Online academic satisfaction during the COVID-19 pandemic in medical students: role of sleep, psychological issues, college adjustment, and digital skills [version 3; peer review: 1 approved, 1 not approved]

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Abstract
Background: The measures taken to contain the COVID-19 pandemic, led to significant changes in university education, resulting in the new normal standard of virtual teaching in many undergraduate medical schools worldwide. Therefore, the aim of this paper was to determine the factors related to academic satisfaction with virtual teaching in medical students during the COVID-19 pandemic.

Methods: A cross-sectional-analytical study was conducted on medical students at a private university in Peru, through self-reported questionnaires divided into sociodemographic data and variables of interest that could influence academic satisfaction during the pandemic. To evaluate possible factors related to academic satisfaction, stepwise regression models were performed for both sexes.

Results: In total, data from 310 medical students, 117 males and 193 females, were analyzed. Academic satisfaction reached a score of 11.2 ± 2.9, which was similar in both sexes. The best regression model for males (AIC: 544.32; RMSE: 2.42; R²: 0.30) showed that adaptation to university life (favorable change) and depression (unfavorable change) explained 30% of changes in students’ academic satisfaction. While in females (AIC: 907.59; RMSE: 2.49; R²: 0.22) the model integrated favorable factors such as adjustment to college life and anxiety; while depression and poor sleep quality were unfavorable factors.
Conclusion: Factors that contributed to academic satisfaction in medical students were determined in this study, which differed by gender. Thus, it is important to take into account the particularities of male and female medical students in order to improve their academic satisfaction during their university careers.

Keywords
COVID-19, Medical students, academic satisfaction, sleep, digital competencies
Introduction

On March 11, 2020, the World Health Organization declared the outbreak of coronavirus disease (COVID-19) a pandemic. Since then, strict measures have been taken to contain the spread of the virus. Social distancing being the main one, has brought with it significant problems for education as it affects nearly 1.6 billion students worldwide.¹ This posed a substantial challenge to medical education forcing an abrupt transition to online formats.² Due to restrictions, there were limitations of access to suitable educational environments (such as laboratories, simulation rooms, and hospitals) leading to rapid transition to remote learning. As a result, there may be skills and health factors that would be impacting students' individual experience and perception of their academic environment.³ Besides, medical students, as well as other students in higher education, experience various difficulties that lead to a general feeling of dissatisfaction and frustration with online education.⁴ In addition, their clinical practices were suspended as a protective measure. Under these conditions, it was determined in Peruvian health students that they had low levels of knowledge, risk perception attitudes, and preventive practices regarding COVID-19.⁵

Academic satisfaction in academic environments through a socio-cognitive model has been highlighted in several studies due to its importance in finding external factors that could have an impact on students' overall academic satisfaction.⁶ In this model, cognitive, affective, and behavioral factors are considered due to students' perceptions of their performance contrary to other studies that focus on the subject's perception in the institutional context.⁷ Due to the COVID 19 pandemic, medical students in Peru have had no choice but to transition to remote education and it is not currently known how satisfied they are with their studies.

In addition, it is important to know the influence that the pandemic has on mental health in college students, previous studies have shown that there is an association with depression and anxiety.⁸ Likewise, it has been observed that the interruption of face-to-face daily activities and social isolation could affect healthy sleep, altering the times of going to bed and waking up, the appearance of sleep disorders, and promoting the development of psychological issues (stress, depression, anxiety).⁹ On the other hand, for the use of technology, the success of acquiring a good experience will depend on the learning obtained by using it, whether for academic or non-academic purposes.¹⁰ In the context of the pandemic, this could influence the experience of using and acquiring digital skills required for optimal learning. Factors such as mental health issues and the need to adapt to the digital environment could be contributing to perceptions of academic satisfaction.

Understanding the factors that positively or negatively influence academic satisfaction could lead us to effectively assess the problem and design targeted interventions according to the needs of a specific group of individuals classified by gender, age or socio-demographic origin. In our study we included variables previously known to have some influence on students' academic satisfaction such as adaptability to university life, digital skills, sleep quality, anxiety and depression. The aim of this work was to determine the factors related to academic satisfaction in medical students during the COVID-19 pandemic.

