



Factors associated with night sleep in adolescents

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Abstract

Introduction: during adolescence there are many changes in lifestyle that also affect sleep patterns, patterns that are key in the development of young people and their health status. Therefore, the objective of the study was to analyse the relationship and influence of various lifestyle habits, physical and psychosocial health indicators, and sociodemographic variables on the duration of night sleep.

Method: a cross-sectional study was applied to a sample of 761 students (14.51±1.63 years) from 25 educational centers in a region of northern Spain. Their hours of nightly sleep were assessed, as well as their adherence to the Mediterranean diet, physical activity engagement, health-related quality of life, self-esteem, maximum oxygen uptake, body mass index, academic performance, and various sociodemographic factors.

Results: being older and having a higher body mass index, as well as lower adherence to the Mediterranean diet and studying in urban centers were predictors of a lower number of hours of nightly sleep, explaining 26.2% of its variance. Likewise, adolescents who did not meet the nightly sleep recommendations had lower rates of health-related quality of life and self-esteem, as well as lower levels of physical activity and maximal oxygen uptake.

Conclusions: interventions aimed at preventing sleep disorders should take into account the aforementioned predictive factors, directing efforts towards promoting healthy habits and environments favourable to rest, especially in urban areas.

Key words:

- Adolescent
 - Health
- Life habits
 - Sleep
- Well-being

Factores asociados al sueño nocturno de los adolescentes

Resumen

Introducción: durante la adolescencia se producen numerosos cambios en los hábitos de vida que afectan también a los patrones de sueño; patrones que son clave en el desarrollo de los jóvenes y en su estado de salud. Por ello, el objetivo del estudio fue analizar la relación e influencia de diversos hábitos de vida, indicadores de salud física y psicosocial, y variables sociodemográficas sobre la duración del sueño nocturno.

Material y métodos: el estudio se llevó a cabo sobre una muestra de 761 estudiantes (14,51 ± 1,63 años) de 25 centros educativos de una región del norte de España. Se valoró el número de horas de sueño nocturno, así como la adherencia a la dieta mediterránea, nivel de actividad física, calidad de vida relacionada con la salud, autoestima, consumo máximo de oxígeno, índice de masa corporal, rendimiento académico y diversos factores sociodemográficos.

Resultados: tener mayor edad e índice de masa corporal, así como una menor adherencia a la dieta mediterránea y estudiar en centros de zonas urbanas fueron predictores de un menor número de horas de sueño nocturno, llegando a explicar el 26,2% de su varianza. Asimismo, los adolescentes que no cumplían con las recomendaciones de sueño nocturno presentaron menores índices de calidad de vida relacionada con la salud y autoestima, así como niveles más bajos de actividad física y consumo máximo de oxígeno.

Conclusiones: las intervenciones dirigidas a la prevención de los trastornos del sueño deberían tener en cuenta los factores predictores citados, orientando los esfuerzos hacia el fomento de hábitos saludables y entornos propicios para el descanso, especialmente, en zonas urbanas.

Palabras clave:

- Adolescente
 - Bienestar
- Hábitos de vida
 - Salud
 - Sueño

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INTRODUCTION

Sleep is defined as a physiological state characterised by being reversible, transient and periodical, a function necessary for life and one of the habits with the greatest impact on health.¹ Current recommendations for the population aged 13 to 18 years focus on adherence to a duration of night-time sleep of 8 to 10 hours.² However, this is a stage in which sleep regulation becomes complicated.³

Poor quality and duration of night-time sleep in the young population is a growing concern in the field of public health.⁴ There is an increasing trend in the frequency of problems falling asleep in adolescents. According to the international study *Health Behaviour in School-aged Children*, approximately 24% of adolescents have sleep problems.⁵ In Spain, based on the Pasos Report, 51.3% of adolescents sleep fewer hours than recommended on weekdays and 44.6% on weekends. Still, sleep patterns appear to vary substantially based on the country and other sociodemographic factors, such as household income or age.⁴

