

Expression of anger in university students according to perceived quality of sleep

Félix Arbinaga¹
Míriam Joaquín-Mingorance¹
Soledad Fernández-Cuenca¹

¹ University of Huelva, Department of Clinical and Experimental Psychology (Huelva - Spain).

ABSTRACT

Objective: We analyzed the expression of anger according to the perceived quality of sleep in university students. **Methods:** A total sample of 1252 students participated in the study, with an average age of 23.58 years. Using an ex-post facto design and an incidental sampling procedure, the Pittsburgh Sleep Quality Index and the State-Trait Anger Expression Inventory-2 were applied. **Results:** Students with poor sleep quality (PSQI scores > 5) scored higher on the subscales of STAXI-2, showing higher risk of obtaining superior values in Trait Anxiety [OR=1.90] and in the Index of Expression of Anger [OR=1.56], but not in Internal Control of Anger. **Conclusions:** There appears to be a marked relationship between quality of sleep and anger, and it is suggested that sleep hygiene programs can help to reduce the negative consequences of poor sleep quality in terms of health and academic performance in students.

Keywords: Anger; Sleep Wake Disorders; Anxiety; Students; Student Health.

Corresponding author: Félix Arbinaga.
E-mail: felix.arbinaga@dpsi.uhu.es
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INTRODUCTION

The relationship between emotions and sleep has been shown to be bidirectional^{1,2}. Sleep disturbances affect emotional reactivity, while sleep quality is strongly influenced by emotional reactions³⁻⁶. Several studies have shown that sleep deprivation is associated with aggressive behavior in both humans and animals^{7,8}, since the inhibitory control function is negatively affected^{9,10}. A good quality of sleep attenuates diurnal emotional discomfort and influences emotional regulation behaviors¹¹.

The emotional states prior to sleep affect REM sleep and the modulation of sympathetic activity during sleep¹². People who express daytime negative emotions, such as anxiety and irritability, often have poor sleep quality¹³⁻¹⁵ and other problems such as insomnia^{16,17}.

It has been suggested that a sleep duration of less than 7 hours per night¹⁸ and subjective reports of inadequate or poor restorative sleep¹⁹ are good predictors of the later onset of depressive symptoms. The duration of sleep per week is reduced by around 12 minutes per year of age during adolescence²⁰. Adolescents tend to sleep around 9.2 hours per night in *ad lib* sleep conditions²¹, and under normal conditions or during the week most get an average of 7.5 hours a day²². Females tend to sleep 29 minutes on average more than men and report more sleep disturbances and fatigue during the day²⁰, results that have not always been fully or partially supported^{23,24}.

Previous studies have reported that more than 60% of the university population shows sleep problems²⁵ and above 25% sleep <7 h / night, as measured by indices reflecting poor sleep quality²⁶. Between 16-23% of university students report insomnia symptoms²⁷⁻²⁹, important mental health problems related to sleep disturbances³⁰, and direct effects of sleep problems on academic performance³¹. Some authors have identified several socio-demographic variables, risk behaviors, and factors related to the associated health states and duration of sleep in students^{26,32}.

The relationship between sleep quality and anger has not been well studied^{10,23,33-35}. Anger is identified as activation, or a tendency to attack that arises as a reaction to a threat, coercion, damage, frustration, or differential treatment³⁶, with a distinction being made between state-anger and trait-anger³⁷. When anger is intense and sustained over time, it can have effects on health³⁸. Because of its negative influence on health¹² the way in which it is expressed must be considered, either as anger-in (or internalized), or as anger-out (or externalized)^{39,40}. It has been shown that control of emotional expression helps to reduce the impact of anger on sleep¹¹ and other health problems⁴¹⁻⁴⁴. An inadequate emotional reaction to daily stressful events has been characterized by a lower density of the sleep spindle⁴⁵ as well as alterations in the duration and development of REM sleep⁴⁶.

Several studies have shown that those with poor sleep quality and a sleep duration <7 h / night have an increased probability of obtaining high scores on both trait-anger and state-anger^{23,33,34} and show less emotional competence⁴⁷. It was found that ruminating anger and negative affect worsened the quality of sleep in university students³⁵. The results show how,

in university students, high scores in cognitive hostility are a risk factor for disturbed sleep⁴⁸. Similarly, research indicates that negative affect and the diminution of positive affect are linked to poor sleep quality⁴⁹⁻⁵¹.

Given the importance of the effects of poor sleep quality and inadequate anger management on the health and academic performance of university students^{12,30,31}, the aim of the current work was to analyze how the expression of anger is characterized by the subjective quality of sleep in university students. As a working hypothesis, we propose that students who have poor sleep quality (PSQI scores > 5), or who present other problems associated with sleep (in terms of latency, efficiency, and duration of sleep), will obtain higher scores on state-anger and trait-anger in comparison with those who report a good quality of sleep (PSQI scores ≤5). As a second hypothesis, it is expected that as problems associated with sleep increase, higher scores will be obtained in terms of external anger (anger-out) and internal anger (anger-in) along with a poorer capacity to control such expressions of anger.