Methods

Study design and population

This analytical cross-sectional study was conducted in students of the Faculty of Medicine of the Universidad Peruana Unión belonging to the first to the seventh year of studies. We used convenience sampling to enlist the students, who were invited to complete an online survey, in which questionnaires related to academic satisfaction, adaptation to the university, digital skills, sleep quality, stress, depression and anxiety were applied. We conducted the study from last week of January, to first week of March, 2021, a virtual meeting was held for students of each academic year and each week a reminder to complete the survey was sent. Inclusion criteria were: 1) Students enrolled during the 2021 academic cycle, 2) who have not completed another health career. Students who didn’t give their informed consent or didn’t complete the survey were excluded from the study. This study was reviewed and approved by the ethics committee of the Universidad Peruana Unión before being conducted (2021-CEUPeU-0005).
Consent
Through a class briefing session per academic year, under the supervision of the academic area coordinator, all students were briefly informed of the purpose of the study and were given an average of 15 minutes to complete the questionnaire. Before completing the questionnaires, the participants who agreed to participate voluntarily gave their informed consent. Likewise, in the presentation, they were informed that the answers were confidential and that only the researchers had access to it for the purpose of this study.

Measuring questionnaires
Socio-demographic aspects were considered, such as year of study, country of origin, place of residence, in order to know the general information of the participants, and to measure the variables of interest we took into account five questionnaires, which are found in their completed version in extended data, and they are detailed below:

1. Brief Scale of Satisfaction with Studies (EBSE): The EBSE is composed of 4 items, it is distributed in 2 factors: satisfaction with studies and negative affect. In this scale good internal consistency and reliability were evidenced (α=0.788). This scale reflects the satisfaction that the student has with respect to their performance and in general with their studies, distributed on a Likert scale of 5 options, ranging from strongly disagree to strongly agree. A higher score indicates greater academic satisfaction.7

2. Adaptability to university life: Developed by Baker and Sirik,11 and adapted by Rodriguez-Ayan and Sotelo. It is a questionnaire that aims to determine the degree of adaptation of students during their stay at the university. It measures 3 dimensions: social, academic and institutional. It consists of 11 items distributed on a 4-point Likert scale. Regarding its reliability evaluated by the test-retest procedure, a correlation of 0.821 was recorded, which implies a good reliability (greater than 0.8), the total score was calculated by adding the 11 items, with the highest score being the best.12

3. Pittsburgh Sleep Quality Index Questionnaire (PSQI): PSQI is a questionnaire used to measure sleep quality and its alterations in the last month.13 The questionnaire consists of 9 self-assessment questions, 4 subjective (questions 1-4) and 5 objective (questions 5-9) questions, that are used to obtain the global score. These questions are distributed in 7 components, which are: subjective sleep quality, latency, duration, efficiency, sleep disturbances, use of medication for sleep, and daytime dysfunction. Each component, have instructions to sum the score of the subjective and objective questions. High scores (Global score>5) indicate poor sleep quality. In its original version this questionnaire has an internal consistency of (α=0.83), while the adapted version in the Peruvian population showed a lower consistency but was equally valid (α=0.564) and regarding construct validity, three factors were found that explain 60.2% of the total variance.14

4. Digital skills: This questionnaire consists of 35 questions measured using a 5-point Likert scale. It is based on the digital skills matrix developed by the National Autonomous University of Mexico (UNAM), exploring the following categories: access to information, communication and collaboration, information security, information management, media management, hardware and virtual learning environments. With respect to its psychometric characteristics, the study conducted by Avitia et al. recorded a good internal consistency (α=0.95) in general, as well as in each of its categories.15

5. Depression, anxiety and stress scale (DASS - 21): This questionnaire consists of 21 questions measured through a Likert scale from 0 to 3 points. It is divided into 3 dimensions which separately measures depression, stress and anxiety, each being composed of 7 items. According to the score obtained in the specific psychological issue it is classified as mild (anxiety: 4, stress: 8-9, depression: 5-6), moderate (anxiety: 5-7, stress: 10-12, depression: 7-10), severe (anxiety: 8-9, stress: 13-16, depression: 11-13) and extremely severe (anxiety≥10, stress≥17, depression≥14). In its Spanish version it has an acceptable internal validity, for stress (α=0.82), depression (α=0.84) and anxiety (α=0.70). And shows a good interrelation between the 3 factors evaluated by this scale.16

