Sleep quality, daytime sleepiness and insomnia in medical students during the COVID-19 pandemic

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Abstract

Introduction: The COVID-19 pandemic represented a challenge for medical education. Online education was the best alternative to avoid the risk of transmission of the virus. However, confinement, uncertainty, fear and various family and economic problems had an impact on the physical and mental health of the most population. The aim of the study was to describe sleep quality, insomnia, and daytime sleepiness among medical students from Yucatan, Mexico, during COVID-19 pandemic.

Methodology: A cross-sectional and analytical study was designed with a probabilistic sample of 114 medicine students who electronically completed the Pittsburgh Sleep Quality, Epworth sleepiness scale, and Insomnia Severity Index questionnaires, from September to December 2021.

Results: 74.5% of the students had poor sleep quality, without differences between ages, sex, or hours of sleep. The subjective quality of sleep was correlated with the result of the questionnaire. On bad sleepers, the time for initiating sleep (latency) was more than twice compared to good sleepers. Insomnia was associated with poor sleep quality (OR 54, CI 95% 6.9-417 p < .001). Students referred to excessive homework (18%) family/personal problems (15%) and worry about exams (7%), and others as causes of insomnia. Daytime sleepiness occurred in 64% of the students and associated with bad sleep quality (OR 3.12; CI 95% 1.3-7.47, p = 0.01).

Conclusion: In conclusion, during the pandemic, most of the medicine students presented poor quality of sleep, insomnia and daytime sleepiness, despite having online classes at their homes.

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Calidad de sueño, somnolencia e insomnio en estudiantes de medicina durante la pandemia de COVID-19
Resumen

Introducción: La pandemia de COVID-19 representó un desafío para la educación médica. La educación en línea fue la mejor alternativa para evitar el riesgo de transmisión del virus. Sin embargo, el confinamiento, la incertidumbre, el miedo y diversos problemas familiares y económicos impactaron la salud física y mental de la mayoría de la población. El objetivo del estudio fue describir la calidad del sueño, el insomnio y la somnolencia diurna entre estudiantes de medicina de Yucatán, México, durante Pandemia de COVID-19.

Metodología: Se diseñó un estudio transversal y analítico con una muestra probabilística de 114 estudiantes de medicina que completaron electrónicamente los cuestionarios de calidad se sueño de Pittsburgh, la escala de somnolencia de Epworth y el índice de severidad de Insomnio, de septiembre a diciembre de 2021.

Resultados: El 74.5% de los estudiantes presentó mala calidad de sueño, sin diferencias entre edades, sexo y horas de sueño. La calidad subjetiva del sueño se correlacionó con el resultado del cuestionario. En los malos dormidores, el tiempo para iniciar el sueño (latencia) fue más del doble en comparación con los buenos dormidores. El insomnio se asoció con la mala calidad del sueño (OR 54, IC 95% 6.9-417 p < 0.001). Los estudiantes refirieron que el exceso de tareas (18%), los problemas familiares/personales (15%) y la preocupación por los exámenes (7%), entre otros, fueron causas del insomnio. La somnolencia diurna se presentó en el 64% de los estudiantes y se asoció con la mala calidad del sueño (OR 3.12; IC 95% 1.3-7.47, p = 0.01).

Conclusión: En conclusión, durante la pandemia, la mayoría de los estudiantes de medicina presentaron mala calidad de sueño, insomnio y somnolencia diurna, a pesar de estar con clases en línea en sus domicilios.

INTRODUCTION

Sleep is a necessary physiological process for human health, whose characteristics depend on several physiological, emotional and environmental factors[1]. Sleep quality represents a multifactorial assessment of objective data such as duration, number of nocturnal awakenings, schedules, latency, and subjective data such as the importance given to its restorative capacity or its repercussions during wakefulness[2]. Systematic reviews estimate that up to a third of the adult population has sleep disorders that is worrisome due to its deleterious implications for health and activities of daily life[3].

