Original Article

Quality of Sleep Profiles and Mental Health Issues among University Students

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Sleep Sci

Abstract

Objective To detect and characterize sleep quality profiles and to analyze their relationship with depression, anxiety, and stress in a sample of 1,861 Chilean students.
Materials and Methods After providing informed consent, the students filled out online questionnaires and received immediate feedback. Hierarchical cluster analyses were conducted to detect sleep quality profiles, which were characterized using the Kruskal-Wallis's test. The Pearson correlation coefficient was used to correlate sleep quality profiles with mental health variables. The dendrogram revealed four distinct groups of interest, each with different patterns in the subscales of the Pittsburgh Sleep Quality Index (PSQI).
Results The results enabled us to establish four sleep quality profiles based on hierarchical cluster analysis, which were, in different ways, associated with the prevalence of symptoms of mental health issues. A profile of good sleeper was found, which presents good overall sleep quality and mild symptoms of mental health issues. The effective sleeper profile presents poor subjective sleep quality and good sleep efficiency, with mild symptoms of mental health issues. The poor sleeper profile presents poor overall sleep quality, sleeping between 5 and 6 hours and presenting moderate symptoms of depression, anxiety, and stress. The sleeper with hypnotic use profile obtains the most deficient results in sleep quality and presents symptoms of severe mental health issues.
Conclusions The present study revealed a strong association and correlation between sleep quality profiles and mental health issues. Four distinct sleep quality profiles were identified, showing notable differences. This understanding enables the application of targeted preventive strategies according to each profile.

Keywords
► sleep quality
► mental health
► university students
► depression
► anxiety

Introduction

The university stage can be considered a critical period in the evolutionary development of students, making this population psychologically vulnerable.[1] This could be due to the fact that university students are in the stage of emerging adulthood (EA), which involves becoming an adult, adapting to a new environment, and adjusting to new learning styles.[2,3] The increase in academic demands, adherence to schedules, and acquisition of behaviors related to the university environment, such as caffeine, tobacco, and alcohol consumption, could lead to sleep quality problems, especially for those who sleep for shorter periods of time.[3,4] Therefore, it is not surprising that the academic environment can be considered one of the greatest stressors in this population and accentuate the development of mental health problems associated with depressive, anxious, and stressful symptoms.[3] Additionally, it has been reported[5] that university students seek less psychological help, which could be due to cultural beliefs regarding psychotherapy and psychological factors such as expectations. These factors could worsen the situation, keeping students from receiving timely support in early stages, in which it is possible to prevent and better address the issue.[6]

International research indicates that mental health problems are common in the university population, with 20% to 30% of students reporting that they have experienced some mental health disorder during the last 12 months, with depression and anxiety disorders being the most common according to studies that include 21 countries.[7,8] The mental health figures among Chilean students are not encouraging. Several studies have reported a high prevalence of mental health problems in the university population,[1,9] mainly high percentages of depressive symptoms (46%), anxiety (45.5%), and stress (53.5%).[4] What is more worrying is that the figures for severe cases of depression (20.7%), anxiety (26.4%), and stress (15.9%) have increased in recent years.[10] During the coronavirus 2019 (COVID-19) pandemic, the levels of depression increased by 18.6%, anxiety, by 6.1%, and stress, by 7.9%.[11]

On the other hand, in the university stage, a relationship has been reported between sleep quality and mental health problems, specifically depression, anxiety, and stress.[12,13] Therefore, mental health problems are closely associated with sleep, since poor sleep has been associated with a higher prevalence of symptoms of mental healthissues.[13] Quality sleep is considered an essential element of a healthy life, and it has a significant effect on the quality of life and well-being of students.[14] Therefore, all daytime activities require good sleep quality, as this improves cognitive functions such as memory, decision-making, and learning.[14,15]

The concept of sleep quality is a complex multidimensional construct that includes quantitative aspects such as sleep latency, duration, and the number of times a person wakes up during the night. It also includes subjective aspects such as the depth of sleep and perceived level of rest.[16] Therefore, it is not clear which specific elements of sleep quality are linked to mental health. Previous research indicates that sleeping for 5 to 6 hours and poor sleep quality are common among university students, particularly during exam periods.[17] Sleeping less during the night increases the risk of developing sleep disorders, as well as anxiety and depression-related symptoms.[18]

In Chile, 64.8% of young people aged 15 to 29 report having difficulty sleeping.[19] During the COVID-19 pandemic, it was also reported that sleep quality decreased by 8% among Chilean university students.[11] It is necessary to explore which elements of poor sleep represent risk indicators, as sleep quality is a heterogeneous construct, with specific types of sleep disturbances varying among individuals.[20] Furthermore, previous evidence has not explored whether there are sleep profiles or styles in the university community, and which profiles are linked to deteriorated mental health. The general objective of the present study was to analyze the relationship between sleep quality profiles and mental health problems (depression, anxiety, and stress) in students at a university in southern Chile. The specific objectives were: 1) to detect the existence of sleep quality profiles among students; 2) to characterize these profiles; and 3) to correlate these profiles with symptoms of depression, anxiety, and stress.