Data analysis
Data analysis was performed in the R programming language version 4.0.2. (https://www.rstudio.com/) (RRID:SCR_001905). The variables were ordered in graphs and tables taking into account their categorical nature expressed as absolute frequency and percentage (%), or numerical as mean ± standard deviation (SD). For the comparative analysis, the χ² (chi-square) or Mann Whitney U test was used according to the non-normal distribution of the variable evaluated by the Kolmogorov-Smirnov test. To establish the best model of factors related to academic satisfaction in medical students, stepwise regression models were performed with bidirectional elimination approach in the adjustment of independent variables. The best regression models were
established based on Akaike’s information criterion (AIC), root mean square error (RMSE), and \( R^2 \). Multivariate regression models stratified by sex were obtained with their respective 95% confidence intervals (95% CI). A value of \( p<0.05 \) was considered statistically significant in the analyses.

**Results**
A total of 310 responses were obtained (rate of responses of 70%). The average age of the participants was 21.6 ± 3 years. The number of men was 117 (37.7%) and women 193 (62.3%). The total number of participants were divided into basic sciences (1st and 2nd academic year) and clinical sciences (3rd to 7th academic year), representing 42.3% and 57.7% respectively. It was found that half the participants belonged to the coastal region (52.9%), while those belonging to the highland region (21%) and those who were foreigners (20%) had similar proportion (Table 1).

In the assessment of psychological issues, the presence of at least one psychological issue was evident in more than half of the respondents. However, this differed according to sex and type of psychological issue.

In women, 64%, 53% and 46% had stress, depression and anxiety respectively, finding that 55% (\( n=106 \)) of the stressors (moderate or severe) belonged to the most worrying states. However, in men, of the 62% who had anxiety, 56% (\( n=66 \)) presented the most worrying states, while 57% and 48% had depression and stress respectively (Figure 1).

A general result and comparison were made according to scores obtained in men and women for digital skills, adaptation to university life and academic satisfaction.

The results showed that, for digital skills, both sexes had a high score (87.5 ± 22.6, \( p=0.012 \)), meaning a good management of digital programs or applications in general. Minimal differences in scores were found, interestingly it was statistically significant for women and men respectively in the following components: virtual environments (10 vs. 8.1, \( p<0.001 \)), media management (7.7 vs. 6.9, \( p=0.021 \)) and information management (15.6 vs. 14.2, \( p=0.007 \)). This shows that there is a greater knowledge about the organization and use of the applications necessary for academic activities. However, this is contrary with respect to the management of search engines and access to online information, as well as a basic knowledge of information security, such as clearing history and logging out of the electronic devices they use.

On the other hand, for adaptation to university life we found an overall result of 36.9 ± 6.5 and for academic satisfaction of 11.2 ± 2.9, which did not present important differences in scores according to sex and were not statistically significant. Therefore, it is evident that they have the same perception in the new virtual teaching.

### Table 1. General characteristics of medical students.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total (n=310)</th>
<th>Men (n=117)</th>
<th>Women (n=193)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>21.6 ± 3.0</td>
<td>21.6 ± 3.0</td>
<td>21.5 ± 2.9</td>
<td>0.63</td>
</tr>
<tr>
<td>Year of studies (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>66 (21.3)</td>
<td>27 (23.1)</td>
<td>39 (20.2)</td>
<td>0.983</td>
</tr>
<tr>
<td>Second</td>
<td>65 (21.0)</td>
<td>23 (19.7)</td>
<td>42 (21.8)</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>49 (15.8)</td>
<td>18 (15.4)</td>
<td>31 (16.1)</td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>40 (12.9)</td>
<td>15 (12.8)</td>
<td>25 (13.0)</td>
<td></td>
</tr>
<tr>
<td>Fifth</td>
<td>41 (13.2)</td>
<td>17 (14.5)</td>
<td>24 (12.4)</td>
<td></td>
</tr>
<tr>
<td>Sixth</td>
<td>45 (14.5)</td>
<td>16 (13.7)</td>
<td>29 (15.0)</td>
<td></td>
</tr>
<tr>
<td>Seventh</td>
<td>4 (1.3)</td>
<td>1 (0.9)</td>
<td>3 (1.6)</td>
<td></td>
</tr>
<tr>
<td>Origin (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coast</td>
<td>164 (52.9)</td>
<td>64 (54.7)</td>
<td>100 (51.8)</td>
<td>0.531</td>
</tr>
<tr>
<td>Highlands</td>
<td>65 (21.0)</td>
<td>25 (21.4)</td>
<td>40 (20.7)</td>
<td></td>
</tr>
<tr>
<td>Jungle</td>
<td>19 (6.1)</td>
<td>9 (7.7)</td>
<td>10 (5.2)</td>
<td></td>
</tr>
<tr>
<td>Foreign</td>
<td>62 (20.0)</td>
<td>19 (16.2)</td>
<td>43 (22.3)</td>
<td></td>
</tr>
</tbody>
</table>

