Comparison of Metabolic Rate Between Concentric and Eccentric Muscle Actions

Zackary J. Valenti, Samantha R. Guarnera, Nicholas A. Carlini, William A. Fountain, Thomas Heinbockel, Colleen E. Lynch, Benjamin M. Meister, Ian M. Matthews, Catherine Raley, and Scott A. Mazzetti, Laboratory for Human Performance, Salisbury University, Salisbury MD, USA.

PURPOSE: Previous studies have reported the energy cost of eccentric exercise to be approximately 1/7 to 1/4 that of concentric exercise, but no study has directly compared concentric-only versus eccentric-only resistance exercise. Therefore, we compared energy expenditure between squats performed with concentric versus eccentric muscle actions. **METHODS:** 7 apparently healthy, college-aged men (20.5±0.53 yrs) with a body mass index (BMI) < 26 performed three exercise protocols once per week designed to compare energy expenditure between different muscle actions; concentric (CON), eccentric (ECC), and a trial incorporating both concentric and eccentric muscle actions (BOTH). Subject's 1-RM was determined using a plate-loaded squat machine. Each energy expenditure protocol was randomly assigned in a counterbalanced order and required subjects to perform 4 sets of 10 repetitions with 50% of 1-RM. Repetition speed (2 sec), ROM, and rest intervals were identical across all protocols. Expired air was collected continuously before (15 min), during (~12 min), and after (30 min) each exercise protocol, using a Parvo TrueOne 2400 Metabolic cart. Data were analyzed using a two-way repeated measures ANOVA, with Tukey honest significant difference (HSD) post hoc analyses wherever appropriate. **RESULTS:** Rates of energy expenditure (kcal/min) during sets 1-4 of CON (4.47±0.44, 4.65±0.57, 4.60±0.65, and 4.50±0.58, respectively) and BOTH (4.43±0.66, 3.60±0.46, 4.26±0.59, and 3.67±0.43, respectively) were significantly greater ($p \leq 0.05$) compared to ECC squats (3.34±0.33, 3.10±0.34, 3.10±0.35, and 3.05±0.27, respectively), with the exception of Set 2 for BOTH versus ECC, which was not significantly different. There were no significant differences in energy expenditure between CON, ECC and BOTH during identical warm-up sets. **CONCLUSION:** When squats are performed with 2 sec CON or ECC muscle actions and 50% of 1-RM, the energy cost of eccentric exercise was 2/3 to 3/4 that of concentric exercise. While our findings show a greater energy cost from eccentric squats relative to concentric, it may be that slower muscle actions (i.e., 2 sec per muscle action) enhance the overall contribution to energy expenditure from eccentric muscle actions due to increased time under tension during resistance exercise.