Using Commercial Wearables for Lifestyle and Metabolic Phenotyping : A Study Protocol of the GLOW UP Study

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The GLOW UP (GLucose Observation and Wearable Utilisation Project) study assesses the predictive value of wearable-based lifestyle factors (e.g., physical activity, sleep, diet) for preventing type 2 diabetes (T2D). The study examines prediabetes primarily based on HbA1c and other glucose metabolism indicators, such as fasting plasma glucose and insulin resistance. By leveraging real-world data from commercially available wearables, the study explores whether lifestyle factors monitored in free-living conditions can predict early glucose metabolism abnormalities. The study also aims to assess the relative importance of each lifestyle factor, offering insights into personalized glucose dynamics and lifestyle patterns, potentially advancing personalized T2D prevention. This prospective case-control study involves 12 weeks of continuous lifestyle monitoring using wearables. Participants are adults aged 45 and above from Switzerland, selected based on specific criteria. Lifestyle behaviors, including physical activity, sleep, diet, stress, and substance use, are tracked via smartwatches and smartphone applications. Blinded continuous glucose monitoring is used to capture glucose profiles. Baseline and follow-up measurements include HbA1c, fasting glucose, insulin levels, and other metabolic markers. Predictive modeling, incorporating machine learning techniques like LASSO and time series models, will assess the relationship between lifestyle factors and glucose metrics. Additional clustering and regression analyses will examine the association between glucose profiles and metabolic characteristics. The study will evaluate the performance of wearable-derived lifestyle data in predicting HbA1c classifications as the primary outcome. Secondary outcomes include the predictive performance of wearable data on other metabolic markers (e.g., fasting plasma glucose, insulin resistance) and the feasibility of wearable-based individualized glucose profiling. Further analysis will explore lifestyle patterns across metabolic profiles, associations between lifestyle factors and glucose levels, and feature importance across metabolic subgroups. Findings are expected to provide detailed insights into how real-time lifestyle data can inform T2D risk at the individual level. The GLOW UP study has the potential to contribute to behavioral nutrition and physical activity fields by introducing a data-driven approach to T2D prevention through digital biomarkers. Anticipated findings may support the development of personalized, data-driven strategies for early T2D risk assessment and preventive healthcare in Switzerland and beyond.