SWIMMING VELOCITY COMPARISSON BETWEEN ELITE SWIMMING AND TRIATHLON BRAZILIAN ATHLETES

Fabiano Gomes Teixeira[12], Fernando Antônio Vanzella[1], Eduardo Riveira Braz[1] , Mauro Gonçalves [2] and Adalgiso Coscrato Cardozo[2]

1-Social Service of Industry (SESI-SP), São Paulo-SP - Brazil
2-Biomechanics Laboratory, Department of Physical Education-IB, São Paulo State University, Rio Claro-SP, Brazil

The purpose of this study was to identify the pattern of elite athletes in velocity modalities swimming and triathlon through Velacqua equipment comparing the kinematic variables that affect the performance of these two modalities in swimming. Participated at this study eight swimmers and eight triathletes, who performed a 25m swimming at maximal speed. The results showed higher VS to swimmers than the triathletes, indicating a higher performance of this group. It is also observed greater values of Vmin, lower CV values and greater LS values indicating that the swimmers are able to maintain more constant velocity, and they do not let the velocity decreases too much during the competition.

KEY WORDS: Swimming, Triathlon, Swimming Velocity and Biomechanics.

INTRODUCTION: Swimming is a sport highly dependent on the technical ability of the athlete (Caputo, Lucas, Greco and Denadai, 2000). Thus, biomechanical factors that interfere on resistive and/or propulsive forces influence the performance more than the capacity of energy production and energy release to the movement on the water.
So, the swimmer's body position in water is essential, since the resistive and propulsion forces, which determine the performance, can influence the kinematic parameters of swimming.
Differences between the technical characteristics of swimmers and triathletes were verified by Toussaint (1990). It was suggested that the triathletes should emphasize more the training of their swimming technique, once they had greater frequencies of strokes (FS) and lower length of strokes (LS) when compared to swimmers, when both groups performed the swim "crawl" in the same speed.
Considering therefore that kinematic biomechanical parameters may change under different conditions of swimming in groups of different specialties swimmers (Craig Junior and Pendergast, 1979), and few studies relate the velocity of swimming in Elite athletes in swimming and triathlon, the objective of this study was to compare kinematic variables between swimmers and triathletes during the swim crawl at maximal speed and identify which variables are able to differentiate the groups.

METHODS: The study included 16 athletes, participants of the main national championships, in which eight were swimmers and eight were triathletes.
After warming up, each participant performed one series of 25m of swimming "crawl" at maximal speed in a pool of 25m (average water temperature: 29,8º C). The athletes were instructed to start the swimming beside the wall and to swim at maximal velocity.
The series were recorded with an underwater camera of 30 frames per second, coupled to the Velacqua® System (submerged at 0.3 m and 2.5m distance from the swimmer) that accompanied the swimmers. I was also obtained the instantaneous velocity of athletes, by means the Velacqua® system. This equipment consists: IOX2 speedometer (equipment coupled to the athlete through a belt, which records the data of the instantaneous swimmer velocity with a sampling rate of 25Hz); the robot Velacqua® (accompanies the athlete during swimming path); and the program SPA - Sports Performance Analyzer (synchronously capture the video images and speedometer data) as illustration in the figure 1 below.

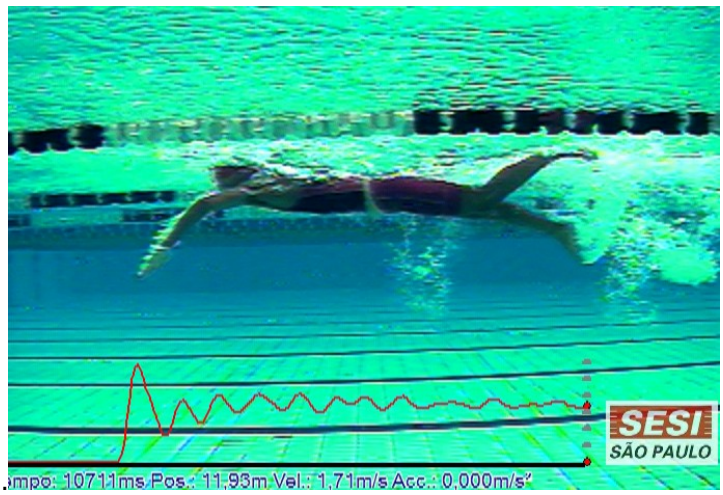

Figure 1- Environment of the software SPA - Velacqua®.

