dicting competition success from different anthropometrical and physiological values in children are important in swimming. Accordingly, the aims of the present investigation were to: 1) assess the use of recovery oxygen consumption values for determining oxygen cost during front crawl swimming; and 2) determine the factors that best predict maximal oxygen consumption and the ability to perform a 400-m front crawl swim.

METHODS

Twenty nine prepubertal (Tanner stages 1 and 2) and pubertal (Tanner stages 3 and 4) boys (13.0±1.8 yrs; 163.6±11.9 cm; 51.6±13.0 kg; %body fat: 12.1±5.3 %) underwent different anthropometrical and physiological measurements. Swimmers also performed 400-m front crawl swimming to determine the validity of calculating exercise oxygen consumption from expired gas samples taken during the first 20 seconds of recovery after the activity. During the 400-m front crawl swimming, the average speed (v), stroke frequency (SF), stroke length (SL), stroke rate (SR) and stroke index (SI) were computed. In addition, energy cost of swimming (Cs) from the measured parameters was calculated. Dual energy X-ray absorptiometry was used to measure different body composition parameters and maximal oxygen consumption was determined on a bicycle.

RESULTS

Prepubertal children had smaller values for measured body composition and maximal oxygen consumption values except for body fat and oxygen consumption per kg body mass values compared to pubertal children. Similarly, mean v (0.99±0.12 vs 1.12±0.13 m/s), SL (0.87±0.11 vs 0.99±0.10 m/cylce), SI (0.87±0.20 vs 1.11±0.22 m^2/s/cycles), Cs (2.38±0.41 vs 3.29±0.67 kJ/min) and oxygen consumption (2.53±0.50 vs 3.92±0.90 l/min) during 400-m front crawl swimming were significantly lower in prepubertal boys compared to pubertal swimmers. Relationship between directly determined maximal oxygen consumption and oxygen consumption determined after 400-m front crawl swimming was highly significant ($r=0.850$; $p<0.001$). Swimming performance at 400-m front crawl distance was best determined by specific anthropometric and body composition (height, arm span, fat free mass, bone mineral mass and density), physiological (maximal oxygen consumption) and swimming technique (v, SL and SI) parameters in boys.

DISCUSSION

It is possible to accurately determine oxygen consumption during maximal swimming using a single, 20-s expired gas collection taken immediately after 5-7 min maximal front crawl swim in prepubertal and pubertal boys. In addition, specific stroke technique parameters are important determinants of the energy cost and variations in performance during swimming in prepubertal and pubertal boys.

ENERGY COST AND INTRA-CYCLIC VARIATION OF THE VELOCITY OF THE CENTRE OF MASS IN BREASTSTROKE.

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INTRODUCTION

The purpose of the present study was to analyse the relationship between energy cost (C) and intra-cyclic speed fluctuations (dv) in breaststroke.

METHODS

Four elite breaststroke swimmers (2 males of 17.0±0.0 yy, 172.5±3.5 cm and 69.4±2.0 kg, and 2 females of 17.5±2.1 yy, 167.0±7.1 cm and 64.2±4.2 kg) performed an incremental intermittent protocol (n x 200m) for maximal oxygen consumption assessment (Fernandes et al., 2003), during which biomechanical and bioenergetical parameters were measured. The test was videotaped in sagittal plane with two SVHS cameras, providing, after mixing and editing, a dual-media image of the swimmer. The APAS software (Ariel Dynamics Inc, USA) was used to calculate the variation coefficient (dv) of the v(t) function of the centre of mass (CM) for each 200m step. Oxygen consumption was measured through a portable gas analyser (K4 b^2, Cosmed, Italy) connected to the swimmers by a respiratory snorkel and valve system. Capillary blood samples were collected from the ear lobe, before and after each set, to analyse blood lactate concentrations (YSI 1500L Sport, USA). The energy expenditure ($\dot{E}$) and C ($\dot{E}.v^{-1}$) were calculated for each 200m using net values of VO_2 and blood [La-], converted with a 2.7 $mlO_2.kg^{-1}.mmol^{-1}$ constant.

RESULTS

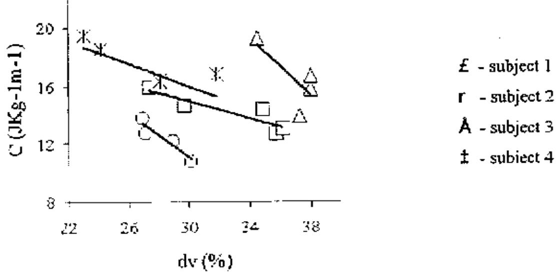

Figure 1. Relation between C and dv.

Intra-cyclic speed fluctuations (dv) decreased with mean swimming velocity ($r=-0.63$, $p\leq 0.01$). $\dot{E}$ increased with v^3, and, as it is possible to observe in Figure 1 for each swimmer, C decreased with increasing dv.

