Sleep Medicine 10 (2009) 1047–1050

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Original Article

Daytime sleepiness during transition into daylight saving time in adolescents: Are owls higher at risk?

Anne-Marie Schneider, Christoph Randler *

University of Education, Heidelberg, Im Neuenheimer Feld 561-2, D-69120 Heidelberg, Germany

ARTICLE INFO

Article history:
Received 1 July 2008
Received in revised form 3 August 2008
Accepted 7 August 2008
Available online 5 April 2009

Keywords:
Chronotype
Circadian rhythm
Daytime sleepiness
Diurnal preference
Morningness–eveningness
Adolescents

ABSTRACT

Background: Individuals differ in their biological rhythms and preferences for time of day. Here, we looked at the transition into daylight saving time (DST) in adolescents. As adolescents tend to be evening types, one may expect that they suffer from a transition into DST.
Methods: To assess these changes, we measured daytime sleepiness and morningness–eveningness preference (CSM score) in adolescents.
Results: Daytime sleepiness correlated with age and CSM score. Older pupils and evening types showed a higher sleepiness. Daytime sleepiness was higher after the transition until the third week after. Older pupils and pupils scoring higher on eveningness reported higher daytime sleepiness after the transition, suggesting that these pupils suffer most from the change. Using cut-off scores for larks and owls, we found that owls showed higher sleepiness than larks.
Conclusion: As one consequence, class and school performance tests should not take place in the first week(s) after the transition into DST.

1. Introduction

Daylight saving time (DST) is used to balance the seasonal-caused daylight exposure changes to the activity peaks of a given population, and it affects millions of people [1]. Therefore, it is necessary to investigate the impact of DST because it affects the diurnal or circadian rhythm, and different chronotypes may respond differently towards DST [1–6]. Individuals differ in their circadian preference and in their circadian clocks; therefore, DST may affect the diurnal rhythm and may lead to abnormalities such as sleep problems [3]. DST adds to the chronic sleep loss [7] as is seen, e.g., in the increase of accidents after DST in spring [8]. Further, sleep reduction is supposed to trigger the appearance of mental illness; DST may also have an influence on the appearance [9]. Disturbances of the sleep–wake cycle are associated with numerical clinical symptoms such as seasonal affective disorder or bipolar disorder [9–13]. With respect to chronotype, depressed patients are often more shifted towards eveningness, suggesting a link between mental health and morningness [11,12].

These individual differences in biological rhythms or in circadian typology are viewed as an interesting facet of personality [14]. In general, "larks," or morning types, prefer to get up and go to bed early, while "owls" prefer later bed times and later rise times [15–19]. Usually, such an assessment of individual difference in chronotype is based on self-reporting [18,19] and these differences in morningness–eveningness (chronotype) can be considered on a continuous scale [20].

The variability in the circadian clock is heritable and some genes have been identified that are associated with morningness–eveningness [21–23]. Above and beyond the genetic influence which is roughly estimated to account for about 50% of the variance in circadian typology [23], social, cultural and environmental factors modulate the circadian preference [24–27].

Chronotype changes significantly during the lifespan. While younger children are often morning larks, adolescents shift considerably towards eveningness during puberty [28–33] and back towards morningness at the end of adolescence [33]. During later years of adulthood, aged people turn far more towards morning activity [34]. Results concerning gender differences were inconclusive [34], but in larger samples morningness was higher in girls or women [35,36]. Morningness–eveningness has been found to correlate with some of Eysenck's personality dimensions [37,38] or with the conscientiousness scale of the Big Five Personality Inventory [39] or Millon Personality Styles [40].

The change in diurnal preference in adolescence has severe consequences on lifestyle and school functioning [41,42], and the turn towards eveningness is associated with depressive tendencies [43], poor performance at non-optimal times of day [16], behavioural difficulties [43,44] and higher familial and social demands [45].

Given these studies, one may expect that adolescents may suffer most from a transition into DST because during the transition in spring time, clocks are typically adjusted forward one hour. The transition into daylight saving has rarely been the focus of

* Corresponding author.
E-mail address: randler@phheidelberg.de (C. Randler).

1389-9457/$ - see front matter © 2009 Published by Elsevier B.V.
doi:10.1016/j.sleep.2008.08.009

research, especially because it is argued that a shift of one hour should be easily coped with (comparably to a jetlag). Studies about DST were carried out by Monk and Folkard [4] and Monk and Aplin [5]. These authors found that adjustment of times of retiring and falling asleep appeared to be instantaneous, while it took up to a week to adjust wake-up times. The results of Berk, Dodd, Hallam, Gleeson and Henry [6] showed that suicide rates in males rise in the weeks following the commencement of daylight saving. Kantermann et al. [2] further suggest that humans do not adapt to DST, while Lahti et al. [3] emphasise that evening types have more problems in adapting to DST, and morning types experience the shift back as more problematic.

We hypothesise that adolescents scoring high on morningness should more easily adapt to DST, especially in adolescence.

2. Method

2.1. Participants and data collection

Data were collected from girls and boys in Germany during the transition into daylight saving time in spring 2008. Participation was voluntary, unpaid and anonymous. Informed consent was obtained from pupils, their parents and the principals of the schools. Four hundred and sixty-nine teenagers participated in this part of the study. There were 251 girls and 218 boys. The mean age was 13.5 years ($SD = 2.2$, range 10–20 years). Participants were recruited from three schools. All students attended classes in a stable morning study schedule from 7:30 a.m. to 1:00 p.m. Participants completed the questionnaires in groups of 30 students during their usual classes in the presence of one of the authors (AS), who provided guidance as needed. Data were obtained between 3rd March and 14th March for the pre-DST sampling, between 31st March and 4th April for the first week (week 1), between 7th and 11th April for the second (week 2), and at the 18th April for the third group (week 3). The questionnaires were administered at different days of the week and at different times during a school morning. The CSM seems unaffected by time-of-day effects and the PDSS was administered as a scale focusing on the last week.

