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Sleep quality and associated factors in Latin American medical students: a cross-sectional and multicenter study

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Abstract

Background Existing literature has not stablished the factors associated with sleep quality, which requires further research in the context of the mental health of future medical professionals. This study aimed to determine the prevalence and factors related to sleep quality in Latin American medical students during the COVID-19 pandemic.

Methods Cross-sectional multicenter analytic study of secondary data analysis in Latin American medical students. The sampling was non-probabilistic snowball sampling. Sleep quality (Pittsburgh questionnaire) and its association with psychosocial-academic variables, depressive symptoms (PHQ-9 questionnaire), anxious symptoms (GAD-7 questionnaire), resilience (abbreviated CD-RISC questionnaire), eating disorder (EAT-26 questionnaire), physical activity (IPAQ questionnaire-short version), tobacco and alcohol consumption (ASSIST questionnaire) and burnout syndrome (Maslash questionnaire) were assessed. Prevalence ratios and 95% confidence intervals were estimated.

Results Of 2019 medical students, the prevalence of poor sleep quality was 62.2% (95%CI: 60.00%-64.28%). In the multiple regression model, factors that were positively associated with poorer sleep quality were female sex (PR: 1.13), moderate risk of smoking (PR: 1.08), the presence of moderate to severe depressive symptoms (PR: 2.19 and PR: 2.14, respectively), as well as moderate and severe anxiety symptoms (PR: 1.21 and PR: 1.22, respectively). On the other hand, factors that were negatively associated with poorer sleep quality were having received training on COVID-19 (PR: 0.95), having a history of COVID-19 (PR: 0.80), and having a high level of resilience (PR: 0.86).

Conclusion It was found that 62.2% of students had poor sleep quality. Factors such as female sex, moderate risk of smoking, and depressive and anxious symptoms were associated with poor sleep quality, while COVID-19 training, history of the disease, and a high level of resilience were linked to better quality. These findings are key for public health, as poor sleep quality affects physical and mental health and academic performance, underscoring the importance of intervening on these factors to improve student well-being.

Keywords Sleep quality, Mental health, COVID-19, Medical students, Latin America

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Introduction

Sleep is a fundamental part of human physiology for proper functioning of the body, mental health and good quality of life [1]. In a pre-pandemic systematic review, it was found that the prevalence of poor sleep quality in medical students was 52.7% using the Pittsburgh Sleep Quality Index (PSQI) instrument, being more common in students from Europe (65.1%) and America (59.9%) [2]. Sleep deprivation in future physicians is a topic of great interest, as medical students find themselves in an environment marked by constant anxiety and stress [1–5]. Therefore, sleep deprivation can make them more susceptible to depressive disorders and affect their neurocognitive and psychomotor performance [6].

The COVID-19 pandemic has affected the quality of sleep of the university population, especially medical students, because they have had to adapt to new education measures during confinement and period of mandatory social isolation [7] Previous studies conducted during the first pandemic wave have estimated 45%, 48.1% and 63.6% of poor sleep quality in medical students from India, Ethiopia and Thailand; respectively [8–10]. In Latin America, 68.4%, 82.5%, 78.16% and 43.4% of countries in Mexico, Ecuador, Brazil and Peru; respectively; have had poor quality of sleep [11–14]. In addition, variables such as depression, stress, anxiety, nomophobia (the term used to describe the fear or anxiety of being without a mobile phone or being unable to use it) [9, 14, 15], excess hours of classes, studies and clinical internships [16], Comorbidities, alcohol consumption once a month, anxiety and depressive symptoms have been documented as influencing factors of poor sleep quality in medical students during the COVID-19 pandemic [17].

Studying sleep quality during the first wave of the COVID-19 pandemic is crucial due to the heightened uncertainty and significantly increased stress levels experienced by individuals during this period. The first wave of the pandemic was characterized by unprecedented global disruption, lockdowns, and a rapidly evolving health crisis, which led to an overwhelming sense of uncertainty and fear [17]. Studies have shown that such stressors can severely impact mental health, leading to higher levels of anxiety, depression, and sleep disturbances [5]. This period of heightened stress and uncertainty is distinct from later waves, as it marked the initial shock of the pandemic, with individuals experiencing a lack of preparedness and understanding of the virus, which compounded psychological strain [18]. Previous research has often focused on the longer-term effects of the pandemic or on specific groups of individuals, such as healthcare workers or patients [19], but there is a gap in understanding the impact of the first wave on medical students, a group particularly vulnerable due to the academic and emotional pressures they face [20]. By focusing on this specific time frame, this study highlights the originality of exploring sleep quality amidst the unique challenges posed during the early stages of the COVID-19 pandemic, providing a deeper understanding of how early stress and uncertainty affected sleep patterns in Latin American medical students.

However, although previous investigations have been conducted on sleep quality and associated factors in human medical students, there is inconclusive evidence regarding this research question. First, most studies have not evaluated students from various medical schools in Latin America [21, 22]. Second, previous studies have not evaluated potential confounders (having received training in COVID-19, having resilience and frequent tobacco consumption), probably causing information bias [15, 23]. Third, similar investigations have been designed with a descriptive approach [13, 24], absence of multiple models that estimate strength and magnitude of association of confounding variables [25, 26], and limited rigor of biostatistical methods to identify factors influencing sleep quality [27–29]. Additionally, there is inconclusive evidence on the topic in the first wave, the most severe moment of the health emergency, since the vast majority have been conducted in the context of the second pandemic wave onwards [30, 31].

For these reasons, the objective of this research is to evaluate sleep quality and its associated factors in medical students in Latin America, during the first wave of the COVID-19 pandemic in 2020.

Methods

Study design and population

Secondary data analytic cross-sectional study, which identified the prevalence and factors associated with poor sleep quality in medical students from 13 Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, Ecuador, El Salvador, Mexico, Paraguay, Peru and Venezuela) during the first pandemic wave period June 15 to September 15, 2020. The primary objective of the research was to identify whether resilience was associated with post-traumatic stress disorder due to COVID-19.

The population consisted of medical students from Latin American and Caribbean countries. Universities eligible for the research were those where a Scientific Society of Medical Students (SOCEM) or another scientific-academic group existed during the COVID-19 pandemic.

In the primary study, we included students who were enrolled in the regular 2020-I cycle at their undergraduate university, approved informed consent, and were 18 years of age or older at the time of participation. We

excluded students who did not respond to the variables of interest in the questionnaires (n = 461) and those who did not provide consent (n = 200). In the secondary data analysis study, all records of students who had completed the variables of interest were included.

The sample size calculation for the primary study was based on the following parameters: 80% power, 95% statistical significance, and a Pearson correlation coefficient of 0.108 between post-traumatic stress symptoms and resilience traits, derived from a previous study of American medical students without COVID-19 ([34]). Using the Epidat program, the minimum required sample size was determined to be 670 students. A 35% loss to follow-up and a 40% rejection rate were factored in, resulting in a final sample of 2,680 medical students.

Sampling method and sample size calculation

The sampling was non-probabilistic snowball sampling, which consists of sharing the link containing the questionnaire. For the sample calculation, the Epidat program was used, which showed that the minimum sample is 670 students. A 35% loss to follow-up and 40% rejection rate were added, giving a final sample of 2680 medical students.

A statistical power of 99.99% was estimated, both for the covariates of resilience and depressive symptoms. The rationale for this calculation was supported by the proportions of inadequate sleep quality in two distinct groups: those with a low level of resilience (p1 = 0.674) and those with a high level of resilience (p2 = 0.535). In addition, the respective sample sizes were considered, with n1 = 1262 for the low resilience group and n2 = 757 for the high resilience group. For depressive symptoms, an additional power estimation was performed using the proportions of inadequate sleep quality in the group without depressive symptoms (p1 = 0.302) and in the group with depressive symptoms (p2 = 0.726), with sample sizes of n1 = 496 for the group without depressive symptoms and n2 = 1523 for the group with depressive symptoms.

Procedures

For the present study, a person in charge (a medical student) was sought for each university in all the Latin American countries through the dissemination of posters in social networks of students who were affiliated to the Latin American Federation of Scientific Societies of Medical Students where the integrated societies are located.

The selected students were provided with training sessions via online platforms, during which they were informed about the study's objectives, ethical considerations, and the importance of accurate data collection. Training included detailed instructions on how to explain the informed consent process to participants, how to guide them through the questionnaire, and how to ensure that the data collection process adhered to ethical and methodological standards.

The chosen students shared information about the study and requested voluntary participation to students, prior acceptance of informed consent, proceeded to disseminate the link containing the data collection form. Data collection was carried out during the months of June to September 2020, during which time the students were in home isolation, a measure generally implemented by governments across the participating countries to limit the spread of COVID-19 during the first wave of the pandemic, though the specifics and enforcement of this measure varied by country, depending on local government policies. Data collection was carried out using the REDCap (Research Electronic Data Capture) program [32–34]. This data collection tool is widely useful for conducting research of various epidemiological designs [35]. The time to fill out the questionnaire was approximately 20 min.

Given the sensitive nature of the study, which involves mental health during the pandemic, strict measures were taken to ensure the privacy and anonymity of all participants. The data collection process was entirely online through the REDCap platform, which ensures secure data storage and encrypted transmission. Participants' personal identifiers were not collected, and all responses were anonymized to protect their identity. The informed consent process explicitly assured participants that their responses would remain confidential and used solely for the purpose of this study. Additionally, data access was restricted to the research team, and no identifiable information was shared. The study followed ethical guidelines and adhered to relevant data protection laws to maintain participant confidentiality throughout the study.

Instruments

Dependent variable

Pittsburgh Sleep Quality Index Questionnaire: evaluates the quality of sleep in the last month through 19 questions organized into 7 components (subjective sleep quality, latency, duration, efficiency, sleep disturbances, use of sleeping medication, daytime dysfunction) whose total score varies between 0 and 21 points, where 5 points or more is an indicator of poor sleep quality [36].

The Spanish version of the PSQI has been validated in a population of Peruvian students [37] and shows good internal consistency, with a Cronbach's α coefficient greater than 0.90 [38]. For Brazilian participants, the Portuguese version of the PSQI was used [39].

Main independent variables

Sociodemographic, socio-educational, and other data section: general variables were identified such as age in years, sex (female and male), marital status (yes/no), religion (none, Catholic and other), having children (yes/no), number of family members, child's role in the family (yes/no) where denotes whether the participant primarily assumes the role of a son within their family structure, body mass index (underweight, normal, overweight and obesity), referred diagnosis of high blood pressure (yes/no) [40], referred diagnosis of diabetes mellitus (yes/no), personal history of mental health (yes/no), which refers to any self-reported history of mental health diagnoses, treatments, experienced by the participant prior to the study period, confirmed by a healthcare professional. The variables related to education were divided into: type of university (national and private), year of study categorized (preclinical/ clinical), remote/virtual academic load (yes/no), belongs to an extracurricular group (yes/no), in-person and/or virtual training on COVID-19 (yes/no). Likewise, information related to COVID-19 was collected: compliance with social isolation measures (yes/no), perception of the severity of the pandemic (yes/no), family member diagnosed with COVID-19 (yes/no), family member who died due to COVID-19 (yes/no), confidence in the government's ability to manage the COVID-19 pandemic (yes/no), and personal history of COVID-19 (yes/no). In Figure 1, the Directed Acyclic Graph (DAG) illustrating the relationships between the various factors and sleep quality is presented.