Previous studies have found that sleep has an important impact on the general health of the population, especially in children and adolescents, in whom non-adherence to recommendations can have serious immediate and future consequences.⁷ In this regard, the literature has demonstrated its interaction with other lifestyle habits, such as physical activity (PA) or dietary habits.^{8,9} In addition, sleep patterns are associated with different aspects of physical and psychological health, including emotional, cognitive and social health,¹⁰ cardiovascular and metabolic health¹¹ and various mental health disorders, such as anxiety or depression.¹²

Effective interventions aimed at improving sleep habits in the adolescent population seems to have positive effects on general health.¹³ Educational settings play a key role in their promotion due to their accessibility and potential for transmitting positive values associated with sleep behaviours, knowledge and hygiene.¹⁴ In addition, the promo-

tion of healthy sleep habits before adulthood is essential, as sleep disturbances during adolescence have a direct impact on sleep disorders in later stages.¹⁵

An overall understanding of the factors associated with night-time sleep could be particularly relevant for health prevention and promotion in the adolescent population. Therefore, the aim of our study was to assess night-time sleep in a representative sample of adolescents, analysing the influence of various indicators of physical and psychosocial health, lifestyle habits and sociodemographic factors. To do so, we assessed the duration of night-time sleep, the level of PA, the adherence to the Mediterranean diet (MD), health-related quality of life (HRQoL), self-esteem, the body mass index (BMI), maximal oxygen consumption (VO₂max) and academic performance, in addition to the aforementioned sociodemographic factors.

MATERIAL AND METHODS

Study design and participants

We conducted a cross-sectional study in a representative sample of adolescents enrolled in years 1 and 4 of compulsory secondary education (ESO: *Educación Secundaria Obligatoria*) in schools of La Rioja, a region in Northern Spain. We selected the participants by single-stage cluster sampling, in which the sampling units were the ESO year 1 and year 4 classes in the region. To achieve a representative sample in both education years, given the size of the population (3470 students in year 1 of the ESO and 2548 in year 4 of the ESO), for a level of confidence of 95%, a precision of 5% and an expected proportion of 50%, we estimated that we needed 346 year 1 students and 334 year 4 students to achieve a representative sample. Given that the average number of students per class was 25 in both cases, and assuming a participation of 60%, we increased those figures correspondingly, randomly selecting 23 year 1 classes and 22 year 4 classes. We invited all students in the selected classes to participate and, since 82% accepted, the

final sample included 761 adolescents belonging to 45 classes in 25 schools, of who 383 were year 1 students and 378 year 4 students. Their ages ranged from 12 to 17 years (14.51 ± 1.63 years), and 50.3% were male and 49.7% female.

Before participation, we obtained the written informed consent of the parents or legal guardians of each student. Furthermore, the participation of the students in the research was voluntary, and students provided verbal assent. The study adhered to the principles of the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of La Rioja. The field work for data collection was carried out between January and June 2018.

Variables

We estimated the hours of night-time sleep based on two questions that asked about the time participants usually went to bed and got up on weekdays. The duration of night-time sleep was calculated as the difference in hours between the times reported by the participants in these two questions. Once we had obtained the duration of sleep, we categorised students based on the recommendations of the American Academy of Sleep Medicine² for the adolescent population as “in adherence” if the slept 8 or more hours or “not in adherence” if they slept fewer hours.

We assessed adherence to the MD through the KIDMED questionnaire.¹⁶ This instrument consists of 16 items with dichotomous answers (yes/no) concerning the consumption of foods associated with the Mediterranean dietary pattern. The overall score can range from -4 to 12, and higher scores indicate greater adherence to the MD.

We assessed the level of PA by means of the Physical Activity Questionnaire for Adolescents, which has been validated for the Spanish adolescent population.¹⁷ This instrument comprises 9 items that assess the PA performed in the past 7 days. The possible final score ranges from 1 to 5 points, and higher scores correspond to higher levels of PA. In addition, the questionnaire includes a tenth

item that allows the exclusion of respondents who were unable to engage in PA as usual in the 7-day period of interest due to illness, injury or any other reason. However, this was not the case in any of the participants.

We assessed HRQoL with the KIDSCREEN-27 questionnaire, validated for use in Spanish adolescents.¹⁸ It has 27 items rated on a Likert scale and grouped into 5 dimensions: physical wellbeing, psychological wellbeing, autonomy and parent relations, school environment and social support and peers. We calculated the final scores according to the instructions of the authors of the questionnaire, and higher scores are associated with a more positive perception of quality of life.

