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## Divergent Changes: Abstinence and Higher-frequency Substance Use Increase among Racial/Ethnic Minority Young Adults during the COVID-19 Global Pandemic

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### Abstract

**Background:** Identifying factors influencing substance use among racial/ethnic minorities (REM) is important given the disproportionate impact of the COVID-19 pandemic on this population.

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Supplemental Material:

Supplemental Table 1: Table of Outcome Measures

Supplemental Table 2: Table of Predictor Measures

Supplemental Figure 1: Correlations

Declaration of Interest

The authors report no conflicts of interest.

**Objectives:** We examined factors in four domains and hypothesized that poor mental health, negative coping behaviors, negative environmental aspects, and belonging to more vulnerable social groups would be associated with increased substance use during the pandemic.

**Methods:** Multiple regression was applied to longitudinal data from a college sample assessed prior (fall 2017 to spring 2019) and during (spring 2020) the pandemic ( $n=323$ ; 81.5% cisgender women; 34.5% African-American, 36.1% Asian-American, 15.5% Hispanic/Latinx, 11.8% multi-racial) to identify factors predicting current alcohol, cannabis, and nicotine use frequency (spring 2020) and change in frequency of use between springs 2019 and 2020.

**Results:** While infrequent substance use (monthly or less) decreased during the pandemic, abstinence rates increased (alcohol 39%; cannabis 18%; nicotine 18%) and higher-frequency alcohol use increased (207%-1600% 2–3 times+/-week) compared to spring 2019. The strongest protective factor was change in living situation during the pandemic, associated with lower current alcohol and cannabis use. Risk factors included a history of trouble with police and impulsivity since the pandemic, both associated with higher current and increased alcohol and cannabis use. REM did not differ on most factors and the outcomes. However, a higher percentage of Asian-Americans than other REM reported living situation changes.

**Conclusion:** Substance use rates diverged during the pandemic, with both increased abstinence and higher-frequency use, attributed mostly to mental health and environmental domain factors with few REM differences.

## Keywords

Alcohol; Cannabis; Nicotine; Substance Use; Pandemic; COVID-19; Racial/Ethnic Minorities

## Introduction

The early months of the COVID-19 pandemic were a stressful time for racial/ethnic minority (REM) young adults, who simultaneously experienced many stressors including learning disruption and job loss (1,2). Additionally, the greater visibility of systematic racism augmented other stressors on top of this global crisis. Concerns were raised about expected mental health problems, such as higher levels of anxiety, depression, and substance use, due in part to social distancing measures taken to limit the spread of the pandemic, which can lead to isolation (3). However, the findings on substance use during COVID-19 are mixed. Studies have found higher alcohol use among college students and individuals experiencing psychological distress (4,5), associations between social isolation and increased cannabis use (6), and increased alcohol and cannabis consumptions during the pandemic (7). Studies also show young adults decreased their level of substance use (8,9), particularly males, those who drank less outside their home compared to a year earlier (e.g., in bars) (10), and college students with more social support (5). Richter (11) notes that these decreases in substance use are not entirely unexpected as stay-at-home orders have meant more time with family and less with peers.

Young adulthood is a critical developmental period that is associated with environmental changes (e.g., decreased parental monitoring, starting college, new peer groups) that pose risks for substance use behaviors (12). Substance use is more common during adolescence

and young adulthood compared to other age groups (13). Furthermore, substance use varies by race/ethnicity. While White individuals report higher use of most substances, followed by Hispanics/Latinxs as compared to other REM groups (14), these differences are narrowing over time and in some cases are reversing (12,13,15). The negative effects of substance use (e.g., poor mental and physical health, poor academic performance) are abundant among young adults (14,16), and studies show that 69–75% of substance-using college students have experienced some of these consequences (16–18).

Given the impact of the pandemic on college students, and the disproportionate effect of the pandemic on REM, further examination of this group is needed. This study utilized the U.S. National Institute of Minority Health and Health Disparities (NIMHD) research framework (19) to examine factors that may influence substance use with data gathered from a longitudinal study of college students (20). We adapted the NIMHD framework's biological domain to include mental health factors, as being underlying vulnerabilities for negative substance use outcomes in the wake of new stressful experiences, which resulted in four domains of influence: mental health, behavioral (i.e., health behaviors, coping mechanisms), environmental (i.e., living situation, supportive relationships, trauma exposure), and sociocultural (i.e., social identities, discrimination). We hypothesized that positive coping behaviors and positive relationships/experiences would be protective and associated with decreased substance use. We further expected that poor mental health, prior trauma, experiencing disruptions in supportive relationships, discrimination experiences, and belonging to more vulnerable social groups would be risk factors and associated with increased substance use. Additionally, because exposure to stressors and assets for promoting health are unequally distributed across race/ethnicity (21,22), we contextualized our understanding of these relationships with substance use by identifying which groups are experiencing greater or lesser exposure to risk and protective factors.

## Methods

### Data Source and Study Sample

Data from this study was collected as part of Spit for Science (20), a large, ongoing longitudinal study on college behavioral health at a mid-Atlantic public university. Details of this IRB-approved study were previously reported, see Dick (20). In short, a cohort of incoming freshmen were recruited at the beginning of fall semester of 2017 and completed a self-report online assessment via Research Electronic Data Capture (REDCap) (23). Students were invited to participate in a follow-up online survey each subsequent spring semester. A COVID-19 specific assessment was conducted between May and July of 2020. Since this study focused on REM, individuals who self-identified as White ( $n=357$ ) were excluded. We were not able to include individuals of American Indian/Native Alaskan ( $n=1$ ) or Native Hawaiian/other Pacific Islander ( $n=9$ ) race/ethnicity due to their small size. The current study included baseline and three follow-up assessments from individuals that self-identified as Black, Asian, Hispanic/Latinx, and more than one race, and did not have missing data on substance use frequency at spring 2019 and 2020 assessments ( $n=323$ ).