Many university students report that academic activities involve a large number of study hours, even using night hours, mainly during exam time. Therefore, they reduce the duration of sleep, which, together with the stress of these periods, leads to poor quality sleep[4]. The highest prevalence of poor sleep quality occurs in medical students[5]. Some reasons to explain this finding are the excess of theoretical content in the academic plans, the stress of clinical practices and work in hospitals, night shifts, among others, worsen the sleep conditions of medical doctors in training[6]. In addition, sleep disorders have negative implications on the students' academic performance. Partial sleep deprivation produces daytime sleepiness, irritability, restiveness, anxiety, depression, and a decrease in motor and cognitive functions. It can also facilitate the development of metabolic and hormonal disturbances, which have been related to diabetes, obesity, and cardiovascular diseases, among others[7]. Daytime sleepiness, resulting from poor sleep quality, affects memory, reduces attention and response speed, and produces lower grades and school performance, increasing the risk of falling behind and even dropping out of school[8].

The COVID-19 pandemic forced drastic lifestyle changes. World governments indicated a mandatory quarantine to reduce the risk of contagion, suspending all non-essential activities, such as school and academic activities[9]. Nevertheless, immediate implemented alternatives such as the use of information and communication technologies to continue the educational process at all levels. Universities tried out different online class models, to avoid impairing students' terminal efficiency. This change included the use of technological tools and equipment, different teaching and assessment methodologies, as well as wider schedule flexibility for students and professors[10]. On the other hand, during this time, uncertainty, fear, and distress about morbidity and mortality from the SARS-COV2 virus and its implication in the family's economy, together with the social interaction difficulties, had a negative impact on mental health, which was also reflected in worse sleep quality[11].

The present study shows an analysis of the sleep quality, daytime sleepiness, and insomnia self-perceived characteristics of Medical School students in Yucatán, México, during the COVID-19 pandemic.

METHODS

This is a transversal, prospective, and analytical survey-based study.

Participants

Students from the Medical School of the Universidad Autonoma de Yucatan (UADY), México, registered as regular students in the Medical Degree, during the school term 2020-2021. Hundred twenty-eight students were necessary, based on a probabilistic sample with a confidence interval of 95% and a 5% margin of error.

A simple random sampling method was used. One hundred fourteen students fully answered surveys and met the selection criteria, the others were eliminated due to incomplete questionnaires.

The inclusion criteria were: 18 years or older, being registered in the first 10 semesters, not having any acute illness (including COVID-19) at the moment of answering the survey, accepting the informed consent, and authorizing the use of the information for scientific purposes. Students in undergraduate rotating internships and social service were not included.

The independent variables were daytime sleepiness, insomnia, and subjective sleep quality. The dependent variable was poor sleep quality.

Instruments

The Pittsburgh Sleep Quality Index. This is a self-report instrument of 19 items, used to evaluate sleep quality, that summarizes seven components (latency, sleep duration, efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction) and gives a global score, ranging from 0 to 21; a score >5 identifies people with poor sleep quality (bad sleepers). The latency was evaluated with the required time to initiate sleep and its weekly frequency, measured as the number of times that more than 30 minutes were required to initiate sleep. Sleep efficiency was measured as the result of dividing sleep time by time lying down, multiplied by 100. The Spanish-validated version has an internal homogeneity of 0.81, with a sensitivity of 88.63%, a specificity of 74.88%, and a predictive value of 80.66%[2,12].

The Insomnia Severity Index. Used to measure clinical insomnia, a short self-administered questionnaire consists of seven questions. Its Spanish-validated version has an internal consistency of 0.91. The total score ranges between 0 and 28 points, interpreted as follows: absence of insomnia (0-7 points), subthreshold insomnia (8-14 points), moderate insomnia (15-21points), and severe insomnia (22-28 points)[13,14].

Epworth Sleepiness Scale. Used to evaluate self-perceived daytime sleepiness, self-administered questionnaire with eight items that rate the tendency to become sleepy in monotonous and soporific situations. The participant answers each item in a Linkert-type format from zero to three with an overall score ranging from zero to 24; a total score <10 is considered normal, 10-12 indicates marginal sleepiness and 13 or more severe sleepiness. The questionnaire has been validated in the Mexican population with acceptable internal consistency, with coefficients of 0.73 in control subjects and 0.88 in subjects with sleeping disorders[15].

