ORIGINAL ARTICLE

Association Between Sleep Duration and High Blood Pressure in Medical Students

Relación entre la duración del sueño y la presión arterial elevada en estudiantes universitarios

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ABSTRACT

Background: Sleep duration is affected in university students. Previous studies revealed that sleep duration could be associated with elevated blood pressure (BP).
Objective: The aim of this investigation was to determine the possible association between sleep duration and high BP in medical students.
Methods: We conducted an analytical, cross-sectional study on 728 medical students. Systolic BP ≥ 130 mm Hg or diastolic BP ≥ 85 mm Hg was considered elevated BP. Sleep duration was classified in < 6, 6 - 8 and > 8 hours/day. Bivariate comparisons (chi-square test) and multivariate analyses (logistic regression) adjusted for risk factors were performed to determine the associated risks.
Results: The percentage of students with high BP was 33.6%. Mean sleep duration was 6.92 ± 0.92 h in students with elevated BP and 6.97 ± 0.95 in those with normal BP. Of the total number of participants, 12.4% slept < 6 hours, 74.6% slept between 6 and 8 hours and 13.0% slept > 8 hours. Bivariate analysis showed that sleep duration was not associated with elevated BP. Adjusted multivariate analysis did not show a significant association between sleep duration and BP.
Conclusion: Sleep duration was similar in students with elevated BP and with normal BP. The percentage of students who sleep less than 6 hours and more than 8 hours is low. No significant association was found between short or long sleep duration and the prevalence of elevated BP.

Key words: Sleep Duration - Blood Pressure - University Students

RESUMEN

Introducción: Los estudiantes universitarios presentan alteraciones en la duración del sueño. Estudios previos revelaron que la duración del sueño puede estar asociada a un aumento de la presión arterial (PA)
Objetivo: Analizar la posible relación entre duración del sueño y la PA en estudiantes de Medicina.
Materiales y métodos: Estudio analítico, de corte transversal en 728 estudiantes de Medicina. Se consideró PA elevada a la PA ≥ a la categoría de PA limítrofe (PA sistólica ≥ 130 mmHg y/o diastólica ≥ 85 mmHg). La duración del sueño se clasificó en: < 6, 6-8 y > 8 horas/día. Para determinar los riesgos asociados se realizaron comparaciones bivariadas (chi cuadrado) y multivariadas (regresión logística) ajustadas por factores de riesgo.
Resultados: El 33,6% de los estudiantes presentó PA elevada. La duración media del sueño para los que presentaron PA elevada fue de 6,92±0,92 horas, mientras que para los estudiantes con PA normal fue de 6,97±0,95 horas. El 12,4% dormían < 6 horas, el 74,6% entre 6-8 horas y 13,0% más de 8 horas. El análisis bivariado mostró que las horas de sueño no estuvieron asociados a PA elevada. El análisis multivariado ajustado no mostró asociación significativa entre las horas de sueño y la PA.
Conclusión: La duración del sueño para los estudiantes con PA elevada fue la misma que para los estudiantes con PA normal. Hay un bajo porcentaje de estudiantes que duermen menos de 6 horas y más de 8 hs. No se encontró asociación significativa entre la duración del sueño corto o largo y la prevalencia de PA elevada.

Palabras clave: Duración del Sueño - Prensión Arterial - Estudiantes Universitarios

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INTRODUCTION

Hypertension (HTN) is a silent threat to health in all the persons worldwide, affecting almost one third of the population (1) and constitutes the main risk factor for cardiovascular disease. In Argentina, the RENATA 2 study reported a prevalence of HTN of 36.3% in the adult population, in agreement with the reports of the World Health Organization (WHO) for the region. Most hypertensive patients are not aware of their condition, only 50% receive treatment and only 25% are controlled. (2) The latest National Survey of Risk Factors conducted in 2018 highlights that the prevalence of HTN has remained constant and sustained over the last 13 years. (3)

The traditional primary interventions implemented worldwide for HTN prevention and management are reducing obesity and dietary sodium and increasing physical activity (PA). (4) In Argentina, the population-based interventions applied in recent years (between 2005 and 2018) were focused on improving these three aspects. The results obtained so far are not encouraging, since the addition of salt after cooking was reduced by only 6.7%, the prevalence of overweight and obesity continues to increase and 61.6% of the population is overweight. In terms of PA the situation has worsened, as 69% of the population has low level of PA and this prevalence has increased by 10% in the past 9 years. (3)

