Optimised Glucose "Time in Range" Using Continuous Glucose Monitors in 4,805 Non-Diabetic Individuals Is Associated With Favourable Diet and Health: The ZOE PREDICT Studies

Sarah Berry,[1] Kate Bermingham,[1] Ana Valdes,[2] Paul Franks,[3] Jonathan Wolf,[4] and Tim Spector[1]

[1]Kings College London; [2]University of Nottingham; [3]Lund University; and [4]Zoe Ltd

Objectives: Continuous glucose monitoring (CGM) enables the dynamic measurement of glycemic control. In diabetic cohorts, time in range (TIR), measured by CGM, is discriminatory of future disease development. However, the value of CGM metrics in non-diabetic populations and their relationship with health outcomes is unclear. This research developed 'optimised' TIR targets specific to healthy populations and explored their relationship with diet and health.

Methods: The ZOE PREDICT studies, one (n = 1002, UK), two (n = 987, US) and three (n = 4,500, US) collected demographic information, habitual and free-living diet data, cardiometabolic blood biomarkers and postprandial responses to standardized meals in clinic and free-living settings. TIR was calculated from CGMs (2–4 days free-living) using 1) the American Diabetes Association (ADA); 70–140 mg/dL (TIR_{ADA}) and 2) a novel optimised; 70–100 mg/dL ($TIR_{optimised}$) target. Habitual diet quality (plant-based diet indices; PDI, healthy-PDI and unhealthy-PDI), and free-living nutrient intakes (% energy) were calculated. Associations (spearman's, adjusted for age, sex and BMI) between TIR and diet were examined, and differences in diet and health outcomes between quintile 1 (Q1) and 5 (Q5) of TIR targets were assessed.

Results: Mean fasting glucose was 91 ± 10 mg/dL, HbA1c 5.3 ± 0.4%, $TIR_{optimised}$ 70 ± 17% and TIR_{ADA} 91 ± 13% (n = 4805 after exclusions, 78% females, mean age 46 ± 12y). Individuals with better glycemic control ($TIR_{optimised}$ Q5 *vs* Q1) were younger (mean ± SD) (45 ± 11 *vs* 49 ± 12y), had lower HbA1c (5.2 ± 0.4 *vs* 5.5 ± 0.5) and fasting glucose (91 ± 14 *vs* 97 ± 23 mg/dL) and higher HDL-cholesterol (1.7 ± 0.4 *vs* 1.6 ± 0.5mmol/L) ($P < 0.001$ for all). $TIR_{optimised}$ (PREDICT 1 n = 868) was associated with a favourable diet (lower unhealthy-PDI and carbohydrate intakes and higher protein intakes) and cardiometabolic risk profile (lower HbA1c and ASCVD) ($P < 0.05$ for all). However, TIR_{ADA} was not associated with diet or health outcomes.

Conclusions: We demonstrate that an optimised TIR target (70–100 mg/dL) is discriminatory of ASCVD risk despite normal fasting HbA1c. These findings demonstrate the utility of CGM's in non-diabetic populations and highlight the potential application of dietary strategies to improve TIR and subsequent metabolic complications.

Funding Sources: ZOE Ltd.