

# Social, Biological and Behavioral Factors Associated with Social Jet Lag and Sleep Duration in University Students from a Low Urbanized City

Xaize de Fátima de Medeiros

Lopes <sup>1</sup>

Mayonara Fabíola Silva Araújo <sup>1</sup>

Natália de Carvalho Cordeiro

Lira <sup>1</sup>

Diego de Sousa Dantas <sup>2</sup>

Jane Carla de Souza <sup>1</sup>

<sup>1</sup>Faculty of Health Sciences of Trairi, Federal University of Rio Grande do Norte, Santa Cruz, State of Rio Grande do Norte, Brazil; <sup>2</sup>Department of Physiotherapy, Health Sciences Center, Federal University of Pernambuco, Recife, Pernambuco, Brazil

**Introduction:** Sleep deprivation and social jet lag are observed in college students from highly urbanized cities. However, does these consequences also present in college students from a low urbanization city?

**Objective:** To evaluate the prevalence and social, biological and behavioral factors associated with sleep deprivation and social jet lag in university students from a low urbanized city of Brazil.

**Methods:** A total of 298 university students participated in the study through application of the Health and Sleep and the Munich Chronotype Questionnaires. Multiple linear regression with stepwise-forward method was adopted to assess the associations of the factors with the outcome variables.

**Results:** Doing leisure activities (LA) ( $B = 23.24$ ) and academic demand (AD) before bedtime ( $B = 19.51$ ), both on the weekend, and doing household chores (HC) before bedtime ( $B = 17.61$ ) in the week were associated with an increase in social jet lag, while stimulating drinks (SD) were associated with a decrease ( $B = -15.17$ ). Shorter sleep duration in the week was related to chronotype ( $B = -0.56$ ), male ( $B = -26.51$ ), doing LA ( $B = -27.63$ ), poor perception about sleeping place (PPSP) ( $B = -43.02$ ) and daily commute ( $B = -68.97$ ). The shorter sleep duration in the weekend was associated to male ( $B = -36.36$ ), PPSP ( $B = -58.16$ ), have recreational and religious activities ( $B = -31.11$ ), doing LA ( $B = -25.10$ ) and AD ( $B = -23.60$ ). Just chronotype was associated with longer sleep duration in the weekend ( $B = 0.25$ ).

**Conclusion:** University students from a low urbanized city present social jet lag, shorter sleep duration on school days and longer sleep duration on free days as a result of biological and social factors, and mostly behavioral factors.

**Keywords:** sleep-wake cycle, level of urbanization, sleep deprivation, sleep irregularity

## Introduction

The National Education Plan (Law No 10,172/2001) in Brazil aims to reduce inequalities in the supply of placements in universities between regions of the country.<sup>1</sup> This plan contributed to a growth in the number of young people entering universities in cities in the interior of States which present a context of low urbanization. This advance in access to education is an important event for society. However, it implies changes in the students' daily routines which can be considered stressful,<sup>2</sup> requiring behavioral and social adaptations.

Students sleep/wake patterns are related to several factors including social factors such as urban context; socioeconomic status and lifestyles.<sup>3</sup> Roenneberg

Correspondence: Jane Carla de Souza  
Campus Faculty of Health Sciences of  
Trairi, Federal University of Rio Grande  
do Norte, Passos de Miranda St, Santa  
Cruz, 59200-000, State of Rio Grande do  
Norte, Brazil  
Tel +55 84 99638-0686  
Email janesouza.ufrn@gmail.com

et al discusses that in more urbanized contexts individuals generally sleep later.<sup>4</sup> Individuals with lower socioeconomic status and less favored social class are those with greater sleep problems, resulting in shorter and lower quality of sleep.<sup>5–8</sup> Another factor which contributes to reducing the sleep duration of these young adults is including university students in the working world.<sup>9</sup>

With further regard to social factors, studies have observed that housing conditions are also related to sleep patterns with longer commute times to school which is a factor associated to waking up earlier, resulting in a significant decrease in sleep duration.<sup>10,11</sup> In addition, accumulation of academic demands and social activities linked to university life make students a vulnerable group to changes in the sleep-wake cycle (SWC).<sup>12,13</sup>

Studies carried out with university students from more urbanized context cities have shown that there is a predominance of academic activities carried out at night which leads to later sleeping hours. This delay in the sleep onset phase, as well as a predisposition to wake up later, are biological characteristics which appear in adolescence, but they can still be present in young adults.<sup>14–16</sup>

This biological tendency to sleep and wake up later combined with high academic demands and the social opening hours of classes in Brazil (around 7 am) lead to a reduction in sleep<sup>17–19</sup> on study days. According to the American sleep association, young adults between 18 and 25 years old have a biological need for 7 to 9 hours of daily sleep.<sup>20</sup> Thus, failure to meet this need leads to possible homeostatic compensation<sup>21</sup> which in turn results in increased sleep duration on free days and contributes to irregular SWC,<sup>22</sup> impacting the individual's health.<sup>23</sup>

This irregularity in the sleep/wake cycle between study days and free days is called social jet lag.<sup>24–26</sup> This imbalanced pattern is usually added to sleep deprivation<sup>8,14</sup> due to academic demands and the start time of classes. Social jet lag and sleep deprivation are associated with negative consequences on attention, executive functions and working memory,<sup>27</sup> together compromising academic performance.<sup>28</sup>

These sleep problems have individual variation in relation to chronotype, meaning that individuals with an evening chronotype have a biological preference for late sleep and wake times and have greater sleep deprivation and social jet lag in relation to morning chronotype.<sup>25,26,29–35</sup> The latter preferably have earlier sleep and wake times.

