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# Sleep Preferences and Chronotype Traits Impact on Academic Performance Among University Students

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**Abstract:** Due to irregular daytime routines, chronotype changes, side jobs and exam periods after the COVID-19 pandemic, university students are trying to find new balances in their everyday life. The aim of the present study is to analyze the impact of daytime chronotype and hour preferences for the circadian rhythm on academic achievement among university students, considering their sleep habits and class frequencies in daytime and nighttime classes. Furthermore, this study aimed to analyze the differences in chronotype preferences with regard to age, sex, and academic schedule students are attending. A sample of 87 university second-year Psychology and Management students attending the academic year 2021/2022 after the governmental relief measures of the COVID-19 pandemic completed a 13-item questionnaire on sleep habits and preferences. Further variables encompassed sleep behaviors, such as age, sex, daytime and nighttime classes, as well as academic achievement. The results of the study showed that university students had a higher preference for the morningness type. Additionally, chronotype traits explained 30% (values from regression analysis) of academic achievement but did not directly impact academic results. The sleep-wake cycle diverged among age groups because the youngest participants (19–21 years old) and older participants (35–44 years old) reported higher academic scores during the first semester and the full academic year. No significant differences were identified with respect to sex. There is a lack of literature explaining the effect of sleep hours on academic achievement among students after stay-at-home rules during the COVID-19 pandemic. Thus, it is imperative to understand the difficulties students face with regard to their studying hours, working shifts, and daytime or nighttime classes to create a sustainable university system that attends to students' needs and necessities.

**Keywords:** *Academic achievement, college students, daytime and nighttime classes, post-pandemic, sleep preferences.*

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## Introduction

The adult population has been the focus of attention in the literature, especially when considering the aggravating effects of work shifts on sleep quality and work performance. On the one hand, before the outbreak of the COVID-19 pandemic, literature has built more robust evidence in this field, understanding the mediating effect of working hours on the relationship between sleep quality and work performance, especially when considering the variety of working schedules, such as shifts or fixed terms (Hasan et al., 2022; Ness & Saksvik-Lehouillier, 2018; Randler & Engelke, 2019). However, the research problems and the questions that support our study are justified by considering the lack of research analyzing the impact of the present pandemic on the work and academic performance of adults who work and study simultaneously on a daily basis. Therefore, the objectives of this study are to examine how the working shifts play a crucial role in defining sleep schedules, especially considering the assumption that university students suffer the most from sleep deprivation. The second objective is to understand how sleep patterns during the COVID-19 pandemic impacted academic performance. The third objective inherent to the previous aims is to understand whether the COVID-19 pandemic is associated with impaired sleep patterns.

In academic settings, the research could help better understand how university students' sleep quality and schedules, as well as their academic achievement, differ based on university campuses with a multicultural population, age differences, daytime and nighttime classes, and the geographic location of universities immediately after the pandemic outbreak. The presence of new additional variables, such as (non) immigrant populations, could enrich the literature framework.

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The lack of organized timetables to ensure good sleep has severe repercussions for academic achievement among university students, making them prone to diurnal somnolence during class (Louzada & Menna-Barreto, 2007; Ness & Saksvik-Lehouillier, 2018; Randler & Engelke, 2019). Sleep privation is common among undergraduate students, mostly referring to weekdays, who in turn choose to compensate for excessive hours of sleep on weekends. This is not balanced sleep; hence, it generates a synchrony effect (Goldstein et al., 2007; Hahn et al., 2012; Healy et al., 2021). By the synchrony effect, we mean the combination of a high alerted time interval of the day and the peak of performance the individual uses to complete a specific task (where task refers to a high demanding activity, for example, an exam). This synchrony effect also indicates that individuals' cognitive preferences to perform the task extended in more than one interval of time in 24 hours. This specific cognitive preference is biologically determined, but moderated by social schedules and habits. Performance patterns (as well as sleep behavior) should be implemented as a daily routine. Therefore, a good sleep schedule will benefit individuals in their daily practice by improving performance and achieving a new balance among work, academic activities, and private life events.

The synchrony effect leads to the chronotype concept, which represents individual preferences for a time interval during the day. Thus, chronotype defines a subject's preferences as a predisposition to task realization (or to be more passive and in the pause stage). There are three chronotypes: Morning, intermediate, and evening (Au & Reece, 2017; Roenneberg, 2012; Werner et al., 2009). The morningness trait explains why individuals prefer earlier wakefulness and bedtime, indicating achrophase in the first hours of the day. The achrophase identifies the best time of day to perform activities and a balanced humor. In contrast, evening types prefer later schedules and achrophases. University students are expected to exhibit evening-type preferences based on evidence that young children prefer more morningness activities (Arbabi et al., 2015; Dunn et al., 2022; Enright & Refinetti, 2017; Paciello et al., 2022).

The chronotype cycle changes across the lifespan and deserves further examination, especially considering the university population that encompasses a broad age group. The sleep of university students differs from that of the general population when taking into account the variety of schedules during the day and academic demands. This shifts away from regular sleep onset to later bedtime (Ness & Saksvik-Lehouillier, 2018). Therefore, there literature found that there is a positive relationship between high academic performance, attention and concentration, good active memory, and good sleep habits (Arbabi et al., 2015; Rahafar et al., 2016; Randler & Engelke, 2019; Roeser et al., 2013).

