

A Comparison Between Heart Rate and Oxygen Consumption in Top Rope vs. Lead Rope While Indoor Rock Climbing. Marmie T, Rhoads S, Padberg D, and Hiebert J. Department of Physical Therapy Education, Rockhurst University, Kansas City, MO. jean.hiebert@rockhurst.edu.

Purpose: The recent interest in rock climbing has raised many questions about the metabolic demands of this activity. Other types of aerobic exercise such as walking, cycling and running demonstrate a linear relationship between heart rate (HR) and oxygen consumption (VO_2), and predictions for VO_2 can be made based upon HR. However, studies investigating rock climbing do not suggest a similar linear relationship between heart rate and oxygen consumption. The purpose of this study was to examine the physiological effects of lead climbing and top rope climbing and determine whether there is a difference in linearity for heart rate and oxygen consumption based on climbing style.

Subjects: Six male and two female experienced rock climbers between the ages of 18 and 45 years from the IBEX Rock Gym in Blue Springs, Missouri volunteered to participate in the study. They had no history of cardiovascular, pulmonary, or neurological problems, no orthopedic conditions requiring medical treatment within the last year, and were classified as low risk according to the American College of Sports Medicine guidelines.

Methods and Materials: Subjects read and signed an informed consent prior to participation. Each subject performed four climbs of four minutes duration each. Oxygen consumption and heart rate were continuously measured using a MedGraphics VO_{2000}^{TM} Portable Metabolic Testing System (St. Paul, MN) and Polar S725XTM (Lake Success, NY), respectively. The four different climbs included: easy top rope, hard top rope, easy lead rope, and hard lead rope. The Yosemite decimal scale was used to rate the difficulty of the climb. An easy climb was defined as the climber's maximum Yosemite level minus four full grades, and a hard climb was maximum Yosemite level minus two full grades.

Results: There was a significant linear relationship between heart rate and oxygen consumption for each of the four climbs. Linear regression analysis to predict the VO_2 and HR response for each climb yielded the following equations: 1) easy top rope: $VO_2 = -43.84 + (.483)HR$ ($r^2 = 0.953$, $p < .01$); 2) hard top rope: $VO_2 = -37.17 + (.404)HR$ ($r^2 = 0.989$, $p < .01$); 3) easy lead rope: $VO_2 = -38.44 + (.424)HR$ ($r^2 = 0.917$, $p < .01$); and 4) hard lead rope: $VO_2 = -27.72 + (.335)HR$ ($r^2 = 0.959$, $p < .01$).

Conclusions: Regardless of climbing style and difficulty of the climb, heart rate and oxygen consumption increased linearly. Based on this data, indoor rock climbing can be used when prescribing an exercise program and the participant's heart rate can be used to predict oxygen consumption during exercise.

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