In addition, university students have a predominance of habits which are associated with SWC disturbances, such as: inadequate diet,<sup>36</sup> physical inactivity<sup>37,38</sup> and consumption of

psychoactive substances (tobacco, alcohol and coffee).<sup>39–41</sup> Another behavior which impacts the sleep health of students is using electronic devices close to bedtime. These devices emit artificial light that generates three impacts on the nervous system: it increases general physiological alertness, suppresses melatonin by the pineal gland, a sleep-inducing hormone in humans and contributes to delay bedtime on the day of exposure and following days.<sup>42</sup> Some authors have discussed that these behavioral factors which impair student sleep can happen due to an individual's lack of knowledge about sleep hygiene.<sup>43</sup>

Therefore, young people's sleep is influenced by social, biological, and behavioral aspects, thus encompassing broad lifestyle characteristics, and which may differ according to the urbanization context. In this study, the housing situation being related to the type of commute to the institution, which was included with a social factor, due been a factor which can cause a change in the lifestyle of these students. Thus, considering universities in low urbanization contexts and the daily migration of students to the municipalities of the educational institution, the aim of this study was to analyze the prevalence and social, biological and behavioral factors associated with sleep deprivation and social jet lag in university students in a low urbanized city.

## Methods

This is a descriptive-analytical-observational cross-sectional study implementing a quantitative approach. The sample size was calculated from the population of students in the academic unit (532), considering 50% heterogeneity, 95% confidence level and 5% margin of error. Therefore, the estimated sample size was 278 students. The invitation to participate in the study was made in the classroom to all students enrolled in the academic unit. Of these, a total of 310 students agreed to participate in the study, of which 12 (3.8%) were excluded and the final sample was 298 students of the Nursing, Physiotherapy, Nutrition and Psychology courses. The academic unit is part of the Federal University of Rio Grande do Norte which is in the countryside (Santa Cruz city) of Rio Grande do Norte state. Santa Cruz is a low urbanized city located 114 km from the state capital and has about 35,797 inhabitants, a population density of 57.33 inhabitants/km<sup>2</sup>, an urbanization rate of 85.2% and a human development index equal to 0.63. These characteristics are peculiar to a countryside city when compared to the characteristics of the capital of the state (Natal = 803,739 inhabitants, population density of 4.805,24

inhabitants/km<sup>2</sup>, urbanization rate of 100% and human development index equal to 0.76).<sup>44</sup>

The study was approved by the Research Ethics Committee of the Faculty of Health Sciences of Trairi (CEP - FACISA) (2,283,235 CAAE: 72209517.3.0000.5568) and adhered to a standard previously set by the Declaration of Helsinki. All participants provided written informed consent, being that anonymity of all recruited individuals was guaranteed throughout the study process. In addition, it is in accordance with resolution 466/2012 of the National Health Council on "Research Involving Human Beings".

Data collection was carried out between November 2017 and June 2019, excluding the days of recess and holidays. Students over 18 years old of both sex were included. Those who did not sign the informed consent form, who did not answer the questionnaires in full or who reported any psychiatric illness (depression, anxiety, bipolar mood disorder, epilepsy, psychotic disorder) or sleep disorders (obstructive sleep apnea, insomnia) were excluded.

Two self-administered questionnaires were used:

1. The Health and Sleep questionnaire is a Brazilian questionnaire proposed by Miriam Andrade<sup>45</sup> for the Brazilian population that aims to evaluate sociodemographic, health problems and behavioral factors, and knowledge about sleep, with 29 items. In general, the individuals' behaviors are evaluated in a dichotomic way (yes or no) performed up to two hours before bedtime and performed as a reason for wake up time, all during the weekdays and in the weekend. The sleep knowledge was obtained from 20 statements with alternative answers of "true", "false" or "I don't know". A question about the student's commute was included in this questionnaire to assess whether the student makes daily trips (commute) to and from the city they reside into the city of the educational institution or lived in the city of the educational institution. In addition, the actual time for university commuting was assessed. The questionnaire of the Brazilian Association of Research Companies (ABEP)/Brazilian Economic Classification Criterion, 2018 was added to this survey. This questionnaire evaluates the socioeconomic class based on 3 items which assesses the level of education of the head of the household, the accesses a public service such as piped water and paved roads, and access to and number of household appliances, employees, and automobiles in the house. The final score ranges from 0 to 46 points and socioeconomic class are divided into 8 groups: A1 (42 to 46 points), A2 (35 to 41 points), B1 (29 to 34 points), B2 (23 to 28 points), C1 (18

to 22 points), C2 (14 to 17 points), D (8 to 13 points), and E (0 to 7 points). These classes were again grouped into A, B, C and D-E.

2. The Munich Chronotype Questionnaire (MCTQ) was used to assess sleep duration on week (study days) and on weekend (free days), the chronotype and social jet lag. Sleep duration was taken into account the recommendation of the American Sleep Foundation for young adults (18–25 years) and adults (25–64 years), which report that 6 h of sleep duration may be recommended, considering individuals differences in sleep duration.

The chronotype was assessed by calculating the corrected midsleep point on free days (MSFc) to correct the sleep debt caused by the compensating for insufficient sleep on school days on free days.<sup>46,47</sup> The MSFc was calculated by the formula:  $[MSFc = MSF - 0.5 * (SDF - (5 * SDw + 2 * SDF) / 7)]$ , in which the MSF indicates the midsleep point on free days; SDF is the sleep duration on free days and SDw is the sleep duration on school/work days. The results obtained are given in hours, ranging from 0 to 12, and the lower values represent morningness while higher values represent eveningness.<sup>47</sup>

To assess the Social Jet lag, it was adopted the Jankowski (2017) proposal, that correct the effect of the sleep debt. The corrected social jet lag (SJLc) was calculated by the absolute difference between sleep onset on free days (Sof) and sleep onset on work/school days (Sow)  $[SJLc = Sof - Sow]$ . Social jet lag was categorized into <1 hour (no social lag), between 1h–2h (low social lag) and > 2h (high social lag).