Secondary independent variables

CD-RISC (Resilience) 10 items: which consists of 10 items, with a Cronbach's alpha of 0.89 (general population) and a test–retest reliability of 0.87 [41]. It is evaluated through a Likert scale with 5 options with a score of 0–4. Which uses a Likert scale of 0 "never", 1 "rarely", 2 "sometimes", 3 "often" and 4 "almost always" [42]. A score above 30 points suggests a high level of resilience [43, 44]. In general, it shows excellent psychometric properties and allows efficient measurement of resilience [45]. It has been used in the COVID-19 context [43, 45–47].

Eating Disorder Questionnaire (EAT-26): made up of 26 questions that are subdivided into 3 domains (bulimia, preoccupation with food and oral control) [48]. The responses have 6 alternatives scored in a positive direction with the symptoms: Always = 3, Very often = 2, Often = 1, Sometimes = 0, Rarely = 0 and never = 0. A score greater than 20 suggests the presence of an eating

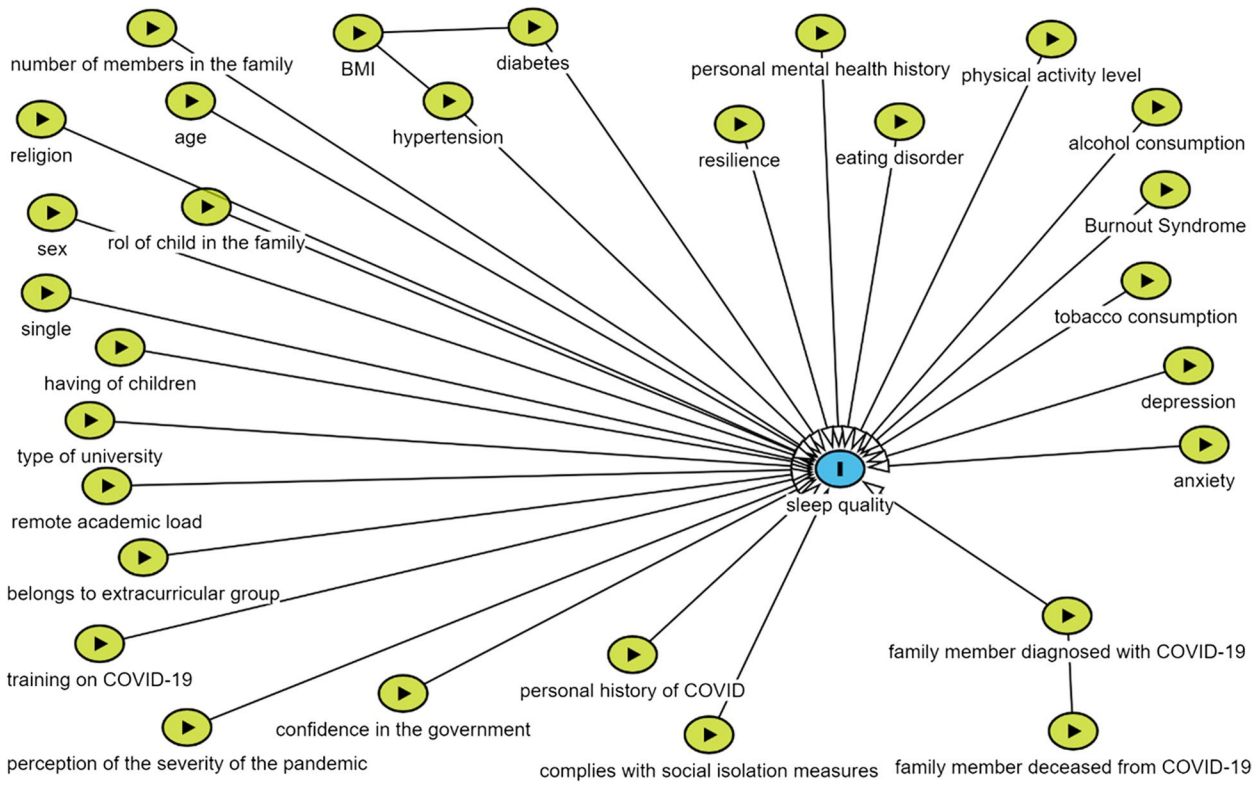

Fig. 1 DAG of Factors Associated with Sleep Quality among Medical Students

disorder. It has been validated in Peruvian university students with a reliability coefficient of 0.90 [49].

Physical Activity Questionnaire (IPAQ-S): assesses physical activity in the last 7 days. It consists of 9 items that are scored on a five-point scale, where 1 = low level and 5 = high level of physical activity [50]. The first 8 questions are useful for scoring and question 9 allows you to know the reasons why you did not do physical activity that week [51]. It has been validated in Peru with internal consistency using a Cronbach's alpha of 0.80 [52].

Maslach Burnout Inventory: it consists of 22 items, it is distributed in three scales called emotional exhaustion (EA), personal accomplishment at work (PR), and depersonalization (DP). Which are used using a Likert scale that has scores of 0 "never", 1 "almost never", 2 "sometimes", 3 "regularly", 4 "quite a few times", 5 "almost always" and 6 "always". The reliability values of the scales also show high internal consistency in Spanish-speaking health personnel (α = 0.88) [53]. For its identification in Peruvian health personnel, it is recommended to use cut-off points predetermined by the creator of the instrument (AE > 26, DP > 9 RP < 34) [54–56].

Generalized Anxiety Disorder Scale (GAD-7): assesses the presence of anxiety symptoms. A cut-off point was identified that optimized sensitivity (89%) and specificity (82%) [57]. It consists of 7 items where scores vary from 0 (not at all) and 3 (almost every day) [58, 59]. It is categorized into absence of anxious symptoms (0 to 4 points), mild (5 to 9 points), moderate (10 to 14 points) and severe (15 to 21 points) anxious symptoms. Therefore, the total score ranges from 0 to 21. Reliability (internal consistency) was high; Cronbach's alpha = 0.87 [60].

Patient Health Questionnaire-9 (PHQ-9): evaluates symptoms of depression, and is easy to use in the context of the primary care system in Peru [61]. It consists of 9 items that evaluate the presence of depressive symptoms (corresponding to DSM-IV criteria) present in the last 2 weeks. Each item has a severity index corresponding to: 0 = "never", 1 = "some days", 2 = "more than half of the days" and 3 = "almost every day". Which presents categories of none ". 0 to 4", mild "5 to 9", moderate "10 to 14", moderately-severe "15 to 19" and severe "20 to 27". It has acceptable internal consistency with a Cronbach's alpha coefficient of 0.83. and high sensitivity (88%) and specificity (92%) values [62].

Substance use questionnaire of Alcohol, Smoking and Substance Involvement Screening Test (ASSIST): consists of 8 questions that inquire about substance use in the last 3 months. The type of risk that exists for tobacco and alcohol consumption is interpreted: low (0 to 10 points), moderate (11 to 26 points) and high (25 to maximum). It has been validated in the Spanish-speaking population [63]. Excellent internal consistency was found in Spanish-speaking patients with psychiatric disorders with total risk scores (TSI) "(α = 0.92 and ω = 0.93) and for each substance (SSI) (α = 0.88 – 0.96 and ω = 0.89 – 0.95)" [12]. With a sensitivity and specificity evaluated in Mexican university students that when using a score of 8 as a cut-off point is 83.8% and 80%, respectively [64].

Statistical analysis

In the descriptive analysis, absolute and relative frequencies of categorical variables were shown. In the case of numerical variables, mean and standard deviation were reported for variables with normal distribution; otherwise, median and interquartile range were presented for those with non-normal distribution. In the bivariate analysis, the association between sleep quality and the rest of the variables was evaluated using the chi-square test of independence for categorical variables, and in the case of numerical variables, the Mann Whitney U test was used, after evaluating the assumption of non-normal distribution.

In the simple regression analysis, it was decided to include all the variables in the study because they were significantly associated with the outcome ($p < 0.05$). The variables that were significantly associated in the simple analysis included: sex, remote/virtual academic load, belonging to an extracurricular group, in-person and/or virtual training on COVID-19, religion, role of child in the family, personal history of COVID-19, personal mental health history, physical activity level, risk of eating disorder, burnout syndrome, resilience, tobacco consumption, alcohol consumption, depressive symptoms, and anxiety symptoms.

In the multiple multivariate analysis, only these variables were included, using the generalized linear model with the Poisson family, log link function, and robust variance. The host country was included as a cluster to account for the possible intra-cluster correlation. Collinearity was evaluated in the independent variables. Prevalence ratios (PR) and 95% confidence intervals (95%CI) were estimated. Statistical analysis was performed in Stata v.17.0 (StataCorp LP, College Station, TX, USA).

The use of the Poisson regression model with the GLM framework was based on its appropriateness for analyzing binary outcome data in cross-sectional studies. The Poisson regression model is particularly well-suited to estimate probabilities of binary outcomes and provides a flexible approach to modeling the relationships between predictors and outcomes, especially when using the log link function. This method is advantageous when the outcome variable represents counts or binary data, and allows for better interpretation in terms of prevalence ratios (PR) rather than odds ratios, which is more suitable for prevalence-based data. Additionally, robust standard

errors were used to account for potential overdispersion and clustering effects, adjusting for the intra-cluster correlation (country), improving the precision of our estimates. The cluster function was incorporated to adjust for correlations within clusters, which helps to prevent the underestimation of variances and biases in the estimates [65].

Results

Characteristics of medical students, descriptive analysis

The median age of participants was 21 years, with an age range from 19 to 23 years. More than half of the participants were male (64.6%). The majority of the study population came from Peru (50.5%) and Colombia (21.5%). In terms of university type, 52% were enrolled in national/public universities. The distribution across the five academic years was relatively similar. Over half (57.8%) of participants reported receiving some form of training on COVID-19.

Regarding health data, 3.5% of students reported having been infected with COVID-19. A high level of physical activity was reported by 54.5% of the participants, while 10.2% were identified as having a relevant risk for eating disorders. Mild depressive and anxiety symptoms were the most frequent, with 32.0% and 31.5%, respectively. Only 1.8% and 1.2% of participants reported being hypertensive and diabetic, respectively. Furthermore, 94.8% of the participants reported adhering to mandatory social isolation measures. Poor sleep quality was present in the majority of students (62.2%) (95% CI: 60.00%−64.28%) (Table 1).

Table 1 Characteristics of medical students ($n = 2019$)

Characteristics	N (%)
Age (years)[a]	21 (19–23)
Sex	
Female	715 (35.4)
Male	1304 (64.6)
Remote/virtual academic load	
No	425 (21.1)
Yes	1593 (78.9)
Belongs to extracurricular group	
No	1314 (65.1)
Yes	704 (34.9)
In-person and/or virtual training on COVID-19	
No	852 (42.2)
Yes	1167 (57.8)
Religion	
None	491 (24.3)
Catholic	1 305 (64.6)
Not Catholic	223 (11.1)
Rol of child in the family	
No	54 (2.7)
Yes	1965 (97.3)
Personal history of COVID-19	
No	1948 (96.5)
Yes	71 (3.5)
Family member diagnosed with COVID-19	
No	958 (47.5)
Yes	1061 (52.6)
Family member deceased from COVID-19	
No	1813 (89.8)
Yes	206 (10.2)
Personal mental health history	
No	1792 (88.8)
Yes	227 (11.2)
Physical activity level	
Low	738 (36.6)
Moderate	180 (8.9)
High	1101 (54.5)
Risk of eating disorder	
Not clinically relevant	1814 (89.9)
Relevant	205 (10.2)
Burnout Syndrome	
No	1990 (98.6)
Yes	29 (1.4)
Resilience	
Low	1262 (62.5)
High	757 (37.5)
Tobacco consumption	
Low	739 (79.6)
Moderate	186 (20.0)
HIgh	4 (0.4)

Sleep quality—Pittsburgh Sleep Quality Index Questionnaire

In Fig. 2, 29% reported having trouble falling asleep within the first half-hour at least 3 or more times a week. Additionally, 21.2% indicated waking up during the night or early morning one or two times a week. Furthermore, 15.8% reported experiencing nightmares one or two times a week. Regarding medication usage, 4.9% reported taking sleep medication one or two times a week. Lastly, 23.6% reported feeling drowsy while engaged in activities.

