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Sleep Quality and Social Jetlag in Young Adults During the Social Distancing Caused by COVID-19

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Abstract

Introduction: This study aimed to evaluate the sleep quality and the Social Jetlag frequency in young adults during social distancing because of COVID-19.
Methods: This is a cross-sectional study with 308 students aged ≥18 years and with Internet access. Questionnaires used: Pittsburgh Sleep Quality Index – Brazil (PSQI-BR), Epworth Sleepiness Scale, and Munich Chronotype Questionnaire.
Results: The mean age of the students was 21 ± 3 years (17 - 42y), with no statistically significant difference between genders. The PSQI-BR indicated that 257 (83.4%) had poor sleep quality. The mean of Social Jetlag for young adults was 02:00 ± 01:49h, and we observed that 16.6% (n = 51) had Social Jetlag. Compared to men in the good sleep quality group, women had higher means for sleep duration on study days and free days, mid-point of sleep on study days and free days and corrected mid-point of sleep on free days. However, when compared to men in the group of poor sleep quality, we observed higher means for women regarding sleep duration on study days, the mid-point of sleep on study days, and the corrected mid-point of sleep on free days.
Conclusions: Thus, the high frequency of young adult students who had poor sleep quality associated with Social Jetlag (2 hours) in the present study may reflect a pattern of sleep irregularity, which may be associated with impairment of environmental synchronizers and stimulation of social synchronizers during the lockdown resulting from the COVID-19 pandemic.

Keywords
- Sleep
- Sleep quality
- Social Jetlag
- Young Adults
- COVID-19
- Social Distancing

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Introduction

The confinement imposed on the population by the social distancing measures related to the COVID-19 pandemic has resulted in profound changes in people's routines and habits.[1] As a relevant consequence of this complex scenario, there were changes in some biological rhythms, particularly on sleep and wakefulness. Those changes compromised sleep quality and quantity as putative mechanisms for changes in sleep patterns and sleep disorders[1.]

Based on such considerations, some studies evaluated symptoms of sleep quality in young adult populations.[2,3] The Pittsburgh Sleep Quality Index[4] was applied to assess sleep quality and its associations with demographic and occupational characteristics in these surveys. Studies confirmed the interference of home confinement in the worsening of the sleep quality.[5]

When assessing the quality of sleep in the Chinese public during the outbreak of COVID-19, Huang et al.[2] observed that almost 1/5 of the participants experienced sleep problems and depressive symptoms, indicating that the uncertainty of the epidemic progression would cause more significant psychological pressure on the population. In this pandemic context, one change in the established sleep-wake cycle was a trend for people to present irregular sleep patterns in the absence of appropriate synchronizers (such as in-person work schedules), with a tendency to increasingly late schedules.[6] This phenomenon, discussed since 2006 by Dr. Till Roenneberg,[7] is called Social Jetlag, and represents the discrepancy or misalignment between the sleep on weekdays and free days (without external requirements, such as work or school schedules) and individual sleep preferences. This condition usually occurs because social impositions of work and schedules often influence sleep on weekdays.[8]

In general, the young adult may have endogenous periods somehow longer than the 24-hour light/dark cycle[9]; thus, they are more prone to delay their sleep/wake pattern in the absence of exposure to a zeitgeber (for example, during weekends). On weekdays, however, they can be forced to wake up early because of social zeitgebers such as school or university schedules, leading to a discrepancy between weekday and weekend sleep in terms of time and duration. Hence, young people with an evening chronotype (chronobiological preference for allocation of sleep onset and offset patterns at later times) would have greater Social Jetlag.[7] In addition, research has suggested that this phenomenon can be an important predictor of the Delayed Sleep-Wake Phase Disorder (the sleep-wake pattern is significantly delayed concerning external demands), resulting in an inability to fall asleep and difficulty waking up at socially acceptable times.[10,11] Besides, Social Jetlag has been associated with a negative impact on daytime functioning, especially causing sleepiness, physiological, neurocognitive, and neurobehavioral changes in healthy individuals.[10,11]

Young adults also may present with some degree of impairment regarding their sleep patterns due to phase delay, inadequate sleep habits, and irregular sleep routines. The average need for sleep has been oscillated between 09h and 09h30min. On the other hand, during the period of social isolation and lockdown imposed by the COVID-19 pandemic was observed an improvement of sleep duration on weekdays and a decreased Social Jetlag, despite chronotype being significantly delayed. A plausible explanation was attributed to changes in lifestyle associated with weaker social cues. Those cues, as school schedules, became more flexible, delayed or even absent, together with lower light exposure in the morning.[12] Genta et al.[13] found delayed bedtime and wake up time among adolescents, social jet lag reduced, shifted chronotype toward eveningness, but sleep duration increased, and sleep quality improved only among students who were more sleep deprived before the pandemic. In addition, during the home confinement, it was observed increased use of electronic devices associated with decreased sleep quality, insomnia symptoms, reduced sleep duration, prolonged sleep onset latency and bedtime and later wake up times.

