Academic performance, physical activity, sleep and gender in university students during the pandemic-2020

Rendimiento académico, actividad física, sueño y género en universitarios durante la pandemia-2020

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Abstract

During the period of confinement, university education was delivered in a virtual modality, which could have an impact on the healthy lifestyles of students. The aim of this study was to evaluate the association between academic performance, physical activity, and sleep quality and determine the existing differences by gender in Physical Education Pedagogy students during the pandemic in 2020. This study was designed as a multicenter, cross-sectional study of 278 university students from Santiago, Talca, and Temuco, Chile. An online survey was applied from July to December, which included questions on physical activity (International Physical Activity Questionnaire, *IPAQ*), sleep quality (Pittsburgh Sleep Quality Index), and sociodemographic information. The results show that women presented better academic performance, worse quality of sleep, and similar physical activity-*MET* than men. The women (β = 0.26, 95% *CI* 0.10 to 0.43 points, p = .002) and those university students who presented a worse indicator in subjective quality of sleep (β = 0.11, 95% *CI* 0.02 at 0.20 points, p = .014) obtained better academic performance in the context of COVID-19. There was no association between academic performance and physical activity. It is essential to look for strategies that allow students to have adequate academic performance and promote healthy habits in this population.

Keywords: academic success, quality of sleep, physical activity, COVID-19.

Resumen

Durante el periodo de confinamiento, la educación universitaria fue impartida bajo modalidad virtual, pudiendo repercutir en los estilos de vida saludable de los estudiantes. El objetivo fue evaluar la asociación entre rendimiento académico, actividad física y calidad de sueño, y determinar las diferencias existentes según género en estudiantes de Pedagogía en Educación Física durante la pandemia en el año 2020. Se realizó un diseño transversal multicéntrico, en 278 universitarios pertenecientes a las ciudades de Santiago, Talca y Temuco; Chile. Se aplicó una encuesta online desde julio a diciembre, incluyendo preguntas sobre actividad física (Cuestionario Internacional de Actividad Física, *IPAQ*), calidad del sueño (Pittsburgh Sleep Quality Index) e información sociodemográfica. En los resultados, las mujeres presentaron mejor rendimiento académico, peor calidad del sueño, y similar actividad física-*METs* respecto a los hombres. Las mujeres (β = 0.26, *IC* 95% 0.10 a 0.43 puntos, p = .002), y aquellos universitarios que presentaron un peor indicador en la calidad subjetiva del sueño (β = 0.11, *IC* 95% 0.02 a 0.20 puntos; p = .014) obtuvieron mejor rendimiento académico en contexto por COVID-19. No existió asociación entre rendimiento académico y actividad Física. Es importante buscar estrategias que permitan un adecuado rendimiento académico, y también favorecer hábitos saludables en esta población.

Palabras clave: éxito académico, calidad de sueño, actividad física, COVID-19.

Introduction

In December 2019, in Wuhan, China, the first contagion by COVID-19 was detected, being declared a pandemic on March 11, 2020. Since then, in Latin America, the number of cases increased to 70 million, and 1.6 million deaths have been confirmed by the World Health Organization (WHO). Particularly in Chile, the number of infections amounts to 4,030,267 and the number of deaths to 58,617 as of the first week of July 2022 (PAHO, 2022). After the initial health alert, each country implemented various strategies, including the suspension of face-to-face classes in schools and universities and the suspension of cultural, sports, and social events.

As a result of health guidelines, virtual education through online platforms emerged as an alternative to continue the teaching-learning process, generating a process of historical transformation (UNESCO, 2020). University education in Chile began its academic year in a virtual mode in March 2020; this ended in December of the same year, providing more flexibility for face-to-face teaching depending on the specific area of the country and limited by the reduced capacity.

The academic performance of university students is an element of great importance and concern in higher education (Fenollar et al., 2007). In this regard, the evidence suggests that multiple factors are associated with academic success, including attitudinal, psychological, and contextual aspects (Fenollar et al., 2007; Pérez-López & Ibarrondo-Dávila, 2020; van Herpen et al., 2017). In parallel, other variables associated with healthy habits, such as sleep quality and physical activity, can influence the academic performance of students (Adelantado-Renau et al., 2019).

