

An Exploratory Factor Analysis to Investigate the Impact on College Students' Stress Levels During COVID-19

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Abstract

The COVID-19 pandemic has caused significant ripples within the academic learning environment. Current research has demonstrated that it has led to elevated stress levels among college students due to the abrupt switch to online instruction. Of particular interest is the need to understand the impact of the pandemic on stress among certain sub-populations of college students. The scope of this study is to analyze perceived stress levels of college students via exploratory factor analysis on a survey study of college students collected at the University of Nevada, Las Vegas. After performing EFA on the results of the Perceived Stress Scale (PSS-10), we obtained a 2-factor model. We subsequently analyzed the factors with respect to various socio-demographic groups using stepwise linear regression and found that sex and age ($p < 0.01$) were significant in predicting each of the factors. We will also provide results from performing a modified group LASSO regression.

Key Words: Survey Study, Mental Health, Exploratory Factor Analysis, Variable Selection

1. Introduction

The United States has reported more than 500,000 deaths due to the COVID-19 pandemic with over 30 million total reported cases of COVID-19 since January 2020 (CDC, 2020). Studies have shown that there is a significant effect on the mental health of students, including anxiety and depression, resulting from the onset of the COVID-19 pandemic (John, 2020; Wang et al., 2020). Due to the transition to an online model, many university campuses have closed and resident students forced out, with many attempting to figure out where to move (Dennon, 2021). Furthermore, the unexpected shift from in-person classes to online instruction has alienated students who do not have free or easy access to digital resources (Dennon, 2021). In addition, increased levels of anxiety and depression have been more prevalently observed within communities of color, especially those of Chinese descent, and women (Cheah et al., 2020; Hou et al., 2020; Molock & Parchem, 2021).

Many survey results have been collected and analyzed regarding the impact of COVID-19 with respect to mental health; however, these have been mainly limited to studies in developing countries (Lakhan et al., 2020). Of the studies that have focused on college students within the United States, they measured anxiety and depression levels using Patient Health Questionnaire Depression scale (PHQ-8) and the Generalized Anxiety Disorder scale (GAD-7) (Fruehwirth et al., 2021; Son et al., 2020; Wang et al., 2020). There have been some studies that included deeper analyses regarding the impact of race and ethnicity with respect to increased levels of stress, anxiety, and depression (Woo &

Jun, 2021). On the other hand, there are very few research studies concerning the mental health of female college students due to the pandemic (Debowska et al., 2020; Thibaut & van Wijngaarden-Cremers, 2020). Moreover, we note that no such comprehensive survey study exists for the University of Nevada, Las Vegas (UNLV) student population, which has been considered the most diverse student body in the United States.

The objective of this study was to conduct a survey-based assessment of stress among college students at UNLV during the COVID-19 pandemic. We measured stress levels among college students using the Perceived Stress Scale (PSS). We sought to identify severity levels of stress related to COVID-19 and examine the relationships between these variables to various subgroups of the population based on gender, ethnicity, and class standing.

2. Methods

2.1 Ethics

This study was approved by the UNLV Institutional Review Board (IRB) in August 2020. All participants signed an informed consent form that was approved by the IRB.

2.2 Recruitment

Student mail addresses were requested by the PI of this study with the inclusion criteria of current enrolled UNLV students with age 18 and older, including undergraduate, graduate, professional, and/or non-degree seeking students from the registrar office at UNLV. Recruitment email was sent to each qualifying participant with a Qualtrics link to invite them to participate in the study voluntarily. An informed consent was shown once the participants who are willing to participate in the study click the survey link in the recruitment email. Only consenting participants were directed to respond to the survey. At the end of the survey, another link was provided for participants, which led to another survey that only collected the information (i.e., email address) for the raffle. After the termination of the survey, 10 participants were randomly selected through the use of randomizing in R software for compensation.