Data expressed as mean ± SD or absolute frequency (%).
Regarding sleep quality, 83.9% (n=260) of the respondents had poor sleep quality, being the majority group in both sexes with this problem (163 women and 97 men), while only 16.1% (n=50) had good sleep quality (Table 2).

Stepwise regression models and factors related to academic satisfaction
The generation of stepwise regression models to explain changes in academic satisfaction in medical students started from a factor pool of digital skills (total scores), adjustment to college life (total scores), psychological issues (total scores), and sleep quality (total scores) for both males and females. The two-way elimination approach showed that for males the best model for academic satisfaction was at step 2 with the integration of adjustment to university life and depression (AIC: 544.32; RMSE: 2.42 and R²: 0.30), while for females the best model was at step 4 with the integration of adjustment to university life, depression, anxiety and sleep quality (AIC: 907.59; RMSE: 2.49 and R²: 0.22) (Table 3).

Table 2. Digital skills, adaptation to university life and academic satisfaction of medical students.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total (n=310)</th>
<th>Men (n=117)</th>
<th>Women (n=193)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to information³</td>
<td>19.9 ± 5.7</td>
<td>19.4 ± 5.4</td>
<td>20.7 ± 6.0</td>
<td>0.082</td>
</tr>
<tr>
<td>Communication and collaboration³</td>
<td>21.7 ± 6.1</td>
<td>21.5 ± 6.2</td>
<td>21.9 ± 5.9</td>
<td>0.586</td>
</tr>
<tr>
<td>Information Security³</td>
<td>10.7 ± 3.3</td>
<td>10.5 ± 3.2</td>
<td>11.0 ± 3.4</td>
<td>0.170</td>
</tr>
<tr>
<td>Information Management³</td>
<td>14.7 ± 5.1</td>
<td>14.2 ± 4.9</td>
<td>15.6 ± 5.3</td>
<td>0.007*</td>
</tr>
<tr>
<td>Media Management³</td>
<td>7.2 ± 2.8</td>
<td>6.9 ± 2.7</td>
<td>7.7 ± 2.9</td>
<td>0.021*</td>
</tr>
<tr>
<td>Hardware³</td>
<td>4.4 ± 1.9</td>
<td>4.4 ± 1.9</td>
<td>4.6 ± 1.9</td>
<td>0.235</td>
</tr>
<tr>
<td>Virtual environments³</td>
<td>8.8 ± 3.9</td>
<td>8.1 ± 3.7</td>
<td>10.0 ± 3.9</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Digital skills³</td>
<td>87.5 ± 22.6</td>
<td>85.1 ± 21.8</td>
<td>91.5 ± 23.3</td>
<td>0.012*</td>
</tr>
<tr>
<td>Adaptation to university life³</td>
<td>36.9 ± 6.5</td>
<td>37.0 ± 6.2</td>
<td>36.7 ± 7.0</td>
<td>0.571</td>
</tr>
<tr>
<td>Academic Satisfaction³</td>
<td>11.2 ± 2.9</td>
<td>11.1 ± 2.8</td>
<td>11.5 ± 2.9</td>
<td>0.170</td>
</tr>
<tr>
<td>Pittsburgh Sleep Quality Index³</td>
<td>8.9 ± 3.3</td>
<td>9 ± 3.2</td>
<td>8.7 ± 3.3</td>
<td>0.337</td>
</tr>
<tr>
<td>Sleep quality (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well (%)</td>
<td>50 (16.1)</td>
<td>30 (60.0)</td>
<td>20 (40.0)</td>
<td>0.841</td>
</tr>
<tr>
<td>Bad (%)</td>
<td>260 (83.9)</td>
<td>163 (62.9)</td>
<td>97 (37.1)</td>
<td></td>
</tr>
</tbody>
</table>