During the pandemic, problems associated with sleep have stood out, which have been described mainly in the population of students of healthcare careers; however, their implication in the context of university students of pedagogy is scarce (Lipert et al., 2021). This is relevant because good sleep quality and duration are associated with good health, especially mental well-being (Baglioni et al., 2016). Sleep recommendations indicate that adults (18 to 60 years old) should sleep between 7 to 9 hours a day (Watson et al., 2015). Cross-sectional studies carried out before and during the pandemic have shown that the prevalence of poor sleep quality in the university population is significantly higher in women (Dongol et al., 2022; Fatima et al., 2016).

Regarding the relationship between academic performance and adequate sleep quality in the university population, the evidence indicates that there is a positive association between the two (Ahrberg et al., 2012; Alotaibi et al., 2020; Fernández-Medina et al., 2020; Okano et al., 2019; Rathakrishnan et al., 2021; Satti et al., 2019; Suardiaz-Muro et al., 2020). Also, an association has been found between academic performance and physical condition in university students of pedagogy (Godoy et al., 2015). Although the minimum physical activity recommended by the WHO for this age range is 150 minutes of moderate physical activity per week (Bull et al., 2020), there are disparate results regarding its association with academic performance. A cross-sectional study found that engaging in two to three hours of weekly physical activity was significantly correlated with higher academic performance in students in their second year of college (Lipošek et al., 2019). On the other hand, a systematic review determined that there was no significant relationship between physical activity and academic performance when analyzing only four studies in a university population (Wunsch et al., 2021).

It has been shown that being physically active is beneficial for perceiving less stress, fewer sleep problems, and improving sleep quality, especially among those exposed to remote work (Lipert et al., 2021). On the other hand, the available evidence shows gender differences in the prevalence of physical activity (McCarthy & Warne, 2022) and sleep quality (Dongol et al., 2022; Fatima et al., 2016) in young and adult populations. Among university students, Physical Education Pedagogy students are physically active (Almagià et al., 2009; Godoy Cumillaf et al., 2021; Ruiz et al., 2012); therefore, they are a population of interest in analyzing these factors during the course of the academic year. The objective of the present study was to evaluate the association between academic performance, physical activity, and sleep quality and to determine the existing differences according to gender in Physical Education Pedagogy students during the pandemic period in 2020.

Methodology

Participants

Multicenter cross-sectional design study. The population was 603 university students from the Physical Education Pedagogy career of a university in Chile who had virtual classes and practices during the 2020 academic year. The study adopted non-probabilistic convenience sampling of students over 18 years of age enrolled in the three cities of the country where the career is taught (Santiago, Talca, and Temuco). The inclusion criterion was to be registered in the Autumn-Spring 2020 semester. Participants who presented subjects not completed at the end of the corresponding academic year were excluded. The final sample consisted of 278 Physical Education Pedagogy students.

The invitation to participate was made through infographics disseminated in the internal social networks and institutional emails of the university students, from which the online survey link (onedrive) could be accessed. The period of application of the instrument was between July and December 2020, a period in which Chile was in confinement.

All university participants had to give informed consent before starting the online survey and voluntarily provide access to their academic data under the 1964 Declaration of Helsinki and its subsequent updates. The project has the approval of the Institutional Scientific Ethics Committee of the Universidad Autónoma of Chile (CEC-2320).

Instruments

The collection considered the following data:

Sociodemographic data

Including information regarding sex, age, with whom they live, and geographic area of residence.

Self-report of chronic diseases

Physical symptoms in the last 14 days, and diagnosed positive for COVID-19.

Healthy habits

Regarding their practice of sport and exercise, type of physical activity, tobacco consumption, and alcohol consumption.

Physical activity

The International Physical Activity Questionnaire (*IPAQ*) was used to measure physical activity. The metabolic equivalent of total physical activity (*MET*) in minutes/week was calculated using the procedure established in the *IPAQ* web portal (www.ipaq.ki.es), and participants were classified into low or inactive, moderate, or high activity levels. For the Low level, the classification criterion was those that did not meet any of the criteria for either moderate or high levels of physical activity. For moderate, it was meeting any of the following criteria: three or more days of vigorous intensity activity for ≥ 20 minutes, five or more days of moderate intensity activity or walking for ≥ 30 minutes, five or more days of any combination of activities with at least ≥ 600 *MET*s min-week. For the High level, the criteria were to perform three or more days of vigorous activity or reach 1500 *MET*s min-week; or perform seven or more days of any combination of walking, moderate intensity, or vigorous intensity activities achieving a minimum total physical activity of at least 3000 *MET*s min-week (Bauman et al., 2011; Craig et al., 2003).

