Intensity-Specific Training Adaptations to Exercise in Females

Julianna P. Mereu[1], Theres Tijo[1], Mitchell J. Sammut[1], C.W. James Melling[1],

1. School of Kinesiology, Faculty of Health Sciences, Western University

INTRODUCTION:

- Previous studies examining the effects of exercise training on metabolism have primarily used males as participants.
- It has been shown that as little as one hour of aerobic exercise in males leads to the alteration of several metabolic enzymes, including phosphoenolpyruvate carboxykinase (PEPCK) and glucose-6-phosphate (G6Pase)[1].
- Changes in glycogen content and differences in the usage of glycogen for fuel following exercise training have also been shown in male rats[2].
- It is unclear whether females demonstrate the same training related metabolic adaptations as males.

PURPOSE:

- The purpose of this project was to examine various metabolic responses to an acute exercise bout in healthy females. The effects of both low intensity and high intensity aerobic training programs were also examined and compared.

METHODS:

Animals: 4 groups of 10 female rats were used in this study

Exercise training protocol:

- The acute control group (AC) did a single bout of exercise at an intensity of 30 m/min at 2% grade on a treadmill after a sedentary period of 8 weeks and 3 days
- The low-intensity and high-intensity training groups (LoT and HiT, respectively) underwent 8 weeks of exercise training before undergoing the same acute bout of exercise as the AC group
- Training intensity for LoT reached 21 m/min, while training intensity for HiT reached 36 m/min

Experimental Measures:

- The rats were either euthanized after the holding period (control) or 30 minutes following an acute exercise bout (AC, HiT, and LoT groups) and liver and muscle tissues were removed. Western blot assays were used to analyze liver PEPCK and G6Pase. A glycogen assay was used to analyze glycogen content in the muscle and liver.

RESULTS:

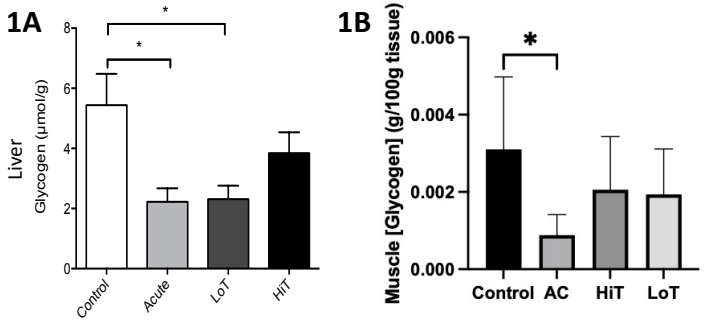

Figure 1: *(A) Mean liver glycogen content (µmol/g). * denotes significance ($p < 0.05$) between control females and both AC and LoT groups. There were no significant differences between any other groups.*

Figure 1: *(B) Mean muscle glycogen content (g/100g tissue). * denotes significance ($p < 0.05$) between control females and the Acute-Con group. There were no significant differences between the control group and both the HiT and LoT groups.*

All data for (A) and (B) are presented as mean ± SEM.

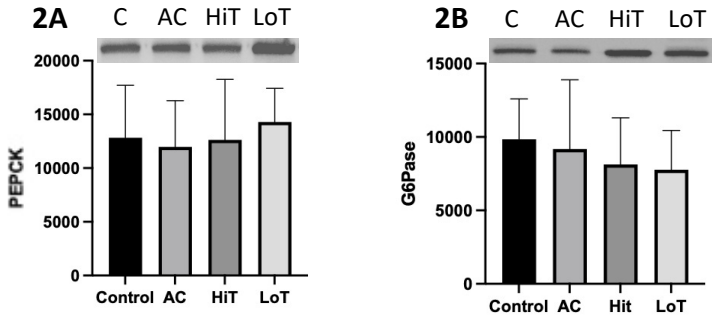

Figure 2: *Mean liver (A) PEPCK and (B) G6Pase protein content in arbitrary units with their respective western blots. All data for (A) and (B) are presented as mean ± SEM. No significant differences were found between any of the groups for either protein.*

SUMMARY:

Liver:

- High-intensity training has a liver glycogen sparing effect during an acute exercise bout, compared to no training or low intensity training.
- There was no increase in the amount of liver gluconeogenic enzymes, PEPCK and G6Pase, in any of the AC, HiT, or LoT groups compared to the control groups. Therefore, the sparing effect is likely not due to increased gluconeogenesis.

Muscle:

- Both high and low intensity training may have a muscle glycogen sparing effect, although there was no significant difference seen with muscle glycogen.

CONCLUSION:

- There is a training related glycogen sparing effect in the liver and the muscle during acute exercise
- The response is intensity-specific in the liver. This effect is not due to enhanced gluconeogenesis
- Future research should examine enzymes within the lipolysis pathway to see if they are using more fat as fuel during the acute exercise bout

REFERENCES:

1. Knudsen, J. G., Biensø, R. S., Hassing, H. A., Jakobsen, A. H., & Pilegaard, H. (2015). Exercise-induced regulation of key factors in substrate choice and gluconeogenesis in mouse liver. *Molecular and Cellular Biochemistry*, *403*(1-2), 209–217. https://doi.org/10.1007/s11010-015-2351-0
2. James, D. E., & Kraegen, E. W. (1984). The effect of exercise training on glycogen, glycogen synthase and phosphorylase in muscle and liver. *European Journal of Applied Physiology and Occupational Physiology*, *52*(3), 276–281. https://doi.org/10.1007/bf01015209

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