The 32.9% of medical students mentioned experiencing poor overall sleep quality, while 6.2% reported very poor sleep quality. Figure 3.

Characteristics associated with poor sleep quality, in bivariate analysis

A significant association was observed between sleep quality and current year of study ($p = 0.015$) and gender ($p < 0.001$). Students who did not participate in extracurricular groups had a higher proportion of poor sleep quality compared to those who did participate (64.2%

Table 1 (continued)

Characteristics	N (%)
Alcohol consumption	
Low	827 (89.0)
Moderate	96 (10.3)
HIgh	6 (0.7)
Depressive symptoms	
None	496 (24.6)
Mild	646 (32.0)
Moderate	410 (20.3)
Moderate to Severe	285 (14.1)
Severe	182 (9.0)
Anxiety symptoms	
None	876 (43.4)
Mild	636 (31.5)
Moderate	316 (15.7)
Severe	191 (9.5)
Sleep quality	
Good	764 (37.8)
Bad	1255 (62.2)

[a] Median (25th percentile—75th percentile)

vs 58.2%; $p=0.008$). Students from national universities had a higher proportion of poor sleep quality compared to those from private universities (58.5 vs 66.1%; $p<0.001$) Students who were diagnosed with COVID-19 had a higher proportion of poor sleep quality compared to those who were not diagnosed ($p=0.043$). Perception of pandemic severity was also associated with sleep quality ($p=0.009$). Students with a history of mental health problems had a significantly higher proportion of poor sleep quality (80.2% vs. 59.9%; $p<0.001$). The presence of eating disorder (EAT-26) was associated with a higher proportion of poor sleep quality (75.1% 60.7%; $p<0.001$). Students with low levels of physical activity had a higher proportion of poor sleep quality relative to those with high levels of physical activity (68.8% vs. 56.3%; $p<0.001$). Those with burnout symptoms had a higher proportion of poor sleep quality (82.8% vs. 61.9%; $p=0.021$). Students with moderate risk of tobacco (74.7% vs. 64.6%; $p=0.011$) and alcohol (77.1% vs. 65.4%; $p=0.049$) use had a higher proportion of poor sleep quality **(**Table 2**).**

Characteristics associated with poor sleep quality, in simple and multiple regression analyses

In the multiple regression model, we found that female students had a 13% higher prevalence of poor sleep quality compared to male students (PR: 1.13; 95%CI: 1.07–1.21). Participation in COVID-19 training was associated with a 5% lower prevalence of poor sleep quality compared to students who had not been trained (PR: 0.95; 95%CI: 0.90–1.00). Students who had been diagnosed with COVID-19 showed a 20% lower prevalence of poor sleep quality compared to those who had not been diagnosed (PR: 0.80; 95%CI: 0.66–0.98). Students with high resilience had a 14% lower prevalence of poor sleep quality compared to other students (PR: 0.86; 95%CI: 0.77–0.96). Students with moderate to severe and severe depressive symptoms showed a 119% (PR: 2.19; 95%CI: 1.53–3.13) and 114% (PR: 2.14; 95%CI: 1.47–3.11) higher prevalence of poor sleep quality, respectively, compared to those without depressive symptoms. Students

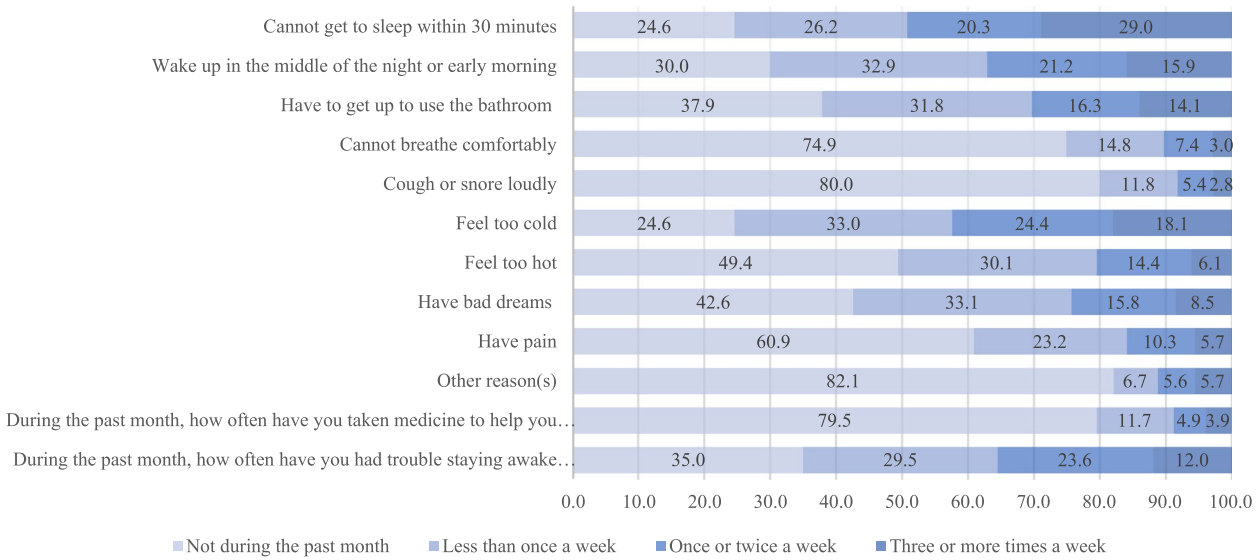

Fig. 2 Distribution of Responses on the Pittsburgh Sleep Quality Index (PSQI) among Medical Students

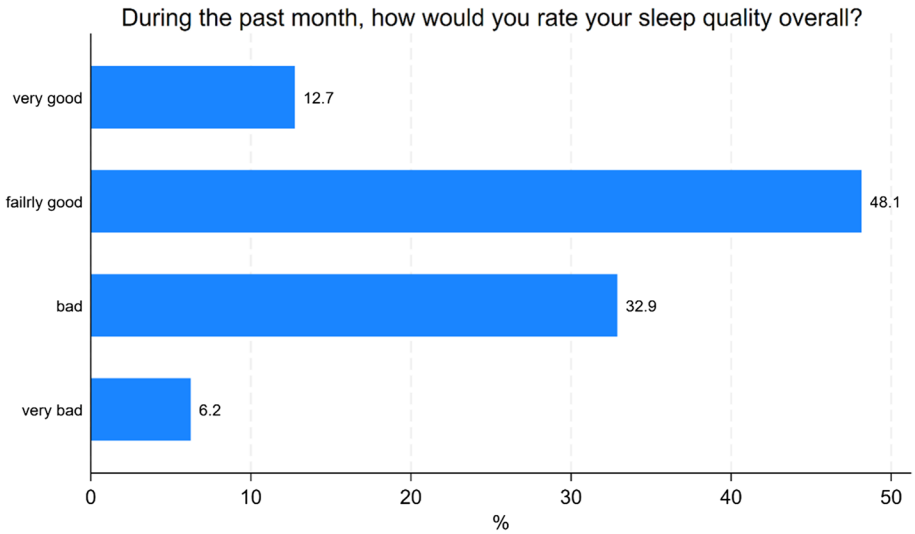

Fig. 3 Assessment of sleep quality in medical students, according to the Pittsburgh Sleep Quality Index (PSQI)

with moderate and severe anxious symptoms showed a 21% (PR: 1.21; 95%CI: 1.05–1.38) and 22% (PR: 1.22; 95%CI: 1.07–1.39) higher prevalence of poor sleep quality, respectively, compared to those without anxious symptoms. Moderate risk of tobacco use increased the prevalence of poor sleep quality by 8% (PR: 1.08; 95%CI: 1.02–1.14) (Table 3and Fig. 1).

Discussion

Prevalence of poor sleep quality

We found that 6 out of 10 students (62.2%) presented poor sleep quality. Similar results were reported in Brazil [66], Tunisia [64] and Anhui, China [65] where 78.2%, 72.5% and 74.3% of medical students had poor quality sleep during the COVID-19 pandemic; respectively. This is similar to what was found in Peru, since in Lima 60.1% [67] and 83.9% [68] of medical students reported insomnia during the first wave of COVID-19, and poor quality of sleep the month before the second pandemic wave; respectively. Likewise, similar results were found in medical students from other regions of Peru; since, in Chiclayo [68], The prevalence of poor sleep quality was 89.5% during the first wave of COVID-19 and, in Piura of 63.7% during the second wave. This trend was not only evident in medical students, but also in university students from different countries such as Taiwan, China, Ireland, Malaysia, South Korea, the Netherlands and the United States with prevalence of poor sleep quality ranging between 42.7%. to 67.2% [69]. However, our results are superior to those described in other universities in China [22, 70] and in Greece [71] where the prevalence of poor sleep quality in medical students was 18.2%, 33.2% and 52.4%; respectively.

These differences could be explained because the population surveyed in China [72] and Greece [71], it was in the second wave and the second year of the pandemic, respectively. Therefore, having previous experience, they probably would have already been able to adapt to this new reality. While, in the study by Xie et al. [73]. The lower prevalence than that found in our study could be due to the fact that the medical students surveyed, when the pandemic began, were not at the university but on vacation, which could help reduce their stress; In addition, the classes were immediately adapted to the virtual modality without delay or exposure of the students. Although medical students have poor sleep quality reported globally [74], During the pandemic this situation worsened. This could have been due to confinement that caused forced lifestyle changes and less time for socialization [75], causing students' stress to increase and therefore their quality of sleep to worsen [76], also negatively affecting your immune system [77]. These results also can be influenced by the sociocultural context and government response to the COVID-19 pandemic played significant roles in shaping individuals' adaptation to stress and, consequently, their sleep quality. In many countries, government measures such as lockdowns, social distancing, and travel restrictions created an environment of uncertainty, fear, and isolation, which increased stress levels. In cultures with strong communal bonds and social networks, the lack of face-to-face interactions and support may have heightened feelings of loneliness and anxiety, leading to disrupted sleep patterns [78]. Conversely, in more individualistic societies, the heightened pressure to adapt independently

Table 2 Characteristics associated with good sleep quality in medical students, bivariate analysis

