


Gender-Based Analysis of the Association Between Mental Health, Sleep Quality, Aggression, and Physical Activity Among University Students During the COVID-19 Outbreak

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Abstract

COVID-19 has spread throughout the world, resulting in significant morbidity, mortality, and negative psychological effects among general population. However, university students are particularly vulnerable in terms of mental health. The present study evaluated the association between mental health, quality of sleep, aggression, and physical activity in university students in Mexico after 1 year of dealing with the COVID-19 pandemic in Mexico, including a gender-sensitive analysis. Participants (935 university students) completed an online questionnaire which collected information regarding demographic data, psychological distress (IES-R scale), depression, anxiety, and stress (DASS-21), aggressiveness Buss-Perry Aggressive Questionnaire, sleep

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quality (PSQI) and physical activity (IPAQ-S). Findings showed that female students showed significantly higher scores in psychological distress, anxiety, stress scores and sleep quality, as compared to male students. By contrast, male students showed significantly higher scores on aggressiveness than female students. In addition, on physical activity, females performed significantly higher MET-min/week on moderate and high levels. Finally, liner regression model accounted for approximately 73.5% of the variance in DASS-21 scores, with the body mass index, IES-R, Pittsburgh Sleep Quality Index, and IPAQ subscales, emerging as significant individual (positive) predictors. Therefore, the pandemic affected female and male students differently. Female students reported more psychological distress, anxiety, and stress while male students reported higher aggressiveness. The differences observed may be due to physiological differences, the response to stress, and differences in sensitivity to life events.

Keywords

mental health, sleep quality, aggression, physical activity, students, COVID-19

Introduction

The COVID-19 pandemic is a major health crisis that has affected several nations. Since the first COVID-19 cases reported in December 2019, more than 137 million individuals have been diagnosed worldwide, including nearly three million cases in Mexico by April 15, 2021 ([Secretaría de Salud, 2021](#)). In response to the COVID-19 outbreak, many countries were forced to adopt severe restrictive measures to slow down the virus propagation. In Mexico, the government issued recommendations, including home confinement for the general population. Also, schools were closed and non-essential activities in all economic sector were suspended ([SEGOB, 2020](#)). Beyond the medical risk, the COVID pandemic brought catastrophic psychological consequences among the Mexican population. Several studies have found an increase in the prevalence of anxiety, depression, stress, and psychological distress as well as sleep disorders among the general population ([Cortés-Álvarez et al., 2020](#); [Galindo-Vázquez et al., 2020](#); [Guzmán-González et al., 2020](#); [Meda-Lara et al., 2021](#); [Pérez-Cano et al., 2020](#)). Of note, research suggests a link between anxiety, stress, and depression ([Lee et al., 2021](#); [McHugh et al., 2020](#)). Similarly, stressors are associated with the induction of aggressive behavior ([Yohe et al., 2012](#)) and aggressive behavior is associated with increased anxiety behavior ([Patki et al., 2015](#)).

University students are particularly vulnerable in terms of mental health as the onset of most mental health disorders occurs in young adulthood ([Eisenberg et al., 2007](#)). In fact, several studies have reported that students have consistently higher levels of mental health problems than the general population ([Auerbach et al., 2016](#)). This vulnerability is mainly due to academic issues and multiple stressors, which are unique to this period of transition to adulthood ([Pedrelli et al., 2015](#)). Alarminglly, alterations in

mental health are associated with lower student performance, energy level, concentration, cognition and memory, suicidal thinking, and alcohol use disorder (Brådvik, 2018; England et al., 2017; Obeid et al., 2020). Even before the pandemic, Mexican university students showed a considerably high prevalence of stress, anxiety, depression, and impulse control disorders (Lazarevich et al., 2013; Reyes Carmona et al., 2017). However, the COVID-19 pandemic and measures implemented in response could aggravate the mental health and well-being of this vulnerable population.

Further, although research on the psychological impact of the pandemic among Mexican university student has been explored (Camacho-Zuñiga et al., 2021; García-Espinosa et al., 2021; González Velázquez, 2020), these studies fail to include a gender-sensitive perspective. Conducting a gender analysis involves the inclusion of a gender perspective in each step of a research project from design to data interpretation and discussion. Recommendations on how to carry out such analyses can be found in guidelines such as the Sex and Gender Equity in Research (SAGER) (Heidari et al., 2016). In Mexico, some studies have reported that gender plays a role in the response to the pandemic in the general population (Cortés-Álvarez et al., 2020; Guzmán-González et al., 2020; Meda-Lara et al., 2021; Pérez-Cano et al., 2020; Ramos-Lira et al., 2020) and medical workforce (Cortés-Álvarez & Vuelvas-Olmos, 2020; García-Reyna et al., 2020; Robles et al., 2020). However, the implications of the psychosocial gender-related variables in those studies have not been fully addressed. Based on the current data, a gender perspective analysis is pivotal to understand, prevent, monitor, and manage the mental health problems that university students experience during the COVID-19 pandemic.

