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KINEMATICAL CHARACTERISATION OF THE BASIC HEAD-OUT AQUATIC EXERCISE "SAILOR'S JIGS"

INTRODUCTION

Massive research has been produced throughout the last decades in order to better understand the role of head-out aquatic exercises in populations' health (Barbosa et al, 2009). Indeed, such studies aimed to characterize the physiological acute and/or chronic response of subjects performing head-out aquatic exercises. Moreover, the comprehensive knowledge about the biomechanical (i.e. kinematical) behavior performing this aquatic activity is quite reduced.

Conducting head-out aquatic exercise sessions, instructors often use the music cadence to achieve a pre-imposed intensity of exertion. Music cadences between 130 and 150 b.min^{-1} are suggested by technical literature for head-out aquatic exercises (Kinder and See, 1992). At least one empirical study reported that for healthy and physically active subjects instructors should choose music cadences between 136 and 158 b.min^{-1} (Barbosa et al., 2010).

Increases in the music cadence imposed significant increases in the acute physiological adaptation (e.g., rate of perceived effort, heart rate or blood lactate) of the subjects (Hoshijima et al., 1999; Barbosa et al., 2010. It is hypothesized that increased physiological response may be explained by the fact that increasing music cadence will also increase movement velocity and frequency, decreasing the segmental range of motion. However, to our knowledge there is no study in the literature reporting the kinematical changes imposed by an incremental cadence protocol at head-out aquatic exercises.

The aim of this study was to analyze the relationships between musical cadence and kinematical characteristics of a basic head-out aquatic exercise, when immersed to the xiphoid process (i.e., breast).

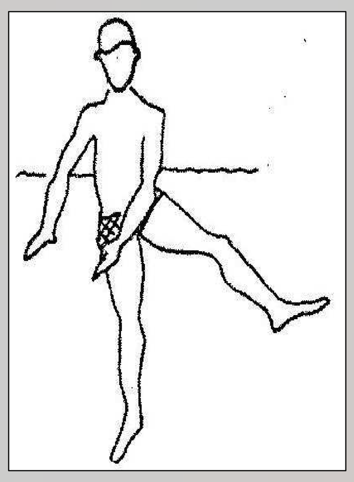

Figure 1. The basic aquatic exercise studied and called "sailor's jigs".

METHODS

Six non-pregnant, clinically healthy and physically active young women holding a graduation degree in Sports Sciences and at least one year of experience conducting head-out aquatic classes volunteered to participate in this study (23.67 ± 0.52 y-old; 57.42 ± 4.78 kg of body mass; 1.64 ± 0.07 m of height; 22.17 ± 2.56 kg.m^{-2} of body mass index).

The protocol consisted of five bouts of 16 repetitions performing the basic head-out aquatic exercise "sailor's jigs" (Figure 1) at the "water tempo" immersed to the xiphoid process (i.e., breast). Bouts intensity were 80 %, 90 %, 100 %, 110 % and 120 % of the cadence reported by Barbosa et al. (2010) to achieve a 4 mmol.l^{-1} of blood lactate, representing respectively 120 b.min^{-1}, 135 b.min^{-1}, 150 b.min^{-1}, 165 b.min^{-1} and 180 b.min^{-1} cadences. Musical cadence was controlled electronically by a metronome (Korg, MA-30, Tokyo, Japan) connected to a sound system.

Data analysis was conducted as reported by Oliveira et al (2010; in press). The protocol was videotaped in sagittal plane with a pair of cameras providing a dual projection from both underwater (GR-SXM25 SVHS, JVC, Yokoama, Japan) and above (GR-SX1 SVHS, JVC, Yokoama, Japan) the water surface.

The images of both cameras were recorded independently. The study comprised the kinematical analysis of the full cycles (Ariel Performance Analysis System, Ariel Dynamics Inc., USA) through a VCR (Panasonic, AG 7355, Japan) at a frequency of 50 Hz. Zatsiorsky's model with an adaptation by de Leva (1996) was used with the division of the trunk in two articulated parts. To create a single image of dual projection as described previously (Vilas-Boas et al.,1997; Barbosa et al., 2005), the independent digitalization from both cameras was reconstructed with the help of a calibration object (0.675 x 0.855 m; 6 control points) and a 2D-DLT algorithm (Abdel-Aziz and Karara, 1971). For the analysis of the curve of the centre of mass's kinematics a filter with a cut-off frequency of 5 Hz was used, as suggested by Winter (1990). For the segmental kinematics a cut-off frequency of 9 Hz was used, near to the value proposed by Winter (1990). A double-passage filtering for the signal processing was used.

METHODS

It was evaluated the: (i) cycle period; (ii) 2D angular position ranges (foot, hand and trunk); (iii) 2D angular velocity ranges (foot, hand and trunk).

The normality of the distributions was assessed with the Shapiro-Wilk test. Linear regression equations models and its coefficients of determination were used to describe the relationships between musical cadence and biomechanical variables. The level of statistical significance was set at $P < 0.05$.

RESULTS AND DISCUSSION

Figure 2 reports the simple scatter gram from the cycle period according to the musical cadence imposed. . Figure 3 and 4 presents respectively the overlay scatter gram for 2D angular range of motion and 2D angular velocity according to the musical cadence imposed.

The cycle period decreased through the incremental protocol. The relative angle between thigh and leg presented a negative and significant relationship with the cadence imposed. The relative angle between arm and forearm presented a negative relationship with the cadence but significant only for the left limb. No significant relationships were verified between musical cadence and the relative angle between thigh and trunk.