Materials and Methods

The study included a sample of 1,861 university students (with ages ranging between 18 and 28 years) majoring in different fields. Given that we could not know beforehand the number of clusters that we would find, it was not possible to estimate an a priori sample size. However, having at least 80 observations per cluster ensured proper statistical power and accuracy in the estimation of the number of clusters.[21] As such, our sample size enabled us to explore the potential existence of more than 20 potential profiles without compromising statistical power and to adopt a fine-grained solution approach. The research was approved by the institutional Scientific Ethics Committee for Research in Human Subjects. The data were collected in November 2020 (during the COVID-19 pandemic) through a virtual survey consisting of a brief self-report questionnaire of sociodemographic variables (gender, age, course) and several mental health questionnaires that students took ~ 20 minutes to fill out. The study used convenience sampling, whereby all university students were invited to voluntarily respond via email. The number of enrolled students that year was of 18,114, resulting in a response rate of 9.7%. Before responding, the participants agreed to sign an informed consent form, which explained the scope of the research, as well as the possibility of withdrawing from the study at any time. After filling out the different self-report questionnaires, the participants received immediate feedback on their results, with recommendations, information on available health networks, and links to delve deeper into each topic. The following instruments were used:

Patient Health Questionnaire-9 (PHQ-9):[22] A questionnaire designed to evaluate the presence of depressive symptoms, according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV),

the students experienced in the two weeks prior to the test application. The scale consists of 9 items constructed in Likert format, scored as "never" (0), "some days" (1), "more than half the days" (2) and "nearly every day" (3), enabling the definition of the severity of the disorder, resulting in scores for major depressive syndrome, other depressive syndromes, positive depressive symptoms, and negative depressive symptoms. The PHQ-9 was adapted and validated for the Chilean population, showing adequate psychometric properties.[23] In this version, the presence of 5 or more of the 9 depressive symptoms with scores $\geq$ 2, and 1 of the symptoms of depressed mood or anhedonia, indicates a major depressive syndrome. When an individual shows signs of 2, 3, or 4 depressive symptoms with scores $\geq$ 2, and 1 of the symptoms is depressed mood or anhedonia, the scale indicates a moderate depressive syndrome. Finally, the presence of 1 or 2 depressive symptoms, but without other criteria, indicates a mild depressive syndrome, and a global score below 2 indicates the absence of depression.

Pittsburgh Sleep Quality Index (PSQI):[24] The scale aims to evaluate sleep quality through 24 self-reports questions with a scale between 0 and 3 points. The scale measures seven components: subjective quality, sleep latency (time it takes the individual to fall asleep), sleep duration, sleep efficiency (percentage of time the person reports sleeping in relation to the time they spend lying down), disturbances (disruptions such as pain, cold, coughing, others), use of hypnotics, and daytime dysfunction (ease of falling asleep while performing an activity or tiredness during the day). The version used was validated in Chile in a population older than 18 years of age, and scores lower than 5 would indicate no sleep problems, between 5 and 7, the need for medical evaluation, between 8 and 14, the need for medical attention and treatment, and scores $\geq$ 15, a serious sleep problem.[25]

Depression, Anxiety, and Stress Scales (DASS-21):[26] It is a self-report instrument that aims to evaluate the frequency and intensity in which symptoms of depression, anxiety, and stress are experienced during the last week. It consists of 21 items with 4 response alternatives in Likert format, ranging from 0 ("Does not describe anything that happened or felt during the week") to 3 ("Yes, this happened to me a lot or almost always"). Each scale contains seven items. The score per subscale can vary between 0 and 21 points, and the higher the score, the greater the presence of symptoms of depression, anxiety, and stress. This instrument was adapted and validated for Chilean university students, showing adequate reliability and validity, and the depression scale has a cutoff score of 6, the anxiety scale, of 5, and the stress scale, of 6.[27]

Statistical Analyses

For the purpose of data analysis, the sleep quality profile variable in the present research was understood as a structured and organized representation of the characteristics and variables that enabled grouping or profiling subjects who shared a common sleep quality pattern,[28] considering that specific categories of sleep disturbances differ among individuals.[20] The depression, anxiety, and stress variables

were assessed according to the DASS-21 model,[26] in which depression is understood as a disorder that includes a decreased mood characterized by hopelessness, self-disdain, anhedonia, lack of interest, and difficulty in continuing daily activities. Anxiety is characterized by its main emotional symptom, fear, combined with physical symptoms characteristic of sympathetic system activation, such as muscle tension, palpitations, sweating, and tremors. Finally, stress is characterized by an irritable mood, impatience, difficulty in relaxing, and constant tension.