The independent variables were grouped into social, biological, and behavioral factors. The social factors were assessed by the Health and Sleep questionnaire and included: socioeconomic class (A, B, C, D-E); knowledge about sleep, which was categorized based on the median number of correct answers from 20 statements ( $\leq 13$  = poor knowledge and  $> 14$  correct answers = highest knowledge). Start time of classes (Irregular times - no set pattern, start between 7:00 am - 7:49 am and between 7:50 am - 8:59 am - the last two groups showed this pattern at least three times a week), work (yes or no), daily commute (yes or no) and perception about sleeping place (good or poor).

The biological factors were sex (male or female), have a health problem in the previous month (yes or no) and age, which was classified according to the proposed in the recommendations by the American Sleep Foundation, with young adults being considered those aged 18 to 25 years (individuals aged  $\leq 25$  years or  $> 25$  years). These factors

were assessed by the Health and Sleep questionnaire. The chronotype added to biological factors (morning, intermediate or evening-types individual) which was accessed by the MCTQ.

Behavioral factors were evaluated in a dichotomous way (yes or no) by the Health and Sleep questionnaire. Among the behavioral factors, some were evaluated only once, such as: practicing physical activity; smoking; consuming stimulant drinks (black tea or yerba mate, coffee, soft drinks) or drinking alcoholic beverages, eating inappropriately before bed (eating a heavy meal or going to bed hungry). However, some behaviors were evaluated during the week and at the weekend, such as: reporting academic demands and household chores before bedtime or as a reason to wake up; using electronic devices before bedtime and performing leisure activities around bedtime; and reporting recreational or religious activities to wake up.

The collected data were tabulated and stored in the SPSS database version 22.0 program. Descriptive statistics of the variables were initially performed. Pearson's correlation coefficient was used to analyze the associations of independent variables with three outcomes: sleep duration in the week (study days), sleep duration in the weekend, and social jet lag. For each outcome, separated analysis were conducted and covariates with theoretical basis and  $p < 0.20$  in univariate analysis were included in the first regression model.

Multiple linear regression with stepwise forward method was conducted, for each outcome, after confirming the absence of outliers and multicollinearity, and the presence of homoscedasticity of the residuals.<sup>48,49</sup> The coefficient of determination ( $R^2$ ), unstandardized regression estimate (B) and the respective 95% confidence intervals (95% CI) were obtained through multiple regression. The final models include only variables which showed a statistically significant association ( $p < 0.05$ ) with the analyzed outcomes.

## Results

In our sample, 43% of students sleep less than 6h per day in the week, while 92.3% of them sleep more than 6h on the weekends. The average sleep duration on the study days was 6h39min  $\pm$  1h28min and 8h01min  $\pm$  1h32min on the free days. The prevalence of social jet lag  $< 1$  hour was 34.3%, 52.3% exhibited social jet lag between 1 and 2 hours, and 13.4% had social jet lag  $> 2$  hours. The average social jet lag of the participants was 1h21min  $\pm$  00h55min.

The average commute time for students who live in the city of the institution was 00:08  $\pm$  00:39 minutes, while those

who commute daily had an average time of 1:04  $\pm$  00:39 minutes.

Regarding the sample characterization, 52.3% of the students are from the economic classification C and have a lower level of knowledge about sleep (52.3%), and 42.5% had irregular class start times. Most students do not work (91.6%), are female (73.2%), under 25 years old (90.6%), with an average of 21 years (Table 1). Regarding

**Table 1** Descriptive Analysis of Variables Classified as Social and Biological Factors. Santa Cruz/ RN. Brazil, 2021

Social and Biological Factors	N	%
Socioeconomic class		
Class A	11	3.7
Class B	95	31.9
Class C	156	52.3
Class D e E	36	12.1
Work		
No	273	91.6
Yes	25	8.4
Knowledge about sleep		
$\leq 13$ hits	156	52.3
$\geq 14$ hits	142	47.7
Start time of classes		
Irregular schedules	124	42.5
Between 7:00 am to 7:49 am	57	19.5
Between 7:50 to 8:55h am	110	37.7
Daily commute		
No	281	94.6
Yes	16	5.4
Perception of sleeping place		
Good	274	91.9
Poor	24	8.1
Sex		
Male	80	26.8
Female	218	73.2
Health problem in the previous month		
No	169	56.7
Yes	129	43.3
Age		
$\leq 25$ years	270	90.6
$> 25$ years	28	9.4
Sleep duration in the week		
$\leq 6$ hours	128	43.0
$> 6$ hours	170	57.0
Sleep duration in the weekend		
$\leq 6$ hours	23	7.7
$> 6$ hours	275	92.3
Social Jet lag		
$< 1$ hour	102	34.3
1 to 2 hours	156	52.3
$> 2$ hours	40	13.4

life habits, 52% of the students reported performing physical activity, not smoking (98%), not consuming stimulating drinks (80.5%) and alcoholic drinks (93.6%). However, they use electronics before bed during the week (76.2%) and on the weekend (86.9%) (Table 2).

The predictive variables for social jet lag were: Leisure activities in the weekend ( $B = 23.24$ ; 95% CI 11.52 to 34.95), academic demand before bedtime in the weekend ( $B = 19.51$ ; 95% CI 8.09 to 30.92), household chores before bedtime in the week ( $B = 17.61$ ; 95% CI 4.32 to 30.89), and consuming stimulant drinks ( $B = -15.17$ ; 95% CI  $-28.67$  to  $-1.77$ ).