There is evidence that sleep greatly affects memory consolidation and learning retention. Sleep organizes human cognitive and physiological processes by selecting and deleting information about what we are exposed to during the day, in formal or incidental settings (Banks & Dinges, 2007). Previous research (Buboltz et al., 2009; Ness & Saksvik-Lehouillier, 2018) denoted that universities should be aware of the difficulties experienced by undergraduate students, mostly considering their sleep routines. When acknowledged, chronotype is important for understanding the impact of academic results during evaluation periods in the classroom. In contrast, neglect concerning the physiological and social needs of the individual, mainly in what respect the undergraduates in the transition phase to the first year of university will be associated with dropout cases, low resilience, increased stress, loneliness, and depression (Becker et al., 2018; Kundu et al., 2021).

Furthermore, past studies such as the investigation of Buboltz et al. (2009) concluded that the undergraduate population self-reported tiredness and high attention deficit in morning schedules, but students in evening schedules revealed more efficacy during late tasks (Hansen et al., 2017). Here, it is important to address the social jetlag once this population, when in evening classes, is attending to a number of hours and tasks that are very different from the daytime classes. The daily shift from the work timetable (and location) to the academic schedule (and location) can explain the constraints identified by social jetlag. This concept is mostly linked to the difference in the midpoints of sleep between weekdays and weekends.

Considering the latest global changes, it is important to address two main arguments. First, university classes are currently becoming more multicultural, mainly in countries with more immigration/refugee representation. This diversity also characterizes social jet lag, considering that students with origins in other countries will show specific routines depending on their culture and ethnic traits. Second, the pandemic, which is currently identified as a variable, can explain social jet lag (Lau et al., 2013; Sasawaki et al., 2022; Stutz et al., 2023). In sum and considering the arguments above, it is important to notice that fundamentals of sleep behaviors are provided by the culture, routines of students, and the pandemic scenario, especially the post-pandemic. Observing the variables of this study: Culture is explained by nationality (from the multicultural population currently at universities) that will influence sleep routines and social jet lag; this social jet lag is explained by the constant change between behaviors practiced at home and at university classes environment; and finally, the COVID-19 pandemic and after stay-in-home orders. It is imperative to explore the effect that the present pandemic had, specifically on university students' populations, there is a lack of research on this matter. Portugal's university structure offers two academic systems: Daytime and nighttime. Thus, and according to the three objectives of the study previously mentioned, the present study aimed to analyze the association of chronotype (preferences for being diurnal or evening active person), culture, COVID-19 effect on sleep, and the daytime or nighttime classes. Attending to this, as previously clarified in our objectives, we will examine how different university' classes/schedules are affecting sleep routines of students and how the sleep is related to the two pandemic/post-

pandemic periods. The following conceptual model illustrates the hypothesized relationships between the key variables in this investigation.

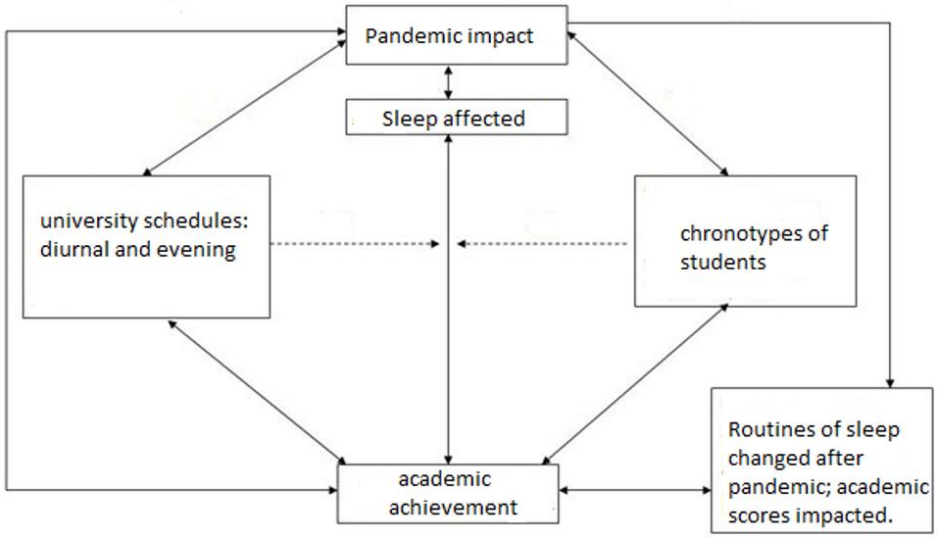


*Figure 1. Conceptual Model With Variables Underlining the Sleep and Academic Achievement of University Students*

## Methodology

*Participants*

A paper-and-pencil survey was administered to 87 university students enrolled at the Universidade Autónoma de Lisboa, in Portugal, attending bachelor's degrees in Psychology and Management. Participants were 56 female (64,4%) and 31 males (35,6%) with an age range spanning from 19 to 44 years (M= 23,5; SD = 5,8), attending daytime and nighttime classes. Thus, we had four samples, considering the two schedules for the classes of the two courses. The inclusion criteria were students attending the second year of bachelor's studies on daytime and nighttime courses in psychology (26,4%) and management (46%) and enrolled at the university in the 2021/2022 academic year. All students attended online classes one year before (2020/2021) at home, returning in person (face to face) at the time of data collection. The Colibri Zoom was the platform attended for teaching classes at the university.

To determine the statistical power and to assure the precision of estimates, the power analysis was conducted with G*Power 3 for the following tests: F and z tests, especially considering the logistic regression. The odds ratio was established at 1.4, the effect size at 0.5, and the 1-β error probability at 0.95 (95% of the sample). The z parameter displayed a value of 1.7 and the sample recommended was 111. For this study, 87 cases were examined, with a short distance from the minimal N 111 calculated through the Power Analysis. To add, the odds ratio revealed a good fit considering the probability power and predictive value expected with this sample (despite of N 111) to examine the association of morningness/eveningness type, COVID-19 effect on sleep, and the daytime or nighttime classes, in university students from classes (schedules).

