THREE HOURS OF MODERATE INTENSITY EXERCISE TRAINING REDUCES GLUCOSE TOLERANCE IN ENDURANCE TRAINED ATHLETES

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BACKGROUND
It is well accepted that exercise training improves glucose uptake and insulin sensitivity, and that endurance trained athletes in general show a high capacity for these parameters and excellent metabolic control. However, some studies fail to observe positive effects on glucose regulation in healthy, trained subjects the day after exercise. These, often unexpected, results have been postulated to be caused by excessive training loads, muscle damage, energy deficit, differences in glucose uptake in the exercised and non-exercised musculature and a metabolic interaction through increased fatty acid metabolism which suppresses glucose oxidation and uptake. The mode or volume of exercise that can lead to glucose intolerance in trained athletes as well as mechanistic insights and its relevance for health and performance are, however, not fully understood.

AIM
We studied the metabolic response to a glucose load the day after a session of high intensity interval training (HIIT) or three hours of continuous exercise (3h) in endurance trained athletes and compared the results with measurements during rest.

METHOD
Nine endurance trained athletes (5 females, 4 males) underwent oral glucose tolerance tests (OGTT) after rest and ~14 hours after exercise on a cycle ergometer (HIIT 5x4 minutes at ~95% of VO_2max or 3h at 65% of VO_2max). Venous blood was sampled at 15-minute intervals for 120 minutes and concentrations of glucose, insulin, free fatty acids (FFA) and ketones (β-hydroxybutyrate) were measured. Statistical analysis was performed using a RM one-way ANOVA with the Giesser-Greenhouse correction and Dunnett's test was used to compare the exercise conditions to the resting condition.

RESULTS
The area under the curve (AUC) during the OGTT increased greatly after 3h (668±124 mM · min) ($p<0.01$) compared to rest (532±89) but was found to be unchanged after HIIT (541±96). Resting values of FFA and ketones were increased after 3h ($p<0.01$ and $p<0.05$, respectively) but not after HIIT. Insulin was found to be unaltered during all conditions.

CONCLUSIONS AND RELEVANCE
Here, we show manifestation of glucose intolerance in endurance trained athletes together with concomitant increases in plasma concentrations of FFA and ketones the day after a session of prolonged exercise training but not after HIIT. This could be a protective response for securing glucose delivery to the brain and therefore have a positive effect on endurance. It also has the potential to reduce the recovery of glycogen depots, glucose uptake during exercise and performance at higher work rates.