Some studies looking for the overall impact of the lockdown on sleep observed an 18.2% prevalence of poor sleep quality as assessed by the Pittsburgh Sleep Quality Index (PSQI), while Zhao et al.[14] found a 37% prevalence, almost double that of the previous study, and Bigalke et al.[15] noted that 66% of the study population rated their sleep as "very poor." This frequency diverges, despite using the same assessment instrument. Therefore, this work aimed to evaluate the sleep quality and the Social Jetlag frequency in young adults during social distancing due to COVID-19. The results make it possible to observe the intricacy behind sleep quality and the relevance of identifying its subjectivity in the young adult Brazilian population facing this confinement to verify these people's sleep behavior. Our main hypothesis is that such changes during social isolation and online classes may have caused changes in the sleep-wake cycle and a worsening in sleep quality resulting in larger Social Jetlag, shorter weekday sleep, longer weekend sleep, and more day-to-day variation in sleep.

Material and Methods

This was a cross-section type study, with a non-probabilistic sampling method (Snowball type). Participants: young adults (academic students) regularly enrolled in 2020 at the Bahiana School of Medicine and Public Health (EBMSP), experiencing social distancing during the COVID-19 pandemic and having online classes starting at 07-08 a.m., were invited to participate in the survey. All students had classes in the morning and afternoon shifts. The term "regularly enrolled" refers to students who were taking the course, as some students were unable to continue their studies due to the COVID-19 pandemic. For the sample size calculation, the WINPEPI program was used, with the following parameters: 95% confidence interval and 30% prevalence of sleep disorders in the general population. The sample was calculated based on a population of 1,000 students regularly enrolled at EBMSP, with an acceptable difference in the prevalence of 7%. Therefore, assuming a 10% loss, the sample size was calculated in 181 young adults; considering a 10% loss, there were

199 young adults. In this period of social isolation, classes became online. The following inclusion criteria were adopted: students aged 18 or over, regularly enrolled in the current semester and having internet access to answer the questionnaires. Exclusion Criteria: students who left their home for more than 07 hours a week from June 5 to June 23, 2020 (governmental established lockdown period in Salvador-Bahia-Brazil according to Decrees 32461 and 32610) of social distancing due to COVID-19 and those who answered the questionnaires incompletely. We considered two groups: one, when the individual respected the lockdown (did not leave home); and the other, when the individual did not respect the lockdown.

Assessment tools

Questionnaires referring to the general characteristics of the sample were used: age, gender, color, marital status, how many people live with, family income (according to the number of minimum wage), use of drugs and/or sleep-inducing medication, besides the weekly hours of leaving home from June 5 to June 23, 2020, to evaluate the level of social distancing the students were exposed. The Pittsburgh Sleep Quality Index - Brazil (PSQI-BR)[4]: subjectively assessed the sleep quality in the last 30 days, consisting of questions subdivided into constructs, whereby the sum of the values obtained in each construct results in an overall score of PSQI-BR. Scores from 0 to 5 indicate good sleep quality; and over 5 points reveal poor sleep quality.[10,11,14,16,17] Thus, the stratification was carried out into two groups: good sleep quality and poor sleep quality. The Epworth Sleepiness Scale - Brazil (ESS)[18]: this scale comprises eight questions evaluating the possibility of daytime sleepiness in everyday situations. The final score varies from 0 to 24 points, adopting $\geq$ 10 as the cut-off point for excessive daytime sleepiness. The Munich Chronotype Questionnaire - Brazil (MCTQ): this questionnaire compares sleep habits on free days and on days of social commitments, such as work or school, which would be determinants for the wake-up time. The comparison between the mid-sleep phase of both situations provides the measure of Social Jetlag. In order to calculate the corrected mid-point of sleep on free days, the following formula[16] was used: MSFsc= MSF-0.5*(SDf-(5*SDw + 2*SDf)/7, in which MSFsc is the corrected mid-point of sleep on free days; MSF is the mid-point of sleep on free days without correction; SDw is the sleep duration on study days; SDf is the sleep duration on free days. This questionnaire allows the sleep assessment on weekdays, as well as on free days (weekends[19–23]). Furthermore, the MCTQ was used to assess chronotype and sleep duration. The Social Jetlag (SJLsc)[24] was calculated in hours by the difference between sleep onset on free days and sleep onset on study days using the following formula: SJLsc = sleep onset on free days – sleep onset on study days. Individuals with over 02 h difference in the mid-point of sleep between weekend and weekdays were identified as having social jet lag.[25]

Protocol for data collection

The questionnaires were sent through the Google Forms platform by e-mail from July 7 to 21, 2020 (without the flexibility of quarantine) after obtaining the e-mails of students regularly enrolled at EBMSP. All participants were informed about the survey's objectives and procedures, and they accepted the informed consent form (TCLE) virtually. After they declared that they had read and agreed with the TCLE, they had access to the online survey links to be answered.

