THE INFLUENCE OF COMPETITIVENESS LEVEL ON MATCH EXERCISE INTENSITY IN ELITE WATER POLO PLAYERS.

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INTRODUCTION
This study was designed to investigate the physiological responses that existed in different competitive level players during water polo games. Specifically, the hypothesis that the players of Greek National Team (NTP) perform with higher intensity than the players of the 1st Greek National League (NLP) was tested.

METHODS
Thirty players, who had equally split to NTP and NLP, participated in this study. Initially, their physiological profile, which was related with their performance, was evaluated. Subsequently, heart rate (HR) was continuously monitored and blood lactate (La) was measured at the end of each period during 10 water polo games.

RESULTS
Maximum oxygen uptake, lactate threshold point as well as HR values corresponding to the threshold are presented in Table 1. In addition, Table 1 shows HR and La values attained during the water polo games and their respective significant differences. No differences were found with respect to the percentage of time spent with exercise intensity above and below the threshold between NTP and NLP. However, as Figure 1 indicates, regardless of relative terms (%), NTP swam with significantly higher velocity than NLP throughout the game.

Table 1: Physiological traits of subjects during performance tests and water polo games

<table>
<thead>
<tr>
<th></th>
<th>NTP</th>
<th>NLP</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Performance tests</td>
<td></td>
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<tr>
<td>VO2max (ml/kg/min)</td>
<td>70.23±6.97</td>
<td>57.14±9.26</td>
<td>0.001</td>
</tr>
<tr>
<td>LTH (mmol/l)</td>
<td>3.47±0.76</td>
<td>4.60±0.80</td>
<td>0.002</td>
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<tr>
<td>HRT (beats/min)</td>
<td>147.5±9.6</td>
<td>163.1±9.6</td>
<td>0.001</td>
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<tr>
<td>Water-polo match</td>
<td></td>
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<tr>
<td>HR (beats/min)</td>
<td>149.8±8.2</td>
<td>162.9±9.9</td>
<td>0.001</td>
</tr>
<tr>
<td>La (mmol/l)</td>
<td>3.04±1.09</td>
<td>4.67±2.17</td>
<td>0.002</td>
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</table>

DISCUSSION
Exercise intensity exhibited during the games was not affected by the level of competitiveness when values were considered relative to lactate threshold; however, NTP had higher swimming velocity than NLP. It is concluded that the players of Greek national team performed at higher absolute exercise intensity than the players of the 1st Greek National League.

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

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INTRODUCTION
The purpose of this study was to examine the relationship between energy cost (C) and intra-cyclic speed fluctuations (dv), in backstroke.

METHODS
Five male elite backstroke swimmers (18.6±1.5 yr, 179.2±2.3 cm and 70.2±8.5 kg) performed an incremental intermittent protocol (n = 200m) for maximal oxygen consumption assessment (cf. Fernandes et al., 2003), during which biochemical and biochemical parameters were measured. The test was videotaped in sagittal plane with two SVS cameras, providing, after mixing and editing, a dual-media image of the swimmer. The ATIS software (Ariel Dynamics Inc, USA) was used to calculate the variation coefficient (dv) of the x,y function of the centre of mass (CM) for each 200m step. Oxygen consumption was measured through a portable gas analyser (K4 b, 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 (E) and C (E/v) were calculated for each 200m using net values of VO2 and blood [La-], converted with a 2.7 mlO2/kg 1.mmol/l constant.

RESULTS
The E vs v presented a linear relationship for the pooled data (r = 0.67, p < 0.001) and for 2 subjects (0.56 ≤ r ≤ 0.99, p ≤ 0.01), and a cubic relationship for the others (0.22 ≤ r ≤ 0.99, p ≤ 0.05). For the pooled data, C increased linearly with dv (r = 0.39, p ≤ 0.05), despite individual relationships showed particular results (Fig. 1).

Figure 1: Mean swimming velocity of water polo players in 10 games.

Figure 2: Individual relationships between C and dv.
DISCUSSION
As it was expected, € increased both linearly, and cubically with $v$. These 2 different results were previously found in literature and may both be explained through the variation of mechanical power with the cube of the swimming velocity and a non linear variation of swimming efficiency with velocity, probably related to changing intra-cyclic variation of $v$. The relationship between $C$ and $dv$ seems to be extremely individual and mostly determined by $v$ and $dv$ relationships.

