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Quantifying teenagers' sleep patterns and sex differences in social jetlag using at-home sleep monitoring

Maria Hrozanova[a], Jan Arvid Haugan[b], Ingvild Saksvik-Lehouillier[c], Věra Skalická[c], Lukas Krondorf[d], Frode Stenseng[e], Frode Moen[b,e]

[a]Dep. of Public Health and Nursing, Norwegian University of Science and Technology (NTNU); [b]Dep. of Education and Lifelong Learning, NTNU; [c]Dep. of Psychology, NTNU; [d] Dep. of Data Science and Research, VitalThings AS; [e]Olympiatoppen Midt-Norge

INTRODUCTION

Bioregulatory and psychosocial factors: Bioregulatory and psychosocial systems undergo important changes in the teen years [1,2] and contribute to the evening shift in alertness and preference for later bedtimes in teens. This results in the "perfect storm of short, ill-timed, and inadequate sleep" [1, 3].

Social jetlag in teenagers: Social jetlag = misalignment in sleep timing between weekdays vs. weekends [4]. Sleep is shorter, and bedtimes and risetimes are earlier on weekdays vs. weekends [5, 6], and sleep quality deteriorates [5]. In teenagers, there is limited evidence of sex differences in social jetlag using objectively-quantified sleep data.

Present study: Quantified teenagers' sleep/wake patterns and sleep stages, investigating sex differences in the daily changes underpinning social jetlag.

METHOD

Participants: 156 teenagers (58.3% girls, 15–16 years).

Sleep monitoring: In teens' home environments, using the unobtrusive SOMNOFY® sleep monitor. The device utilizes an impulse radio ultra-wideband (IR-UWB) pulse radar and Doppler technology and has been validated against polysomnography in a sample of healthy adults [7].

Statistical analyses: Data was analyzed using linear mixed effect models in R. Models utilized Maximum Likelihood Estimation, and included an interaction term with sex (0 = boys, 1 = girls) and night of the week (1 = night starting on Monday [intercept], 2 = night starting on Tuesday …, 7 = night starting on Sunday) to predict each dependent sleep variable.

RESULTS

Average sleep patterns (Fig. 2)

	Overall		Weekdays		Weekends	
	Mean	SD	Mean	SD	Mean	SD
Sleep onset (hh:mm)	23:41	01:09	23:25	00:55	00:43	01:32
Sleep offset (hh:mm)	07:48	01:21	07:19	00:48	09:34	01:18
Sleep duration (h)	7.7	1.1	7.5	1.0	8.4	1.3
Sleep efficiency (%)	85.8	7.3	86.1	7.0	84.4	8.4

Figure 2. Average sleep patterns. Means and standard deviations (SD) are based on up to 10 consecutive nights of sleep data in 156 Norwegian teenagers, in the overall period of data collection, during weekdays (i.e., school nights) and weekends.

Sex differences in social jetlag (Fig. 3)

