NEUROMUSCULAR RESPONSES TO STATIONARY RUNNING AT DIFFERENT CADENCES IN AQUATIC AND DRY LAND ENVIRONMENTS

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INTRODUCTION

Some studies have analyzed the neuromuscular responses in aquatic environment for human gait (Miyoshi et al., 2004; Barela et al., 2006) or therapeutic exercises (Kelly et al., 2000; Pöyhönen et al., 2001). However, these responses are unknown in water aerobics exercises.

The aim of the present study was to analyze the neuromuscular response of young women performing stationary running exercise at different cadences in aquatic and dry land environments.

METHODS

The study sample consisted of twelve young women (22.33 ± 0.57 years), experienced in water aerobics.

Electrodes were placed on the belly of vastus lateralis (VL), biceps femoris (BF), rectus femoris (RF) and semitendinosus (ST) muscles, with a 3-cm center-to-center spacing. Transparent dressing was used to insulate electrodes for the water condition trials.

The electromyographic signals (EMG) were registered with a 4-channel EMG system (Miotool400 USB, Brazil), with a common mode rejection ratio >110 dB and a sampling rate of 2000 Hz by channel.
The filtering of the raw EMG was performed with a filter Butterworth type, with a bandwidth of 25–500 Hz. The EMG data of each muscle were normalized by maximal voluntary isometric contraction (MVC).

The sample performed two test protocols, one land-based and the other water-based, with a two-hour interval between them. The stationary running exercise was executed in each of these environments during 4 min at 3 sub-maximum cadences (60, 80, and 100 bpm) and during 15 s at maximum effort, with a 5 min-interval between each situation.

We used blocked variance analysis, in which the effect of the subject was considered an additional source of variation for the statistical analysis. The data was processed using the SPSS (version 13.0) and R-project programs, with a $p < 0.05$.

RESULTS AND DISCUSSION

The neuromuscular responses showed no significant increase on EMG signal from the VL, BF, RF and ST muscles with higher cadence of execution, except from the sub-maximum cadences to the maximum effort. When comparing the environments, the dry land environment presented significantly greater EMG signal responses from all the muscles at the sub-maximum cadences, except for the ST muscle which presented similar responses in both environments. However, at the maximum effort, all the analyzed muscle groups showed similar responses in both environments (Figure 1).

SUMMARY

In summary, at the cadences used in the present study, the performance of the stationary running exercise in an aquatic environment at sub-maximum cadences presents lower neuromuscular responses than the same exercise performed on land. Yet, at maximum intensities, the amplitude of the EMG signal may present similar muscular activation patterns in the two environments.

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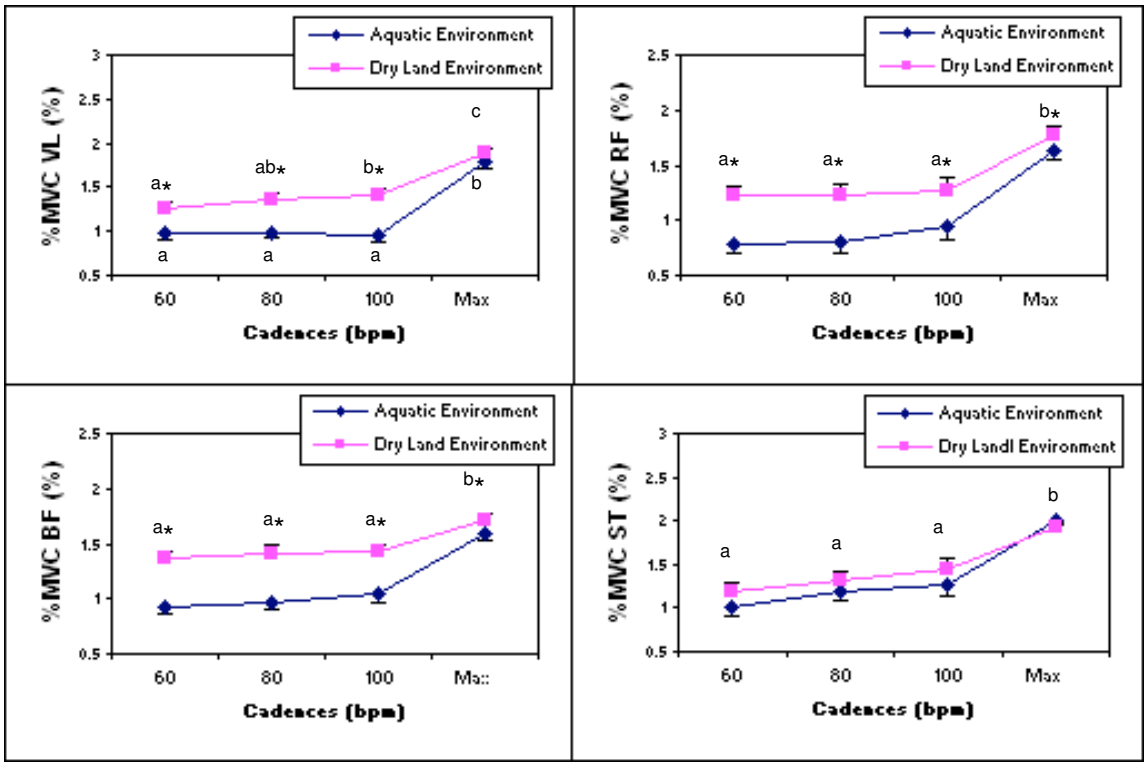

Figure 1 – The EMG normalized by maximal voluntary isometric contraction (MVC) of vastus lateralis (VL), biceps femoris (BF), rectus femoris (RF) and semitendinosus (ST) muscles. Mean values expressed as $\log_{10}$. * indicates significantly differences between aquatic and dry land environments ($p < 0.05$). Different letters indicate statistically significant differences for cadences ($p < 0.001$).