As mentioned before, the present study had three specific objectives: 1) to detect the existence of sleep quality profiles among students; 2) to characterize these profiles; and 3) to correlate these profiles with symptoms of depression, anxiety, and stress. It was relevant to realize that, even though the PSQI could characterize different dimensions of sleeping properly, our aim was to detect population profiles grouping characteristics scorings through PSQI dimensions. To carry out objective 1, hierarchical cluster analyses were performed. The variables were standardized using Z-scores, and then the distances between observations were estimated using the Ward method.[29] The number of clusters was chosen based on the structure of the dendrogram and the drop in height in it, favoring a fine-grained solution. For objective 2, the variables used to generate the clusters and those related to mental health were characterized using descriptive and inferential statistics, following the rationale of previous research in healthcare and mental health.[30–32] For the descriptive statistics, we reported the mean and standard deviation values regarding age, number of semesters completed, and socioeconomic status (SES) quintile; the numerical variables were expressed as median and range values. For sex, numbers and percentages were reported. We reported the descriptive statistics for each cluster and overall. The clusters were contrasted using one-way analysis of variance (ANOVA, and the Tukey post-hoc test) and the Chi-squared test for the numerical and factor variables respectively. For inferential statistics, the Kruskal-Wallis's test was performed, and the Mann-Whitney U test was used as a post-hoc test, corrected through the Bonferroni method. For objective 3, we used the Pearson correlation coefficient. For all data analyses, we used the R statistical software (R Foundation for Statistical Computing, Vienna, Austria).[33]

Results

The dendrogram showed a gradual and smooth decrease in height, and four groups of interest could be detected immediately. When the scores on each subscale of the PSQI (subjective sleep quality; sleep latency; sleep duration; habitual sleep efficiency; sleep disturbances; use of medication; and daytime dysfunction) were evaluated, four distinctive patterns were observed (►Fig. 1). One group had high scores overall, particularly regarding use of medication subscale ($n = 175$; 9.39%), while the rest of the groups generally presented low scores on that subscale. A second group had high scores overall ($n = 520$; 27.9%), except for the use of medication subscale, followed by a third group that
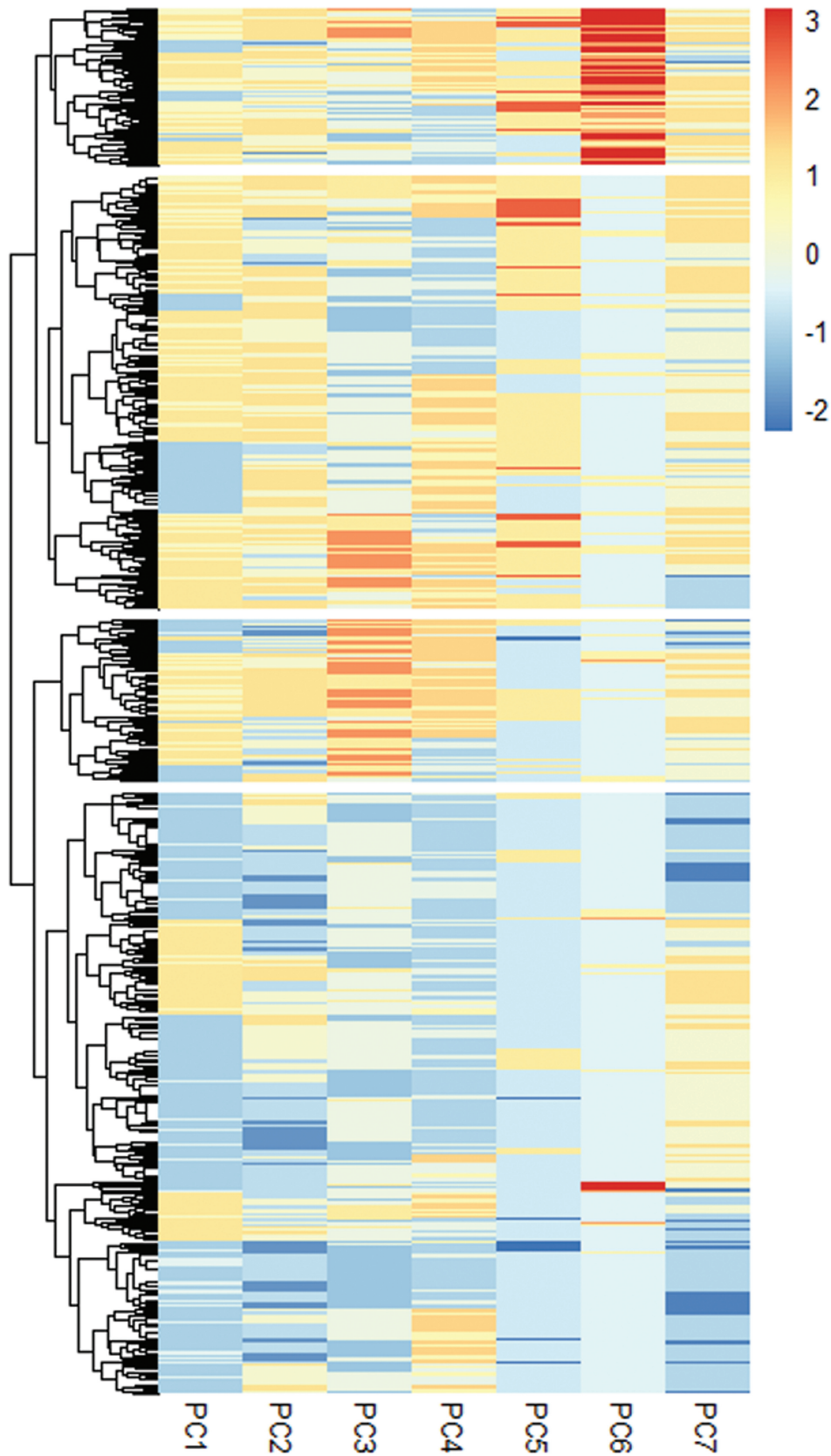
Fig. 1 Dendrogram obtained from the hierarchical cluster analysis, with participant scores for each variable used in the cluster analysis. The color scale represents the Z-score of each participant's score on each subscale. Separations (indicated as a blank space between rows) indicate where one group ends, and another begins.