Variables	Quality Sleep		*p**
	Good (*n* = 764)	Bad (*n* = 1 255)	
	n(%)	n(%)	
Age (years)***	21 (19–23)	21 (19–23)	**0.022****
Sex			**< 0.001**
Female	321 (44.9)	394 (55.1)	
Male	443 (34.0)	861 (66.0)	
Type of university			**< 0.001**
Nationa or Public	435 (41.5)	614 (58.5)	
Private	329 (33.9)	641 (66.1)	
Country			**< 0.001**
Argentina	22 (31.0)	49 (69.0)	
Bolivia	41 (27.0)	111 (73.0)	
Brasil	7 (36.8)	12 (63.2)	
Chile	0 (0.0)	1 (100.0)	
Colombia	151 (34.8)	283 (65.2)	
Cuba	2 (100.0)	0 (0.0)	
Ecuador	28 (26.2)	79 (73.8)	
El Salvador	0 (0.0)	1 (100.0)	
México	4 (100.0)	0 (0.0)	
Paraguay	37 (63.8)	21 (36.2)	
Panamá	0 (0.0)	1 (100.0)	
Perú	400 (39.3)	619 (60.8)	
Venezuela	72 (48.0)	78 (52.0)	
Study year (categorized)			0,472
Preclinical years	442 (38.5)	705 (61.5)	
Clinical years	322 (37.0)	549 (63.0)	
Remote/virtual academic load			**0,054**
No	178 (41.9)	247 (58.1)	
Yes	586 (36.8)	1 007 (63.2)	
Belongs to extracurricular group			**0,008**
No	470 (35.8)	844 (64.2)	
Yes	294 (41.8)	410 (58.2)	
In-person and/or virtual training on COVID-19			0,213
No	309 (36.3)	543 (63.7)	
Yes	455 (39.0)	712 (61.0)	
Status civil of single			0,203
No	27 (45.8)	32 (54.2)	
Yes	737 (37.6)	1 223 (62.4)	
Religion			0,502
None	196 (39.9)	295 (60.1)	
Catholic	488 (37.4)	817 (62.6)	
Not Catholic	80 (35.9)	143 (64.1)	
Having of children			0,376
No	736 (37.7)	1 218 (62.3)	
Yes	28 (43.1)	37 (56.9)	
Number of members in the family**	4 (3—5)	4 (3—5)	0.867**
Rol of child in the family			**0,031**
No	28 (51.9)	26 (48.2)	
Yes	736 (37.5)	1 229 (62.5)	

Table 2 (continued)

Variables	Quality Sleep		*p**
	Good (*n* = 764)	Bad (*n* = 1 255)	
	n(%)	n(%)	
BMI (categorized)			0,347
Under weight	32 (39.0)	50 (61.0)	
Normal	506 (37.9)	831 (62.2)	
Overweight	197 (39.2)	305 (60.8)	
Obesity	29 (29.6)	69 (70.4)	
Arterial hypertension			0,574
No	752 (37.9)	1 231 (62.1)	
Yes	12 (33.3)	24 (66.7)	
Mellitus diabetes			0,697
No	754 (37.8)	1 241 (62.2)	
Yes	10 (41.7)	14 (58.3)	
Complies with social isolation measures			0,226
No	46 (43.4)	60 (56.6)	
Yes	718 (37.5)	1 195 (62.5)	
Perception of the severity of the pandemic			**0,009**
Very serious	442 (35.3)	809 (64.7)	
Serious	306 (41.6)	429 (58.4)	
Mild/Not serious	16 (48.5)	17 (51.5)	
Confidence in the government's ability to manage the COVID-19 pandemic			0,112
No	575 (36.9)	983 (63.1)	
Yes	189 (41.0)	272 (59.0)	
Personal history of COVID-19			**0,043**
No	729 (37.4)	1 219 (62.6)	
Yes	35 (49.3)	36 (50.7)	
Family member diagnosed with COVID-19			0,680
No	367 (38.3)	591 (61.7)	
Yes	397 (37.4)	664 (62.6)	
Family member deceased from COVID-19			0,444
No	681 (37.6)	1 132 (62.4)	
Yes	83 (40.3)	123 (59.7)	
Personal mental health history			**< 0.001**
No	719 (40.1)	1 073 (59.9)	
Yes	45 (19.8)	182 (80.2)	
Physical activity level			**< 0.001**
Low	230 (31.2)	508 (68.8)	
Moderate	53 (29.4)	127 (70.6)	
High	481 (43.7)	620 (56.3)	
Risk of eating disorder			**< 0.001**
Not clinically relevant	713 (39.3)	1 101 (60.7)	
Relevant	51 (24.9)	154 (75.2)	
Burnout Syndrome			**0,021**
No	759 (38.1)	1 231 (61.9)	
Yes	5 (17.2)	24 (82.8)	
Resilience			**< 0.001**
Low	412 (32.7)	850 (67.4)	
High	352 (46.5)	405 (53.5)	

Table 2 (continued)

Variables	Quality Sleep		*p**
	Good (*n* = 764)	Bad (*n* = 1 255)	
	n(%)	n(%)	
Tobacco consumption			**0,011**
Low	262 (35.5)	477 (64.6)	
Moderate	47 (25.3)	139 (74.7)	
Hlgh	0 (0.0)	4 (100.0)	
Alcohol consumption			**0,049**
Low	286 (34.6)	541 (65.4)	
Moderate	22 (22.9)	74 (77.1)	
Hlgh	1 (16.7)	5 (83.3)	
Depressive symptoms			**< 0.001**
None	346 (69.8)	150 (30.2)	
Mild	253 (39.2)	393 (60.8)	
Moderate	84 (20.5)	326 (79.5)	
Moderate to Severe	54 (19.0)	231 (81.1)	
Severe	27 (14.8)	155 (85.2)	
Anxiety symptoms			**< 0.001**
None	486 (55.5)	390 (44.5)	
Mild	196 (30.8)	440 (69.2)	
Moderate	51 (16.1)	265 (83.9)	
Severe	31 (16.2)	160 (83.8)	

* *p* value of categorical variables calculated with the Chi Square test

** *P* value of categorical—numerical variables calculated with the U test (Mann–Whitney)

*** Median—interquartile range

to new norms and work-from-home arrangements may have exacerbated stress and sleep disturbances, as people struggled with balancing work, home life, and uncertainty about the future [79].

It is necessary to mention that although the median age of the participants is reported as 21 years, this age range may have important implications for sleep quality. Young adulthood is a period characterized by significant changes in lifestyle, academic and social pressures, and increased use of technology, all of which can contribute to maladaptive sleep patterns. Research has shown that individuals in this age group are more likely to experience irregular sleep schedules, delayed sleep onset, and insufficient sleep, which can be exacerbated by stress, anxiety, and the use of electronic devices late at night [80]. Additionally, sleep disturbances during this stage can have long-term consequences on mental health, cognitive performance, and overall well-being [65]. Therefore, understanding the relationship between age and sleep quality in this demographic is essential for developing interventions to promote healthy sleep habits among young adults.

Factors associated with poor sleep quality

Female students had a 14% higher prevalence of poor sleep quality. This is similar to what was found in Italy [29] and Greece [71] where female medical students had more sleep problems, and also agrees with what was reported in Turkey [19], where female sex was found as a risk factor for poor sleep quality in sixth-year medical students and medical residents. Likewise, in China [72], the prevalence of poor sleep quality in medical students was significantly higher in women (35.8%) compared to men (28.7%, $p = 0.019$), and, in this last group, they were less likely to suffer from poor quality sleep (OR: 0.74). It coincides with what was found in Venezuela [81], where female medical students had more insomnia and hyperinsomnia ($p = 0.036$ and 0.016, respectively) during the COVID-19 pandemic. This is contrary to what was described by Tahir et al.[29, 19] in the Dominican Republic, Mexico, Egypt, Guyana, India, Pakistan and Sudan; by López Pesántez et al. [81] in Ecuador; and by Fernandes et al. [54] in Brasil, who found no significant differences regarding sleep quality between male and female medical students during the COVID-19 pandemic. Finally, it

Table 3 Characteristics associated with good sleep quality in medical students, in simple and multiple regression analysis

Variables	Sleep Quality					
	Simple regression			Multiple regression		
	PR	IC 95%	p*	PR	IC 95%	p*
Age (years)***	0,99	0.97–1.00	0,136			
Sex						
Female	Ref			Ref		
Male	1,20	1.12–1.28	**< 0.001**	1,14	1.07—1.21	**< 0.001**
Type of university						
Nationa or Public	Ref					
Private	1,13	0.95—1.34	0,159			
Remote/virtual academic load						
No	Ref			Ref		
Yes	1,09	1.03—1.15	**0,003**	0,98	0.92—1.06	0,655
Belongs to extracurricular group						
No	Ref			Ref		
Yes	0,91	0.82—1.00	0,061	1,07	0.93–1.23	0,337
In-person and/or virtual training on COVID-19						
No	Ref			Ref		
Yes	0,96	0.92—0.99	**0,040**	0,95	0.90—0.99	**0,027**
Study year (categorized)						
Preclinical years	Ref					
Clinical years	1.03	0.95 – 1.11	0.510			
Status civil of single						
No	Ref					
Yes	1,15	0.90–1.48	0,271			
Religion						
None	Ref			Ref		
Catholic	1,04	0.91—1.20	0,557	1,03	0.93—1.14	0,547
Not Catholic	1,07	1.02—1.12	**0,008**	1,11	0.99—1.25	0,074
Having of children						
No	Ref					
Yes	0,91	0.81—1.03	0,128			
Number of members in the family	0,99	0.97—1.01	0,804			
Rol of child in the family						
No	Ref			Ref		
Yes	1,30	1.16—1.46	**< 0.001**	1,23	0.92—1.65	0,170
BMI (categorized)						
Under weight	Ref					
Normal	1,02	0.83—1.24	0,850			
Overweight	1,00	0.79—1.26	0,976			
Obesity	1,15	0.90—1.48	0,260			
Arterial hypertension						
No	Ref					
Yes	1,07	1.89—1.29	0,442			
Mellitus diabetes						
No	Ref					
Yes	0,94	0.75—1.17	0,568			
Complies with social isolation measures						
No	Ref					
Yes	1,10	0.95—1.29	0,210			

Table 3 (continued)

Variables	Sleep Quality					
	Simple regression			Multiple regression		
	PR	IC 95%	p*	PR	IC 95%	p*
Perception of the severity of the pandemic						
Very serious	Ref					
Serious	0,90	0.81—1.01	0,076			
Mild/Not serious	0,80	0.62—1.03	0,082			
Confidence in the government's ability to manage the COVID-19 pandemic						
No	Ref					
Yes	0,94	0.80—1.09	0,389			
Personal history of COVID-19						
No	Ref			Ref		
Yes	0,81	0.74—0.89	**< 0.001**	0,80	0.66—0.98	**0,035**
Family member diagnosed with COVID-19						
No	Ref					
Yes	1,01	0.94—1.10	0,726			
Family member deceased from COVID-19						
No	Ref					
Yes	0,96	0.90—1.02	0,168			
Personal mental health history						
No	Ref			Ref		
Yes	1,34	1.25—1.43	**< 0.001**	1,04	0,94 – 1,16	0,445
Physical activity level						
Low	Ref			Ref		
Moderate	1,03	0.94—1.12	0,568	1,00	0.92—1.09	0,992
High	0,82	0.78—0.85	**< 0.001**	0,97	0.90—1.05	0,440
Risk of eating disorder						
Not clinically relevant	Ref			Ref		
Relevant	1,24	1.11—1.38	**< 0.001**	0,94	0.87—1.02	0,123
Burnout Syndrome						
No	Ref			Ref		
Yes	1,34	1.16—1.54	**< 0.001**	1,02	0.87—1.20	0,813
Resilience						
Low	Ref			Ref		
High	0,79	0.72—0.88	**< 0.001**	0,86	0.77—0.96	**0,008**
Tobacco consumption						
Low	Ref			Ref		
Moderate	1,16	1.05—1.27	**0,002**	1,08	1.02—1.14	**0,007**
HIgh	1,55	1.46—1.64	**< 0.001**	1,13	0.94—1.35	0,188
Alcohol consumption						
Low	Ref			Ref		
Moderate	1,18	1.10—1.26	**< 0.001**	1,03	0.96—1.12	0,371
HIgh	1,27	0.85—1.92	0,248	0,97	0.76—1.23	0,809
Depressive symptoms						
None	Ref,			Ref		
Mild	2,01	1.64—2.47	**< 0.001**	1,71	1.20—2.43	**0,003**
Moderate	2,63	2.25—3.08	**< 0.001**	2,23	1.63—3.03	**< 0.001**
Moderate to Severe	2,68	2.25—3.19	**< 0.001**	2,19	1.53—3.13	**< 0.001**
Severe	2,82	2.23—3. 56	**< 0.001**	2,14	1.47—3.11	**< 0.001**

