ACUTE EFFECTS OF ESCALATING DENSITY TRAINING ON CARDIORESPIRATORY AND PERCEPTUAL RESPONSES

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INTRODUCTION

- Superset training, defined as performing two or more exercises in succession with an abbreviated or no rest interval, has become an increasingly popular method of time-efficient training for coaches, trainers, and athletes.
- Similarly, escalating density training (EDT), is a time-efficient style of resistance training that increases sets and repetitions within a given timeframe (i.e., training density) for a given session.
- During an EDT workout, alternating sets of two types of exercises (agonist-antagonist, or upper-lower body) are performed for a prearranged number of repetitions (i.e., 5) per set for as many sets as possible within a given amount of time (i.e., 15 min) without predetermined rest interval.
- The characteristics of EDT have been proposed to promote physiological changes for improvements in both cardiorespiratory and musculoskeletal fitness; however, there are no evidence supporting this proposal.

PURPOSE

- To compare the acute physiological, perceptual, and enjoyment responses between a single bout of EDT and TRAD.

METHODS

- On separate days, twelve physically active performed both EDT and TRAD.
- During the EDT trial, participants performed chest and leg press exercises in a superset fashion for 15 minutes.
- Subjects were encouraged to perform as many sets as possible during the 15-minute period and to self-select rest intervals.
- For the TRAD trial, the same exercises were performed for sets of up to 8 repetitions until volume was matched from the EDT trial.
- Rest interval duration was 3-minutes.
- Repetitions were performed at a load corresponding to 10-repetition maximum with a 2:1 second cadence.
- Oxygen consumption (VO_2) and heart rate (HR) were measured before and during exercise. Blood lactate (BLa) was measured pre- and post-exercise.
- Creatine kinase (CK) was measured pre- and 48 hours post-exercise. Rating of perceived exertion (RPE), physical activity enjoyment (PACES), and VO_2 were measured post-exercise for the estimation of energy expenditure.

RESULTS

Table 1. Participant Characteristics

Characteristic	All (n= 12)	Male (n=6)	Female (n= 6)
Age (years)	21.4 ± 3.0	22 ± 3.8	20.8 ± 2
Weight (kg)	69.8 ± 7.9	74.4 ± 7.3	65.3 ± 6.1
Height (cm)	172.9 ± 12.4	177.8 ± 5.6	163.1 ± 13.5
Body Fat (%)	15.1 ± 6.8	10.2 ± 4.9	20.1 ± 4.1
VO_2max (ml · kg^{-1} · min^{-1})	44.7 ± 9.2	52 ± 6.9	37.4 ± 3.1
HRmax (bpm)	192.0 ± 14	192.5 ±13.7	191 ± 15
Chest Press 10- RM (kg)	60.5 ± 19.2	75.6 ± 12	45.4 ± 11.1
Leg Press 10- RM (kg)	175 ± 21.5	178.9 ± 19.2	171.2 ± 24.9
Chest Press TVL (kg)	3, 485.8 ± 1147.8	3, 975.8 ± 1, 163.3	2, 995.8 ± 984.2
Leg Press TVL (kg)	10, 994.5 ± 2, 422.2	10, 685 ± 984.2	11, 304 ± 3, 421.8