*Measures*

The survey was divided into two sections. The first part included sociodemographic data (sex, age, course attendance at the time of the study, and daytime or nighttime classes). For the purpose of academic achievement, participants were asked to report their average scores on academic performance in the first semester and full academic year. The second part included the Composite Scale of Morningness (CSM; Smith et al., 1989) to measure chronotypes. The CSM contains 13 questions and addresses preferred rise and bedtimes, preferred times for physical and mental activity, and subjective alertness after waking. The score ranged from 13 (extreme eveningness) to 55 (extreme morningness), and the internal consistency coefficient of the full scale was .87. The internal consistency and cross-cultural validity of the CSM had been well established (Silva et al., 1995; Smith et al., 2002). CSM is one of the most widely used tools for accessing CSM. It has long been used in research in Portugal, but very few detailed reports exist regarding its psychometric properties in younger ages and student samples. For questions regarding preferred sleeping and waking times, the respondents selected the most suitable option from a list of time increments. Issues such as ease of waking, alertness throughout the day, and exercising were also queried. Potential scores for the scale items range from 1 to 4 or 5, with higher scores indicating a greater degree of morningness. For example, for the item "Assuming normal circumstances, how easy do you find getting up in the morning" the categories of the Likert scale are as follows 1 (not at all easy) to 4 (very easy); and other items "At what time in the evening do you feel tired and, as a result, in need of sleep?" The Likert scale was inverted

from 5 (8:00-9:00 pm) to 1 (1:45 – 3:00). These chronotype preferences had also been validated in younger populations (Figueiredo et al., 2018; Werner et al., 2009).

*Internal Consistency*

The internal consistency of the CSM scale was acceptable in our sample. The alpha coefficient is .67. Following a thorough statistical analysis of the total item correlation, it was considered that deleting item "c) easiness to wake-up" the Cronbach's coefficient of the scale would increase to .74. Hereby, in order to increase the internal coefficient, it was proceeded with the deletion of item "c" (Table 1).

*Table 1. Reliability Analysis (Excluded Item "c"): Correlation Among Major Scales Items*

| Scale Items | Mean if item deleted | Variance if item deleted | Corrected item-total correlation | Multiple correlation squared | Cronbach's Alpha if item deleted |
|---|---|---|---|---|---|
| a) Wake-up in workdays | 23,32 | 20,063 | 0,42 | 0,363 | .710 |
| b) Bedtime | 23,46 | 19,812 | 0,481 | 0,386 | .701 |
| d) Awakeness after 1hr | 24,38 | 25,71 | -0,243 | 0,19 | .786 |
| f) Optimal state | 24,59 | 19,9 | 0,437 | 0,313 | .708 |
| g) Sleep onset | 23,65 | 20,719 | 0,345 | 0,252 | .722 |
| h) Best time to complete 2hr test | 24,85 | 19,002 | 0,593 | 0,469 | .683 |
| i) Morning/evening type | 24,86 | 19,235 | 0,476 | 0,552 | 701 |
| j) Wake-up in freedays | 23,91 | 19,484 | 0,514 | 0,355 | .695 |
| l) Readiness after awake | 24,88 | 20,915 | 0,359 | 0,329 | .719 |
| m) More active: During day or night | 24,91 | 18,981 | 0,523 | 0,542 | .693 |

*Data Analysis*

All analysis were performed using SPSS (Statistical Package for Social Sciences, Version 29). Pearson's correlation analysis was used to explore relationships among study variables (age, semester average, academic year average, and sleeping intervals). The Kolmogorov Test confirmed the normality and homogeneity criteria of the sample, controlling for outlier cases. In this last case, for the correlation's analyses, we used Spearman test. Moreover, regression analysis was performed to examine predictors of chronotype preferences and semester/full academic year achievement. In the total of 87 participants, no missing data were detected.

*Data Collection*

The study was approved by the Ethical Committee of the Psychology Research Centre and the relevant university authorities in the area. These approvals meet international ethical standards. Written consent to administer the survey was obtained from all participants. Participation was voluntary and anonymous. The data collection included four classes corresponding to the two courses of Psychology and Management, and each class was divided into students attending daytime and nighttime classes. Questionnaires were completed separately in the auditorium for each class in the presence of the researcher and their respective professors. The data were collected between September 2021 and July 2022. The questionnaire lasted approximately 20 min to complete. Students were instructed in the questionnaire to provide their academic scores for half a semester and the final academic year.

*Questions and Variables*

The statistical analysis aimed to respond to the main research question: Can the daytime chronotype and hour preferences for the circadian rhythm impact academic achievement among university students, considering their sleep habits and class frequencies in daytime and nighttime classes? This study aimed to analyze differences in chronotype preferences with regard to age, sex, and academic schedule students are attending.

Students attending daytime and nighttime classes in Psychology and Management followed the same subjects and curricular program, lectured by different professors with the same area of expertise. Thus, it was important to differentiate the sample with regard to chronotype preferences (morningness and eveningness) and the impact it had on academic achievement based on their daytime and nighttime courses, as well as attending Psychology or Management classes. Regarding Chronobiology and Chronopsychology, the execution of more or less complex tasks refers to the structural content defined by language and mathematics subjects. Thus, the study had four independent variables, including age, sex, chronotype preferences, and daytime or nighttime classes, while academic achievement served as a dependent variable.

## Results

*Descriptive results*

*Chronotype Preferences and Sleep Habits Among University Students*

Initially, the study proceeded with the calculation of the mean of the following items from the chronotype preferences scale respectively: a), b), d), f), g), h), i), j), l), and m). In this study, these items are considered as independent variables. The analysis found that the standard deviation between .723 and 1.002.

