

OBSERVATIONS

Altered Sleep Patterns in Adolescents With Type 1 Diabetes: Implications for Insulin Regimen

Changes in sleep duration and pattern are well described in adolescence. Only 20% of adolescents meet recommendations for hours of sleep during the week (9–9.25 h) (1), and adolescents frequently overcompensate on weekends with delayed awakening times (2). Limited data exist describing sleep patterns in type 1 diabetic patients. This is directly relevant to determining optimal insulin treatment regimens and achieving target metabolic control. We describe sleeping times in adolescent diabetic patients in relation to age-matched peers with attention to the influence of insulin regimens.

Seventy-five adolescent patients with diabetes and 54 healthy individuals aged 12–18 years were assessed. Sleep timings on typical weekends and weekdays were collected as part of a larger, institutional ethics committee approved study evaluating activity using a questionnaire (Habitual Activity Estimation Scale) (3), which was completed by patients during routine diabetes clinic visits. The control group was recruited from a local high school. Insulin treatment regimen, diabetes duration, A1C, and anthropomorphic measures were extracted from the medical charts. These variables were compared between patients with diabetes and the control group and within the patient population between different insulin regimen groups. Data were compared using un-

paired *t* tests and linear regression analysis.

Study and control subjects were of similar age (diabetic subjects 16.0 vs. control subjects 16.3 years, $P = 0.07$) and sex (diabetic subjects 44% female, control subjects 57% female, $P = 0.13$). Forty percent of patients were on a three times daily insulin regimen, 44% were on multiple daily injection, and 16% were on continuous subcutaneous insulin infusion.

Mean weekday sleep duration was significantly longer in adolescents with diabetes compared with matched peers (diabetic subjects 8.4 h, control subjects 8.0 h, $P = 0.01$). Weekend sleep duration was significantly longer than weekday sleep duration in both groups with (mean increase in sleep, diabetic subjects 1.8 h, control subjects 2.2 h). The mean wake up time during the weekend was similar between diabetic subjects and the control group (11:16:00 A.M. vs. 11:06:00 A.M., respectively). In both groups, sleep duration during weekdays was inversely correlated with age such that 18-year-old subjects experienced 1 h less sleep than 12-year-old subjects (weekday sleep duration at age 12 years 8.9 h, age 18 years 7.9 h, $P = 0.02$). A1C did differ based on insulin regimen (continuous subcutaneous insulin infusion 7.4 ± 0.4 , multiple daily injection 7.9 ± 0.2 , three times daily insulin regimen 8.8 ± 0.2 , $P = 0.007$), but mean sleep times or wake times did not differ based on insulin regimen, A1C, or duration of disease.

During adolescence, total sleep duration changes and sleep/wake times shift such that teenagers go to bed late and wake up even later. The circadian timing system responsible for this phase delay in sleep is influenced by hormonal changes during puberty, specifically a delay in melatonin secretion (4). Altered sleep may be of greater relevance in adolescents with diabetes, because disrupted sleep architecture occurs in children with diabetes, and sleep deprivation does impair

insulin sensitivity in diabetic subjects (5). Therefore, earlier intensification of insulin regimen should be considered to better accommodate the reality of adolescent sleeping habits.

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