MATERIALS AND METHODS

Participants

The sample was composed of a total of 1252 university students, of which 64% (n=801) were females. The average age of the participants was 23.58 years, with an SD=3.28 (Min=20 and Max=41 years). The data collection took place between April 2016 and November 2017. We requested the collaboration of University students between the first and fourth year in the degrees of Psychology, Primary Education, Infant Education, and Nursing.

The participants were recruited through various procedures: 1) *University class presentations*. With the authorization of the teacher, in the last 20 minutes of the class, we asked for volunteers in the classroom. They were informed that the objective of the work was to improve our knowledge of sleep quality in university students, with the task being to complete paper and pencil tests. These presentations were given in the morning and afternoon teaching sessions. 2) *Announcements on the web*. Advertisements were placed on the website of the various faculties requesting volunteers, and providing the same information that was given in the classroom presentations. In addition, information was sent through social networks. The inclusion criteria for participation were to be a university student, to not present chronic or psychiatric illnesses, to not take medication at present, to sign the informed consent, and to agree to participate in the study voluntarily. The study was approved by the University's Bioethics Committee. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and the Helsinki Declaration of 1975, as revised in 2000.

Instruments

A brief interview was conducted *ad hoc* with regard to socio-demographic variables, collecting data on gender and age. Self-reports of height and weight were also collected. Body

mass index (BMI) was calculated [weight(kg)/[height(m)]²], a standard formula used as a reliable indicator of body fatness⁵².

To assess Subjective Sleep Quality, the *Pittsburgh Sleep Quality Index (PSQI)*⁵³ was applied in its Spanish adaptation⁵⁴, which has shown high internal consistency (Cronbach's alpha of .81). The predictive validity data of Buysse et al.⁵⁵ indicated that if a cut-off point of 5 was set (PSQI scores > 5 defines worse sleep quality), the sensitivity was 89.6% and the specificity 86.5%.

The 19 items analyze the defining factors of sleep quality, grouped into seven components: subjective sleep quality, sleep latency (time taken to fall asleep), sleep duration (reported amount of time spent sleeping), sleep efficiency (reported amount of time sleeping as a percentage of the time spent in bed) sleep disturbances, use of sleeping medications, and daytime dysfunction (drowsiness, mood, etc.). Each component is assigned a score of 0-3. The total PSQI score is obtained by adding the seven component scores, which varies from 0 to 21 points (the higher the score, the worse the sleep quality). In this work, the reliability obtained, assessed using Cronbach's alpha, in the subjective test of quality of sleep quality (PSQI) was $\alpha=.749$.

To evaluate Emotion-Anger the *State-Trait Anger Expression Inventory-2 (STAXI-2)*⁵⁵ was applied in its Spanish adaptation⁵⁶. The Spanish STAXI-2, with 49 items, maintains the same structure as the State-Anger (S-Anger), with three subscales that assess the different components of the intensity of anger as an emotional state: Feeling (S-Ang/F), Verbal Expression (S-Ang/V) and Physical Expression (S-Ang/P).

A total score for Trait-Anger (T-Anger) is calculated using the two subscales of Anger temperament (T-Ang/T) and Anger reaction (T-Ang/R). Finally, a scale for the Anger Expression Index (AX Index) is included with four subscales: Anger Expression-Out (AX-Out), Anger Expression-In (AX-In), Anger Control-Out (AX/Con-Out), and Anger Control-In (AX/Con-In). A total score is obtained that provides a general measurement of anger expression and control. The authors report a test-retest correlation of .71 and a Cronbach's *alpha* coefficient of .89 for the State-Anger scale, of .82 for the Trait-Anger scale and .69 for the Anger Expression Index⁵⁶. For Spielberger⁵⁷ the subjects with scores higher than the 75th percentile on the Trait-Anger and Anger Expression Index scales, experienced or expressed feelings of anger to a degree that may interfere with optimum behavior, which was not the case in the State-Anger scale for which a different distribution of the scores was carried out.

The reliability obtained in this work, assessed by Cronbach's alpha, is as follows: in the STAXI-2 for S-Anger, $\alpha=.914$; for S-Ang / F, $\alpha=.842$; for S-Ang / V, $\alpha=.833$; and for S-Ang / P, $\alpha=.849$. For the T-Anger scale, $\alpha=.834$; for T-Ang / T, $\alpha=.871$; and T-Ang / R, $\alpha=.755$. Finally, on the AX Index scale, $\alpha=.744$; for AX-Out, $\alpha=.699$; for AX-In, $\alpha=.694$; for AX / Con-Out, $\alpha=.882$; and in AX / Con-In, $\alpha=.827$.

Statistical Analysis

Statistical analyzes were conducted using SPSS Statistics 23 (IBM). Descriptive statistics were also computed (M, SD).

The Student's t test, and its effect size with Cohen's d, (small= 0.2-0.3, medium = around 0.5, and large= ≥ 0.8) was used in the comparison by gender of sleep quality and expression of anger. The χ^2 , and its effect sizes (Phi), were used in the analysis of categorical variables, calculating the Odds Ratio [OR] for each of them. The Snedecor F and Tukey post hoc tests were used in the corresponding univariate and multivariate between groups ANOVAs using a General Linear Model.