Sleep quality

It was assessed with the self-administered Sleep Quality Index (Pittsburgh Sleep Quality Index, *PSQI*) questionnaire (Buysse et al., 1989), which provides a sleep quality score based on the assessment of seven components: 1) subjective sleep quality; 2) sleep latency; 3) sleep duration; 4) sleep efficiency; 5) sleep disturbance; 6) use of sleep medication; and 7) daytime dysfunction. The sum of the seven components creates a scale from 0 to 21 points (*PSQI* score). A higher score indicates poorer sleep quality. A *PSQI* score of ≤ 5 was determined as good sleep quality.

Academic Performance

From the central database of the University, the final grades of the academic process of each student were requested considering all the subjects taken during the 2020 period (March to December). In Chile, the grading system ranges from 1.0 to 7.0 points (7.0 is the maximum qualification), with 4.0 points being the passing grade.

Statistical analysis

The characteristics of the sample were obtained through a descriptive analysis using means and standard deviation (*SD*) for continuous variables and proportions for categorical variables. The normality and homoscedasticity of the variables were examined through the Kolmogorov-Smirnov and Levene's tests, respectively. For the analyses differentiated by sex, the Chi. test and the variance test (ANOVA) were used according to the nature of the variables, applying the Welch test in the case of non-normality. Spearman's Rho correlations were performed to analyze the direction and strength of the association between academic performance and the general sleep quality score, each of their components, and physical activity *MET*s. To analyze academic performance with qualitative variables, analysis of variance (ANOVA) was used, applying the Welch test and Bonferroni post hoc tests if required. Subsequently, a multivariate linear regression analysis was carried out with academic performance as the dependent variable, including the associated variables and the geographical area adjustment variables. The level of significance was established at $p < .05$. Analyzes were performed using IBM SPSS® 28 and RStudio 4.0.3 software.

Results

The sample reached was 281 students, obtaining a response rate of 47%. Three students who did not present valid data in the physical activity questionnaire were excluded. Finally, 278 participants were analyzed.

The characteristics of the participants are shown in Table 1. The mean age was 21.3 ± 2.3 years, ranging between 18 and 29 years, and women represented 27.3% of the sample.

Regarding the sociodemographic characteristics, 15.8% indicated that they reside in a rural area, 50% currently live with both parents, and 35.3% only with their mother. According to the distribution of university students by geographical area, Santiago and Temuco had a higher proportion of male (43.6%) and female (40.8%) students compared to Talca, respectively ($p = .003$).

Table 1. Sociodemographic and health characterization of students

	Total	Men	Women	*p*-value
	N = 278	n = 202	n = 76	
Sex, %		72.7	27.3	
Age, years, mean (*SD*)	21.3 (2.3)	21.4 (2.3)	21.1 (2.2)	.160
Urban zone, % (n)	84.2 (234)	85.6 (173)	80.3 (61)	.273
Geographic area				.003
Santiago, % (n)	37.8 (105)	43.6 (88)	22.4 (17)	
Talca,% (n)	33.1 (92)	31.7 (64)	36.8 (28)	
Temuco,% (n)	29.1 (81)	24.8 (50)	40.8 (31)	
Academic year				.263
Fourth or more, % (n)	24,1 (67)	23.8 (48)	25.0(19)	
Third, % (n)	19.8 (55)	20.8(42)	17.1 (13)	
Second,% (n)	21.6 (60)	18.8 (38)	28.9 (22)	
First, % (n)	34.5 (96)	36.6 (74)	28.9(22)	
Residence home				.066
Lives with both parents, % (n)	50.0 (139)	53.0 (107)	42.1 (32)	
Lives only with mother,% (n)	35.3 (98)	35.1 (71)	35.5 (27)	
Live alone, with other family or friends,% (n)	14.7 (41)	11.9 (24)	22.4 (17)	
Has children, Yes,% (n)	5.0 (14)	4.0 (8)	7.9 (6)	.181
Works, Yes,% (n)	27.0 (75)	26.2 (53)	28.9 (22)	.650
Habits and health				
Have any disease, Yes,% (n)	8.3 (23)	5.4 (11)	15.8 (12)	.005
Diagnosis of COVID-19, Yes,% (n)	3.2 (9)	3.5 (7)	2.6 (2)	.726
Tobacco consumption, , Yes,% (n)	13.7 (38)	10.9 (22)	21.1 (16)	.028
Alcohol consumption, Yes,% (n)	63.7 (177)	63.4 (128)	64.5 (49)	.864
Environment				
Green areas near the home,% (n)	87.1 (242)	90.1 (182)	78.9 (60)	.014
Use of green areas prior to COVID-19,% (n)	64.7 (180)	75.3 (143)	56.1 (37)	.003

