UNIVERSITY STUDENT MENTAL HEALTH BEFORE AND AFTER COVID-19:

HETEROGENEOUS SYMPTOM PROFILES

By

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ABSTRACT

Introduction: Research on the effects of the COVID-19 pandemic on mental health has produced conflicting findings. Several studies claim the effects of quarantines related to COVID-19 could be of substantial harm to mental health, while others claim that the public has shown substantial mental health resilience despite pandemic-related stress. The objective of this study is to identify psychiatric symptom patterns in University students as they relate to the implementation of COVID-19 quarantines.

Method: The U.S. college-based Stimulant Norms and Prevalence (SNAP) online survey was distributed across seven universities preceding and succeeding university COVID-19 closure announcements (CCAs) to identify mental health profiles from before and after COVID-19. We evaluated these survey data with unsupervised machine learning, through the use of latent profile analysis. Domains considered included self-report measures of depression, anxiety, sleep, anger, marijuana use, marijuana use consequences, binge drinking, alcohol consumption, and alcohol consumption consequences.

Results: We found eight mental health profiles from the pre-CCA data, and the same eight mental health profiles emerged from in post-CCA data. For both sets of profiles, the trends for the profiles mirrored each other, with only small differences in the percentage of the sample that was associated with each profile. Among the eight profiles identified, three profiles consisted of lower severity in psychopathology, three profiles consisted of moderate-level psychopathology, and the remaining two were categorized as higher-severity psychopathology. Alcohol and marijuana consumption varied across these profiles.

Conclusion: The data preceding and succeeding the COVID-19 pandemic was remarkably stable, with the same eight profiles emerging pre- and post-CCA, and the proportion of participants in each profile differed by less than 5% when comparing pre- and post-CCA profiles. Results from this study can contribute to the development of efficient quarantine treatment plans aimed to treat mental health and substance abuse.

Introduction

The COVID-19 pandemic is responsible for approximately 513 million cases and six million deaths (Worldometers, 2022). The social distancing protocols and quarantine restrictions initiated some of the most strict widespread isolation that the world has seen in generations. The prohibition of large gatherings and public building shutdowns (such as schools, workplaces and restaurants) initiated a substantial increase in unemployment as well as a lack of daily structure for millions. Thirty-nine percent of Americans lost their jobs to COVID-19 by May of 2020. The surplus of free time led many to seek comfort in a variety of new-found hobbies or, for some, drugs and alcohol.

According to the 2019 National Survey on Drug Use and Health (NSDUH), 47.1% of adults ages 18–22 drank alcohol within the past 30 days. 7% of these reported heavy drinking and 8.1% met the criteria for an alcohol use disorder (Substance Abuse and Mental Health Services Administration, 2019). Alcohol misuse is defined as drinking in a demeanor, situation, frequency, or amount that has the potential to harm yourself or someone around you. The National Institute on Alcohol Abuse and Alcoholism defined binge drinking as a pattern of drinking that leads to BAC levels of 0.08 or higher at least once a month. The average amount of drinks required to meet this level is four for women or five for men in the span of two hours (Substance Abuse and Mental Health Services Administration, 2020).

Alongside alcohol, marijuana is the most used intoxicating substance with approximately 18% of Americans having at least one experience in the year of 2019. Marijuana use has been linked to disorientation and unpleasant thoughts and feelings in frequent high doses (Substance Abuse and Mental Health Services Administration, 2020).

From March 2019 to March 2020, there was an increase in 2,464 deaths due to overdose as opposed to the previous year (Avena, 2021). Beyond this basic foundation, current marijuana research in relation to COVID-19 is sparse. Our desire to include this domain stems from how broadly the drug is used across the public. With a lack of structure and increase in freedom for so many U.S. citizens, the possibility of substance use can increase drastically. Especially for a drug like marijuana, which is already so well-known and used frequently across the states.

