

take-off velocity, the body segment angles and the V-angle of the skis.

Discussion: The results clearly show that a small body-ski angle in combination with a small vertical velocity of the COM after one second of flight are the best predictors for long flights in ski-jumping. These results emphasize the findings of previous studies (Schwameder & Müller 1995, Arndt et al. 1995, Virmavirta et al. 2004). The correlations between these variables and the jump lengths show a tendency to be higher on the big hill (K120) (Virmavirta et al. 2004). This indicates that aerodynamic conditions increase with the size of the hill and factors of explosiveness during take-off are more important on smaller hills.

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Keywords : *ski-jumping, kinematics, aerodynamics*

P64J11

Relation of chosen morphological features with kinaesthetic memory at representatives of combat sports and students representing University School of Physical Education in Wrocław

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The presented paper deals with defining relations between the level of the analysed kinaesthetic memory and the range of morphological asymmetry of limbs and the level of fat tissue at the investigated subjects. 200 people participated in the research, in that number 120 representatives of combat sports and 80 students of Wrocław University of Physical Education. Having analysed the range of the so called kinaesthetic memory with the use

of „characterograph of muscle strength of upper and lower limbs” and having evaluated the degree of asymmetry with Martin’s Method, it turned out that the higher level of kinaesthetic memory is characteristic for the leading limb in the peripheral range. Such relation is present at representatives of all disciplines but the smallest asymmetry, and thus the differences between upper and lower limbs, appear at boxers, kick-boxers, judokas, whereas the greatest at karatekas and students. At the same time, the analysis of relationships between kinaesthetic memory of limbs (investigated together or separately) and the level of fat tissue revealed the worst results at persons at whom the fat level was higher than 27% in case of men and 32% of women.

Keywords : *kinaesthetic memory, combat sport, morphological featur*

P64J12

Could isokinetic performance differentiate between good and better Slovenian track and field sprinters?

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Strength and speed are inherently interrelated in sprinting. Regarding to that, strength evaluating and testing is one of the most important part for sprinters preparation. Isokinetic dynamometry has been used in testing and performance enhancement for many years. Many studies have found isokinetic dynamometry to discriminate among athletes in different sports, different competition levels or positional roles within a single sport. The aim of the study was to find out, if isokinetic testing of strength could discriminate among two qualitative groups of track and field sprinters.

We submitted two groups of elite Slovenian sprinters. The first subgroup consisted of 9 athletes (81.2±7.0kg, 183.8±5.5cm). Their average maximal speed was 10.1±0.1ms⁻¹. The second subgroup consisted of 9 athletes (79.6±7.4kg, 181.6±5.2cm). Their average maximal speed was 9.4±0.3ms⁻¹. The maximal running velocities (v_{max}) developed during 60 meters run were measured with BROWER TIMING SYSTEM. The stride frequency (SF), the stride length (SL), the flight (FT) and the contact time (CT) were measured between the 30th and 50th meter on a tensiometric carpet (ERGO TESTER – BOSCO) of

20 m length and width 0.8 m. The index of relative frequency (SF*BH) and the index of relative stride length (SL/BH) were calculated.

Peak knee extension (PKE) and flexion torques (PKF) for each subject were measured on a Technogym isokinetic dynamometer (Great Britain) at one speed (180°/s) through four different range of motion (20°, 40°, 60°, 80°). Peak knee torques at different range of motion were adjusted by body weight (R). The significance of differences between two subgroups was tested with independent sample t – test at 5% alpha error.

Two groups of sprinters did not differ significantly in morphological characteristics and peak knee torques measured with isokinetic dynamometer. The differences in CT and SL were on the verge of statistical significance (P<0.08).

Strength is undoubtedly an important factor of sprint performance, but the ability of the nervous system to appropriately activate the specific motor units and specific muscle during the contact phase of sprint stride was probably the most important factor, which might differ between good and better sprinter.

Keywords : *track and field, sprinting, isokinetic dynamometry*

P64J13

Speed fluctuation as a determinant factor of energy cost in Butterfly stroke

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The purpose of this study was to examine the relationships between the speed fluctuation of the centre of mass and the EC, in butterfly stroke.

Five national level Portuguese swimmers performed one maximal and two sub-maximal (85% and 75%) 200-m butterfly swims in a 25-m swimming pool. Cardio-pulmonary and gas exchange parameters were measured breath by breath for each swim to analyze VO₂ and other energetic parameters by portable metabolic cart (K4b2, Cosmed, Rome, Italy). A respiratory snorkel and valve system with low hydrodynamic resistance was used to measure pulmonary ventilation and to collect breathing air samples. Blood samples from the ear lobe were collected before and after each swim to analyze blood lactate concentration (YSI 1500L, Yellow Springs, US). Total energy expenditure (Ė_{tot}) and EC were calculated for each swim. The swims were videotaped (50 Hz) in sagittal plane with a set of two cameras providing dual-media images from both underwater and above the water surface. The cameras were real time synchronised and the images were edited on a mixing table to create one single image of dual-media. APAS system (Ariel Dynamics Inc, USA) was used to analyse speed fluctuation for the centre of mass. Coefficients of variation for the horizontal velocity of the centre of mass along the stroke cycle (dV) were calculated. Linear regressions between the bioenergetic and biomechanical variables were computed, as well as, its (0.05) ≤ coefficients of determination and correlation (p).

There was a significant and linear relationship between Ė_{tot} and velocity (r=0.827, p=0.0005). Statistically significant correlation coefficient between the EC and the dV (r=0.807, p=0.0009) was found, the coefficient of determination being r²=0.651. This means that the increase in the EC being strongly associated with the increase in the speed fluctuation. The individual coefficients of correlation and determination between the EC and the dV were very high (mean r² 0.018, ranging from 0.973 to 1.000). The mean of individual correlation ± = 0.986 0.009 ± coefficients was higher than the overall correlation coefficient (r=0.993 vs r=0.807) of the pooled data.

It is concluded that the speed fluctuation of the centre of mass was related to less efficient swimming and vice versa in butterfly. We suggest that the swimmers should strive to improve their technique performances by avoiding large variations in the speed fluctuation.

Keywords : *butterfly stroke, energy cost, speed fluctuation*