Data expressed as mean ± SD or absolute frequency (%).
³Total scores.
* p<0.05, statistically significant by Mann Whitney U test.
Table 3. Stepwise regression models of the study variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Addition to the model</th>
<th>R² adjusted</th>
<th>AIC</th>
<th>RMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptation</td>
<td>Step 1</td>
<td>0.244</td>
<td>552.64</td>
<td>2.52</td>
</tr>
<tr>
<td>Depression</td>
<td>Step 2</td>
<td>0.302</td>
<td>544.32</td>
<td>2.42</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptation</td>
<td>Step 1</td>
<td>0.195</td>
<td>911.93</td>
<td>2.53</td>
</tr>
<tr>
<td>Depression</td>
<td>Step 2</td>
<td>0.165</td>
<td>917.93</td>
<td>2.58</td>
</tr>
<tr>
<td>Anxiety</td>
<td>Step 3</td>
<td>0.206</td>
<td>910.26</td>
<td>2.51</td>
</tr>
<tr>
<td>Sleep</td>
<td>Step 4</td>
<td>0.221</td>
<td>907.59</td>
<td>2.49</td>
</tr>
</tbody>
</table>

AIC, Akaike's information criterion; RMSE, Root mean squared error.

Table 4. Relationship of significant factors to the academic satisfaction of medical students.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Bivariate</th>
<th>R²</th>
<th>Multivariable</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β (95%CI)</td>
<td></td>
<td>β (95%CI)</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptation</td>
<td>0.21 (0.14, 0.28)**</td>
<td>0.24</td>
<td>0.16 (0.09, 0.23)**</td>
<td>0.30</td>
</tr>
<tr>
<td>Depression</td>
<td>-0.24 (-0.33, -0.15)**</td>
<td>0.18</td>
<td>-0.15 (-0.24, -0.06)**</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptation</td>
<td>0.13 (0.06, 0.19)**</td>
<td>0.07</td>
<td>0.08 (0.02, 0.14)*</td>
<td>0.22</td>
</tr>
<tr>
<td>Depression</td>
<td>-0.20 (-0.26, -0.14)**</td>
<td>0.16</td>
<td>-0.25 (-0.36, -0.14)**</td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>-0.13 (-0.33, -0.15)**</td>
<td>0.05</td>
<td>0.13 (0.01, 0.24)*</td>
<td></td>
</tr>
<tr>
<td>Sleep</td>
<td>-0.22 (-0.34, -0.10)**</td>
<td>0.06</td>
<td>-0.13 (-0.24, -0.01)*</td>
<td></td>
</tr>
</tbody>
</table>

β, Beta coefficient; 95% CI, 95% confidence interval.

Discussion

Education systems in all countries have been directly affected by the restrictions due to COVID-19, affecting about 1.57 billion students in 191 countries.17 Higher education institutions were forced to migrate to virtual means in order to continue academic activities. Pre-pandemic studies showed that distance learning in medical students could lead to an increase in knowledge, yet not be effective on academic satisfaction.18 Since student satisfaction is a way of addressing the quality of university services, knowing the factors that affect it has become vitally important for these institutions, especially under the remote modality in which they are currently being conducted. In this study, during the global pandemic contingency due to COVID-19, it was determined that the academic satisfaction of medical students of both sexes in the multivariate analysis was positively influenced by adequate adaptation to university life, and interestingly in women, by anxiety. On the other hand, in both males and females, depression had significant negative effects on academic satisfaction and in relation to poor sleep quality, interestingly, it only affected females.