Previous to introducing these results it is important to clarify that when calculating chronotype preferences (through the quotation of scale items that evaluate the hours during a 24-hours cycle), percentile analyses allowed the identification of two chronotypes: Morningness (< 35 points) and eveningness (> 29 points). Students in this study presented a higher prevalence of morningness and, thus, early schedules. Such information will be analyzed later in relation to age and academic achievement. Items d), e), and k) were inversely calculated in accordance with the scale quotation standards. More recent studies using the same instrument had allowed for the comparison of cutoff points. Thus, the cutoff point in the present study falls within the range of cutoff scores found in other recent studies. However, it is important to highlight that there are variations in the cutoffs, mostly from morningness in the university population literature in recent years. Means, percentages, distribution analysis, and regression analysis with univariate tests of variance are introduced below.

Considering the "waking hour preference" variable, the mean was 3.67, with a standard deviation of .923. Thus, there is a general preference for the option *"9h45m-11h00m"* interval compared with other possible options:*5h-6h30m; 6h30m-7h45m; 7h45m – 9h45m* and *11h00m-12h (morningness hours).*

The "bedtime hour" variable the mean is 3.54, with the majority of picks in all options with the exception of *"20h-21h"*, with a standard deviation of .90. The general prevalence leans on the interval *"22h15m – 00h30m",* compared with other possible options:*20h-21h; 21h-22h15m; 00h30m-1h45m* and *1h45m-3h (eveningness hours).*

The variable "alertness during the first half after awakening in the morning" had a mean of 2.6, considering all alternative options distributed with a standard deviation of .723. The global prevalence goes for the second option "slightly alert' compared with the other possible responses "*not at all alert", "fairly alert",* and *"very alert".*

Regarding the "engaging in exercises in a early schedule" variable, the mean was 2.37, with a possible response to all the options with a standard deviation of .941. The general prevalence is for the option "*would be in reasonable form*" compared to the other options *"would be in good form", "would find it difficult"* and *"would find it very difficult".*

The variable "time in the evening you feel tired and, as a result, in need of sleep" had a mean of 3.36, and a standard deviation of .927. The general prevalence goes for the interval *"22h15m – 00h30m"*, compared to all the other options:*20h-21h; 21h-22h15m; 00h30m-1h45m* and *1h45-3h.*

The variable "peak performance for a test lasting for two hours" had a mean of 2.14, with responses in all options with a standard deviation of .891. It is considered the general prevalence for the interval *"11h – 13h"*, compared to the other possible options:*8h-10h; 15h-17h* and *19h-21h.*

Continuing with the "morning and evening chronotypes", the mean was 2.14, with responses in all options with a standard deviation of 1.002. General prevalence goes for the option *"more a morning than an evening type*" compared to the other options of the scale: *"definitely a morning type", "more an evening than a morning type"* and *"definitely an evening type".*

The variable "preferred rising time considering a full day work," with a mean of 3.07, responses in all options, and a standard deviation of .910. General prevalence was notices on the interval option *"7:30 a.m. – 8:30 a.m.",* compared to all other options: "*before 6h30m"; "6h30m – 7h30m" and "8h30m or later".*

Regarding the variable "recover your senses after rising from night sleep," the mean was 2.13, with responses in all options and a standard deviation of. 873. The general prevalence lean on the interval of *"11-20 minutes",* compared to the other options face: "*0-10 minutes"; "21-40 minutes"* and *"more than 40 minutes".*

Regarding the variable "morning or evening active individual," the mean was 2.10, with responses in all options and a standard deviation of 1.000. The general responses are the option *"to some extent, morning active"* compared with the other possible options: *"pronounced morning active", "to some extent, evening active",* and *"pronounced evening active".*

Lastly, regarding the item "*considering your only "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening*" it was noticed a higher prevalence for the option "*9h45 - 11h"* following the interval "*7h45 - 9h45"*, with 44.83% and 26.4% respectively. This response prevalence was higher among psychology and management students attending daytime classes. Tables 2-4 show the frequencies of waking hours, bedtime hours, and morningness/eveningness based on the daytime and nighttime classes and sex.

*Table 2. Waking Hours Considering Variables as Sex and Daytime or Nighttime Classes*

| | Psychology nighttime | | Psychology daytime | | Management daytime | | Management nighttime | |
|---|---|---|---|---|---|---|---|---|
| **Waking hours** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** |
| 5h-6h30 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 6h30-7h45 | 0 | 0 | 0 | 2 | 2 | 1 | 3 | 1 |
| 7h45-9h45 | 0 | 2 | 2 | 3 | 7 | 2 | 3 | 4 |
| 9h45-11h | 0 | 4 | 2 | 13 | 6 | 13 | 0 | 1 |
| 11h-12h | 0 | 1 | 0 | 1 | 3 | 6 | 2 | 2 |

*Table 3. Bedtime Hours in Accordance to Sex and Daytime or Nighttime Classes*

| | Psychology nighttime | | Psychology daytime | | Management daytime | | Management nighttime | |
|---|---|---|---|---|---|---|---|---|
| **Bedtime hours** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** |
| 20h-21h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21h-22h15 | 0 | 0 | 0 | 4 | 0 | 2 | 1 | 1 |
| 22h15-00h30 | 0 | 6 | 1 | 8 | 8 | 8 | 5 | 4 |
| 00h30-1h45 | 0 | 0 | 2 | 5 | 6 | 7 | 2 | 1 |
| 1h-45-3h | 0 | 1 | 1 | 2 | 4 | 5 | 1 | 2 |

*Table 4. Morningness versus Eveningness Type*

| | Psychology nighttime | | Psychology daytime | | Management daytime | | Management nighttime | |
|---|---|---|---|---|---|---|---|---|
| **Morningness vs. Eveningness** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** |
| Definitely a morning type | 0 | 2 | 0 | 7 | 6 | 5 | 4 | 5 |
| More a morning than an evening type | 0 | 3 | 0 | 5 | 5 | 9 | 3 | 1 |
| More an evening than a morning type | 0 | 1 | 4 | 4 | 4 | 7 | 2 | 1 |
| Definitely an evening type | 0 | 1 | 0 | 3 | 3 | 1 | 0 | 1 |

*Association among Age, Chronotype Preference and Academic Achievement*

The results obtained from the CSM are presented in table 5, which identifies statistically significant correlations between age and academic achievement. For academic achievement, students introduced their academic classification, semester average (SA), and academic year average (AYA) in consideration of all classes.

