https://doi.org/10.6063/motricidade.31773

Abstract

Muscle oxygen saturation and perceived exertion at moderate intensity: a comparative study between treadmill, elliptical, and cycle

Isabel Machado[1,2*], Daniel Santarém[1], Catarina Abrantes[1,2]

[1] Department of Sports Science, Exercise and Health, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal
[2] Research Center in Sports Sciences, Health Sciences and Human Development, CIDESD, Vila Real, Portugal

*E-mail: isamachado@utad.pt

Conflict of interest: nothing to declare. **Funding:** This work was supported by the Foundation for Science and Technology (FCT, Portugal) and the European Social Fund (ESF), through a doctoral grant endorsed to Isabel Machado (COVID/BD/152736/2022) under the Human Potential Operating Program (POPH).

Muscle oxygen saturation (SmO_2) is the balance between oxygen supply and demand measured in a local muscle (Pilotto et al., 2022). Understanding the acute dynamic changes in SmO_2 and perceived exertion (RPE) in response to different exercise modalities is crucial for optimising exercise prescription and training outcomes. However, the influence of exercise mode on SmO_2 and RPE remains unclear. This study aimed to assess the acute SmO_2 responses in the *gastrocnemius medialis* (GM) and *vastus lateralis* (VL) muscles, and the RPE during treadmill, elliptical and cycle exercises, at identical percentages of heart rate reserve (% HRR).

Fourteen healthy volunteers (8 males/6 females, age:34.9±9.1years) performed exercise on three different ergometers at 50% HRR for 5-minute periods. The Tanaka formula (208-0.7×age) was used to estimate maximal HR. SmO_2 was continuously measured using a near-infrared spectroscopy device (MOXY) placed on the GM and VL muscles. A HR monitor (Garmin) was used to assess the cardiovascular intensity during the

session, and the RPE was reported immediately after each exercise period using the Borg Scale (6-20). The SmO_2-related variables, such as average (SmO_{2avg}), minimum (SmO_{2min}), and variation (ΔSmO_{2min}) were determined. Results showed that for the same cardiovascular effort, a significant effect of exercise mode was found in SmO_{2avg} ($\chi^2(2)=18.436$, $p<0.001$, in GM), SmO_{2min} ($\chi^2(2)=8.769$, $p=0.012$ and $\chi^2(2)=15.857$, $p<0.001$, in VL and GM, respectively), and ΔSmO_{2min} ($\chi^2(2)=8.769$, $p=0.012$ and $\chi^2(2)=15.857$, $p<0.001$, in VL and GM, respectively). All these variables were significantly different between the cycle and treadmill, with lower SmO_{2min} and higher ΔSmO_{2min} values reached during the cycle in the VL ($p=0.014$, for both variables) while in GM ($p<0.001$, for both variables), the same results were observed for the opposite (*i.e.*, treadmill). Only GM showed a significantly lower SmO_{2avg} during the treadmill compared to the cycle ($p<0.001$). There were no significant differences in SmO_2-related variables between cycle and elliptical or between elliptical and treadmill in both muscles. RPE was significantly different between exercise modes ($\chi^2(2)=8.857$, $p=0.012$), with a higher RPE in the cycle compared to elliptical ($p=0.049$) and treadmill ($p=0.042$). These findings highlight the distinct SmO_2 and RPE responses elicited by different exercise modes, even at equal cardiovascular intensity. The cycle exercise induced a higher response of SmO_2 in VL, while the treadmill elicited a higher response of SmO_2 in the GM muscle. This reinforced the importance of considering exercise mode when designing and optimising training programs to target specific muscle groups and achieve desired physiological responses.

Keywords: Ergometer, constant moderate intensity, muscle oximetry, near-infrared spectroscopy, perceived exertion.

References

Pilotto, A. M., Adami, A., Mazzolari, R., Brocca, L., Crea, E., Zuccarelli, L., Pellegrino, M. A., Bottinelli, R., Grassi, B., Rossiter, H. B., & Porcelli, S. (2022). Near-infrared spectroscopy estimation of combined skeletal muscle oxidative capacity and O2 diffusion capacity in humans. *The Journal of Physiology*, *600*(18), 4153-4168. https://doi.org/10.1113/JP283267