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Physiological Adaptations to Head-Out Aquatic Exercises With Different Levels of Body Immersion

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Abstract. Barbosa, T.M., M.F. Garrido, and J. Bragada. Physiological adaptations to head-out aquatic exercises with different levels of body immersion. *J. Strength Cond. Res. 21(4):1255–1259. 2007.*—The purpose of this study was to compare the physiological adaptations to basic head-out aquatic exercises with different levels of body immersion. Sixteen young and clinically healthy subjects (9 women and 7 men) volunteered to participate in this study. Each subject performed 3 repetitions (on land, immersed to the hip, and immersed to the breast) of the aquatic exercise "rocking horse" for 6 minutes. The rating of perceived effort (RPE), the maximal heart rate achieved during the exercitation (HRmax), the percentage of the maximal theoretical heart rate estimated (%HRmax), the peak of oxygen uptake during the exercise ($\dot{V}O_2$peak), and the energy expenditure (EE) were evaluated. The RPE was significantly higher when exercising immersed to the hip than on land ($p < 0.01$) and immersed to the breast ($p = 0.03$). The HRmax and %HRmax were significantly lower when exercising with immersion to the breast than on land ($p < 0.01$) and with immersion to the hip ($p < 0.01$). The $\dot{V}O_2$peak was significantly different between all conditions. The lower mean value was verified when exercising immersed to the breast, followed by immersion to the hip and on land. The EE was significantly higher when performing aquatic exercises on land than when immersed to the hip ($p = 0.02$) and the breast ($p < 0.01$). So, physiological responses when exercising immersed to the hip are higher than when immersed to the breast. The physiological responses when exercising on land are higher than when exercising with immersion to the hip and to the breast.

Key Words. basic aquatic exercises, rating of perceived effort, heart rate, oxygen uptake, energy expenditure

Introduction

Head-out aquatic exercises became one of the most popular physical activities within the fitness context. The benefit of this type of exercise for special populations, such as elderly persons (e.g., 36, 38), pregnant women (e.g., 24, 25), and patients with osteoarthritis or muscular pathologies (e.g., 23, 29, 41), is widely accepted in the literature. However, the physiological benefits of head-out aquatic exercises for young and clinically healthy subjects are not so clear-cut.

The rating of perceived effort (RPE) is one of the most evaluated variables in aquatic exercises (2, 32, 33, 36, 42). For the same intensity of exertion, the RPE is described as being higher during aquatic exercises than during land exercises (8, 11, 16, 42). Nevertheless, to our knowledge, there is no study in the literature comparing the RPE when exercising at different depths.

The cardiovascular response is another parameter monitored on a regular basis. During immersion of the body, the heart rate is lower than on land (12, 19, 31, 42). The lower heart rate in aquatic activities is a well-documented phenomenon (9) and is related to (a) the diving bradycardia reflex (19, 36) and (b) the improved conditions for the heart filling during diastole, due to hydrostatic pressure and buoyancy, promoting a higher stroke volume at rest and at submaximal oxygen uptake (19). Benelli et al. (4) and Town and Bradley (39) observed that the heart rate decreased significantly when the increase of body volume was immersed.

Several investigations reported that when exercising on land, bioenergetic parameters, such as oxygen uptake or energy expenditure (EE), were significantly higher than in aquatic exercises (8, 16, 42). On the other hand, some studies observed that those parameters were significantly lower in land-based exercises than in aquatic exercises (10) or with no significant differences (15). Nevertheless, oxygen uptake was described as being higher for shallow water than for deep-water running (39). So, it seems quite interesting to examine the response of bioenergetic parameters during basic head-out aquatic exercises with different levels of body immersion.

The results described previously and those reported in the literature were obtained during aquatic walking and running activities (27, 39), in specific land-based aerobic routines adapted for the aquatic environment (20, 37), or in swimming (3, 19). It seems that there are a small number of investigations about the influence of different levels of body immersion during the performance of basic head-out aquatic exercises.

Another lack in the literature is the methodological design. In a large number of investigations, the comparison was made between aquatic exercises and land exercises performed in a gym (e.g., 4, 10, 15, 20, 36). It is known that environmental conditions have a significant influence on the thermoregulation system and, therefore, in the physiological response to exercise (17). However, to our knowledge, the published literature has no investigation comparing aquatic exercises with land exercises performed at the poolside, as done by aquatic instructors.

The purpose of this study was to compare the physiological adaptations (RPE, heart rate, oxygen uptake, and EE) to head-out aquatic exercises with different levels of body immersion.

Methods

Experimental Approach to the Problem

The present study intended to analyze whether different levels of body immersion could provide appropriated physiological responses to the improvement of physical fitness. The study included an experimental design comprising a within-subjects protocol. A group of 16 subjects completed the same basic aquatic exercise but in 3 different levels of body immersion (poolside, immersed to the