Physical activity (PA) has been associated with improved psychological outcomes (Aylett et al., 2018; Chekroud et al., 2018; McDowell et al., 2019) and a good sleep quality, in both clinical and non-clinical population (Feng et al., 2014; Garfield et al., 2016). The neurobiological effects of PA seem to influence several neural mechanisms related to mental disorders (Helmich et al., 2010; Yates et al., 2020). Studies show that the regular practice of PA can be compared to pharmacological measures for the treatment of mental disorders such as depression (Blumenthal et al., 2007; Carek et al., 2011; WHO, 2019; Xie et al., 2021). By contrast, the absence or reduction of PA has been associated with an increased risk of mental disorders (Dunn et al., 2001; Stubbs et al., 2018). Although an ideal dose of exercise for this type of diseases cannot be clearly established, there is evidence demonstrating that PA at 2500 metabolic equivalents (METs), corresponding to 108 min of light, 80 min of moderate, or 45 min of vigorous physical activity, per week is sufficient to mitigate mental health problems, as recently reported in studies conducted during the pandemic (Zhang et al., 2020). Similarly, sleep problems have been considered a consequence of mental health issues (Baglioni et al., 2016; Winokur, 2015). For instance, poor sleep quality may contribute to the development of new mental health problems and to the maintenance of existing ones (Baglioni et al., 2011; Freeman et al., 2012; Soehner et al., 2013). In fact, it has been suggested that education and the application of policies regarding sleep hygiene

may prevent, in some cases, the development of mental health problems (Dinis & Bragança, 2018).

However, amid the global public health crisis scenario, little is known about the relationship between mental health status, PA, and sleep during the current pandemic. Moreover, it would be important to know if PA habits and improved sleep quality would be related to markers of stress, anxiety, depression, and aggression. In view of the above, the present study aimed to evaluate the association between mental health, quality of sleep, aggression, and PA in university students in Mexico after 1 year of dealing with the COVID-19 pandemic in Mexico, including a gender-sensitive analysis.

Materials and Methods

Participants and procedure

This cross-sectional study was conducted in University of the Guanajuato, state of Guanajuato, Mexico, between April 15 and May 5, 2021. The participants were university students (adult, both genders, physically healthy, non-disabled, and without COVID-19 diagnosis), who gave informed consent through an online form.

An anonymous self-administered questionnaire was sent to the participants through an online survey platform ("Google Forms," Google Inc, California USA) for the data collection. Students completed the questionnaire during the online classes under their teachers' guidance, who were previously instructed by the investigators. This study was conducted in compliance with the Norma Oficial Mexicana-012-SSA3-2012 and Declaration of Helsinki. In addition, the survey process was revised by school principals and approved by the institution for ethics clearance.

Measures

Demographic data. The data were collected following the SAGER guidelines to conduct a gender perspective analysis (Heidari et al., 2016). The data collected included gender instead of biological sex as the participants reported their identity rather than their biological attributes. In addition, participants were asked about age, weight and height (self-reported data). The body mass index (BMI) was calculated using the following formula $BMI = \text{weight (kg)} / \text{height}^2 \text{ (m)}$. The classification and parameters proposed by the World Health Organization (WHO) (OMS, 2020) were used to determine overweight or obesity ($BMI \geq 25 = \text{overweight}$ and $BMI \geq 30 = \text{obesity}$).

IES-R. The Impact of Event Scale-Revised (IES-R) is a 22-item scale that measures the psychological distress among people experiencing an acute psychological traumatic event. It is rated on a 0 (not at all) to 4 (completely agree) scale with respect to how distressing each item has been during the past week. The IES-R questionnaire has been applied to the Mexican sample for determining the extent of psychological distress after

traumatic and/or stressing experiences (Mojica et al., 2013). A higher score reflects higher levels of distress (Tiemensma et al., 2018). In the present study, Cronbach's alpha for the IES-R was 0.97.