Data collection and data analysis

Previous authorization from the UADY Medical School authorities, students were contacted and invited online via social media. The objectives and

Table 1. Sleep duration, latency, efficiency, and other characteristics in medical students during the COVID-19 pandemic

Indicator	Value	General (n = 114)	Good sleepers (n = 29)	Bad sleepers (n = 85)	p
Age	Years	22.21 ± 3.11	23 ± 1	21.91 ± 3.34	†.08
Sex	Men	54 (47.5%)	16 (55%)	38 (45%)	*.32
	Woman	60 (52.5%)	13 (45%)	47 (55%)	
Sleeping time	H:Min	0:45 ± 1:15	0:52 ± 1:18	0:42 ± 1:14	†.68
Awakening time	H:Min	7:26 ± 0:58	7:33 ± 1:07	7:25 ± 0:58	†.61
Average time to initiate sleep	Min	19.51 ± 18.33	10.72 ± 5.85	24.16 ± 20.9	†<.001
Couldn´t fall asleep in the first 30 minutes	Never	24 (21.5%)	17 (59%)	6 (7%)	*<.001
		OR 0.05 (CI 95% .017-.16)			
	< 1 week	39 (35%)	10 (34%)	29 (34%)	* .45
	1-2 week	35 (31%)	2 (7%)	34 (40%)	* .09
	3 > week	14 (12.5%)	0	16 (19%)	* .2
Lying down time	Hours: min	6:45 ± 1:06	6:40 ± 0:54	6:46 ± 1:12	†.78
Sleep duration	Hours: min	6:28 ± 1:07	6.36 ± 0:51	6:24 ± 1:12	†.57
Efficiency	%	94.27 ± 9.5	97.56 ± 1.69	92.9 ± 10.75	†.02
Subjective sleep quality	Very good	7 (6%)	6 (21%)	1 (1%)	*.005
		OR 21.9 (IC 95% 2.3-191)			
	Good	64 (56%)	20 (69%)	44 (52%)	* .11
	Bad	42 (37%)	3 (10%)	39 (46%)	* .002
		OR 7.23 (IC 95% 2.2-26)			
	Very bad	1 (1%)	0	1 (1%)	*.97

Sleeping and awakening time are expressed in Mexico City Time Zone. H: hours, Min: minutes. Good and bad sleepers are related.
† t-Student test for independent samples.
* Chi-squared.
CI: confidence interval 95%; OR: odds ratio. OR was performed only for statistically significant associations.

implications of the study were explained and those who voluntarily accepted to participate, and gave their informed consent, received the corresponding survey; a QR code was sent via email and WhatsApp, as well as the link of the electronic format in Forms®. Data collection was carried out between September and December 2021 and emptied into an SPSS 20.1 software database. Descriptive statistics were frequencies, percentages, averages, and standard deviation; the normality was determined with the Shapiro-Wilk test. Scores of the good and bad sleepers were compared with a t-Student test for independent measures. Daytime sleepiness, insomnia, and poor sleep were associated using chi-square and Odds ratios (OR) with 95% confidence interval. Pittsburgh index score and subjective sleep quality were related with a Pearson's linear regression model. All $p < .05$ values were considered statistically significant.

ETHICAL CONSIDERATIONS

The UADY Medical School authorized the protocol, number 03-2021. Participants gave their informed consent and all ethical principles. All students received the results of their surveys. The present study is a "research without risk" according to the General Healthcare Law in the Field of Health Research for the Mexican State.

