**Lipidome-predicted dietary pattern scores and their associations with cardiometabolic risk factors in Australian adults**

**Aim:** Building on our validated lipidomic platform, we applied plasma lipidomic profiling to predict scores derived from empirically identified dietary patterns. We then assessed how these lipidome-predicted dietary pattern (LPDP) scores associate with cardiometabolic risk factors in Australian adults.

**Methods:** Data from the Australian Diabetes, Obesity and Lifestyle Study (AusDiab, n = 10,339) were analysed. Dietary patterns were derived via factor analysis from a 74-item food frequency questionnaire (FFQ). Plasma lipidomic profiling (LC-MS/MS) quantified 743 lipid species. Ridge regression (lipidomics as predictors, FFQ scores as outcomes, adjusted for age and sex) was used to generate LPDP scores. Associations between LPDP scores and BMI, HDL-C, HbA1c, and systolic blood pressure (SBP) were assessed using adjusted regression models.

**Results:** Two dietary patterns were identified: Western (high in processed meats, snacks, takeaway foods) and Prudent (high in vegetables, fruits, fish, whole grains). Lipidomic profiles explained 35% of variance in the Western pattern and 18% in the Prudent pattern. Each one standard deviation (SD) increase in the Western LPDP score was associated with a 0.08 SD increase in BMI (95% CI: 0.05, 0.11), a 0.19 SD decrease in HDL-C (95% CI: -0.22, -0.17), a 0.07 SD increase in HbA1c (95% CI: 0.04, 0.10), and a 0.08 SD increase in SBP (95% CI: 0.05, 0.10). Conversely, a one SD increase in the Prudent LPDP score was associated with a 0.09 SD decrease in BMI (95% CI: -0.12, -0.07), a 0.05 SD increase in HDL-C (95% CI: 0.025, 0.066), a 0.07 SD decrease in HbA1c (95% CI: -0.10, -0.05), and a 0.07 SD decrease in SBP (95% CI: -0.08, -0.05).

**Conclusion:** LPDP scores offer a biologically grounded method to characterise habitual dietary patterns and their associated metabolic risk profiles, supporting an objective approach to dietary exposure assessment and advancing precision nutrition research.