Atención Primaria

SCIENTIFIC ARTICLE

Sleep-wake patterns and their influence on school performance in Portuguese adolescents

João Duarte*, Paula Nelas, Cláudia Chaves, Manuela Ferreira, Emília Coutinho, Madalena Cunha

Escola Superior de Saúde de Viseu, Instituto Politécnico de Viseu, Viseu, Portugal

Abstract
Objective: To characterise sleep-wake patterns and their influence on academic performance for a sample of Portuguese adolescents.
Research design: Cross-sectional, analytical-explanatory, correlational epidemiological research. The protocol includes the composite morningness questionnaire (Barton et al, 1985 adapted by Silva et al, 1985), the Epworth Sleepiness Scale (Murray, 1991), chronic fatigue scale (Smith et al, 1995), the Pittsburgh Sleep Quality Index (Buysse, 1988), Educational Achievement (Fermin, 2005), personal and academic data.
Participants: 2094 students (55.3% girls; 16-23 years old; M = 16.82 ± 1.25) attending secondary school in central Portugal. Living in urban areas, living with their parents and about 57.1% are in a family with reasonable economic resources.
Results: Adolescents' sleep patterns reveal that they sleep on average between 8-9 hours a night, do not use medication to sleep, with sleep latency within the normal range, with good sleep efficiency, without daytime dysfunction and with undisturbed sleep, predominantly intermediate chronotype. Minor drowsiness, increased sleep efficiency, improved subjective sleep satisfaction, less sleep disturbance, less daytime dysfunction, not consuming hypnotic medications, associated with better academic performance. Morningness/eveningness, sleep efficiency, daytime dysfunction and sleep latency emerge as predictors of academic performance. The chronotype interacts to predict the quality of sleep enhancing it as a mediator of school performance.
Conclusions: Sleep and associated individual characteristics should be considered in the diagnosis and intervention process in secondary education.
© 2014 Elsevier España, S.L. All rights reserved.

*Corresponding author.
E-mail: jduarte@essv.ipv.pt (J. Duarte).

Background

Sleep is a multifaceted phenomenon involving organic functioning, psychological state, social interaction and behavioural components and even environmental factors and learning. It is an experience that needs to be managed properly to produce success in adolescent life. If we also accept that sleep and learning are two poles of dynamic interaction that mutually influence each other, how does sleep contribute to the existence of higher academic performance in secondary school students?

With respect to sleep in adolescence, the phenomenon known as "delayed sleep phase" is often observed. This refers to the displacement of sleep episodes to later times. With the onset of puberty, some features of the sleep-wake cycle begin to change: the schedule of sleeping and waking become later, especially in situations where school hours become less of an imposition (holidays and weekends). A trend toward decreased duration of nocturnal sleep on weekdays has been observed with a concomitant increase in the incidence of daytime sleepiness, difficulty in waking in the morning and problems falling asleep at night.

One possible explanation for the changes in adolescent sleep/wake cycle focuses on their acquiring new habits for greater involvement with peer groups and less parental control over their schedules. Such hypotheses are possibly complementary, i.e., the interaction between biological and sociocultural factors predispose sleep/wake cycle to changes during adolescence.

In outlining this research, the following objective arises: to characterise sleep-wake patterns and their influence on school achievement for a sample of Portuguese adolescents.

Material and methods

The research model adopted was cross-sectional, explanatory, analytical-correlational and epidemiological. 2094 10th, 11th and 12th year students participated (55.3% girls; 16-23 years old, M = 16.82 ± 1.25), attending public secondary schools in the central region of Portugal. They were studied during class time. They live in urban areas with their parents, of whom approximately 57.1% attended higher education and they are in families with reasonable economic resources. The data collection protocol includes the composite morningness questionnaire (Barton et al, 1985 adapted by Silva et al, 1985), the Epworth sleepiness scale (Murray, 1991) the chronic fatigue scale (Silva et al, 1995), the Pittsburgh Sleep Quality Index (PSQI) (Buysse, 1988), and School Achievement (Fermin, 2005) and personal and academic data constructed for the purpose.

Results

The sample consists of 2094 adolescents, 55.3% female, with a minimum age of 14 and a maximum of 23 (X = 16.82 anos ± 1.256). They mainly inhabit the city. Over three quarters of the sample live with their parents, who are mostly married (84.5%) and have a similar level of educational background. 57.1% of the students consider their parents' income average.

The most common habits for males before bedtime most frequently are using their computer and doing sports. Females prefer to study, read and have a warm drink. Watching tv/dvd/video and spending time with friends before bedtime is more common in young people aged over 19. Adolescents aged up to 16, more commonly use their computer, listen to music, study, read, do sports and have a warm drink. For both sexes, 72.6% say they are always or often tired at bedtime.