Table 3 (continued)

Variables	Sleep Quality					
	Simple regression			Multiple regression		
	PR	IC 95%	p*	PR	IC 95%	p*
Anxiety symptoms						
None	Ref			Ref		
Mild	1,55	1.43—1.69	**< 0.001**	1,12	0.99—1.28	0,080
Moderate	1,88	1.70—2.08	**< 0.001**	1,21	1.05—1.38	**0,007**
Severe	1,88	1.74—2.04	**< 0.001**	1,22	1.07—1.39	**0,003**

* *p* values obtained with Generalized Linear Models (GLM), Poisson family, log link function, robust variance and cluster by country

is equal at Chen et al., that their systematic review conducted in medical students in China where they did not found a difference between male and female [82]. This could be due to the fact that the fear of contagion of COVID-19 and misinformation was similar in both sexes and this affected the quality of sleep in both groups [71]; in addition to that in the Ecuador study [72]. They used a different questionnaire than our study (Oviedo Sleep Questionnaire). Likewise, in a review of global literature prior to the pandemic, an inconsistent effect is reported regarding the sex of medical students and poor quality of sleep [83]. On the other hand, in a study carried out in India [74] the sleep quality of female medical students was better than that of male students of the same career [84]. The main difference could be that this research was carried out long before the COVID-19 pandemic. Also in China [75], It was found that a risk factor for having sleep problems was being male; However, this study was applied to university students in general and using the Chinese version of the "Youth Self-Rating Insomnia Scale (YSIS)". In students in general, poorer sleep quality has already been reported in women [66], since they face stress in a different way and are characterized by needing more social support, and greater emotional social support would be associated with less perceived stress in women and less anxiety [85]; which was more difficult to achieve during the confinement due to the COVID-19 pandemic. Additionally, women are at greater risk of developing sleep disorders due to biological factors, such as hormonal changes during the menstrual cycle [84], pregnancy and menopause, as well as psychological and social factors such as stress, anxiety and depression [85]. Second, women may have greater demands and responsibilities in their daily lives, such as childcare, work, and studies, which can interfere with the quantity and quality of sleep [86]. Third, women may be more exposed to stressors such as discrimination and gender violence, which can affect their mental health and quality of sleep [87].

Students who reported having received training in COVID-19 had a 5% lower prevalence of poor sleep quality. This is similar to what was reported in China [79], where, regarding knowledge about COVID-19, being familiar with the topic acted as a protective factor for poor sleep quality in university students (OR: 0.62). This association may have several explanations. Firstly, better understanding about COVID-19 may have helped students know the necessary prevention measures, which reduced levels of worry and thus associated anxiety and stress levels, thus preventing cortisol from affecting regulation of sleep and circadian rhythm [84]. Secondly, the training on COVID-19 increased students' awareness of the importance of sleep for health and its consequences of not doing so, which would allow them to apply preventive actions and healthy practices to improve health [84, 88], in addition to allowing us to know that longer and higher quality sleep would improve memory and academic performance [89, 90].

Reporting having had COVID-19 reduced the prevalence of poor sleep quality by 20%. This is contrary to what was described in a multicenter study carried out in the Dominican Republic, Egypt, Guyana, India, Mexico, Pakistan and Sudan, where those medical students who reported a diagnosis of COVID-19 or presented symptoms related to the disease had more likely to report poor sleep quality (OR: 0.66; OR: 0.62, respectively) [69]. Similarly, female medical students in Greece who had COVID-19 or had close contact with a case of the disease reported having more nightmares [71]; and, in a systematic review that included the general population of 39 countries, the corrected prevalence of sleep problems was 57% in patients with COVID-19, in addition to being infected with this disease was observed to be a significant predictor of the increased association between sleep problems and psychological distress in the general population [90]. This could be explained because suffering from the disease would make people more worried that COVID-19 would negatively impact their way of

life, which would be associated with poor quality of sleep [83].

Students with a high level of resilience had a 14% lower prevalence of poor sleep quality. This is consistent with what was described by Wang et al. in China [91], who reported that higher resilience scores predicted better sleep quality in adolescent students before the COVID-19 pandemic. Likewise, in two investigations carried out on university students in China [92, 93]. A similar situation arose, finding that, before the COVID-19 pandemic, resilience could have reduced the effect of stressful life events on sleep quality [94]; and also, after said pandemic, at higher levels of resilience there was better quality of sleep (β = −0.337, t = −15.711). On the other hand, in Mexico [95], It was found that the higher the level of resilience, the better the quality of sleep (R = —0.1) in university students during the first wave of COVID-19. While, in Portugal [96], Long before the COVID-19 pandemic, something similar occurred, as students were more likely to have good quality sleep if they had higher levels of resilience (OR: 0.97).

The association found could be explained because resilience has been reported as a protective factor for stress [97], It is also related to the adaptability of people, since a person with high levels of resilience will have more psychological and coping resources to use in the face of adverse situations [98]. This would contribute to better emotional regulation [99], and would have helped students better manage the stress and anxiety associated with the pandemic, leading to better quality of sleep [100], This is why, furthermore, resilience training would be quite useful for medical students to react better to these types of stressful situations [98].

Having a moderate risk of tobacco consumption increases the prevalence of poor sleep quality by 8%. This is similar to what was found in Tunisia [65] where tobacco consumption also contributed to poor sleep quality in medical students during confinement in the first wave of COVID-19 ($p < 0.0001$). It agrees with what was reported in China [101], where smoking was associated with poor sleep quality in male college students of any major before the COVID-19 pandemic (OR: 1.75). In two Peruvian studies [99, 102] similar situations were found; In Lima, an association was found between having insomnia and having ever used tobacco (RPa = 1.23) in medical students during the second wave of COVID-19; and, in Chiclayo [68], A scant positive correlation (rxy = 0.068) was reported between sleep quality and tobacco consumption in nursing students before the COVID-19 pandemic. On the other hand, in Argentina [91], It was found that medical students who consumed alcohol, coffee or tobacco (20 to 30 cigarettes per day) reported a worse quality of sleep compared to those who did not consume these substances (U: 480, $p = 0.011$). This could be explained because smoking causes disturbances in the sleep process, such as nocturnal awakenings, a decrease in the duration of sleep cycles and a decrease in total sleep time; in addition to respiratory problems such as sleep apnea, which would reduce the ability of these people to have quality sleep, especially in those who consume more than 10 cigarettes a day [73]. Additionally, the nicotine present in tobacco can act as a stimulant, increasing blood pressure [90], and stimulating the release of dopamine, which produces euphoria, excitement and reduction of fatigue [93], making the person who consumes it feel less likely to sleep. Additionally, nicotine can reduce the production of melatonin, a hormone produced in the pineal gland that plays a key role in regulating sleep; That is why this hormone is also used in the treatment of nicotine addiction [94].

Having mild, moderate, moderate-severe and severe depressive symptoms increased the prevalence of poor sleep quality by 71%, 123%, 119% and 114%; respectively. This is similar to what was described in Greece during the COVID-19 pandemic [65], where it was found that, the worse the quality of sleep, the higher the levels of anxiety ($r = 0.487$) and depression ($r = 0.566$) in medical students. In a systematic review and meta-analysis of studies from 39 countries [81]. It was also found that sleep problems were associated with depression in health professionals, the general population and patients with COVID-19 (Fisher's Z: −0.28, −0.30 and −0.36, respectively). This can be explained because it is known that sleep problems have a correlation with mental health, especially during the COVID-19 pandemic [61]. Likewise, social isolation would have led to greater use of the internet [95] which has been associated with a higher risk of depression, anxiety and stress [103]. In addition, it can affect the circadian rhythm, causing insomnia and greater psychological problems [71]. Finally, insomnia can also act as a predictor of depression and anxiety [104].

Having moderate, moderate-severe and severe anxious symptoms increased the prevalence of poor sleep quality by 12%, 21% and 22%. Similar situations were reported in Tunisia [57], where anxiety was correlated with poor sleep quality in medical students during confinement ($r = 0.214$); and, in India, anxiety was correlated with poor sleep quality in medical students during confinement ($r = 0.214$) [97], where having anxiety symptoms increased the probability of having poor sleep quality in medical students (OR:3.61). This is consistent with what has been described in Mexico [105], where sleep problems were associated with anxiety and depression, and in a systematic review [81], sleep problems were positively associated with anxiety in health professionals, general population and patients with COVID-19 (Fisher's Z: 0.55,

0.48 and 0.49, respectively). This is similar to what was found in another Peruvian study [106] in which anxiety in male medical students increased the prevalence of poor sleep quality by 34% during the COVID-19 pandemic (PR:1.34). On the other hand, in Indonesia [103] a negative correlation was also found between sleep duration and anxiety ($r=-0.153$). This could be explained since as the stressors due to COVID-19 increase, anxiety would also increase, which, added to the situation of fear and uncertainty, would harm the quality of sleep. Likewise, stress and fatigue can contribute to poor quality sleep, also affecting the mental health of medical students [104]. Finally, confinement and the resulting greater time spent using video games and social networks have been reported to be associated with higher levels of anxiety ($r=0.169$) [90] and therefore, worse quality of sleep during the COVID-19 pandemic [71].

Bidirectional relationship between mental health and lack of sleep

It is known that the pandemic has directly affected the quality of sleep (through lack of social interaction, decreased level of physical activity, increased time in front of electronic screens, fake news and the absence of social and family support) and indirect (by increasing sleep time, decreasing its quality and altering the time dedicated to it) which were considered factors that conditioned poor sleep quality and the development of mental disorders (anxiety, depression, stress and post-traumatic stress disorder) and viceversa [107]. This bidirectional association between sleep disorders and mental health disorders has created a new perspective that sleep problems are "no longer an epiphenomenon of altered mental health but rather a prodromal symptom predictive of it" [108]. Thus, patients with mental disorders almost inevitably present sleep abnormalities, such as a "shorter latency to enter rapid eye movement (REM) sleep and a decrease in delta power of the electroencephalogram during normal sleep". Lack of sleep can be stressful and the accumulation of stress leads to deterioration of mental health and contributes to the development of mental disorders [109]. Likewise, several mechanisms have been postulated that can explain the bidirectional association between poor sleep quality and mental health disorders, including neurobiological factors such as neurotransmitters and brain structures, biological factors, such as greater inflammatory deregulation. in response to sleep disorders, which are associated with anxiety and depression; and common factors (e.g., genetic, familial, social and environmental) that independently contribute to the development of mental disorders. It is difficult to reach a conclusion and more longitudinal studies are needed to understand if there is a relationship bidirectional [102]. Therefore, it is a critical need for future research to elucidate this relationship.

Relevance of mental health findings

Medical students have significantly higher levels of mental health problems compared to students in other undergraduate majors [92, 100], poor sleep quality is one of the aggravating factors, since it not only affects their academic performance, but also their functional capacity [96, 110]. This poor sleep quality was further increased during the COVID-19 pandemic. For this reason, the present study will be useful to identify students who are more vulnerable to having a poor quality of sleep and to promote future interventions that contribute to the prevention of this problem. In this way, the repercussions on the mental health of future physicians in the country will be avoided, so that they in turn can provide better health care and make the most appropriate decisions in their clinical practice [108].