The data from the Substance Abuse and Mental Health Services Administration (SAMHSA), Centers for Disease and Control Prevention (CDC) and the U.S. Department of Justice indicated that in 2020, 21% of United States Adults experienced a mental illness. Of the diagnosed mental illnesses, 19.1% were anxiety disorders, 8.4% were major depressive episodes and 3.6% were posttraumatic stress disorders. 1 in 5 adults reported that the pandemic had a significant negative impact on their mental health (National Alliance on Mental Illness, 2020). A study between April and May of 2020 indicated a relationship between COVID-19 induced worries and substance use as a coping mechanism (Rogers, et al., 2020). In the year 2020, 15% of individuals who drank alcohol reported an increase in their drinking and 10% of drug users reported an increase in drug use. Additionally, 6.7% of U.S. adults reported experiencing a substance use disorder and a mental illness, this constituted approximately 17 million people (National Alliance on Mental Illness, 2020). The aggregation of these studies indicates a difference in substance reliance preceding and succeeding the COVID-19 pandemic as well as a direct correlation between substance use and a negative impact on mental health.

Pandemic research produced conflicting studies and conflicting media headlines which developed a great amount of confusion for the public as well as uncertainty regarding the support that the public may or may not need in this time of great change. In a study of 1,079 subjects with substance use disorders, 74% of the self-reported responses noted a change in their emotions since the pandemic had begun (Avena, 2021). One study found that self-rated anxiety levels in adults in Southern China with a direct experience with the pandemic were overall higher (by a minimum of 4%) than individuals who had not experienced themselves or a loved one enduring COVID-19 or quarantine (Hossain, et al., 2020). In a different study, Tang assessed nearly 2500 quarantined students through the use of the PTSD Checklist Civilian and PHQ-p. His findings concluded that the PTSD prevalence was 2.7% while depression was 9.0% (Hossain, et al., 2020). Rajkumar states that "preliminary evidence suggests that symptoms of anxiety and depression (16–28%) and self-reported stress (8%) are common psychological reactions to the COVID-19 pandemic, and may be associated with disturbed sleep" (Rajkumar, 2020). Common psychological effects associated with a pandemic include anxiety, depression, maladaptive behaviors, emotional distress, anger, insomnia, boredom and a phenomenon described as "headline stress disorder" which is a large amount of stress induced from an overexposure to the media panic (Talevi, et al., 2020). These results imply that the proximity of an individual to the effects of COVID-19 is significant and that the stress of the overall change in daily life could have an impact on the mental state of civilians. These findings contributed to our hypothesis that the change in lifestyle initiated by quarantine and social distancing had the potential to seed a change in mental health.

In contrast other studies and articles shared findings that were representative of great resiliency in the public. One example claiming women reported positive changes in their workout routines and overall little to no change in their mental health (Faulkner, et al., 2021). News outlets like the Atlantic producing headlines implying that the panic of mental health suffering from COVID-19 were greatly exaggerated. That university students are not demonstrating an increase in mental health issues like other studies claim. Outdoor recreation such as family walks are on the rise demonstrating incredible self-reliance (Mills, 2020).

These varying narratives have created confusion regarding the impact of COVID-19 quarantines on mental health and substance use. The variety of different findings among news outlets and sources leave many questions regarding the state of the public as a whole as well as its needs for support. One particular problem that can emerge from these conflicting results is that they "cancel out" - some studies may show an increase in symptomatology, while others may show no change, and traditional research approaches would aggregate both of these findings into a single diluted result. To address this problem, unsupervised machine learning is well suited. Unsupervised machine learning is well suited. Unsupervised machine learning focuses on identifying subgroups within data - in this case, it can identify specific groups that show lower functioning after COVID-19 quarantines and separate them from those groups that did not have a change in functioning. It may be that both conflicting narratives are true, but for different subgroups - some have had a worsening of functioning, while others have stayed the same, and unsupervised machine learning can help identify specific attributes associated

with each profile. This can inform personalized intervention strategies, where we can seek to identify specific needs of individuals beyond single aggregate group averages.

