Dose-response associations of device-measured physical activity micropatterns with incident Type 2 diabetes

Kar Hau Chong, Nicholas A. Koemel, Matthew N. Ahmadi, Raaj K. Biswas, Monique E. Francois, Angelo Sabag, Martin Gibala, Shelley Keating, Jonathan Little, Cecilie Thøgersen-Ntoumani, Emmanuel Stamatakis

Background: Current type 2 diabetes (T2D) prevention and management guidelines place a great emphasis on structured exercise as the primary behavioural intervention, despite its persistently low uptake and adherence in real-world settings. We examined the dose-response associations of vigorous intermittent lifestyle (i.e. incidental) physical activity micropatterns (VILPA, bouts lasting up to 1 minute) and its moderate-to-vigorous equivalent (MV-ILPA, bouts lasting up to 3 minutes) with incident type 2 diabetes (T2D).

Methods: This prospective cohort analysis included 22,706 adults (mean age 62.3 years; 56.4% female) participants from the UK Biobank accelerometry substudy who reported no leisure-time exercise and had no prevalent T2D. Daily duration (minutes/day) and frequency (number of bouts/day) of VILPA and MV-ILPA were estimated from 7-day wrist-worn accelerometry data using a validated machine learning-based intensity and posture classification schema. Incident T2D was identified through linked self-reports, primary care records, hospital inpatient records and death registry data. Dose-response associations were modelled using Fine-Gray subdistribution hazard models accounting for competing risks, with adjustment for demographic, lifestyle and health-related covariates.

Results: Over an average follow-up of 7.9 years, 665 incident T2D events occurred. There was an inverse, non-linear dose-response association between daily durations of VILPA and MV-ILPA and incident T2D. The sample median duration of 3.9 minutes/day of VILPA and 25.3 minutes/day of MV-ILPA were associated with 36% (hazard ratio [HR] 0.64, 95% CI 0.52−0.79) and 46% (HR 0.54, 95% CI 0.42−0.71) lower risk of incident T2D, respectively, compared with the sample minimum durations of 0 minutes/day of VILPA and 3.9 minutes/day of MV-ILPA. There was a near-linear dose-response association for daily VILPA frequency, with the median frequency of 10.4 bouts/day corresponding to a HR of 0.64 (95% CI 0.51−0.81). Daily MV-ILPA frequency exhibited a U-shaped association with T2D incidence, with the beneficial association plateauing at approximately 55.7 bouts/day (HR 0.54, 95% CI 0.39−0.76)

Conclusions: This study highlights the potential of regular, brief bursts of higher-intensity incidental physical activity as a practical and behaviourally sustainable strategy for T2D prevention.