Intelligence affected by sleep habits: the chronotype of Portuguese school-aged children, performance and school schedules

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The literature in chronobiology has emphasized the correlation between the evening chronotype and low academic performance of adolescent and adult populations. However, this correlation has not been studied regarding school-aged individuals who perform school tasks at different times according to the task's academic field. The synchrony effect has already been duly tested in adults for its impact on executive functions and attention by means of fluid and crystallized intelligence measurement tasks. However, the studies remain less consistent regarding the analysis of this impact involving children's samples, especially knowing the attention fluctuation according to chronotype. The main evidence refers to adolescent and adult populations. Intelligence is perceived as an indisputable factor for the prediction of academic success, but intelligence (perceived through performance at certain times of the day) and academic achievement can be mediated by the chronotype effect, and caution must be taken in assuming greater intelligence for certain diurnal types in different school contexts.

Accordingly, the research evaluates the performance of Portuguese schoolchildren (4-11 yr) in the context of a specific attention task of the (Portuguese version) Wechsler Intelligence Scale– symbols subtest - in different periods of the day and during the current school schedule, with an interval of one week. In addition, and related to the purpose of the study, the children's chronotype was evaluated by means of a validated questionnaire for the Portuguese population.

Method

Forty-six Portuguese children, 23 (50%) male and 23 (50%) female attending the first cycle of Basic Education (years 2-4, year 1 not included) were selected. They had no idisturbances, aged 7 to 11 years (M=8.67; SD=1.034). Of the 46 children, 24 (52.2%) were of the morning type and 22 (47.8%) were of the evening type. The criterion for chronotype selection followed the work of Couto et al. (2011),

Instruments

1) Chronotype
The Children's Chronotype Questionnaire (CCTQ) was developed by Werner et al. (2009). Couto et al. [12] adapted in 2011 the Portuguese version. The CCTQ includes a brief demographic questionnaire on gender, age, birth order, household and schooling, as well as questions on sleep-wake parameters on free days and on days with schedules. It assesses the bedtime hour, sleep latency, time to wake up, time to get up and time the child is fully awake, corresponding to the Midsleep point (MSP).

2) Attention
.The subtest of symbols measures attention and corresponds to one of the 13 subtests of the Wechsler Intelligence Scale for Children (WISC-IV). The identified Cronbach's alpha varies between .62 and .93 . The subtest was administered to children twice a day, in a first session in the morning at 9:30 am and in a second session in the afternoon at 3:30 p.m., a week apart. The two sessions aimed to identify the best performance in the two evaluation periods (morning and afternoon) in each chronotype. The CCTQ was handed over to the parents to be filled in.

Results

We used descriptive statistical analysis (mean and standard deviation), Pearson correlation coefficient and the percentile calculation for the chronotype identification. The scores for the Wechsler subtest were converted into standardized results by calculating the mental age. The normality assumptions were analyzed using the Shapiro-Wilk test. For the homogeneity analysis, we used the Levene test. The SPSS, v. 24 was used.

In the analysis between the morning and the afternoon period regarding the results of the subtest of symbols produced by the two chronotypes' groups, the Mann-Whitney U test was used because we are not able to proceed with the student's t-test for paired and independent samples considering the normality assumptions were not met, not allowing the use of that psychometric test

The results indicate no significant differences (U = 234.000, p = .506) between the two children' groups in the morning schedule (U = 234.000, p = .506), as well observed for the afternoon schedule (U = 251.000, p = .774). Scores of children, previously identified as morning and evening types, were very similar in this subtest. See figure 1.

Figure 1. Performance of morning and evening types in the symbols subtest of the Wechsler Intelligence Scale for Children (Portuguese version)

Discussion

This study confirms that chronotypes are not significantly affecting the children' performance in the morning and afternoon schedules for the specific subtest of symbols decoding. On the other hand, the study revealed a high number of very young children of the evening type, which has been a different evidence in studies in this area. The data suggest that children are not exclusively or mostly of the morning type, and that their critical period for changing from morningness to eveningness develops more rapidly. The children's attention did not increase throughout the day. Previous studies on time-of-day effects suggest, but in pre-adolescents aged 10-12 years, that attention tasks require a cognitive demand that may be more positively associated with the afternoon period, which may explain the close and high means of the morning and afternoon groups in the performance obtained in the twice-administered trial study in the afternoon. A strong point of this study is that the evaluation of cognitive aspects - attention – is not based on information arising from school or academic classifications. Regarding limitations of this study, we do not present covariates to observe the moderation of the performance of the attention task by controlling factors such as gender and socioeconomic status. Further studies should include more extensive samples, more attention scales and more information on correlation coefficients between the studied variables. It is of utmost importance to collaborate in the validation of this type of evidence for an improved intervention in schools and in the schedules of the psychological tests that are currently practiced, also taking into account the geographical and time differentiation of school populations.