*Study Results*

*Association among Age, Chronotype Preference and Academic Achievement*

Table 5 introduces the correlation analysis between the age of the students and academic achievement. Regarding the academic achievement, students introduced two moments of their academic classification, semester average (SA), and academic year average (AYA), in consideration of all classes.

*Table 5. Correlations Among Age, SA, and AYA*

| **Correlations** | | **Age** | **Age (According to SA)** | **Age (According to AYA)** |
|---|---|---|---|---|
| | Pearson Correlation | 1 | .179 | .060 |
| **(Age)** | *Sig*. (2 tailed) | | .098 | .581 |
| | N | 87 | 87 | 87 |
| | Pearson Correlation | .179 | 1 | .584** |
| **(SA)** | *Sig*. (2 tailed) | .098 | | .000 |
| | N | 87 | 87 | 87 |
| | Pearson Correlation | .060 | .584** | 1 |
| **(AYA)** | *Sig.* (2 tailed) | .581 | .000 | |
| | N | 87 | 87 | 87 |

Note **$p$<.01 level (two tailed)

The study found that older students had significantly better annual academic achievement (r=.584; $p< .01$). Moreover, the study found that particularly students older than 40 years old reported better academic classifications relevant to semester average and full academic year average.

Regarding chronotype preferences, following the percentile analysis to calculate the chronotype cutoff points, these selected age groups had a higher morningness score. As previously mentioned, the study verified both chronotype types (without an intermediate type), and the highest cutoff points corresponded to morningness. The inverse order corresponds to eveningness. For example, such a calculation is not relevant to the chronotype measure in children 4-11 years old (Werner et al., 2009).

The study proceeded analysing the correlation between age and sleeping intervals (waking time and bedtime). Table 6 introduces the results of these correlations, specifically explaining a significant negative correlation between age and waking time and bedtime respectively (r=-.323; $p< .01$), (r=-.270; $p< .05$).

Furthermore, the study conducted a non-hierarchical linear regression between chronotype preferences and semester/full academic year achievement. The linear regression was explored with the main goal to understand more about the association between the variables involved in the rational of the questions of the present study. Moreover, the chronotype and the achievement at university, considering the different schedules that students were attending. Specifically, the regression test determines the predictive value of chronotype as independent variable over the academic achievement as dependent variable. The chronotype explained 30% of the variance in students' academic achievement. More specifically, the linear regression indicated that behaviors relevant to the morning and evening types of people significantly influenced the academic year achievement of students, explaining 50% of its variance. Students indicated the most preferred bedtime in the interval 22h15 and 00h30. However, this result could had been influenced by the schedule that the working student needs to attend daily.

As in regard to the semester achievement, the predicting variable was item "d" referring the level of alertness during the first half hour after wakening. This chronotypical behavior explained 6.5% ($ß = .771$; $R^2 = .065$; $p< .05$) of the variance in academic achievement. Participants felt alerted one hour after being awaken, relevant to all courses in psychology and management.

With regard to the psychology course and students attending daytime classes, the linear regression revealed two chronotype variables predicting academic achievement through the year average. The predicting variable were: Item "j" referring to the preferred interval hours to wake up ($ß = 3.247$; $R^2 = .873$; $p < .05$) and "h" referring to the preferred peak of performance to realize a test of two hours ($ß = -.1.718$; $R^2 = .972$; $p < .05$). The results of the $\chi^2$ test indicated that students preferred mainly to wake up during the late morning intervals and indicated that academic exams that require a more cognitive commitment to be held as late as possible. The results were not expected, considering the time they indicated.

The item "g" explained the variance ($ß= .2.606$; $R^2= .875$; $p < .05$) of the semesterly academic achievement. The specific item indicated that students during the interval 00:30 and 1:45 in the evening felt tired and, as a result, in need of sleep.

Specifically, for the management course, among students attending daytime classes, the variable "i" (the type of people they consider morning or evening) introduced the highest coefficient ($ß= -.649$; $R^2= .356$; $p < .05$) to explain academic achievement.

Furthermore, this predictive relationship was negative. Thus, through the $\chi 2$ test, we explored the students' distribution in the management course and daytime or nighttime classes. Students who responded with more morningness behaviors had better academic achievement than did the eveningness behavior students.

The nighttime class students from the management course varied in their academic achievement, where the principal predictor was the variable referring to readiness one hour after awakening ($ß= .2,427$; $R^2= .493$; $p < .05$). The $\chi 2$ test indicated that participants with better academic achievement were referred to be ready one hour after the waking time.

Considering the age variable, it is important to identify the statistically significant correlations with bedtime hours from the Pearson analyses with a significance level of .05. Similarly, for waking time and age, this correlation was statistically significant from the Spearman analyses with a significance of .05. Table 6 presents the results.