The survey was approved by CEP/EBMSP- CAAE: 33549620.6.0000.5544. Therefore, it followed the guidelines of the Declaration of Helsinki of 1989 and the Resolution 466/12 on research involving human beings of the National Health Council (CNS).

Statistical analysis

Statistical Package for the Social Sciences (SPSS) version 14.0 for Windows was used for data tabulation and analysis. Quantitative variables were expressed as mean $\pm$ standard deviation or median and interquartile range (IQR). The qualitative variables were expressed through simple and relative frequencies. For numerical variables, depending on the data distribution, Student's t test or Mann-Whitney test was used for inter-group associations, and paired Student's t test or Wilcoxon test for intra-group associations. For effect size measurement purposes, Cohen's d was used for data with normal distribution and the r value according to the formula ($r = z$ / square root of N in which N = total number of cases) for data with non-normal distribution. The Chi-square test was used for the categorical variables and Cramer's V was calculated to indicate the effect size. The significance level $p < 0.05$ was considered.

Results

Three hundred and eight (308) young adults participated in the study, of whom 11 (3.6%) tested positive for SARS-CoV-2. The students' age ranged from 18 to 22 years, with a mean of 21 $\pm$ 3 years (17–42y), with no statistically significant difference between genders (p= 0.885). The median hours that young adults left home in the last 30 days was 02 (01 - 05) h. None of them left home more than 7 hours per week. The PSQI-BR indicated that among the 308 young adults, 51 (16.6%) had good sleep quality, 257 (83.4%) had poor sleep quality. According to the sleep quality, the general characteristics of the sample are described in ►**Table 1**. There was no difference between the good sleep and poor sleep quality groups in the number of hours per week left home during social isolation: 02 (01 - 03) h *vs* 02 (01 - 05)h, respectively. There was also no difference between the groups good sleep and poor sleep quality regarding the number of people with whom they live in the same house or apartment, presenting the following minimum and maximum values: (0 and 5 *vs* 0 and 6), respectively. ►**Table 2** presents the characteristics derived from the MCTQ according to the young adults' sleep quality during the social distancing because of COVID-19. The percentage of females with poor sleep quality was 82% (n = 174) and that of males was 84.6% (n = 83). ►**Tables 3A** and **3B** show the differences between female and male about characteristics derived from the MCTQ according to young adults' sleep quality. ►**Tables 4A** and **4B** indicate differences in the questions derived from the MCTQ according to the

Table 1 General characteristics, Epworth Scale and Pittsburgh Sleep Quality Index of the sample according to the young adults' sleep quality during the social distancing due to COVID-19.

Variable		Good Sleep Quality	Poor Sleep Quality	*p value*	Effect Size
		(n = 51)	(n = 257)		
Age (years)		21.9 ± 4.1	21.0 ± 2.9	0.090+	0.12
Gender	Female	36 (70.6%)	174 (67.7%)	0.696†	0.02
	Male	15 (29.4%)	83 (32.3%)		
Family income (dollars)		12 (08–20)	10 (07–16)	**0.026**‡	0.13
Single marital status		51 (100%)	253 (98.4%)	0.669†	0.04
Epworth scale		5.0 ± 3.2	7.4 ± 3.7	<**0.001**+	0.32
Pittsburgh Sleep Quality Index		2.9 ± 1.0	6.1 ± 2.7	<**0.001**+	0.62

+Student's t-test.
†Chi-square test.
‡Mann-Whitney test.

young adults' good or poor sleep quality comparing weekdays with weekends.In both groups (good and poor sleepers), the biggest difference is found in the time of waking up, with high effect size, followed by the time the individual decide to go to sleep, with medium effect size.

►**Tables 5A**, **5B**, **6A** and **6B** show differences in almost all questions characteristics derived from the MCTQ according to the female and male young adults' good and poor sleep quality comparing weekdays with weekends. Similarly, in all groups, the highest effects were found on the question regarding the time to wake up, followed by the time the individual decides to go to sleep.