Note: *SD* = standard deviation.

Regarding the academic year, 56.1% of university students were in their first or second year of studies.

In health status, women reported almost three times more prevalence of some diseases than men ($p > .05$), and only 3.2% of the participants had been diagnosed with COVID-19 at the time of the survey.

The habit of alcohol consumption was the most prevalent, being over 60%, and with a similar response between both sexes. A difference was observed in tobacco consumption, where women had almost twice the prevalence as men (1.9 times more, $p = .028$).

Academic performance presented an annual average of 5.8 ± 0.6 points, with women performing 0.3 tenths of a point better than men ($p < .001$). At the end of the year, 98% of the university students obtained satisfactory academic approval (Table 2).

Table 2. Characterization of academic performance, physical activity and sleep quality of students

	Total N = 278	Men n = 202	Women n = 72	*p*-value
Academic Performance				
Annual average, mean (*SD*)	5.8 (0.6)	5.7 (0.6)	6.0 (0.6)	< .001
% Academic approval, mean (*SD*)	98.0 (8.5)	97.9 (8.1)	98.4 (9.3)	.337
Physical Activity				
Total METs week, mean(*SD*)	3584.4 (2687.7)	3697.6 (2771.1)	3282.8 (2444.0)	.226
Physical activity level, *IPAQ*				.020
High, % (n)	52.5 (146)	57.4 (116)	39.5 (30)	
Moderate, % (n)	37.4 (104)	32.7 (66)	50.0 (38)	
Low, % (n)	10.1(28)	9.9(20)	10.5 (8)	
Sleep quality				
PSQI score, mean (*SD*)	8.4 (3.3)	8.0 (3.2)	9.3 (3.4)	.003
Good sleep quality, % (n)	20.5 (57)	23.8 (48)	11.8 (9)	.028
≥ 7 hours of sleep, % (n)	64.0 (178)	64.9 (131)	61.8 (47)	.641

Note: *SD* = Standard deviation, *IPAQ* = International Physical Activity Questionnaire, *PSQI* = Pittsburgh Sleep Quality Index Good sleep quality: ≤ 5 *PSQI* points.

The university students of pedagogy in Physical Education presented a 52.5% high level of physical activity, and when compared by sex, men obtained a prevalence 18% higher than women (p = .002). Total physical activity was 3584.4 ± 2687.7 *METs*/week, with no differences between sex (Table 2).

Within the physical activities carried out by university students during the pandemic, specific activities such as strength, metabolism, flexibility, and general level exercises predominated.

The sleep quality of university students was 8.4 ± 3.3 points, which was 3 points above the criterion for a good quality of reference sleep. In this aspect, women scored higher than men (p = .004).

Only 20.5% of the university students presented an excellent quality of sleep, with the difference between the sexes persisting, as women obtained a 12% lower prevalence than men in this indicator (p = .028).

Pedagogy students had a sleep duration of 7.3 ± 2.0 hours, while 36% of university students did not meet the recommended minimum of 7 hours (Table 2).

When considering each of the components of sleep quality separately, the most remarkable alterations were in the sleep latency indicators, followed by subjective sleep quality and daytime dysfunction (presence of excessive sleepiness), which showed the highest values among students.

Differences between sexes were observed in the subjective quality of sleep (p = .030), sleep disturbances (p = .041), and daytime dysfunction (p = .007): these indicators were worse in women, Figure 1.

