both sexes spend more than 5.5 hours a day sitting on average. A total of 39% of probands have higher levels of total body fat than the recommended norms. **Conclusion:** The study showed that lower levels of physical activity are associated with higher values of total body fat in university students. At the same time, within our sample both sexes out of 84% comply with general recommendations regarding the volume and intensity of physical activity.

**Keywords:** physical activity, body composition, IPAQ, body fat, skeletal muscle mass, university students

# Differences in motivation for exercise between male and female high school students

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Petra Rajković Vuletić<sup>1,2</sup>, Marijana Čavala<sup>2</sup>, Nenad Rogulj<sup>2</sup>

<sup>1</sup> Faculty of Kinesiology, University of Zagreb

<sup>2</sup> Faculty of Kinesiology, University of Split

Lack of movement is one of the biggest issues today so it is necessary to encourage as many people as possible to an active lifestyle. Therefore it is necessary to explore the motives for exercise. The aim of this study was to determine differences in motivation to exercise according to gender. Exercise motivation was assessed by the Croatian questionnaire version of the EMI (the Exercise motivation inventory), which consists of 14 motives (factors): weight control, disease prevention, revitalization, appearance, social pressure, stress control, health, strength and endurance, enjoyment, group affiliation, prescribed exercise, competition, mobility and challenge. The research was conducted on a sample of 240 high school students „School of Civil Engineering and Geodesy“ and „School of Design, Graphics and Sustainable Construction“ in Split. The total sample was divided by gender into subsamples, so 165 female and 75 male students were selected. The Mann-Whitney U test was used to determine gender differences. From the obtained results, it is evident that the participants of this research rated the motives of health, strength and endurance, and the motive of refreshment as the most important. They assessed the prescribed exercise, social pressure and belonging to the group as the least important motives. Out of a total of 14 factors, seven of them showed a statistically significant difference in relation to gender. Weight control, disease prevention, refreshment, stress control and health are more significant motivating factors for exercise in female students (compared to male students). In the male population (compared to the female), the motivating factors for exercise are the competition factor and group affiliation.

**Keywords:** factors, difference, gender, questionnaire

# Analysis of somatotype of young croatian volleyball players in the women's national team

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Tomica Rešetar\*<sup>1</sup>, Marin Marinović<sup>2</sup>, Marija Ivanković<sup>1</sup>

<sup>1</sup> Faculty of Kinesiology University of Zagreb, Zagreb, Croatia

<sup>2</sup> Faculty of Kinesiology University of Osijek, Osijek, Croatia

\* [tomica.resetar@kif.unizg.hr](mailto:tomica.resetar@kif.unizg.hr)

The aim of this research was to determine the somatotype of young Croatian national team members, as well as simultaneously within the same sample, on one side, compare two different age categories and, on the other side, players of different playing status. The sample of examinees was formed by top-level young Croatian female volleyball players ( $n=28$ , age= $15.7\pm1.0$  years, body height= $179,6\pm7,2$  cm body weight= $64,8\pm7,0$  kg), which was further then divided into subsamples regarding age category (U16, U18) and playing status (starters, non-starters). Players' somatotype was calculated according to the Heath-Carter method, whereas the significance of differences between the pairs of groups was determined with the Student independent t-test. The average somatotype of all players was calculated as a balanced ectomorph (3.2–2.7–4.2), and accordingly also for subsamples U16 balanced ectomorph (3.2–3.0–4.2) and U18 endomorphic-ectomorph (3.1–2.3–4.2), while for starters endomorphic-ectomorph (3.0–2.4–4.6) and for non-starters central somatotype (3.3–3.0–3.9). In addition, upon analysis of the somatotype of all players, it was determined there was a total of 10 categories out of the possible 13 somatotypes, and that among those the most represented were endomorphic-ectomorphs (39,3%) and central somatotypes (17,9%). Among players in the U16 and U18 age categories there were no differences determined in none of the somatotype components, whereas among starters and non-starters players there were differences found only in the ectomorph somatotype component. This research provided insight into information about the somatotypes of top-level young female volleyball players that can be used as orientational data in the selection process of future young candidates for the national team, as well as allow for comparison of chosen players with the sample of the senior national team.

**Keywords:** volleyball, female players, age category, player status, morphology

# Somatotypes of top Croatian volleyball players

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Tomislav Đurković<sup>1</sup>, Marino Pašuld<sup>1</sup>, Domeniko Kresoja<sup>2</sup>

<sup>1</sup> Faculty of Kinesiology, University of Zagreb, Croatia

<sup>2</sup> Volleyball club Zadar, Croatia

**Purpose:** The aim of this study is to determine the somatotypes of top Croatian volleyball players and to analyze possible differences in 10 anthropometric measures according to the Heath-Carter method of somatotype determination. Examinees are members of Croatian premier league teams, categorized according to their playing role.