## Study Measures

For full details of study measures, see Supplemental Tables 1 and 2.

**Outcome variables**—Three substance use outcomes (i.e., alcohol, cannabis, nicotine) were tested independently. The first was current use frequency from the spring 2020 COVID-19 survey where higher scores corresponded to higher substance use frequency (Table 1). Next, to examine changes in use from before and during the pandemic, two additional binary outcome variables were constructed to identify those with (1) *increased* frequency and (2) *decreased* frequency of use compared to the previous year. These variables were created by subtracting spring 2020 COVID-19 frequency of use from the prior year's frequency (Table 2). A positive score was classified as *increased* frequency of use, a negative score was classified as *decreased* frequency of use, and a score of 0 was classified as no change compared to the previous year.

**Alcohol Use Frequency:** Alcohol Use Frequency during the past year and since the onset of the COVID-19 crisis was assessed using the item “How often do you have a drink containing alcohol?” from the Alcohol Use Disorder Identification Test (24). Response options ranged from “never” to “4 or more times a week.”

**Cannabis Use Frequency:** Cannabis Use Frequency during the past year and since the onset of the COVID-19 crisis was assessed using the item “How often do you use cannabis?” from the Cannabis Use Disorder Identification Test-Revised (25). Response options ranged from “never” to “4 or more times a week.”

**Nicotine Use Frequency:** Nicotine Use Frequency during the past month was assessed using the item “How frequently did you use a tobacco product (cigarettes, e-cigarettes, smokeless tobacco, hookah) in the last 30 days?” adapted from SAMHSA (26). Response options ranged from “I did not use” to “daily or almost daily.”

**Independent variables**—Independent variables are conceptually organized around four of the NIMHD's research framework domains (19). All measures were assessed in the COVID-19 survey of spring 2020 except impulsivity pre-COVID-19 and lifetime probable PTSD (mental health), interpersonal trauma (environmental), and demographics (sociocultural). Individuals who responded with “I choose not to answer” were coded as missing values. For continuous variables, such as anxiety, support disruption, or discrimination, higher scores corresponded to higher levels of the construct.

## Mental Health Domain

**Anxiety and Depression.**—Four items each assessed past 30-day anxiety and depression symptoms from the Symptom Checklist 90 (SCL-90; (27)) using the prompt “During the past month, how often did you feel the following ways:” with questions such as “worried” (anxiety) or “happy” (depression). Response options ranged from “never” to “everyday,” were coded from 0 to 5, respectively, and items were reverse coded as necessary. A sum score was created for both anxiety and depression.

**Impulsivity Pre-COVID-19 & Impulsivity since COVID-19.**—Impulsivity pre-COVID-19 was assessed in fall 2017 using an abbreviated 15-item version of the original Urgency Premeditation Perseverance-Sensation Seeking-Positive Urgency (UPPS-P) scale (28). Impulsivity since COVID-19 was assessed using the item, “In the time since the coronavirus began spreading, to what extent have you acted more impulsively?”. Response options ranged from “not at all” to “extremely.” The UPPS-P assesses impulsivity as a relatively stable personality trait, whereas the single-item measure of impulsivity since COVID-19 indexes impulsivity at a particular moment in time and is thereby more dynamic in nature.

**Posttraumatic Stress Disorder (PTSD).**—Current PTSD symptoms were assessed using the PTSD Checklist for DSM-5 (PCL-5; (29)) based on participants’ experience with “the COVID-19 crisis.” Lifetime Probable PTSD was assessed using the PCL-5 from fall 2017 through spring 2019 timepoints based on their worst traumatic event.

**Behavioral Domain**—All items in the behavioral domain were adapted from the Coronavirus Health Impact Survey (CRISIS) (30).

**Change in Exercise Since COVID-19 Crisis:** Change in Exercise Since COVID-19 Crisis was assessed using the item “Since the onset of the COVID-19 crisis, is this more or less than before the coronavirus onset?” Response options were “more,” “less,” or “about the same.”

**Change in Outdoors Time Since COVID-19 Crisis:** Change in Outdoors Time Since COVID-19 Crisis was assessed using the item “Since the onset of the COVID-19 crisis, is this more or less than before the coronavirus onset?” Response options were “more,” “less,” or “about the same.”

**Sleep Duration:** Sleep Duration was assessed using the item “Since the onset of the COVID-19 crisis, how many hours per night do you sleep on average?” Response options ranged from “< 5” to “10+ hours.”

**Sleep Satisfaction:** Sleep Satisfaction was assessed using the item “Since the onset of the COVID-19 crisis, how satisfied or dissatisfied have you been with your sleep patterns?” Response options ranged from “very dissatisfied” to “very satisfied.”

**Environmental Domain**—All items in the environmental domain were adapted from the CRISIS (30).

**Change in Living Situation:** Change in Living Situation was assessed using the item “Since the campus closed, did you change your living situation?” Response options were “yes” or “no.”

**Positive Changes due to COVID-19:** Positive Changes due to COVID-19 were assessed using the item “Has the COVID-19 crisis led to any positive changes in your life (e.g.,

more quality time with family, friends, or partner/spouse, more time for enjoyable activities, etc.)?” Response options were “none,” “only a few,” or “some.”