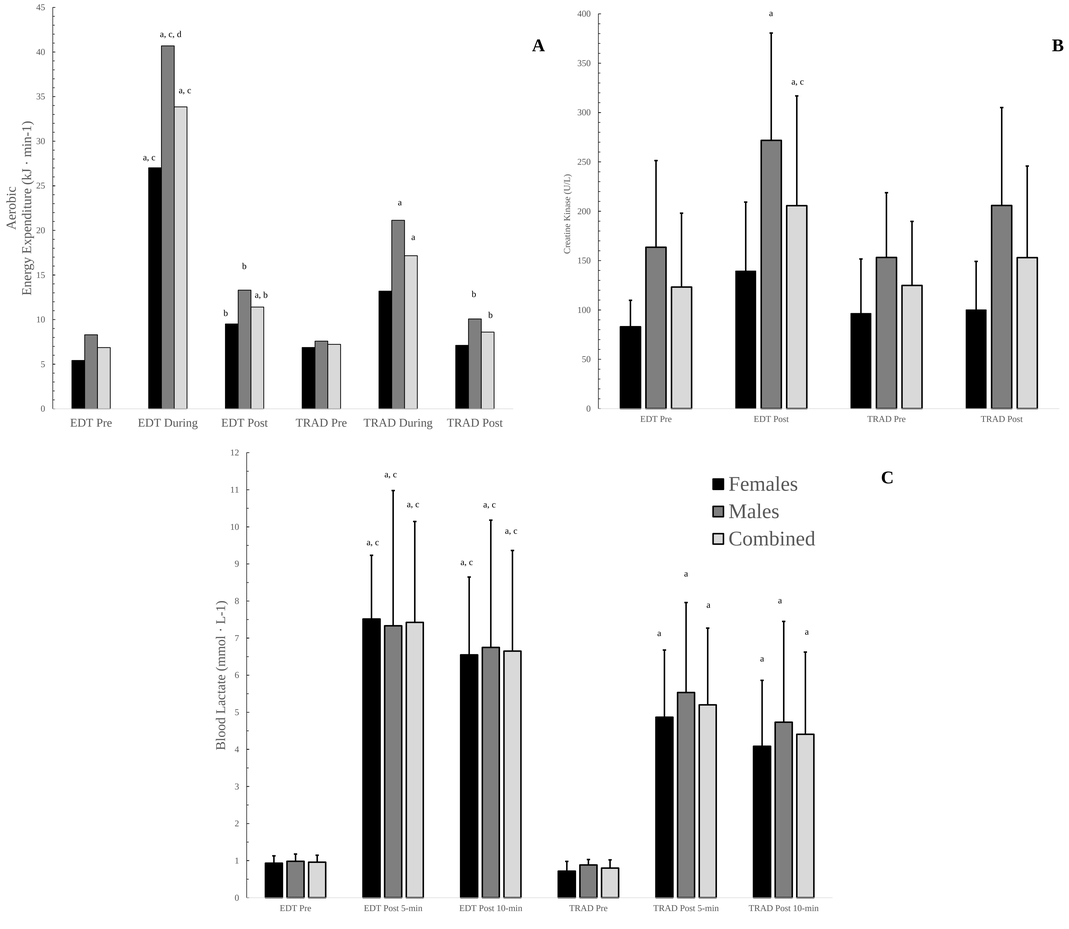

Figure 1. Comparisons between EDT and TRAD for aerobic energy expenditure (A) and creatine kinase (B), and blood lactate (C) pre, during, and post exercise. Data are presented as means ± standard deviation. [a] denotes statistical differences ($p < 0.05$) between pre within same protocol, [b] denotes significant differences during exercise within same protocol, [c] significantly different between protocols, and [d] significant differences between sex within protocols, $p < 0.05$.

RESULTS, cont.

Table 2. Comparison between EDT and TRAD for %HRpeak and %VO_2peak

Dependent Variable	Sex	Condition	Mean ± SD
%HRpeak	Male (n = 6)	EDT	79.0 ± 4.0[a]
		TRAD	48.0 ± 20.8
	Female (n = 6)	EDT	78.8 ± 11.0[a]
		TRAD	58.1 ± 7.5
	Combined (n = 12)	EDT	78.9 ± 7.9[a]
		TRAD	53.0 ± 15.8
%VO_2peak	Male (n = 6)	EDT	53.7 ± 6.1[a]
		TRAD	21.7 ± 3.0
	Female (n = 6)	EDT	58.7 ± 7.1[a]
		TRAD	25.7 ± 5.5
	Combined (n = 12)	EDT	56.2 ± 6.8[a]
		TRAD	23.7 ± 4.7

Data are presented as means ± standard deviation. [a] denotes statistical differences ($p < 0.05$) between EDT and TRAD conditions and [b] denotes statistical difference between male and female within same condition, $p < 0.05$.

CONCLUSIONS

- Energy expenditure, %HR peak, and %VO_2peak for EDT was greater compared to TRAD ($p < 0.05$) suggesting greater cardiorespiratory stress during EDT compared to TRAD.
- Mean elevations from baseline to 5- min post in BLa were significantly greater for EDT (7.4 ± 2.7 mmol/L) compared to TRAD (5.2 ± 2.1 mmol/L), p < 0.001. Additionally, 10- min post BLa was significantly greater for EDT (6.7 ± 2.7 mmol/L) compared to TRAD (4.4 ± 2.2 mmol/L), p < 0.001. These data suggest EDT is elicits greater metabolic stress compared to TRAD.
- The CK levels after EDT were significantly greater than before EDT, p = 0.002. Noteworthy, the CK levels after TRAD were not significantly different than the CK levels before TRAD, p = 0.430. Post EDT CK levels were significantly greater than post TRAD CK levels, p = 0.037. Thus, EDT results in greater muscle damage compared to volume-matched TRAD.
- TRAD trials (43 ± 10.21 minutes) were significantly longer than EDT (15 minutes) (p < 0.05), therefore; EDT may serve as a time-effective method of RT for experienced exercisers, trainers, and coaches seeking to decrease training time while simultaneously increasing training density.