REFERENCES

THE INFLUENCE OF TUCK INDEX, DEPTH OF FOOT-PLANT, AND WALL CONTACT TIME ON THE VELOCITY OF PUSH-OFF IN THE FREESTYLE FLIP TURN.
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INTRODUCTION
Effective turns play a critical role in the outcome of swimming competition. In short-course events, turns comprise up to one-third of the total race time. At elite competitive levels, mid-pool swimming velocity is the primary determinant of race performance. However, turns have the potential to determine a winner among swimmers with the same mid-pool swimming velocities. The purpose of this study was to examine the effect of three variables on the velocity of the push-off during the freestyle flip-turn. These variables are: (a) The distance from the wall a swimmer's hips should be at foot contact (Tuck Index); (b) The depth of the foot plant on the wall during push-off; and (c) The wall-contact time.

METHODS
Twelve male and eleven female members of a University (Division I) swimming team participated in the study. Their ages ranged from 19 to 25 years. Each subject was required to perform a series of trials, each trial consisting of a 50-yard freestyle swim over a 25 yard (22.5 m) course which included one turn. Subjects were instructed to perform the flip turn at race pace, swimming at maximum speed for 5 meters before and after the turn. Each turn was videotaped from underwater using a single digital camera. The camera was placed at a depth of half a meter, and located 2 meters from the end of the pool and 7 meters lateral to the turning surface. A four-point calibration rod was used as a scaling factor for the kinematic analysis. 2D analyses in the sagittal plane were made using motion analysis software (Vicon/Pex, Denver, Colorado). A Pearson correlation coefficient matrix was constructed to identify the relationship between variables. Simultaneous regression analysis was conducted using the push-off velocity as a dependent variable to determine the overall predictive characteristics of the variables.

RESULTS & DISCUSSION
The mean push-off velocity was 2.47 m/s. The minimum velocity was 1.3 m/s and the maximum push-off velocity was 3.29 m/s. Tuck index is the ratio measurement used to indicate how close a swimmer is to the wall. A higher tuck index indicates straighter legs. In the present study, the mean tuck index of all turns was 0.57 ± 0.14, indicating that the hips were a mean distance from the wall that was approximately 57% of the length of the swimmer's legs. The study found a significant, negative correlation between push-off velocity and tuck index, indicating that the more tucked position (lower tuck index) predicted higher push-off velocity. No significant correlations existed between push-off velocity and foot-plant, Wall Contact Time (WCT) was divided into two segments, a "preparatory" segment and an "active" segment. The mean percentage of the wall contact spent in the "active" push-off phase was 74.31%. Although previous studies have shown positive correlations indicated that longer active segments resulted in faster final push-off velocities, no significant relationship was found between "active" WCT and push-off velocities.

COMPARISON BETWEEN DIFFERENT METHODS FOR THE ASSESSMENT OF THE VO2 SLOW COMPONENT OF FREESTYLE ELITE SWIMMERS.
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INTRODUCTION
The purpose of this study was to compare different methods for the assessment of the Oxygen Slow Component (SC) in elite swimmers in a time limit test at the minimum velocity that elicits maximal oxygen consumption (TLim-VO2max).

METHODS
Five females (16.9±1.5 yr; 59.0±3.1 kg and 165.8±3.2 cm) and two males (18.5±1.0 yr; 74.6±8.5 kg and 176.0±11.3 cm) elite front crawl swimmers swim until exhaustion at their previously determined VO2max to assess TLim+VO2max (Fernandes et al., 2003). VO2 was measured by a portable gas analyser (K4 b, Cosmed, Italy) connected to the swimmers by a respiratory snorkel. To describe the SC kinetics was used a mathematical model with three exponential functions (cf. Machado et al., 2006). This model was compared with different methods of rigid time intervals defined as the difference between the end VO2 and the one at the 2nd min (ΔVO2[2min]) or at the 3rd min of exercise (ΔVO2[3min]), with different averages around the 2nd and 3rd min, and the end of the exercise (20 s, 30 s or 40 s).

RESULTS