DASS-21. The Depression, Anxiety, and Stress scale (DASS-21) is a self-report tool containing 21 items that assess the negative emotional states of depression (items 3, 5, 10, 13, 16, 17, and 21), anxiety (items 2, 4, 7, 9, 15, 19, and 20), and stress (items 1, 6, 8, 11, 12, 14, and 18). Each item is scored on a 4-point Likert scales from 0 (did not apply to me at all) to 3 (applied to me most of the time). This instrument was validated for use in the Mexican population (García-Rivera et al., 2014). Because the DASS-21 is a short-form version of the DASS (42 items), the total score for each subscale is multiplied by two to obtain the final scores. A higher score on the subscales indicates greater severity or frequency of these negative emotional symptoms (González-Rivera et al., 2020). The Cronbach's α coefficients of the total scale and each subscale of the DASS-21 were calculated. Cronbach's α was 0.82, 0.84, and 0.80 for anxiety, depression, and stress, respectively. Cronbach's α for the total scale was 0.89.

BPAQ. The Buss-Perry Aggressive Questionnaire (BPAQ) is a self-report measure of aggressiveness that uses a four-factor model or subscales, including physical aggression (items: 1, 5, 9, 12, 13, 17, 21, 24 and 29), verbal aggression (items: 2, 6, 10, 14 and 18), anger (items: 4, 8, 15, 16, 20, 23, 26 and 28), and hostility (items: 3, 7, 11, 19, 22, 25 and 27). This instrument was validated for use in the Mexican population (Pérez Matías et al., 2013). The BPAQ comprises a 29-item questionnaire where participants rank each item on a scale of 1 (extremely uncharacteristic of me) to 5 (extremely characteristic of me). Items 9 and 16 were reverse scored. The score of each dimension was the sum of scores for the corresponding items, and the overall aggressiveness score was the sum of the four components. Higher scores indicate higher aggressive behavior (Zhang et al., 2020). The Cronbach's α coefficient was 0.91.

PSQI. The Pittsburgh Sleep Quality Index (PSQI) was used to assess the overall weekly sleep quality in the last month. This instrument was validated for use in the Mexican population (Genchi-Jiménez et al., 2008). The PSQI investigates seven components of sleep, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, step sleep disturbances, use of sleeping medication, and daytime dysfunction. This questionnaire comprises 19 self-rated questions and five questions rated by the bed partner or roommate (if available). Only, self-rated questions were included in the scoring. Each component has a score range of 0–3; 0 indicates no difficulty whereas three indicates severe sleep difficulty. The global PSQI score, ranging from 0 to 21, is the sum of all the component scores, and a higher score indicates a lower quality of sleep (Ojeda-Paredes et al., 2019). A score of ≥ 5 is cut-off point to differentiate good from bad sleepers (Ojeda-Paredes et al., 2019). In the present study, Cronbach's alpha for the PSQI was 0.89.

Table 1. The International IPAQ Committee qualification of PA levels. MET: Metabolic equivalent task.

High	Moderate	Low
<ul style="list-style-type: none"> • Vigorous physical activity at least 3 days a week achieving a total of at least 1500 MET-minutes/week • Seven or more days of any combination of walking with moderate, and/or vigorous physical activity, achieving a total of at least 3000 MET-minutes/week 	<ul style="list-style-type: none"> • Three or more days of vigorous physical activity for at least 20 minutes per day • Five or more days of moderate physical activity or walking for at least 30 minutes per day • Five or more days of any of the combinations of walking, moderate, or vigorous physical activity achieving as minimum a total of physical activity of at least 3000 MET-minutes/week 	<ul style="list-style-type: none"> • People who had walked or performed another moderate or vigorous physical activity with a cumulative daily duration of at least 10 min but did not meet the criteria for moderate or high levels were classified into this level

IPAQ-S. To determine the self-reported levels of physical activity, the short version (7 items) of the International Physical Activity Questionnaire (IPAQ-S) was used. This scale is suitable for individuals aged 15–69 years old and is mainly used to compare physical activity levels between populations (Medina et al., 2012). In addition, it is validated for use in the Mexican population (Medina et al., 2013). The IPAQ questionnaire considers physical activity performed in the last 7 days, including the time spent performing physical activities (moderate to vigorous), such as walking, and inactivity (time spent sitting). The Cronbach's α coefficient was 0.78. The methodology of the IPAQ questionnaire (Alarcón Meza & Hall-López, 2021) quantifies the days and minutes of performed physical activity to determine a classification, depending on the metabolic equivalent task METs value, in three levels: high, moderate, and low. Therefore, all variations of walking intensity had an average MET value of 3.3. Excluding walking, all moderate intensity physical activities were had a MET value of 4, and vigorous intensity activities a MET value of 8. After categorization of the MET values, the MET-minutes/week were calculated using the following formulas: (1) walking = 3.3 MET*minutes of walking*days practiced per week, (2) moderate physical activity = 4 MET*minutes of moderate physical activity*days practiced per week, (3) vigorous physical activity = 8 MET*minutes of vigorous physical activity*days practiced per week, and (4) total = walk + moderate physical activity + vigorous physical activity. Once the total value was obtained, the subjects were classified into three levels of physical activity, as shown in Table 1.