DISCUSSION

As it was expected, a cubic relationship between $\dot{E}$ and dv was found, once energy output is a function of mechanical power, and the latter is expected to be a function of v^3. The relationship obtained between C and dv do not confirm previous literature (Vilas-Boas, 1996). This finding may be due to differences in methodological procedures, or more obviously due to the higher influence of v, than dv, in $\dot{E}$.

REFERENCES

Fernandes RJ, Cardoso CS, Soares SM, Ascensão AA, Colaço PJ, Vilas-Boas JP (2003). Time limit and VO_2 slow component at intensities corresponding to VO_2max in swimmers. Int. J. Sports Med. 24: 576-581.

Vilas-Boas JP (1996). Speed fluctuations and energy cost of different breaststroke techniques. In J. P. Troup, A. P. Hollander, D. Strasse, S. W. Trappe, J. M. Cappaert, T. A. Trappe (Eds.) Biomechanics and Medicine in Swimming VII. E & FN Spon. London, 167-171.

ACUTE EFFECTS OF THE USE OF A BIOFEEDBACK SYSTEM FOR THE TECHNICAL TRAINING IN BREASTSTROKE SWIMMING.

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INTRODUCTION

The purpose of this research was to develop, validate, and evaluate a biofeedback system for the technical training in breaststroke swimming. The system lied on the assessment of speed fluctuation curves of an anatomical landmark of the swimmer (hip).

METHODS

The research developed through the informations displayed by a cable speedometer, specifically produced for the study, which signal was synchronized with dual media video images of the swimmer's performance. The velocimetric signal was graphically registered, and acoustically provided to the swimmer and coach during the performance. For the appreciation of the utility of the biofeedback solutions proposed for the technical training of breaststrokers, the acute effect of their use was analysed. For that purpose, the acute biomechanical response of five homogeneous (speed fluctuations and sex) groups to five different technical training programs with one hour of duration were studied. All the groups intended to minimize the speed fluctuations within a stroke cycle (dv = variation coefficient (VC) of the instantaneous velocity distribution) at the mean velocity correspondent to the race pace of the 200m breaststroke event. The sample was composed by 50 swimmers distributed by five groups of 10. Group 1 used only informations provided by the swimmer's coaches, Group 2 used also the graphical data provided by the speedometer, Group 3 included also dual media video images, and groups 4 and 5 accumulated concomitant acoustic informations (Group 4 every cycle, and Group 5 once in each two cycles).

RESULTS & DICUSSION

VC ranged from 0.40 to 0.43, without statistical significant differences between groups. The mean values of stroke length (SL) were between 1.41m and 1.65m, with less homogeneity between groups. The cycle duration (T) ranged between 1.5sec and 1.7sec. The mean velocity per cycle (V) was between $0.9m.s^{-1}$ and $1.0m.s^{-1}$, and the Stroke Index (SI=V*SL) varied between 1.4 and $1.8m^2.s^{-1}$. The higher positive acceleration values were observed, in all groups, during the propulsive leg action, and ranged between $4.8m.s^{-2}$ and $5.7m.s^{-2}$. Among the main conclusions of this research, it is possible to state that: (i) the use of the biofeedback devices (graphical and acoustic displays of the speedometer, and dual media video images) influenced the motor learning processes associated to the acute effect of the swimming technical training provided - this effect is as larger, as higher and frequent the quantity of information provided; (ii) the swimming technical training of one hour of duration, complemented or not by additional technological means, has as acute effect a depression of the subjects' technical ability; (iii) the technical changes with training, at least during a one hour process, are not temporal, but spatial, or derived ones (velocity, and acceleration), and each group distinguished from the others, in each evaluation moment, from very detailed and changing technical variables.

EVOLUTION OF BUTTERFLY TECHNIQUE WHEN RESISTED SWIMMING WITH PARACHUTE, USING DIFFERENT RESISTANCES.

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INTRODUCTION

The use of resistance training with parachute, modifying posterior diameter, produces variations in the stroke frequency (SF), the stroke length (SL), speed (S) and stroke index (SI) during swimming. It is necessary to observe the progressive modifications produced in these parameters as the resistance swimmers must drag is increased. With this data trainers can decide the type of load and period of preparation in which it should be used, in order not to negatively affect swimmers' performance. It will also permit him to know which parameters have greater variation and must be controlled during training.

METHODS

The study was carried out with 18 swimmers of national level between 19 and 22 years of age. They carried out 6 tests consisting in swimming butterfly style 25 meters at maximum intensity using normal swimming (NS) and resisted swimming with parachute (RSWP) with a front diameter of 30cm and a posterior diameter of 30cm, 22.5cm, 15cm, 7.5cm and 0cm. The lap times and number of cycles in the central 10 meters, of the 25 meter distance were registered. SF, SL, S, and SI variables were analyzed in these tests. An intra-subject design was applied and the study of the data was carried out by means of a variance analysis for repeated measures.

RESULTS

The results obtained showed how the SF does not significantly differ with different spans, but there are significant differences between NS and 0cm ($p=0.015$), 15cm ($p=0.001$) and 30cm