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Acute molecular responses to resistance exercise with low skeletal muscle glycogen levels and different carbohydrate availability in young healthy males

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Introduction

It has been postulated that when endurance and resistance exercise are combined within the same day, ingestion of carbohydrates in the pre-resistance exercise period is required to amplify the intramuscular anabolic signals in the post-resistance exercise period.

Aim & hypothesis

We aimed to examine the effects of LOW and HIGH pre-exercise carbohydrate ingestion on mRNA expression patterns of genes associated with mitochondrial biogenesis, protein degradation and substrate metabolism after a bout of resistance exercise with low skeletal muscle glycogen levels. Based on previous findings, it is hypothesized that the intramuscular response in the post-resistance exercise period is not affected by the amount of carbohydrates in the pre-resistance exercise period.

Methods

N = 14 Age = 21 ± 2 BMI = 22 ± 1 VO_{2max}= 51 ± 5

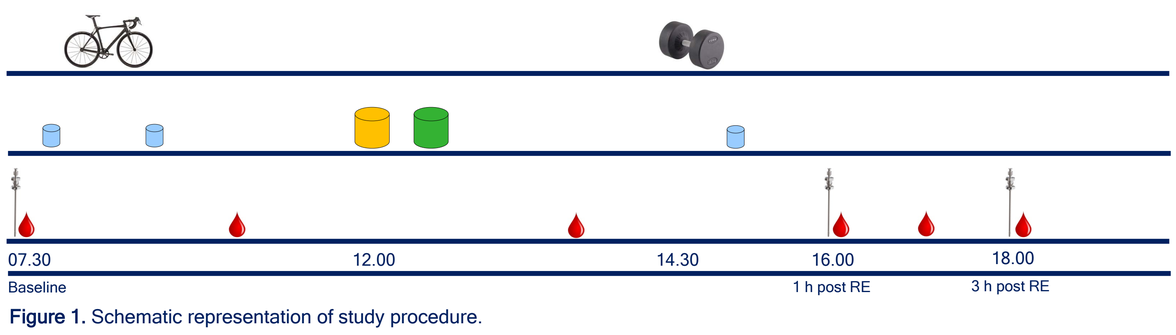

Figure 1. Schematic representation of study procedure.

KEY
90 min moderate 70% VO_{2max}
Leg press + leg extension 5 x 8 = 80% 1-RM
RE = resistance exercise
HIGH CHO meal 3124 kJ
53 PRO; 9 FAT; 110 CHO
LOW CHO meal 3207 kJ
53 PRO; 52 FAT; 20 CHO
PROTEIN beverage
10g casein (left) 15 g casein (middle) 25 g whey (right)

Results (glycogen)

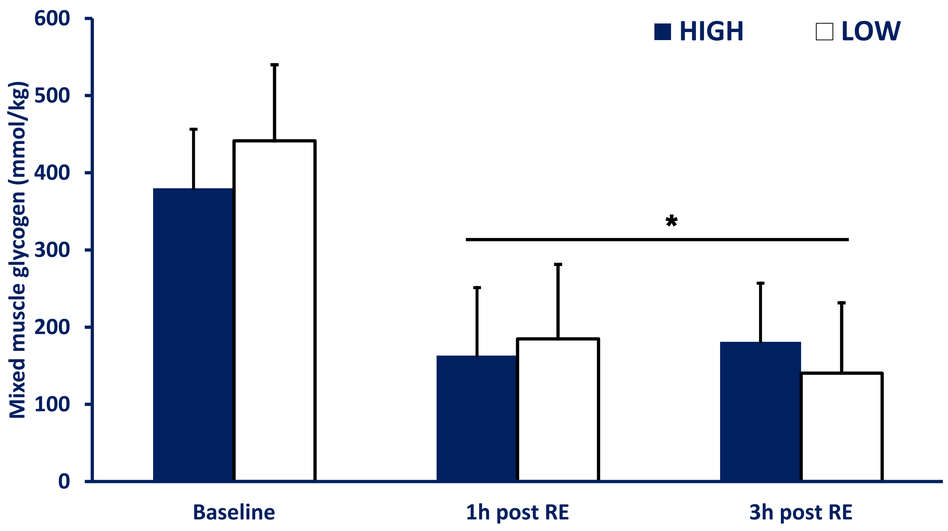

Figure 2. Skeletal muscle glycogen levels between HIGH and LOW at baseline, 1h post RE and 3h post RE. *Significantly different compared to baseline (P < 0.05). (RE = Resistance Exercise)

Results (mRNA responses)