In this study, the swimming velocity (VS) was expressed in meters per second and it was obtained by averaging the instantaneous velocity from the start of swimming (hand entry in water to make the first stroke) to the marking swimming pool at 20 meters. The maximum velocity (Vmax) and minimum velocity (Vmin) of swimming were obtained from the same range and data were also measured in meters per second, and were considered as the maximum instantaneous velocity and the minimum velocity at the instant swimming respectively. It was also obtained the Velocity Boost (VB) in meters per second from the maximum instantaneous rate achieved after the push wall, and the coefficient of variation of the velocity of swimming (CV) determined by the following formula:

CV = standard deviation of the instantaneous velocity / VS * 100

In addition to the velocity variables, it was also obtained the frequency of stroke (FS), this being the number of cycles per second, and the length of stroke (LS) in meters. These variables were obtained from six stroke cycles.
The comparison between groups was performed using Student's t test for independent samples, and adopted the significance level $\alpha < 0.05$, and the effect size was calculated by *d* cohen.

RESULTS: The results of swimmers and triathletes groups are shown in Table 1.

Table 1
Mean values (standard deviations) of the variables of the two groups and their effect size

Variable	Swimmer	Triathlete	Effect Size
Velocity Swim (VS) ($m.s^{-1}$)	1.83 (0.08)	1.70 (0.12)	1.27*
Maximum velocity (Vmax) ($m.s^{-1}$)	2.43 (0.14)	2.37 (0.20)	N.S.
Minimum Velocity (Vmin) ($m.s^{-1}$)	1.27 (0.18)	1.05 (0.28)	0.93*
Velocity Boost (VB) ($m.s^{-1}$)	3.48 (0.53)	3.17 (0.40)	N.S.
Coefficient of Variation (CV) (%)	13.53 (2.88)	18.38 (5.54)	1.09*
Frequency of Strokes (FS) ($cicles.s^{-1}$)	0.85 (0.05)	0.94 (0.13)	N.S.
Length of Strokes (LS) (m)	2.13 (0.09)	1.81 (0.18)	2.24**

N.S. – Not significant
*** p<0.05**
**** p<0.01**

The results showed higher VS to swimmers than the triathletes, indicating a higher performance of this group. It is also observed greater values of Vmin, lower CV values and

greater LS values. However, no difference was found for Vmax ($p = 0.258$), VB ($p = 0.105$) and FS ($p = 0.106$).

DISCUSSION: This study was conducted in order to check possible effects of swimming velocity in maximum intensity in different sports (swimmers and triathletes). Such concerns with these variables have been described in the literature (Keskinen and Komi, 1993; Hay and Guimarães, 1983).
In relation to the swimming velocity of swimmers and triathletes De Souza Castro, Guimarães, Moré, Lammerhirt and Marques (2005) found values of 1.86 $m.s^{-1}$ for swimmers and 1.53 $m.s^{-1}$ for triathletes, when they performed the swim at maximal intensity in 25m pool. In our study we found similar velocity for swimmers, but, 10% higher to triathletes.
The ability to achieve high VS both in swimming and in triathlon is directly related to higher LS. Thus, athletes who have higher LS obtain higher VS. Craig Junior and Pendergast (1979) suggest that performance in swimming can be improved if the athlete practices with slow FS to get a higher LS, since there is a negative relationship between FS and LS. In this case, if the increment of LS is able to reduce costs, at least equal of FS, VS would remain constant. So the most suitable suggestions is to try to increment the LS with a lower reduction of the FS. There for, considering the LS and the VS and assuming that the technique used by swimmers as a standard, the triathletes should seek higher LS to optimize performance. This strategy could provide better propulsion and economy in swimming (Toussaint and Beek, 1992).
In addition to these differences between groups, two other important variables must be considered to explain the better performance of the swimmers: lower CV values and higher Vmin values. These variables show us that swimmers are able to maintain higher VS not because they can reach higher velocity during the test, since Vmax shows no differences between the groups, but because they are able to maintain a more constant velocity and allow a smaller drop in velocity along the test. Larger velocity fluctuations and greater decreases in velocity, as presented by triathletes, can promote changes in body position in the water, increasing resistive forces and reducing the athlete's performance (De Souza Castro et al., 2005).
These findings indicate that triathletes should have training protocols that improve not just the LS, but also that enable reductions in velocity fluctuations and that emphasize the need to not allow that velocity decreases greatly during the swimming.

CONCLUSION:
Swimmers have a higher VS compared to triathletes due mainly to higher LS values found. Other factors that may contribute to this better performance are the smallest CV and the largest Vmin values found, indicating that the swimmers are able to maintain more constant velocity, and they do not let the velocity decreases too much during the competition.

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