2.4 Measures

The most prominent measuring instrument that we used to analyze perceived stress is the PSS-10 (Perceived Stress Scale). PSS-10 includes 10 questions and the participants of this study choose their degree of agreement (4 = Very often; 3 = Fairly often; 2 = Sometimes; 1 = Almost Never; 0 = Never) (Cohen et al., 1983). The items of the scale measure the stress and ability to cope with the stress. Previous studies suggested that PSS-10 has good reliability measures among college students (Roberti et al., 2006). Demographic information including gender, age, ethnicity, class standing, marital status, and financial situation.

2.5 Statistical Analyses

The data were downloaded from the online survey (Qualtrics). Statistical analysis was conducted using R statistical software.

A factor analysis using the principal axis method and the varimax rotation method was conducted on the responses from 1,699 participants who completed the PSS-10. Based on the previous factor analysis on PSS-10 (Chatterjee et al., 2021; Roberti et al., 2006), we extracted the factors correspondingly in our exploratory factor analysis.

Stepwise linear regression using Akaike Information Criterion was applied to assess the association between demographic variables and the factors extracted in the factor analysis stage.

3. Results

3.1 Sample Demographics

A total of 2,091 responses were collected via Qualtrics. After removing the responses who did not complete the PSS-10, 1,699 responses are left. Among these 1,699 students, 1,152 (67.8%) are females. The sample includes both undergraduates ($n = 1,303$, 76.7%) and graduate students ($n = 364$, 22.4%). 38.3% of the students ($n = 650$) identified themselves as “White/Caucasian”; 23.7% of the students ($n = 403$) are “Hispanic/Latino”; 20.1% of the students ($n = 341$) are “Asian/Asian American”; 6.8% of the students ($n = 115$) classified themselves as “Biracial/Multiracial”; 5.7% of the students ($n = 96$) are “Black/African American”; 1.9% of the students ($n = 32$) identified themselves as Pacific Islanders/Native Hawaiian; 1.5% of the students are “Middle Eastern or Northern African (MENA)/Arabic Origin”; 0.9% ($n = 16$) identified themselves as “American Indian/Native Alaskan”. Age, gender, marital status, ethnicity, class standing, employment status, and financial situation are summarized in Table 1.

Table 1: Demographic Information

<i>Variable Name</i>	<i>Sample Size (n = 1,699)</i>	<i>Percentages</i>
Age		
18-24	1,151	67.7%
25-34	371	21.8%
35-44	120	7.1%
45-54	43	2.5%

55-64	12	0.7%
65-74	2	0.1%
75 or older	0	0.0%
Gender		
Male	515	30.3%
Female	1,152	67.8%
Other	32	1.9%
Marital Status		
Married	205	12.1%
Widowed	3	0.2%
Divorced	27	1.6%
Separated	12	0.7%
Partnered	209	12.3%
Single	1,226	72.2%
Other	17	1.0%

Ethnicity		
American Indian/Native Alaskan	16	0.9%
Asian/Asian American	341	20.1%
Black/African American	96	5.7%
Hispanic/Latino/a/x	403	23.7%
MENA/Arabic Origin	25	1.5%
Pacific Islanders/Native Hawaiian	32	1.9%
White/Caucasian	650	38.3%
Biracial/Multiracial	115	6.8%
Other	21	1.2%
Class Standing		
1st year undergraduate	285	16.8%
2nd year undergraduate	270	15.9%
3rd year undergraduate	317	18.7%
4th year undergraduate	273	16.1%

5th year or more undergraduate	158	9.3%
Master's	174	10.2%
Doctorate	190	11.2%
Not seeking a degree	8	0.5%
Other	24	1.4%
Employment Status		
Full-time	316	18.6%
Part-time	595	35.0%
Unemployed	520	30.6%
Laid off due to COVID-19	178	10.5%
Retired	10	0.6%
Not working due to disability	13	0.8%
Other	67	3.9%
Financial Situation Compared to pre COVID-19		
A lot more stressful	626	36.8%

Somewhat more stressful	601	35.4%
No change	392	23.1%
Somewhat less stressful	49	2.9%
A lot less stressful	31	1.8%
*These 1,699 participants completed all questions from PSS-10 scale		

3.2 Descriptive Statistics

For all the participants who completed PSS-10, the average PSS score is 21.54772. 83.9% of these participants perceived moderate to severe stress. The female participants have a mean PSS score of 22.19745 while the male participants have a mean PSS score of 19.72796. The mean PSS score of the other participants is 27.44666.

