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Effect of ketogenic diet on exercise efficiency and metabolic regulation during exercise in adults

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A ketogenic diet (KD) has suggested to enhance metabolic health in individuals with obesity, metabolic syndrome, and diabetes. However, it is unknown if short-term KD is beneficial for exercise efficiency and metabolic adjustment during exercise. **PURPOSE:** To examine the effects of 3 days of KD on exercise efficiency and hormonal response during and after the graded exercise testing (GXT). **METHODS:** Fourteen adults (age 26.3±3.1 [SD] years; BMI 23.6±4.2 kg/m²) completed 3 days of mixed diet (MD; 15% fat, 25% protein, 60% carbohydrate) followed by 3 days of wash-out period and another 3 days of KD (75% fat, 20% protein, and 5% carbohydrate). After 3 days of each diet arm, GXT on treadmill was performed with: low- (LIE; 40% of VO₂max), moderate- (MIE; 55%), and high-intensity exercise (HIE; 70%). Exercise efficiency was calculated as power output (kcal/min) / exercise energy expenditure (EEE; kcal/min) (Amati, *J Appl Physiol*, 2008). Repeated measures ANOVA with Bonferroni's post-hoc tests was used to examine changes in outcome measures over the GXT by each diet arm, with significance set at p<0.05. **RESULTS:** All participants complied with MD and KD regimens. Weight loss (2.2±0.6 kg, p<0.01) with no reduction in total body fat mass was observed after KD. Fat oxidation at recovery period was higher in KD vs. MD (1.1±0.2 vs. 0.6±0.3 kcal/min, p<0.01). In response to the same workload during HIE, KD vs. MD showed higher EEE (10.2±2.7 vs. 9.1±3.0 kcal/min, p<0.01), leading 11% lower exercise efficiency (18.4±0.7 vs. 20.7±0.3 %, p<0.01). After KD, free fatty acid (FFA) was higher at MIE and recovery vs. resting (1221.0±95.1, 1606.7±93.8 vs. 682.7±40.6 mg/dL, respectively, p<0.01), and beta-hydroxybutyrate (BOHB) was lower at HIE vs. resting (252.2±47.5 vs. 546.6±114.1 mg/dL, p<0.01). Cortisol level after KD was higher in recovery vs. resting (17.0±9.0 vs. 13.7±8.4 ug/dL, p=0.02), with no significant changes during GXT after MD. **CONCLUSION:** Our data suggest that short-term KD is favorable to fat metabolism leading increased circulation of FFA and BOHB during LIE to MIE. However, it is notable that KD may cause (1) exercise inefficiency manifested by increased EEE and (2) elevated exercise stress during HIE and recovery period evidenced by high cortisol levels. Combined effects of KD + exercise on metabolic adaptation should be uncovered.

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