Table 2. Socio-demographic features.

Variable	Overall	Female (n=584)	Male (n=351)	p value
Age (years)	24.17 ± 5.50	24.69 ± 5.33	23.28 ± 4.76	0.405
Height (m)	1.65 ± 0.09	1.64 ± 0.07	1.67 ± 0.10	0.446
Weight (kg)	67.90 ± 13.98	67.75 ± 13.77	70.16 ± 14.36	0.662
BMI (kg/m²)	24.90 ± 4.38	24.81 ± 4.47	25.05 ± 4.23	0.415

Notes: Data are expressed as mean and standard deviation.

Data Analysis Strategy

Categorical data were expressed as frequencies and percentage and were compared using the chi-square test. Raw scores of psychological tools, PSQI and IPAQ-S were reported as mean and standard deviation and compared with Student's t-test. The normality of the groups and the homogeneity of variance of the data were verified through the Kolmogorov–Smirnov test with a degree of significance of p -Value < 0.05. Correlations between variables were calculated using Pearson correlation tests. We conducted multiple linear regression by steps analyses to identify the contribution of relevant predictors on the DASS-21 total scores; these factors included age, gender, age, IMC, IES-R, BPAQ, PSQI, and IPAQ-S. All statistical analyses were conducted using IBM SPSS v25. Two-tailed p values < 0.05 were deemed significant.

Results

Demographic Characteristics

The study sample included 935 students, 62.46% female ($n=584$) and 37.54% male ($n=351$). Demographic characteristics are shown in [Table 2](#). The statistical analysis revealed no significant difference between groups.

Psychological distress, depression, anxiety, stress, and aggression.

The mean scores of the IES-R, DASS-21, and BPAQ scales by gender are presented in [Table 3](#). Briefly, the psychological distress, anxiety, and stress domains revealed that female students showed significantly higher scores than did male students. By contrast, in all the aggressiveness subscales and total score, male students showed significantly higher scores than female students.

Sleep quality

On the mean global PSQI score, females reported significantly higher mean score compared to males (8.21 ± 3.79 vs. 7.49 ± 3.54 , respectively; $p=0.004$). In addition, the prevalence of poor sleep quality (total PSQI score ≥ 5) was 82.19% among females and

Table 3. Means, standard deviations, and t-value of the mental health scales scores.

Scales	Female	Male	<i>p</i> value
	Mean ± SD	Mean ± SD	
IES-R (Psychological distress)			
Total score (0–66) ^a	37.42 ± 10.01	34.91 ± 7.85	0.049*
DASS-21 (Depression, anxiety, and stress)			
Depression (0–42) ^a	12.81 ± 4.67	11.36 ± 3.77	0.130
Anxiety (0–42) ^a	13.86 ± 4.52	11.16 ± 3.86	0.036*
Stress (0–42) ^a	18.53 ± 5.11	16.08 ± 4.81	0.022*
Total score (0–126) ^a	45.57 ± 13.28	41.60 ± 12.72	0.018*
BPAQ (Aggressiveness)			
Physical aggression (9–45) ^a	25.12 ± 7.30	28.37 ± 6.70	<0.001**
Verbal aggression (5–25) ^a	26.77 ± 8.48	29.79 ± 8.30	0.023*
Anger (8–40) ^a	18.58 ± 7.24	20.21 ± 5.21	0.040*
Hostility (7–35) ^a	11.13 ± 2.19	14.40 ± 2.74	0.032*
Total score (29–145) ^a	83.59 ± 11.61	88.77 ± 9.49	0.026*

Notes: ^aScore range, **p*<0.05, ***p*<0.01.

80.34% among males (no significant difference, *p* => 0.005). The subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, step sleep disturbances, use of sleeping medication, and daytime dysfunction are shown in [Table 4](#). Finally, there was a statistically significant difference in the subjective sleep quality (fairly bad and very bad), sleep latency (≤15 min), time of going to bed (02:00–02:59), time of getting up in the morning (6:00–6:59), habitual sleep efficiency (>85%), step sleep disturbances (0 and one to nine and daytime dysfunction, all categories) between females and males.