Among all the age groups, the participants aged between 18-24 have the highest PSS score as 22.19740 while the participants aged between 65-74 have the lowest PSS score as 15.00424.

The African American/Black participants have the lowest mean PSS score as 20.258 and the MENA/Arabic origin participants have the highest mean PSS score as 22.28837.

Among all the class standings, the undergraduate participants generally have higher mean PSS scores (Freshmen: 20.64723; Sophomore: 22.45686; Junior: 22.88783; Senior: 22.28802; 5th year or more: 22.51783) compared to all other students (Master's: 19.56772; PhD: 19.47796; Non-degree seeking: 19.37560).

The participants identified themselves as “a lot more stressful” in financial situations during COVID-19 have the highest mean PSS score as 24.67688 while the participants identified themselves as “a lot less stressful” in financial situations have the lowest mean PSS score as 17.06810.

For the employment status, the retired participants have the lowest mean PSS score 16.60963 and the participants who were not working due to disability have the highest mean PSS score as 26.46636. The participants who lost their jobs due to COVID-19 also have a high mean PSS score as 23.92786.

The students who were married have the lowest mean PSS score (19.02817) while the students who were separated have the highest mean PSS score (26.42856).

3.3 Factor Analysis

An initial factor analysis was performed on all 10 measures from the PSS-10. The Kaiser-Meyer-Olkin (KMO) value of 0.9 justified that the sample was factorable. Bartlett's test was performed to confirm the homogeneity of variance ($\chi^2(45) = 8276.4$, p-value < 0.001). We obtained the anti-image correlation matrix to determine if any of the 10 items should be dropped. Within the anti-image correlation matrix, there were five items with the corresponding diagonal elements < 0.5 (Q1, Q2, Q3, Q6, Q10). These items were not included in the final step of factor analysis.

The final step of the factor analysis was conducted using five items (Q4, Q5, Q7, Q8, Q9). KMO value of 0.81 indicates the sample was factorable and Bartlett's test provides significant evidence for homogeneity of variance ($\chi^2(10) = 2215.764$, p-value < 0.001). Communalities were above 0.4 except for Q9. However, we did not drop the item since it still has a communality over 0.2 and we found the necessity to keep it in the next step of the factor analysis in terms of the interpretation of the model.

We extracted two factors after we inspected the scree plot. The two factors explained 52.7% and 17.5% of the total variance correspondingly. The cumulative percentage of variance explained by these two factors was 70.2%. The rotated component matrix and the communalities for five measures were provided in **Table 2**. After comparing the factor analysis result with the past literature on PSS-10 ([Chatterjee et al., 2021](#); [Wu & Amtmann, 2013](#)), we named the first factor as “Irritability” and the second factor as “Anxiety”. The factor “Anxiety” contained only one item but we kept it for the fact that this factor provided a different aspect on perceived stress in comparison to the first factor “Irritability”.

Table 2: Factor Analysis Summary with Rotated Component Matrix

	<i>Factor (Irritability)</i>	<i>1 Factor (Anxiety)</i>	<i>2 Communalities</i>	<i>Diagonal of anti-image matrix</i>
PSS_4	0.727	0.199	0.569	0.633
PSS_5	0.568	0.419	0.498	0.567
PSS_7	0.491	0.414	0.412	0.634
PSS_8	0.555	0.524	0.583	0.507
PSS_9	0.155	0.468	0.243	0.567

* Varimax rotation with PA (Principal Axis) Factoring

* keep the objects with corresponding diagonal element > 0.5 in the anti-image matrix

3.4 Stepwise Linear Regression

The factor scores for all participants who completed PSS-10 were computed using a regression method. A stepwise linear regression with demographic variables (Gender, age, financial situation, marital status, class standing, employment status, and ethnicity) as predictors was done for two factors. Since most of the demographic variables are categorical, we created the dummy variables correspondingly.