For the assessment of self-esteem, we used the Rosenberg scale validated in Spanish adolescents.¹⁹ This instrument comprises 10 items rated on a scale from 1 to 4 to assess positive and negative feelings about the self. The final score can range from 10 to 40 and higher scores are associated with greater self-esteem.

When it came to sociodemographic data, participants reported their own sex, date of birth and nationality (born in Spain or in another country). We established the type of setting of the schools (urban or rural) based on the number of inhabitants in the location, considering a population of at least 5000 an urban town. Socioeconomic status (SES) was established by means of the Family Affluence Scale (FAS II), a questionnaire comprised of 4 questions about material wealth.²⁰ The final score ranges from 0 to 9, and is categorised as follows: low (≤ 2), medium (3-5) or high (≥ 6). In the analysis of the data, we combined participants with a low (1.8%) and medium (28%) SES into a single category due to the small percentage of the former.

In addition, with the aim of identifying and excluding from the analysis self-reports filled out randomly, dishonestly or pseudo-randomly, we used the Oviedo Infrequency Scale, which consists of a series of questions with basic dichotomous yes/no responses.²¹ We inserted 6 of these questions throughout the questionnaire (for instance, “have

you ever watched a movie on television?”). Participants who responded illogically to more than one of these questions were excluded from the analysis. Specifically, this was the case in 2 participants. We assessed cardiorespiratory fitness with a 20-metre shuttle run test.²² In this test, 2 line markers are set up at a distance of 20 m to demarcate the starting point and end of each shuttle. Participants have to run at the pace marked by an audio signal, which establishes the time available to run the distance between the two lines in succession. The initial speed is 8.5 km/h, and it increases by 0.5 km/h each minute. The test ended when the participant stopped or did not complete the distance at the established pace in 2 consecutive shuttles. Afterward, with the obtained results, we calculated the VO_2 max using the formula provided by the author of the test.

The height and weight were measured with a Holtain® stadiometer (Holtain Ltd., Dyfed, United Kingdom) accurate to 1 mm and a SECA® scale (713, Hamburg, Germany) accurate to 0.1 kg, respectively. Once these measurements were taken, we calculated the body mass index (BMI).

We assessed academic performance by reviewing the grades of the students, obtained through the Department of Education of the Government of La Rioja, and specifically basing it on the average grade obtained in the year that the study was conducted. Before doing so, we requested explicit consent from the families of the participants, which was granted by 90% of them.

Statistical analysis

We have expressed quantitative variables as mean and standard deviation, and qualitative variables in terms of frequencies. We assessed the normality and homogeneity of variance of the data with the Kolmogorov-Smirnov and Levene tests, respectively. We compared means with the Student t test in the case of a normal distribution and otherwise with the Mann-Whitney U test. We used the χ^2 test to analyse the association between qualitative variables.

To identify potential predictors of the hours of night-time sleep, we fitted a multiple linear regression model with the backward elimination method. The variables included in the model were: sex, nationality, socioeconomic status, school setting, HRQoL, self-esteem, adherence to the MD, level of PA, VO_2 max and BMI. The statistical analysis was performed with the software IBM-SPSS® version 25 for Windows, and we defined statistical significance as $p < 0.05$.

RESULTS

Of the total sample, 28.2% of adolescents did not adhere to night-time sleep recommendations. The age, adherence to MD, level of PA, VO_2 max, BMI and academic performance of adolescents in relation to their adherence to night-time sleep recommendations are shown in **Table 1**. We found that adolescents who adhered to recommendations exhibited greater adherence to the MD and had higher levels of PA and VO_2 max values, while their age and BMI were lower.

Table 2 presents the results of the assessments of self-esteem and HRQoL, overall and for its 5 dimensions, in relation to the adherence to night-time sleep recommendations. Adolescents that met sleep recommendations had significantly higher scores for self-esteem and HRQoL, overall and in every dimension save for “social support and peers”, in which we found no differences.

Table 3 reflects the impact of specific sociodemographic factors on the adherence to night-time sleep recommendations. We only found significant differences based on the setting of the school, with a higher frequency of non-adherence in students in urban areas.