RESULTS

The males in our sample had an average age of 24.18 years ($SD=3.36$), significantly higher ($t=4.920, p<.001$) than that of the females ($M=23.24, SD=3.19$ years); although the effect size of the differences observed in the age of the students is small ($d=0.29$).

Female students show a higher risk (Odds Ratio [OR]=1.7) of poor sleep quality (PSQI scores > 5) compared with males ($\chi^2_{(1,1252)}=19.718, p<.001, Phi=0.125; 95\% CI [1.34-2.13]$). Compared with males, the females obtained significantly higher scores ($p<.001$) in T-Anger and on the AX Index (Table 1). Females scored higher on both the S-Anger / P subscale ($p<.001$) and AX-Out ($p<.001$) in comparison with males and had a lower score on AX / Con-Out ($p<.001$) in comparison with the males.

To analyze the possible interaction between gender and PSQI scores, several multivariate ANOVAs were carried out using a General Linear Model, with gender and PSQI scores (> 5) as independent variables and S-Anger, T-Anger and AX Index scores as dependent variables.

In the case of S-Anger, the interaction between gender and PSQI scores (> 5) is significant $F_{(1,1251)}=7.020, p=.008$. The main effect of gender is significant, $F_{(1,1251)}=3.951, p=.047$, along with sleep quality, $F_{(1,1251)}=28.609, p<.001$. However, on the T-Anger scale this interaction is not significant, $F_{(1,1251)}=0.002, p=.968$; although there is a significant main effect of sleep quality (PSQI scores > 5), $F_{(1,1251)}=43.787, p<.001$; and for gender, $F_{(1,1251)}=24.728, p<.001$. In the AX Index, the interaction between gender and sleep quality ($F_{(1,1251)}=0.019, p=.889$, failed to reach significance, although there are significant main effects of sleep quality (PSQI scores > 5) ($F_{(1,1251)}=25.502, p<.001$, and gender, $F_{(1,1251)}=11.398, p=.001$.

In Table 2 it can be seen that those university students with poor sleep quality (PSQI scores > 5) obtained higher and more significant scores in all subscales of STAXI-2; except in the AX / Con-In, where no significance is observed. The effect size of the observed differences is small for both the subscale S-Anger ($d=0.26$) and for the AX-Index ($d=0.32$) and medium ($d=0.43$) for the subscale of T-Anger.

Students with poor sleep quality (PSQI scores > 5) show an increased risk of obtaining scores equal to or higher than the 75th percentile both on T-Anger [OR=1.90] and in the AX Index [OR=1.56], compared with those who have good sleep quality (PSQI scores ≤ 5). On the S-Anger scale, the significance is residual, and no significant differences are observed in S-Ang / F and in AX / Con-In (Table 3).

Table 1. Scores for Subjective Sleep Quality (PSQI) and Anger (STAXI-2) according to the gender of the sample.

	TOTAL 1252	FEMALE 801 (64.0%)	MALE 451 (36.0%)			
	M(SD)	M(SD)	M(SD)	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
PSQI	6.27 (3.04)	6.54 (3.02)	5.80 (3.02)	4.158	<.001	0.25
Sleep quality	1.09 (0.75)	1.12 (0.78)	1.04 (0.68)	2.086	.037	0.11
Sleep latency	1.33 (0.93)	1.43 (0.91)	1.16 (0.94)	4.972	<.001	0.29
Sleep duration (hours)	6.90 (0.97)	6.87 (0.99)	6.96 (0.93)	1.450	.147	
Sleep efficiency (%)	88.74 (8.93)	88.39 (9.19)	89.36 (8.42)	1.886	.060	0.11
Sleep disturbances	1.12 (0.45)	1.15 (0.45)	1.08 (0.45)	2.621	.009	0.16
Daytime dysfunction	1.07 (0.81)	1.11 (0.80)	1.01 (0.82)	2.168	.030	0.12
Hours in bed	7.81 (1.02)	7.81 (1.03)	7.82 (1.00)	0.114	.910	
S-Anger	18.06 (5.50)	17.90 (5.07)	18.35 (6.17)	1.367	.172	
S-Ang/F	6.34 (2.31)	6.35 (2.29)	6.32 (2.34)	0.249	.804	
T-Anger	20.56 (5.33)	21.20 (5.38)	19.41 (5.05)	5.778	<.001	0.34
T-Ang/T	8.36 (3.15)	8.77 (3.26)	7.64 (2.80)	6.418	<.001	0.37
AX Index	29.59 (10.09)	30.45 (10.52)	28.07 (9.08)	4.190	<.001	0.24
AX-Out	11.57 (3.22)	11.81 (3.28)	11.14 (3.06)	3.578	<.001	0.21
AX-In	12.77 (3.67)	12.76 (3.73)	12.80 (3.56)	0.207	.836	
AX/Con-Out	16.59 (4.65)	15.90 (4.65)	17.81 (4.41)	7.140	<.001	0.42
AX/Con-In	14.16 (4.36)	14.23 (4.45)	14.05 (4.20)	0.673	.501	

S-Anger.- State-Anger, S-Ang/F.- Feeling, S-Ang/V.- Verbal Expression, S-Ang/P.- Physical Expression, T-Anger.- Trait Anger, T-Ang/T.- Anger Temperament, T-Ang/R.- Anger Reaction, AX Index.- Anger Expression Index, AX-Out.- Anger Expression-Out, AX-In.- Anger Expression-In, AX/Con-Out.- Anger Control-Out, AX/Con-In.- Anger Control-In, PSQI.- Pittsburgh Sleep Quality Index.