Both male ($\beta = -0.46$, $t = -3.38$, $p < 0.001$) and female ($\beta = -0.41$, $t = -3.06$, $p = 0.002$) predicted irritability. When fixing all other predictors (i.e., age, financial situation, marital status, class standing, employment status, and ethnicity), females were associated with higher irritability in comparison to males. However, the base level “other” is associated with highest irritability compared to males and females. Stressful financial situations (“A lot more stressful”: $\beta = 0.38816$, $t = 7.858$, $p < 0.001$; “Somewhat more stressful”: $\beta = 0.13405$, $t = 2.712$, $p = 0.007$) were highly associated with higher irritability. Students aged between 35-44 years old ($\beta = -0.2591$, $t = -3.335$, $p < 0.001$) and students aged between 45-54 years old ($\beta = -0.46796$, $t = -3.878$, $p < 0.001$) were also associated with higher irritability. Ethnicities, employment status, and marital status of students were not found to be significantly associated with the factor “irritability”.

Both male ($\beta = -0.46$, $t = -3.38$, $p < 0.001$) and female ($\beta = -0.41$, $t = -3.06$, $p = 0.002$) predicted anxiety. While fixing all other predictors, females were associated with higher anxiety compared to male. Similar to the analysis on factor 1 (“Irritability”), the base level “other” was associated with higher anxiety in comparison to other two groups. Stressful financial situations were associated with higher anxiety (“A lot more stressful”: $\beta = 0.44605$, $t = 10.774$, $p < 0.001$; “Somewhat more stressful”: $\beta = 0.13405$, $t = 3.986$, $p < 0.001$). Age groups, ethnicities, employment status, and marital status of students were not found to be significantly associated with the factor “anxiety”.

Table 3: Results of Stepwise Linear Regression on Categorical Predictors

<i>Response</i>	<i>Predictor(s)</i>	β	<i>t</i>	<i>p-value</i>	<i>F</i>	<i>df</i>	<i>p-value</i>
Irritability	Gender: Male	-0.46324	-3.382	0.000737	8.315	19, 1679	<0.001
Base level: Gender = Other;							
Age = 18-24;							
Financial Status = No Change	Gender: Female	-0.41273	-3.063	0.002226			
	Age: 25-34	-0.05522	-1.049	0.294551			

	Age: 35-44	-0.25901	-3.335	0.000872			
	Age: 45-54	-0.46796	-3.878	0.000109			
	Age: 55-64	-0.35598	-1.597	0.110422			
	Age: 65-74	-0.93377	-1.684	0.092348			
	Financial Status: a lot more stressful	0.38816	7.858	6.89*10⁻¹⁵			
	Financial Status: somehow more stressful	0.13405	2.712	0.006747			
	Financial Status: somehow less stressful	-0.01505	-0.132	0.895001			
	Financial Status: a lot less stressful	0.01694	0.12	0.904718			
Anxiety	Gender: Male	-0.41896	-3.644	0.000277	13.74	14,1684	<0.001
Base level:							
Gender = Other;							
Age = 18-24; Financial Status = No Change	Gender: Female	-0.32137	-2.84	0.004568			

	Financial Status: a lot more stressful	0.44605	10.774	<2*10⁻¹⁶			
	Financial Status: somehow more stressful	0.16507	3.986	7*10⁻⁵			
	Financial Status: somehow less stressful	0.11684	1.222	0.221956			
	Financial Status: a lot less stressful	0.04544	0.385	0.699988			