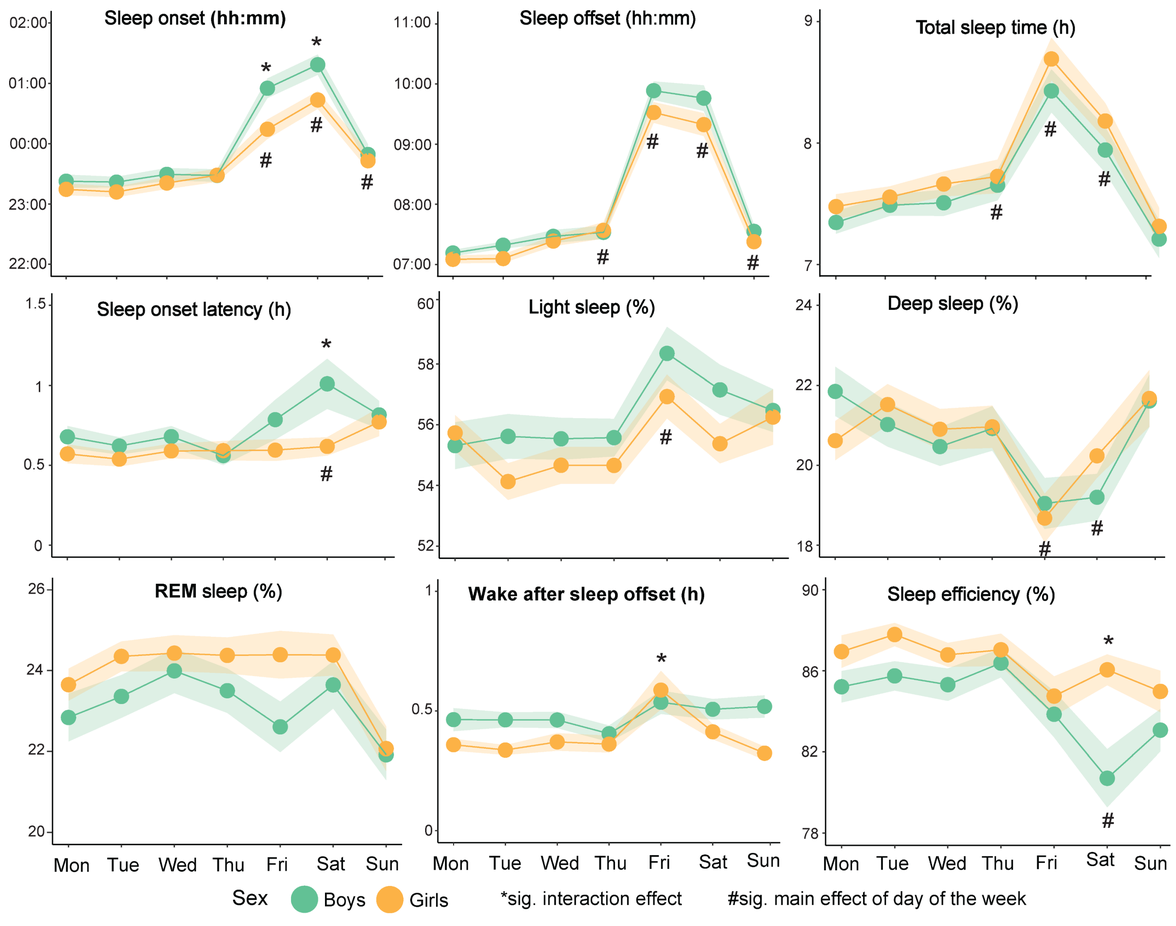

Figure 3. Sex differences in social jetlag. Data is based on sleep monitoring in 156 Norwegian teenagers across up to 10 consecutive days. Each dot represents the mean score of each sex on each night of the week in the respective sleep variables. The shaded areas represent the S.E. Girls are shown in yellow, and boys in green. The x-axis shows the day the sleep was initiated, i.e., Mon represents nights of sleep starting on Monday, and ending on Tuesday. * represents a significant interaction term, and # represents a significant main effect of day of the week, controlled for the effects of sex.

CONCLUSION

Sleep patterns of teenagers are in line with normative data: The sample exhibited healthy, albeit somewhat short sleep. Sleep stage distributions were in line with normative sleep data for this age group.

Teenagers exhibit social jetlag: We found convincing evidence of social jetlag. The sample had later sleep onset and offset, longer sleep duration, less deep and more light sleep on Friday and Saturday nights. At the same time, we observed poorer sleep efficiency and longer sleep onset latency on Saturday nights.

Teenage girls have less severe social jetlag than boys: Girls had longer nightly time awake on Friday nights, but also shorter sleep onset latency and higher sleep efficiency on Saturday nights, and earlier sleep onset on Friday and Saturday nights.

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CONTACT

Maria Hrozanova: maria.hrozanova@ntnu.no; X: @Maria_Hrozanova

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