According to Huebner and Gilman,19 student satisfaction is a multidimensional and complex affective variable that includes students' enjoyment and evaluation of their experiences in the educational environment. It has been verified
that the difficulty of adaptation to the university environment is a factor that encourages student repetition and desertion and directly affects student satisfaction.24 This study has confirmed the positive influence of adaptation to university life on academic satisfaction in both male and female medical students. Similar results were reported for first-year university students, in which it was also shown that social support networks of family and faculty members could improve academic satisfaction related to adjustment to university life.25 Additionally, it has been verified that academic adjustment positively influenced the success of Netherlands university students. This success was measured in terms of their grades, number of credits earned, and intention to stay.26 In Peru, university education faces a high dropout rate; according to the government regulator, it was estimated that 27% of students who enter university studies drop out during the first year.27 This high dropout rate could be influenced by the difficulty of adapting to university life, which could lead to dissatisfaction and early abandonment.

Understanding and meeting students' expectations to improve their satisfaction in academic life is a challenge for universities, as students bring in multiple expectations. Efforts are needed, especially because of the potential impact of academic satisfaction on students' psychological health and well-being.24 In this study it has been verified that depression negatively influences the academic satisfaction of both male and female students. Depression is an important psychological problem for university students,25 and the exposure of medical students to depression during their university years has been previously related to their academic satisfaction.26

However, due to the pandemic context, the levels of depression in medical students have increased, mainly due to the influence of isolation,27 which could generate academic problems and be reflected in their satisfaction. Universities should ensure that students have access to psychosocial services to help them cope with depression, mental distress and improve students' satisfaction with their studies.

It has been documented that the prevalence of anxiety symptoms in medical students is high.28 Additionally, it has been verified that the symptom of anxiety in medical students is associated with female gender and academic performance.29 For example, a study conducted among medical students showed a significant gender difference with twice the rate of anxiety among women compared to men.30 Another study shows that the highest rates of anxiety in female students occur in the first years of study.31 To explain the difference in anxiety levels between male and female students, it has been verified that female Chinese university students had higher levels of anxiety than males and these anxiety levels were associated with their body image, alcohol consumption habits and academic performance.32 Many papers show that lower academic satisfaction scores are strongly associated with psychological disorders such as anxiety, depression and stress.34 Interestingly, in this study it was found that anxiety positively influences academic satisfaction in female students. In that sense, in a study with Chilean medical students it was found that those who present high levels of motivation are also more stressed and suffer greater anxiety because they want to have good results.35 Additionally, one study highlighted the top three student concerns associated with anxiety: academic performance, pressure to succeed, and post-graduation plans.36 More studies are required to determine the factors related to mental problems such as anxiety that influence the academic achievement of medical students.

It has been shown that during the COVID-19 pandemic, the number of hours of sleep per night has varied among individuals, including students, which has been putting healthy lifestyles at risk.34 In addition, previous studies have shown that most medical students sleep less than 6 hours per night,35 and that sleep quality is a factor that directly affects academic performance and satisfaction with their studies.36 In this sense, in this study more than 80% of the students had poor sleep quality, and this variable was strongly associated and negatively influenced the academic satisfaction in female students. During the COVID-19 pandemic, it has been verified that compared to men, women reported lower quality and efficiency of sleep and greater symptoms of insomnia.37 This difference is probably due to women being more concerned about their family's health and the risk of exposure to the coronavirus.38 The gender difference seems to play a role in influencing sleep quality and satisfaction with studies in medicine students. This difference should be taken into account when planning educational interventions for medical students on the importance of proper sleep hygiene and the consequences of poor sleep practices. Additionally, university students, mainly in health sciences such as medicine, should receive more knowledge about sleep hygiene to improve satisfaction with their studies.

This study had some limitations. The majority of medical students who responded to the survey were from the first years with a predominance of women and it was conducted in a single university center. However, there was participation of students from different regions of Peru including a considerable participation of students residing abroad. Additionally, there were no cut-off scores for most of the questionnaires used, however, most of these questionnaires have been previously used in the Latino population.39,40 On the other hand, we did not consider other specific factors by academic year, which could influence academic satisfaction, such as academic demand or clinical courses, because of which we could cover most common factors among medical students. However, future studies should consider these limitations and
include these factors to have a better understanding of the outcome of academic satisfaction. Despite these limitations it is important to highlight the use of stepwise regression in uni- and multivariate models for the determination of the influence of each factor on academic satisfaction.