*Table 6. Correlations Between Age and Sleeping Intervals*

| | | **Age** | **Waking time** |
|---|---|---|---|
| **Age** | Pearson Correlation | 1 | -.323** |
| | *Sig.* (2 tailed) | | 0.002 |
| | N | 87 | 87 |
| **Waking time** | Pearson Correlation | -.323** | 1 |
| | *Sig.* (2 tailed) | 0.002 | |
| | N | 87 | 87 |

*Table 6. Continued*

| | | Age | Bedtime hour |
|---|---|---|---|
| **Age** | Pearson Correlation | 1,000 | -.270* |
| | *Sig*. (2 tailed) | | 0.011 |
| | N | 87 | 87 |
| **Bedtime hour** | Pearson Correlation | -.270* | 1 |
| | *Sig*. (2 tailed) | 0.011 | |
| | N | 87 | 87 |

Note: * $p<.05$ and ** $p<.01$ level (two tailed)

In conclusion, reviewing all the data, the results indicated expected variances in sleep preferences among university students. This variance is explained through the preference of different intervals of time from the sleep itself, university schedules, and everyday activities. Thus, all of these factors had a chronic origin. As for chronotype, students presented two types: Morningness and eveningness, where morningness behaviors are predominant in this population. This differentiation influenced academic achievement, especially with regard to eveningness. Evening individuals were prejudiced considering the lower results for the academic classifications (by semester/by year) compared to the morning students. The students influenced more by morningness behaviors had better academic achievement more specifically during the semesterly classifications, considering also the university schedules for both courses and nighttime or daytime classes. Students were not asked the impact of the recent pandemic to avoid any impact on the results. We concluded that the morningness tendency not expected for adult university students with late bedtime schedules was caused by the daily work, school, and sleep habits during the lockdown. The COVID-19 outbreak has had a serious impact on acknowledging the differences and variability of sleep and academic features among the university population.

## Discussion

The present study adds to the sleep literature framework, highlighting how sleep preferences affect university students' academic performance when returning to in-person classes after the COVID-19 pandemic. Thus, the present study was administered to university students attending the academic year 2021/2022 after the governmental relief measures of the COVID-19 pandemic. We should notice the limitation observed for our sample, considering the low number of participants representing the college population. Findings discussed should take in account this matter. The results showed that academic achievement was directly affected by routine sleep preferences. However, one year before, during the stay-at-home measures, these sleep traits underwent many changes. In specific, we examine here the three objectives of the study: To examine how the working shifts play a crucial role in defining sleep schedules considering university students (1); to understand how sleep patterns during the COVID-19 pandemic impacted academic performance (2); to understand whether the COVID-19 pandemic is associated with impaired sleep patterns (3). The third aim is a direct consequence from the two first main objectives.

In general, thus this study aimed to measure whether these newly adopted sleep preferences impacted academic performance. Considering the main study findings, morningness type and sleep preferences greatly (considering effect size and significant values obtained – Results section) impacted university students' academic results for both groups attending daytime and nighttime classes in Psychology and Management. In a critical narrative of this discussion toward our findings, we will address the significant results concerning each question of the study.

First, university students from the four samples (daytime and nighttime classes in Psychology and Management) unexpectedly showed a high prevalence of the morningness type. Additionally, chronotype traits explained 30% (values from regression analysis) of academic achievement for both courses (Psychology and Management) but did not directly impact the academic results. At this point of findings and related discussion, we need to notice that the students felt more morning type (according to their self-report), but in fact they practice late schedules for academic and cognitive demanding tasks, and for sleep hygiene new habits.

The regression analysis confirmed that the result was announced in descriptive analysis (percentiles and the correlation scores obtained). The regression values attested that even when individuals self-report to be morning type or preferring the early hours to awake and work/study, in fact the academic achievement reveals other situations: More evening tendency and more sleepiness than expected in the morning. Despite the morning type being associated with better academic performance.

Previous data support, in part, this conclusion, providing a more comprehensive analysis of chronotypes and other related sleep factors (Balcı & Çalışkan, 2022). That comprehensive analysis should include variation in morningness/eveningness preference and the possibility of characteristics from both chronotypes. See that the morningness preferences in our sample contradict, partially, the results of previous studies reporting that university students, including all academic generations (freshmen and senior students), have a higher prevalence of eveningness preference (Arifuddin et al., 2021; Núñez et al., 2019). On the other hand, more recent studies found that university students increasingly report morningness preferences (Drezno et al., 2019; Hasan et al., 2022; Sharma & Kaushik, 2023).

Therefore, we are observing a misalignment between circadian preferences and the identification of correct chronotypes accounting for academic schedules at universities (Becker et al., 2018; Relvas et al., 2024; Saad et al., 2021). That misalignment is, in fact, a new chronotypical scenario that we may clarify for the post-pandemic university population. We need to add here an argument related to the culture variable: The pandemic and post-pandemic periods, considering the university population, count also with the multicultural factor. We examined participants in a changing scenario, not only because of the pandemic measures transition, but also considering the war conflict the moved thousands of refugees to Portugal (as well as to other European countries). Some of our university students are refugees and asylum seekers. This may be an important variable to understand the sleep schedule differences: The type of routines for schooling and working; the alertness according to latitude in different countries (country of origin and the hosting country); the cultural constraints during the academic adaptation.

To reinforce, the regression analysis provided evidence that supported the negative correlation coefficients between late schedules and younger age, for example. Thus, youngers tend to prefer earlier schedules at university, but older students prefer to perform activities – at university – in later timetables. To add, the first findings in the descriptive analysis inform about morningness/eveningness based on self-report. The correlations and regression tests attested to the real chronotypical behaviors and their influence on academic achievement and readiness.

