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Meal pattern validation: associations of meal size and meal timing with glucose concentrations in a population-based cohort

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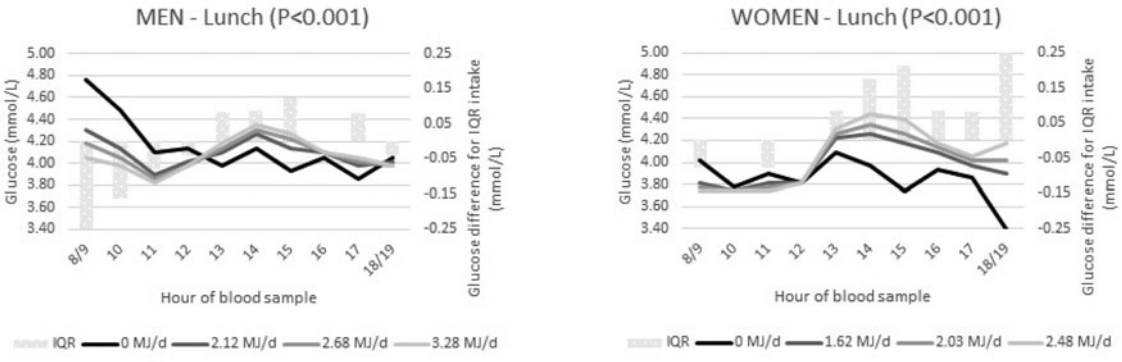
Meal patterning encompassing time, quantity and frequency of eating has been associated with diet quality, cardiovascular risk factors and coronary heart disease [(1)]. In observational studies, underreporting is common and might be time-of-day dependent [(2)]. Underreporting may bias associations between meal patterns and disease. Glucose concentrations have circadian variation corresponding to food intake [(3,4)]. We aimed to validate reported meal patterns by associating meal size with glucose concentrations over the day.

The Norfolk-based European Prospective Investigation into Cancer and Nutrition (EPIC-Norfolk) recruited 25,636 men and women, aged 39-79 y from GP practices between 1993-1998 [(5)]. At a health visit, anthropometry was measured and non-fasting blood samples were collected (08:00-19:00); serum glucose concentrations were analysed (n = 18,631). Participants using glucose and lipid lowering medication were excluded as well as those who reported <4 days, illness or nightshifts in their 7-day diet diary (7dDD). The pre-structured 7dDD had eight recording sections: before breakfast (BB), breakfast (B), midmorning (MM), lunch (L), tea (T), dinner (D), evening (E) and 'unknown time' (U). We calculated mean reported energy intake (MJ/d) for each section, representing 'meal size'. Analysis of covariance was adjusted for: daily energy intake (DEI), hour of blood sampling, hours fasted, eating frequency, season, sex, age, physical activity, smoking, alcohol, education and BMI (N = 15,506). Adjusted means of glucose (Y-axis) were graphed by hour of blood sampling (X-axis) for zero, 25th, 50th and 75th centiles of average meal size (lines). The significance of the interaction between meal size and sampling time was determined by the F-test ($P < 0.05$).

Mean (SD) DEI was 9.53 (2.10) and 7.23 (1.58) MJ/d in men and women respectively (with 4.0, 0.3 and 0.2 % skipping B, L, D respectively). Mean daily glucose was 4.23 (1.49) and 4.16 (1.32) mmol/L respectively, with approximately 0.5 mmol/L interval between mean peak and trough over the day ($P < 0.001$). Significant interactions between blood sampling time and lunch size were observed ($P < 0.001$), but not for breakfast or dinner.

Glucose concentrations measured at morning appointments had no dose-response association with breakfast, whereas such associations were observed for afternoon and lunch size, in addition to afternoon insulin resistance [(3)]. Evening blood samples were lacking. In this free-living population, meals were not iso-caloric, but represent gradual increments of meal sizes over the day (the latter more clearly observed for triglycerides [(6)]). Verifying meal skipping, and therefore meal frequency, may help elucidate meal pattern-disease associations.



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