**Table 2** Descriptive Analysis of Behavioral Factors. Santa Cruz/RN. Brazil. 2021

Behavioral Factors		
	Yes	No
Physical activity	155 (52%)	143 (48%)
Behavioral factors related to bedtime	Yes	No
Being a smoker	6 (2%)	292(98%)
Consume stimulating drinks	58(19.5%)	240(80.5%)
Consume alcoholic beverages	19 (6.4%)	279(93.6%)
Eat inadequate food	107(35.9%)	191(64.1%)
Academic demand		
Week	227(76.2%)	71 (23.8%)
Weekend	207(69.5%)	91 (30.5%)
Use electronic devices		
Week	277(76.2%)	71 (23.8%)
Weekend	259(86.9%)	39 (13.1%)
Leisure activities		
Week	80 (26.8%)	218(73.2%)
Weekend	85 (28.5%)	213(71.5%)
Household chores		
Week	62 (20.8%)	236(79.2%)
Weekend	226(75.8%)	72 (24.2%)
Behavioral factors related to wake up time	Yes	No
Academic demand		
Week	250(83.9%)	48 (16.1%)
Weekend	69 (23.2%)	229(76.8%)
Household chores		
Week	61 (20.5%)	237(79.5%)
Weekend	93 (31.2%)	205(68.8%)
Recreational and religious activities		
Week	43(14.4%)	255(85.6%)
Weekend	88(29.5%)	210(70.5%)

Only the consumption of stimulant drinks was associated with a decrease in social jet lag (Table 3).

According to the multiple regression chronotype ( $B = -0.56$ ; 95% CI:  $-0.65$  to  $-0.47$ ), male sex ( $B = -26.51$ ; 95% CI:  $-44.36$  to  $-8.67$ ), do leisure activities before bedtime in the weekend ( $B = -27.63$ ; 95% CI:  $-45.29$  to  $-9.97$ ), poor perception about sleeping place ( $B = -43.02$ ; 95% CI:  $-72.05$  to  $-13.99$ ), and daily commute ( $B = -68.97$ ; 95% CI:  $-104.13$  to  $-33.82$ ) are predictors of shorter sleep duration during the week. The predictor variables for shorter sleep duration in the the weekend were: male ( $B = -36.36$ ; 95% CI:  $-57.97$  to  $-14.76$ ); poor perception about sleeping place ( $B = -58.15$ ; 95% CI  $-93.77$  to  $-22.53$ ); have recreational and religious activities upon waking up ( $B = -31.11$ ; 95% CI  $-58.64$  to  $-3.58$ ); doing leisure activities before bedtime in the weekend ( $B = -25.10$ ; 95% CI  $-46.44$  to  $-3.76$ ) and academic demand before bedtime ( $B = -23.60$ ; 95% CI  $-44.23$  to  $-2.97$ ) (Table 4). Chronotype ( $B = 0.25$ ; 95% CI 0.13 to 0.36) was associated with longer sleep duration in the weekend (Table 4).

## Discussion

The prevalence of shorter sleep duration ( $< 6:00$  h) on study days (43%) compared to sleep duration on free days (7.7%) and social jet lag greater than 1h (65%) are findings which corroborate other studies in university students.<sup>17,50–53</sup> This, added to the average increase of 1h21min in sleep duration on free days may indicate that these students have partial sleep deprivation on study days and seek to compensate for the sleep deprivation on free days. The students of this study are from cities in the countryside which present a lower degree of urbanization and even so, they presented similar prevalence of sleep deprivation and social jet lag to a study carried out in a context of greater urbanization.<sup>17,53</sup> Thus, a need for public policies which aim to reduce sleep problems in university students stands out, regardless of the urbanization context.

In the present study, it was not observed an association between sleep parameters and knowledge level about sleep and socioeconomic classification. However, 52.3% of students scored less than 13 correct answers out of a total of 20 statements. It is noteworthy that the lack of knowledge about sleep hygiene is associated with a practice of inappropriate habits close to bedtime,<sup>54</sup> which may have contributed to the university students present behaviors which impact sleep. We emphasize that the level of knowledge about sleep encompasses broader characteristics of access



**Table 3** Multiple Linear Regression Analysis of Variables Associated with Social Jet Lag in University Students. Santa Cruz/RN. Brazil, 2021

Model I – Outcome: Social Jet Lag (Minutes)	B <sup>a</sup>	t	p	IC 95% <sup>b</sup>
Variables				
Leisure activities in the weekend	23.24	3.90	0.001*	11.52 to 34.95
Academic demand before bedtime in the weekend	19.51	3.36	0.001*	8.09 to 30.92
Household chores before bedtime in the week	17.61	2.60	0.010*	4.32 to 30.89
Consuming stimulant drinks	-15.17	-2.21	0.028*	-28.67 to -1.67

**Notes:** Parameters of Multiple regression – Social Jet lag (Constant of model B = 47.45; F= 10.96; p<0.001; R<sup>2</sup>=0.126) <sup>a</sup>Unstandardized Coefficients <sup>b</sup>Confidence Interval. \*p-value <0.05. Social Jet lag was expressed in minutes.

**Table 4** Multiple Linear Regression Analysis of Variables Associated with Duration of Sleep in the Week and in the Weekend in University Students. Santa Cruz/RN. Brazil, 2021

Variables	B <sup>a</sup>	t <sup>b</sup>	p	IC 95%
Model II - Outcome: Duration of sleep in the week (minutes)				
Male (sex)	-26.51	-2.92	0.004*	-44.36 to -8.67
Chronotype	-0.56	-11.74	<0.001*	-0.65 to -0.47
Leisure activities before bedtime in the weekend	-27.63	-3.080	0.002*	-45.29 to -9.97
Poor perception about sleeping place	-43.02	-2.917	0.004*	-72.05 to -13.99
Daily Commute	-68.97	-3.86	<0.001*	-104.13 to -33.82
Model III – Outcome: Duration of sleep in the weekend (minutes)				
Male (sex)	-36.36	-3.31	0.001*	-57.97 to -14.76
Chronotype	0.25	4.31	<0.001*	0.13 to 0.36
Poor perception about sleeping place	-58.16	-3.21	0.001*	-93.78 to -22.54
Recreational and religious activities upon waking	-31.11	-2.22	0.027*	-58.65 to -3.58
Leisure activities before bedtime in the weekend	-25.10	-2.32	0.021	-46.44 to -3.76
Academic demand before bedtime	-23.60	-2.25	0.025	-44.23 to -2.97

**Notes:** <sup>a</sup>Unstandardized Coefficients <sup>b</sup>Confidence Interval. \*p-value <0.05. Parameters of Multiple regression - Duration of sleep in the week (Constant of model B = 644.01; F=40.52; p<0.001; R<sup>2</sup>=0.414). Parameters of Multiple regression - Duration of sleep in the weekend (Constant of model B = 402.31; F=9.56; p<0.001; R<sup>2</sup>=0.168).

to information and public educational policies, which was not possible to measure from the assessment used in this study. Furthermore, knowledge of appropriate health practices does not guarantee their application in practice. Therefore, even if students have knowledge about sleep, the characteristics of university life may prevent them from practicing these healthy habits.