Physical activity

The type of physical activity is shown in [Table 5](#). When compared females versus males according to the frequency, difference was statistically significant in the low and moderate levels. Also, there was statistically significant difference on MET-min/week on moderate and high levels. Finally, 16.10% of females and 7.69% of males failed to achieve the recommended physical activity level of ≥500 MET-min/week ([Department of Health and Human Services, 2018](#); [Eckel et al., 2014](#); [Piepoli et al., 2016](#)), as shown [Table 6](#).

Correlations among study measures.

Correlations among all the variables using Pearson's *r* were calculated. The correlations according to gender are shown in [Tables 7 and 8](#).

Table 4. PSQI components.

Components	Female	Male	p value
	n (%)	n (%)	
Subjective sleep quality			
Very good	140 (23.97)	104 (29.63)	0.237
Fairly good	202 (34.59)	140 (39.89)	0.451
Fairly bad	185 (31.68)	87 (24.79)	0.021*
Very bad	57 (9.76)	20 (5.70)	0.014*
Sleep latency			
≤15 min	194 (33.22)	144 (41.03)	0.003**
16–30 min	205 (35.10)	102 (29.06)	0.234
31–60 min	106 (18.15)	56 (15.95)	0.325
>60 min	79 (13.53)	49 (13.96)	0.734
Sleep duration			
>7 h	309 (52.91)	207 (58.97)	0.245
6–7 h	163 (27.91)	82 (23.36)	0.184
5–6 h	73 (12.50)	43 (12.25)	0.832
<5 h	39 (6.68)	19 (5.41)	0.193
Habitual sleep efficiency			
>85%	206 (35.27)	92 (26.21)	0.012*
75–84%	139 (23.80)	101 (28.77)	0.083
65–74%	121 (20.72)	72 (20.51)	0.721
<65%	118 (20.21)	86 (24.51)	0.152
Step sleep disturbances			
0	216 (36.99)	107 (30.48)	0.008**
1 to 9	177 (30.31)	141 (40.17)	0.005**
10 to 18	160 (27.40)	90 (26.64)	0.298
19 to 27	31 (5.30)	13 (2.71)	0.102
Use of sleep medication			
Yes ^a	114 (19.52)	56 (15.95)	0.129
No ^b	470 (80.48)	295 (84.05)	0.201
Daytime dysfunction			
1 to 2	157 (26.88)	123 (35.05)	0.002**
3 to 4	191 (32.71)	149 (42.45)	0.003**
5 to 6	182 (31.16)	57 (16.24)	0.001**
Every day	54 (9.25)	22 (6.26)	0.124

Notes: ^aLess than once a week, once or twice a week, and three or more times a week, ^bnot during the past month. Notes: * $p < 0.05$, ** $p < 0.01$.

Predicting of mental health.

Table 9 presents the summary statistics of the final step of the linear regression model predicting the scores on the DASS-21 scale, which assessed the mental health among

Table 5. Type of physical activity.

Level	Female	Male	<i>p</i> value
Low	308 (52.74) ^a	123 (35.04) ^a	0.004*
	276.11±73.78 ^b MET-min/week	298.15 ± 67.90 ^b MET-min/week	0.234
Moderate	204 (34.93) ^a	175 (49.86) ^a	0.011*
	1976.92±147.8 ^b MET-min/week	1479.48 ± 129.81 ^b MET-min/week	0.001**
High	72 (12.33) ^a	53 (15.10) ^a	0.235
	3381.35±345.13 ^b MET-min/week	3245.13 ± 334.57 ^b MET-min/week	0.021*

Notes: * $p < 0.05$, ** $p < 0.01$. ^aData are expressed as frequency and percentage, ^bData are expressed as mean and standard deviation, ^cIndependent-samples t-test, ^dchi-squared tests.

Table 6. University students who achieve the recommended physical activity level of ≥ 500 MET-min/week.