Method

The U.S. college-based Stimulant Norms and Prevalence (SNAP) online survey began to circulate from September 2019 to May of 2020. The questionnaire was distributed to 2,951 university students across seven campuses spanning six different states (Colorado, New Mexico, New York, Texas, Virginia, and Wyoming) before university COVID-19 closure announcements (CCAs). University CCAs can be placed anywhere between March 11th to March 19th. Responses were recorded again in a separate set of data beginning 30 days after CCAs to record the substance use habits and mental health symptoms for subjects in the midst of the COVID-19 pandemic (N = 865). The 30 day break is to account for some of the domains we chose to assess (i.e. the domain considering the frequency of alcohol consumption following the CCAs was measured to assess drinking in the past 30 days). This ensured there was no cross contamination of responses that span across the defined time separating 'before' and 'after CCAs. The online survey consists of assessments developed by the DSM-5 Level 1 Cross-Cutting Symptom measure questionnaire, Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ) and Brief Marijuana Consequences Questionnaire (B-MACQ) aggregated to record substance use habits and scores of mental health symptoms. The University of Wyoming institutional review board supervised the ethics review for all study sites.

Measures

Measured demographics include sex at birth, race, age, socioeconomic status (SES) as a child, school year classification and current grade point average. Alcohol measures consist of lifetime alcohol use and any use in the past 30 days among those who responded positively to lifetime use. A modified version of the Daily Drinking Questionnaire was used to measure the quantity and days alcohol consumption occurred over the previous 30 days (DDQ; Collins et al., 1985). Binge drinking was measured over the previous 30 days. Binge alcohol use is defined as four or five alcoholic drinks within the span of 2 hours. The Marijuana Use Grid was used to report the frequency of 30-day cannabis use for those who reported lifetime marijuana use.

In order to measure consequences of 30-day alcohol use the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ) was used to analyze 24 dichotomous (yes or no) consequences. Similarly, marijuana consequences were measured via Brief Marijuana Consequences Questionnaire (B-MACQ), used to evaluate 21dichotomous (yes or no) consequences.

Psychiatric symptoms were measured according to the DSM-5 Level 1 Cross-Cutting Symptom measure. This is a 23-item questionnaire used to evaluate the mental health of an individual regarding the past 14 days (American Psychiatric Association, 2013). Responses are measured on a five-point Likert scale starting at zero ("none") and extending to four ("severe"). Measured domains include depressive symptoms (anhedonia and low mood), anxiety symptoms (nervousness, worry, panic, and avoidance of anxiety stimulating situations), sleep quality (single-item), and anger (single-item). Previous research suggests that the DSM-5 Cross-Cutting Symptom

Measure, B-MACQ, and B-YAACQ are sufficient and reliable to evaluate our chosen domains (Bravo et al., 2018).

Responses completed prior to university closure announcements are included in our pre-COVID-19 data while those who completed the online survey after the CCA are included in the post-COVID-19 data. This distinction gives us two separate sample sets.

Participants

Participants were recruited from seven universities spanning six states. The mean age was 19.24 (SD = 3.56) with a grand total of 3,816 participants. The pre-COVID-19 sample consists of 77.4% of the participants while post-COVID-19 carries 22.6%. The pre-COVID-19 sample was 27.5% male at birth and 72.5% female at birth with a mean age of 19.83 (SD = 3.55). Fifty-point five percent of the pre-sample is white, 6.8% was Asian, 0.6% was American Indian or Alaska Native, 11.5% was Black or African American, 6.5% was Hispanic or Latinx, 0.03% was Native Hawaiian or Pacific Islander, and 24% was multiple races or a race not listed. The post-COVID-19 sample was 37.5% male at birth and 62.5% female at birth with a mean age of 20.11 (SD = 3.59). Forty-four-point five percent of the pre-sample is white, 7.7% was Asian, 0.3% was American Indian or Alaska Native, 15.9% was Black or African American, 6.2% was Hispanic or Latinx, 0.2% was Native Hawaiian or Pacific Islander, and 24.9% was multiple races or a race not listed. Any survey responses completed before CCAs are designated to the pre-pandemic sample. All responses completed thirty days following CCAs are included in post-pandemic data. Any survey responses completed before CCAs are designated to the pre-pandemic sample. All responses completed thirty days following CCAs are included in post-pandemic data.