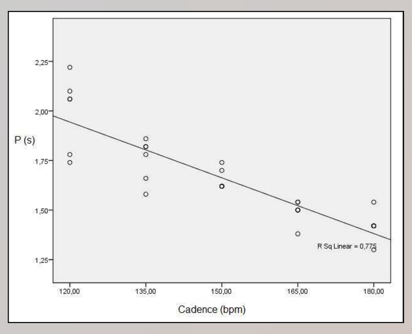

Figure 2. Simple scatter gram from the cycle period according to the cadence imposed.

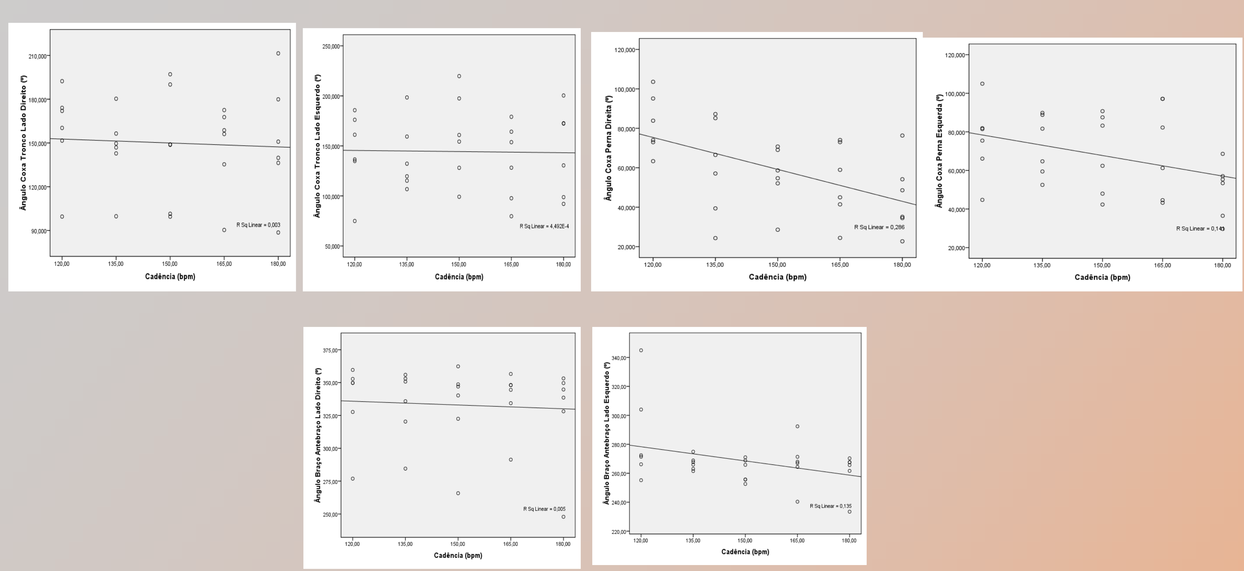

Figure 3. Overlay scatter gram from 2D angular position ranges according to the cadence imposed.

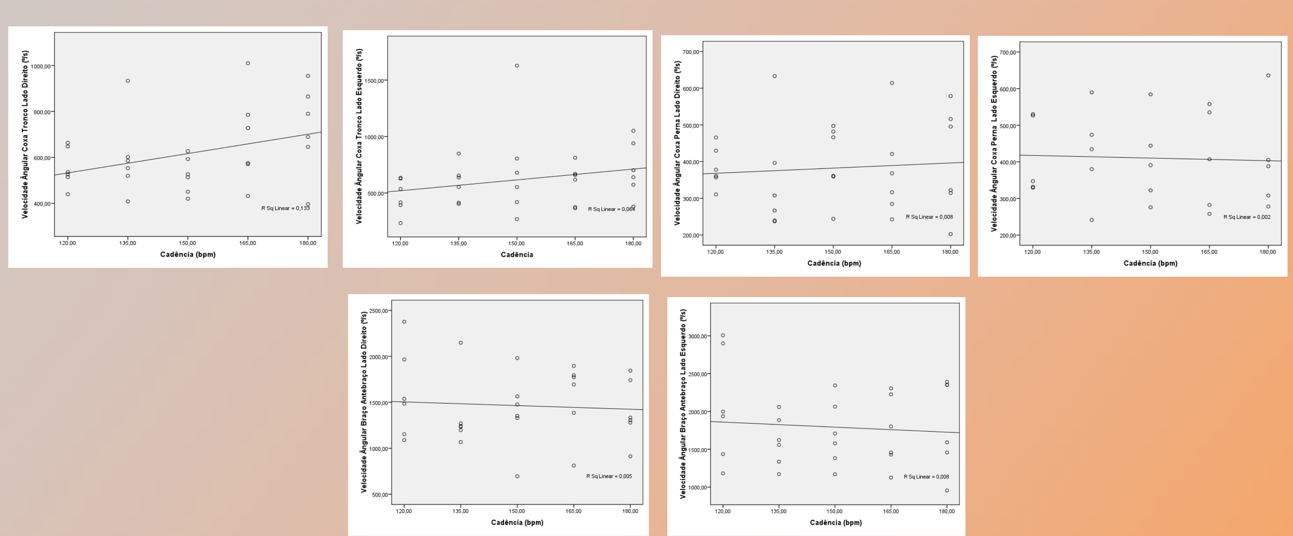

Figure 4. Overlay scatter gram from 2D angular velocity according to the cadence imposed.

CONCLUSION

On overall, no significant relationships have been verified between the angular velocity and the cadence. So, range of motion seems to decrease with increasing cadence when performing the "Sailor's jigs" exercise.

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