Recent studies using the Composite Scale of Morningness (CSM) revealed that morningness is becoming more prevalent among undergraduate students, considering its association with depression and personality traits (Przepiorka et al., 2021). It is important to highlight the shift from eveningness to morningness since 2020 and after the pandemic confinement, especially among worker students (Figueiredo, 2022; Hasan et al., 2022) who felt obliged to shift their schedules to work mainly from home. During the past three years, changes in work and studying schedules might had affected the circadian preference of university students who would rather wake up earlier and extend bedtime hours (Hasan et al., 2022). Thus, the social jetlag, reinforced by the new social schedules imposed by COVID-19 constraints, partially explains the chronotype shift (Hasan et al., 2022; Korman et al., 2020). Consequently, the synchrony effect is constrained (Goldstein et al., 2007; Hahn et al., 2012; Healy et al., 2021). On the contrary, studies of Balcı and Çalışkan (2022), Capinding (2021) and of Staller (2023) revelated no direct effect of chronotype or significant chronotypical changes in the academic scores of university students in this recent period of world changes. In fact, Staller (2023) observed five studies that, despite indicating some negative prejudice for evening types, demonstrated more flexibility reported by individuals to work and to develop their school tasks. With more autonomy and flexibility in schedules, mostly during the remote learning.

Second, this study aimed to measure sleep and daytime preferences by following the CSM standard. The results showed that students manifested preferences for earlier awakening hours and later bedtime hours. Normally, earlier waking hours indicate earlier bedtime hours; however, we argue that university schedules, together with daytime working schedules, greatly shifted university students' social timetables such that these preferences became more an option than realistic preferences. These sleeping habits (earlier waking hours and later bedtime hours) among worker students have persisted for a long time, and thus have become a lifestyle pattern. Continuously, full work schedules and university course hours heavily impact students' emotional regulation and, as a result, their sleep balance. The literature highlights that procrastination of bedtime hours directly affects sleep balance and mental health (Meng et al., 2022; Zavgorodniaia et al., 2021; Zhu et al., 2022). However, these new sleep habit schedules were forcibly adopted during the lockdown measures, along with the remote modality of work and university classes (Ali et al., 2022). Other studies present a contradictory perspective with no sleep effect for education of university sample with origin in Philippines (Capinding, 2021).

Previous studies had commonly associated high academic performance with better attention and concentration as well as better active memory and sleep habits (Arbabi et al., 2015; Rahafar et al., 2016; Randler & Engelke, 2019; Roeser et al., 2013). In our study sample, students reported short periods of sleep for both the daytime and nighttime classes. We argue that despite sleep deprivation, motivation and resilience to obtain a university degree would encourage students to proceed with their academic path. There is limited literature highlighting these results, and further examination is required (Hershner & Chervin, 2014; Yu et al., 2019). As previously mentioned, these new behavior patterns are mostly the result of pandemic restrictions and the new habits adopted by students.

Third, the overall results of the study indicated that students feel awake one hour after and shortly after ready to start their daily activities. Sleep habits and duration were aligned for both students from Psychology and Management courses attending daytime classes. The same results were not obtained among students attending nighttime classes. Furthermore, the students reported a higher preference for earlier activities; however, bedtime hours were the latest possible. This result is likely related to the repeated behavior of late bedtimes and extended online exposure and schedules during lockdown (Oliveira et al., 2022). Moreover, students reported an earlier onset of somnolence, with a great distance from somnolence behavior to bedtime timetables. We believe that this will affect sleep duration and sleep quality or decrease daily sleep duration.

To the best of our knowledge, this is the first study to compare student chronotypes and sleep quality between daytime and nighttime classes. Despite the studies with a high number of university populations from several international

institutions, the type of course degree attended by students does not account for the variance of sleep effect in academic performance (Lund et al., 2010; Mulè et al., 2022); with the exception of students from biomedical, medical, and nursing courses that reported poorer sleep quality as well as poorer dietary habits (Jalali et al., 2020; Lau et al., 2013; Luciano et al., 2021).

In continuity, evaluating the chronotypical characteristics, the study found that students reported being morning-type and preferred to perform highly demanding tasks such as exams (with a duration of two hours) mainly in the morning, but avoiding the earlier hours (mostly around 11 am). These results are corroborated by previous investigations by Natale et al. (2003) and Jankowski and Ciarkowska (2008). Similarly, studies had also found that students prefer earlier schedules to fulfill highly demanding academic (Goldstein et al., 2007). Thus, our study found that students reported avoiding waking up in the early hours of the morning, such as 6 am, because they considered it unpleasant and very difficult.

Fourth, the study aimed to measure the role of sleep preferences on academic performance, considering differences in age, sex, and daytime or nighttime classes. The sleep–wake cycle diverged among age groups because the youngest participants (19 to 21 years old) and the older participants (35 to 44 years old) reported higher academic scores during the first semester and the full academic year. No significant differences were identified with respect to sex. The results supported the conclusions of previous studies among university students, claiming that they are more prone to develop sleep discrepancies, with high prejudice for sleep hygiene, but with distinct sleep duration for the younger population (7-9 hours are evaluated as enough) and older population (7-8 hours) (Brown et al., 2002; Hirshkowitz et al., 2015; Ness & Saksvik-Lehouillier, 2018). On the other hand, age did not distinguish the chronotype based on the computation that we added the percentiles to achieve the cut-off point of chronotype.

Consistent with the results of Paciello et al. (2022), claimed that age did not differ among chronotypes and that older students are more resistant to seasonal variations throughout the year. Furthermore, Paciello et al. (2022) addressed another issue, explaining that eveningness scores from the quotation of the CSM were similar to the results from other studies using different instruments. Despite the age of the participants, the students reported a higher prevalence of morningness behaviors.