Our findings regarding the prevalence of poor sleep quality and its associated factors should be interpreted in the context of the COVID-19 pandemic period. Comparing these results to pre-pandemic and post-pandemic times presents challenges due to differences in circumstances and context. It is important to recognize that factors such as pandemic-induced stress, changing academic burdens due to remote education, and social isolation measures have had a significant impact on sleep quality during the pandemic. These factors may not have been present or may have had a different impact in pre and post-pandemic periods [105]. The comparison of our findings with pre-pandemic or post-pandemic periods is an important aspect that deserves attention. However, it is important to note that our study is cross-sectional in nature, which means that we lack measurements prior to the pandemic and, therefore, cannot establish direct comparisons with previous periods. Additionally, the lack of post-pandemic measurements also limits our ability to assess how sleep patterns and associated factors may have evolved over time. Despite these limitations, our results provide a valuable snapshot of sleep quality and predictor factors during the pandemic, which may be useful for informing future research and intervention strategies in this context.

Limitations and strengths

This research has some limitations. First, information bias since it has not been possible to measure other variables potentially associated with sleep quality such as Internet or cell phone use [111], COVID-19 vaccination status, type of diet, type of food [112], consumption of coffee before going to sleep, physical condition [113], type of housing (rural or urban) [114], capital stock [115],

training in the clinic and in contact with patients [116], employment status [117], students' chronotype or diurnal preference [118, 119], and academic performance [120]. Second, selection bias, given that the research findings cannot be inferred to all medical students in Latin America and the Caribbean, due to non-random sampling and the participating medical schools were eligible by snowball sampling. Third, due to the study design it is not possible to attribute causality in the factors that were associated with poor sleep quality. Fourth, there is potential self-selection bias, as individuals with more severe sleep issues may have excluded themselves from participating in the study due to stigma. This is an important limitation, as it could affect the generalizability of the findings. Furthermore, the target population size was not reported, which limits the ability to assess the representativeness of the sample.

Nevertheless, this research highlights as its main virtue the meticulous exploration of possible factors linked to poor sleep quality. This achievement is based on a robust methodological design and data analysis, supported by an extensive sample of medical students from Latin America, capturing the complexity of the scenario during the first wave of the COVID-19 pandemic in several cities. In addition, it is distinguished by the evaluation of variables not contemplated in previous studies, and its instruments exhibit solid psychometric properties, guaranteeing the reliability and validity of the findings. These aspects consolidate the relevance and soundness of the results obtained in the field of sleep quality and its connection with mental health in the context of the global health crisis.

Conclusions

This study reveals that poor sleep quality is present in nearly 6 out of 10 participating Latin American medical students, and is influenced by multiple factors. Participation in COVID-19 training and having been diagnosed with COVID-19 were associated with lower prevalence of poor sleep quality. Resilience also showed a protective effect. However, female gender, moderate smoking, depressive and anxious symptoms were strongly associated with a higher prevalence of poor sleep quality. The results underscore the intricate web of factors that influence the sleep quality of medical students during crisis situations such as the pandemic. This picture suggests the imperative need for targeted interventions, particularly in the context of potential future disasters or epidemics, to safeguard the mental health and improve the sleep quality of these students, thereby ensuring their holistic well-being in challenging educational environments.

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Authors' contributions
MJ. V-G were responsible for the conceptualization, methodology, investigation, data curation, writing—original draft preparation, and writing—review and editing. N M-A; J.P Z-V; LA. Z, HM, S-C; D.A.R; CI. P.C; F. J-M; CG. V-M; ES. B. A; EC. PN; H.D-T; VJ. V-P; D. V-G; VE. F-R; CJ. P–V; C C. and PR. C-U were responsible for the methodology, investigation, writing—original draft preparation, and writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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Data availability
The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The primary study has approval from the COVID-19 Research Ethics Committee of the Seguro Social de Salud-EsSalud-Lima. The ethical principles according to the Declaration of Helsinki were taken into account, the acceptance of informed consent was requested from the students before accessing the questionnaire virtually. The principal investigator of the study was the only person who had access to the shared personal information and anonymized databases were managed using numerical codes.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Perotta B, Arantes-Costa FM, Enns SC, Figueiro-Filho EA, Paro H, Santos IS, et al. Sleepiness, sleep deprivation, quality of life, mental symptoms and perception of academic environment in medical students. BMC Med Educ. 2021;21(1):111.
2. Rao WW, Li W, Qi H, Hong L, Chen C, Li CY, et al. Sleep quality in medical students: a comprehensive meta-analysis of observational studies. Sleep Breath septiembre de. 2020;24(3):1151–65.
3. Jahrami H, BaHammam AS, Bragazzi NL, Saif Z, Faris M, Vitiello MV. Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. J Clin Sleep Med. 2021;17(2):299–313.

4. Gardani M, Bradford DRR, Russell K, Allan S, Beattie L, Ellis JG, et al. A systematic review and meta-analysis of poor sleep, insomnia symptoms and stress in undergraduate students. Sleep Med Rev. 2022;61:101565.
5. Hernández-Yépez PJ, Muñoz-Pino CO, Ayala-Laurel V, Contreras-Carmona PJ, Inga-Berrospi F, Vera-Ponce VJ, et al. Factors Associated with Anxiety, Depression, and Stress in Peruvian University Students during the COVID-19 Pandemic. Int J Environ Res Public Health. 2022;19(21):14591.
6. Kaul V, Gallo de Moraes A, Khateeb D, Greenstein Y, Winter G, Chae J, et al. Medical Education During the COVID-19 Pandemic. Chest. 2021;159(5):1949–60.
7. Mishra J, Panigrahi A, Samanta P, Dash K, Mahapatra P, Behera MR. Sleep quality and associated factors among undergraduate medical students during Covid-19 confinement. Clin Epidemiol Glob Health. 2022;15:101004.
8. Molla A, Wondie T. Magnitude of Poor Sleep Hygiene Practice and Associated Factors among Medical Students in Ethiopia: A Cross-Sectional Study. Sleep Disord. 2021;2021:6611338.
9. Thaipisuttikul P, Theansukont T, Boonmueng R, Wisajun P. Sleep quality problems in Thai medical students. Sleep Sci. 2022;15(Spec 1):244–8.
10. Pasillas DJT, de la Luna SR, Medina MJE, Amaro NZG, Vázquez GT, Castañeda JAN, et al. Prevalencia de ansiedad, estrés, depresión e insomnio durante la pandemia COVID-19 en estudiantes universitarios de Zacatecas. Enfermería, Innovación y Ciencia. 2021;3(1):29–38.
11. Salinas SEB, Coronel DCI, Zhizhpón AAC, Bermeo PAR. Hábitos alimenticios, nocivos y rendimiento académico en estudiantes universitarios en tiempos de Covid-19. Revista Vive. 2021;4(12):659–72.
12. Fernandes ACA, Padilha D de MM, de Moura ACMA, de Aquino CEF, Lima IB de A, Mota-Rolim SA. COVID-19 pandemic decreased sleep quality of medical students. Sleep Sci. 2022;15(4):436–40.
13. Copaja-Corzo C, Miranda-Chavez B, Vizcarra-Jiménez D, Hueda-Zavaleta M, Rivarola-Hidalgo M, Parihuana-Travezaño EG, et al. Sleep Disorders and Their Associated Factors during the COVID-19 Pandemic: Data from Peruvian Medical Students. Medicina (Kaunas). 2022;58(10):1325.
14. Janatmakan Amiri A, Morovatdar N, Soltanifar A, Rezaee R. Prevalence of Sleep Disturbance and Potential Associated Factors among Medical Students from Mashhad. Iran Sleep Disord. 2020;2020:4603830.
15. Rodríguez JV, Parra AM, Morales MF. Análisis de estilos de vida, ansiedad y depresión en estudiantes de medicina de la Universidad Regional Autónoma de Los Andes, Uniandes. Ambato. AVFT – Archivos Venezolanos de Farmacología y Terapéutica. 2022;41(11). Disponible en: http://saber.ucv.ve/ojs/index.php/rev_aavft/article/view/25892. Citado 28 de diciembre de 2024.
16. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet. 2020;395(10227):912–20.
17. Giorgi G, Lecca LI, Alessio F, Finstad GL, Bondanini G, Lulli LG, et al. COVID-19-Related Mental Health Effects in the Workplace: A Narrative Review. Int J Environ Res Public Health. 2020;17(21):7857.
18. Paz DC, Bains MS, Zueger ML, Bandi VR, Kuo VY, Cook K, et al. COVID-19 and mental health: A systematic review of international medical student surveys. Front Psychol. 2022;13. Disponible en: https://doi.org/10.3389/fpsyg.2022.1028559/full. Citado 28 de diciembre de 2024
19. Tahir MJ, Malik NI, Ullah I, Khan HR, Perveen S, Ramalho R, et al. Internet addiction and sleep quality among medical students during the COVID-19 pandemic: A multinational cross-sectional survey. PLoS ONE. 2021;16(11): e0259594.
20. Trevorrow T, Scanlan S, Aumer K, Tsushima V, Kim BSK, Harris S. University students' sleep during the COVID-19 pandemic in the State of Hawai'i. J Am Coll Health diciembre de. 2024;72(9):3651–61.
21. Luciano F, Cenacchi V, Vegro V, Pavei G. COVID-19 lockdown: Physical activity, sedentary behaviour and sleep in Italian medicine students. Eur J Sport Sci octubre de. 2021;21(10):1459–68.
22. Wu H, Li H, Li X, Su W, Tang H, Yang J, et al. Psychological Health and Sleep Quality of Medical Graduates During the Second Wave of COVID-19 Pandemic in Post-epidemic Era. Front Public Health. 2022;10:876298.
23. Sandoval KD, Morote-Jayacc PV, Moreno-Molina M, Taype-Rondan A. Depresión, estrés y ansiedad en estudiantes de Medicina humana de Ayacucho (Perú) en el contexto de la pandemia por COVID-19. Rev Colomb Psiquiatr. 9 de noviembre de 202; Disponible en:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8576172/. Citado 28 de diciembre de 2024.
24. Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, et al. The prevalence of depressive symptoms, anxiety symptoms and sleep disturbance in higher education students during the COVID-19 pandemic: A systematic review and meta-analysis. Psychiatry Res julio de. 2021;301:113863.
25. Sheshtawy HA, Hemead S, Shaheen A, Shaheen N, Elrewany E, Hemead HM. Prevalence of depression, anxiety and stress disorders among medical students in Alexandria Faculty of Medicine during COVID-19 pandemic. BJPsych Open. 2021;7(Suppl 1):S2.
26. Alkalash S, Alzubaidi H, Alessi N, Alghanmi A, Almasoudi A. Sleep quality among Al Qunfudhah medical students and its effects on their academic performance during covid-19 pandemic. Medical Science. 2022;26:1.
27. Coppi F, Nasi M, Sabatini S, Bellini P, Generali L, Mecugni D, et al. Lifestyle changes during the first and second waves of the COVID-19 pandemic in medical college students: are there gender-related differences? Acta Biomed. 2022;93(5): e2022312.
28. Luo C, Santos-Malave G, Taku K, Katz C, Yanagisawa R. Post-traumatic Growth and Resilience among American Medical Students during the COVID-19 Pandemic. Psychiatr Q junio de. 2022;93(2):599–612.
29. Tahir S, Imran N, Haider II, Mustafa AB, Rehman A ur, Azeem MW, et al. A study to evaluate the impact of COVID-19 on Lifestyle of Medical students. Pakistan Journal of Medical Sciences. 22 de agosto de 2022;38(7). Disponible en: https://www.pjms.org.pk/index.php/pjms/article/view/6031
30. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)–a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform abril de. 2009;42(2):377–81.
31. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, et al. The REDCap consortium: Building an international community of software platform partners. J Biomed Inform julio de. 2019;95: 103208.
32. Software – REDCap. Disponible en: https://projectredcap.org/software/. Citado 28 de diciembre de 2024.
33. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res mayo de. 1989;28(2):193–213.
34. Rosales E, Egoavil M, La Cruz C, Rey de Castro J. Somnolencia y calidad del sueño en estudiantes de medicina de una universidad peruana. Anales de la Facultad de Medicina. 2007;68(2):150–8.
35. Ravelo Bobadilla MF. Validez y confiabilidad del cuestionario de calidad de sueño de Pittsburgh en estudiantes universitarios peruanos. Repositorio Institucional - UCV. 2022. Disponible en: https://repositorio.ucv.edu.pe/handle/20.500.12692/87440. Citado 28 de diciembre de 2024.
36. Bertolazi AN, Fagondes SC, Hoff LS, Dartora EG, Miozzo IC da S, de Barba MEF, et al. Validation of the Brazilian Portuguese version of the Pittsburgh Sleep Quality Index. Sleep Med. 2011;12(1):70–5.
37. Rossi R, Socci V, Talevi D, Mensi S, Niolu C, Pacitti F, et al. COVID-19 Pandemic and Lockdown Measures Impact on Mental Health Among the General Population in Italy. Front Psychiatry. 2020;11:790.
38. García-León MÁ, González-Gómez A, Robles-Ortega H, Padilla JL, Peralta-Ramírez MI, García-León MÁ, et al. Propiedades psicométricas de la Escala de Resiliencia de Connor y Davidson (CD-RISC) en población española. Anales de Psicología marzo de. 2019;35(1):33–40.
39. Notario-Pacheco B, Solera-Martínez M, Serrano-Parra MD, Bartolomé-Gutiérrez R, García-Campayo J, Martínez-Vizcaíno V. Reliability and validity of the Spanish version of the 10-item Connor-Davidson Resilience Scale (10-item CD-RISC) in young adults. Health Qual Life Outcomes. 2011;9:63.
40. Valladares-Garrido MJ, Huamani-Colquichagua Y, Anchay-Zuloeta C, Picón-Reátegui CK, Valladares-Garrido D. Time in Service and Resilience in Active Military Personnel during the COVID-19 Pandemic: A Cross-Sectional Study in Northern Peru. Int J Environ ResPublic Health. 2022;19(17):11052.
41. Leiva León NF. La resilencia como factor asociado al Sindrome de Burnout, depresión y ansiedad en el personal de salud que labora en las Unidades de Cuidados Intensivos durante la pandemia COVID-19 en el Perú. 2021. Disponible en: https://repositorio.upch.edu.pe/handle/20.500.12866/8964. Citado 28 de diciembre de 2024.

