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Circadian preferences and sleep in 15- to 20-year old Finnish students

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ABSTRACT

Purpose: Despite progress in research concerning adolescent and young adult sleep and circadian preferences, several aspects have remained unexamined. This study explored gender and diurnal rhythms in relation to several sleep-related factors: sleep duration, bedtime, wake-up time, tiredness, sleepiness, and optimal subjective sleep duration

Methods: Circadian preferences and sleep were investigated in 555 (Females N=247) Finnish students aged 15–20. The self-report measures included a shortened version of the Horne-Östberg Morningness-Eveningness Scale, the Epworth Sleepiness Scale as well as items probing feelings of tiredness, optimal subjective sleep durations, and bedtime and wake-up time on the most recent day and a typical weekend. Data were collected from Tuesday to Thursday during an ordinary school week.

Results and conclusion: The most frequent chronotype was the intermediate type (54%), and compared to previous studies, the prevalence of evening-oriented individuals was high (37%), whereas only 9% of the participants were classified as morning oriented. No gender-specific or chronotype-specific differences in sleep durations were observed, but girls/women and evening-orientated individuals reported suffering more from sleepiness, compared to boys/men and more morning-typed participants, respectively. About 20% of the total sample indicated that their subjective need for sleep was not satisfied during the weekdays nor the weekend, indicating chronic sleep deprivation. Among girls/women and evening-oriented individuals, the subjective sleep need was greater for weekday nights.

1. Introduction

The temporal organization of sleep varies among adults [1,2] and adolescents [3,4]. Between-individual differences in the preference for the timing of sleep and other daily activities is usually estimated with self-report questionnaires probing chronotypes, i.e., whether a person prefers to go to bed relatively early in the evening and wake up early in the morning (morningness, Morning-type=M-type) or go to bed late and also wake up late (eveningness, Evening-type=E-type) [1,2]. Most individuals, however, fall somewhere between these opposites and represent the Intermediate type (I-type). Children are prone to morningness [5], but the onset of puberty brings a major change towards eveningness [4,6–9]. However, a small shift back to morningness usually occurs before the age of 20, probably due to social pressure [4]. Recent research suggests that increased sensitivity to light may trigger this change toward eveningness in puberty [10]. Accordingly, youngsters living in rural areas with no electric lighting exhibit earlier bedtimes than their peers in more urban areas [11,12].

Several lines of recent evidence suggest that eveningness has a negative effect on sleep. Eveningness-typed adolescents report having a poorer quality of sleep than individuals exhibiting other chronotypes [3,7,13], and daytime sleepiness is often [3,14,15], but not always [16], reported by E-types. Short et al. [13] point out that daytime sleepiness or tiredness in E-types is caused by poor sleep quality. Compared to morning-orientated adolescents, E-types are reported to sleep less during the school week [3,7]. Although adults usually sleep for the same length of time on weekday nights irrespective of their chronotypes, E-typed adults complain of insufficient sleep [16,17].

Defining optimal sleep is a matter of considerable complexity [18]; in this study, only subjective sleep need was assessed. The discrepancy between reported sleep length and subjective need for sleep was used to define excessive sleep and sleep deprivation. Mercer et al. [19] found two groups of adolescents with respect to this: those wanting more sleep on weekday nights, and those satisfied with their sleep duration. They suggested that eveningness might explain why the respondents felt they needed more sleep.

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Compared to other chronotypes, adult E-types have shown equivalent sleep duration on weekday nights, but have expressed not having a sufficient amount of sleep [16]. The present article further tested whether differences exist in bedtime, wake-up time, duration of sleep, subjective sleep need, and tiredness among different chronotypes. Sleep-related factors in adolescence tend to be at least partly gender specific [4,6,20,21], therefore we were also interested in seeking possible differences between male and female participants.

In short, the present study was carried out to further explore sleep and morningness-eveningness in a student population. Based on previous work, we hypothesized that compared to morning-oriented students, participants with more evening-type orientation would a) sleep less during the school week and more on weekend nights, b) complain insufficient sleep during the school week in particular, and c) report a higher level of tiredness on weekdays. The relatively mixed previous results concerning gender differences do not lend themselves to hypotheses.

2. Method

2.1. Procedure and sample

The study design was approved by an ethical board at the University of Helsinki. The participants were recruited from different high schools (49% of the sample) and vocational schools (51% of the sample). In Finland, after 9-year compulsory comprehensive school, about a half of the cohort continues to high school and half studies further in vocational school. Only a very small minority discontinue their education. Data were collected in three major metropolitan cities (together comprising about 1 million inhabitants) and two towns (54,000 and 21,000 inhabitants) in southern Finland. These municipalities are located between 60° and 61° North latitudes and 24° and 26° East longitudes.