The socioeconomic classification was assessed using a nationally valid questionnaire, and even so there was no association with the outcomes. Therefore, the model used in this study remains valid, especially considering that this study is innovative as it was carried out in a different context and population than other works. Furthermore, as it is a study involving numerous behavioral and biological factors, it can be proposed that these factors have a greater impact on individuals' sleep. Regarding the evaluation of the student who also works, it was observed that

a minority of students work, which may have compromised the analysis of this variable and no associations were observed.

In relation to housing conditions, a poor sleep place perception and who daily commute had an overall impact on the shorter sleep duration on school days. It is important to note that adequacy of the sleep environment is part of the recommendations regarding sleep hygiene, which comprises behavioral and environmental practices which aim to promote good sleep quality and adequate duration.<sup>55</sup> In addition, students who daily commute to the university probably had to wake up earlier, since it took more than 1 hour to get to the university, which led to a decrease in their sleep duration during school days in relation to other students. This longer travel time to the institution was associated with waking up earlier and a significant reduction in sleep duration in other studies.<sup>10,11</sup>

This is a new finding, since we have not found reports in the literature so far about how these different housing situations resulting from the context of moving teaching institutions to smaller less urbanized centers can impact students sleep/wake patterns. If on the one hand moving education institutions to less urbanized cities is inclusive and offers more opportunity for students to access, on the other hand it also generates changes in their routines which can impact sleep. Despite the existence of university residences which offer low numbers of places, it is necessary that public policies guarantee access to higher education integrated with a policy of greater support for students.

Regarding biological factors, our hypothesis predicted that women would have shorter sleep duration and more social jet lag compared to men. This idea is based on the literature that points out an influence of external issues such as the double workday associated to the female with shorter sleep duration,<sup>23,52</sup> greater daytime sleepiness,<sup>56</sup> poor sleep quality and greater nighttime awakenings<sup>17</sup> in relation to men.

However, it was found that female students had a longer sleep duration both on study days and on free days when compared to males, which is in line with the scientific literature that assesses the biological need for sleep.<sup>57,58</sup> Thus, the increase in the sleep duration of women compared to men may be related to the fact that our sample is made up of young women, for which the majority do not have children, are not married and do not work, which would not generate a double workday, as observed in other studies of female workers.

Added to biological factors, higher values of chronotype which represents evening tendency was associated with shorter sleep duration on study days and longer sleep duration on free days, as in other studies.<sup>30,32,46</sup> The evening chronotype is predominant in young people, with a greater tendency to accumulate sleep on school days and compensate on free days, resulting in the highest social jet lag.<sup>25,26,30–35</sup> However, in this study, higher values of chronotype were not associated with greater social jet lag.

Although sleep organization, structure and regulation are coordinated by intrinsic biological processes, SWC can also be influenced by behavioral factors.<sup>59</sup> Students who reported doing leisure activities before sleep time on the weekend had a shorter sleep duration on school, study and free days, and greater social jet lag compared to those who did not report doing leisure activities. These activities

performed at night occur under exposure to artificial light. Therefore, considering that light incidence exposure at night causes delay in the SWC on the day of exposure and on the following days,<sup>15,60</sup> it is proposed that these activities carried out during the week are contributing to this result on the weekend. In addition, sleeping later on the weekend may lead to a misalignment of the average sleep point between weekdays and the weekend, resulting in the increase observed in social jet lag with regard to leisure activities.

It is important to note that this study was carried out with university students who live in the countryside and have different habits than students from the capital city. Students in large cities have greater access to leisure activities with 24-hour service availability, among other factors which impact sleep. However, the students in this study live in a municipality in the interior with less urbanization, where leisure options are restricted to some restaurants, bars or cafeterias which do not operate 24 hours a day. In addition, there are no shopping malls or cinemas and local shops close in the early evening.

Although our study shows the negative impact of leisure activities on student sleep/wake patterns, it is important to note that leisure is fundamental for the social interaction of society. Our finding suggests the need to include knowledge which aims to offer individuals an education on sleep hygiene in order to help them use these opportunities so as not to harm their health.

Recreational and religious activities upon waking up during the week were also associated with decreased sleep duration over the weekend. Regular lifestyle habits influence the SWC and early morning exposure can lead to an advance in wake up and bedtime in the following days. Therefore, wake up early in the week to participate in recreational and religious activities may reflect biological oscillators advancing in the weekend and reduced sleep duration. Furthermore, this result may be a reflection of students with characteristics of small sleepers, needing a shorter sleep duration to consider themselves well during the day. However, we did not carry out this assessment, which is a limitation of our study.

It was also observed that students who perform domestic chores before going to sleep during the week presented greater social jet lag when compared to those who do not. The university students in this study attend face-to-face classes during the two-day shifts, which may justify the report of 75.8% of the sample performing household chores before going to sleep. In addition, the majority of

students (87.2%) do not live with their families, thus they are the only ones responsible for domestic tasks which can result in misaligned sleep schedules and explain the increase in social jet lag.

Another behavior associated with shorter sleep duration on free days and greater social jet lag in the students in this study was academic demand on the weekend. The literature demonstrates that high academic demand and extracurricular activities are related to delayed sleep onset and shorter sleep duration on study days.<sup>15,61,62</sup> Therefore, the result observed here demonstrates that this impact also occurs on free days.