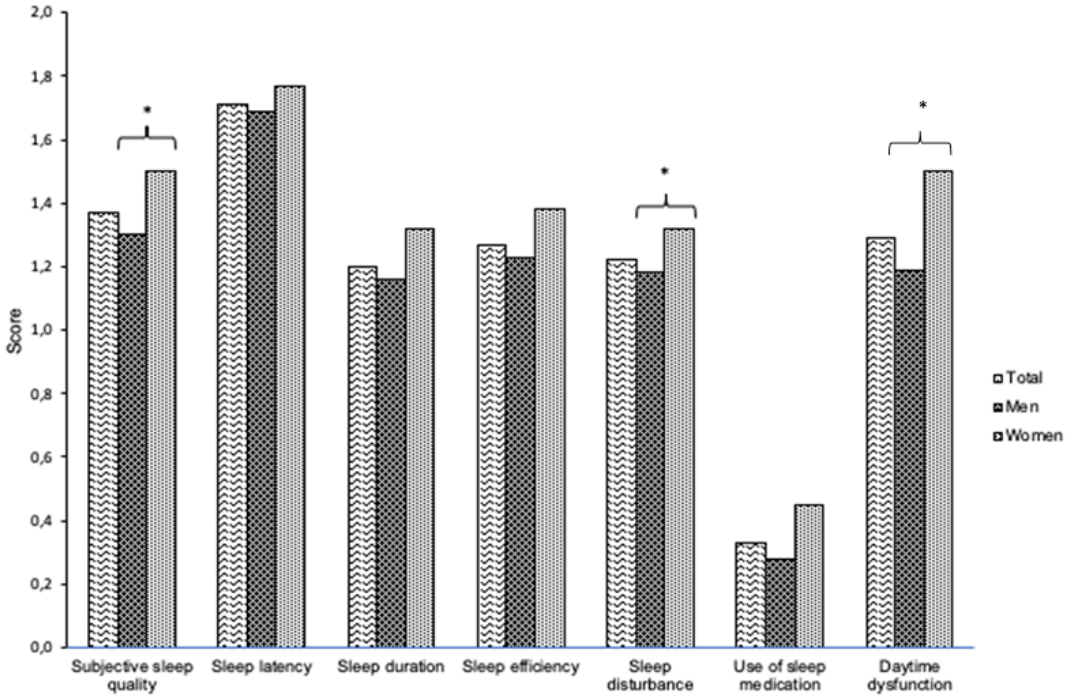

Figure 1. Analysis of the components of the sleep quality of students
*p < .05

When analyzing the association between academic performance and geographical area, there were significant differences. The annual average in Santiago was 5.7 ± 0.6 points, Talca 5.6 ± 0.5 points, and Temuco 5.9 ± 0.7 points (p = .034) specifically presenting a difference in performance between Talca and Temuco (p = .028).

When considering the habits of physical activity, alcohol consumption, and tobacco consumption, there was no association with academic performance; for all p > .05 (data not shown).

When analyzing the annual average and its association with the general sleep quality score, a weak positive correlation was found (r = .17; p = .005). When performing the analysis with each component, there was only a correlation between academic performance and subjective sleep quality (r = .15; p = .015) (Figure 2). In contrast, when analyzing academic performance and physical activity performed in *MET*s/week, there was no significant correlation (r = -.026, p = .663). The results showed no difference when analyzing the association between academic performance and level of physical activity (Low: 5.8 ± 0.6 points, Medium: 5.8 ± 0.6 points, High: 5.7 ± 0.7 points; p = .395).