stood out for having scored low scores on use of medication and sleep disturbances ($n = 361$; 19.3%). Finally, the fourth and largest group was composed of students with low scores in most of the subscales ($n = 805$; 43.2%). Given the structure of the dendrogram and the fact that each group presented distinctive and interesting characteristics, we proceeded to work with 4 clusters, which were named based on their characteristics: "Poor Sleeper," "Effective Sleeper," "Good Sleeper," and "Sleeper with Hypnotic Use," which are described below.

Profile Characterization

The Sleeper with Hypnotic Use was the profile that exhibited the highest symptoms of mental health problems. This cluster presented the poorest subjective sleep quality (alongside the Poor Sleeper profile), a sleep duration between 6 and 7 hours (Me = 1.00), and the highest number of sleep disturbances (alongside the Poor Sleeper profile), occurring 1 to 2 times per week (Me = 2.00). These students also presented low sleep efficiency, lower than 65% (Me = 2.00). This was the only profile that scored above 0 in medication use (Me = 3.00), hence its name (►Fig. 2A).

The Poor Sleeper profile presented moderate symptoms of depression, anxiety, and stress. It had a very poor subjective sleep quality, the worst sleep duration, (between 5 and 6 hours; Me = 2.00), and low sleep efficiency, lower than 65% (Me = 2.00). Along with the Sleeper with Hypnotic use Profile, these students presented the highest number of sleep disturbances, occurring 1 to 2 times per week (Me = 2.00), but they did not report medication use (Me = 0.00).

The Effective Sleeper profile stood out for presenting the best sleep efficiency among the profiles, reaching 100% (Me = 0.00). Despite this, it had poor subjective sleep quality (Me = 3.00), equal to that of the Poor Sleeper profile. It did not report hypnotic medication use (Me = 0.00), and it presented moderate symptoms of depression (Me = 7.00), moderate anxiety (Me = 5.00), and mild stress (Me = 8.00).

Finally, the Good Sleeper profile had lower scores in all subcategories, except for sleep duration (Me = 1.00), in which it equaled all other profiles (except for the Poor Sleeper profile), with a duration ranging from 6 to 7 hours. It had a sleep efficiency between 75 and 84% (Me = 1.00), only surpassed by the Effective Sleeper profile, and fewer than 1 sleep disturbance per week (Me = 1.00), equal to the Effective Sleeper profile. It presented mild symptoms of depression, anxiety, and stress (►Fig. 2B).

Regarding the demographic variables, significant differences between clusters were only observed in terms of sex and SES quintile (►Table 1). The sex differences were due to a higher presence of female participants in the sample. Moreover, the Good Sleeper group presented fewer women than the overall sample, suggesting a higher relative presence of males. The Sleepers with Hypnotic Use group presented a higher percentage of women compared with the overall sample, suggesting a higher frequency of women in this group. When assessed through the Tukey post-hoc test, the SES quintile difference presented only 1 significant contrast between the Good and Poor Sleeper groups (difference:

0.295; $p < 0.001$). Therefore, the clusters were relatively homogeneous in terms of age and semesters completed, with minor differences regarding the SES quintiles.