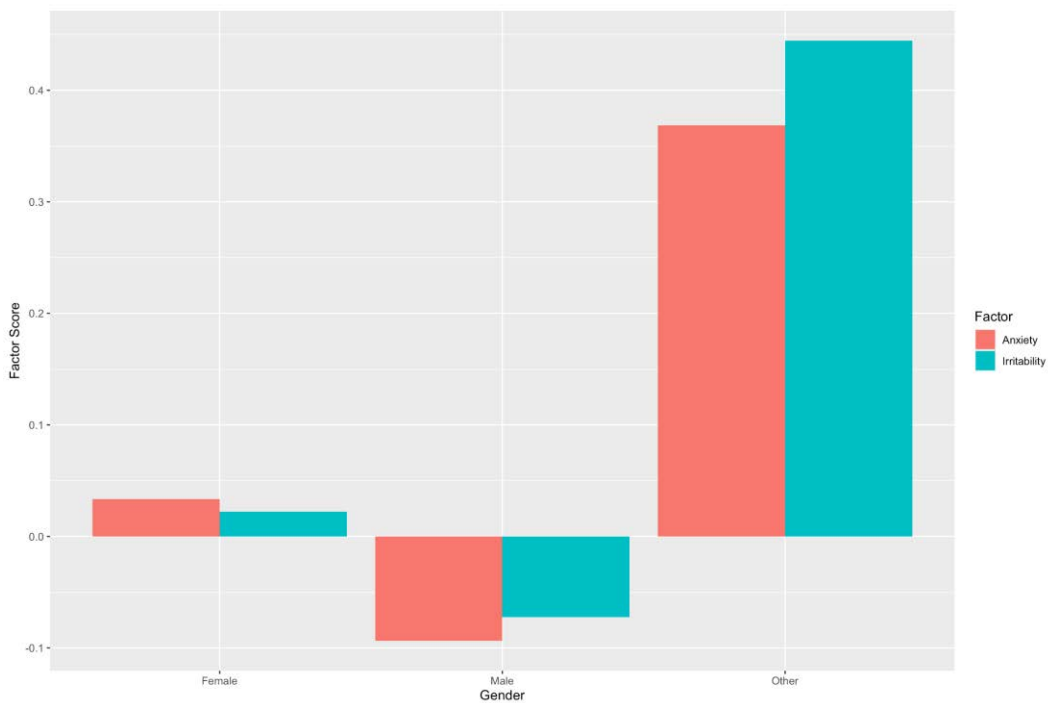


Figure 1: Mean Factor Scores for UNLV Students by Gender

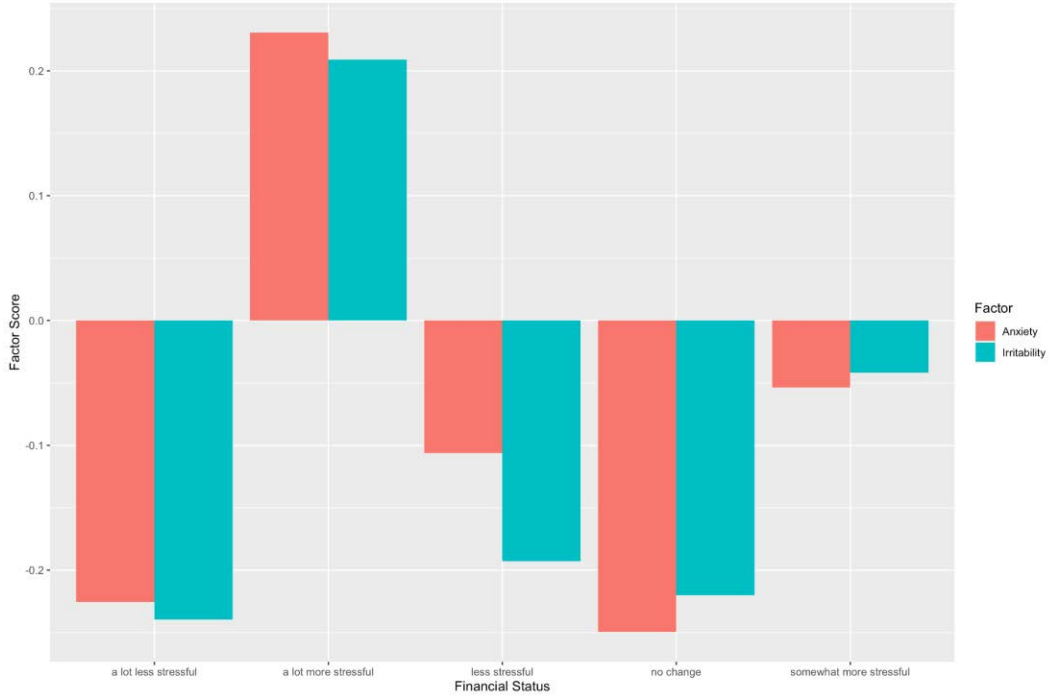


Figure 2: Mean Factor Scores for UNLV Students by Financial Status

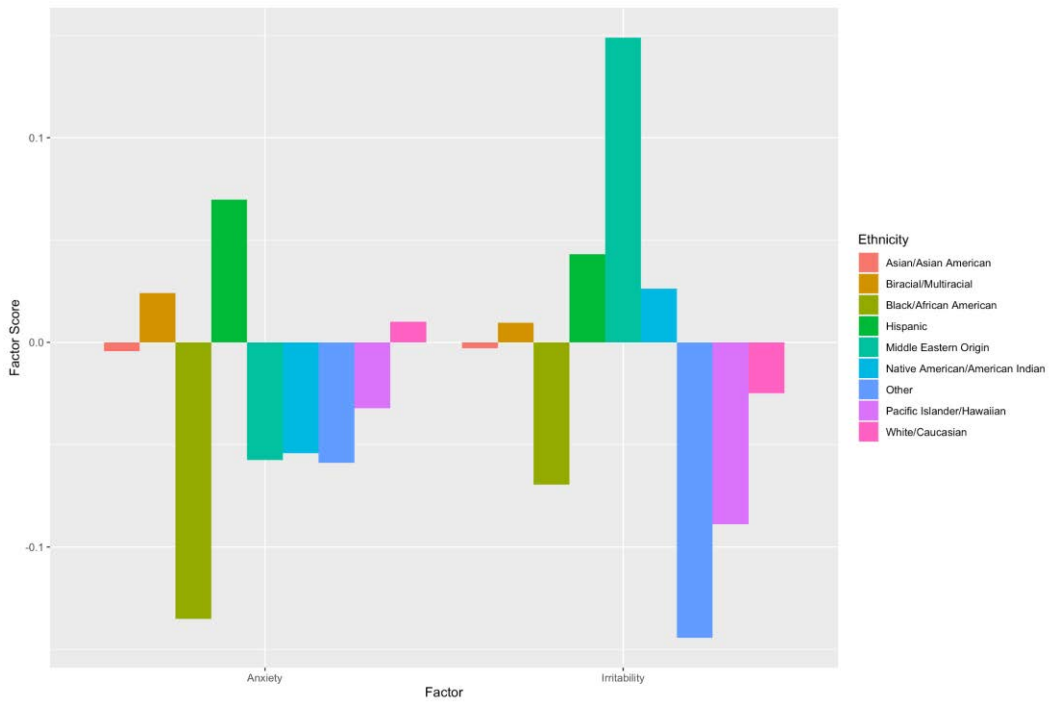


Figure 3: Mean Factor Scores for UNLV Students by Ethnicity

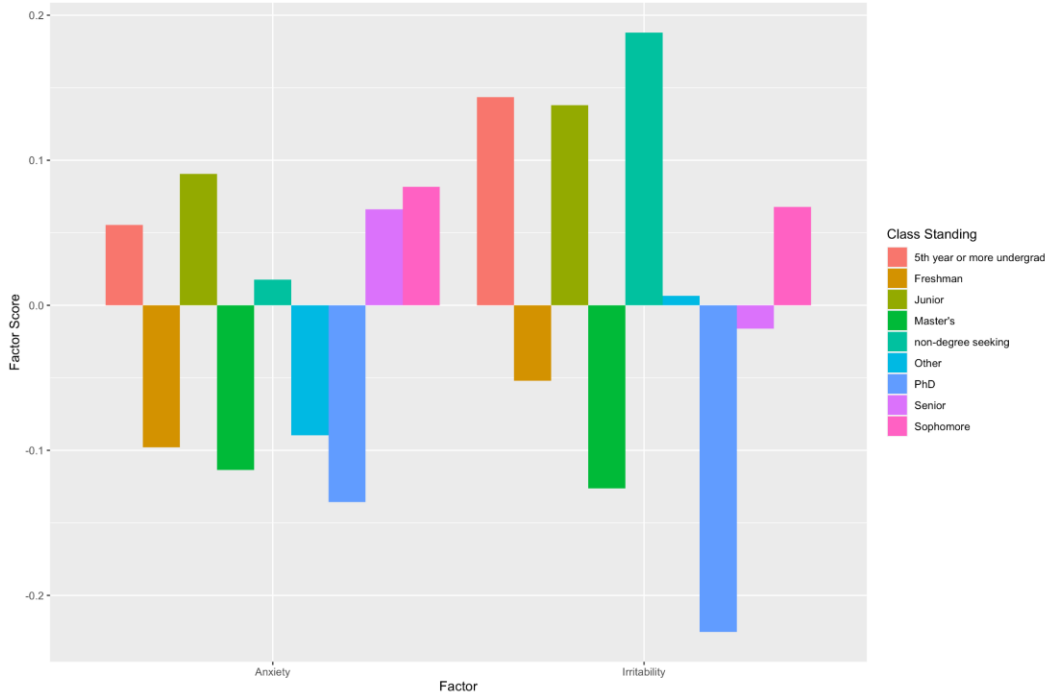


Figure 4: Mean Factor Scores for UNLV Students by Class Standing

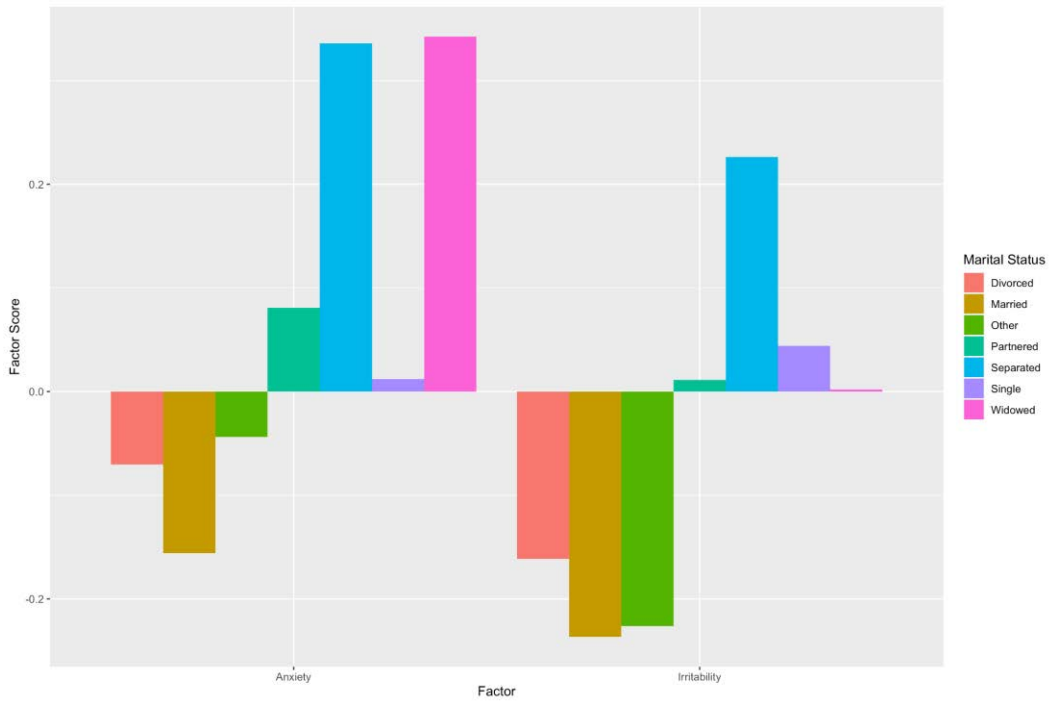


Figure 5: Mean Factor Scores for UNLV Students by Marital Status

4. Discussion

The aim of this study is to investigate how COVID-19 pandemic impacts the psychological status of college students and what demographic variables possibly contribute to such impacts. The factor analysis resulted in two factors: Anxiety and Irritability. The two-factor model is consistent with Wu and Amtmann (2013).

For the first factor “Irritability”, students who identified themselves as “other” gender scored significantly higher in this factor in comparison to the students who identified themselves as either male or female. This is reasonable since LGBTQ young persons might experience unique