The use of stimulating drinks (coffee, black or mate tea, cola or guarana soda) two hours before bedtime in the week was reported by 19.5% of students and was associated with a decrease in social jet lag. Stimulating caffeine-based drinks are responsible for increasing alertness and attention, providing decreased fatigue and drowsiness.<sup>63</sup> Therefore, this habit may have contributed to students increasing alertness and sleeping later in the week and this may have contributed to students presenting more regularity in the SWC due to the natural feature of sleeping later on the weekend.

Thus, the negative impact of consuming these drinks may be offset by physiological mechanisms which can generate regularity and contribute to the average sleep point of these students being similar between the week and the weekend, causing less social jet lag. In addition, this behavior may be influenced by the chronotype, since morning individuals may be using these drinks to stay alert during the night in order to meet academic demands, thus maintaining a similar bedtime and waking time between the weekdays, which relates to lower social jet lag.<sup>26</sup>

Most students had irregular hours (42.5%) regarding the start time of classes. There is a report of a smaller number of students with early start of classes in the morning, which may have contributed to the absence of an association with sleep duration and social jet lag.

As limitations of this study, it can be noted that socioeconomic status was assessed by the ABEP questionnaire, which is related to family living conditions. However, part of our participants who do not commute daily, may have moved to the municipality where the university campus is located to live without family support, thus presenting housing conditions different from the family context. Furthermore, another limitation was the absence of an objective evaluation of sleep parameters by actimetry and light exposure, which would allow a more detailed

assessment of the sleep-wake cycle and a direct evaluation with respect to urbanization.

From the above, it is clear how sleep is part of the general conditions of individuals and that several factors cause negative repercussions in the human body. Thus, it is proposed in this study that there is a greater view of Brazilian public policies regarding the influence of sleep on people's quality of life and health. In addition, this study can help to support discussions in the university context with an emphasis on improving sleep habits based on knowledge about sleep hygiene and the influence that biological factors and behaviors have on the sleep of university students.

## Conclusion

University students from a low urbanized city present social jet lag, shorter sleep duration on school days and longer sleep duration on free days. Shorter sleep duration during the school days and free days was associated a biological, social, and mostly behavioral factors. Higher social jet lag was associated with behaviors performed up to two hours before bedtime and drinking stimulant drinks was associated with lower social jet lag. There was no association of social jet lag with biological and social factors. From these results, it can be inferred that the sleep duration and social jet lag are caused by a multifactorial influence, which may have repercussions on the days when the behaviors are performed and on the following days.

## Abbreviations

SWC, sleep-wake cycle; RN, Rio grande do Norte; UFRN, Federal University of Rio Grande do Norte; FACISA, Faculty of Health Sciences of Trairi; MCTQ, Munich Chronotype Questionnaire; MSF, Midsleep point on free days; MSW, Midsleep point on work/school days.

## Acknowledgments

The authors would like to express thanks to all individuals for their involvement in the study, including university students for their support during data collection. We thank the support from UFRN and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brazil (CAPES) - Funding Code 001.

## Disclosure

The authors declare that there is no conflicts of interest in this work.