Once the profiles were characterized (►Table 2), potential differences in the association between sleep and mental health were evaluated in each of them. Thus, Pearson correlations were performed between mental health variables and PSQI subscales, as shown in ►Fig. 3. The results supported the existence of a general relationship between sleep and mental health. However, this relationship differed for each group (►Figure 3A, 3B, 3C, 3D). For example, the associations between subjective sleep quality and symptomatology were higher and negative for the Poor Sleeper group, while the Sleeper with Hypnotic Use group presented comparable intensities of association, but they were positive. Sleep duration made a different contribution to symptomatology in all groups. Habitual sleep efficiency was only associated with the Sleeper with Hypnotic Use group, and medication use had almost no association with the Poor Sleeper profile, while in the rest of the groups, a significant association was observed. Finally, in general, the intensities of the associations varied significantly among the groups.

Discussion

The present research was conducted with the aim of exploring which components of sleep, grouped into profiles, are associated with depression, anxiety, and stress. As a first step, sleep quality profiles were identified and defined among university students. The four profiles obtained were associated with symptoms of mental health issues, to clarify the mechanisms underlying these relationships and provide information that can guide the development of specific interventions to enhance students' mental health.

Data from previous studies[34] suggest that sleep impacts a range of psychological functions, including cognitive function, and that good sleep quality enables satisfactory performance of daily activities and serves as a predictor of physical and mental health, as well as overall quality of life. In the university population, there is evidence that sleep quality problems and mental health symptomatology are recurrent aspects that can also be associated.[13,34]

The poor sleep quality presented by students may be a consequence of psychological challenges inherent to this stage of life and a result of the required adaptation in social, academic, and personal spheres. The transition to university entails significant changes in students' daily habits, including sleep patterns, which can impact their psychological and physical health.[2,35] This is related to other variables, such as academic demands and limited time available for university activities.[17,36] Our findings align with these factors and indicate that Chilean university students also experience poor overall sleep quality, which occurs irrespective of demographic factors. Specifically, in the current research, the associations between symptoms of mental health issues and sleep quality ranged from low to moderate, depending on the profile, which is consistent with findings reported by other studies involving university populations,[12,37] which
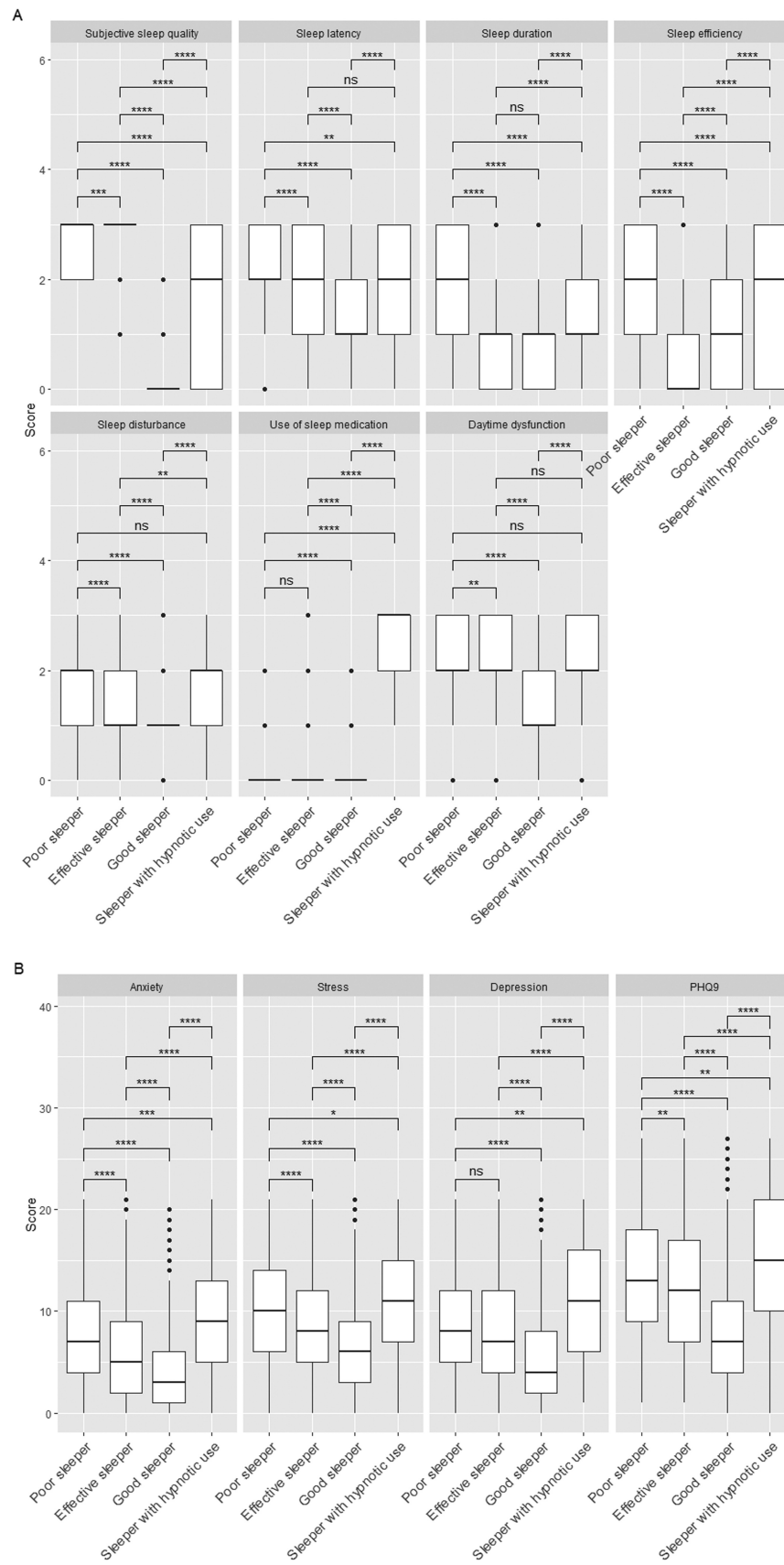
Fig. 2 Box plots for the scores on the Pittsburgh Sleep Quality Index (PSQI) (**A**), on the Depression, Anxiety, and Stress Scales (DASS-21), and on the Patient Health Questionnaire-9 (PHQ-9) (**B**) for the 4 profiles identified. Notes: Results of the Mann-Whitney U tests corrected through the Bonferroni method are presented; $^{*}p < 0.05$; $^{**}p < 0.01$; and $^{***}p < 0.001$.

