A marker for the end of adolescence

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Supplemental Data: A marker for the end of adolescence

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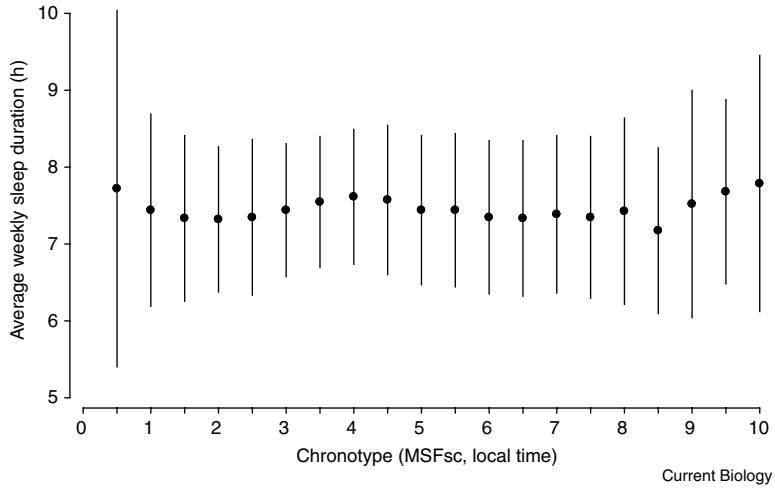

Figure S1. The average weekly sleep duration (see Definitions) does not change significantly with chronotype (as measured by MSF_{sc}).

Definitions

The mid-sleep time on free days (MSF) is calculated from questions concerning sleep onset and awakening time on days on which there are no work or social obligations. MSF is the mid-point between these two times. Except for the extreme early chronotypes, most subjects accumulate a sleep debt on work days, which they compensate for on free days. This sleep debt depends systematically on chronotype – the later the MSF, the larger the work-week accumulated sleep debt (see Figure 6A in [S1]). Our analysis shows that subjects compensate for this sleep debt predominantly by sleeping in on free days and not by going to bed earlier. To clean chronotype from the confounder sleep debt, we corrected MSF (MSF_{sc}) as follows:
$MSF_{sc} = MSF - 0.5*(SD_F - (5*SD_W + 2*SD_F)/7)$
where SD_F is sleep duration on free days and SD_W is sleep duration on work days. $(5*SD_W + 2*SD_F)/7$ represents the average weekly sleep duration or need (see Figure S1).

Validations

We have introduced the MCTQ as an alternative to the widely used Morning-Eveningness questionnaire (MEQ, [S2]) for several reasons: (1) the use of simple, straight-forward questions about times, (2) identical questions separately for work and free days, and (3) the use of time-based rather than score-based chronotype description.

MCTQ derived MSF times and MEQ scores, compared in a study involving 2481 subjects [S3], show a good correlation (r = -0.73). Also, the MCTQ has now been validated by six-week-long sleep logs in 484 subjects (Tim Kuehnle, Martha Merrow, and Till Roenneberg, in preparation).

Several studies have shown good correlations between chronotype (assessed by MEQ) and circadian parameters such as melatonin [S4–S6]. As a clinical validation of the MCTQ, we measured the daily profiles of several blood parameters in 12 subjects (without the influences of activity, sleep, food, or light) and found that the phases of both the melatonin and the cortisol rhythms strongly correlate with chronotype as determined by the MCTQ (data not shown).

Sleep Duration and Chronotype

Because sleep duration changes with age it is important to identify how much sleep duration contributes to the age-dependent chronotype curve shown in Figures 1C and D. Based of the evaluation of our database, we find that average sleep duration and chronotype are controlled independently (Figure S1 and [S1]).

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