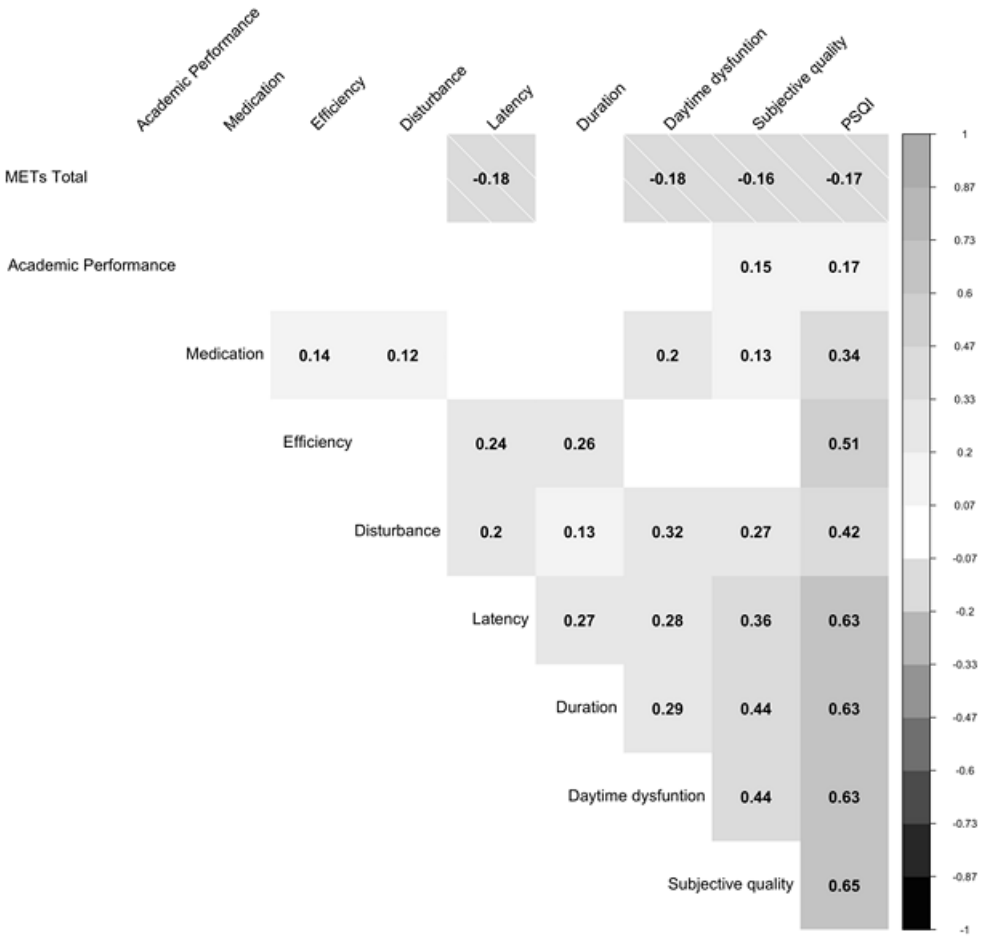

Figure 2. Correlation between academic performance, sleep quality and physical activity *METs*
Note: *PSQI*: Pittsburgh Sleep Quality Index. Significant results are shown with *p*-values < .05 from Spearman's correlation analysis.

When analyzing academic performance and the general sleep quality score, including gender and geographic adjustment, the association is lost (β = 0.014, 95% *CI* -0.008 to 0.036 points, p = .222). Finally, academic performance and the component of subjective sleep quality were analyzed—adjusted for geographic area and with gender as a co-variable. The results showed that women (β = 0.26, 95% *CI* 0.10 to 0.42 points, p = .002) and university students who presented a worse indicator in the subjective quality of sleep (β = 0.11, 95% *CI* 0.02 to 0.20 points; p = .014) presented a better annual academic performance considering the 2020 COVID-19 context. Only 7.5% of the academic average is explained by the variables described above.

Discussion

The objective of this study was to evaluate the association between academic performance, physical activity, and sleep quality and to determine the differences according to gender in Physical Education Pedagogy students during the pandemic period in 2020.

Worsening sleep quality was associated with better academic performance; in contrast, there was no correlation between academic performance and physical activity in university students of Physical Education Pedagogy during the COVID-19 pandemic. Our results show that the female gender, and specifically a worsening subjective sleep quality, was associated with higher academic performance during the pandemic.

Few studies analyze the association of these three variables. A pre-pandemic study of 219 Pakistani medical students found that physical activity (r = .61; p = .003) and better sleep quality (r = -.69; p < .001) were associated with academic performance (Satti et al., 2019). However, the pandemic context, the gender distribution (57% women), and the physical activity level profile (Level: 16.4% high, 40.2% low) may be the answer to the differences found in the present investigation.

Our study found that only 10.5% did not meet the physical activity recommendations (Low level), and 52.5% of university students declared a high level of physical activity during the pandemic, a high prevalence that is to be expected in the physical activity area student population (Farinola, 2011), and close to the 64% reported in Swiss students while in lockdown (Taeymans et al., 2021).