Table 1 Descriptive statistics by group and overall.

	Poor Sleeper (N = 464)	Effective Sleeper (N = 326)	Good Sleeper (N = 731)	Sleeper with Hypnotic Use (N = 150)	Overall (N = 1671)	*p*-value
Age						
Mean (SD)	22.2 (3.70)	22.4 (4.04)	22.6 (3.89)	23.2 (3.80)	22.5 (3.86)	0.0531
Median (min, max)	21.0 (17.0, 47.0)	21.0 (17.0, 58.0)	22.0 (18.0, 56.0)	23.0 (19.0, 38.0)	22.0 (17.0, 58.0)	
Sex: n (%)						
Female	312 (67.2%)	208 (63.8%)	424 (58.0%)	108 (72.0%)	1052 (63.0%)	**0.0008*****
Male	152 (32.8%)	118 (36.2%)	307 (42.0%)	42 (28.0%)	619 (37.0%)	
Semesters completed						
Mean (SD)	4.49 (2.95)	4.51 (2.84)	4.83 (3.05)	4.79 (2.87)	4.67 (2.97)	0.166
Median (min, max)	4.00 (0, 14.0)	4.00 (0, 11.0)	4.00 (0, 13.0)	4.00 (0, 13.0)	4.00 (0, 14.0)	
Socioeconomic status quintile						
Mean (SD)	2.63 (0.903)	2.79 (1.00)	2.93 (1.07)	2.72 (0.975)	2.80 (1.01)	**4.89e-05*****
Median (min, max)	2.00 (2.00, 5.00)	2.00 (1.00, 5.00)	3.00 (1.00, 5.00)	2.00 (2.00, 5.00)	2.00 (1.00, 5.00)	
Missing: n (%)	51 (11.0%)	36 (11.0%)	100 (13.7%)	23 (15.3%)	210 (12.6%)	

Abbreviations: max, maximum; min, minimum; SD, standard deviation.
Notes: The results of the analysis of variance and Chi-squared test are reported in the *p*-value column; *$p < 0.05$; **$p < 0.01$; and ***$p < 0.001$.

Table 2 Description of the sleep quality profiles.

| Type of sleeper	Main characteristic	Sleep duration	Symptoms
Poor sleeper	Difficulty in falling asleep at night, higher sleep latency, and shorter sleep duration. Ineffective sleep and high daytime dysfunction.	5–6 hours.	Moderate symptoms of depression, anxiety, and stress.
Efficient sleeper	Subjective poor sleep quality and higher sleep efficiency.	6–7 hours.	Moderate symptoms of depression and anxiety. Mild stress.
Good sleeper	Lower scores on all subscales, except for sleep duration and efficiency.	6–7 hours.	Mild symptoms of depression, anxiety, and stress.
Sleeper with hypnotic use	Use of hypnotics to aid sleep onset.	6–7 hours.	Moderate symptoms of depression, anxiety, and stress.

describe a significant relationship between poor sleep quality and higher levels of depression, anxiety, and stress.

We detected and characterized four distinct profiles of sleep quality, which presented significant differences. This enabled us to specifically determine when and how mental health and sleep quality related in students.