Classification	Female	Male	<i>p</i> value
≥ 1500 MET-min/week	399 (68.32)	293 (83.48)	0.0001**
1000–1499 MET-min/week	44 (7.53)	17 (4.84)	0.716
500–999 MET-min/week	47 (8.05)	14 (3.99)	0.009**
<500 MET-min/week	94 (16.10)	27 (7.69)	0.003**

Notes: * $p < 0.05$, ** $p < 0.01$. Data are expressed as frequency and percentage.

students. In Step 1, age gender and BMI accounted for 1.6% of the variance ($F(3, 930) = 5.005, p = 0.002$). When the IES-R and BPAQ was added in Step 2, an additional 10.5% of the variance was accounted for, which was statistically significant ($F(5, 928) = 27.583, p < 0.001$). Further, addition of the PSQI in Step 3 explained an additional 22.6% of the variance, which was statistically significant ($F(6, 927) = 38.198, p < 0.001$). Finally, the overall model accounted for approximately 73.5% of the variance in DASS-21 scores ($F(7, 926) = 55.325, p < 0.001$), with the BMI, IES-R, PSQI, and IPAQ subscales, emerging as significant individual (positive) predictors.

Discussion

University students are particularly vulnerable in terms of mental health. Monitoring the psychological status of university students in Mexico during the COVID-19 pandemic is essential because the impact of the pandemic on this vulnerable population is still not well understood. The present study was a gender analysis designed to understand the psychological state of university students in Mexico after 1 year of dealing with the COVID-19 pandemic and to explore the associations between mental health, quality of sleep, aggression, and PA. Conducting a gender approach analysis to mental health can be used as a guide to mental health systems and governments to

Table 7. Pearson correlation of demographic characteristics, IES-R, DASS-21, BPAQ, PSQI, and IPAQ-S score in males.

	1	2	3	4	5	6	7	8	9
1. Age									
2. BMI	-0.007								
3. Psychological distress score	-0.037	-0.072							
4. Depression score	-0.033	-0.138**	0.599**						
5. Anxiety score	-0.047	-0.108*	0.679**	0.751**					
6. Stress score	-0.018	-0.172**	0.706**	0.818**	0.809**				
7. Aggressiveness total score	-0.157**	-0.012	0.123**	0.064	0.085*	0.054			
8. Sleep quality total score	-0.097*	-0.002	0.078*	0.061	0.143*	0.170**	0.351**		
9. Total PA MET-minutes/week	0.045	-0.005	-0.089*	-0.096*	-0.103**	-0.157**	0.051	-0.243**	

Notes: *p<0.05, **p<0.01. Raw scores were used for regression model.

Table 8. Pearson's correlation of demographic characteristics, IES-R, DASS-21, BPAQ, PSQI, and IPAQ-S score in females.

	1	2	3	4	5	6	7	8	9
1. Age	1								
2. BMI	-0.009	1							
3. Psychological distress score	-0.047	-0.118*	1						
4. Depression score	0.032	-0.155*	0.673**	1					
5. Anxiety score	0.050	0.102*	0.722**	0.798**	1				
6. Stress score	-0.017	-0.158*	0.731**	0.853**	0.818**	1			
11. Aggressiveness total score	-0.064	0.059	0.061	0.126*	0.078	0.113*	1		
19. Sleep quality total score	0.006	0.001	0.092*	0.129**	0.113*	0.143**	0.538**	1	
20. Total PA MET-minutes/week	0.057	-0.018	-0.063	-0.059	-0.064	-0.071*	-0.031	-0.112*	1

Notes: * $p < 0.05$, ** $p < 0.01$. Raw scores were used for regression model.

Table 9. Final step of the linear regression model predicting the scores on the DASS-21 scale.

Variable	R ²	B	SE _β	β	t	P	sr ²
Predicting DASS-21	.735					<0.001	
Age		0.052	0.098	0.012	0.529	0.597	0.012
Gender		0.717	0.544	0.011	0.464	0.643	0.010
BMI*		0.540	0.167	0.172	1.243	0.001	0.072
IES-R*		1.244	0.039	0.724	3.161	<0.001	0.717
BPAQ		0.029	0.028	0.026	0.826	0.305	0.023
PSQI*		0.805	0.108	0.601	3.391	<0.001	0.791
IPAQ*		-1.116	0.179	0.711	2.760	<0.001	0.617

Notes: DASS-21 – Depression Anxiety Stress Scale, BMI – Body Mass Index, IES-R – Impact of Event Scale-Revised, BPAQ – Buss-Perry Aggression Questionnaire, PSQI – Pittsburgh Sleep Quality Index, IPAQ – International Physical Activity Questionnaire. *p <0.05.

design suitable interventions and public policies (Afifi, 2007). In that regard, the gender-based analysis presented in our study serves as a valuable precedent for such purposes. In our study, we included both a descriptive and a correlation analysis. It is important to keep in mind that correlation does not imply causation (Rohrer, 2018). However, the interpretation of such correlations allows us to expand our understanding of the impact of COVID-19 on student's mental health and serves as a precedent to further studies.

