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Abstract

Investigation to Isolate the Acute Metabolic Effects of Carbohydrate Restriction on Postprandial Substrate Metabolism with or without Energy Restriction †

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Abstract: Intermittent energy-restricted diets have shown improved metabolic health and alterations in postprandial glucose and lipid responses. Given these diets' inherent low carbohydrate content due to fasting and carbohydrates' crucial role in postprandial metabolism, it is essential to determine if the observed benefits are primarily due to decreased carbohydrate consumption. This study aims to evaluate the acute metabolic effects of carbohydrate restriction on postprandial substrate metabolism, both in the presence and absence of energy restriction, compared to an iso-caloric balanced diet. Twelve (six male) healthy adults (27.33 ± 1.82; 26.64 ± 1.64 kg/m^2) participated in this acute, three-arm crossover study. Participants consumed three pre-prepared intervention diets for one day (36 h), each separated by a 5-day washout period: a normal-carbohydrate (55% of energy) energy-balanced diet (nEB), a low-carbohydrate (50 g/day) energy-balanced (100% energy) diet (LCEB), and a low-carbohydrate (50 g/day) energy-restricted (25% energy) diet (LC25). Following each 36 h diet phase, blood metabolites were measured in the morning fasted state and serially across 360 min postprandially. Concurrently, substrate utilization (RQ) and energy expenditure were evaluated using indirect calorimetry. Data were analysed using repeated-measures ANOVA and Wilcoxon signed-ranks, with results displayed as mean ± SEM. Resting energy expenditure and postprandial thermogenesis showed no significant difference across the three study arms ($p > 0.05$) although RQ was markedly decreased in both LC arms ($p < 0.001$). Elevated hepatic 3-β-hydroxybutyrate production was observed in both low-carb groups compared to control ($p < 0.01$). Following 36 h of both low-carbohydrate diet improved postprandial TAG levels ($p < 0.001$). However, glucose tolerance was impaired in both low-carb diets ($p = 0.04$), while insulin responses showed no statistical difference between all diets ($p > 0.05$). Fasted and postprandial NEFA levels increased in both low-carb diets ($p = 0.02$, $p < 0.01$, respectively). Similarly, fasting GLP-1 levels rose in low-carb arms ($p < 0.5$), declining postprandially ($p < 0.05$). No significant difference was found between them in all analysed parameters ($p < 0.05$). This data suggest that limiting carbohydrates without concurrent energy restriction can mimic the short-term metabolic effects of fasting. Further research is needed to evaluate the long-term impacts of intermittent low-carb diets and their viability as alternatives to traditional energy-restricted plans, factoring in tolerance, sustainability, and lasting physiological effects.

Keywords: carbohydrate restriction; intermittent energy restriction

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