RESULTS

74.5% of the students were classified as bad sleepers, with a duration average of 6.5 hours of sleep, without differences in age and sex. Good and bad sleepers did not show differences in the hours of sleep; however, the bad sleepers' latency was higher, as shown in **table 1**. The subjective perception of sleep quality was consistent with the questionnaire's general score. For the good sleepers, the Pearson's linear

Figure 1. The correlation of the students' perception of their sleep with the results of the Pittsburg test is shown. In A they show the students with good sleep and in B the bad sleepers. In both cases a significant correlation was found p<0.0001 and p<.001respectively. Although it is stronger in good sleepers
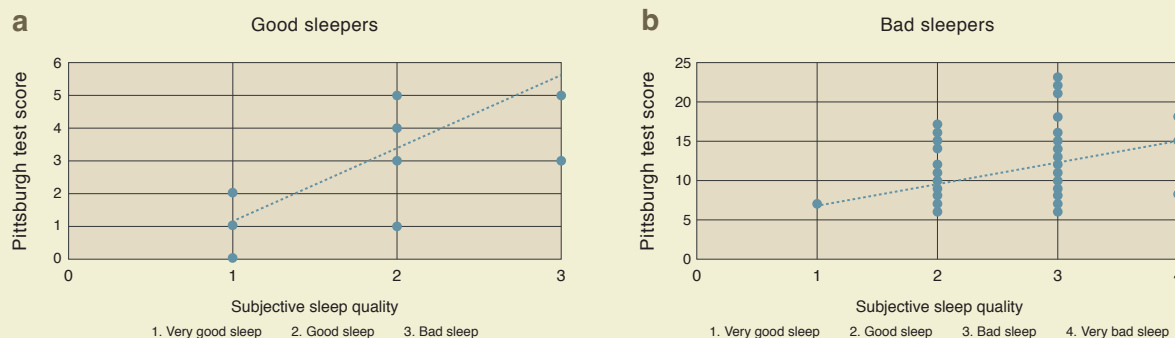
regression analysis between the Pittsburgh Index score and the subjective sleep quality demonstrated a strong correlation (R) 0.688, p < 0.0001, Y = 1.2304 + 0.2123X; in bad sleepers, the correlation is significant too (R) 0.376, p < 0.001, Y = .9572 + 0.05108X, as shown in **figure 1**.

Bad sleepers require more than twice the time for initiating sleep (latency) compared to good sleepers, consequently falling asleep during the first 30 minutes after lying down is a protective factor for sleep quality. As stated before, the subjective sleep quality is consistent with the questionnaire results.

An important part of sleep quality is the number and reasons for nocturnal awakenings, especially when sleeping again is not achieved (insomnia). **Table 2** shows the results classified as good and bad sleepers.

Students refer that taking sleep medications, snoring or coughing were not awakening causes associated with poor sleep quality. Other causes that students mentioned, and are not considered in the instrument, are noise (2%), worrying or fear of exams (7%), family or personal problems (15%), and homework excess (18%).

To evaluate the insomnia level, students answered the Severity Insomnia Index. 51% were classified without insomnia and 49% with insomnia (sub-threshold 37.5%, moderate 11.5% and none with severe insomnia. Absence of insomnia was associated with good sleep (OR .02; CI 95% .002-.15,

p < .001), whole the insomnia was high risk for bad sleep (OR 54, CI.95% 6.9-417).

Finally, diurnal repercussion of sleep quality was evaluated using the Epworth Sleepiness Scale. Students referred 36% normal, 19% marginal and 45% excessive daytime sleepiness. Good sleepers had normal daytime sleepiness (OR.09; CI 95% .02-.32, p < .001), while poor sleepers had sleepiness (OR 3.12; CI 95% 1.3-7.47, p = 0.01).

DISCUSSION

The COVID-19 pandemic generated a radical change in our activities, including education. To prevent educational backwardness and maintain physical distancing during the most critical months of the pandemic, different online and long-distance class models were implemented worldwide. This new educational model has been a turning point in the paradigm of teaching and learning medicine. Most of the students and professors acknowledge the advantages, mainly regarding flexibility and resource efficiency, but also mention some disadvantages such as Internet connection difficulties, distractions, and inadequate environments, among others[10]; therefore, these models are still being reviewed and adapted, to ensure the maximal benefits for the students.

