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Association Between Whole-Body and Skeletal Muscle Oxygen Consumption Rate while Ambulatory

Aaliyah S. Butts, Claire Howell, Rian Q. Landers-Ramos, Nicolas D. Knuth. Towson University, Towson, MD.

Near-infrared spectroscopy (NIRS) is a relatively novel device that allows for non-invasive measurement of oxy- and deoxy-hemoglobin content in skeletal muscle (SM). Among other things, NIRS can be used to measure SM oxygen consumption rate. However, scarce studies have evaluated the relationship between SM and whole-body O_2 consumption rates at rest and during physical activity. **PURPOSE:** The purpose of our study is to investigate the correlation between NIRS-derived SM O_2 consumption rate (mVO_2) and whole-body O_2 consumption ($wbVO_2$) at rest and while walking at varying speeds. **METHODS:** mVO_2 was measured by placing a NIRS device on the belly of the medial gastrocnemius (MG) of the participant's dominant leg (N=9, 22 ± 2 years old). A pneumatic rapid inflation cuff was placed proximal to the testing site for occlusion of arterial blood flow. While laying supine, resting mVO_2 was measured while participants experienced 5 minutes of rest followed by three rounds of 30s arterial occlusion and 30s of rest. Ambulatory mVO_2 was measured during a 10s arterial occlusion immediately following 5min of walking at usual gait speed over a 40m course and after walking on the treadmill at 8 different speeds (0.0, 1.1, 1.5, 1.9, 2.3, 2.7, 3.1, and 3.5 mph). Whole-body oxygen consumption ($wbVO_2$) rate was measured at rest (15 min) and during ambulation by portable indirect calorimetry and compared to mVO_2 through Pearson correlations. **RESULTS:** No correlation was found between $wbVO_2$ and mVO_2 while at rest ($r=0.01$, $p=0.97$) or while standing ($r=-0.12$, $p=0.78$). However, correlations between $wbVO_2$ and mVO_2 was seen at speeds of 1.1 mph ($r=0.68$, $p=0.06$), 2.7 mph ($r=0.71$, $p=0.05$), and 3.5 mph ($r=0.64$, $p=0.09$). The speed of 2.7 mph is closest to the group's average over-the-ground walking self-selected gait speed (1.25 ± 0.20 m/s). **CONCLUSION:** Even at the slowest measured speed of ambulation (i.e., 1.1 mph), an association between whole-body and muscle oxygen consumption rate was detected, however, no association was found during rest or standing. These findings indicate a greater contribution of SM metabolism to whole-body metabolism while active compared to when sedentary. **SIGNIFICANCE/NOVELTY:** This is the first known study to report associations between NIRS-measured SM metabolism and whole-body metabolism during activity. These results suggest that through the utilization of NIRS, medical professionals may non-invasively obtain valuable insights into the metabolic changes occurring in muscles in response to activity and allow for improved assessment and diagnoses of SM metabolism impediments during various disease states. Such information can help in the development of more targeted treatment plans and facilitate more accurate assessments of patient progress.

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