mental health problems in comparison to other gender groups during COVID pandemic (Salerno et al., 2020). Female students, however, are more likely to be irritable in comparison to male students in our study. This is consistent with Hou et al. (2020). The students that experienced a lot more stress financially are also associated with higher irritability. Among all the ethnic groups, the students with Middle East origin demonstrated higher irritability during COVID pandemic in comparison to other ethnicities. However, as the stepwise linear regression suggests, the ethnicity of college students does not show up as a significant predictor of irritability. Our results also suggested that PhD students and master’s students have lower irritability levels in comparison to other students. This might come as a surprising result since the master’s students and PhD students generally experience quite a lot of pressure due to their coursework or research. However, due to their long-term experience of coping with stress during their academic career, they might have developed a good ability to deal with stress under unexpected circumstances such as COVID. The students who were laid off during COVID and the students who cannot work due to disability generally have higher irritability in comparison to other groups. This is to be expected since the unemployment due to COVID led to mental health issues as previous study suggested (Posel et al., 2021).

The second factor “Anxiety” is associated with stressful financial status and gender based on our stepwise regression analysis. Again, the students who identified themselves as “other” gender have significantly higher anxiety levels in comparison to male or female. Among all the ethnicities, the Hispanic-origin students have the highest level of anxiety. However, our stepwise linear regression suggests that the ethnicities of students are not significant predictors of anxiety. The students who were widowed and separated have higher anxiety levels than other students. This is to be expected since the loss of support from their loved ones might reduce their ability to cope with the stress. This result is also partially consistent with (Nkire et al., 2021).

Figures 1-5 summarize the mean factor scores for the mentioned demographic variables. The results of the factor analysis and stepwise linear regression confirms some observations in the literature, such as the correlation of gender with anxiety and stress due to COVID. Interestingly, in contrast to what has been suggested by some researchers (Cheah et al., 2020; Woo & Jun, 2021), our results show that ethnicity seems to be a significant risk factor in neither irritability nor anxiety. We speculate that due to the ethnically diverse UNLV student body and the overall social atmosphere that characterizes the university environment that this leads to a tendency for less discrimination, hence ethnicity is considered insignificant in predicting stress.

5. Future Research

While in this work we considered stepwise regression to analyze the significant factors contributing to stress, we hope to compare these results with those that come from a regression that performs variable selection via Group LASSO. Group LASSO allows for the use of categorical variables, and it would be beneficial to know how the results would differ from those based on the former method.

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