The median SJLsc for young adults was 02:00 ± 01:49h, and we observed that 16.6% (n = 51) had Social Jetlag. The SJLsc value was similar between groups with good sleep quality and poor sleep quality. As well as the SJLsc value was similar between groups that did or did not respect social distancing during the COVID-19 pandemic. There was no statistically significant difference in the SJLsc when comparing subjects according to gender, either in those who had good sleep quality or in those who had poor sleep quality.

When comparing adults who did not respect during the period of social isolation with those who did, we observed that there was no difference regarding the PSQI-BR [7 (5 - 9) *vs* 7 (5 - 9); p= 0.409] and the ESS-BR [7 (4 - 10) *vs* 7 (4 - 10); p = 0.509]. As for the assessment through the MCTQ, there was no difference in the value of the corrected mid-point of sleep on free days between the groups (4:20 ± 00:59 *vs*

Table 2 Characteristics derived from the Munich Chronotype Questionnaire according to the young adults' sleep quality during the social distancing due to COVID-19.

Variable	Good Sleep Quality	Poor Sleep Quality	p value‡	Effect Size
	(n = 51)	(n = 257)		
I go to bed at __: __ h*	23:00 (22:30–23:50)	23:30 (23:00–00:00)	**0.036**	0.12
I decide to sleep at __: __ h*	23:20 (22:45–01:00)	00:00 (23:30–01:00)	0.131	0.09
I need __ minutes to fall asleep*	10 (05–10)	20 (10–35)	<**0.001**	0.43
I woke up on time without alarm*	39 (76.5%)	213 (82.9%)	0.279	0.06
I wake up at __ h*	07:30 (07:00–08:00)	07:30 (07:00–08:00)	0.629	0.03
After __ minutes I get up*	05 (05 - 10)	10 (05 - 20)	**0.032**	0.12
I go to bed at __: __ h**	00:30 (00:00–02:00)	00:00 (23:00–01:30)	0.575	0.03
I decide to sleep at __: __ h**	02:00 (00:30–23:00)	01:30 (01:00–03:00)	0.109	0.09
I need __ minutes to fall asleep**	10 (05 - 10)	20 (10 - 30)	<**0.001**	0.39
I woke up on time without alarm clock**	41 (80.4%)	213 (82.9%)	0.670	0.02
I wake up at __ h**	09:10 (08:45–10:00)	10:00 (08:30–11:00)	**0.026**	0.13
After __ minutes I get up**	10 (05–20)	20 (10–30)	<**0.001**	0.20

*Weekdays.
**Weekends.
‡Mann-Whitney test.

Table 3A Characteristics derived from the Munich Chronotype Questionnaire according to the female and male young adults' good sleep quality during the social distancing due to COVID-19.

Variable	Good Sleep Quality (n = 51)		p value†	Effect Size
	Female (n = 36)	Male (n = 15)		
I go to bed at __: __ h*	23:00 (22:30–23:30)	23:30 (22:00–00:30)	0.685	0.06
I decide to sleep at __: __ h*	23:00 (22:45–00:00)	23:40 (22:30–00:30)	0.655	0.06
I need __ minutes to fall asleep*	10 (05–10)	10 (05–10)	0.405	0.12
I wake up at __ h*	07:00 (07:00–08:00)	07:00 (06:30–08:00)	**0.048**	0.28
After __ minutes I get up*	05 (05 - 15)	05 (03 - 10)	0.766	0.04
I go to bed at __: __ h**	00:37 (00:00–02:00)	00:00 (23:00–01:00)	0.223	0.17
I decide to sleep at __: __ h**	00:00 (23:20–01:16)	00:30 (23:10–01:40)	0.149	0.08
I need __ minutes to fall asleep**	10 (05 - 10)	05 (02 - 10)	0.136	0.21
I wake up at __ h**	09:30 (09:00–10:00)	08:45 (07:30–10:00)	0.059	0.26
After __ minutes I get up**	10 (05–20)	10 (05–20)	0.891	0.02

*Weekdays.
** Weekends.
†Mann-Whitney test.

Table 3B Characteristics derived from the Munich Chronotype Questionnaire according to the female and male young adults' poor sleep quality during the social distancing due to Covid-19.

Variable	Poor Sleep Quality (n = 257)		p value†	Effect Size
	Female (n = 174)	Male (n = 83)		
I go to bed at __: __ h*	23:05 (22:30–00:00)	00:00 (23:00–01:00)	**0.009**	0.16
I decide to sleep at __: __ h*	00:00 (23:00–01:00)	00:10 (23:45–01:30)	**0.003**	0.19
I need __ minutes to fall asleep*	20 (10 - 40)	20 (10 - 30)	0.408	0,05
I wake up at __ h*	7:30 (7:00–8:00)	7:30 (7:00–8:00)	0.484	0,04
After __ minutes I get up*	10 (05 - 20)	10 (01 - 15)	<**0.001**	0.22
I go to bed at __: __ h**	00:00 (23:00–01:30)	00:00 (23:00–01:30)	0.811	0.01
I decide to sleep at __: __ h**	01:00 (00:00–02:00)	01:30 (01:00–02:40)	**0.001**	0.22
I need __ minutes to fall asleep**	20 (10 - 30)	20 (10 - 30)	0.467	0.05
I wake up at __ h**	10:00 (8:30–11:00)	10:00 (9:00–11:30)	0.178	0.08
After __ minutes I get up**	20(10–30)	15 (10–30)	**0.007**	0.17

*Weekdays.
** Weekends.
†Mann-Whitney test.