Genes involved in substrate metabolism

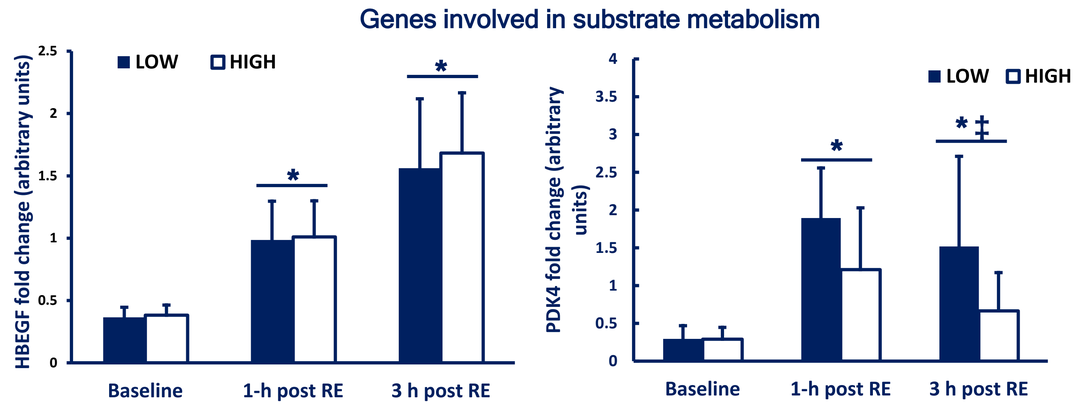

Figure 3. mRNA responses of HBEGF (left) and PDK4 (right). *Significantly different compared to baseline (P < 0.05). ‡Significant different between LOW and HIGH condition (P < 0.05).

Genes involved in protein degradation

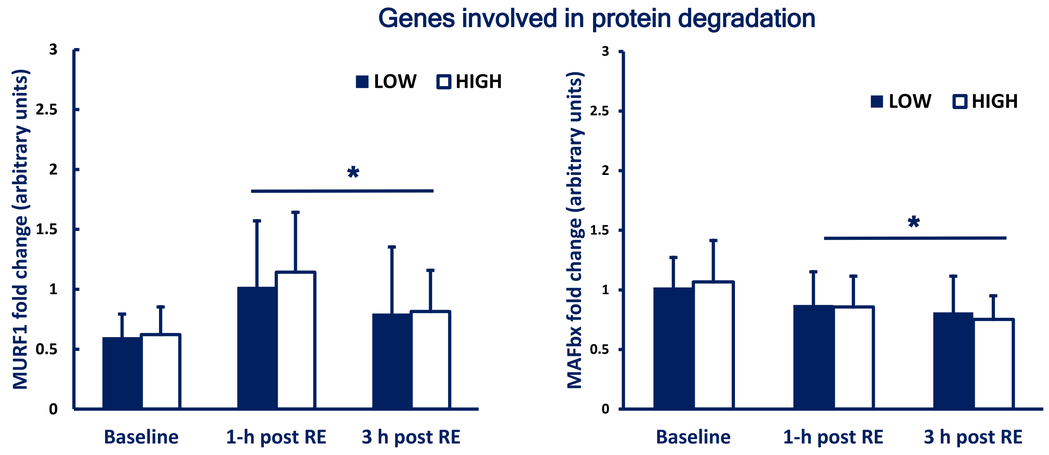

Figure 4. mRNA responses of MURF1 (left) and MAFbx (right). *Significantly different compared to baseline (P < 0.05).

Genes involved in mitochondrial biogenesis

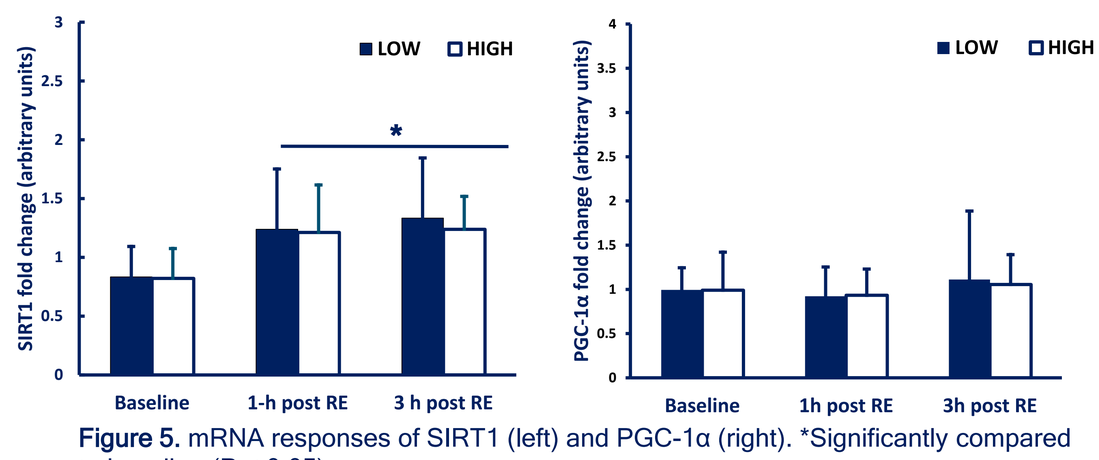

Figure 5. mRNA responses of SIRT1 (left) and PGC-1α (right). *Significantly compared to baseline (P < 0.05).

Conclusions

- There was no difference in post-resistance exercise muscle glycogen levels between the LOW and HIGH carbohydrate condition.
- HBEGF, MURF1, MAFbx, SIRT1 responded as a result of exercise. PDK4 mRNA expression was higher for LOW at 3h post-resistance compared to the HIGH condition. mRNA levels of PGC-1α remained unchanged over the course of the day.
- Intramuscular mRNA expression after a resistance exercise with low muscle glycogen levels was not affected by the amount of carbohydrates in pre-exercise meal.
- PDK4 was differentially expressed between LOW and HIGH groups, suggesting a shift towards fat oxidation and reduced glucose oxidation in the LOW condition.

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