Analytic Plan

For the scope of this research, the domains considered include anxiety symptoms, depression symptoms, sleep, anger, marijuana consumptions, consequences of marijuana consumption, alcohol consumption, consequences of alcohol consumption and binge drinking. To identify adequate profiles meant to represent the demographic, we used latent profile analysis (LCA). This analysis determines if participants can be assigned into a discrete number of profiles based on our forementioned domains. To determine the correct number of profiles, we evaluated the data on an iterative process, starting at one profile and continuing to analyze the data at each value all the way up to 12 profiles. The best final model of profiles was determined by the Bayesian information criterion (BIC). Additionally, the qualitative interpretability of profile structures was considered.

Results

After evaluating BIC values and Lo-Mendell Ruben test values, it was determined that an eight-profile model would be most accurate and representative for both pre- and post-CCA data sets. This was a remarkably stable find, where all of the profiles remained the same and no profile showed more than a 5% difference in the number of participants who were classified in each respective profile.

Approximately 40% of the pre-COVID sample reported low (good) mental health with low marijuana use. 36% reported a moderate level of mental health impairment. 11% reported a high (bad) mental health status. Of the entire sample, 61% reported drinking a moderate amount of alcohol and 27% recorded a high marijuana use. Profile 1 consisted of 20% of the sample which reported low mental health, low marijuana use and low alcohol. Profile 2 and 3 are consistent with low mental health issues, moderate

drinking and associated consequences and differ with marijuana use/consequences with profile 2 having low marijuana use and profile 3 reporting high use. Profile 4, 5 and 6 all report a moderate amount of mental health issues with differing substance use reports. Profile 4 reported no alcohol and marijuana consumption. Profile 5 reported a low marijuana use and moderate alcohol use and associated consequences. Profile 6 can be described as moderate mental health, moderate alcohol consumption/consequences and high marijuana use/consequences. The last profile left to be described is profile 7, which consists of reports of high mental health issues and low alcohol and marijuana reports. Profile 8 which makes up 5% reporting moderate to high levels of mental health issues, marijuana and alcohol use/adverse consequences.

Approximately 36% of the post COVID-19 sample reported low (good) mental health. 40% reported a moderate level of mental health impairment. 11% reported a high (bad) mental health status. Of the entire sample, 63% reported drinking a moderate amount of alcohol and 31% recorded a high marijuana use. Profile 1 which makes up 18% of the overall sample recorded low mental health, low marijuana use/consequences and low alcohol consumption/consequences. Profile 2 and 3 reported low mental health issues and moderate alcohol use/consequences with differing marijuana levels. Profile 2 reported low marijuana use/consequences whereas profile 3 scored high in this area. Profiles 4, 5 and 6 reported moderate mental health issues. Profile 4 reported low on both substance uses/consequences. Profile 5 and 6 had moderate alcohol reports with profile 5 reporting low scores for marijuana and profile 6 reporting high scores. Profile 7 can be described as high scores for mental health issues with low alcohol and marijuana scores.

Profile 8 that reported high numbers on mental health issues, a moderate amount of drinking and associated consequences and high marijuna consumption and consequences.

