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Oral glucose tolerance test results are affected by prior sleep duration: a randomised control crossover trial of normoglycaemic adults

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Oral glucose tolerance tests (OGTTs) remain the key clinical tool for assessing glucose control and diagnosing diabetes. Current guidelines[1] for administering such tests emphasise the importance of a preceding 8 hour fast (often undertaken overnight) but overlook the potential role that preceding sleeping patterns night might play in glucose control the following day. A range of recent studies, both observational and experimental, suggest that poor sleep is associated with an increased risk of diabetes. However, it remains unclear whether poor sleep causes an immediate effect on glucose control sufficient to influence the outcome of an OGTT.

The aim of the present study was therefore to explore the effect of early vs. late bedtimes on OGTT results using a cross-over randomised controlled trial. Following stratification by self-reported pre-existing sleep patterns (as assessed using the Pittsburgh Sleep Quality Index; PSQI), n = 40 normoglycaemic adults were randomly allocated to either a 'short' (2·00am-7·00am) then 'long' (10·00pm−7·00am), or a 'long' then 'short' sleep duration, on two consecutive nights. On each occasion, objective measures of sleep were obtained using the 'SleepMeister'[2] application on an iPhone 4, with additional subjective assessments of sleep provided by subsequent completion of a version of the PSQI adapted to generate self-reports of sleep during the preceding night (as opposed to the preceding month). On each of the mornings following 'short' or 'long' sleep, participants again completed the PSQI and underwent a two-hour 75 g oral glucose tolerance test (OGTT), with blood glucose readings taken at 0, +30, +60, +90 and +120 minutes thereafter using finger-prick tests.[3] Data were analysed using STATA v12. Ethical approval was granted by the University of Leeds REC (Ref:HSLTLM12075).

Both the 'SleepMeister' application and the PSQI recorded significantly later bedtimes (SleepMeister: −19·9; 95 %CI: −20·1,−19·7; PSQI: −19·9; 95 %CI: −20·1,−19·7) and significantly shorter sleep durations (decimal hours: 'SleepMeister': −3·8;95 %CI: −4·3,−3·4; PSQI: −3·4; 95 %CI: −3·9,−2·9) following a 2am (vs.10pm) bedtime (i.e. 'short' and 'long' sleep duration, respectively) – indicating that levels of compliance were high. Neither of the objective nor subjective measures recorded a significant difference in 'sleep efficiency' (i.e. the percentage of time spent in bed asleep: 'SleepMeister': -0·419 %; 95 %CI: −4·9, 4·0; PSQI: 3·6 %; 95 %CI: −2·4,9·7), but both recorded significantly shorter sleep latencies (i.e. time to fall asleep) following a 2am vs. 10pm bedtime (decimal minutes: SleepMeister: −18·9; 95 %CI: −22·4,−15·5; PSQI: −20·6; 95 %CI:−34·6,−6·6).

After adjustment for sleep duration sequence (i.e. 'short' then 'long' vs. 'long' then 'short') and a modest imbalance in gender between the two intervention sequence groups, there was no significant effect of sleep duration on fasting blood glucose levels prior to the OGTT. However, glucose levels recorded after the ingestion of 75 g glucose were consistently higher following a 'short' as opposed to a 'long' sleep duration, and levels recorded at +60 and +90 minutes were significantly higher by 1·18 mmol/l (95 %CI: 0·43,1·92; $p = 0·003$) and 0·55 mmol/l (95 %CI: 0·05,1·06; $p = 0·032$), respectively.

These results indicate that short sleep duration the night before results in an immediate elevation in blood glucose levels the following morning in normoglycaemic adults, and lends weight to the suggestion that sleep plays an important role in the aetiology of diabetes and obesity. Similar effects amongst patients selected for clinical assessment might warrant further standardisation of pre-OGTT sleep duration, similar to that for an overnight fast.

1. National Institute for Clinical Excellence (NICE). (2012) *Preventing Type 2 Diabetes: Risk Identification and Interventions for Individuals at High Risk*. NICE Guidelines PH38.
2. Sleep Meister – Sleep Cycle Alarm Lite Version 14·5; Studio Amuate.
3. Bethel MA, Price HC, Sourij H *et al.* (2013) Evaluation of a self-administered oral glucose tolerance test. *Diab Care* **36**, 1483–8.