Lastly, **Table 4** presents the results of the multiple linear regression analysis of the hours of night-time sleep. Older age, a higher BMI, lower adherence to the MD and attendance to school in an urban setting were predictors of decreased night-time sleep duration, and explained up to 26.2% of the variance in the number of hours of night-time sleep.

Table 1. Characteristics of the sample in relation to adherence to night-time sleep recommendations

	Hours of night-time sleep		P value
	Did not adhere (n = 215)	Adhered (n = 546)	
Age	15.54 ± 1.32	14.1 ± 1.57	<0.001
Adherence to Mediterranean diet	6.86 ± 2.14	7.48 ± 2.08	<0.001
Physical activity	2.51 ± 0.6	2.65 ± 0.62	0.005
Maximal oxygen consumption	43.29 ± 7.94	44.55 ± 6.39	0.028
Body mass index	21.76 ± 3.21	20.72 ± 3.23	<0.001
Academic performance	6.51 ± 1.35	6.62 ± 1.51	0.294

Table 2. Psychosocial wellbeing in relation to adherence to night-time sleep recommendations

	Hours of night-time sleep		P value
	Did not adhere (n = 215)	Adhered (n = 546)	
Health-related quality of life	241.16 ± 30.19	253.64 ± 33.67	<0.001
Physical wellbeing	43.79 ± 8.62	45.2 ± 8.68	<0.001
Psychological wellbeing	47.67 ± 8.24	51.15 ± 9.59	<0.001
School environment	47.08 ± 8.36	50.71 ± 9.53	<0.001
Autonomy and parents	49.84 ± 8.57	51.62 ± 8.72	0.048
Social support and peers	52.78 ± 9.88	53.87 ± 9.08	0.184
Self-esteem	31.77 ± 4.7	33.05 ± 4.98	<0.001

DISCUSSION

The results of the study show that 28.2% of participants did not adhere with sleep recommendations for the adolescent population, a percentage that was lower compared to the results of a previous nationwide study.⁶

Night-time sleep was associated with several indicators of physical and psychosocial health, lifestyle habits and sociodemographic variables, which allowed the identification of predictors.

Age was one of them, as older adolescents slept the fewest hours per night. A study by Mazzer (2019)²³ corroborates this decreasing trend with increasing age in adolescents, and also showed an increase in the prevalence of cases of poor sleep associated with psychological distress. In this sense, there is a relevant frequency of problems in other areas associated with sleep disturbances in adolescents, an issue that persists in adulthood¹⁵ and that may be related to the use and impact of social networks and screens, in addition to increasing deficiencies in a weekly structure or schedule with increasing age in youth.^{24,25}

The setting also served as a predictor of the hours of sleep, with a lower proportion of adherence to recommendations in the group of adolescents who attended schools in urban areas. Residence in more urbanised areas has been found to be associated with poorer quality, duration and regularity of sleep in adolescents.²⁶ Factors related to various physical and social aspects (population density or availability of green spaces), aspects related to the neighbourhood (safety, order and social relations) or environmental factors (air pollution, noise or exposure to artificial light) seem to have a key impact on sleep habits.²⁷

Adolescents with higher BMIs slept fewer hours, confirming BMI as a predictor of sleep duration. The association between sleep and obesity is widely documented in the previous literature, evincing the important effect of sleep habits on body composition.²⁸ Evidence to date has identified an increased BMI as a risk factor for disorders such as sleep apnoea,²⁹ which may result in respiratory difficulties leading in turn to intermittent hypoxaemia, increased daytime somnolence and/or poorer sleep quality.³⁰ Increases in fat mass also

		Hours of night-time sleep				P value
		Did not adhere (n = 215)		Adhered (n = 546)		
		N	%	N	%	
Nationality	Spanish	182	29.4%	436	70.6%	0.127
	Immigrant	33	23.1%	110	76.9%	
Sex	Male	109	28.5%	274	71.5%	0.898
	Female	106	28%	272	72%	
Socioeconomic status	Low/middle	67	29.5%	160	70.5%	0.614
	High	148	27.7%	386	72.3%	
School setting	Urban	192	29.5%	458	70.5%	0.034
	Rural	23	20.7%	88	79.3%	