The Good Sleeper profile was characterized by good sleep quality, shorter sleep latency, and fewer sleep disturbances, which enables them to function adequately during the day. This profile presented milder symptomatology of depression, anxiety, and stress, which is in line with the findings of studies that reported that adequate sleep duration and good sleep quality were associated with a lower prevalence of depressive symptoms,[38,39] anxiety, and stress.[12]

The Effective Sleeper profile is characterized by poor subjective sleep quality and high levels of sleep disturbance. Despite presenting a shorter time spent in bed without sleeping, these students typically sleep between 6 and 7 hours. Additionally, they exhibit moderate symptoms of depression and anxiety, and mild symptoms of stress. These findings may be associated with those of previous studies[38,39] that have linked short sleep duration (fewer than 7 hours) and poor sleep quality to a higher prevalence of depressive symptoms and lower subjective well-being in adolescents and adults.
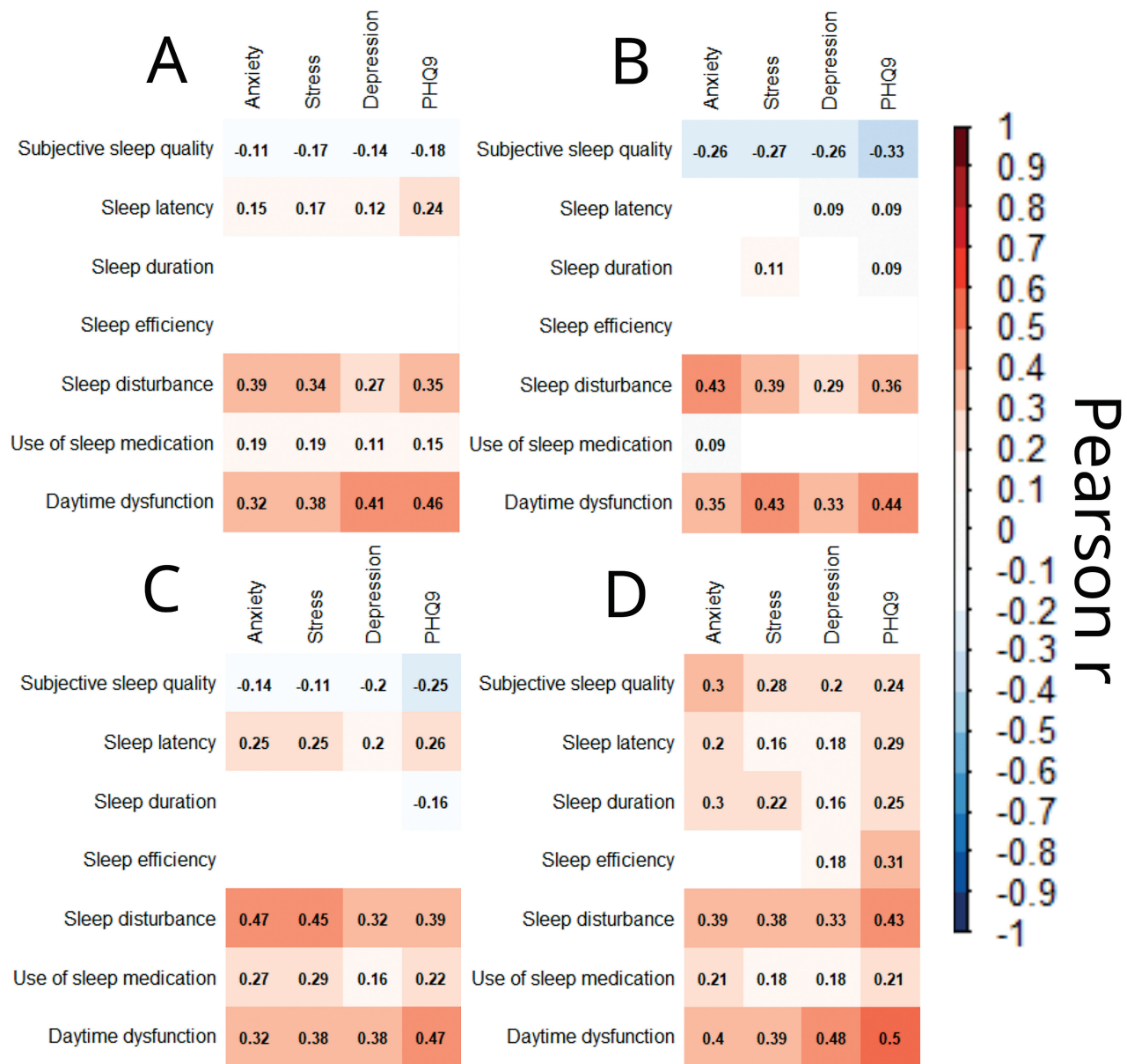
Fig. 3 Independent Pearson correlation matrices for the (A) Good Sleeper, (B) Poor Sleeper, (C) Effective Sleeper, and (D) Sleeper with Hypnotic Use profiles. Each cell presents the Pearson r numerically and in a color scale. Blank cells represent correlations that were not significant.

