sion (p<0.01). There were no group differences in test front leg variables or in leg flexion (p>0.05). The Phi test did not show any correlation between gender (Phi=-0.031, p>0.05) or standing position (Phi=0.324, p>0.05) with lower body injury rate.

DISCUSSION: The results indicate that relative leg/hip extension strength may be important in the prevention of lower body injuries. Eccentric strength is important in the compression phase of the turn in slalom and giant slalom and landings in freestyle and snowboard cross events. The H/Q ratios in the injured group were better, but this could be due simply to the fact that the injured group was weaker in extension and similar in flexion strength. Athletes in alpine sports such as snowboarding and skiing typically have strong quadriceps and often neglect hamstring training. In conclusion, relative leg/hip strength and bilateral leg strength balance are beneficial in preventing lower body injuries.

REFERENCES

Platzer HP, Raschner C, Patterson C (2009). Comparison of physical characteristics and performance among elite snowboarders. J Strength Cond Res, in press.

Torjussen J, Bahr R (2006). Injuries among elite snowboarders (FIS Snowboard World Cup). Br J Sports Med, 40:230-234.

14:00 - 15:30

Oral presentations

OP-ST03 Sports 3

PROPELLING EFFICIENCY IN MASTER SWIMMERS

ZAMPARO, P., MASSEI, E., GATTA, G., BENELLI, P.

UNIVERSITY OF VERONA

INTRODUCTION. When the swimming records in master competitions are evaluated, it becomes apparent that performance (e. g. maximal speed, vmax) decreases steadily as a function of age. In Italian front crawl swimmers the decrease is of about 0.2 m/s every 10 years of age in short distance (50 m) races and of about 0.1 m/s every 10 years of age over long distance (800 m) races. AIMS. The aim of this study was to investigate if this decrease could be related to a decrease in the propelling efficiency (ηP) of the arm stroke. This work stems from a previous study [1] where this parameter was investigated in children and adults (9-59 yrs of age) of good technical skill but where the adult swimmers were not attending master competitions. SUBJECTS. 61 male master swimmers were tested. They were divided into 4 classes of age: M1: 20-29 yrs (25.9±3.2, n = 17); M2: 30-39 yrs (34.8±2.7, n = 22); M3: 40-49 yrs (44.3±3.1, n = 12); M4: 50-59 yrs (54.1±3.0, n = 10). No major differences in the anthropometric characteristics were found in these subjects even if stature tended to decrease (1.81 vs. 1.77 m) and body mass to increase (72 vs. 78 kg) from M1 to M4. PROTOCOL. The subjects were asked to swim a 25 m pool length at constant speed and to repeat the swim at six different, incremental speeds (from slow, to moderate, to maximal). During each trial, average speed (v) and stroke frequency (SF) were measured in the middle 10 m of each lane. The distance per stroke (DS) was calculated from the ratio v/SF and ηP was estimated according to the simple model proposed by [2], on the basis of values of v, SF and of the shoulder to hand distance. RESULTS. The values of v (1.48, 1.42, 1.34, 1.06 m/s), SF (0.87, 0.86, 0.85, 0.69 Hz) and DS (1.74, 1.70, 1.61, 1.52 m) attained at vmax (in M1, M2, M3 and M4, respectively) show a steady decrease as a function of age. In M1, M2 and M3 both DS (1.9-2.0 m) and ηP (0.28-0.30) show a plateau at slow to moderate speeds whereas in M4, DS and ηP show a continuous decrease with increasing speed and are, even at their top (1.7 m and 0.23, respectively), lower than in the other classes of age. DISCUSSION. Between 20 and 50 yrs, ηP at vmax decreases of about 2% per decade (the decrease in vmax is similar: about 3% per decade). Between 50 and 60 yrs, ηP decreases to a larger extent (about 14%) yet less than the decrease in vmax (about 21% in this decade). This suggest that in masters up to 50 years of age the decrease in performance can be essentially attributed to a decrease in propelling efficiency but that, after this age, also other factors should be taken into account to explain the decrease in swimming performance.

REFERENCES

[1] Zamparo P, DR Pendergast, J Mollendorf, A Termin, AE Minetti. (2005) An energy balance of front crawl. Eur J App Physiol 96: 459-470

[2] Zamparo P (2006) Effects of age and gender on the propelling efficiency of the arm stroke Eur J App Physiol 97: 52 – 58

COMPARATIVE METHOD TO ESTIMATE PROPELLING ABILITY

KARSAI, I., SILVA, A., GARRIDO, N., LOURO, H., LEITAO, L., MAGYAR, F., ÁNGYÁN, L., ALVES, F.

UNIVERSITY OF PÉCS

INTRODUCTION: Producing propelling force in an efficient way in the right swimming direction is one of the key factors in competitive swimming. During the action the extremities of the swimmer give energy to the water molecules to accelerate them, to generate flow around and along the hand-arm complex to achieve the highest pressure difference in the right time and space. There are differences in morphological and physical characteristics between swimmers and there is an infinite number of possible motion variations to perform the crawl arm stroke. Difference should exist between swimmers, and in the way they can exploit the potential of the fluid environment. Direct force measurement is impossible during free swimming and the analitical investigations up to date did not provide a useful method to calculate the force production, therefore a special approach is necessary to express the level of the propelling ability.

METHODS: 8 internationally recognised male swimmers (19,8 ±0,9 yrs, 73,9 ±6,0 kg, 181,7 ±5,5 cm) were asked to perform the non-breathing, only arm task on a special device which recorded the force (f=200). The legs were tied and supported. The starting frequency (FR) was set at f=0,5 Hz and was increased with f=0,083 Hz steps till the swimmer could maintain the stabil rhythm. 4 underwater cameras (50 Hz) were used to record the kinematic parameters and the APAS system was employed to calculate the 3D data for the analysis. Reference forces were calculated based on anthropometric and kinematic data with a 3-segment simple model concerning the drag equation without the C value and a projection to the swimming direction were related to the measured force data. The Pearson correlation was employed between the 100m sprint velocity and the result to test the suitability of the method.

RESULTS: The main force at the starting FR were 50,6 ±21,9 N. The force production increased almost in a linear fashion and peaked at the f=0,65 Hz: 76,2 ±24,5 N and dropped considerably at the highest FR value. The ratio between the measured and the reference force