In conclusion, both sexes had a good organization and management of digital programs, the factors that influenced academic satisfaction for both sexes were adaptation to the university and depression. In addition, in women it influenced the quality of sleep and anxiety. The factors found in this study can suggest universities to implement programs to have a good mental health and to educate medical students about the importance of proper sleep hygiene. In addition, this may help teachers to develop plans and strategies for adaptation to the university, in this way they could improve the academic satisfaction of medical students during their university career.

Data availability statement
Underlying data
Figshare: “Online academic satisfaction during the COVID-19 pandemic in medical students: role of sleep, emotions, college adjustment, and digital skills” https://doi.org/10.6084/m9.figshare.19113827.v2.41

Extended data
Figshare: “Online academic satisfaction during the COVID-19 pandemic in medical students: role of sleep, emotions, college adjustment, and digital skills”

This project contains the following extended data: https://doi.org/10.6084/m9.figshare.19119353.v4.42

Reporting guidelines
STROBE checklist for “Online academic satisfaction during the COVID-19 pandemic in medical students: role of sleep, emotions, college adjustment, and digital skills” https://doi.org/10.6084/m9.figshare.19113959.43

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Author’s contribution
Medina-Ramirez S.A: Conceptualization, Investigation, Software, Supervision, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; Rojas-Humpire R: Conceptualization, Investigation, Methodology, Software, Writing – Original Draft Preparation, Writing – Review & Editing; Canaza J.F: Conceptualization, Investigation, Methodology, Writing – Review & Editing; Hernandez F: Conceptualization, Investigation, Methodology, Writing – Review & Editing; Huancahuire-Vega S: Conceptualization, Investigation, Methodology, Supervision, Resources, Writing – Original Draft Preparation, Writing – Review & Editing.

References


Open Peer Review

Current Peer Review Status: ✔️ ✗

version 2

Reviewer Report 11 August 2022

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Amin Nakhostin-Ansari
Sports Medicine Research Center, Neuroscience Institute, Tehran University of Medical Sciences, Tehran, Iran

This is an interesting study evaluating the factors associated with academic satisfaction in medical students during the COVID-19 pandemic. The authors have performed a subgroup analysis in this study. They have found that different factors are related to academic satisfaction among males and females during the COVID-19 pandemic, which is one of the strengths of this study. The findings also have practical implications in the post-COVID era. However, the methods are not explained well, and there is a need to add further details to the discussion and introduction sections.

Specific comments:
1. Depression, anxiety, and stress are evaluated in the present study. However, according to the title, the study was supposed to evaluate the role of emotion in academic satisfaction. As depression, anxiety, and stress are psychological issues and are not considered emotions, I would suggest changing the title accordingly. Also, please correct this issue throughout the manuscript.

2. I would suggest explaining the role of sleep in medical students' life during the COVID-19 pandemic and justifying why you evaluated it in your study.

3. Please add more details on the study setting (e.g., location and the time study was conducted) in the methods section.

4. What do you mean by “non-probability” convenience sampling?

5. Please add your exclusion and inclusion criteria for participants in the methods section.

6. I would suggest explaining the basic and demographic characteristics evaluated in your questionnaire in the methods section.
7. Please add more details on interpreting the questionnaires' scores (e.g., what higher or lower scores mean).

8. Add more details on how PSQI's scoring system, please.

9. You should ensure that your variables were distributed normally before using parametric tests in your study. I would suggest performing suitable tests (e.g., the Kolmogorov-Smirnov test) to determine if your variables were distributed normally. In the case of non-normal distribution, you should use non-parametric tests to compare the groups.

10. Add the response rate to the results section, please.

11. In the results section, you have categorized individuals into groups with mild to severe psychological issues. Please explain how you divided individuals into these groups and provide cut-offs in the methods section.

