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DISCUSSION

Discussion of "Cardiorespiratory alterations induced by low-intensity exercise performed in water or on land"

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We have read with great interest the article by Ayme et al. (2015), recently published in *Applied Physiology, Nutrition, and Metabolism*, that was on cardiorespiratory alterations induced by low-intensity exercise performed in water or in land. The authors found no differences in echocardiographic parameters during exercise (at approximately 37% of dry-land peak oxygen uptake ($\dot{V}O_{2peak}$) and higher respiratory rate and ventilation in immersed versus dry-land ergocycle. We would like to make several comments regarding this publication, particularly for the Methods section. The authors stated that "previous studies failed to demonstrate cardiorespiratory differences between the 2 conditions under the threshold of 40%–60% $\dot{V}O_{2peak}$". Our research group has demonstrated that oxygen uptake ($\dot{V}O_2$) is reduced during immersed ergocycling, even at very low exercise intensities (Garzon et al. 2015), owing principally to a reduced arteriovenous difference. As a consequence, $\dot{V}O_{2peak}$ measured during dryland ergocycling is not similar to the one measured during immersed ergocycling and can be reduced by 27% in immersion (Garzon et al. 2015). Therefore, matching exercise intensity with a percentage of dry-land $\dot{V}O_{2peak}$ value (37% in this study) (Ayme et al. 2015) may represent a potential bias and would lead to a higher relative percentage of exercise intensity in the water condition. As an example, 38% of $\dot{V}O_{2peak}$ for dry-land conditions (75 W or 60 revolutions per minute (rpm), Table 1 (Garzon et al. 2015)) correspond to 46% of $\dot{V}O_{2peak}$ measured on immersed ergocycling. Therefore, this could explain why respiratory rate and ventilation were found higher during exercise in water condition (Table 3) (Ayme et al. 2015). However, this result is in contradiction with a previous study demonstrating similar respiratory rate and ventilation at 60% of $\dot{V}O_{2peak}$ (dry-land condition) (Bréchat et al. 1999). We also demonstrated no differences in respiratory rate and ventilation at submaximal and maximal intensities matched with similar external power output (Garzon et al. 2012). To avoid this problem, we developed a biomechanical method to match the exercise intensity according to a similar external power output for immersed and dry-land ergocycles (Garzon et al. 2014, 2015). As well, in the Methods section, the model of the aquabike and the corresponding rpm used in the study is not indicated (Ayme et al. 2015). This can have major impact on the $\dot{V}O_2$/rpm relationship, depending on the aquabike model used (Giacomini et al. 2009) and also on the reproducibility of the study results by others research groups. Additionally, the authors stated that

> The workload was adapted for each volunteer owing to the fact that pedalling cadence should be similar during exercise on land and in water. With this aim, the volunteers selected their optimal pedalling cadence in the first session, and this cadence was reproduced in the second session.

In water ergocycling, the external power output is dependent on drag forces on pedals, paddles, rods, and legs and their tangential speed (pedalling rate: rpm) (Garzon et al. 2014, 2015). Therefore, the only way to increase exercise intensity is to increase rpm. However, the workload and rpm for the dry-land condition were not indicated by the authors, making difficult to interpret the data by others researchers. Because on the high density of the water, pedaling at a same cadency (rpm) would lead to a higher external output and $\dot{V}O_2$ in water as clearly demonstrated in previous studies (Bréchat et al. 1999, 2013). Regarding hemodynamics variables, the authors demonstrated similar values for stroke volume and cardiac output at a similar percentage of dry-land $\dot{V}O_{2peak}$ value, in agreement with the previous work of Bréchat et al. (2013). When exercise intensities are matched to a similar external power, stroke volume and cardiac output are significantly higher in the water during exercise compared with the dry-land condition (Bréchat et al. 2013; Garzon et al. 2015). In conclusion, those methodological considerations should be taken into account for the results and their interpretation of the study published by Ayme et al. (2015).

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