Table 2. Scores for Anger (STAXI-2) according to Subjective Sleep Quality (PSQI scores >5 vs. PSQI scores <5) of the sample.

	PSQI scores >5 668 (53.4%) M(SD)	PSQI scores ≤5 584 (46.6%) M(SD)	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
S-Anger	18.72 (6.19)	17.31 (4.45)	4.681	<.001	0.26
S-Ang/F	6.63 (2.52)	6.01 (1.98)	4.908	<.001	0.27
S-Ang/P	5.69 (1.92)	5.41 (1.37)	3.093	.002	0.17
S-Ang/V	6.40 (2.57)	5.90 (1.94)	3.908	<.001	0.22
T-Anger	21.59 (5.57)	19.38 (4.77)	7.559	<.001	0.43
T-Ang/T	8.87 (3.41)	7.78 (2.72)	6.269	<.001	0.35
T-Ang/R	12.72 (3.27)	11.60 (3.02)	6.315	<.001	0.36
AX Index	31.08 (9.97)	27.89 (9.95)	5.656	<.001	0.32
AX-Out	12.05 (3.25)	11.02 (3.09)	5.693	<.001	0.33
AX-In	13.16 (3.63)	12.33 (3.67)	4.021	<.001	0.23
AX/Con-Out	16.14 (4.63)	17.10 (4.63)	3.686	<.001	0.21
AX/Con-In	13.99 (4.31)	14.36 (4.41)	1.500	.134	

S-Anger.- State-Anger, S-Ang/F.- Feeling, S-Ang/V.- Verbal Expression, S-Ang/P.- Physical Expression, T-Anger.- Trait Anger, T-Ang/T.- Anger Temperament, T-Ang/R.- Anger Reaction, AX Index.- Anger Expression Index, AX-Out.- Anger Expression-Out, AX-In.- Anger Expression-In, AX/Con-Out.- Anger Control-Out, AX/Con-In.- Anger Control-In, PSQI.- Pittsburgh Sleep Quality Index.

Problems associated with sleep include sleep efficiency (<85%, ≥ 85%) and sleep duration (<7 hours, ≥7 h hours). The data show that 26.3% (N=329) of the students indicate an efficiency lower than 85%. Those with an efficiency < 85% show higher scores in S-Anger ($p=.031$) and in the AX Index ($p=.004$); indicating a lower AX / Con-Out ($p=.041$). On the other hand, 39.5% (N=494) of the sample reported sleeping less than 7 hours / night (Table 4). These students obtained higher scores in S-Anger ($p=.020$), in T-Anger ($p=.002$) and in the AX Index ($p=.041$). Those who sleep less than 7 hours also

obtained higher scores in AX-Out and in AX-In; but they did not differ from those who sleep 7 or more hours in their scores on AX / Con-Out or in AX / Con-In.

Sleep Latency (time taken to fall asleep: [a] <15 minutes, [b] 16-30 minutes, [c] 31-60 minutes and [d] > 60 minutes) has shown significant scores on the S-Anger scale ($F_{(3,1251)}=8.435$, $p<.001$), where differences have been observed between: [a] <[c] ($p=.012$); [a] <[d] ($p<.001$) and [b] <[d] ($p=.001$). On the T-Anger scale significant differences ($F_{(3,1251)}=12.315$, $p<.001$) have been observed between the scores: [a] <[c] ($p<.001$); [a]

Table 3. Risk of participants with poor sleep quality (PSQI scores > 5) of obtaining high scores on the STAXI-2 subscales.

N (%)	PSQI scores >5 668 (53.4)	χ^2 (1,1252)	<i>p</i>	phi	OR	95%CI
¹ S-Anger	13 (76.5)	3.700	.054	.054	2.88	0.93-8.88
S-Ang/F	7 (77.8)	2.173	.140	.042	3.08	0.64-14.89
S-Ang/P	12 (80.0)	4.331	.037	.059	3.54	0.99-12.62
S-Ang/V	13 (81.3)	5.067	.024	.064	3.84	1.09-13.56
² T-Anger	182 (65.5)	21.067	<.001	.130	1.90	1.44-2.51
T-Ang/T	181 (64.6)	18.466	<.001	.121	1.82	1.38-2.39
T-Ang/R	156 (65.8)	18.260	<.001	.121	1.89	1.41-2.54
² AX Index	158 (62.0)	9.530	.002	.087	1.56	1.17-2.06
AX-Out	150 (61.0)	7.145	.008	.076	1.47	1.11-1.96
AX-In	236 (61.6)	15.143	<.001	.110	1.62	1.27-2.08
AX/Con-Out	195 (48.8)	5.008	.025	-.063	0.76	0.60-0.97
AX/Con-In	235 (50.1)	3.179	.075	-.050	0.81	0.65-1.02

