Metabolomic Shifts in Metabolically Healthy Adolescents and Adults Following Dental Prophylaxis

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Purpose:
The oral metabolome undergoes dynamic changes in response to physiological and environmental factors. Oral metabolites can reflect the physiological state of the mouth; these metabolites can serve as biomarkers of disease progression. This study investigated shifts in the metabolome of healthy adults and children following dental prophylaxis, aiming to identify age-related differences in metabolic adaptations and their potential implications for oral and systemic health.

Methods:
Fourteen participants, comprising 7 healthy adults (BMI <25) and 7 healthy children (BMI 5th–85th percentile per CDC standards), were included. Active caries and periodontal disease were exclusion criteria. Baseline assessments recorded height, weight, and BMI. Saliva was collected at baseline and after 3 months. Dental prophylaxis was performed after initial saliva collection using a combination of hand instruments and dental prophylactic handpieces. Metabolomic profiling was performed using Gas Chromatography/Mass Spectrometry and Liquid Chromatography/Mass Spectrometry. Significance of longitudinal metabolite changes were determined using spline modeling.

Results:
In adults, significant reductions were observed in isoleucine, pterin, glycerol, tryptophan, and succinate, while ribulose 5-phosphate and ribose 5-phosphate increased at 3 months. In children, reductions occurred in indoleacetate, beta-hydroxybutyrate, succinate, uracil, o-phosphoserine, and pantothenate, with increases in glycerol, erythrose, fructose, gluconate, and glucose. These changes reflect alterations in amino acid metabolism, energy pathways, and nucleotide synthesis.

Conclusions:
Distinct metabolomic shifts in adults and children highlight age-dependent metabolic responses. Decreased succinate in both groups suggests reduced inflammatory or anaerobic microbial activity, while increases in glucose and fructose in children may indicate shifts in carbohydrate metabolism. Ribulose 5-phosphate and ribose 5-phosphate in adults may signify enhanced nucleotide turnover. These findings provide insights into how oral hygiene practices influence metabolic pathways and microbial-host interactions, potentially informing personalized approaches to maintaining oral and systemic health. Future directions for this research include investigating the influence of specific microbial populations on oral and systemic metabolic shifts after dental prophylaxis as well as linking metabolite changes post-prophylaxis to personalized strategies for maintaining optimal oral and systemic health.