12. I would suggest rewriting the results of the regression analysis. Please simply mention the factors associated with academic satisfaction with their beta, 95% CI for beta, and P-values. Also, it is not obvious what are your references for independent variables. For example, do you mean depression score of DASS or having depression vs. not having depression?

13. In the discussion section, please compare differences between males and females regarding the factors associated with academic satisfaction. Also, please compare your findings with other studies, and discuss the differences and similarities. Finally, please focus on the results of the regression analyses in your discussion. You have mentioned that sleep quality was an important factor affecting academic satisfaction in both males and females; however, sleep quality was not independently associated with academic satisfaction in males, according to your regression analysis.

14. I would suggest adding one or two sentences on the take-home message of this article to the conclusion section.

Is the work clearly and accurately presented and does it cite the current literature?  
Partly

Is the study design appropriate and is the work technically sound?  
Partly

Are sufficient details of methods and analysis provided to allow replication by others?  
No

If applicable, is the statistical analysis and its interpretation appropriate?  
Partly

Are all the source data underlying the results available to ensure full reproducibility?  
Yes
Are the conclusions drawn adequately supported by the results?
Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Public health, medical education, internal medicine

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

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**Version 1**

Reviewer Report 26 April 2022

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Oriana Rivera Lozada
South American Center for Education and Research in Public Health, Universidad Norbert Wiener, Lima, Peru

The article addresses a very interesting topic for medical education today, such as the topic of satisfaction in times of Covid. The document is quite clear and concrete. However, it could be improved in some aspects:

Introduction:
It is well structured, however, it can be strengthened with information from Peruvian studies that have been carried out (background).

Methodology:
1. Add the reliability data of the instrument Adaptability to university life.

2. Specify sample and sampling data

Results and Discussion:
Add the biases of the study and what they did to control them. The discussion should strengthen with preferably national background.

Specify some interventions that can be proposed based on this research.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Public Health, epidemiology, infectious diseases and health education.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 06 Jun 2022

**Salomon Huancahuire-Vega,** Peruvian Union University (UPeU), Lima, Peru

**Introduction:**
It is well structured, however, it can be strengthened with information from Peruvian studies that have been carried out (background).

Thank you for your comment. We have added information about Peruvian studies: “In addition, their clinical practices were suspended as a protective measure. Under these conditions, it was determined in Peruvian health students that they had low levels of knowledge, risk perception attitudes, and preventive practices regarding COVID-19”

**Methodology:**
Add the reliability data of the instrument Adaptability to university life.

Thank you for your comment. We have added reliability information about Adaptability to university life instrument: “Regarding its reliability evaluated by the test-retest procedure, a correlation of 0.821 was recorded, which implies a good reliability (greater than 0.8)”

Specify sample and sampling data
Thank you for your comment. We have added information about sampling data
“Participants were selected by non-probability convenience sampling”

Results and Discussion:
Add the biases of the study and what they did to control them. The discussion should strengthen with preferably national background.

Thank you for your comment. In the last part of the discussion we put a paragraph with the limitations and possible biases of the study, we also commented on explanations for each of them.

“This study had some limitations. The majority of medical students who responded to the survey were from the first years with a predominance of women and it was conducted in a single university center. However, there was participation of students from different regions of Peru including a considerable participation of students residing abroad. Additionally, there were no cut-off scores for most of the questionnaires used, however, most of these questionnaires have been previously used in the Latino population. On the other hand, we did not consider other specific factors by academic year, which could influence academic satisfaction, such as academic demand or clinical courses, because of which we could cover most common factors among medical students. However, future studies should consider these limitations and include these factors to have a better understanding of the outcome of academic satisfaction. Despite these limitations it is important to highlight the use of stepwise regression in uni- and multivariate models for the determination of the influence of each factor on academic satisfaction”

Specify some interventions that can be proposed based on this research.

Thank you for your comment. Given that depression and anxiety influenced academic satisfaction, it is proposed that universities implement programs to monitor the mental health of students. These recommendations are at the end of the conclusion paragraph:

“The factors found in this study can suggest universities to implement programs to have a good mental health. In addition, this may help teachers to develop plans and strategies for adaptation to the university, in this way they could improve the academic satisfaction of medical students during their university career”

Competing Interests: No competing interests were disclosed.
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