Of the total sample, 56.2% never wake during the night and in the morning are awakened by a radio/alarm clock with girls using this method the most (64.9% vs 55.4%). However, 33.6% of the boys and 25.3% of the girls are awakened by family members and 10.0% do not require help to awaken. Approximately 5 in 10 adolescents mention feeling fine when waking up; this value is slightly higher in males. Girls feel tired more often upon waking (33.4%), in a bad mood (21.0%) and with headaches (8.4%).

The Epworth Sleepiness Scale, with an index of 0-24, estimates the level of daytime sleepiness. It has a minimum and maximum value of 0 and 24 respectively with means ranging from 8.66 for girls and 8.80 for boys (X = 8.72).

Young people over 19 show severe somnolence (33.7%), while those aged 17-18 are scored with more cases of normal sleep (30.0%) and low sleepiness (32.2%).

Regarding year of schooling, students in different years are balanced without statistical significance ($\chi^2 = 10.307$; $P = .244$) with similar percentages in all sleepiness groups. It is, however, noteworthy that among those who reported excessive sleepiness, equal percentages (41.2%) are found in the students who attend the 10th and 11th year.

From the chronotype characteristic – morningness and eveningness, females (X = 34.57) have higher morningness rates than males (X = 34.44).

With regard the greater or lesser tendency for morningness/eveningness, 9 out of 10 students is an intermediate type (90.8%), while we find the highest percentage among girls (56.1%). For their part boys show more eveningness (56.3%). Nevertheless, approximately 50.0% are also classified as morning-type without statistical significance ($\chi^2 = 4.718$; $P = .095$).

The Pittsburg Sleep Quality Index, which assesses subjective sleep quality, sleep latency, sleep duration, overall sleep efficiency, disruption of sleep, the use of hypnotic medication, daytime dysfunction and overall sleep index was used. The overall index has a minimum score of 0 and a maximum of 19. Mean variability is low and the lowest is in the use of sleep medication (mean = 0.248). The highest variability is in subjective sleep quality (mean = 1.149), while for the overall index the mean value is 5.140. What stands out is that 10th year students show better sleep quality in all aspects.

The perception that adolescents have on their subjective sleep quality for the majority (54.9%) is that it is good enough or very good (16.9%). Among those who consider it good enough, the largest percentage is females (55.4%) and those who consider it very good, 6 in 10 are boys. As for those who report having rather poor sleep quality (24.5%) or very poor (3.7%), approximately 7 out of 10 are girls with statistical significance ($\chi^2 = 56.887$; gl = 3; $P = .000$) for males with very good subjective sleep quality and females with very poor sleep subjective quality.

Sleep latency is a very severe sleep disorder which may occur at any age. The highest percentage of adolescents (41.1%) scored between one and two points corresponding to a delay in sleep of 16-30 minutes with a frequency of occurrence of less than once a week; this percentage being higher in girls (56.3%).

Nearly 8 in 10 teens who participated in the study sleep over seven hours per night (75.6%), registering a higher prevalence among girls (53.5%). Moreover, the highest percentage those who sleep 6-7 hours per night were found to be girls (63.2%). The relationship between sleep duration and gender was found to be statistically significant ($\chi^2 = 12.363$; $P = .002$).

Most adolescents (71.6%) report sleep disturbance less than once a week with girls contributing 54.9% and boys, 45.1%. We also found that 71.7% of adolescent females report having sleep disturbances, once or twice a week and 73.1%, three or more times a week. 9.8% did not have sleep disturbances.

With regard to age and year of schooling, it was the younger adolescents and those attending the 10th year that have no sleep disturbances with 41.5% and 36.6% respectively. The percentage of those who had disturbances less than once a week in this age group and year of schooling, it was 44.3% and 38.2% respectively.

Predominately young people aged up to 16 never use sleep medication (43.8%). The same age group relates taking it three or more times a week, with significant differences but in similar proportion (42.3%). Young people aged 17-18 years recorded the highest percentage (40.3%) taking sleep medication once or twice a week. For those over the age of 19 years, it is observed that the higher percentages are use the medication once or twice a week (37.7%) and three or more times a week (39.4%) with statistical significance for this group.

Analysing the results by age and years of schooling, adolescents aged up to 16 have higher levels of sleepiness. In fact, 42.7% of the adolescents in this age group, 43.2% reported daytime dysfunction three or more times a week and 41.3% once or twice a week. These percentages decrease in our sample with age so that for the 17-18-year-old age group, the percentage values for both situations is 29.5% and 32.6% and for older adolescents 27.4% and 26.1% respectively.