Our results also agree with the patterns of physical activity according to gender (Rodríguez-Larrad et al., 2021); a moderate level of physical activity predominated among women and a high level of physical activity among men. Although the absolute values of the *METs*/week performed by the students are within the recommendation for prevention and health benefits (Kyu et al., 2016), they are low values according to antecedents prior to the pandemic in Physical Education pedagogy students (≥ 6.000 *METs*/ week) (Farinola, 2011). Despite this, they were similar to

the *MET*s/week described in university students in Ireland (Du et al., 2021) and Switzerland during the pandemic (Taeymans et al., 2021). We found no gender differences in this aspect; women probably had to reduce their physical activity less than men as they were less dependent on outdoor activities (Rodríguez-Larrad et al., 2021). In this context, there was no association between physical activity and academic performance in physically active university students, possibly due to the homogeneity in these data among our participants. The review by Wunsch et al. (2021) is consistent with our findings and shows significant heterogeneity in their results from four analyzed studies (Wunsch et al., 2021).

On the other hand, the high level of physical activity in our university students during the pandemic may respond to a need of students to meet all the demands of the academic load, motivation, and self-determination to maintain this habit (Zubiaur et al., 2021), as well as a strategy to reduce their anxiety and stress during confinement by being aware of the benefit to their mental health (Martinez et al., 2020; Planchuelo-Gómez et al., 2020). Likewise, it can respond to the need to remain physically active, which is reflected in the activities they preferably developed during this time, adapting to the conditions and limitations of space in their homes. This situation goes hand in hand with what was exposed by Rodríguez-Larrad et al. (2021) regarding the modifications made by university students to stay active, i.e., preferring high-intensity and short-duration training (Rodríguez-Larrad et al., 2021).

In line with the evidence, the Sleep Quality Index (*PSQI* 8.4) and the prevalence of poor sleep quality (79.5%) were elevated during the COVID-19 pandemic in university students, reflecting poor sleep hygiene in Physical Education Pedagogy students. Previously, Chen Du et al. (2021), in their study of 2,254 university students from China, Ireland, Malaysia, South Korea, Taiwan, Netherlands, and the United States, with 66.6% of female participants, revealed unhealthy values in sleep quality, specifically among students from Ireland and the USA, both with a *PSQI* score of 7.4 ± 3.6 (Du et al., 2021).

Another study conducted during the pandemic in Spanish university students presented a *PSQI* score of 7.2 ± 3.9 and indicated that sleep quality worsened during the pandemic (Martínez-de-Quel et al., 2021). Parallel to this, university students from the United States and Europe reported worse health indicators (diet, alcohol consumption, sleep quality, and physical activity) compared to Asian countries during the pandemic (Du et al., 2021). It would be interesting to consider Latin American countries in the comparison, given the different socio-cultural contexts and the high prevalence of poor sleep quality in Chilean university students. Worse sleep quality reduces the time of alertness and memory, which is related to attention and difficulty in academic performance. Its negative effect on cognition and mental health can influence good academic performance in university students in the long term (Rathakrishnan et al., 2021).

Adequate sleep is essential for motivation, attention, and memory (Fernández-Medina et al., 2020). It has been described that those who report a poor quality of sleep have more daytime dysfunction problems related to fatigue, sleepiness, and worse cognition than those who sleep better (Okano et al., 2019). The study developed by Gelaye et al. (2014) in a heterogeneous sample of university students from different countries that included 880 students in a pre-pandemic context indicated an excessive daytime dysfunction present in students from Peru, Chile, and Thailand (Gelaye et al., 2014). Our results presented a more significant alteration in subjective quality of sleep and daytime dysfunction, which is in line with what has been reported in pre-pandemic studies in university students (Lemma et al., 2014; MacHado-Duque et al., 2015; Mirghani et al., 2015; Wong et al., 2013).

Accordingly, students from Italy presented a 73.3% prevalence of poor sleep quality (Marelli et al., 2021), emphasizing that the isolation period had a more significant impact on the sleep quality of women and students when compared to workers. In particular, our results show significant differences according to gender, associated with a greater impact on the quality of sleep during confinement in women. They presented a more remarkable alteration in the subjective quality of sleep, sleep disturbances, and daytime dysfunction. These data are consistent with previous studies in a university population (Cellini et al., 2021; de la Portilla Maya et al., 2019; Durán et al., 2017; Fawzy & Hamed, 2017) and with the evidence from different age groups, in which a lower quality of sleep associated with the female gender is reported, possibly due to differences in the architecture of sleep in the "non-REM" phase (Mallampalli & Carter, 2014) and the physiological responses generated from the menstruation cycle (Colten et al., 2006).