4:12 ± 00:59; p = 0.377), as well as the value of the Social Jetlag [00 (0.30 - 01:00) vs 00:00 (00:30 - 01:00; p = 0.198)], for the group that respected social isolation and those that did not, respectively. ►**Tables 7A** and **7B** demonstrate characteristics derived from the MCTQ in females and males according to good or poor sleep quality. Among good sleepers, all questions showed significant differences, with medium effect sizes. Among poor sleepers, three questions showed significant differences, but with negligible effect sizes.

Discussion

Our main hypothesis was that changes during social isolation and online classes may have caused changes in the sleep-wake cycle and a worsening in sleep quality; in such a way, with the present study we observed that 257 (83.4%) students had poor sleep quality. In addition, research has shown that students whose classes start between 07 a.m. and 08 a.m. tend to have worse sleep quality.[26] Huang et al,[2] when comparing healthcare professionals with other occupational groups, observed that the former reported the highest rate of poor sleep quality (23.6%). Cellini et al.[3] observed through the PSQI that changes in sleep habits occurred during the lockdown in Italy. The proportion of people with poor sleep increased from 40.5% to 52.4%, and the participants went to bed later. On average, bedtime was delayed by approximately 41 minutes. Bigalke et al.,[15] when studying 103 individuals, observed that most participants (56.3%) reported decreased/worsening in sleep quality, where 66% classified

Table 4A Characteristics derived from the Munich Chronotype Questionnaire according to the young adults' good sleep quality comparing weekdays with weekends during the social distancing due to COVID-19.

Variable	Good Sleep Quality (n = 51)		p value	Effect Size
	Weekdays	Weekends		
I go to bed at __: __ h	23:00 (22:30–23:50)	00:30 (00:00–02:00)	<**0.001**[†]	0.60
I decide to sleep at __: __ h	23:20 (22:45–00:10)	00:00 (23:20–01:30)	<**0.001**[†]	0.70
I need __ minutes to fall asleep	10 (05–10)	10 (05 - 10)	0.733[†]	0.10
I woke up on time without alarm clock	29 (56.9%)	12 (23.5%)	0.050[‡]	0.34
I wake up at __ h	07:30 (07:00–08:00)	09:10 (08:45–10:00)	<**0.001**[†]	0.83
After __ minutes I get up	05 (05 - 10)	10 (05–20)	**0.001**[†]	0.47

[†]Wilcoxon test for intra-group.
[‡]Chi-square test.

Table 4B Characteristics derived from the Munich Chronotype Questionnaire according to the young adults' good sleep quality comparing weekdays with weekends during the social distancing due to COVID-19.

Variable	Poor Sleep Quality (n = 257)		p value	Effect Size
	Weekdays	Weekends		
I go to bed at __: __ h	23:30 (23:00–00:00)	00:00 (23:00–01:30)	<**0.001**[†]	0.34
I decide to sleep at __: __ h	00:00 (23:30–01:00)	01:00 (00:00–02:00)	<**0.001**[†]	0.72
I need __ minutes to fall asleep	20 (10–35)	20 (10 - 30)	**0.002**[†]	0.19
I woke up on time without alarm clock	169 (65.8%)	44 (17.1%)	<**0.001**[‡]	0.49
I wake up at __ h	7:30 (7:00–8:00)	10:00 (08:30–11:00)	<**0.001**[†]	0.82
After __ minutes I get up	10 (05 - 20)	20 (10–30)	<**0.001**[†]	0.51

[†]Wilcoxon test for intra-group.
[‡]Chi-square test.

sleep quality as "poor sleep", while 47.6% reported signs of insomnia. Thus, we observed that 68.5% of young adults considered sleep quality as poor, even during social isolation (students who left home more than 7 hours a week from July 5 to July 23, 2020). Cellini et al.[3] found that in the second week of confinement in Italy, sleep-wake rhythms changed considerably, with people going to bed and waking up later and spending more time in bed, but paradoxically also reporting lower sleep quality. Decreased sleep quality was more severe for people with a higher level of depression, anxiety, and stress symptomatology and also associated with a greater sense of time expansion.[3,27,28] Other factors associated with poor sleep quality are pre-existing insomnia, not exercising, excessive use of electronic devices, negative attitude towards COVID-19 control measures, higher education level, family burden, low social capital, COVID-19 related worries[27,29–31]