Of the 36.6% of the sample classified with disturbances in their overall sleep quality, girls have the highest percentage (63.6%) with a significant difference ($\chi^2 = 33.09$; $P = .000$) compared to boys.

Comparing adolescents' overall sleep quality with age and years of schooling, it is clear that younger adolescents and those attending the 10th year are the ones who were found not to show disruption in overall sleep quality with 45.3% and 38.9% respectively. Among adolescents classified with disturbances in their overall sleep quality, the highest percentage were found in the youngest age group (38.1%) and for those attending the 11th year (35.1%) with statistical significance in both cases with the chi-square test being ($\chi^2 = 10.921$; $P = .004$) for the age group and ($\chi^2 = 6.710$; $P = .035$) for the 11th year.

About 6 in 10 adolescents with poor quality sleep related mild fatigue and 25.7%, moderate fatigue. Once again, there is statistical significance between the variables ($\chi^2 = 209.530$; $P = .000$), especially those with mild, moderate and chronic fatigue and poor sleep quality, and those without fatigue and good sleep quality.

The highest percentage of adolescents (57.3%) spend an average of up to five hours a week studying, with the lowest percentage (13.4%) among those who spend between 6 and 7 hours studying. Boys study less as 52.9% spend up to 5 hours a week, while 68.0% of girls study between 6 and 7 hours and 66.3% over 8 hours. The chi-square test reveals statistical significance ($\chi^2 = 79.423$; $P = .000$) indicating the adjusted residuals that for females it is between studying 6-7 hours and over 8 hours per week while for males it is 5 hours per week.

The scale used to determine school performance enables us to analyze the study environment, planning for studying, study methods, reading skills and motivation for study, in addition to overall school achievement .

The statistics obtained for each of the factors described above allow us to verify that for all sub-scales there is a minimum rate of eight and a maximum of 40. Students have the best mean index for study environment (mean = 32.39), while the lowest is for planning for studying with 24.87.

When we analyse the relationship between school performance and sleep quality, which immediately highlights that students with high academic achievement have better quality of sleep (67.7%) with statistical significance ($\chi^2 = 20.594$; $P = .000$). Poor academic achievement is observed between those who have poor sleep quality, also with statistical significance.

As for morningness/eveningness, there is a direct effect of −0154 and an indirect effect of $(0.149 \times -0.046) = -0.006$, which results in a total effect of −0.160. Since the correlation between morningness/eveningness and school achievement is ($r = -0219$), a percentage of 73.05% can be attributed to the effect of morningness/eveningness on school performance.

Discussion

The sample consisted of 2094 secondary school students with a slight predominance of females (55.3%). Ages ranged between 14 and 23 years (X = 16.82 years). Analysis of several studies investigating adolescent sleep problems found a higher prevalence in female.[1-4]

Feeling tired at bedtime is manifested by 72.6% of the adolescents; however, about 50% state they feel fine when they wake up and 6.0% reported never feeling sleepy during the day. Girls reported greater number of night awakenings and more daytime sleepiness. These data corroborate a study[5] that inferred that adolescent computer users take longer to start sleep and have irregular sleep patterns of 2-6 hours a night. For night time computer users, the daytime sleepiness index was higher (7.69% vs. 26.7%) with greater difficulty in performing daily tasks and manifesting symptoms of malaise during the day.

During adolescence there is a sleep debt such that there is usually an eveningness character in adolescent sleep patterns. This partial but constant deprivation is characterised by being short during weekdays and during the class time and long at weekends and during holiday periods. One of the most problematic effects of lack of

sleep is decreased memory and attention, which makes learning more and has a negative impact on school performance and students' mental functioning.[5,6]

Our adolescents' sleep problems are similar to previous studies, as the overall score of the Pittsburgh Index reached a mean value of 5.14, which still ranks them as good sleepers with the minimum and maximum ranging between 0 and 19, i.e., 63.4% of the entire sample was classified as having good sleep quality and 36.6% as having poor quality.

In this study younger and male adolescents have better sleep quality in all subscales except sleep latency, which confirms that this is a characteristic of young subjects with sleep problems. As for the school year some discrepancies were found between those attending the 11th year, who scored the worst rates in duration and sleep disturbances and those in the 12th year in sleep latency, habitual sleep efficiency and use of sleep medication with significant localized differences for sleep efficiency and use of sleeping medication.