One of the possible causes of poor sleep quality in our general population is a longer exposure time to screens (Hjetland et al., 2021; Muhammad & Hussain, 2021) and their use close to bedtime (Guo et al., 2021; Islam et al., 2021). Increased time spent using electronic devices is associated with worsening sleep quality, higher sleep latency, and later wake-up time (Amra et al., 2017; Christensen et al., 2016; El Hangouche et al., 2018). In this regard, studies have reported a significant increase in the use of screens during the pandemic (Pišot et al., 2020). Specifically, Physical Education students attended classes and practices in a mainly "online" modality.

These antecedents suggest that students experienced increased use of electronic devices to follow their academic activities synchronously (connected in real-time) and asynchronously (independently to study their various subjects), which could affect their sleep quality in the context of a pandemic.

Another cause may be the sleep schedule of students during the pandemic. In our study, the sleep schedule of university students was from ~ 3:00 *am* to ~ 9:00 *am*. This is in line with the results of Csépe et al. (2021) on university students, which suggest that, during the confinement period, there was a delay in the time to go to sleep and greater flexibility in the time to get up, shifting the chronotype toward the evening (Csépe et al., 2021; Genta et al., 2021). Therefore, this new structure can cause drowsiness, changes in the biological rhythm, and a worsening of the subjective quality of sleep by reducing melatonin synthesis (Ahrberg et al., 2012; Marelli et al., 2021).

Finally, it has been suggested that a combination of anxiety and stress caused by the COVID-19 pandemic could be responsible for the negative results observed in sleep quality (Martínez-de-Quel et al., 2021).

Interestingly, the results showed a significant correlation between the *PSQI* score and academic performance, consistent with previous studies (Ahrberg et al., 2012; Alotaibi et al., 2020; El Hangouche et al., 2018; Fernández-Medina et al., 2020; Rathakrishnan et al., 2021; Satti et al., 2019; Suardiaz-Muro et al., 2020). In contrast, we found a weak positive correlation between overall sleep quality (r = .17; p > .05) and the subjective sleep quality component (r = .15; p = .015) with yearly grade point average.

A study conducted on sleep, well-being, and academic performance of Singapore university students stated that daytime dysfunction also had a low correlation with academic performance (r = -.240; p = .013) (Armand et al., 2021). However, the trend of the results prior to the COVID-19 pandemic shows a direction of the association that contrasts with the findings of our study.

Among the multiple factors associated with academic performance, self-efficacy and the establishment of study habits can be highlighted (Kocak et al., 2021). In the context of the pandemic, developing skills and achieving the performance required staying connected through various electronic devices.

The students with the highest academic performance likely were those who spent more time connected to electronic devices, perhaps preferably in the evening, which, in turn, affected their sleep quality.

The results of the association between academic performance with physical activity and sleep quality in a university population of Physical Education pedagogy students should be taken with caution; longitudinal studies are necessary to deepen the understanding of these factors.

Our work presents a cross-sectional design that does not allow us to evaluate the change in the academic performance of students as a consequence of the pandemic, nor the impact of sleep quality and physical activity on it. The low response rate of participants due to the difficulty of online application and saturation of different activities through virtual media during the pandemic, the gender imbalance, and not controlling the time of exposure to screens or technological devices make our results not generalizable to other populations.

The strengths of the study are its multicenter nature, carried out in a university population of Latin American Physical Education pedagogy students during the COVID-19 period, and with the application of validated and internationally used instruments.

The projections require studies with objective evaluations of sleep quality and physical activity to contrast the self-reported results, as well as including exposure time and screen use, such as longitudinal designs to deepen the understanding of the findings and risk indicators found in college students that may affect their cognitive and mental health in the long term.

Conclusion

Academic performance was associated with worse sleep quality among Physical Education pedagogy university students, specifically related to a worsening in the subjective quality of sleep component. In general, during the pandemic, women presented a worse quality of sleep and better academic performance than men. Physical activity was not associated with academic performance. 90% of the university students complied with the recommendations for physical activity during this period; men stood out in the high level and women in the moderate level of physical activity.

It is crucial to monitor the behavior of these variables for an academically demanding environment that favors healthy habits that impact the physical and mental well-being of university students throughout the process and post-pandemic.

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