1.High category in the response scores (High vs. Half-Low) according to STAXI-2; 2.- Response Category (High => 75th percentile) according to STAXI-2; S-Anger.- State-Anger, S-Ang/F.- Feeling, S-Ang/V.- Verbal Expression, S-Ang/P.- Physical Expression, T-Anger.- Trait Anger, T-Ang/T.- Anger Temperament, T-Ang/R.- Anger Reaction, AX Index.- Anger Expression Index, AX-Out.- Anger Expression-Out, AX-In.- Anger Expression-In, AX/Con-Out.- Anger Control-Out, AX/Con-In.- Anger Control-In, PSQI.- Pittsburgh Sleep Quality Index.

Table 4. Scores on the subscales of the STAXI-2 according to the Efficiency and Duration of Sleep (PSQI).

	Sleep Efficiency(PSQI)		<i>t</i>	<i>p</i>	Sleep Duration (PSQI)		<i>t</i>	<i>p</i>
	< 85% <i>M(SD)</i>	≥ 85% <i>M(SD)</i>			< 7 h. <i>M(SD)</i>	≥ 7 h <i>M(SD)</i>		
S-Anger	18.62 (6.17)	17.86 (5.22)	2.156	.031	18.80 (6.29)	17.58 (4.85)	3.639	.020
S-Ang/F	6.62 (2.58)	6.24 (2.19)	2.370	.018	6.55 (2.49)	6.20 (2.16)	2.529	.012
S-Ang/P	5.63 (1.76)	5.53 (1.67)	0.904	.366	5.76 (1.96)	5.43 (1.48)	3.159	.002
S-Ang/V	6.37 (2.60)	6.09 (2.20)	1.766	.078	6.49 (2.67)	5.95 (2.03)	3.839	<.001
T-Anger	20.99 (5.71)	20.41 (5.18)	1.714	.087	21.15 (5.67)	20.17 (5.06)	3.104	.002
T-Ang/T	8.65 (3.46)	8.26 (3.03)	1.847	.065	8.65 (3.41)	8.17 (2.95)	2.517	.012
T-Ang/R	12.34 (3.33)	12.15 (3.16)	0.912	.362	12.50 (3.35)	12.00 (3.10)	2.681	.007
AX Index	30.95 (10.39)	29.11 (9.93)	2.856	.004	30.31 (10.31)	29.12 (9.92)	2.042	.041
AX-Out	11.88 (3.39)	11.45 (3.15)	2.017	.044	11.82 (3.28)	11.41 (3.17)	2.235	.026
AX-In	13.04 (3.71)	12.68 (3.65)	1.511	.131	13.03 (3.77)	12.61 (3.60)	1.982	.048
AX/Con-Out	16.12 (4.84)	16.75 (4.58)	2.048	.041	16.52 (4.75)	16.63 (4.59)	0.435	.664
AX/Con-In	13.84 (4.37)	14.28 (4.35)	1.509	.112	14.02 (4.38)	14.26 (4.35)	0.940	.347

S-Anger.- State-Anger, S-Ang/F.- Feeling, S-Ang/V.- Verbal Expression, S-Ang/P.- Physical Expression, T-Anger.- Trait Anger, T-Ang/T.- Anger Temperament, T-Ang/R.- Anger Reaction, AX Index.- Anger Expression Index, AX-Out.- Anger Expression-Out, AX-In.- Anger Expression-In, AX/Con-Out.- Anger Control-Out, AX/Con-In.- Anger Control-In, PSQI.- Pittsburgh Sleep Quality Index.

<[d] ($p < .001$) and [c] <[d] ($p = .001$). Finally, on the AX Index scale the differences ($F_{(3,1251)}^2 = 12.323, p < .001$) have shown that [a] <[c] ($p < .001$); [a] <[d] ($p < .001$) and [c] <[d] ($p = .005$).

DISCUSSION

In this work we have sought to analyze how the expression of anger is characterized in terms of the subjective quality of sleep in university students.

Regarding the first of these hypotheses, the data have shown that those university students with poor sleep quality (PSQI scores > 5) obtained higher scores on all subscales of the STAXI-2, although the effect size is small for the S-Anger and AX-Index and medium for the T-Anger subscale. It is observed that students with poor sleep quality show a higher risk of obtaining scores that indicate disturbances derived from high scores on trait anger and anger expression. These results

support those of previous studies showing that people who manifest diurnal negative emotions often have poor sleep quality^{13-15,33,34,45}, as it is the case of anger^{23,34,35}.