**Support Disruption:** Support Disruption was assessed using the item “Which of the following supports were in place for you before the COVID-19 crisis and have been disrupted?” Participants then checked all that applied out of 19 options such as LGBTQIA+ support, or individual/group counseling. They also reported if they found an alternative that is working well, found an alternative that is not as effective, or have not found an alternative source of support. Total scores ranged from 0–19.

**Stress due to Change in Quality of Family & Friendships Relationships:** Stress due to Change in Quality of Family & Friendships Relationships was assessed using two items: 1) “Has the quality of the relationships between you and members of your family changed?”; and 2) “How stressful have these changes in family contacts been for you?” Response options ranged from “a lot worse” to “a lot better,” and “not at all” to “extremely,” respectively. These items were asked again about relationships with friends.

**Interpersonal Trauma (IPT):** Lifetime IPT was assessed in fall 2017 and IPT experienced since the prior assessment was measured from spring 2018 through spring 2019 using an abbreviated version of the Life Events Checklist (31). Categories of IPT were separated into four dichotomous (yes/no) lifetime variables: physical assault, sexual assault, other unwanted or uncomfortable sexual experiences, and trouble with the police.

### **Sociocultural Domain**

**Sociodemographics:** Data included self-reported race/ethnicity, gender identity, and sexual orientation (Table 3).

**Discrimination:** Discrimination was adapted from the Experiences of Discrimination measure (32). Racial/ethnic, sexual orientation, and gender-based discrimination was assessed using the item “Since the onset of the COVID-19 crisis, have you experienced discrimination or harassment based on your race, ethnicity, gender, or sexual orientation in the following situations?” Total scores ranged from 0–7.

## **Data Analysis**

To test for differences among risk and protective factors based on race/ethnicity, ANOVA and Chi-Square analyses were applied using SPSS version 26. To identify risk and protective factors predicting substance use frequency and changes in use frequency, we applied the multiple regression framework using full information maximum likelihood (FIML) to account for missing data using the lavaan package (33) in R version 4.0.3 (34). For each substance (alcohol, cannabis, nicotine), risk and protective factors were tested for three outcome (endogenous) variables: spring 2020 use frequency (continuous) and increased or decreased use since the previous year (binary) for a total of nine multiple regression models. To facilitate interpretation across predictors and model convergence, the continuous variables were centered and scaled. Since the current implementations in the lavaan software do not support multi-level categorical variables, the race/ethnicity and gender identity

exogenous variables were recoded into n-1 binary variables, where n is the number of levels. For correlations between variables see Supplemental Figure 1.

## Results

### Racial/Ethnic Group Differences among Predictor Variables

There were significant racial/ethnic group differences among sleep satisfaction, change in living situations, unwanted/uncomfortable sexual experience history, and identifying as a sexual minority (Table 3).

### Substance Use Frequencies in Spring 2019 and 2020

The proportion of individuals that reported no alcohol (32.8% vs. 45.5%), cannabis (65.0% vs. 76.8%), or nicotine (80.5% vs. 94.7%) use since the onset of the pandemic increased from spring 2019 to 2020 (Table 1), as well as those reporting alcohol use 2 to 3 times per week (4.3% vs. 13.3%) and 4 or more times per week (0.3% vs. 5.3%). The proportion of individuals that reported alcohol use monthly or less (40.9% vs. 19.5%), cannabis use monthly or less (18.0% vs. 6.5%), and nicotine use once or twice a month (10.2% vs. 1.2%), a few days per month (5.6% vs. 0.6%), and a couple days per week (1.2% vs. 0.0%) decreased from spring 2019 to 2020.

### Mental Health Domain

Being more impulsive since the start of the pandemic was associated with higher current frequencies of alcohol ( $p=.003$ ) and cannabis ( $p=.005$ ) use during the pandemic, as well as using alcohol ( $p=.004$ ) and cannabis ( $p=.033$ ) at a higher frequency compared to the prior assessment before the pandemic (Table 4). Higher current PTSD symptom severity from the experience of the global pandemic was associated with higher current frequencies of cannabis use during the pandemic ( $p=.001$ ), as well as using at a higher frequency compared to the prior assessment before the pandemic ( $p=.007$ ). However, a lifetime probable PTSD diagnosis was negatively associated with using nicotine at a higher frequency compared to the prior assessment before the pandemic ( $p=.013$ ). Higher current anxiety symptom severity was negatively associated with using nicotine at a lower frequency compared to the prior assessment before the pandemic ( $p<.001$ ), but current depression symptom severity was associated with using nicotine at a lower rate ( $p=.042$ ).

### Behavioral Domain

No statistically significant associations were found for exercise and time outside with substance use frequency. However, sleep satisfaction was significantly associated with cannabis use (Table 5), whereby greater sleep satisfaction was associated with lower current frequencies of cannabis use during the pandemic ( $p=.010$ ), and negatively associated with using cannabis at a higher frequency compared to the prior assessment before the pandemic ( $p=.047$ ).

## Environmental Domain

A change in living situation since the start of the COVID-19 pandemic was associated with lower current frequencies of alcohol ( $p=.018$ ) and cannabis ( $p=.001$ ) use during the pandemic (Table 6). A history of trouble with the police was associated with higher current frequencies of alcohol ( $p<.001$ ) and cannabis ( $p<.001$ ) use during the pandemic, as well as using alcohol ( $p=.042$ ) and cannabis ( $p<.001$ ) at a higher frequency compared to the prior assessment before the pandemic. A history of physical assault was associated with using nicotine at a higher frequency compared to the prior assessment before the pandemic ( $p=.001$ ). A history of unwanted/uncomfortable sexual experience was associated with higher frequencies of current alcohol use during the pandemic ( $p=.003$ ), and using at a higher frequency compared to the prior assessment before the pandemic ( $p=.009$ ). Stressful friendships were associated with higher frequencies of current alcohol ( $p=.035$ ) and nicotine ( $p=.043$ ) use during the pandemic, as well as using cannabis at a lower frequency compared to the prior assessment before the pandemic ( $p=.019$ ). Positive changes due to COVID-19 were associated with using cannabis at a lower frequency compared to the prior assessment before the pandemic ( $p=.009$ ). Support disruption during COVID-19 was associated with using cannabis at a higher frequency compared to the prior assessment before the pandemic ( $p=.020$ ).