This circumstance suggests that we should investigate whether the reduction in total sleep time during the weekdays could be associated with class schedules since studies have shown that classes starting between 7-8 hours in the morning may imply a reduction in total sleep time during the week.[26,32] These results corroborate with Blume et al.,[33] who observed that the overall sleep quality decreased slightly

Table 5A Characteristics derived from the Munich Chronotype Questionnaire according to female young adults' good sleep quality comparing weekdays with weekends during the social distancing due to COVID-19.

Variable	Good Sleep Quality - Female Group (n = 36)		p value[†]	Effect Size
	Weekdays	Weekends		
I go to bed at __: __ h	23:00 (22:30 - 23:30)	00:37 (00:00 - 02:00)	<**0.001**	0.66
I decide to sleep at __: __ h	23:00 (22:45 - 00:00)	00:00 (23:20 - 01:16)	<**0.001**	0.69
I need __ minutes to fall asleep	10 (05 -10)	10 (05 - 10)	0.705	0.06
I wake up at __ h	07:30 (07:00 - 08:00)	09:30 (09:00 - 10:00)	<**0.001**	0.84
After __ minutes I get up	05 (05 - 15)	10 (05 - 20)	**0.001**	0.54

[†]Wilcoxon test for intra-group.

Table 5B Characteristics derived from the Munich Chronotype Questionnaire according to male young adults' good sleep quality comparing weekdays with weekends during the social distancing due to COVID-19.

Variable	Good Sleep Quality - Male Group (n = 15)		p value†	Effect Size
	Weekdays	Weekends		
I go to bed at __: __ h	23:30 (22:00 - 00:30)	00:00 (23:00 - 01:00)	0.059	0.49
I decide to sleep at __: __ h	23:40 (22:30 - 00:30)	00:30 (23:10 - 01:40)	**0.005**	0.72
I need __ minutes to fall asleep	10 (05 - 10)	05 (02 - 10)	0.109	0.41
I wake up at __ h	07:00 (06:30 - 08:00)	08:45 (07:30 - 10:00)	**0.001**	0.82
After __ minutes I get up	05 (03 - 10)	10 (05 -20)	0.115	0.41

†Wilcoxon test for intra-group.

Table 6A Characteristics derived from the Munich Chronotype Questionnaire according to the female young adults' poor sleep quality comparing weekdays with weekends during the social distancing due to COVID-19.

Variable	Poor Sleep Quality - Female Group (n = 174)		p value†	Effect Size
	Weekdays	Weekends		
I go to bed at __: __ h	23:05 (22:30 - 00:00)	00:00 (23:00 - 01:30)	<**0.001**	0.42
I decide to sleep at __: __ h	00:00 (23:00–01:00)	01:00 (00:00 - 02:00)	<**0.001**	0.73
I need __ minutes to fall asleep	20 (10 - 40)	20 (10 -30)	**0.001**	0.25
I wake up at __ h	7:30 (07:00 - 08:00)	10:00 (08:30 - 11:00)	<**0.001**	0.83
After __ minutes I get up	10 (05 -20)	20 (10 - 30)	<**0.001**	0.51

†Wilcoxon test for intra-group.

Table 6B Characteristics derived from the Munich Chronotype Questionnaire according to male young adults' poor sleep quality comparing weekdays with weekends during the social distancing due to COVID-19.

Variable	Poor Sleep Quality - Male Group (n = 83)		p value†	Effect Size
	Weekdays	Weekends		
I go to bed at __: __ h	00:00 (23:00 - 01:00)	00:00 (23:00 - 01:30)	0.113	0.17
I decide to sleep at __: __ h	00:10 (23:45 - 01:30)	01:30 (01:00 - 02:40)	<**0.001**	0.70
I need __ minutes to fall asleep	20 (10 - 30)	20 (10 - 30)	0.419	0.09
I wake up at __ h	07:30 (07:00 - 08:00)	10:00 (09:00 - 11:30)	<**0.001**	0.79
After __ minutes I get up	10 (01 - 15)	15 (10 - 30)	<**0.001**	0.53

†Wilcoxon test for intra-group.

Table 7A Characteristics derived from the Munich Chronotype Questionnaire in females and males according to good sleep quality during the COVID-19 pandemic distancing due to COVID-19.