Similarly, those who present problems associated with sleep, such as sleep efficiency <85%, showed higher scores in S-Anger and the AX Index. Moreover, those who report sleeping less than 7 hours / night obtained higher scores in S-Anger, in T-Anger, and in the AX Index. It has also been observed that as sleep latency increases, higher values are obtained in S-Anger, T-Anger and the AX Index scale. In this regard, previous work has already confirmed that university students with high scores in cognitive hostility are those who show a greater risk of presenting sleep disturbances^{35,48} such as alterations in sleep duration⁴⁶ and other problems such as primary insomnia^{16,17}. The data support the findings of other authors that link increased negative affect and reduced positive affect with poor sleep quality⁴⁹⁻⁵¹.

Regarding our second hypothesis it has been observed that those students with poor sleep quality (PSQI scores > 5) show higher values in external and internal expression of anger and less external control of anger; whilst no differences were observed in the internal control of anger. Among the problems associated with sleep it has been observed that a lower Sleep Efficiency (<85%) appears to be indicative of greater external expression of anger and less external control of anger (AX / Con-Out); however, there are no differences in the expression of anger and the internal control of anger. On the other hand, those who report sleeping for less than 7 hours obtain higher scores in external and internal expression of anger; but they do not differ from those who sleep 7 or more hours in terms of AX / Con-Out or AX / Con-In.

It should be noted that the second hypothesis is not fully supported. We found that the greater the number of problems related to sleep quality, efficiency, and duration of sleep, the higher the score on expression of anger (out-in). However, control seems to be lower only in the external manifestations of anger; except in the case of those who report sleeping less than 7 hours, which do not differ from their control (out-in) i.e. those who sleep 7 or more hours per night. In this regard, it has already been stated that those with poor sleep quality show less competence and emotional control⁴⁷ and that an inadequate emotional reaction to daily stressful events is associated with a poor quality of sleep, as well as alterations in sleep duration and development^{45,46}. It has been shown that adequate control of emotional expression reduces the impact of anger on sleep¹¹ and other health problems⁴¹⁻⁴⁴, and is linked to a healthier lifestyle at an early age⁵⁸.

Among the limitations of this work, it is worth noting the non-experimental nature of this study, which therefore limits the explanatory capacity of the data. There have been no analyzes regarding the specific factors that mark the differences found here in relation to gender, since the data obtained on the anger scales, considering both the gender of the students and sleep quality, have shown an interaction for the scores on the state anger scale. However, quality of sleep appears to be the variable that exerts the strongest impact, regardless of gender, on scores of all the anger scales. Similarly, it is important to determine which environmental factors (e.g., consumption of drugs, tobacco, and alcohol) might underlie both the development of sleep problems and an inadequate management of emotional responses in students.

Finally, it is interesting to note that a significant number of factors related to sleep problems are modifiable, not only by pharmacological therapy. For instance, it is possible to design and include intervention programs aimed at improving sleep strategies. In this regard, a one-hour session in sleep hygiene education has been shown to improve both the reported quality and quantity of sleep⁵⁹. Along with this it could be possible to develop strategies that help the students in their abilities and strategies for coping that allow for control of emotional expression, since this control has been shown to mitigate the impact of sleep on anger¹¹ both of which have an effect on the academic performance of students³¹.

