Oral presentation

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The anthropometric and physiological profile of the Greek international 200-m sprint kayakers

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The physical characteristics of 1,000-m and 500-m sprint kayakers have been previously reported (e.g. Fry and Morton, 1991, *Medicine and Science in Sports and Exercise*, **23**, 1297-1301). Despite the introduction of the 200-m event to the World Championship programme in 1994, no data have been published on the physical characteristics of top performers in this event. Hence the principal aim of this investigation was to determine the anthropometric and physiological profile of the Greek international 200-m kayakers. A secondary aim was to determine the relationships between these characteristics and competitive performance in 200-m kayak racing. Thirteen male kayakers with a mean age of 25 ± 5 years (Mean±SD), who were all current members of the Greek National team and had competed in international 200 m racing, participated in this study. Subjects were required to visit the laboratory for familiarisation and assessment of anthropometric and physiological measures. Anthropometric assessment undertaken was the measurement of body mass, stature, the sum of four skinfolds and estimated percent body fat. Girth measurements and bone breadths were taken to allow the calculation of somatotype using the Heath-Carter procedure. Pulmonary function was determined by means of a spirometry system (Oxycon Alpha, Mijnhardt b.v., The Netherlands). Characteristics of isometric strength and isokinetic power during a simulated kayak stroke, were assessed using an isokinetic dynamometer (Cybex II, Lumex Inc., New York). A maximal incremental exercise test was performed on an air-braked kayak ergometer (K_1 ERGO, Australian Sports Commission) to determine VO_{2peak} and the submaximal VO_2-power regression, which was used to calculate the accumulated oxygen deficit during a 2-min ergometry trial. In addition, subjects performed a 30-s modified Wingate Anaerobic test on the kayak ergometer. Pearson product moment correlations were employed to determine the relationship of anthropometric and physiological parameters with 200-m race performance, recorded at a national competition held at the time of testing. The mean 200-m race time for the subjects was 39.9 ± 0.8 sec (Mean±SD). The anthropometric assessment identified a body mass of 84.5 ± 4.9 kg, a stature of 1.829 ± 0.056 m, a sum of skinfolds of 31.6 ± 9.5 mm, an estimated body fat of 14.1 ± 2.9 %, and a somatotype of 2.6 ± 0.8, 4.9 ± 0.9 and 2.1 ± 0.7 (for endomorphy, mesomorphy and ectomorphy, respectively). Of these, the sum of skinfolds, estimated body fat and the rating of endomorphy were inversely related to 200-m race time ($r = -0.76$, $P < 0.01$; $r = -0.72$, $P < 0.01$, and $r = -0.66$, $P < 0.05$, respectively). The only parameter of pulmonary function that was correlated with 200-m time ($r = 0.72$, $P < 0.01$) was FEV_1 (5.3 ± 0.6 L). Neither peak isometric strength (450.8 ± 77.3 $N \cdot m^{-1}$) nor peak isokinetic power (721.2 ± 104.4 W) was related to race time. The VO_{2peak} of the subjects (4.3 ± 0.4 $l \cdot min^{-1}$) was not correlated with 200-m time, though when expressed relative to body mass (52.6 ± 4.9 $ml \cdot kg^{-1} \cdot min^{-1}$) a relationship with time was found ($r = 0.54$, $P < 0.05$). The accumulated oxygen deficit (51.8 ± 9.6 ml O_2 $Eq \cdot min^{-1}$), the work done in the modified Wingate test (15.29 ± 1.63 kJ) and the peak power in the modified Wingate test (615.1 ± 81.5 W) demonstrated no significant relationships with 200-m kayaking performance. The results show that within a homogeneous group of top-level 200-m kayakers, the best performers exhibited a relatively high level of adiposity and a relatively low aerobic power when normalised for body mass. These findings compare to previous literature (e.g. Fry and Morton, 1991) that has shown low levels of body fat and superior aerobic capabilities to be related to successful 1,000-m and 500-m sprint kayaking performance. Therefore this study identifies the anthropometric and physiological profile of the 200-m kayaker, and illustrates the disparities with those of athletes specialising in the longer sprint kayaking events.

Notes

The kayakists reported to the Water Sports Laboratory in the Department of Physical Education and Sport Science of the National and Kapodistrian University of Athens for physiological and anthropometric assessment. Testing was conducted over 3 days separated at least by 48h. Subjects were required to provide written informed consent prior to testing, to maintain their normal diet and training throughout the study and to not train on the day prior to each test. They were also instructed to be adequately hydrated and to not have eaten 3 h prior to each test. The sample included 13 internationally ranked male paddlers. Physiological variables measured in the test battery included pulmonary function, muscular strength, anaerobic capacity and power, maximal oxygen consumption and accumulated oxygen deficit.

Anthropometric assessment. Anthropometric variables were standing and sitting height, body mass, girth measures, measures of skeletal size and the sum of four skinfold sites. All measurements were carried out by the same person, using the same equipment. Harpendon skinfold calipers were employed to measure skinfolds at four sites: biceps, triceps, subscapular, and abdomen. From these data the sum of four skinfold sites was calculated and used as the measure of adipose composition.

The body density equations of Durnin and Wormersley (1974) and the Siri equation (1956) were used.

Pulmonary function. Forced vital capacity was assessed using a Oxycon Alpha dry spirometer. Volumes were expressed in units under BTPS conditions and American Thoracic Society standards (1979) were required to be achieved for test scores to be accepted. The scores were taken as the best of two trials.

Muscular strength. Isometric peak strength was measured at a relative angular position of 90◦ at the elbow joint. Isokinetic peak torque at the angular speed of 30?/sec was measured. Speed of 30?/sec was chosen because most closely reproduce the speed of paddle movement observed during kayak racing as confirmed by several participants in the study and data from Plagenhoeff (1979) and Mann and Kearney (1980). Torque was expressed in nm. Five trials performed and there was a 180 sec recovery period enforced between each trial and 15 min recovery period between each side.

30 sec all-out test. Anaerobic power and capacity were assessed using a 30 sec all-out test on a calibrated, air-braked kayak ergometer (K1 Ergo, Garran, Australia). According to van Someren et al (2000) and Campagne et al (1982), K1 Ergo accurately simulates the physiological demands of short term high intensity kayaking. The foot-bar position of the kayak ergometer was adjusted prior to each test to resemble the paddler's own kayak. The ergometer was interfaced with a computer that continuously measured, calculated and stored accumulated work and power using specifically designed software. Work was expressed in joules. The subject was encouraged to perform maximally throughout the test and aim to achieve his peak power within the first few seconds.

Aerobic performance test. The following pulmonary gas exchange and ventilatory variables were recorded breath by breath: oxygen uptake ($\dot{V}O_2$), carbon dioxide output ($\dot{V}CO_2$), respiratory ratio (RER) and minute ventilation (VE). The gas analysis system was calibrated before and after each test. The subject initially sat on the ergometer for 3 min while data for resting metabolism were obtained. Following this period paddling commenced for 2 min at their own maximal exercise intensity.