Associations of Diet With the Intestinal Microbiota and Short-Chain Fatty Acids Among Young Adults With Type 1 Diabetes: The ACT1ON Ancillary Gut Microbiome Pilot Study

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Objectives: Diet, a key component of type 1 diabetes (T1D) management, modulates the intestinal microbiota and its metabolically active byproducts, short-chain fatty acids (SCFA), via fermentation of dietary carbohydrates such as fiber. The relationships among diet, the intestinal microbiota, and SCFA have been studied proximal to T1D onset, but remain largely unexplored in longstanding T1D. We hypothesized that increased carbohydrate intake, including fiber, was associated with increased SCFA-producing microbes, fecal SCFA, and gut microbial diversity among adults with longstanding T1D and overweight or obesity.

Methods: Participants provided stool samples at up to four time points. Trained interviewers collected 24-hour dietary recalls. 16S rRNA gene sequencing determined the abundance of SCFA-producing intestinal microbes. Gas-chromatography mass-spectrometry computed total and specific fecal SCFA (acetate, butyrate, and propionate) levels. Adjusted and Bonferroni-corrected generalized estimating equations modeled the associations of dietary fiber and carbohydrate with the abundance of SCFA-producing microbes, fecal SCFA, and gut microbial diversity. Data collection was interrupted by COVID-19; therefore, analyses were repeated with restriction to pre-COVID visits.

Results: Data were available for 44 participants at 99 visits, including 42 participants with 57 visits pre-COVID. Intake of soluble fiber (all data) and available carbohydrates (pre-COVID) were inversely associated with the genus *Bacteroides* and *Eubacterium alistipes*. Pre-COVID, total and soluble fiber and available carbohydrates were positively associated with total SCFA and acetate levels, and available carbohydrates were positively associated with the genus *Roseburia* and *Eubacterium ventriosum*.

Conclusions: In our sample of young adults with longstanding T1D, increased carbohydrate intake, including fiber, was associated with both reduced and increased SCFA-producing microbes but increased total fecal SCFA and acetate, which might influence lipid metabolism and weight. Mechanistic studies may examine how a diet designed to modulate the SCFA-producing capacity of the intestinal microbiota influences metabolism and energy balance in the metabolically unique setting of T1D.

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