Our results suggest that the pandemic affected female and male students differently. Female students reported higher psychological distress, anxiety, and stress, whereas male students reported higher aggressiveness. In line with our findings, several studies have also reported the gender differences of the impact of COVID-19 on mental health. A study in Mexico including 1173 subjects revealed higher levels of stress in females compared to males (Zamarripa et al., 2020). Female students experienced higher levels of anxiety than their male counterpart in a study conducted on 192 university students in Chile (Castillo Riquelme et al., 2021). In Mexico, a study with 12,158 participants highlighted that female university students reported a higher impact of the pandemic on their mental health than male students (Castañeda et al., 2021). Significant differences between female and male students were reported in a study conducted on 418 university students in Mexico in which female students reported higher scores in the fear and depression dimensions (Rodríguez de los Ríos et al., 2020). Furthermore, a more pronounced emotional impact in terms of anxiety was also reported in a study including 257 Mexican university students (García-Rivera et al., 2014). It is important to highlight that most of the studies on the impact of the COVID-19 outbreak in university students in Mexico have used a descriptive approach. To our knowledge, our study is the first in presenting a correlation analysis among study variables, including of mental health domains, sleep quality, aggressiveness, and PA, in university students in Mexico in addition to the descriptive approach.

Previous studies suggest that female and male participants respond differently to the COVID-19 measures, and gender is a consistent predictor of mental health outcomes (Gualano et al., 2020; Mazza et al., 2020; Qiu et al., 2020; Stroud & Gutman, 2021; Wang et al., 2020). For instance, the socio-demographic data of a study conducted in China from January to February 2020 reported a higher psychological impact of the pandemic on females as they showed higher anxiety, depression, and stress scores (Wang et al., 2020). In a large-scale survey on psychological distress in the general population in China and the autonomous regions of Hong Kong, Macau, and Taiwan, female participants reported higher psychological distress than their male counterpart (Qiu et al., 2020). In a study conducted from April to November 2020 in the UK, a clear association between being female and having poor mental health was established. In the same study, the trajectory of females' mental health showed that their mental health worsened as the lockdown restrictions were tighten compared to males' mental health (Stroud & Gutman, 2021). In Italy, a national cross-sectional study carried out during the last 14 days of the lockdown between April and May 2020, reported that females showed a higher risk of experiencing anxiety (Gualano et al., 2020). Similarly, increased anxiety, depression, and stress in female participants was reported in another nationwide survey conducted in Italy (Mazza et al., 2020).

The gender differences in psychological and behavioral response to stress have been previously documented (Needham & Hill, 2010; Taylor et al., 2000). For instance, women tend to show higher rates of internalizing disorders such as mood and anxiety disorders (Needham & Hill, 2010) and adopt a tend-and-befriend pattern in response to stress, a response characterized by nurturant activities to protect the self and offspring the creation and maintenance of social networks to aid the process (Taylor et al., 2000). Our results showed that female students experienced higher psychological distress, anxiety, and stress. An explanation for these results could be higher rates of internalizing disorders (e.g., anxiety and depression) reported in women (Gao et al., 2020; Needham & Hill, 2010) which have been increasing during the pandemic (Stroud & Gutman, 2021). The vulnerability of women to experience mental problems at higher rates compared to men could be associated to physiological differences such as hormones and cortisol levels that may be reflected in their behaviors and emotions (Gao et al., 2020). From the stress response point of view, females and males display different sensitivity to events (Afifi, 2007) in which females are more vulnerable to stress than males (Gao et al., 2020). Furthermore, the tend-to-befriend response to stress exhibited by women can contribute to experiencing a greater care burden because of their tendency to care for both outside and inside their home during the pandemic (Needham & Hill, 2010). Since women rely on their social network to aid the response to stress (Taylor et al., 2000), the confinement and reduced social interaction could have diminished the social support contributing to their vulnerability to negative life events compared to men whose vulnerability does not get affected by the lack of social support in such events (Afifi, 2007).