Without a doubt, the new teaching methodologies in medicine open new horizons in the development of present and future study programs. Technology, through the Internet and different online

Table 2. Causes of sleep disturbances in medical students during the COVID-19 Pandemic

Cause	Times per week	General (n = 114)	Good sleepers (n = 29)	Bad sleepers (n = 85)	p
Awakes without cause and can't sleep again	None	61 (53%)	24 (83%)	37 (43%)	.002
	< 1	31 (28%)	5 (17%)	26 (31%)	
	1-2	16 (14%)	-	16 (19%)	
	3 or more	6 (5%)	-	6 (7%)	
Going to the toilet and can't sleep again	None	79 (69%)	28 (97%)	51 (60%)	.005
	< 1	21 (18%)	1 (3%)	20 (23%)	
	1-2	10 (9%)	-	10 (12%)	
	3 or more	4 (3.5%)	-	4 (5%)	
Breathing difficulties and can't sleep again	None	91 (80%)	28 (97%)	63 (74%)	.02
	< 1	15 (13%)	1 (3%)	14 (16%)	
	1-2	4 (3.5%)	-	4 (5%)	
	3 or more	4 (3.5%)	-	4 (5%)	
Snoring or coughing and can't sleep again	None	110 (96)	29 (100%)	81 (95%)	.43
	< 1	2 (1.5%)	-	2 (2.5%)	
	1-2	2 (1.5%)	-	2 (2.5%)	
	3 or more	0	-	-	
Feeling cold or hot and can't sleep again	None	81 (71%)	28 (97%)	53 (62%)	.006
	< 1	24 (21%)	1 (3%)	23 (27%)	
	1-2	9 (8%)	-	9 (11%)	
	3 or more	0	-	0	
Nightmares and can't fall sleep again	None	85 (75%)	26 (90%)	59 (68%)	.04
	< 1	22 (19%)	3 (10%)	19 (23%)	
	1-2	5 (4%)	-	5 (6%)	
	3 or more	2 (2%)	-	2 (2.5%)	
Feeling pain and can't sleep again	None	86 (76%)	29 (100%)	57 (67%)	.01
	< 1	21 (18%)	-	21 (25%)	
	1-2	7 (6%)	-	7 (8%)	
	3 or more	0	-	-	
Requires sleep medication	None	107 (94%)	29 (100%)	78 (91%)	.24
	<1	4 (3.5%)	-	4 (5%)	
	1-2	1 (1%)	-	1 (1%)	
	3 or more	2 (1.5%)	-	2 (2.5%)	

P: Chi-squared test.

platforms, has allowed the implementation of long-distance education and/or hybrid medicine, and the use of databases for immediate information has also been an advantage that promotes the students' empowerment in their training process; however, it also implies some risks. In 2021, a multicenter study carried out in seven countries, including Mexico, reported an increasing number of medical students with Internet addiction. This is mainly because the Internet is used for other purposes such as social media, entertainment, romance, and leisure, interfering with study time and even sacrificing time for their physiological needs. The same study found that students with Internet addiction were the ones with worse sleep quality levels, a very important fact for its impact on health and academic performance[16].

In the present study, students in undergraduate rotating internships and social service were not included, since being in hospital environments tends to worsen sleep quality levels[17]. Moreover, due to the

health system conditions during the pandemic, they were highly vulnerable to stress. We found that most of the participants were classified as bad sleepers, with no differences between age and sex; likewise, these same students showed a correlation between sleep quality perception and the questionnaire score, which means consistency in their answers. Our research group published in 2019, that 94% of the first-year medical students with face-to-face classes were bad sleepers[13]. This shows a 20% decrease in bad sleep quality, in medical students of the same school but with online classes. Some studies mention that, with home office, designated time for transportation is saved, and waking-up hours can be postponed; besides, during this period, social activities were restricted which probably allowed them to increase sleeping hours and synchronize with their biological sleep need[18].

Interestingly, students' sleep quality during the pandemic did not depend on the hours of sleep, since both good and bad sleepers referred similar durations. Insomnia, understood in this case as the longer time or latency to initiate sleep or nocturnal awakenings, was the one associated with poor sleep quality. A literature review published in 2021, proposes that some people are more susceptible to developing insomnia due to certain genetic variations, high-stress levels at an early age, some extraordinary life events, and a specific brain structure and function. Such vulnerability to developing insomnia could be located in the neural circuits that regulate emotion and excitement, especially at the level of the locus coeruleus, triggering an insufficient adaptation to nocturnal distress, which results in an accumulated hyperarousal that, in turn, increases the risk of awakening and inhibit restful sleep[19].