In addition to these traditional risk factors, several studies have established that an inadequate sleep pattern (sleep deprivation or long sleep duration) constitute a modifiable risk factor for HTN and should be considered for preventive interventions. (4-6) The quantity and quality of sleep has been considerably reduced due to the rapid modern pace of life; indeed, it has been demonstrated that people sleep 1.5 hours less nowadays than in the last century. (7-9) Over the past few decades, there is evidence that sympathetic nervous system activity is increased when sleep duration is short and that melatonin (a hormone that increases at night and can affect physiological functions, including sleep promotion) is effective in lowering blood pressure. (10) Sleep duration shorter than 6 hours or greater than 8 hours was found to be associated with increased risk of HTN. (11-14) Consequently, the normal decline in blood pressure that occurs during nighttime sleep is impaired and blood pressure levels become abnormal, increasing the risk of cardiovascular mortality. (14-16)

HTN rarely produces symptoms during the first stages. Many cases may not be diagnosed in young adults due to insufficient screening in this age group. In the young population, detection of prehypertension is even more important, as these subjects are more likely to develop HTN, increasing the risk of cardiovascular events independently of other risk factors. In the RENATA trial, the prevalence of HTN in the age group < 35 years was 18.5% in men and 6.9% in women. (2)

Particularly, sleep quality and quantity are affected among university students, due in part to the increased academic activity and the time they spend studying or performing extracurricular activities. (17,18) There is evidence that university students sleep less than the recommended number of hours, (19) and this is more evident among medical students. (18,20)

Based on this evidence, the aim of this investigation was to determine the possible association between sleep duration and high blood pressure, in first-year, second-year, and third-year medical students attending a public university.

METHODS

We performed an analytical cross-sectional study with consecutive sampling among 1211 first-year, second-year and third-year students at the School of Medicine of Universidad Nacional del Litoral (FCM-UNL) during 2018. Students with any chronic disease, pregnant or breastfeeding women, and those students who did not answer all the questions were excluded from the study. A total of 1080 students completed the blood pressure (BP) record, and of these, 728 had complete sleep records.

The protocol was approved by the Committee on Ethics of FCM-UNL and was conducted following the recommendations of the Declaration of Helsinki. (21) Written informed consent to use the results of the survey and the anthropometric and blood pressure measurements was obtained from all the students. The participation of the students was voluntary.

The main variables analyzed were BP and sleep duration in hours. The covariates (confounding variables) considered were family history of cardiovascular disease (CVD), diabetes and HTN, alcohol intake, smoking habits, waist circumference (WC) and PA.

Blood pressure was measured following the recommendations of the Consensus on Hypertension of the Argentine Society of Cardiology (9) using standard aneroid sphygmomanometers with a pressure scale in mm Hg. All the participants with systolic BP ≥ 130 mm Hg or diastolic BP ≥ 85 mm Hg were considered at risk, according to the Argentine Consensus on Hypertension. (23)

A questionnaire was given to the students to obtain data about sleep duration, in which they recorded the daily hours of sleep (including night rest and nap) for one week. (24) The participants were classified into three groups, according to the number of hours of sleep per day: < 6 hours, between 6 and 8 hours, and > 8 hours, as several authors have established. (11,12,25,26)

Surveys were submitted to the students and were completed in the presence of the investigators to obtain information about their family history (HTN, CVD and diabetes), alcohol intake and smoking habits. Alcohol intake was evaluated according to the GAPA (Dietary Guidelines for Argentine population), which considers binge drinking when alcohol intake is ≥ 56 g in women or ≥ to 70 g in men. (27) Tobacco use was evaluated following the criteria of the 2018 National Survey on Risk Factors. Smoking of at least one cigarette a day or a history of former smoking was considered a risk factor (3)

The WC was measured following the recommendations of the WHO STEPS Instrument (STEP 2); a WC ≥ 90 cm in men ≥ 80 cm in women was considered a risk factor accord-

ing to the recommendations of the International Diabetes Federation (IDF). (29)

Physical activity was assessed with the IPAQ (International Physical Activity Questionnaire). (30) Physical inactivity or low physical activity (not exceeding 600 MET-minutes per week) was considered a risk factor.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation and categorical variables as percentage. The association between sleep duration (main independent variable or predictor variable) and the prevalence of elevated BP was assessed by logistic regression analysis and adjusted for possible confounding variables including sex, WC, smoking habits, alcohol intake, and PA. Those variables with significant association with elevated BP and those clinical variables that are known potential effect modifiers were considered in the multivariate analysis. All the calculations were performed using IBM SPSS Statistics 22 software package. A p value < 0.05 was considered statistically significant.

RESULTS

A total of 728 students (age 19.3 ± 1.3 years) were evaluated; 66% of them were women. The percentage of students with high BP was 33.6% (Table 1) and most of them were men (54.9%) The prevalence of students with large WC was higher in those with elevated BP levels. Sleep duration was 6.92 ± 0.92 h (95% CI 6.81-7.04) in students with elevated BP levels and 6.97 ± 0.95 (95% CI 6.88-7.06) in those with normal BP, with no significant differences (p = 0.498). Tobacco use and alcohol intake was similar in both groups. The prevalence of low level of PA was greater in the normotensive group (p = 0.009).