42. Campbell-Sills L, Stein MB. Psychometric analysis and refinement of the Connor-davidson Resilience Scale (CD-RISC): Validation of a 10-item measure of resilience. J Trauma Stress diciembre de. 2007;20(6):1019–28.
43. Zila-Velasque JP, Grados-Espinoza P, Coba-Villan N, Quispe-Chamorro J, Taipe-Guillén YF, Pacheco E, et al. Mental Disorders and Level of Resilience in Eight High-Altitude Cities of Peru during the Second Pandemic Wave: A Multicenter Population-Based Study. Int J Environ Res Public Health. 2022;20(1):519.
44. Valladares-Garrido MJ, Picón-Reátegui CK, Zila-Velasque JP, Grados-Espinoza P, Hinostroza-Zarate CM, Failoc-Rojas VE, et al. Suicide Risk in Military Personnel during the COVID-19 Health Emergency in a Peruvian Region: A Cross-Sectional Study. Int J Environ Res Public Health. 2022;19(20):13502.
45. Constaín GA, Ricardo Ramírez C, Rodríguez-Gázquez M de los Á, Álvarez Gómez M, Marín Múnera C, Agudelo Acosta C. Validez y utilidad diagnóstica de la escala EAT-26 para la evaluación del riesgo de trastornos de la conducta alimentaria en población femenina de Medellín, Colombia. Aten Primaria. 2014;46(6):283–9.
46. Zila-Velasque JP, Grados-Espinoza P, Regalado-Rodríguez KM, Sosa-Nuñez F, Alcarraz-Jaime A, Cortez-Soto AG, et al. Sociodemographic and educational factors associated with mental health disorders in medical students of clinical years: A multicenter study in Peru. PLOS ONE. 2023;18(6):e0286338.
47. Wyszyńska J, Matłosz P, Podgórska-Bednarz J, Herbert J, Przednowek K, Baran J, et al. Adaptation and validation of the Physical Activity Questionnaire for Adolescents (PAQ-A) among Polish adolescents: cross-sectional study. BMJ Open. 2019;9(11):e030567.
48. Martínez-Gómez D, Martínez-de-Haro V, Pozo T, Welk GJ, Villagra A, Calle ME, et al. Fiabilidad y validez del cuestionario de actividad física PAQ-A en adolescentes españoles. Revista Española de Salud Pública. 2009;83(3):427–39.
49. Trujillano AAM, Rebatta DAP, Mendoza AEFT, Olivari ECM, Fernández PRA. Nivel de actividad física según el cuestionario PAQ-A en escolares de secundaria en dos colegios de San Martin de Porres – Lima. Revista Herediana de Rehabilitación. 2016;1(1):21–21.
50. González-Rodríguez R, Domínguez Alonso J, Verde-Diego C, Frieiro PP. Psychometric properties of the Maslach Burnout Inventory - Human Services in Social Work professionals in Spain. Health Soc Care Community mayo de. 2022;30(3):949–56.
51. Olivares-Faúndez V, Mena-Miranda L, Macía-Sepúlveda F, Jélvez-Wilke C. Validez factorial del Maslach Burnout Inventory Human Services (MBI-HSS) en profesionales chilenos. Univ Psychol. 2014;13(1):145–60.
52. Mejia CR, Valladares-Garrido MJ, Talledo-Ulfe L, Sánchez-Arteaga K, Rojas C, Arimuya JJ, et al. Síndrome de Burnout y factores asociados en estudiantes de medicina: Estudio multicéntrico en siete facultades de medicina peruanas. Revista chilena de neuro-psiquiatría septiembre de. 2016;54(3):207–14.
53. Valladares-Garrido MJ, León-Figueroa DA, Dawson FM, Burga-Cachay SC, Fernandez-Canani MA, Failoc-Rojas VE, et al. Association between childhood trauma and mental health disorders in adolescents during the second pandemic wave of COVID-19. Chiclayo-Peru Front Psychiatry. 2023;14:1169247.
54. Domingues EAR, Alexandre NMC, da Silva JV. Adaptación cultural y validación del Freiburg Life Quality Assessment-Wound para la lengua portuguesa de Brasil. Rev Latino-Am Enfermagem. 2016;24:e2684.
55. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med. 2006;166(10):1092–7.
56. Valladares-Garrido MJ, Picón-Reátegui CK, Zila-Velasque JP, Grados-Espinoza P, Vera-Ponce VJ, Pereira-Victorio CJ, et al. Depression and anxiety in peruvian military personnel during the pandemic context: a cross-sectional study. BMC Public Health. 2023;23(1):691.
57. García-Campayo J, Zamorano E, Ruiz MA, Pérez-Páramo M, López-Gómez V, Rejas J. The assessment of generalized anxiety disorder: psychometric validation of the Spanish version of the self-administered GAD-2 scale in daily medical practice. Health Qual Life Outcomes. 2012;10:114.
58. Calderón M, Gálvez-Buccollini JA, Cueva G, Ordoñez C, Bromley C, Fiestas F. Validación de la versión peruana del PHQ-9 para el diagnóstico de depresión. Revista Peruana de Medicina Experimental y Salud Publica. 2012;29(4):578–578.
59. Baader MT, Molina FJL, Venezian BS, Rojas CC, Farías SR, Fierro-Freixenet C, et al. Validación y utilidad de la encuesta PHQ-9 (Patient Health Questionnaire) en el diagnóstico de depresión en pacientes usuarios de atención primaria en Chile. Revista chilena de neuro-psiquiatría marzo de. 2012;50(1):10–22.
60. Rubio Valldolid G, Martínez-Raga J, Martínez-Gras I, Ponce Alfaro G, de la Cruz BJ, Jurado Barba R, et al. Validation of the Spanish version of the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST). Psicothema mayo de. 2014;26(2):180–5.
61. López-Lazcano AI, López-Pelayo H, Balcells-Oliveró M, Segura L, Solé AG. Validation of the Alcohol Smoking and Substance Involvement Screening Test (ASSIST) in acute psychiatric inpatients. Adicciones. 2022;34(4):259–72.
62. Tiburcio Sainz M, Rosete-Mohedano MG, Natera Rey G, Martínez Vélez NA, Carreño García S, Pérez Cisneros D. Validity and Reliability of the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) in University Students. Adicciones. 2016;28(1):19–27.
63. Rabe-Hesketh S, Skrondal A. Generalized Linear Mixed Models. En: International Encyclopedia of Education. Elsevier; 2010;171–7. Disponible en: https://linkinghub.elsevier.com/retrieve/pii/B9780080448947013324. Citado 28 de diciembre de 2024.
64. Saguem BN, Nakhli J, Romdhane I, Nasr SB. Predictors of sleep quality in medical students during COVID-19 confinement. Encephale febrero de. 2022;48(1):3–12.
65. Chen J, Tuersun Y, Yang J, Xiong M, Wang Y, Rao X, et al. Association of depression symptoms and sleep quality with state-trait anxiety in medical university students in Anhui Province, China: a mediation analysis. BMC Medical Education. 2022;22(1):627.
66. Coico-Lama AH, Diaz-Chingay LL, Castro-Diaz SD, Céspedes-Ramirez ST, Segura-Chavez LF, Soriano-Moreno AN. Asociación entre alteraciones en el sueño y problemas de salud mental en los estudiantes de Medicina durante la pandemia de la COVID-19. Educacio´n Me´dica. 2022;23(3):100744.
67. Olarte-Durand M, Roque-Aycachi JB, Rojas-Humpire R, Canaza-Apaza JF, Laureano S, Rojas-Humpire A, et al. [Mood and sleep quality in Peruvian medical students during COVID-19 pandemic]. Rev Colomb Psiquiatr. 9 de diciembre de 2021;
68. Alcantara Villanueva GF. Calidad de sueño en alumnos de medicina de Chiclayo durante la pandemia por COVID-19. 2022. ; Disponible en: http://tesis.usat.edu.pe/handle/20.500.12423/4628. Citado 28 de diciembre de 2024.
69. Du C, Zan MCH, Cho MJ, Fenton JI, Hsiao PY, Hsiao R, et al. Health Behaviors of Higher Education Students from 7 Countries: Poorer Sleep Quality during the COVID-19 Pandemic Predicts Higher Dietary Risk. Clocks Sleep. 2021;3(1):12–30.
70. Xie J, Li X, Luo H, He L, Bai Y, Zheng F, et al. Depressive Symptoms, Sleep Quality and Diet During the 2019 Novel Coronavirus Epidemic in China: A Survey of Medical Students. Front Public Health. 2020;8: 588578.
71. Eleftheriou A, Rokou A, Arvaniti A, Nena E, Steiropoulos P. Sleep Quality and Mental Health of Medical Students in Greece During the COVID-19 Pandemic. Front Public Health. 2021;9: 775374.
72. Zhou Y, Bo S, Ruan S, Dai Q, Tian Y, Shi X. Deteriorated sleep quality and influencing factors among undergraduates in northern Guizhou. China PeerJ. 2022;10:e13833.
73. Xie G, Wu Q, Guo X, Zhang J, Yin D. Psychological resilience buffers the association between cell phone addiction and sleep quality among college students in Jiangsu Province. China Front Psychiatry. 2023;14:1105840.
74. Toubasi AA, Khraisat BR, AbuAnzeh RB, Kalbouneh HM. A cross sectional study: The association between sleeping quality and stress among second and third medical students at the University of Jordan. Int J Psychiatry Med marzo de. 2022;57(2):134–52.
75. Xiang YT, Yang Y, Li W, Zhang L, Zhang Q, Cheung T, et al. Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. Lancet Psychiatry marzo de. 2020;7(3):228–9.
76. Pfefferbaum B, North CS. Mental Health and the Covid-19 Pandemic. New Engl J Med. 2020;383(6):510–2.