REFERENCES

1. Baglioni C, Spiegelhalter K, Lombardo C, Riemann D. Sleep and emotions: a focus on insomnia. *Sleep Med Rev*. 2010;14(4):227-38.
2. Roberts RE, Roberts CR, Duong HT. Sleepless in adolescence: prospective data on sleep deprivation, health and functioning. *J Adolesc*. 2009;32(5):1045-57.
3. Altena E, Micoulaud-Franchi JA, Geoffroy PA, Sanz-Arigita E, Bioulac S, Philip P. The bidirectional relation between emotional reactivity and sleep: From disruption to recovery. *Behav Neurosci*. 2016;130(3):336-50.
4. Ireland JL, Culpin V. The relationship between sleeping problems aggression, anger, impulsivity in a population of juvenile young offenders. *J Adolesc Health*. 2006;38(6):649-55.
5. Kalmbach DA, Pillai V, Roth T, Drake CL. The interplay between daily affect and sleep: a 2-week study of young females. *J Sleep Res*. 2014;23(6):636-45.
6. Prather A, Bogdan R, Hariri A. Impact of sleep quality on amygdala reactivity, negative affect, and perceived stress. *Psychosom Med*. 2013;75(4):350-8.
7. Benedetti F, Fresi F, Maccioni P, Smeraldi E. Behavioural sensitization to repeated sleep deprivation in a mice model of mania. *Behav Brain Res*. 2008;187(2):221-7.
8. Randler C, Vollmer C. Aggression in young adults—a matter of short sleep and social jetlag? *Psychol Rep*. 2013;113(3):754-65.
9. Thomas M, Sing H, Belenky G, Holcomb H, Mayberg H, Dannals R, et al. Neural basis of alertness and cognitive performance impairments during sleepiness. I. Effects of 24 h of sleep deprivation on waking human regional brain activity. *J Sleep Res*. 2000;9(4):335-52.
10. Kamphuis J, Lancel M. The Interrelations Between Sleep, Anger And Loss Of Aggression Control. In: Babson KA, Feldner MT, eds. *Sleep and Affect: Assessment, Theory and Clinical Implications*. London: Academic Press; 2015. p. 247-76.
11. Diestel S, Rivkin W, Schmidt KH. Sleep quality and self-control capacity as protective resources in the daily emotional labor process: results from two diary studies. *J Appl Psychol*. 2015;100(3):809-27.
12. Delannoy J, Mandai O, Honoré J, Kobayashi T, Sequeira H. Diurnal Emotional States Impact the Sleep Course. *PLoS One*. 2015;10(11):e0142721.
13. Brissette I, Cohen S. The contribution of individual differences in hostility to the associations between daily interpersonal conflict, affect and sleep. *Pers Soc Psychol Bull*. 2002;28(9):1265-74.
14. Mezick EJ, Matthews KA, Hall M, Kamarck TW, Buysse DJ, Owens JF, et al. Intra-individual variability in sleep duration and fragmentation: associations with stress. *Psychoneuroendocrinology*. 2009;34(9):1346-54.
15. Ong JC, Carde NB, Gross JJ, Manber R. A two-dimensional approach to assessing affective states in good and poor sleepers. *J Sleep Res*. 2011;20(4):606-10.
16. Akerstedt T, Kecklund G, Axelsson J. Impaired sleep after bedtime stress and worries. *Biol Psychol*. 2007;76(3):170-3.
17. Lundh LG, Broman JE. Insomnia as an interaction between sleep-interfering and sleep-interpreting processes. *J Psychosom Res*. 2000;49(5):299-310.
18. Roberts RE, Duong HT. The prospective association between sleep deprivation and depression among adolescents. *Sleep*. 2014;37(2):239-44.
19. Chang PP, Ford DE, Mead LA, Cooper-Patrick L, Klag MJ. Insomnia in young men and subsequent depression. The Johns Hopkins Precursors Study. *Am J Epidemiol*. 1997;146(2):105-14.
20. Olds T, Blunden S, Petkov J, Forchino F. The relationships between sex, age, geography and time in bed in adolescents: a meta-analysis of data from 23 countries. *Sleep Med Rev*. 2010;14(6):371-8.
21. Carskadon MA, Acebo C. Regulation of sleepiness in adolescents: update, insights, and speculation. *Sleep*. 2002;25(6):606-14.
22. Olds T, Maher C, Blunden S, Matricciani L. Normative data on the sleep habits of Australian children and adolescents. *Sleep*. 2010;33(10):1381-8.
23. Arbinaga F. Subjective quality of sleep and anger. *Int J Psychol Behav Sci*. 2017;7(1):41-8.
24. Coulombe JA, Reid GJ, Boyle MH, Racine Y. Sleep problems, tiredness, and psychological symptoms among healthy adolescents. *J Pediatr Psychol*. 2010;36(1):25-35.
25. Lund HG, Reider BD, Whiting AB, Prichard JR. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Health*. 2010;46(2):124-32.
26. Quick V, Byrd-Bredbenner C, Shoff S, White AA, Lohse B, Horacek T, et al. Relationships of Sleep Duration With Weight-Related Behaviors of U.S. College Students. *Behav Sleep Med*. 2016;14(5):565-80.
27. Bixler EO, Vgontzas AN, Lin HM, Vela-Bueno A, Kales A. Insomnia in central Pennsylvania. *J Psychosom Res*. 2002;53(1):589-92.
28. Cukrowicz KC, Otamendi A, Pinto JV, Bernert RA, Krakow B, Joiner TE Jr. The impact of insomnia and sleep disturbances on depression and suicidality. *Dreaming*. 2006;16(1):1-10.