## References

1. Brazil. Law nº 10.172, of January 09, 2001. Approves the National Education Plan. Brasília; 2001. Available from [http://www.planalto.gov.br/ccivil\\_03/leis/leis\\_2001/110172.htm](http://www.planalto.gov.br/ccivil_03/leis/leis_2001/110172.htm). Accessed January 6, 2020.
2. Luz A, Castro A, Couto D, Santos L, Pereira A. *Stress and perception academic performance in higher education students. Annals of the X Galician -Portuguese International Congress of Psychopedagogy; 2009.*
3. Luff R, Ellmers T, Eysers I, Young E, Arber S. Time spent in bed at night by care-home residents: choice or compromise? *Ageing Soc.* 2011;31(7):1229–1250. doi:10.1017/S0144686X10001285
4. Roenneberg T, Kumar CJ, Mewro M. The human circadian clock entrains to sun time. *Curr Biol.* 2007;17(2):R44–R45. doi:10.1016/j.cub.2006.12.011
5. Barros MFG. Social determinants of sleep quality of seniors [Master Dissertation]. Minho's University, Portugal: Instituto of Social Sciences (ISC); 2013.
6. Chatzitheochari S, Arber S. Lack of sleep, work and the long hours culture: evidence from the UK Time Use Survey. *Work Employ Soc.* 2009;23(1):30–48. doi:10.1177/0950017008099776
7. Johnson DA, Jackson CL, Williams NJ, Alcántara C. Are sleep patterns influenced by race/ethnicity – a marker of relative advantage or disadvantage? Evidence to date. *Nat Sci Sleep.* 2019;11:79–95. doi:10.2147/NSS.S169312
8. Neubauer DN, Pagel JF, Zee P. Comorbid conditions caused by sleeping disorders. *Med Roundtable Gen Med Ed.* 2016;1(3):222–229.
9. Teixeira L, Lowden A, Moreno CR, et al. Work and excessive sleepiness among Brazilian evening high school students: effects on days off. *Int J Occup Environ Health.* 2010;16(2):172–177. doi:10.1179/oeh.2010.16.2.158
10. Pereira ÉF. *Sleep and daytime sleepiness in high school adolescents. [Doctoral Thesis].* Department of Physical Education; 2011.
11. Tagaya H, Uchiyama M, Ohida T, et al. Sleep habits and factors associated with short sleep duration among Japanese high-school students: a community study. *Sleep Biol Rhythms.* 2004;2:57–64. doi:10.1111/j.1479-8425.2003.00079.x
12. Suehiro ACB. University everyday issues. *Psycho-USF.* 2006;11(1):127–129. doi:10.1590/S1413-82712006000100015
13. Teixeira MAP, Dias ACG, Wottrich SH, Oliveira AM. Adaptation to university among young freshmen students. *School and Educational Psychology.* 2008;12(1):185–202. doi:10.1590/S1413-85572008001000013
14. Crowley SJ, Cain SW, Burns AC, Acebo C, Carskadon MA. Increased sensitivity of the circadian system to light in early/mid-puberty. *J Clin Endocrinol Metab.* 2015;100(11):4067–4073. doi:10.1210/jc.2015-2775
15. Crowley SJ, Wolfson AR, Tarokh L, Carskadon MA. An update on adolescent sleep: new evidence informing the perfect storm model. *J Adolesc.* 2018;67:55–65. doi:10.1016/j.adolescence.2018.06.001
16. Valdez P, Ramirez C, Garcia A. Delaying and extending sleep during weekends: sleep recovery or circadian effect? *J Chronobiol Int.* 1996;13(3):191–198. doi:10.3109/07420529609012652
17. Carone CMM, Silva BDP, Rodrigues LT, Tavares PS, Carpena MX, Santos IS. Factors associated with sleep disorders in university students. *Reports in Public Health.* 2020;36(3):1–16. doi:10.1590/0102-311x00074919
18. Enright T, Refinetti R. Chronotype, class times, and academic achievement of university students. *Chronobiol Int.* 2017;34(4):445–450. doi:10.1080/07420528.2017.1281287
19. Owens JA. Etiologies and evaluation of sleep disturbances in adolescence. *Adolesc Med State Art Rev.* 2010;21(3):430–viii.
20. Hirshkowitz M, Whiton K, Albert SM, et al. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep Health.* 2015;1(1):40–43. doi:10.1016/j.sleh.2014.12.010
21. Carskadon MA, Dement WC. Normal human sleep: an overview. *Principles Pract Sleep Med.* 2011;5:16–26.
22. Ferreira LG. Influence of Social Jet lag on circadian markers of activity-rest and heart rhythms in medical students [Master Dissertation]. Natal/RN: Federal University of Rio Grande do Norte; 2015.
23. Ferreira LRC, Martino MMF. Sleep Patterns and Fatigue of nursing students who work Journal of the School of Nursing of USP. 2012;46(5):1170–1183. doi:10.1590/S0080-62342012000500020
24. Beauvalet JC, Quiles CL, Oliveira MAB, Ilgenfritz CAV, Hidalgo MP, Tonon AC. Social jetlag in health and behavioral research: a systematic review. *Chrono Physiol Ther.* 2017;7:19–31. doi:10.2147/CPT.S108750
25. Roenneberg T, Kantermann T, Juda M, Vetter C, Allebrandt KV. Light and the human circadian clock. *Handb Exp Pharmacol.* 2013;217:311–331.
26. Wittmann M, Dinich J, Mewro M, Roenneberg T. Social jetlag: misalignment of biological and social time. *Chronobiol Int.* 2006;23(1–2):497–509. doi:10.1080/07420520500545979
27. Del Angel J, Cortez J, Juárez D, et al. Effects of sleep reduction on the phonological and visuospatial components of working memory. *Sleep Sci.* 2015;8(2):68–74. doi:10.1016/j.slsi.2015.06.001
28. Minges KE, Redeker NS. Delayed school start times and adolescent sleep: a systematic review of the experimental evidence. *Sleep Med Rev.* 2016;28:86–95. doi:10.1016/j.smrv.2015.06.002
29. Alapin I, Fichten CS, Libman E, Creti L, Bailes S, Wright J. How is good and poor sleep in older adults and college students related to daytime sleepiness, fatigue, and ability to concentrate? *J Psychosom Res.* 2000;49(5):381–390. doi:10.1016/S0022-3999(00)00194-X
30. Duarte LL. Human Chronotypes. Cruz das Almas/BA: UFRB; 2018.
31. Keller LK, Grünewald B, Vetter C, Roenneberg T, Schulte-Körne G. Not later, but longer: sleep, chronotype and light exposure in adolescents with remitted depression compared to healthy controls. *Eur Child Adolesc Psychiatry.* 2017;26(10):1233–1244. doi:10.1007/s00787-017-0977-z
32. Roenneberg T, Wirz-Justice A, Mewro M. Life between clocks: daily temporal patterns of human chronotypes. *J Biol Rhythms.* 2003;18(1):80–90. doi:10.1177/0748730402239679
33. Roenneberg T, Kuehnle T, Pramstaller PP, et al. A marker for the end of adolescence. *Curr Biol.* 2004;14(24):1038–1039. doi:10.1016/j.cub.2004.11.039
34. Roenneberg T, Allebrandt KV, Mewro M, Vetter C. Social jetlag and obesity. *Curr Biol.* 2012;22(64110):939–943. doi:10.1016/j.cub.2012.03.038
35. Roenneberg T, Keller LK, Fischer D, Matera JL, Vetter C, Winnebeck EC. Human activity and rest in situ. *Methods Enzymol.* 2015;552:257–283.
36. Troncoso PC, Amaya PJP. Social factors in feeding behavior of university students. *Chilean Journal of Nutrition.* 2009;36(4):1090–1097.
37. Oliveira CS, Gordiab AP, Campos TM. Physical activity of Brazilian university students: a literature review. *Journal of Health Care.* 2014;12(42):71–77.
38. Tassitano RM, Bezerra J, Tenório MCM, Barros VMG, Hallal PC. Physical activity in Brazilian adolescents: a systematic review. *Brazilian Journal of Cineanthropometry and Human Performance.* 2007;9(1):55–60.
39. Lopes HS, Meier DAP, Rodrigues R. Sleep quality among nursing students and associated factors. *Biological and Health Sciences.* 2018;39(2):129–136.