The relationship between year/school level and latency phase of sleep in adolescence was studied[7] for 1572 Taiwanese students. The authors noted that the proportion of evening-type young people increased among students of more advanced grade levels, which was associated with a decrease in the duration of nocturnal sleep, later sleeping and waking times, increased daytime sleepiness and increased duration of sleep at weekends.

The perception that participants in this study have on the subjective quality of sleep is that it is quite good (54.9%) or very good (16.9%). The highest percentage of those reporting good sleep quality went to girls (55.4%). On the other hand, of those reporting poor sleep quality (28.3%) approximately 7 in 10 are girls. Similar findings are presented in,[5] in which very good and good sleep were perceived by 23.13% and 94.75% respectively.

Analysing the question on sleep latency, we found a study that questioned 943 adolescents about sleep problems. A quarter of the sample reported they needed much more sleep than they got and 10% of the sample had difficulty falling asleep.[8]

We concluded that 41.1% have difficulty sleeping mainly among girls because its occurrence is found between 16 to 30 minutes. They are mostly younger and 10th year adolescents who take less time to fall asleep, while those in the 11th year took longer to fall asleep and with the highest number of occurrences per week. In a review article,[9] the authors argue that the decrease in sleep latency is associated with increased daytime sleepiness.

Sleep latency is associated with nocturnal sleep efficiency. In our study, most adolescents (87.2%) showed a sleep efficiency of greater than or equal to 85%, being higher in females (56.3%). These results are in line with a study[10] investigating a group of Brazilian workers and non-workers, which found an average efficiency of 99.66%. The author states that sleep restriction and sleep extension in healthy subjects affect night-time efficiency, adding that "specifically when sleep is reduced and efficiency increases when sleep is extended sleep efficiency is reduced."

Younger adolescents (43.7%) and those attending the 10th year (38.1%) reported sleeping more than 7 hours a night. However, for the 17-18 age group and those attending the 11th year, we observed the highest percentages sleeping only 5-6 hours.

Most adolescents (71.6%) reported having sleep disturbances less than once a week with higher percentages in girls (54.9%) than boys (45.1%). It was also found that over 71.0% of young women have sleep disturbances twice or more times per week. Only a small fringe of the sample (9.8%) claimed not to have sleep disturbances. Lower values are documented[11] where from a sample of 125 adolescents, 3.1% reported sleep difficulties. However approximately 18.0% considered having poor subjective sleep quality. This might be due to adolescents not valuing sleep disturbances.

Younger adolescents and those attending the 10th year reported fewer sleep disturbances, but it is worth pointing out that 37.6% of 11th year students and 42.3% in the 12th year reported them once or twice and week and three times a week or more, respectively. In a similar study[12] sleep disturbances were found in adolescents reporting poorer health, less energy and poorer cognitive functioning.

The first result of early waking or sleep deprivation is daytime dysfunction. Sleepiness in the classroom decreases attention and interest and may impair school performance. Another consequence is also related to learning, more specifically with the storage process. About half of the adolescent respondents of both sexes reported having drowsiness less than once a week (49.2%) while driving, eating or doing another activity, which is more prevalent among girls (55.3%). It is also among them that daytime sleepiness reached the highest percentage once or twice a week and three or more times.

Young people, under 16, have higher levels of sleepiness and these values decrease with age. Regarding year at school, most adolescents of all three academic years think they suffer from daytime dysfunction less than once a week (49.2%), being more prevalent in the 10th year (36.9%); however, we found the 12th year students had the highest percentage (36.8%) reporting daytime dysfunction three or more times a week.

Comparing values related to sleep disorders with the literature, it is observed that the results presented in this study were relevant. These data are equivalent,[3] which in investigating the prevalence of sleep disorders in adolescents, a sample of 652 secondary school students between 13-19 found that 35.7% exhibited persistent sleep disturbances and for Texan adolescents,[13] insomnia was found to be the most common disorder of 12.4%.

Chronotype is a predictor of sleep quality, i.e., higher morningness, better sleep quality. On the other hand, chronotype interacts in predicting sleep quality of as a mediator of school performance.

We found that girls have better school performance in all subscales when compared to boys. Gender differences are effectively the subject of some disagreement in the scientific community. Besides studies in which no differences were found,[14] others present different values. For some authors girls take greater responsibility for their educational successes and failures when compared to the opposite sex.[15] They rely more on their ability and effort, while in other studies boys seem to attribute poor school performance to lack of effort and ability.[16]

In relation to the influence of gender on the pattern of student sleep-wake cycles, the intermediate type is predominant. It is the most commonly observed chronotype in both sexes.