77. Suardiaz-Muro M, Morante-Ruiz M, Ortega-Moreno M, Ruiz MA, Martín-Plasencia P, Vela-Bueno A. Sleep and academic performance in university students: a systematic review. Rev Neurol. 2020;71(2):43–53.
78. Short MA, Gradisar M, Lack LC, Wright HR. The impact of sleep on adolescent depressed mood, alertness and academic performance. J Adolesc diciembre de. 2013;36(6):1025–33.
79. Salfi F, Lauriola M, Amicucci G, Corigliano D, Viselli L, Tempesta D, et al. Gender-related time course of sleep disturbances and psychological symptoms during the COVID-19 lockdown: A longitudinal study on the Italian population. Neurobiol Stress. 2020;13:100259.
80. Ergin N, Kılıç BB, Ergin A, Varlı S. Sleep quality and related factors including restless leg syndrome in medical students and residents in a Turkish university. Sleep Breath septiembre de. 2022;26(3):1299–307.
81. López Pesántez AM. Calidad de sueño y factores asociados en estudiantes de medicina de la Universidad de Cuenca en tiempos de pandemia COVID-19, junio-noviembre 2022. 13 de abril de 2023. Disponible en: http://dspace.ucuenca.edu.ec/handle/123456789/41703. Citado 28 de diciembre de 2024.
82. Chen J, Zhang Y, Zhou X. Effects of gender, medical school class year, and majors on sleep quality in Chinese medical students: a systematic review and meta-analysis. Sleep Breath marzo de. 2020;24(1):259–66.
83. Mengin A, Allé MC, Rolling J, Ligier F, Schroder C, Lalanne L, et al. Conséquences psychopathologiques du confinement. L'Encéphale. 2020;46(3):S43-52.
84. Giri P, Baviskar M, Phalke D. Study of sleep habits and sleep problems among medical students of pravara institute of medical sciences loni, Western maharashtra. India Ann Med Health Sci Res. 2013;3(1):51–4.
85. Azad MC, Fraser K, Rumana N, Abdullah AF, Shahana N, Hanly PJ, et al. Sleep Disturbances among Medical Students: A Global Perspective. J Clin Sleep Med. 2015;11(1):69–74.
86. Chen C, He Z, Xu B, Shao J, Wang D. A latent profile analysis of sleep disturbance in relation to mental health among college students in China. Front Public Health. 31 de mayo de 2023;11. Disponible en: Citado 28 de diciembre de 2024;11. https://doi.org/10.3389/fpubh.2023.1107692/full
87. McLean CL, Chu GM, Karnaze MM, Bloss CS, Lang AJ. Social support coping styles and psychological distress during the COVID-19 pandemic: The moderating role of sex. J Affect Disord. 2022;308:106–10.
88. Pengo MF, Won CH, Bourjeily G. Sleep in Women Across the Life Span. Chest julio de. 2018;154(1):196–206.
89. Reynaud E, Vuillermoz C, Léon C, Roland N, El Khoury F. Association between the experience of sexual violence and insomnia in a national sample of French adults. Sleep Med enero de. 2023;101:228–32.
90. Wang R, He L, Xue B, Wang X, Ye S. Sleep Quality Of College Students During COVID-19 Outbreak In China: A Cross-Sectional Study. Altern Ther Health Med marzo de. 2022;28(3):58–64.
91. Morin CM, Carrier J, Bastien C, Godbout R, Canadian Sleep and Circadian Network. Sleep and circadian rhythm in response to the COVID-19 pandemic. Can J Public Health. 2020;111(5):654–7.
92. Zhang Y, Zhang H, Ma X, Di Q. Mental Health Problems during the COVID-19 Pandemics and the Mitigation Effects of Exercise: A Longitudinal Study of College Students in China. Int J Environ Res Public Health. 2020;17(10):3722.
93. Okano K, Kaczmarzyk JR, Dave N, Gabrieli JDE, Grossman JC. Sleep quality, duration, and consistency are associated with better academic performance in college students. npj Sci Learn. 1 de octubre de 2019;4(1):1–5.
94. Maheshwari G, Shaukat F. Impact of Poor Sleep Quality on the Academic Performance of Medical Students. Cureus. 2019;11(4):e4357.
95. Alimoradi Z, Broström A, Tsang HWH, Griffiths MD, Haghayegh S, Ohayon MM, et al. Sleep problems during COVID-19 pandemic and its' association to psychological distress: A systematic review and meta-analysis. EClinicalMedicine junio de. 2021;36: 100916.
96. Canaza Apaza JM. Capital social y calidad de sueño en estudiantes de medicina durante la pandemia por COVID-19. 2022.
97. Li Y, Gu S, Wang Z, Li H, Xu X, Zhu H, et al. Relationship Between Stressful Life Events and Sleep Quality: Rumination as a Mediator and Resilience as a Moderator. Front Psychiatry. 2019;10:348.
98. Zhang C, Ye M, Fu Y, Yang M, Luo F, Yuan J, et al. The Psychological Impact of the COVID-19 Pandemic on Teenagers in China. J Adolesc Health diciembre de. 2020;67(6):747–55.
99. Echevarría Gianello A. Relación entre los trastornos del sueño y el consumo de sustancias en estudiantes universitarios. 2021. Disponible en: https://repositorio.comillas.edu/xmlui/handle/11531/50860. Citado 28 de diciembre de 2024.
100. Reis M, Ramiro L, Paiva T, Gaspar-de-Matos M. National Survey on the importance of sleep in the quality of academic life and mental health of college students in Portugal. Sleep Sci. 2021;14(Spec 2):125–32.
101. Velasco Villavicencio V, Rodriguez BG, Palencia E, Jasso Medrano J, Monteiro M, Zamarripa J. LA SALUD MENTAL EN TIEMPOS DE PANDEMIA POR COVID-19: UN ABORDAJE DESDE LA SALUD PÚBLICA. 2023.
102. Gonzalez-Argote J. Calidad del Sueño: Factor Clave en la Recuperación Física y Mental de Estudiantes de Medicina. Interdiscipl Rehab / Rehabilitacion Interdisciplinaria. 2022;2:21.
103. Wang J, Zhang X, Simons SR, Sun J, Shao D, Cao F. Exploring the bidirectional relationship between sleep and resilience in adolescence. Sleep Med septiembre de. 2020;73:63–9.
104. Li Y, Guo K. Research on the relationship between physical activity, sleep quality, psychological resilience, and social adaptation among Chinese college students: A cross-sectional study. Front Psychol. 10 de febrero de 2023;14. Disponible en: https://www.frontiersin.org/journals/psychology/articles/https://doi.org/10.3389/fpsyg.2023.1104897/full. Citado 28 de diciembre de 2024.
105. Reyes KMG. Relación entre el nivel de resiliencia y los hábitos de alimentación, actividad física y calidad del sueño de los estudiantes de educación superior, en tiempos de pandemia. 13 de marzo de 2023 [citado 28 de diciembre de 2024]; Disponible en: https://ri-ng.uaq.mx/handle/123456789/7892
106. Valladares-Garrido MJ, Zapata-Castro LE, Picón-Reategui CK, Mesta-Pintado AP, Picón-Reategui RA, Huaman-Garcia M, et al. Association between Working Time and Burnout Syndrome in Peruvian Military during the Second Epidemic Wave of COVID-19. Int J Environ Res Public Health. 2022;19(20):13614.
107. Houpy JC, Lee WW, Woodruff JN, Pincavage AT. Medical student resilience and stressful clinical events during clinical training. Med Educ Online. 2017;22(1):1320187.
108. Vidal Dominguez FA. "USO DE PSICOESTIMULANTES Y CALIDAD DE SUEÑO EN ESTUDIANTES DE MEDICINA HUMANA DE LA UNIVERSIDAD RICARDO PALMA, 2021". 2023. Disponible en: https://hdl.handle.net/20.500.14138/6422.Citado 28 de diciembre de 2024.
109. Payeza Chaname YC. Calidad de sueño, somnolencia diurna y consumo de tabaco en estudiantes de enfermería de una universidad privada. Chiclayo, Perú. 2019. 2021. Disponible en: http://tesis.usat.edu.pe/handle/20.500.12423/3358.Citado 28 de diciembre de 2024.
110. Lock AM, Bonetti DL, Campbell ADK. The psychological and physiological health effects of fatigue. Occup Med (Lond). 2018;68(8):502–11.
111. Mishra J, Panigrahi A, Samanta P, Dash K, Mahapatra P, Behera MR. Sleep quality and associated factors among undergraduate medical students during Covid-19 confinement. Clin Epidemiol Glob Health. 2022;15:101004.
112. Neculicioiu VS, Colosi IA, Costache C, Sevastre-Berghian A, Clichici S. Time to Sleep?-A Review of the Impact of the COVID-19 Pandemic on Sleep and Mental Health. Int J Environ Res Public Health. 2022;19(6):3497.
113. Fang H, Tu S, Sheng J, Shao A. Depression in sleep disturbance: A review on a bidirectional relationship, mechanisms and treatment. J Cell Mol Med abril de. 2019;23(4):2324–32.
114. Bartlett J, Fowler K. Beyond the curriculum: a cross-sectional study of medical student psychological distress, and health care needs, practices and barriers. Soc Psychiatry Psychiatr Epidemiol septiembre de. 2020;55(9):1215–21.
115. Alvaro PK, Roberts RM, Harris JK. A Systematic Review Assessing Bidirectionality between Sleep Disturbances, Anxiety, and Depression. Sleep. 2013;36(7):1059–68.
116. Maser B, Danilewitz M, Guérin E, Findlay L, Frank E. Medical Student Psychological Distress and Mental Illness Relative to the General Population: A Canadian Cross-Sectional Survey. Acad Med noviembre de. 2019;94(11):1781–91.

117. Abdulah DM, Piro RS. Sleep disorders as primary and secondary factors in relation with daily functioning in medical students. Ann Saudi Med. 2018;38(1):57–64.
118. Paniagua DLO, Salvador J de JH, Ayala KJZ, Hernández LJR, Elizarraraz LBV, García PSG, et al. Impacto en la calidad del sueño y trastornos psicológicos en estudiantes universitarios. JÓVENES EN LA CIENCIA. 2023;21:1–15.
119. Jacob R, Li T yan, Martin Z, Burren A, Watson P, Kant R, et al. Taking care of our future doctors: a service evaluation of a medical student mental health service. BMC Med Educ. 2020;20(1):172.
120. Alsaggaf MA, Wali SO, Merdad RA, Merdad LA. Sleep quantity, quality, and insomnia symptoms of medical students during clinical years. Relationship with stress and academic performance. Saudi Med J. febrero de 2016;37(2):173–82.

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