## Sociocultural Domain

Self-identifying as a sexual minority was associated with using cannabis at a higher frequency compared to the prior assessment before the pandemic ( $p=.044$ ; Table 7). Self-identifying as a cisgender man was associated with higher frequencies of current nicotine use during the pandemic ( $p=.002$ ), using nicotine at a higher frequency compared to the prior assessment before the pandemic ( $p=.015$ ), and using alcohol at a lower frequency compared to the prior assessment before the pandemic ( $p=.005$ ). Experiencing more discrimination was negatively associated with using cannabis at a higher frequency compared to their prior assessment before the pandemic ( $p=.032$ ), and associated with using nicotine at a lower frequency compared to their prior assessment before the pandemic ( $p=.046$ ).

## Discussion

This study used the NIMHD research framework (19) and longitudinal data to investigate risks and protective factors that influence substance use among REM young adults during the pandemic. These results add to a growing literature investigating substance use during the pandemic (3–6,10). Similar to prior research, findings showed both increases and decreases in substance use during the pandemic (8). Results demonstrated that positive experiences were protective and associated with decreased cannabis use, while poor mental health, prior trauma, disruptions in supportive relationships, and belonging to more vulnerable social groups were associated with increased substance use. Similar to Richter (11), results showed that the strongest predictor of decreases in current levels of substance use was from the environmental domain, or change in living situation, which likely meant more time with family and less with peers, reducing access to substances. Our results



showed that a higher percentage of Asian-American individuals reported a change in living situation during the pandemic compared to other REM groups.

In the mental health domain, increases in impulsivity since the start of the pandemic was associated with increases in alcohol and cannabis use, while greater PTSD symptom severity related to the pandemic was positively associated with current levels of and an increase in cannabis use. Likewise, individuals with greater current anxiety symptoms were less likely to report a decrease in nicotine use. The self-medication literature supports the relationship between mental health symptoms (i.e., PTSD, anxiety) and substance use (35). However, individuals who met criteria for lifetime probable PTSD were less likely to report an increase in nicotine use. These contrasting results could be due to measurement differences as individuals who reported their PTSD symptoms during the pre-pandemic assessments were reporting on various stressful experiences, whereas the assessment during the pandemic asked individuals to report on PTSD symptoms in response to the COVID-19 crisis. Trait impulsivity is a known antecedent risk factor for the onset and maintenance of substance use (36). However, results show that recent, state- and context-dependent changes in impulsivity since the onset of the pandemic were more influential on substance use compared to pre-pandemic trait impulsivity. Impulsivity is a commonly manifested behavior during public health emergencies, which has been shown to influence behaviors that lead to negative outcomes, such as food consumption and shopping (37,38). The pandemic restricts possible activities and causes isolation, which may lead to boredom and sensation-seeking (39), and may have influenced alcohol and cannabis use.

In the behavioral domain, sleep satisfaction was negatively associated with current cannabis use frequency, and individuals with greater sleep satisfaction were less likely to report an increase in cannabis use (40). Additionally, Hispanic/Latinx individuals reported greater sleep satisfaction compared to Asian- and African-American individuals in our study. Although cannabis use is associated with the expectation of improved sleep (41), there is limited support that cannabis helps insomnia (42). Increased frequency of cannabis use predicts worse subjective sleep efficiency (42), which provides a possible explanation as to why individuals who reported more sleep satisfaction were less likely to report higher levels of current cannabis use frequency and those with worse sleep satisfaction were more likely to report an increase in cannabis use.

In the environmental domain, a history of trouble with the police was positively associated with current alcohol and cannabis use frequency, and an increase in alcohol and cannabis use. Additionally, a history of unwanted or uncomfortable sexual experiences was positively associated with current use and an increase in alcohol use, with a higher percentage of individuals who identified as more than one race reporting a history of unwanted/uncomfortable sexual experiences. A history of physical assault was also associated with an increase in nicotine use. These findings are consistent with the self-medication literature, which demonstrates that IPT is positively associated with substance use through self-medicating trauma symptoms (43). Support disruption was associated with an increase in cannabis use, which is also consistent with research on cannabis use during the pandemic (6). Bartel (6) found that self-isolating individuals used more cannabis compared to those who did not during the pandemic. The current study demonstrated that the more sources of

support an individual reported losing without finding a replacement, the more likely they were to report an increase in cannabis use. An increase in stress related to friendships was associated with higher frequencies of current alcohol and nicotine use, and a decrease in cannabis use, which is also consistent with previous research demonstrating that limited socialization due to the pandemic has caused social isolation and increased stress on relationships (11). Since individuals may be spending less time with peers, this period of decreased socialization has also likely led to reduced access to illicit substances (i.e., cannabis) and substance-using peers.