Our findings are consistent with those of a study[35] that identified an association of sleep patterns with emotional regulation, in which the group defined as having moderate sleep reported deficient sleep patterns, with a mixture of adaptive and maladaptive sleep hygiene behaviors.[35] In conclusion, students in the Effective Sleeper group, even though they may fall asleep without experiencing insomnia, show significant indicators of poor sleep and symptoms of mental health issues, aspects that undoubtedly result in lower quality of life and difficulties in developing an adequate daily routine.[40,41]

The Poor Sleeper profile is characterized by poor subjective sleep quality, difficulties in falling asleep, and a sleep duration of fewer than 6 hours. Additionally, these students report inefficient sleep, with high sleep disturbances and daytime dysfunction. They also exhibit moderate symptoms

of depression, anxiety, and stress. Our findings align with those of previous research[42,43] that reported that students with insomnia or short sleep duration presented higher levels of depression, anxiety, stress, and daytime sleepiness, as well as poorer sleep hygiene and greater daytime dysfunction compared with students without insomnia. Furthermore, inadequate sleep during the night is associated with higher levels of stress and anxiety during the day, difficulty concentrating, and subjective distress, all of which contribute to heightened reactivity to environmental demands.[44] Poor sleep quality can negatively affect emotional well-being and physical functioning, limiting these students' functionality in their daily activities.[38,44]

The Sleepers with Hypnotic Use are a heterogeneous group of students who use hypnotic drugs to sleep and

present moderate scores regarding anxiety, depression, and stress. However, this group reports an acceptable sleep duration (between 6 and 7 hours), which could be explained by the use of medication, as hypnotic drugs increase sleep duration but do not necessarily improve its quality.[45] This finding is consistent with that a study in which students who frequently used sleep medications presented fewer sleep problems but a similar level of daytime dysfunction as other groups, as well as symptoms of depression, anxiety, and stress.[42] Likewise, higher scores on sleep disturbance and hypnotic use are related to elevated anxiety symptoms.[46] It is unclear whether the use of drugs by the students who participated in the present study was medically supervised, so the observed relationship cannot be explained. Neither do we know if these students were attending psychological therapy or receiving any mental health assistance, as these factors could positively influence or mediate the relationship between sleep quality and mental health.[47,48] Although sleepers who use hypnotics may experience improvements in reducing insomnia and increasing the number of hours of sleep, this does not translate into improvements in sleep quality or daytime functioning.[42]

The profiles defined in the current research link sleep quality and mental health in varying degrees, although, overall, adequate sleep quality seems to have a positive influence on the mental health of students. These profiles likely reflect different styles of coping and adaptation to EA, which may explain how the association between sleep and mental health changes according to each profile. Therefore, future studies should aim to clarify the behavioral patterns reflected in these profiles to identify early coping styles associated with higher mental health risks.

Furthermore, there are variables not considered in the research that could interact with the variables considered and influence the results obtained. Among these are sleep hygiene practices, which have a positive effect on the subjective well-being of university students,[39] or the use of substances, such as alcohol or drugs, associated with higher rates of mental health issues.[3,17] Therefore, we suggest that universities implement preventive interventions to promote quality sleep and reduce university-related stress, which could positively impact the students' cognitive functions.[14,15] According to our findings regarding the use of hypnotics for sleep, it is likely that there are students who consume hypnotics without medical supervision. Therefore, it is pertinent to conduct information and prevention campaigns in this regard.

The present study has several strengths, including being the first study conducted in Chile that has attempted to empirically define sleep quality profiles and link them to symptoms of mental health issues in a large sample of university students. Another strength of the study is the large sample size, which enabled us to explore sleep profiles with minimal sampling errors. On the other hand, the limitations of the study lie in the convenience sampling, so it may not necessarily be a representative sample, since more profiles may exist, for example, and students fitting these profiles may be reluctant to voluntarily answer the survey.

In similar fashion, the relative frequency of each profile may also be biased in terms of how likely each profile is to voluntarily answer the survey. Additionally, the data were collected in 2020 during the COVID-19 pandemic, which could have influenced the results, as the prevalence of sleep problems and mental health issues in the university population was affected during the lockdown.[49,50] In future research, it would be desirable to replicate the identified sleep quality profiles in other samples to better understand how these variables interact and give them the relevance they deserve.

Conclusion

The sleep quality profiles provide a distinct depiction of the varying degree of interconnectedness among depression, anxiety, stress, and sleep quality. Adequate sleep has a positive impact on the mental health of students. However, those who sleep more hours do not necessarily sleep adequately, so it is not only relevant to educate and enhance sleep duration but also its quality. Understanding which profiles are at a higher risk of experiencing symptoms of depression, anxiety, or stress would enable the establishment of early warning and prevention plans to improve sleep quality. This would have a positive impact on the overall mental health of the students and likely also on their cognitive functions.

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