Permission to carry out the study was received from local school authorities. The authors of the present article gathered the data during regular school lessons. To obtain the most accurate sleep information possible, data collection was organized only from Tuesday to Thursday on ordinary school weeks and unconnected to holidays over two academic years from 2013 to 2015. Sampling took place from September to October and March to May during these academic years. Most of the data were gathered from March to May, when there is much daylight in southern Finland. Using paper and pencil, the participants responded to several scales exploring sleep and well-being in a 20-minute session. About 580 participants produced eligible answers, but those older than 20 were removed from the data. Hence, 555 students (247 females, 44.5%, one missing gender value) aged 15–20 years remained in the data. Missing values, which were relatively infrequent and random, decreased the number of informants in some scales.

2.2. Measures

2.2.1. Chronotypes

A shortened version [22] of the Morningness-Eveningness Questionnaire [23] was used to assess the chronotypes of the participants. The shortened version includes six items, yielding 5–27 points. Participants obtaining 19–27 points were classified as M-types, those with 13–18 points intermediate types, and those with 5–12 points evening types [17].

Generally, in addition to questionnaires probing daily activities and sleep habits, circadian preferences are often estimated using the sleep midpoint time (the time between sleep onset and sleep offset): the later the sleep midpoint is, the more the respondent is inclined towards eveningness. Two indices of mid-sleep were calculated in this study: one for a school weeknight, and another for a weekend night [2].

2.2.2. Self-reported sleep length and subjective sleep need

Sleep durations during the school week and the weekend were enquired about with four questions: "When did you go to bed yesterday?", "When did you wake up today?", "When do you usually go to bed on Friday and Saturday?", and "When do you usually wake up on Saturday and Sunday?" The actual time in bed was calculated using these values. In addition, the participants were asked to indicate how many hours of sleep they would need on weekday and weekend nights to remain alert during the daytime.

2.2.3. Sleepiness/tiredness

The *Epworth Sleepiness Scale* (ESS) [24] is an eight-item measure of daytime sleepiness. The participants are asked to evaluate how likely it is that they doze or fall asleep in everyday situations (e.g., "Sitting and reading" and "As a passenger in a car for an hour without a break"). The scale includes four options: 0 = would never doze, 1 = slight chance of dozing, 2 = moderate chance of dozing, and 3 = high chance of dozing. A total score over the eight items was calculated.

Tiredness was estimated using four questions (1 = very alert – 5 = very tired) concerning how tired the participant was in the morning and during the day on weekends and weekdays. Composite scores (range 2–10) were calculated for tiredness on weekdays and during weekends.

2.3. Data analysis

The data were analyzed using SPSS 22 software. To reveal gender-specific and chronotype-specific differences in sleep variables, a series of two-way ANOVAs was carried out. For pairwise group comparisons, a Least Significant Difference (LSD) test was applied. Cross-tabulation was used to compare whether the same individuals showed excessive sleep or sleep deprivation during both the school week and over the weekend. The significance level in all analyses was set at $p < .05$ to indicate nominal significance, and after Bonferroni correction at $p < .0027$.

3. Results

Descriptive information is shown in Table 1. The internal consistencies that could be calculated for the measures were acceptable. When school week and weekend sleep were compared, some significant differences were seen. The participants reported that they slept about two hours less on weeknights than weekend nights, $t(549) = -26.87$, $p < .001$, and were more tired during the school week, $t(553) = 29.93$, $p < .001$. Compared to weekends, they also went to bed earlier on weekdays, $t(554) = -25.62$, $p < .001$, and woke up earlier, $t(549) = -47.17$, $p < .001$.

In the present data, the prevalence of the morning type was low (N = 47, 8.9%). The proportion of the intermediate type was the highest (N = 298, 54.5%), followed by evening type (N = 194, 35.0%). The genders were equally represented in the chronotypes, Pearson $\chi^2(2) = 1.79$, n.s.

Sleep deprivation and excessive sleep during the school week were calculated by subtracting the subjective sleep need from the self-reported sleep length. Not all 555 participants produced eligible answers to the items investigating sleep length. Of the 549 participants with eligible answers, 310 (56.5%) reported having slept less during the previous night than their optimal sleep need, whereas 195 (35.5%) indicated that their sleep length during the