Defining Profiles

The first three profiles can be categorized as 'low mental health' profiles with varying substance use habits. Our first profile deemed 'mentally healthy' consists of students with low mental health issues and low substance use. The second profile can be described as 'mentally healthy with alcohol consumption', these students demonstrate low mental health issues with moderate drinking habits. Profile 3 is termed as "mentally healthy with substance use habits" categorizes individuals with low mental health issues and moderate drinking and marijuana habits. The next three profiles; profile 4 (moderate mental health), profile 5 (moderate mental health with alcohol consumption), and profile 6 (moderate mental health with substance use) fall into the category of 'moderate health issues with varying substance use habits. The profiles differ in the way that profile 4 demonstrates no substance use while profiles 5 and 6 vary in their substance consumption. Our last two profiles make up the population with high scores on mental health issues. Profile 7 is termed as 'high mental health issues' and profile 8 is referred to as 'high mental health issues with substance use'.
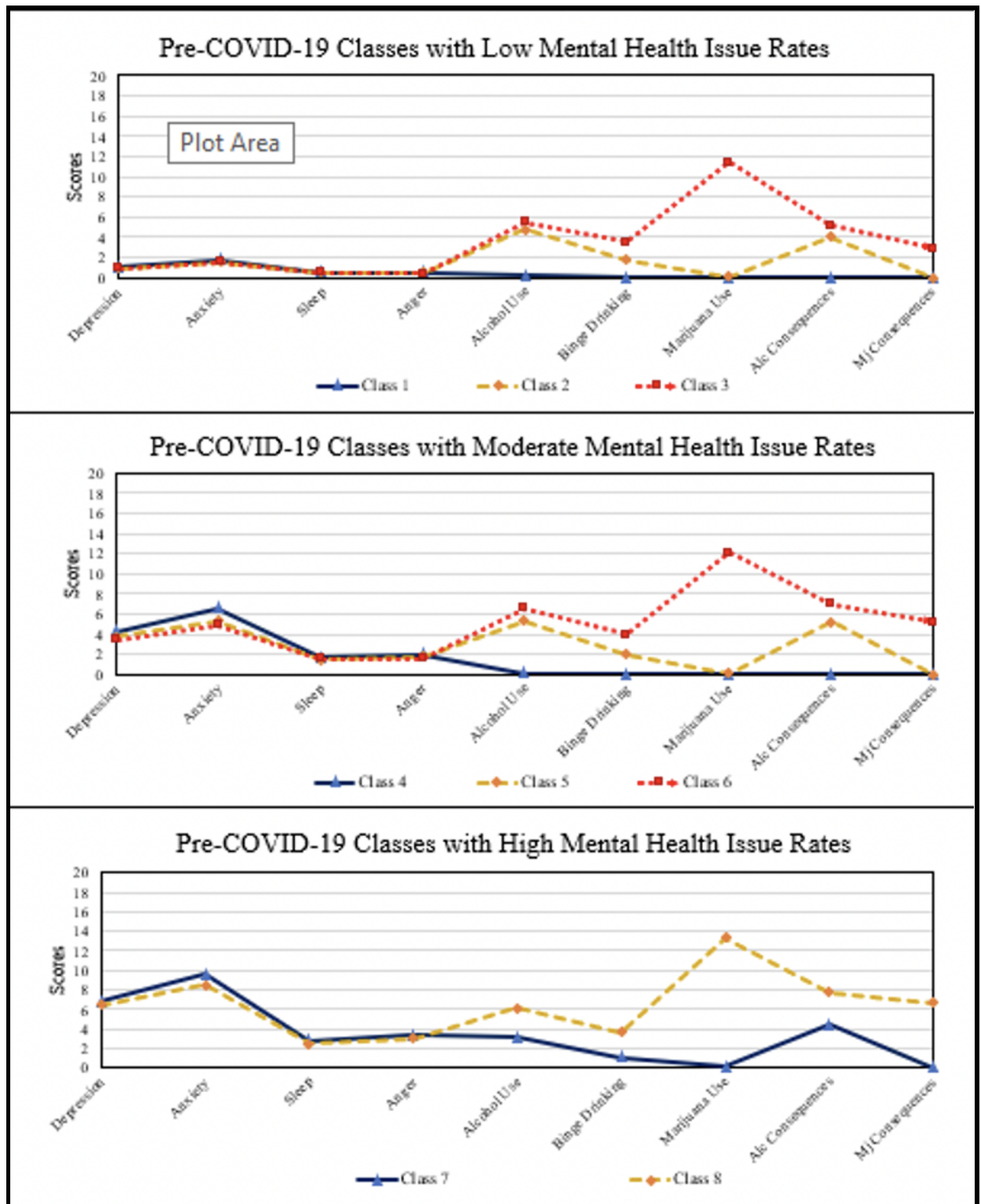
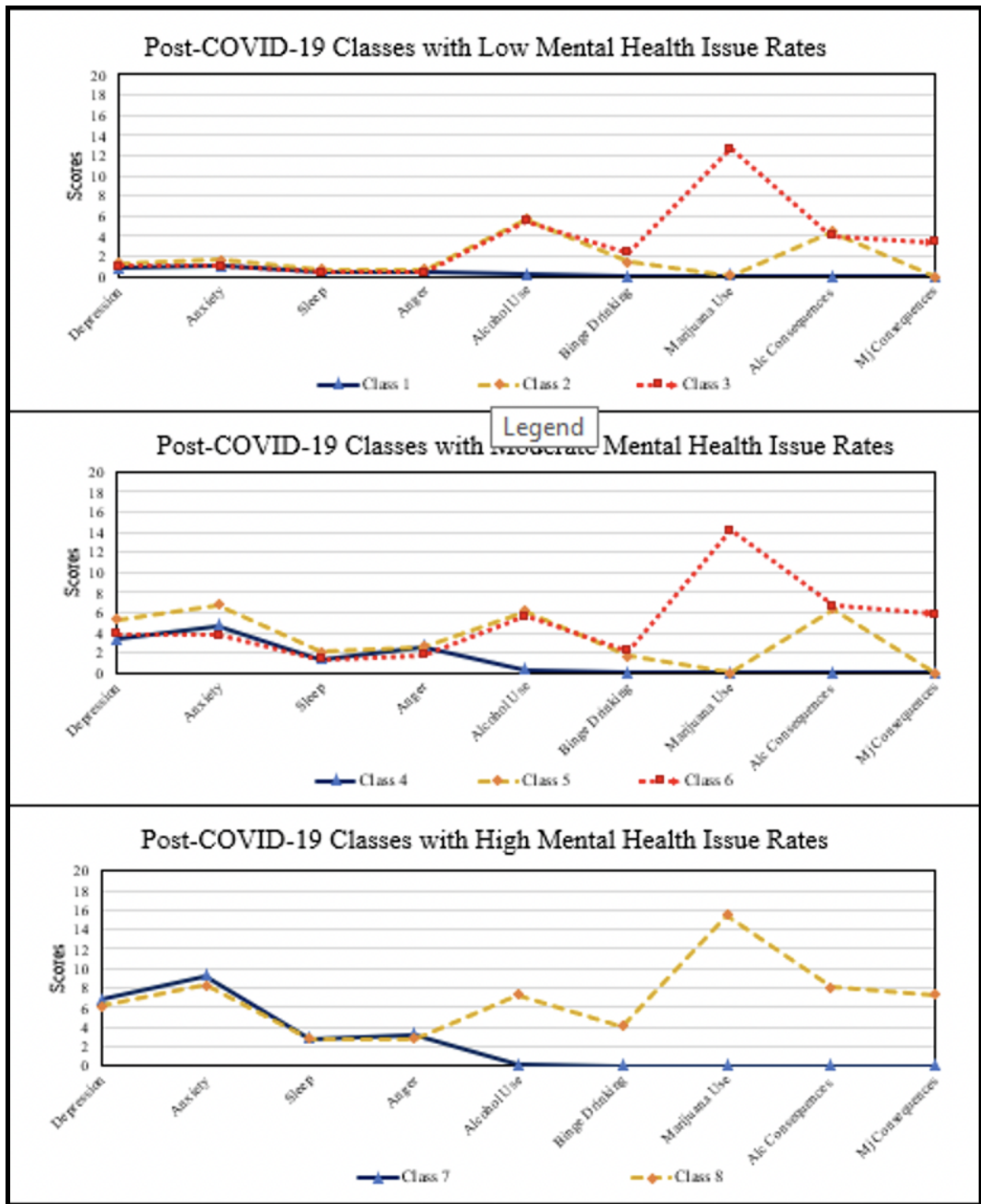*Figure 1. Pre-COVID-19 Latent Profile Analysis Model*