On the other hand, men show higher rates of externalizing disorders, namely, impulse control and substance abuse (Needham & Hill, 2010), and their response to

stress primarily involves the fight-or-flight response (Taylor et al., 2000). In our study, male students reported higher aggressiveness, a behavior often associated to externalizing disorders (Mendez et al., 2021). Our study is the first to report aggressiveness in male university students in Mexico during the COVID-19 pandemic. Contrary to women, who are more likely to have been socialized to express dysphoria, men have been socialized to express anger in response to stress (Afifi, 2007). Therefore, the higher aggressiveness reported by male students could be explained by the fact that men are more likely to express anger and aggressiveness in stressful situations. Concepts related to the traditional masculinity and femininity can also contribute to the reactions and attitudes towards life events (Afifi, 2007). For instance, masculinity involves traits such as individualism, dominance, and control of emotions, whereas femininity is displayed as affection and sensitivity to others' needs (Díaz Loving et al., 2012; Gibson et al., 2016). The masculinity traits may support that the COVID-19-related confinement conditions did not affect male students' mental health as negatively as it was observed in female students. Also, the gender stereotype patterns is often associated to women tendency to experience mood disorders such as depression and anxiety while those patterns can be associated to anger, substance abuse, and aggressiveness in males (Díaz Loving et al., 2012). The aggressiveness reported by male students should be considered to develop suitable strategies to address this issue.

The demographic data showed that most students had normal weight ($n = 544$), while fewer students were overweight ($n = 247$) or obese ($n = 97$). Significant negative correlations were found in male students (BMI and depression, $r = -0.138$; BMI and anxiety, $r = -0.108$; BMI and stress, $r = -0.172$) but not in female students. Previous studies on BMI and mental health in university students showed higher rates of emotional problems in obese and underweight students in comparison with normal and overweight students suggesting a U-shape relationship between BMI and depression, anxiety, and stress (Abdel Sadek et al., 2016). The relationship between high BMI and risk of mood disorders has been previously discussed (Almandoz et al., 2020). The findings of the present study support the evidence of the association between BMI and mental health. Considering PA as an intervention strategy during the pandemic may contribute not only to mitigate the impact of the outbreak on mental health but also to assist in keeping a normal BMI, which is also associated with improved mental health outcomes.

Differences between male and female students regarding the association among the study variables were evident. For instance, PA showed a significant negative correlation between sleep quality ($r = -0.243$), stress ($r = -0.157$), psychological distress ($r = -0.089$), anxiety ($r = -0.103$), and depression ($r = -0.096$) in male students. On the other hand, a significant negative correlation between PA and sleep quality ($r = -0.122$), and stress ($r = -0.071$) was observed in female students. A large body of evidence supports the beneficial effects of PA on mental health in both clinical and non-clinical populations (Carek et al., 2011; Paluska & Schwenk, 2000; Rebar et al., 2015). It has been suggested that PA reduces the symptoms of depression and anxiety by getting the person distracted from negative thoughts (Şenışık et al., 2020). Negative

thoughts and concerns related to the COVID-19 pandemic and the isolation period have been linked to increased risk of experiencing mental health symptoms such as anxiety, depression, and stress (Xiao et al., 2020; Şenışık et al., 2020). Therefore, PA arises as an accessible, practical, cheap, and easy to implement intervention strategy that could be used to mitigate the negative effects of the COVID-19 outbreak in university students. Although the results of our correlation analysis of the variables do not imply causality, the results can be useful to design future studies to assess the effect of PA on mental health considering a gender perspective. As the correlation analysis suggests, the mental health variables in male students are negatively associated to sleep quality and mental health variables in male students. However, the clinical assessment of the effect of PA on mental health in future studies is essential.

Limitations

This study has several limitations. Firstly, cross-sectional studies involve the analysis of observational data. Therefore, the main limitation of the present study is that it is not possible to establish a causal relationship without longitudinal data. Secondly, the use of a self-reported measure of PA is a limitation of the study as it is a subjective tool and not allow to quantify the PA time and intensity (e.g., beats per minute).

Conclusions

The findings of the study revealed that the impact of the COVID-19 outbreak was different in female and male students. Our results suggest that female university students are more vulnerable to experience mental health issues than their male counterpart. Policy makers and university management need to keep in mind those differences to design recommendations and intervention programs. Furthermore, the effect of PA on mental health was different in male compared to female students. In fact, PA showed a positive effect on more mental health domains (psychological distress, depression, anxiety, and stress) than the mental health domains in female students (stress only). This trend suggest that PA-based intervention strategies may be more impactful in male students. Finally, mental health intervention strategies other than PA should be considered for female students.

Recommendations

The findings of the present study suggest that future comprehensive crisis prevention measures and intervention strategies should consider the gender differences of the impact of COVID-19 in university students in Mexico. For instance, intervention strategies targeting female students need to be designed focusing on psychological distress, anxiety, and stress. Conversely, attention should be paid towards tacking aggressiveness in male students. A qualitative approach to identify contributing factors

to university students' mental health during the outbreak is worth being implemented to design preventive strategies that universities and policy makers could consider.

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