A study carried out in 2017, with Egyptian students, finding that anxiety, depression, and stress were related to poor sleep quality and that these indicators were worse in females that lived alone or outside their family homes[20]. In this sense, our population lived in their family homes due to the pandemic. A weakness area of the study is the fact that we didn't assess depressive symptoms, not anxiety, we neither considered having any sick relatives nor the loss of economical income, two relevant situations at the moment the study was carried out, and

that could have been influencing their perceived sleep quality. In fact, 15% referred personal or family problems, without specifying motives. One of the insomnia referred causes were breathing problems, which could be related to anxiety symptoms since acute illnesses were discarded as an exclusion criterion. During the pandemic, not only fear of disease and death increased, but also anxiety about the mandatory lockdown and the lack of social support under adverse circumstances, which increases people's vulnerability to develop emotional disorders or sharpen mental illnesses, especially in teenagers and young adults[11].

The main cause of poor sleep quality was students' insomnia, due to either sleep latency or nocturnal awakenings. These situations are very changeable, since are from a multifactorial origin, but could improve with some sleep hygiene strategies. A study conducted in 2012 on school-aged children reported a direct correlation between sleep quality and sleep hygiene, mentioning that students that sleep more time have better sleep hygiene habits. For example, students with a television in their rooms, single-parented families, or parents with sleep disturbances tend to have sleep quality disorders[21].

In Polish students, during the pandemic, insomnia was related to psychosomatic stress symptoms, with increased use of psychoactive substances and a decrease in physical activity[22]. Although in this study taking medication was not associated with sleep quality, it would be very interesting to associate other drug consumption and sleep quality among Mexican university students.

In the pandemic context, we expected many students to refer fear to the disease, even though 15% stated non-specified family problems, 25% said that the excess of homework or fear of exams was the cause related to their insomnia. It is important to consider that in Mexico, during 2021, all young adults between 18 and 29 years old were vaccinated against COVID-19 if requested, that the worse mortality peaks were being controlled, and that this age range was not as vulnerable to developing severe symptoms, facts that could influence their answers.

We found that 45% of the medical students referred extreme daytime sleepiness, similar to what was found in Ethiopia, with 31%; therefore, sleepi-

ness is common among medical students[23]. The clinical impact is very relevant since it has been related to different dysfunctions, morbidity and mortality risks; for example, it is known to increase fatigue and decrease work performance, attention capacity, manual abilities, and logical reasoning[24], all of them essentials in medical students, especially when participating in real patient scenarios where time response is vital. Moreover, it increases the risk of cardio-metabolic and mental diseases, addictions, and car accidents that represent the main morbidity and mortality causes in this age group[7].

CONCLUSION

During the COVID-19, pandemic most of medical students referred a poor sleep quality. Insomnia and daytime sleepiness were the cause and consequence of bad sleep. Even with online classes and school activities were done at home, medical students are not satisfied about theirs dream. During this period, the students were more worried about the exams, homework, than COVID-19 infection. Therefore, implementing strategies that allow students to increase their resilience and improve their quality of sleep is necessary.

CONTRIBUCIÓN INDIVIDUAL

- RZHA: Autor principal que se encargó del análisis, redacción del documento y fue el responsable técnico y administrativo del proyecto.
- VOD: Fue el responsable de la elaboración de la base de datos y de los análisis estadísticos.
- PHNE: Se encargó de revisar y corregir el documento.
- ECDF: Fue la responsable de la aplicación de las encuestas y de la selección de los participantes.

PRESENTACIONES PREVIAS

No se han realizado presentaciones previas con los resultados manifestados en el presente documento, ni ha sido enviado a otra revista.

CONFLICTO DE INTERESES
Ninguno.

DECLARACIÓN DE IA Y TECNOLOGÍAS ASISTIDAS POR IA EN EL PROCESO DE ESCRITURA
Declaramos que en la elaboración de este documento no se utilizó de IA ni otras tecnologías asistidas por IA en el proceso de escritura. 🔍

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