Figure 2. Post-COVID-19 Latent Profile Analysis Model

Discussion

Latent profile analysis produced eight profiles each for the pre- and post-COVID-19 data. Of the eight profiles, three are composed of participants described as having low scores for mental health issues. Among these three profiles, substance use can be broken into the categories falling into each profile. One profile is sober, one participates in alcohol consumption, and one uses alcohol and marijuana. In the next three profiles, the mental health issues are moderate with substance use dividing the profiles into three: one being sober, one participating in alcohol and on participating in alcohol and marijuana. The last two profiles demonstrate high scores for mental health issues. Profile 7 is the only profile that differs between pre- and post- in their substance use. Pre-COVID-19 profile 7 participates in alcohol consumption while post-COVID-19 profile 7 is sober. Lastly, profile 8 partakes in alcohol and marijuana. Overall profile characteristics remained the same between data sets with only the minor variation in profile 7 as well as a small amount of change in the size of the population that makes up each profile.

Some notable differences and consistencies between the pre and post data include the difference in the sample size. Due to the difference in time duration responses were being collected for this data, there is a significantly smaller sample size for post COVID-19 responses. Overall, there was a 4% decrease in the 'good' mental health reports which is characterized by low scores in the mental health domains from the survey. Moderate mental health issues increased from 36% to 40%. These values are consistent with similar studies declaring between 30% to 40% of their samples reported the presence of anxiety or depression post COVID-19 (Wu, et al., 2021). The 'high' scoring reports for mental health issues remain to be 11% of the sample with 5% of this

constituting the high mental health issues with substance use profile. Approximately 5% of individuals develop PTSD post a traumatic event, this could represent the 5% constituting profile 8. Overall, the sample demonstrated resilience and capability to adapt to change well.

High marijuana use and consequences increased by 4% from pre data to post. Despite this being a low quantity, this still accounts for up to 153 individuals within our data. Beyond this measure of how many days each subject partook, we do not have any domains to account for the daily frequency or amount of marijuana consumed. This limits our knowledge regarding differences in substance habits of subjects that consistently used marijuana before the pandemic.

Individuals who reported little to no use of both alcohol and marijuana decreased by 3%. Alcohol on average is consistently reported to be moderate across all mental health categories. Additionally, the lack of structure for many college students could create an imbalanced atmosphere. The high alcohol consumption average may hint at a lack in healthy drinking knowledge and an ongoing need for public intervention as well as healthy coping mechanisms to assist.

This data can be broken into two components: COVID-19 impact data and general college mental health and substance use data. This data can be used to track the habits of this demographic and develop more efficient resources for individuals processing circumstances that induce stress and isolation.

Despite these discrete changes, broad patterns show that 'good' mental health still makes up a majority of both data sets. It also should be noted that one profile in each mental health category (low, moderate, and high) documented heavy marijuana use in pre

and post data. This could indicate marijuana use that takes place regardless of mental health status. The small shift from low to moderate mental health issues is concurrent with an increase in alcohol consumption, this indicates a direct relationship supported by information presented by NAMI and SAMHSA. We see the most prominent changes in those with moderate mental health and moderate substance use. Profiles 5, 6 and 8 seem to be struggling the most, this accounts for approximately ⅓ of the sample and is reflective for a large portion of the population. In both data sets an extreme profile is found on both sides of the spectrum with low reports of substances and mental health struggles or high reports in both.

Due to the data being completed at different times, we did not collect data from the same sample limiting our knowledge on the changes of specific individuals. We can only infer the impact that COVID-19 had on our demographic. Additionally, it must be considered that responses could be biased due to the self-reporting nature of the data collection. However, in research regarding the degree of biases that can result with self-reports, 80% of studies reported the presence of a biased nature of self-reports as compared to objective measures but 87% of these biased results were determined to be overestimations of what was declared objective (Adams, et al., 1999). For this reason, we can infer that the reality of our sample's mental health and substance use can be no higher than the results of our analysis. Additionally, we have no reason to believe that one group would inaccurately report any more than the other, considering this, inaccuracies may cancel each other out between data sets. Regarding marijuana data, quantity smoked was not measured so there is not comparable marijuana data that mirrors the binge drinking data.

This data is relevant for universities attempting to create student support programs. According to Macaskill, it is safe to assume that the data we collect from university students regarding their mental health pre- and post- COVID-19 quarantine should give an accurate depiction of the state of the samples surrounding population (Macaskill, 2013). Beyond the scope of the project, the mental profiles created are reflective of the university student demographic coping with a large change. To address all students, universities could develop a set of broad, yet unique, treatment protocols to help a range of individuals who vary in their mental health and coping mechanisms. Additionally, this can be used as a model to predict common patterns in a population set to experience a stressful event. Overall, these findings are relevant both with regard to the impact of large-scale stressors on mental health and substance abuse, as well as for designing treatment programs to match the needs of University students.

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