	Hours of night-time sleep			R ²
	B	T	P value	
Age	-0.435	-12.472	<0.001	0.262
Location of school (urban setting)	-0.159	-4.734	<0.001	
Adherence to Mediterranean diet	0.71	2.097	0.036	
Body mass index	-0.074	-2.144	0.032	

appear to be associated with different biological mechanisms that have a direct impact on sleep.³¹

Last of all, among the lifestyle habits, the MD diet was also a predictor, with adolescents who adhered less to it reporting fewer hours of sleep at night. The MD has been found to be positively associated with sleep, both directly and through the improvement of de body composition.³² The consumption of vegetables and fruits seemed to have a positive impact on sleep due to their polyphenol content, as these substances have a direct impact on biological mechanisms such as the circadian rhythm.³³ Furthermore, decreased sleep duration was associated with a greater intake of sandwiches, fast food and sugary drinks and a lesser intake of fruits and nuts.³⁴

In addition to the predictors described above, night-time sleep was associated with other variables, including sociodemographic characteristics and indicators related to physical health and lifestyle habits.

As regards psychosocial health, the scores for both self-esteem and perceived quality of life (overall

and in its 5 dimensions) were lower in adolescents who did not adhere to sleep recommendations. Sleep deprivation seems to affect physical wellbeing, as it increases the prevalence of symptoms such as headache, fatigue and dizziness.³⁵ Some studies have corroborated the association between sleep duration and psychological wellbeing in adolescents,³⁶ finding that decreased sleep duration increases the probability of experiencing mental health disorders³⁷ and perceiving the family climate negatively.³⁸

Inadequate sleep patterns are a determinant in school burnout in adolescents,³⁹ which could partly explain our findings in relation to wellbeing in the school environment.

The PA level was lower in adolescents who did not meet night-time sleep recommendations, and in this regard the literature shows that increasing levels of physical activity is likely to improve sleep quality.⁴⁰ Furthermore, moderate intensity to vigorous PA is associated with greater sleep duration and efficiency,⁴¹ although different factors modulate this effect, such as mental health disorders⁴² or the improvement of electrophysiological and

biochemical elements of sleep associated with aerobic exercise.⁴³

The maximal oxygen consumption values were also lower in adolescents who did not meet night-time sleep recommendations, which could result from the decreased levels of physical activity noted above.⁴⁴ In this regard, the association between lifestyle habits and cardiorespiratory fitness is well established, and previous studies have found an association between poor sleep habits and a lower cardiorespiratory fitness⁴⁵ as well as an increased cardiovascular and metabolic disease risk.⁴⁶

One of the strengths of the study was that we obtained a representative sample of adolescents, which allowed us to assess the association of the hours of night-time sleep with other lifestyle habits, different sociodemographic variables and indicators of physical and psychosocial wellbeing. For the purpose of future research, it may be worth considering the assessment of sleep through polysomnography or accelerometers. In any case, the instruments used in this study have been found reliable and valid in previous studies in samples of similar characteristics. On the other hand, the cross-sectional study design did not allow an assessment of causality, and in the future, studies with a longitudinal design could complement our current findings.

CONCLUSION

An older age, higher BMI, lower adherence to the MD attendance to schools in urban areas were

predictors of fewer hours of night-time sleep de horas, explaining 26.2% of the variance in sleep duration. Adolescents who did not adhere to night-time sleep recommendations had lower scores for self-esteem and HRQoL (overall score and most of the dimensions), a lower level of PA and lower VO₂max values. The observed associations underscore the need to develop interventions for the prevention of sleep disorders from a multidisciplinary approach. In this regard, the development of spaces more suitable for rest in urban areas as well as the promotion of PA and adherence to healthy dietary patterns could have a positive impact on both sleep duration and quality and, in turn, on the general health of adolescents, especially those who are older or reside in urban areas.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare in relation to the preparation and publication of this article.

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ABBREVIATIONS

BMI: body mass index • **ESO:** Educación Secundaria Obligatoria (Compulsory Secondary Education) • **FAS II:** Family Affluence Scale II • **HRQoL:** health-related quality of life • **MD:** Mediterranean diet • **PA:** physical activity • **SES:** socioeconomic status • **VO₂max:** maximal oxygen consumption.

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