CEREBRAL OXYGENATION RESPONSES TO ARM AND LEG CYCLING PERFORMED AT MODERATE AND HEAVY INTENSITIES

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INTRODUCTION

The response of cerebral oxygenation during cardiorespiratory exercise is influenced by several factors, such as exercise intensity, duration, individual fitness level, and the presence of underlying health conditions. However, the impact of cardiorespiratory exercise mode on cerebral oxygenation, specifically involving major upper and lower body skeletal muscle groups, requires further investigation. In this study, we examined the concentrations of oxygenated hemoglobin in the prefrontal cortex before, during, and after an isocaloric exercise session performed at moderate and heavy intensity domains.

METHODS

Participants (16 females and 14 males), 23 ± 4 years old, body mass index of 25 ± 5, completed two visits to determine the gas exchange threshold (GET) for arm and leg cycling. Four additional randomized and counterbalanced visits for arm and leg cycling at moderate (i.e., below GET) and at heavy (i.e., above GET) intensity completed to 100 kcals were used to investigate the prefrontal responses of oxygenated hemoglobin utilizing near-infrared spectroscopy. These were measured pre, during, and post exercise test. Mixed effect models were used to quantify the fixed effects of mode (arm- vs. leg cycling), intensity (moderate vs. heavy), and condition (pre vs. exercise vs. post-test) on oxygenated hemoglobin, with participants as a random effect. Significance was considered as $p<0.05$, and effect sizes were quantified and interpreted as pseudo R2 and semipartial R2.

RESULTS

No significant interaction existed between mode, intensity, and condition ($p = 0.179$). There was no significant interaction between mode and condition ($p = 0.328$) or mode and intensity ($p = 0.117$). There was no significant main effect of intensity ($p = 0.585$). However, there was a significant interaction between intensity and condition ($p = 0.015$). There was also a significant main effect of condition ($p <0.001$). The most parsimonious model contained the interaction between intensity and condition and main effects of intensity and condition (marginal effect R2 = 0.650; condition semipartial R2 = 0.529; intensity semipartial R2 = 0.013; intensity*condition semipartial R2 = 0.022).

DISCUSSION

These data suggest no significant difference in prefrontal cortex oxygenation between cardiorespiratory exercises involving major upper and lower body skeletal muscle groups. Furthermore, cerebral oxygenation remained significantly higher post-test than the initial pre-test condition, with a small effect size for oxygenated hemoglobin after heavy (71%) compared to moderate (66%) cardiorespiratory exercise. Healthy individuals performing either arm or leg cycling with a duration necessary to expend 100 kcals at moderate or heavy exercise intensities should not expect significant differences in cerebral oxygenation. However, considerable increases in cerebral oxygenation of approximately 45% should be expected in short-term rest post exercise.

Healthy individuals who engage in either **arm or leg cycling** exercises at **moderate or heavy** intensities should **not** expect significant **differences** in **brain oxygen levels.**

Figure 1: The Artenis Portalite hardware, operated by the Oxysoft software, was utilized in this study. The device was wrapped with a translucent plastic film and positioned on the forehead while securely fastened around the participant's head with a long stretch elastic bandage.

RESULTS

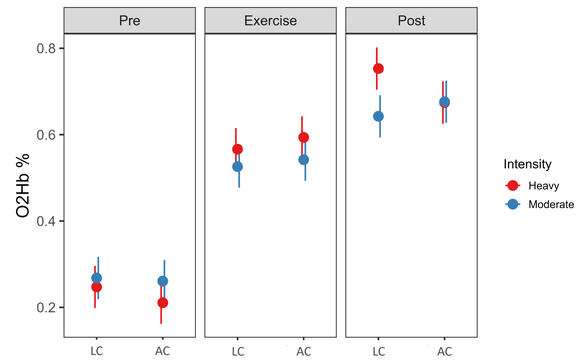

Figure 2. This graph illustrates the percentage of oxygenated hemoglobin concentrations, representing the three-way interactions between Mode (LC: leg cycling and AC: arm cycling), Intensity (heavy and moderate), and Condition (pre-exercise, exercise, and post-exercise). The means and 95% confidence intervals are depicted for each combination of factors.

Condition	Moderate	Heavy	Marginal
Pre-exercise	26.4 (1.0)	22.9 (1.4)	24.7 (1.2)
Exercise	53.4 (1.2)	58.0 (1.5)	55.7 (1.4)
Post-exercise	65.9 (1.7)	71.4 (1.4)	68.7 (1.6)

Table 1: This table presents the percentages of oxygenated hemoglobin concentrations for different conditions (pre-exercise, exercise, and post-exercise) and intensities (heavy and moderate). Mean values with standard deviations are provided, along with marginal means.

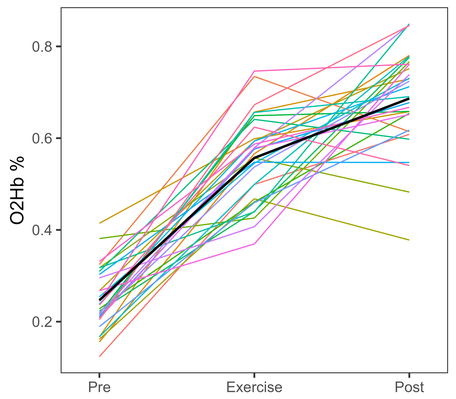

Figure 3. This figure showcases participant-specific responses of oxygenated hemoglobin as a percentage, presenting the marginal mean values for each condition.

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