**Methods:** The research was conducted on 40 senior volleyball players (age  $22.3 \pm 4.0$ ) all members of Croatian premier league teams. Players were categorized as setters ( $n=10$ ), middle blockers ( $n=10$ ), outside hitters ( $n=10$ ) and liberos ( $n=10$ ). The sample of independent variables consisted of 10 anthropometric measures used for Heath – Carter method procedure and measured on the right side of the body: body height (BH), body weight (BW), triceps skinfold (TSF), subscapular skinfold (SSF), supraspinal skinfold (SSPSF), calf skinfold (CSF), humerus breadth diameter (HBD), femur breadth diameter (FBD), flexed arm girth circumference (FAGC), flexed calf girth circumference (FCGC). Dependent variable – playing role – is numerically defined and represents the affiliation of a player to a specific group: (1) setters, (2) middle blockers, (3) outside hitters and (4) libero players. Descriptive statistic for all measured variables is calculated by using SPSS, and possible differences between groups of volleyball players were checked by the Kruskal-Wallis test and the Mann-Whitney U post-hoc test. Somatotypes were calculated according to Heath - Carter method. The level of significance was set at 0.05.

**Results:** A statistically significant difference between the groups is detected in body height (BH), body weight (BW), flexed arm girth circumference (FAGC), flexed calf girth circumference (FCGC) and calf skinfold (CSF). According to the results, groups of setters (2.8–3.8–3.4) and middle blockers (2.3–3.8–3.6) belong to mesomorph – ectomorph category while groups of outside hitters (2.5–4.3–3.1) and libero players (2.4–4.6–3.0) belongs to group of is ectomorph – mesomorph. The results of the research are in line with related research. It confirms the importance of the longitudinal dimensionality of the skeleton in volleyball. Therefore, in the future of development of volleyball game we can expect the growth of the ectomorphic, with a decrease in the mesomorphic component of the somatotype.

**Key words:** Heath – Carter, somatotype, volleyball, anthropometry

# Duration of active and passive phases of the game in top level indoor and beach volleyball matches

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Tomislav Đurković, Domagoj Babok, Marino Marelić

Faculty of Kinesiology, University of Zagreb, Croatia

**Purpose:** The aim of this research is to check whether there is a statistically significant difference in the average duration of the active (time elapsed from server contact with the ball to the end of the point) and passive phase (time elapsed from the end of the previous active phase to the beginning of the next active phase) of the game between indoor and beach volleyball on a sample of top-level senior volleyball matches.

**Methods:** The research was conducted on the base of 10 volleyball matches. Five played during the indoor World Club Championship (Betim, 2019) and five played during beach World Championship (Hamburg, 2019). A total of 2392 active and passive phases were measured, of which 1438 in indoor volleyball (727 active and 711 passive phases) and 954 in beach volleyball matches (484 active and 470 passive phases). Descriptive statistic for all measured variables is calculated by using SPSS, and possible differences between indoor and beach volleyball were checked by the Mann Whitney U Test. The level of significance was set at 0.05.

**Results:** The average duration of the active phase in indoor volleyball is  $5.55s \pm 4.38$  while the average duration of the passive phase is  $35.27s \pm 25.96$ . The average duration of the active phase of beach volleyball is  $6.00s \pm 3.44$  while the average duration of the passive phase is  $33.82s \pm 22.98$ . Mann Whitney U Test showed a statistically significant difference ( $p = 0.00$ ) in the variable active phase of points played in indoor volleyball ( $Md = 3.53$ ,  $n = 727$ ) and active phase of points played in the beach volleyball ( $Md = 3.43$ ,  $n = 484$ ),  $U = 140770.00$ ,  $z = -5.90$  with little effect according to Cohen's criterion ( $r = 0.14$ ). The Mann Whitney U test ( $U = 160773.00$ ,  $z = -1.10$ ) showed no statistically significant difference ( $p = 0.27$ ) in the average duration of the passive phases at indoor volleyball and beach volleyball.

**Keywords:** volleyball, beach volleyball, time motion, active phases, passive phases



# Comparison of some kinetic and kinematic parameters during performance of straight punch with two boxing techniques – case study

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Dukarić Vedran, Očić Mateja, Bon Ivan, Rupčić Tomislav, Knjaz Damir

Laboratory for Sports Games, Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia

**Purpose:** Performance in boxing is a combination of strength, speed, and stability to create maximum impact. One of the types of punches commonly used in boxing is the straight punch. The magnitude of force exerted at the point of impact is influenced by a number of factors. Therefore, some biomechanical parameters can have greater effect than others during punch performance. Likewise, different technique modalities influence punch force. This study aims to determine differences between kinetic and kinematic parameters of punches performed with two different techniques (with and without weight shifting). **Methods:** Overall, 20 straight punches were performed (10 for each observed technique) by a top-level female boxer (26.1 years old, height 170.3 cm, weight 63.2 kg). Afterwards, four kinematic variables (shoulder, upper arm, forearm, and hand velocities) were analyzed together with the position of center of mass (Xsens, Awinda). Also, overall foot pressure force of both feet (Novel pressure insoles) was analyzed for each technique, as well as the impact force of each punch (Punchsensor). Differences between the techniques were determined by MANOVA. **Results:** Significant differences were found in foot pressure force and impact force, with higher values of punch force determined in the straight punch performance that includes weight shifting ( $p=0.00$ ). Regarding kinematic parameters, there were significant differences in shoulder velocity, forearm velocity, and center of mass position ( $p=0.00$ ). Upper arm and hand velocity variables did not differ significantly. This result indicates that different punch preparation can exhibit greater force and better performance. **Conclusion:** The understanding of movement pattern in punching could provide insightful instruction to coaches and boxers on how to generate powerful straight punches. The presented data objectively determined differences between two approaches in performing a straight punch which could help in correcting technical performance.