In the sociocultural domain, identifying as a cisgender man was shown to be positively associated with current nicotine use frequency and an increase in nicotine use during the pandemic, but also with a decrease in alcohol use compared to cisgender women. Additionally, identifying as a sexual minority was shown to be positively associated with an increase in cannabis use during the pandemic compared to heterosexuals. Belonging to more vulnerable social groups (e.g., sexual orientation) and identifying as a male has been previously associated with increased substance use (44,45). There were no differences by race/ethnicity for substance use, when comparing Blacks to other REM groups. Surprisingly, experiencing more sexual-, gender-, or race/ethnicity-based discrimination was found to be associated with a lower risk for an increase in cannabis use, as well as a decrease in nicotine use. While inconsistent with most previous research demonstrating a positive association between discrimination and substance use (46), some research has shown that the association between discrimination and substance use was associated with decreased odds of smoking, but only among women (47). Negative associations found between discrimination and substance use in our sample could be confounded by our majority cisgender women sample, as well as this sample being more socially isolated than prior studies.

Findings extend previous research on substance use during the pandemic in several ways. First, this study used a longitudinal design, which allowed for a prospective approach to examine substance use measured before and during the pandemic. Previous research utilized a cross-sectional design to examine substance use before and/or during the pandemic (5,10) or a longitudinal design that began during the pandemic and retrospectively asked about prior substance use, which does not allow for an accurate pre-pandemic estimate or inference regarding the direction of effect (8). Second, the current study predicted both current levels of and changes in substance use. Using the same frequency measures assessed pre- and during the pandemic allowed for an objective measure of the change in substance use frequency. To decrease the influence of those who were abstinent pre-pandemic and remained abstinent during the pandemic, separate changes in substance use scores (i.e., increase, decrease) were created as opposed to an overall change score. By differentiating between types of change in substance use, this study was able to evaluate whether mental health, behavioral, environmental, and sociocultural domains influenced divergent changes in substance use.

Several study limitations should be noted. Results may not generalize to all REM populations, but they may generalize to other college-age populations based on comparisons of similar prior U.S. studies (20). Additionally, while our sample was a predominately

Asian-American and cisgender women, it maps onto the parent study's demographics (excluding White individuals), which is representative of the university's highly diverse study body (20). Our adaptation of the NIMHD research framework uses a mental health domain in place of the original biological domain. Mental illnesses have both behavioral and biological components to them, which does not map perfectly onto NIMHD's research framework. Additionally, we only examined individual-level influences within the NIMHD research framework due to the limitations of the dataset. Future research should use a more intersectional approach to classifying those factors while also assessing interpersonal, community, and societal influences that may impact substance use behavior. The substance use measurement was limited given the prioritization of breadth as opposed to depth due to the wide range of behaviors assessed in the current dataset. Frequency of use was measured, and while higher frequency may be indicative of more problematic substance use, future research should collect more information on substance use (i.e., quantity, use-related problems), which could help identify those more likely to experience adverse health outcomes. Lastly, it is unclear the extent to which the findings can be isolated to responses to the pandemic. As mentioned in the introduction, there were significant stressors related to minority status (e.g., greater visibility of systemic racism/Black Lives Matter movement, Asian-American COVID-19-related discrimination) during the study's assessment period. Thus, it is difficult to determine which phenomenon to attribute the findings to even though the study measures were adapted to account for pandemic-related changes.

## Conclusions

This study is among the first longitudinal studies with pre- and during-pandemic assessments to investigate individual-level factors among REM young adults that may influence current levels of and changes in substance use during the pandemic. Utilizing the NIMHD research framework, results demonstrated that there were mental health, behavioral, environmental, and sociocultural influences on current levels and changes in substance use. Study findings demonstrate that changes in college students' living situations were the strongest protective factor and associated with lower current levels of use, which was likely due to more time with family and less time with peers, reducing access to substances. Alternatively, mental health factors were associated with more substance use. These findings further contribute to the understanding of substance use in response to a pandemic among REM young adults and have implications for prevention and intervention efforts within this population.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1.**

Alcohol, Cannabis, and Nicotine Use Frequencies in Spring 2019 (Pre-Pandemic) and Spring 2020 (During Pandemic)

	Spring 2019 <i>n</i> (%) [95% CI] <i>n</i> = 330	Spring 2020 <i>n</i> (%) [95% CI] <i>n</i> = 330
<b>Alcohol Use Frequency</b>		
Never	110 (33.3%) [28.5%, 38.5%]	151 (45.8%) [40.3%, 51.2%]
Monthly or less	135 (40.9%) [35.8%, 46.1%]	66 (20.0%) [15.8%, 24.2%]
2 to 4 times a month	70 (21.2%) [17.0%, 25.5%]	53 (16.1%) [12.1%, 20.0%]
2 to 3 times a week	14 (4.2%) [2.1%, 6.7%]	43 (13.0%) [9.4%, 16.7%]
4 or more times a week	1 (0.3%) [0.0%, 0.9%]	17 (5.2%) [3.0%, 7.6%]
<b>Cannabis Use Frequency</b>		
Never	213 (64.5%) [59.1%, 69.4%]	251 (76.1%) [70.9%, 80.3%]
Monthly or less	61 (18.5%) [14.5%, 23.0%]	24 (7.3%) [4.5%, 10.0%]
2 to 4 times a month	17 (5.2%) [2.7%, 7.6%]	14 (4.2%) [2.1%, 6.7%]
2 to 3 times a week	15 (4.5%) [2.4%, 7.0%]	11 (3.3%) [1.5%, 5.5%]
4 or more times a week	24 (7.3%) [4.5%, 10.3%]	30 (9.1%) [6.4%, 12.4%]
<b>Nicotine Use Frequency</b>		
I did not use	267 (80.9%) [76.4%, 85.2%]	313 (94.8%) [92.4%, 97.0%]
Once or twice	33 (10.0%) [6.7%, 13.3%]	4 (1.2%) [0.3%, 2.4%]
A few days (3 to 4 days a month)	18 (5.5%) [3.0%, 8.2%]	2 (0.6%) [0.0%, 1.5%]
A couple of days a week (5 to 11 days a month)	4 (1.2%) [0.3%, 2.7%]	0 (0.0%) [0.0%, 0.0%]
3 times a week (12 to 14 days a month)	3 (0.9%) [0.0%, 2.1%]	3 (0.9%) [0.0%, 2.1%]
Most days of the week (15 to 25 days a month)	2 (0.6%) [0.0%, 1.5%]	8 (2.4%) [0.9%, 4.2%]
Daily or almost daily (26 to 30 days a month)	3 (0.9%) [0.0%, 2.1%]	0 (0.0%) [0.0%, 0.0%]