This study addressed the differences in sleep preferences among students attending daytime and nighttime classes in Psychology and Management. The univariate analysis of variance and linear regression tests found that the later levels of tiredness and somnolence for students attending nighttime classes increased 50% of their academic performance when comparing the semester and full academic year scores. Participants showed a higher preference for later bedtime hours, which could be interpreted as a result of repeated daily routines at work and university schedules. Moreover, we highlighted that sleep routines during lockdown measures played a significant role in their sleep preferences.

Findings in Oginska and Pokorski's (2006) study are important in explaining that fatigue and somnolence are more prevalent among adolescents; however, they are not highly reported among young adult and adult students. Rodrigues et al. (2002) discovered that sleepiness patterns vary according to semester and exam. Later bedtime hours did not necessarily indicate lower academic scores. Further investigation is needed to understand the differences between university students' ages after the COVID-19 pandemic.

Fifth, the regression coefficients supported the results approached for awakeness of participants after the first hour (after the wake-up hour) and explained how readiness influenced 77% of academic achievement. However, Ikeda and Hayashi (2012) addressed the misunderstanding between waking up and awakeness. These are different and can be distant in time. Thus, if an individual sleep with no forced awakening (during the night), it is normal to experience self-regulation of awakening and awareness processes in the early hours (Matsuura & Hayashi, 2009). Considering daytime and nighttime classes among students attending psychology, in what respects to psychology degree, two variables emerged as more predictive of academic scores: Wake-up hours and the hour preference to fulfil a long and demanding task (two-hour task or test). Contrary to expectations, students reported a higher preference for later wake-up hours, as well as for executing long and demanding tasks.

Previous studies (Preuß et al., 2010) had already observed that undergraduate students in psychology courses present high levels of cortisol, which could impair evaluation moments such as written or oral tasks. Thus, the literature explains that social fear and stress generated from the awareness of a long and demanding task impacts the preferences of later hours preferences (Evans et al., 2021; Preuß et al., 2010). Evans et al. (2021) also observed that undergraduate psychology students attending their second academic year are more prone to choose evening/later hours to execute tasks. It is important to note that later schedules are not always associated with procrastination behaviors (Sirois et al., 2015).

Finally, regarding academic achievement by semester, students experienced nocturnal somnolence only at the end of nighttime classes. Studies that analyzed worker-students concluded that work has a predictive value for academic achievement in general (Tessema et al., 2014). Thus, a worker-student, as indicated by the results of this study, gains coping strategies to resist somnolence and melatonin segregation until the end of nighttime classes. However, different studies had specified that part-time jobs are more positive predictors of academic performance among university

students (Tessema et al., 2014). Additionally, the majority of research supports the idea that long-term jobs are not compatible with college attendance (Zhang et al., 2020).

Specifically, the students in the management course reported a higher prevalence of morningness. Morningness students performed better than eveningness students. As for the daytime and nighttime classes, students showed a variety of academic scores caused by the awakened state during the first hour after waking up. These results explain the association between morningness and higher academic scores. The results indicated that even students attending night-time classes had a higher preference for morning schedules. However, no evidence has been found in the literature to corroborate the association between students' daytime and nighttime classes and sleep habits, with implications for academic achievement.

## Conclusion

In conclusion, we believe that future studies are necessary to explain these results, including a larger population and other variables such as cultural and geographical factors. Different countries and their students respond differently to sleep schedules and resilience. Geolocation plus cultural factors are associated with pandemic restrictions and phases. Additionally, we understand that each country has different acute phases related to seasonal factors and the leadership and norms administered. Thus, social jetlag increased as a variable to account for the very different sleep routines that university students are showing and with prejudice in some cases. In particular, student workers. More recent research has attested to the geolocation and sociocultural differences in this topic, but with no relation to the pandemic as a component of the social jetlag equation. This is the first evidence concerning Portuguese (European) university students and their morningness and atypical sleep patterns and preferences.

## Recommendations

The findings of this study highlight the impact of morningness, eveningness, and sleeping hours on university students' academic performance. Other factors should be considered in future studies, such as sleep features and awakening habits, as a result of lockdown pandemic schedules. In practice, university human resources and academic administration should be aware of the chronotypical characteristics of sleep to ensure sleep hygiene among university students. However, considering the positive results in academic performance, nighttime classes need a better schedule composition. Promoting these findings among university students and staff can provide a better understanding of the effects of sleep on academic achievement.

Concerning the pre and post COVID-19 context, we found that students adopted their sleeping schedules greatly in order to adapt to university classes. Remote learning and working changed sleep and academic investment but gained the resilience of adult students toward long schedules of daytime activities and later bedtime hours. Coping strategies were deduced from our research and should be explored in depth in future research, considering that motivation to attain a certain degree might moderate the effects of sleep deprivation. These results implicitly impact college students' well-being. Further studies should be replicated with university students to compare international and Portuguese samples to understand how academic scores differ among students attending the same daytime and nighttime classes but in different languages and cultures.

## Limitations

The number of participants and the unstable context post-pandemic, in what respects university schedules, can be pointed out as limitations to be observed in future research. Attending to those limitations, sample sizes were very small in some subgroup of statistical analyses. To add, the instability of estimates from such small groups is considered as other limitation. Finally, we did not provide details for the effect size in this study, with priority for the statistical significance. This fact may generate a bias for false positive findings. In further studies that may replicate this investigation, we encourage more analysis for the effects.

## Ethics Statements

The studies involving human participants were reviewed and approved by Universidade Autónoma de Lisboa. The participants provided their written informed consent to participate in this study.

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**Conflict of Interest**

There is no conflict of interest.

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**Authorship Contribution Statement**

Figueiredo: Conceptualization, design, data acquisition, statistical analysis, supervision, final approval. Kulari: Analysis, writing, critical revision, editing/reviewing.

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