**Keywords:** Punchsensor, straight punch, force

# **Correlation of speed, power, and reactive agility in U19 basketball players**

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**Tomáš Vencúrik, Vincent Anton, Jiří Petrů, Dominik Bokůvka, Martin Vyroubal, Jan Kozina**

**Faculty of Sports Studies, Masaryk University, Brno, Czech republic**

The study aims to ascertain the correlation between speed, power, and reactive agility in U19 basketball players. Thirteen young elite female basketball players participated in this study. Players were assessed in 5, 10, 20 m linear sprint test, 5–0–5 change of direction speed test, Y reactive agility test, and countermovement jump. Pearson's correlation coefficient showed large correlation between Y reactive agility test and 5, 10, 20 m linear sprint test, 5-0-5 change of direction speed test, and countermovement jump ( $r = 0.63$ ;  $r = 0.7$ ;  $r = 0.68$ ;  $r = 0.61$ ;  $r = -0.57$ , respectively). Based on the presented results, it is possible to presume that basketball, and strength and conditioning coaches of U19 female basketball players, can also develop reactive agility performance when developing speed and power.

# **Construction of questionnaire for assessment of corruption intensity in tennis**

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**Gabrijel Šarić, Petar Barbaros, Zlatan Bilić**

**Faculty of Kinesiology, University of Zagreb**

Acts of corruption in tennis represent a problem for all tennis participants. Match-fixing and different types of malfeasance are hard to prove, however, there are several proven cases of match-fixing connected with betting houses and corruption. In 2008, the Tennis Integrity Unit organization was founded with the objective of detecting corruption practices in tennis. The aim of this paper is to construct a questionnaire for assessing the corruption intensity in tennis, as well as to verify the measurement properties of this newly constructed questionnaire. A scale consisting of 36 particles with responses on a five-degree Likert scale was constructed. The questions refer to the perception of various different types of corruptive actions in tennis. The verification of metric characteristics was completed on a sample of 202 students (59,4% male and 40,6% female students) from the Faculty of Kinesiology University of Zagreb, with an average age of 23 years. The reliability of the overall result from 32 particles was determined as a Cronbach coefficient of internal consistency which amounted to a very well 0,90. The average correlation between scale particles is 0,221. The results show that the scale could be more significantly reduced, while it would still maintain satisfactory measuring properties. Upon completing the research, the conclusion can be made that the appearance of sports betting houses in recent times significantly contributed to the occurrence of corruption and increasingly common match-fixing in tennis, and thus also to the perception of corruption in tennis.

**Keywords:** corruption perception, tennis

# Does painting and guitar lessons improve cognitive abilities of older adults?

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Vlatko Vučetić<sup>1</sup>, Vesna Šantak<sup>2</sup>, Dalibor Medvedec<sup>3</sup>, Katarina Kamber<sup>1</sup>

<sup>1</sup> University of Zagreb, Faculty of Kinesiology

<sup>2</sup> University of Zagreb, Academy of Fine Arts

<sup>3</sup> Academy of Music

The central nervous system continues its development long after man's birth and comes to an end in the mid-twenties. After reaching its peak in development, there is a stable maintenance of various cognitive functions at a higher or lower level, and after some time, under the influence of aging, there is a global decline of these functions (Galić, 2009). Numerous studies have shown that with age, cognitive functions such as episodic and verbal memory, attention, executive functions, spatial orientation, visual perception, and information processing speed decline (Glisky, 2007; West, 1996; Glisky and Kong; 2008, Schaie, 1994; Souchay, Isingrini and Espagnet, 2000; all according to Zadro et al., 2016) and some as early as the mid-twenties (Park et al., 2002, according to Zadro et al., 2016). Also, given that the decline in cognitive abilities significantly affects the quality of life of older people, a number of studies have addressed this problem and examined whether it is possible to delay or prevent a decline in cognitive abilities or return them to previous levels. This study examined whether painting and guitar lessons affect the cognitive status of older adults. The research was conducted on a sample of 26 older adults (22 females and 4 males). The average age was 69.5 years. Subjects participated in painting and guitar lessons twice a week for 10 weeks led by an academic painter and music professor. At the beginning and at the end of the research, testing with a Trail making Test, Purdue Pegboard Test and Digit Span Test was conducted. It was found that participation in these art programs did not lead to a significant improvement in cognitive abilities and coordinated work with fingers compared to the initial measurement. These results are in contradiction with the results so far which have shown that the training of fine arts in older adults has yielded improvements in cognitive abilities. One possible reason for this is too short exposure to painting and music lessons.

**Keywords:** cognitive abilities, drawing lessons, guitar lessons, art



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