40. Martinez G, Escãno HC, Sousa MH, Pinto CAL. The influence of ethanol and coffee on medical students' sleep quality. *Journal of medicine (São Paulo)*. 2018;97(3):267–272. doi:10.11606/issn.1679-9836.v97i3p267-272
41. Reissig CJ, Strain EC, Griffiths RR. Caffeinated energy drinks – a growing problem. *Drug Alcohol Depend*. 2009;99(1–3):1–10. doi:10.1016/j.drugalcdep.2008.08.001
42. Chang AM, Aeschbach D, Duffy JF, Czeisler CA. Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proc Natl Acad Sci U S A*. 2015;112(4):1232–1237. doi:10.1073/pnas.1418490112
43. Azevedo CVM, Sousa I, Paul K, et al. Teaching chronobiology and sleep habits in school and university. *Mind Brain Educ*. 2008;2(1):34–47. doi:10.1111/j.1751-228X.2008.00027.x
44. Brazilian Institute of Geography and Statistics. Brazilian Cens of 2010. Rio de Janeiro; 2010. Available from <https://cidades.ibge.gov.br/brasil/rn>. Accessed January 6, 2020.
45. Mathias A, Sanchez RP, Andrade MMM. Encourage proper sleep habits: a challenge for educators. In: Pinho S, Saglietti JJ, editors. UNESP teaching centers. UNESP; 2006:718–731.
46. Jankowski KS. Social jet lag: sleep-corrected formula. *Chronobiol Int*. 2017;34(4):531–535. doi:10.1080/07420528.2017.1299162
47. Roenneberg T, Pils LK, Zerbini G, Winnebeck EC. Chronotype and social jetlag: a (self-) critical review. *Biology (Basel)*. 2019;8(3):54.
48. Greenland S, Pearce N. Statistical foundations for model-based adjustments. *Annu Rev Public Health*. 2015;36(1):89–108. doi:10.1146/annurev-publhealth-031914-122559
49. Greenland S, Daniel R, Pearce N. Outcome modelling strategies in epidemiology: traditional methods and basic alternatives. *Int J Epidemiol*. 2016;45(2):565–575. doi:10.1093/ije/dyw040
50. Araújo MFM, Lima ACS, Alencar AM, Araújo TM, Fragoso LVC, Damasceno MMC. Sleep quality assessment in college students from fortaleza-ce. *Text Context Nurs*. 2009;22(2):352–360. doi:10.1590/S0104-07072013000200011
51. Danda GJN, Ferreira GR, Azenha M, Souza KFR, Bastos O. Sleep-wake cycle patterns and excessive daytime sleepiness in medical students. *Brazilian Journal of Psychiatry*. 2005;54(2):102–106.
52. Lima PF, Araujo JF, Araujo JF. Sleep-wake pattern of medical students: early versus late class starting time. *Braz J Med Biol Res*. 2002;35(11):1373–1377. doi:10.1590/S0100-879X2002001100016
53. Nafital AC. Influence of the temporal allocation of sleep in the nights prior to assessments on academic performance in medical students at the Federal University of Rio Grande Do Norte. [Doctoral Thesis]. Natal/RN: Universidade Federal Do Rio Grande Do Norte; 2020.
54. Souza JC, Galina SD, Sousa IC, Azevedo CVM. Effect of a sleep education program on sleep knowledge and habits in elementary and high school teachers. *Estudos de Psicologia*. 2016;21(4):369–380. doi:10.5935/1678-4669.20160036
55. Almondes KM, Leonardo MEM, Moreira AMS. Effects of a cognitive training program and sleep hygiene for executive functions and sleep quality in healthy elderly. *Dement Neuropsychol*. 2017;11(1):69–78. doi:10.1590/1980-57642016dn11-010011
56. Ciampo LA, Del Louro AL, Ciampo IRL, Ferraz IS. Characteristics of sleep habits among adolescents living in the city of Ribeirão Preto (SP). *J Human Growth Dev*. 2017;27(3):307–314.
57. Ramalho MC. Sleep characteristics in adolescents: relationship to components risk factors of the pathobiological determinants of atherosclerosis score in youth. [Master in Public Health]. Campina Grande/PB: State University of Paraíba; 2015.
58. Tonetti L, Natale V, Randler C. Association between circadian preference and academic achievement: a systematic review and meta-analysis. *Chronobiol Int*. 2015;32(6):792–801. doi:10.3109/07420528.2015.1049271
59. Felden ÉPG, Filipin D, Barbosa DG, Andrade RD, Meyer C, Louzada FM. Factors associated with short sleep duration in adolescents. *Rev Paul Pediatr*. 2016;34(1):64–70. doi:10.1016/j.rpped.2015.05.006
60. Chellappa SL, Steiner R, Blattner P, Oelhafen P, Götz T, Cajochen C. Non-visual effects of light on melatonin, alertness and cognitive performance: can blue-enriched light keep us alert? *PLoS One*. 2011;6(1):e16429. doi:10.1371/journal.pone.0016429
61. Araújo DF, Almondes KM. Sleep quality and its relationship with academic performance in college students of different shifts. *Psycho*. 2012;43(3):350–359.
62. Wadeley A. Sleep and academic performance: how should you approach your coursework? *Psychol Rev*. 2002;9(1):20–23.
63. Souza RAG, Sichieri R. Caffeine intake and food sources of caffeine and prematurity: a case-control study. Reports in Public Health. 2005;21(6):1919–1928. doi:10.1590/S0102-311X2005000600042

## Journal of Multidisciplinary Healthcare

Dovepress

### Publish your work in this journal

The Journal of Multidisciplinary Healthcare is an international, peer-reviewed open-access journal that aims to represent and publish research in healthcare areas delivered by practitioners of different disciplines. This includes studies and reviews conducted by multidisciplinary teams as well as research which evaluates the results or conduct of such teams or healthcare processes in general. The journal

covers a very wide range of areas and welcomes submissions from practitioners at all levels, from all over the world. The manuscript management system is completely online and includes a very quick and fair peer-review system. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/journal-of-inflammation-research-journal>