Variable	Good Sleep Quality		p value+	Effect Size
	Female (n = 36)	Male (n = 15)		
Sleep duration on study days	08:02 ± 01:39	07:33 ± 01:09	**0.006**	0.40
Sleep duration on free days	09:20 ± 01:09	08:08 ± 01:00	**0.002**	0.45
Mid-point of sleep on study days	04:00 ± 00:48	03:56 ± 00:54	**0.005**	0.41
Mid-point of sleep on free days	04:52 ± 00:58	04:06 ± 00:57	**0.001**	0.47
Corrected mid-point of sleep on free days	04:10 ± 00.42	03:57 ± 00:44	**0.002**	0.44

+Student's t-test.

during social isolation, and they attributed it to compromised physical and mental well-being. On the other hand, studies have shown that individuals who were able to preserve good sleep quality during the confinement period also had more hours of sleep when compared to those with impaired sleep quality.[34]

Table 7B Characteristics derived from the Munich Chronotype Questionnaire in female and male according to poor sleep quality during the COVID-19 pandemic distancing due to COVID-19.

Variable	Poor Sleep Quality		p value+	Effect Size
	Female (n = 174)	Male (n = 83)		
Sleep duration on study days	07:54 ± 01:37	07:07 ± 01:20	**0.009**	0.18
Sleep duration on free days	09:13 ± 01:54	08:38 ± 02:20	0.099	0.11
Mid-point of sleep on study days	04:06 ± 01:09	03:45 ± 01:00	**0.016**	0.17
Mid-point of sleep on free days	04:26 ± 01:17	04:09 ± 01:30	0.117	0.10
Corrected mid-point of sleep on free days	04:19 ± 01:03	03:58 ± 00:52	**0.008**	0.18

+Student's t-test.

In modern society, it is common to reduce sleep hours, which reinforces Social Jetlag. However, with the COVID-19 pandemic, there was the possibility of changing this condition. We observed that 16.6% (n = 51) had Social Jetlag. Research conducted prior to the COVID-19 pandemic showed that the time spent by the population in work and study hours influenced restorative sleep hours, representing the phenomenon of Social Jetlag. During the same period, Wright et al.[35] found an increase in average sleep duration in students on both weekdays and free days, as well as a reduction in the variation in sleep time during both study days and days off. Furthermore, the social jet lag phenomenon is intrinsically linked with the chronotype concept, as it can be hypothesized that the evening-type people were marked by the more significant reduction of social jet lag in a period of unlocked time for sleep.[36] However, recent investigations demonstrated that the evening chronotype represents a vulnerable group for sleep problems during the lockdown period.[36] This evidence could explain the poor sleep quality in a context of reduced social jet lag.

Similar to what we found regarding the reduction of Social Jetlag, we observed that only 16.6% of young adults had good quality sleep. Blume et al.[33] found that the reduction in Social Jetlag was driven by a delay in the mid-sleep on working days during social isolation, which they associated with two factors: first, the increase in home office activity, which in turn was linked to the greater flexibility of working hours; second, reduction in working hours.

We also observed that the mean SJLsc for young adults was 02:00h. In order to understand these data, we must consider that the temporal parameters of sleep-in humans are controlled by the interaction between circadian and homeostatic regulatory mechanisms that, according to their endogenous properties, allow them to have a propensity for the onset and offset sleep synchronized with the light/dark cycle of the Earth and dependent on the amount of previous wakefulness. Nevertheless, social time and artificial light exposure at night also modify sleep time.[37] Accumulation of academic demands and social activities linked to university life make students a vulnerable group to sleep-wake cycle (SWS)[38] desynchronizations, even during the lockdown, since modern lifestyles imply changes in the form of social interaction, for example, excessively using electronic devices to maintain contacts and favoring the disrespect to physiological rhythmicity by following desynchronizing routines for individuals, such as maintaining communication at times when they should be sleeping, promoting sleep-wake cycle pattern irregularities. This sleep-wake cycle irregularity between study days and free days is called social jet lag,[38] that is, the social synchronizers misalign the "biological time" of the individuals and the expression of this misalignment is an irregular pattern of the sleep-wake cycle, resulting in sleep deprivation[39] because of the academic demands and the starting time of classes (in Brazil, the social time of classes occurs around 07 a.m.), which can lead to homeostatic compensation on free days. This biological tendency to sleep and wake up later combined with the high academic demand and lead to a reduction of sleep[40] on study days. Thus, this output leads to possible homeostatic compensation[41] which in turn results in increased sleep duration on days off and contributes to irregular SWC.[42]