2.2. Measurement instruments

2.2.1. Composite Scale of Morningness (CSM) [19]

The CSM consists of 13 questions regarding the time individuals get up and go to bed, preferred times for physical and mental activity, and subjective alertness. Five of the elements of the scale refer to different times of day. The score is obtained by adding the items and ranges from 13 (extreme eveningness) to 55 (extreme morningness). The reliability and validity of the CSM has been corroborated into German speaking populations [31], as well as its transcultural validity [25,26]. Cronbach's α of the present sample was 0.82, indicating a good reliability of the scale. Mean CSM scores were 34.41 ± 6.38 (SD).

2.2.2. Pediatric Daytime Sleepiness Scale (PDSS) [46]

The PDSS contains eight items in a Likert type response format and one item is reverse coded. The score is obtained by adding the items. Reliability of the scale was good prior to (Cronbach's $\alpha = 0.74$) and after the transition (Cronbach's $\alpha = 0.78$).

The PDSS was applied prior to the transition into daylight saving time (see methods) in all pupils. Afterwards, it was applied a second time in these pupils, but pupils were split randomly into three different groups: in the first, second and third week after the transition, the PDSS was filled in a second time. It was advised that the pupils consider the time span of the last week when answering the questions of the PDSS.

Please note that not all participants were present during the two dates of data collection and that not all of the pupils filled in the complete form. We used only complete questionnaires for analysis.

3. Results

Daytime sleepiness and eveningness both correlated with age, suggesting that daytime sleepiness and eveningness increase with age (PDSS: pre: $r = 0.267$, $p < 0.001$; post: $r = 0.315$, $p < 0.001$; CSM: $r = -0.226$, $p < 0.001$). The CSM scores and both measures of daytime sleepiness were also correlated (prior: $r = -0.623$, $p < 0.001$, $N = 432$, Fig. 1; post: $r = -0.565$, $p < 0.001$, $N = 384$) suggesting that evening types report higher daytime sleepiness.

Daytime sleepiness was higher after the transition into daylight saving time (means ± SD): scores were 12.9 ± 5.5 before and 13.3 ± 5.8 after the transition. This difference was significant ($t(397) = -2.02$, $p = 0.04$; pooled data of all three post-transition measurements). In detail, PDSS scores of subjects measured in the first week were 13.23 ± 5.49 prior and 13.77 ± 6.11 after DST ($N = 164$), in the second week 12.64 ± 5.46 (pre-DST) and 13.26 ± 5.62 (post-DST; $N = 113$), and 12.69 ± 5.64 (pre) and 12.74 ± 5.65 in the third week ($N = 121$; NB: please note that there are three different baseline levels because of different age of the participants). CSM scores for each subgroup were 34.71 ± 6.60 (group 1), 33.68 ± 6.32 (group 2) and 34.70 ± 6.17 (group 3). Daytime sleepiness prior to transition did not differ between these three groups (One-way-ANOVA: $F_{2,410} = 0.665$, $p = 0.51$), suggesting that the three groups show comparable means. Daytime sleepiness after the transition was influenced by age, CSM score and by the PDSS score prior to transition but not by sex. Older pupils and pupils scoring higher on eveningness reported higher daytime sleepiness after the transition, suggesting that these pupils suffer most from the change (Table 1). The relationship between daytime sleepiness and chronotype remained significant after controlling for age and pre-transition PDSS scores via a partial correlation ($r = -0.160$, $p = 0.002$, df = 368).

To account for these confounding variables (age, CSM score and pre-transition PDSS score), we used a linear model to test for differences among weeks 1, 2 and 3 after transition. We found no

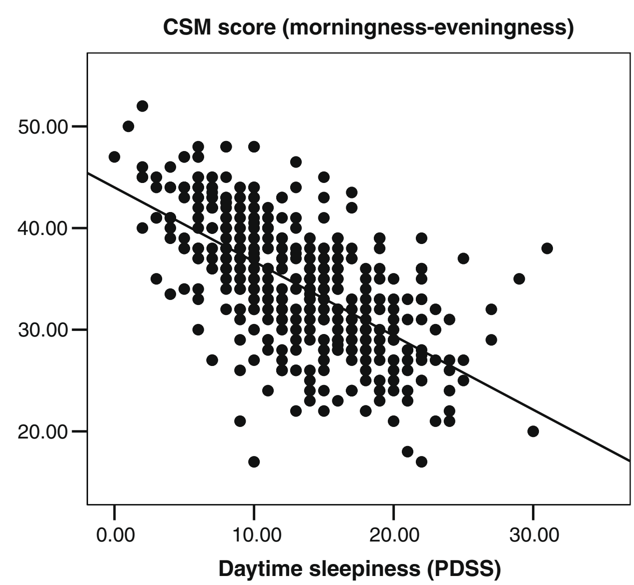

Fig. 1. Relationship between daytime sleepiness (as measured by the Pediatric Daytime Sleepiness Scale, PDSS) and the scores on the Composite Scale of Morningness (CSM). High scores on the PDSS represent high daytime sleepiness; high scores on the CSM represent morning types.