**Table 2.**

Increased and Decreased Frequency of Alcohol, Cannabis, and Nicotine Use From Spring 2019 (Pre-Pandemic) to Spring 2020 (During Pandemic)

	Increased Frequency of Use <i>n</i> (%) [95% CI]	Decreased Frequency of Use <i>n</i> (%) [95% CI]
Alcohol		
Yes	94 (29.1%) [24.2%, 33.8%]	81 (25.1%) [20.3%, 29.9%]
No	229 (70.9%) [66.2%, 75.8%]	242 (74.9%) [70.1%, 79.7%]
Cannabis		
Yes	34 (10.5%) [6.4%, 13.2%]	65 (20.1%) [15.9%, 24.6%]
No	289 (89.5%) [86.8%, 93.6%]	258 (79.9%) [75.4%, 84.1%]
Nicotine		
Yes	6 (1.9%) [0.7%, 3.5%]	55 (17.0%) [13.3%, 22.0%]
No	317 (98.1%) [95.6%, 100%]	268 (83.0%) [79.1%, 88.8%]

Note: Percentages indicate those students who used more or less frequently when comparing their substance use during the pandemic with their pre-pandemic use.



**Table 3.**

## Sample Demographics and Domains and Model Predictors by Racial/Ethnic Group

<b>Domain / Predictors</b>	<b>Total</b>	<b>Asian</b>	<b>Black</b>	<b>Hispanic/Latinx</b>	<b>More than One Race</b>	<b>p-value</b>
	<b>M (SD) or n (%)</b>	<b>M (SD) or n (%)</b>	<b>M (SD) or n (%)</b>	<b>M (SD) or n (%)</b>	<b>M (SD) or n (%)</b>	
	<b>N = 323</b>	<b>n = 119</b>	<b>n = 114</b>	<b>n = 51</b>	<b>n = 39</b>	
<b><u>Mental Health Domain</u></b>						
Impulsivity (trait-like)	31.33 (5.68)	32.01 (5.23)	30.44 (5.98)	31.32 (5.82)	31.56 (5.82)	.121
Impulsivity since COVID-19	0.58 (0.92)	0.57 (0.92)	0.60 (0.93)	0.51 (0.87)	0.64 (0.97)	.858
Lifetime Probable PTSD Diagnosis	125 (31.3%)	47 (31.8%)	36 (27.5%)	20 (30.8%)	22 (39.3%)	.462
Current PTSD Symptoms (during COVID-19)	18.61 (18.51)	18.28 (18.48)	17.14 (18.83)	20.85 (18.54)	0.41 (17.82)	.408
Current Depression Symptoms (during COVID-19)	5.64 (4.80)	5.51 (4.64)	5.15 (4.75)	6.76 (4.74)	5.82 (5.33)	.088
Current Anxiety Symptoms (during COVID-19)	2.80 (3.88)	2.75 (3.81)	2.33 (3.74)	3.49 (4.17)	3.16 (3.99)	.126
<b><u>Behavioral Domain</u></b>						
Sleep	2.36 (1.19)	2.21 (1.12)	2.38 (1.20)	2.52 (1.29)	2.57 (1.23)	.077
Sleep Satisfaction	2.34 (1.14)	2.24 (1.14)	2.20 (1.11)	2.69 (1.20)	2.53 (1.04)	<b>.002</b> <sup>b</sup>
Exercise	0.76 (0.84)	0.78 (0.85)	0.72 (.80)	0.92 (.89)	0.63 (.83)	.172
Time Outside	0.49 (0.77)	0.46 (0.77)	0.51 (0.76)	0.51 (.79)	0.54 (.78)	.867
<b><u>Environmental Domain</u></b>						
Living Situation	328 (63.7%)	143 (71.1%) <sup>c</sup>	98 (60.1%)	50 (58.1%)	37 (56.9%)	<b>.043</b>
Trouble with Police History	40 (7.7%)	8 (4.0%)	15 (9.1%)	9 (10.5%)	8 (11.8%)	.073
Sexual Assault History	61 (11.7%)	13 (6.4%) <sup>c</sup>	21 (12.8%)	15 (17.4%)	12 (17.6%)	<b>.014</b>
Physical Assault History	113 (21.7%)	36 (17.7%)	40 (24.4%)	19 (22.1%)	18 (26.5%)	.321 <sup>a</sup>
Unwanted/Uncomfortable Sexual Experience History	171 (32.9%)	54 (26.9%)	48 (29.3%)	37 (43.0%)	32 (47.1%) <sup>c</sup>	<b>.002</b>
Support Disruption	1.98 (1.35)	2.04 (1.37)	1.86 (1.25)	2.07 (1.61)	1.97 (1.12)	.730
Friends Stress	0.51 (1.06)	0.49 (1.04)	0.49 (1.01)	0.46 (1.03)	0.66 (1.30)	.676
Family Stress	0.37 (.98)	0.44 (1.05)	0.26 (0.84)	0.38 (0.98)	0.39 (1.04)	.303
Positive Changes due to COVID-19	1.74 (.87)	1.72 (0.85)	1.75 (0.90)	1.74 (.84)	1.76 (.94)	.980
<b><u>Sociocultural Domain</u></b>						
Sexual Minority	57 (12.7%)	16 (9.2%)	13 (9.1%)	13 (18.1%)	15 (24.6%) <sup>c</sup>	<b>.004</b>
Gender identity						.352
Cisgender Woman	402 (77.0%)	150 (73.5%)	132 (80.5%)	70 (81.4%)	50 (73.5%)	
Cisgender Man	99 (19.0%)	44 (21.6%)	27 (16.5%)	15 (17.4%)	13 (19.1%)	
Gender Minority	21 (4.0%)	10 (4.9%)	5 (3.0%)	1 (1.2%)	5 (7.4%)	
Discrimination	0.44 (0.96)	0.45 (0.86)	0.46 (1.02)	0.42 (.96)	0.44 (1.11)	.709