29. Hardison HG, Neimeyer RA, Lichstein KL. Insomnia and complicated grief symptoms in bereaved college students. *Behav Sleep Med.* 2005;3(2):99-111.
30. Taylor DJ, Gardner CE, Bramoweth AD, Williams JM, Roane BM, Grieser EA, et al. Insomnia and mental health in college students. *Behav Sleep Med.* 2011;9(2):107-16.
31. Gomes AA, Tavares J, de Azevedo MH. Sleep and academic performance in undergraduates: a multi-measure, multi-predictor approach. *Chronobiol Int.* 2011;28(9):786-801.
32. Peltzer K, Pengpid S. Sleep duration and health correlates among university students in 26 countries. *Psychol Health Med.* 2016;21(2):208-20.
33. Engin E, Keskin G, Dulgerler S, Bilge A. Anger and alexithymic characteristics of the patients diagnosed with insomnia: a control group study. *J Psychiatr Ment Health Nurs.* 2010;17(8):692-9.
34. Shin C, Kim J, Yi H, Lee H, Lee J, Shin K. Relationship between trait-anger and sleep disturbances in middle-aged men and females. *J Psychosom Res.* 2005;58(2):183-9.
35. Stoia-Caraballo R, Rye MS, Pan W, Brown Kirschman KJ, Lutz-Zois C, Lyons AM. Negative affect and anger rumination as mediators between forgiveness and sleep quality. *J Behav Med.* 2008;31(6):478-88.
36. Fernández E. The Angry Personality: A Representation on Six Dimensions of Anger Expression. In: Boyle GJ, Matthews D, Saklofske D, eds. *The SAGE Handbook of Personality Theory and Assessment: Volume 2 — Personality Measurement and Testing.* London: Sage. 2008. p. 402-19.
37. Spielberger CD, Jacobs G, Russell S, Crane R. Assessment of anger: The state-trait anger scale. In: Butcher JN, Spielberger CD, eds. *Advances in Personality Assessment.* Hillsdale: Lawrence Erlbaum Associates; 1983. p. 112-34.
38. Chida Y, Steptoe A. The association of anger and hostility with future coronary heart disease: a meta-analytic review of prospective evidence. *J Am Coll Cardiol.* 2009;53(11):936-46.
39. Gerin W, Davidson KW, Christenfeld NJ, Goyal T, Schwartz JE. The role of angry rumination and distraction in blood pressure recovery from emotional arousal. *Psychosom Med.* 2006;68(1):64-72.
40. Ramsay JM, McDermott MR, Bray C. Components of the anger-hostility complex and symptom reporting in patients with coronary artery disease: a multi-measure study. *J Health Psychol.* 2001;6(6):713-29.
41. Caska CM, Hendrickson BE, Wong MH, Ali S, Neylan T, Whooley MA. Anger expression and sleep quality in patients with coronary heart disease: findings from the Heart and Soul Study. *Psychosom Med.* 2009;71(3):280-5.
42. Eng PM, Fitzmaurice G, Kubzansky LD, Rimm EB, Kawachi I. Anger expression and risk of stroke and coronary heart disease among male health professionals. *Psychosom Med.* 2003;65(1):100-10.
43. Kitayama S, Park J, Boylan JM, Miyamoto Y, Levine CS, Markus HR, et al. Anger expression and ill-health in two cultures: an examination of inflammation and cardiovascular risk. *Psychol Scien.* 2015;26(2):211-20.
44. Pickett SM, Barbaro N, Mello D. The relationship between subjective sleep disturbance, sleep quality, and emotion regulation difficulties in a sample of college students reporting trauma exposure. *Psychol Trauma.* 2016;8(1):25-33.
45. Dang-Vu TT, Salimi A, Boucetta S, Wenzel K, O'Byrne J, Brandewinder M, et al. Sleep spindles predict stress-related increases in sleep disturbances. *Front Hum Neurosci.* 2015;9:68.
46. Lai CT, Chen CY, Kuo TB, Chen CM, Yang CC. Sympathetic Hyperactivity, Sleep Fragmentation, and Wake-Related Blood Pressure Surge During Late-Light Sleep in Spontaneously Hypertensive Rats. *Am J Hypertens.* 2016;29(5):590-7.
47. Brand S, Kirov R, Kalak N, Gerber M, Schmidt NB, Lemola S, et al. Poor Sleep Is Related to Lower Emotional Competence Among Adolescents. *Behav Sleep Med.* 2016;14(6):602-14.
48. Taylor ND, Fireman GD, Levin R. Trait hostility, perceived stress, and sleep quality in a sample of normal sleepers. *Sleep Disord.* 2013;2013:735812.
49. Norlander T, Johansson A, Bood SA. The affective personality: its relation to quality of sleep, well-being and stress. *Soc Behav Pers.* 2005;33(7):709-22.
50. Paterson JL, Dorrian J, Ferguson SA, Jay SM, Lamond N, Murphy PJ, et al. Changes in structural aspects of mood during 39-66 h of sleep loss using matched controls. *Appl Ergon.* 2011;42(2):196-201.
51. Scott BA, Judge TA. Insomnia, emotions, and job satisfaction: a multilevel study. *J Manag.* 2006;32(5):622-45.
52. Centers for Disease Control and Prevention. About BMI for adults. [cited 2014 Apr 24]. Available from: https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html
53. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 1989;28(2):193-213.
54. Macías JA, Royuela A. The Spanish version of the Pittsburgh Sleep Quality Index. *Infor Psiquiatr.* 1996;146:465-72.
55. Spielberger CD. *State-Trait Anger Expression Inventory-2 (STAXI-2): Professional Manual.* Odessa: Psychological Assessment Resources; 1999.
56. Miguel-Tobal J, Casado M, Cano-Vindel A, Spielberger C. *Inventario de Expresión de la Ira Estado-Rasgo, S.T.A.X.I.-2. State-Trait-Anger-Expression-Inventory.* Madrid: TEA Ediciones; 2001.
57. Spielberger CD. *Manual for State-Trait-Anger-Expression-Inventory.* Palo Alto: Consulting Psychologists Press; 1996.
58. Musante L, Treiber FA. The relationship between anger-coping styles and lifestyle behaviors in teenagers. *J Adolesc Health.* 2000;27(1):63-8.
59. O'Donnell S, Driller MW. Sleep-hygiene Education improves Sleep Indices in Elite Female Athletes. *Int J Exerc Sc.* 2017;10(4):522-30.