Table 2 shows the characteristics of the study population by sleep duration. Of the total number of participants, 12.4% slept < 6 hours, 74.6% slept between 6 and 8 hours and 13.0% slept > 8 hours. Bivariate analysis showed that both short sleep duration and long sleep duration were not associated with elevated BP, abdominal obesity, alcohol intake, low PA, or family history, but were associated with current smoking or former smoking.

Finally, we examined the association of sleep duration categories with elevated BP (expressed as OR and 95% CI) taking as reference the 6-8 h sleep category (Table 3). In the students evaluated, there was no significant association between short sleep duration and long sleep duration (<6 h and > 8 h) and the risk of elevated BP. This tendency persisted after adjusting for other risk factors for HTN, including sex, abdominal obesity, smoking habits, alcohol consumption, or low PA.

DISCUSSION

In the present study, 36.1% of medical students have high BP levels, and the prevalence is greater in male students. These results are consistent with a previous study in first-year medical students at the same School of Medicine (31) and confirm data from other studies, demonstrating the importance of an early diagnosis of prehypertension in young individuals. (32) The students evaluated slept 7 h in average. Similar results were reported in fifth-year medical students from the National University of Córdoba (6.6 h) (33) and in university students in Chile (6.4 h). (19,34) Nevertheless, the number of students who slept less than the recommended number of hours is variable. In our study, short sleep duration (< 6 h) was observed in 12.3% of the students. In contrast, in the study conducted at the National University of Córdoba, Argentina, the prevalence of students sleeping less than 6 hours was much higher (48.2%) (33) and similar to the one reported in the Chilean study in which 54.5% of students slept less than 7 hours. (34) Another study conducted by Mello Carone et al. on university students in Brazil found that 32% slept less than the recommended number of hours during weekdays (6 hours per day). (35) This disparity in results is probably related to the number of hours of classes and study in each career and to extracurricular activities, which may modify the number of hours of sleep. In our study, the students do not attend classes at night, and this probably allows them to better organize their

Table 1. Relation of blood pressure (BP) with the covariates analyzed

Variable	Elevated BP % (95% CI)	Normal BP % (95% CI)	p value
Sleep duration (h)			
<6 (n=90)	13.6 (9.3-18.8)	15.4 (11.9-19.4)	0.714
>8 (n = 95)	11.2 (7.2-16.1)	17.9 (14.2-22.0)	0.095
Sex			
Men (n = 363)	54.8 (49.8-59.9)	21.6 (18.5-24.8)	<0.0001
Women (n = 718)	45.2 (40.1-50.2)	78.4 (75.2-85.4)	
Large waist circumference (n = 204)	30.4 (25.7-35.4)	13.9 (11.3-16.8)	<0.0001
Current smoker or former smoker (n = 146)	15.34 (11.8-19.4)	13.0 (10.6-15.8)	0.294
Binge drinking (n = 104)	11.0 (8.1-14.6)	9.1 (7.0-11.5)	0.310
Low physical activity (n = 225)	17.3 (13.5-21.6)	24.3 (21.1-27.7)	0.009
Family history (n = 45)	5.0 (3.0-7.7)	3.8 (2.5-5.5)	0.370

BP: Blood pressure.
Results expressed in percentage with 95% confidence interval. The p value reported in the one associated to the chi-square test with $\alpha = 0.05$.

Table 2. Description of the participants by sleep duration.

Variables	Sleep duration (hours/day)			p value
	< 6 hours (n = 90) % (95% CI)	6 - 8 hours (n = 543) % (95% CI)	> 8 hours (n = 95) % (95% CI)	
Sex				
Men	33.3 (23.7-44.0)	34.2 (30.2-38.4)	31.5 (22.4-41.9)	0.8745
Women	66.6 (55.9-76.2)	65.7 (61.5-69.7)	68.4 (58.1-77.5)	
Blood pressure				
Elevated	33.3 (23.7-44.0)	35.1(31.1-39.3)	25.3 (16.9-35.2)	0.1684
Normal	66.6 (55.9-76.2)	64.8 (60.6-68.8)	74.7 (64.8-83.1)	
Waist circumference				
Large	18. 9 (11.4-28.5)	19.3 (16.1-22.9)	15.8 (9.1-24.7)	0.7166
Normal	81.1 (71.5-88.5)	80.6 (77.0-83.9)	84.2 (75.3-90.8)	
Tobacco use				
Current /former smoker	26.7 (17.9-37.0)	12.1 (9.5-15.2)	11.6 (5.9-19.7)	0.0009
Never smoker	73.3 (62.9-82.1)	87.9 (84.8-90.4)	88.4 (80.2-94.0)	
Binge drinking				
Yes	7.8 (3.1-15.3)	10.1 (7.7-12.9)	7.3 (3.0-14.6)	0.5874
No	92.2 (84.6-96.8)	89.9 (80.7-92.2)	92.6 (85.4-97.0)	
Low physical activity				
Yes	22.2 (14.1-32.2)	21.9 (18.5-25.6)	28.4 (19.6-38.6)	0.3746
No	77.8 (67.8-85.8)	78.1 (74.3-81.5)	71.6 (61.4-80.3)	
Family history (CVD, diabetes, HTN)				
Yes	6.7 (2.5-13.9)	5.1 (3.4-7.3)	5.2 (1.7-11.8)	0.8398
No	93.3 (86.0-97.5)	94.8 (92.6-96.5)	94.7 (88.1-98.2)	