Note: **Bolded** = statistically significant; Chi-square and ANOVA F tests assessed relationships with race/ethnicity for, respectively, categorical and continuous predictors;

<sup>a</sup>The exception was when the assumption of homogeneity of variances was not met and the Welch F was used;

<sup>b</sup>Tukey post-hoc tests evaluated pairwise mean differences [Hispanic/Latinx-Asian  $p = .011$ ; and Hispanic/Latinx-Black  $p = .005$ ]; and

<sup>c</sup>Standardized residuals identified cells where observed and expected counts were different.

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**Table 4.**

Mental Health Domain: Mental Health Variables Predicting Current Substance Use Frequency During the COVID-19 Pandemic and Substance Use Change Since the COVID-19 Pandemic

Predictors	Alcohol Use Frequency <sup>1</sup>		Alcohol Use Increase <sup>2</sup>		Alcohol Use Decrease <sup>2</sup>		Cannabis Use Frequency <sup>1</sup>		Cannabis Use Increase <sup>2</sup>		Cannabis Use Decrease <sup>2</sup>		Nicotine Use Frequency <sup>1</sup>		Nicotine Use Increase <sup>2</sup>		Nicotine Use Decrease <sup>2</sup>			
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE		
Impulsivity (trait-like)	-.03	.07	-.04	.03	.04	.03	.05	.07	-.03	.02	.02	.02	-.02	.05	<.01	.01	<.01	.01	.02	
Impulsivity since COVID-19	<b>.24</b> <sup>**</sup>	<b>.08</b>	<b>.09</b> <sup>**</sup>	.03	-.03	.03	<b>.22</b> <sup>**</sup>	<b>.08</b>	<b>.04</b> <sup>*</sup>	<b>.02</b>	-.04	.03	.03	.06	<.01	.01	<.01	.03	.03	
Lifetime Probable PTSD Diagnosis	.03	.18	-.00	.07	-.05	.07	-.26	.17	-.01	.05	.03	.06	-.17	.13	<b>-.05</b> <sup>*</sup>	<b>.02</b>	<.01	<.01	.06	
Current PTSD Symptoms (during COVID-19)	-.06	.12	-.05	.04	<.01	.04	<b>.36</b> <sup>**</sup>	<b>.11</b>	<b>.08</b> <sup>**</sup>	<b>.03</b>	.02	.04	.08	.09	<.01	.01	<.01	.06	.04	
Current Depression Symptoms (during COVID-19)	.21	.11	.04	.04	<.01	.04	-.08	.11	-.02	.03	.03	.04	-.01	.09	.01	.01	.01	.01	<b>.04</b>	
Current Anxiety Symptoms (during COVID-19)	-.13	.11	.01	.04	-.01	.04	-.10	.11	-.02	.03	-.05	.04	-.02	.08	-.01	.01	-.01	.01	<b>-.13</b> <sup>***</sup>	<b>.04</b>

Note:

\*  $p < .05$ ,

\*\*  $p < .01$ ,

\*\*\*  $p < .001$ ;

<sup>1</sup> Substance use frequency outcomes were measured in spring 2020 and indicated use since the onset of the coronavirus/COVID-19 crisis;

<sup>2</sup> The change outcomes, both increase and decrease, combined frequency measures at two time points (spring 2020 - spring 2019). During spring 2019, frequency of use was measured in the past year for alcohol and cannabis and in the past month for nicotine.

**Table 5.**

Behavioral Domain: Behavioral Variables Predicting Current Substance Use Frequency During the COVID-19 Pandemic and Substance Use Change Since the COVID-19 Pandemic

Predictors	Alcohol Use Frequency <sup>1</sup>		Alcohol Use Increase <sup>2</sup>		Alcohol Use Decrease <sup>2</sup>		Cannabis Use Frequency <sup>1</sup>		Cannabis Use Increase <sup>2</sup>		Cannabis Use Decrease <sup>2</sup>		Nicotine Use Frequency <sup>1</sup>		Nicotine Use Increase <sup>2</sup>		Nicotine Use Decrease <sup>2</sup>	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
Sleep	.03	.06	.03	.02	-.02	.02	.03	.05	.02	.01	-.03	.02	.03	.04	.01	.01	<.01	.02
Sleep Satisfaction	-.11	.06	-.01	.02	<.01	.02	-.15**	.07	-.03*	.02	-.01	.02	.04	.04	-.01	.01	.01	.02
Exercise	.02	.09	.01	.03	-.05	.03	-.08	.08	-.02	.02	.02	.03	-.04	.07	-.01	.01	-.03	.03
Time Outside	.17	.09	.06	.03	-.03	.03	.14	.09	-.01	-.02	<.01	.03	.06	.07	<.01	.01	.03	.03