In some comparisons in this study, we observed that the data related to "I go to bed at" had earlier values than "I decide to sleep at" (the latter variable being respectively earlier and later than bedtime per se). We hypothesize that during the lockdown, sleep habits, study hours, and physical activity were impaired, which could lead individuals to already be in bed doing another activity, even before the time they decide to go to sleep. In the second week of the lockdown, Cellini et al.[3] found that in the social isolation in Italy, people had sleep-wake rhythms markedly changed, spending more time in bed, but, paradoxically, also reporting a lower sleep quality. Besides, young adults can still maintain phase delays in circadian rhythms with the slower build-up of homeostatic pressure to sleep during wakefulness, delaying sleep starting times. Light exposure can also reinforce this delay at nighttime by the use of electronic devices.[43–45]

We could observe that the frequency of the alarm clock used was high in all groups during weekdays. It was also possible to observe important changes in the misalignment of rhythm between weekdays and weekends since they did not use the alarm clock on weekends. In these groups, irregularity of awakening times is a good index to assess the misalignment of the rhythm between the school and days of free time occurring due to a conflict between the phase delay sleep-wake cycle and morning school hours.[46,47] The sleep deficit resulting from classroom days is usually compensated on free days when students can increase their sleep duration by waking later.[48]

When we compared males and females with poor sleep quality, they presented similar sleep duration on free days and mid-point of sleep on the study days. Lin et al.,[49] when conducting research, including 1,069 men (56.4%) and 828 (43.6%) women, showed that the mean age of these participants was 36.6 ± 11.5 years. Sleep quality, measured by the PSQI scale, revealed a mean sample score of 6.09 ± 2.90. A total of 569 (30%) participants were considered bad sleepers. Concerning sleep quality, we found that 82.9% of women and 85% of men described their sleep as poor sleep quality. On the other hand, the duration of self-reported sleep during the week was lower in the good and poor sleep quality when compared to the weekend. Kantermann[50] observed that reduction in Social Jetlag with increased sleep duration did not necessarily coincide with better sleep quality, suggesting new research to explore the Social Jetlag and sleep quality concepts to establish to what extent people can determine their sleep quality and quantity.

The present study shows sleep gender differences in young adults during the COVID-19 pandemic and confinement. Although the percentage of women with poor sleep quality was as high as that of men, we could observe that the sleep duration of the women was longer than men in the good and poor sleep quality group. Studies have shown similar results as the one conducted by Marelli et al.,[51] composed of 307 Italian university students with a mean age of 22.84 ± 2.68 years and observed poor sleep quality in 73.3% of them. In Bangladesh, pre-COVID-19 studies found 66.6% of poor sleep quality among university students[52] and, 69.5% of poor sleep quality among medical students.[53] Pinto et al,[54]in 2017, before the COVID-19 pandemic, studied 200 individuals and observed that 69.6% of participants reported having at least one complaint related to difficulty sleeping, while frequent awakenings were the most prevalent difficulty (n = 200, 54.8%). According to the literature, women generally seem to report a greater need for sleep, yet they have more subjective complaints of non-restorative sleep than men.[55] One justification for the sleep duration of the women was longer than men may be related to the fact that men use more electronics than women, since problematic internet and cell phone use by college students may be lower in female students compared to males.[56] According to the task force of the European CBT-I Academy,[53] during the lockdown, the sleep habits of individuals were challenged by various factors. One of these factors is the high prevalence of Internet access through smartphones or tablets among college students[57] that can promote stimulation of the central nervous system by participating in games and watching action movies online before sleep, contributing to extend sleep latency, associated with the emission of blue light through the screens, suppressing melatonin secretion from the pineal gland. However, we should consider that the female gender is typically associated with the poorest sleep quality[58] and a higher predisposition to insomnia conditions even in the pre-outbreak period.[55] Consistently, a recent longitudinal study showed that the time course of sleep disturbance was different between men and women, and the male gender appeared as the most vulnerable to the prolongation of the restraining measures.[56]

The present study had some limitations: not conducting actigraphy, not filling the sleep diary, and data were obtained exclusively with subjective instruments. Another point is that the subsample with putative poor sleep quality may have poorer sleep quality due to worse housing conditions and sleep environment (e.g., noise, mobile phone, TV).

In conclusion, our main hypothesis was that changes during social isolation and online classes may have caused changes in the sleep-wake cycle and worsened sleep quality resulting in larger Social Jetlag, shorter weekday sleep duration, longer weekend sleep duration, and more day-to-day variation in sleep. In this way, we could observe the high frequency of young adult students who presented poor sleep quality associated with Social Jetlag (2 hours) in the present study may reflect a pattern of sleep irregularity. However, we observed that women had longer sleep duration despite this impairment when considering the groups with good and poor sleep quality. Therefore, we suggest new comparative studies during the period of lockdown among individuals who study at regular hours between 07-08 hours in the morning and those who start later.

Conflict of Interest Statement
The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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