NUTRITION COUPLED WITH HIGH-LOAD TRADITIONAL OR LOW-LOAD BLOOD FLOW RESTRICTED EXERCISE DURING HUMAN LIMB SUSPENSION

K. J. Hackney[1,4], M. Everett[2], L. L. Ploutz-Snyder[3,4]

[1]Wyle Integrated Science and Engineering, Houston, TX, [2]University of Houston, Houston, TX, [3]Universities Space Research Association, Houston, TX, [4]Syracuse University, Syracuse, NY

High-load resistance exercise (HRE) and low-load blood flow restricted (BFR) exercise have demonstrated efficacy for attenuating unloading related muscle atrophy and dysfunction. In recreational exercisers, protein consumption immediately before and/or after exercise has been shown to increase the skeletal muscle anabolic response to resistance training. **PURPOSE:** To compare the skeletal muscle adaptations when chocolate milk intake was coupled with HRE or low-load BFR exercise [3 d/wk] during simulated lower limb weightlessness. **METHODS:** Eleven subjects were counterbalanced [based on age and gender] to HRE (31 ± 14 yr, 170 ± 13 cm, 71 ± 18 kg, 2M/3W) or low-load BFR exercise (31 ± 12 yr, 169 ± 13 cm, 66 ± 14 kg, 2M/4W) during 30 days of unilateral lower limb suspension (ULLS). Both HRE and BFR completed 3 sets of single leg press and calf raise exercise during ULLS. BFR exercise intensity was 20% of repetition maximum (1RM) with a cuff inflation pressure of 1.3 × systolic blood pressure (143 ± 4 mmHg). Cuff pressure was maintained during all 3 sets including rest intervals (90s). HRE intensity was 75% 1RM and was performed without cuff inflation. Immediately (<10 min) before and after exercise 8 fl oz of chocolate milk (150 kcal, 2.5g total fat, 22g total carbohydrate, 8g protein) was consumed to optimize acute exercise responses in favor of muscle anabolism. ULLS analog compliance was assessed from leg skin temperature recordings and plantar accelerometry. Muscle cross-sectional area (CSA) for knee extensor and plantar flexor muscle groups were determined from analysis of magnetic resonance images using ImageJ software. 1RM strength for leg press and calf raise was assessed on the Agaton exercise system. Muscular endurance during leg press and calf raise was evaluated from the maximal number of repetitions performed to volitional fatigue using 40% of pre-ULLS 1RM. **RESULTS:** Steps detected by plantar acceleometry declined by 98.9% during ULLS relative to an ambulatory control period. Average skin temperature of the unloaded calf declined from 27.4˚ C to 26.8˚ C (-2.1%), while there was a slight increase (+1.1%) in skin temperature in the loaded calf (27.6˚ C to 27.9˚ C). Collectively, these measures indicate strong subject compliance with the ULLS analog. Unloaded limb work performed during leg press (1514 ± 334 vs. 576 ± 103) and calf raise (2886 ± 508 vs. 1233 ± 153) exercises sessions was greater in HRE vs. BFR, respectively. Leg press training loads were 44 ± 7 kg in HRE compared to 11 ± 1 kg in BFR. Similarly, calf raise training loads were 81 ± 11 kg in HRE and 16 ± 1 kg in BFR. Pre to post-ULLS training adaptations in the unloaded leg are shown in the table below.

	HRE (N=5)			BFR (N=6)		
	Pre-ULLS	Post-ULLS	%Change	Pre-ULLS	Post-ULLS	%Change
KE CSA (cm^2)	59.2 ± 9	60.3 ± 9	+1.8	55.1 ± 4	53.7 ± 9	-2.3
PF CSA (cm^2)	40.1 ± 4	40.3 ± 3	+0.4	37.8 ± 2	36.0 ± 2	-4.8
LP 1RM (kg)	57.2 ± 9	65.7 ± 12	+15.1	49.1 ± 6	43.2 ± 6	-11.9
CR 1RM (kg)	101.6 ± 5	110. 6 ± 5	+9.0	85.8 ± 7	80.1± 3	-6.6
LP Endurance (reps)	44.2 ± 8	39.6 ± 6	-10.0	36.8 ± 3	42.0 ± 3	+14.0
CR Endurance (reps)	30.4 ± 4	34.4 ± 5	+13.0	31.5 ± 2	47.8 ± 5	+51.8

Mean ± SE, KE = Knee Extensors, PF = Plantar Flexors, LP = Leg Press, CR = Calf Raise.

CONCLUSION: The preliminary results of this investigation suggest when HRE is optimized for muscle anabolism during unloading muscle size and strength are preserved (or enhanced) at the expense of muscle endurance. In contrast, when BFR exercise is optimized for muscle anabolism during unloading muscle endurance is preserved (or enhanced) at the expense of muscle size and strength.