Regarding the relationship between age and chronotype, younger students were more evening-type. With respect to chronotype and academic achievement, morningness/eveningness is a predictor of study methods, reading skills, the motivation for study, and overall achievement, varying inversely, which is to say that the morning-type will have better academic achievement in the aspects described above.

We found that excessive daytime sleepiness affects most adolescents, observing that older ones and those attending the 11th grade had greater daytime sleepiness.

Identical data was found, that is, a high occurrence of excessive daytime sleepiness in adolescents, especially during class time.[17]

The results of this study demonstrate the influence of various socio-demographic variables (age and gender), chronotype and sleep quality on school achievement as perceived by the participants themselves. Thus, maintaining family members involved in care with regards to sleep hygiene and learning, by providing emotional, informational and instrumental support, is essential for more satisfying sleep quality as well as greater academic success.

What we known about the theme

Sleep is a multifaceted phenomenon involving the organic functioning, the psychological state, social interaction and behavioural components and even environmental factors and learning. It is an experience that needs to be managed properly to produce successes in adolescents' lives.

What we get out the study

The results of this study demonstrate the influence of various socio-demographic variables (age and gender), chronotype and sleep quality on school performance, as perceived by the participants themselves.

Funding

Conflicts of interest

The authors declare that there are no conflicts of interest.

References

1. Saarenpää-Heikkilä O, Laippala P, Koivikko M. Subjective daytime sleepiness in schoolchildren. Family Practice. 2000;17:129-33.
2. Carskadon MA, Wolfson AR. Understanding adolescents' sleep patterns and school performance: a critical appraisal. Sleep Medicine Reviews. 2003;7:491-506.
3. Bailly D, Bailly-Lambin I, Querleu D, Beuscart R, Collinet C. Sleep in adolescents and its disorders. A survey in schools. Encephale. 2004;30:352-59.
4. Salcedo AF, Rodríguez AFM, Monterde AML, García JMA, Redondo MP, Marcos NA. Sleeping habits and sleep disorders during adolescence: relation to school performance. Aten Primaria. 2005;35:408-14.
5. Duarte GGM. A qualidade do sono, o aproveitamento escolar e o stress em adolescentes que permanecem em frente ao computador durante a noite. Dissertação de Mestrado. Campinas, SP: Faculdade de Ciências Médicas da Universidade Estadual de Campinas; 2007.
6. Duffy JF, Wright KP Jr. Entrainment of the human circadian system by light. J Biology Rhythms. 2005;20:326-8.
7. Gau SF, Soong WT. The transition of sleep: wake patterns in early adolescence. Sleep. 2003;26:449-54.
8. Morrison DN, McGee R, Stanton WR. Sleep problems in adolescence. J Am Acad Child Adolesc Psych. 1992;31:94-8.
9. Fallone G, Owens JA, Deane J. Sleepiness in children and adolescents: clinical implications. Sleep Med Rev. 2002;6:287-306.
10. Teixeira LR. Efeitos das actividades diárias nos níveis de sonolência, em estudantes do ensino médio trabalhadores e não trabalhadores. Dissertação de doutoramento. São Paulo: Universidade de São Paulo; 2006.
11. Santos PL. Problemas de saúde mental de crianças e adolescentes atendidos em um serviço público de psicologia infantil. Psicologia em Estudo. 2006;11:315-21.
12. Rohde LA, Eurípedes Filho C, Benetti L. Transtorno de déficit de atenção/hiperatividade na infância e na adolescência: considerações clínicas e terapêuticas. Revista de Psiquiatria Clínica. 2002. Available at: http://urutu.hcnet.usp.br/ipq/revista/vol31/n3/124.html
13. Roberts RE, Lee ES, Hemandez M, Solari AC. Symptoms of insomnia among adolescents in the lower Rio Grande Valley of Texas. Sleep. 2004;27:751-60.
14. Mascarenhas SAN. Avaliação dos processos: estilos e abordagens de aprendizagem dos alunos de ensino médio do estado de Rondónia, Brasil. Tese doutoramento. A Coruña: Universidade A Coruña; 2004.
15. Docampo MMC. Diferenças do género en las explicaciones causales de adolescentes. Psicothema. 2002;14:572-6.
16. Mascarenhas S, Almeida SA. Atribuições causais e rendimento escolar: impacto das habilitações escolares dos pais e do género dos alunos. Revista Portuguesa de Educação (Universidade do Minho). 2005;18:77-91.
17. Giannotti F, Cortesi F, Sebastiani T, Ottaviano S. Circadian preference, sleep and daytime behavior in adolescence. J Sleep Res. 2002;11:191-9.