CVD: cardiovascular disease; HTN: hypertension.
Results expressed in percentage with 95% confidence interval

Table 3. Odds ratio (95% confidence interval) for the probability of elevated BP associated with sleep duration in hours/day

	Sleep duration (hours/day)					
	< 6 hours			> 8 hours		
	OR	95% CI	P	OR	95% CI	P
Non-adjusted	0.91	(0.57-1.47)	0.714	0.65	(0.40-1.08)	0.095
Adjusted						
Model 1	0.975	(0.58-1.64)	0.975	0.675	(0.38-1.19)	0.093
Model 2	0.944	(0.55-1.61)	0.832	0.650	(0.36-1.15)	0.142

Model 1: adjusted for sex and waist circumference
Model 2: adjusted for sex, waist circumference, physical activity, smoking habits and binge drinking

day; thus, most of them sleep the recommended number of hours.

The number of students who sleep more hours than those recommended (13%) is similar (15.6%) to that of the study carried out on students in Córdoba, (33) but differs from the result found in the Chilean study (6.2%). (34)

The association between sleep duration and the prevalence of elevated BP was assessed by logistic regression analysis. Crude odds ratios were calculated on multivariate analysis adjusted for sex, PA, tobacco use and binge drinking, and the results obtained were very similar to those of bivariate analysis. Although in statistical terms it is not convenient to adjust for multiple variables when the bivariate associations are not significant, adjustment was made prioritizing the clinical significance and possible value of sleep duration as a predictor of elevated BP. Considering sleeping 6 to 8 hours as a reference, shorter sleep duration is not associated with the prevalence of elevated BP in medical students. These results differ from other investigations carried out in adults in different countries that

show that sleeping less than 6 hours is associated with an increased risk of HTN. (6,8,12,36) However, some authors did not find any association between sleep duration and HTN. (5,11) In a review published by Gangwish in 2014, sleep duration was not associated with hypertension in a longitudinal study and in one cross-sectional study. (7) A recent study carried out in men and women, with an average age of 35 years, demonstrated that short or long sleep duration was associated with HTN in people with insomnia. (26) A previous study by Bansil et al. found that short sleep duration combined with sleep disorders but not short sleep only was associated with HTN. (37) These results would indicate a possible interaction between sleep quantity and quality that should be considered when the influence on BP is evaluated.

In the present study we did not find a significant association between sleep duration > 8 h and elevated BP. The same results were obtained after adjusting for confounders. Although some studies demonstrated an association between longer sleep duration and HTN (6,8), other investigations failed to demonstrate such effect. (12,36,38) Thus, the association between sleep duration and BP is not completely understood and may even be contradictory in some cases.

The present study has some limitations. The number of students analyzed is lower than in many studies analyzing the association between HTN and sleep, which generally correspond to national health surveys from different countries. Although there were 1081 BP records, only 728 subjects completed the sleep survey. Another limitation is that the study was based on student self-reported data, and therefore the information is subjective; nevertheless, several authors have demonstrated that self-reporting compares favorably with actigraphy. (12,39) In addition, factors affecting sleep quality were not evaluated in this study, as we only focused on sleep duration.

One strength of this study is that it was conducted in a young population with a very narrow age range (18-21 years), while most of the research had been conducted in adults with a wider age range (18-44 years, 18-65 years), which might have included students and people with work responsibilities. For this reason, we believe it is necessary to reproduce the study with a larger number of students from different universities, and additionally evaluate sleep quality to generate more robust evidence.

CONCLUSIONS

In the medical students evaluated, the high prevalence of elevated BP is noteworthy. The percentage of students who sleep less than 6 hours and more than 8 hours is low. No significant association was found between short or long sleep duration and the prevalence of elevated BP.

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Conflicts of interest

None declared.

(See authors' conflict of interests forms on the web/Additional material.)

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