Note:

\*  $p < .05$ ,

\*\*  $p < .01$ ,

\*\*\*  $p < .001$ ;

<sup>1</sup> Substance use frequency outcomes were measured in spring 2020 and indicated use since the onset of the coronavirus/COVID-19 crisis;

<sup>2</sup> The change outcomes, both increase and decrease, combined frequency measures at two time points (spring 2020 - spring 2019). During spring 2019, frequency of use was measured in the past year for alcohol and cannabis and in the past month for nicotine.

**Table 6.**

Environmental Domain: Environment-related Variables Predicting Current Substance Use Frequency During the COVID-19 Pandemic and Substance Use Change Since the COVID-19 Pandemic

Predictors	Alcohol Use Frequency <sup>1</sup>		Alcohol Use Increase <sup>2</sup>		Alcohol Use Decrease <sup>2</sup>		Cannabis Use Frequency <sup>1</sup>		Cannabis Use Increase <sup>2</sup>		Cannabis Use Decrease <sup>2</sup>		Nicotine Use Frequency <sup>1</sup>		Nicotine Use Increase <sup>2</sup>		Nicotine Use Decrease <sup>2</sup>	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
Living Situation	<b>-.33*</b>	.14	-.03	.05	.09	.05	<b>-.43**</b>	.13	-.03	.04	.06	.05	-.11	.10	-.01	.02	-.05	.04
Trouble with Police History	<b>.76***</b>	.23	<b>.17*</b>	.08	-.12	.08	<b>.94***</b>	.21	<b>.21***</b>	<b>.06</b>	.02	.07	.11	.16	-.02	.03	.10	.07
Sexual Assault History	-.07	.23	-.05	.09	.03	.09	.20	.22	.02	.06	.07	.08	-.18	.17	-.03	.03	.01	.07
Physical Assault History	.11	.17	<.01	.06	-.02	.06	.08	.16	-.05	.04	.02	.06	.15	.13	<b>.06**</b>	<b>.02</b>	-.01	.05
Unwanted/Uncomfortable Sexual Experience History	<b>.46**</b>	.15	<b>.15**</b>	.06	.04	.06	.29	.15	-.03	.04	.06	.05	.13	.12	.02	.02	.04	.05
Support Disruption	-.05	.07	-.01	.03	.03	.02	.11	.07	<b>.04*</b>	<b>.02</b>	-.02	.02	-.06	.06	-.01	.01	-.02	.02
Friends Stress	<b>.14*</b>	<b>.06</b>	.04	.03	-.01	.02	<.01	.06	-.02	.02	<b>.05*</b>	<b>.02</b>	<b>.10*</b>	<b>.05</b>	<.01	.01	.01	.02
Family Stress	.13	.07	.03	.03	.01	.03	-.05	.07	.01	.02	.03	.02	.04	.05	.01	.01	-.02	.02
Positive Changes due to COVID-19	.04	.08	.02	.03	.02	.03	-.07	.08	<.01	.02	<b>.07**</b>	<b>.03</b>	.04	.06	.01	.01	.04	.03

Note:

\*  $p < .05$ ,

\*\*  $p < .01$ ,

\*\*\*  $p < .001$ ;

<sup>1</sup> Substance use frequency outcomes were measured in spring 2020 and indicated use since the onset of the coronavirus/COVID-19 crisis;

<sup>2</sup> The change outcomes, both increase and decrease, combined frequency measures at two time points (spring 2020 - spring 2019). During spring 2019, frequency of use was measured in the past year for alcohol and cannabis and in the past month for nicotine.

**Table 7.**

Sociocultural Domain: Sociocultural Variables Predicting Current Substance Use Frequency During the COVID-19 Pandemic and Substance Use Change Since the COVID-19 Pandemic

Predictors	Alcohol Use Frequency <sup>1</sup>		Alcohol Use Increase <sup>2</sup>		Alcohol Use Decrease <sup>2</sup>		Cannabis Use Frequency <sup>1</sup>		Cannabis Use Increase <sup>2</sup>		Cannabis Use Decrease <sup>2</sup>		Nicotine Use Frequency <sup>1</sup>		Nicotine Use Increase <sup>2</sup>		Nicotine Use Decrease <sup>2</sup>		
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	
Race/Ethnicity																			
Asian (ref: Black)	-.13	.15	-.02	.06	-.05	.06	-.23	.14	-.03	.05	-.10	.05	<.01	.11	.01	.02	-.02	.05	
Hispanic/Latinx (ref: Black)	.19	.20	.04	.08	.05	.07	.22	.19	-.01	.05	.09	.07	.24	.15	.01	.02	-.04	.06	
More Than One Race (ref: Black)	.32	.21	.08	.08	.02	.08	.25	.20	.06	.05	-.08	.07	.17	.16	.01	.03	.04	.07	
Sexual Minority (ref: Heterosexual)	.03	.22	-.03	.08	-.10	.08	.35	.21	.11*	.06	-.12	.07	-.09	.17	-.01	.03	.06	.07	
Gender identity																			
Cisgender Man (ref: Cisgender Woman)	-.13	.17	-.09	.07	.18**	.07	.32	.17	<.01	.05	.06	.06	.40**	.13	.05*	.02	.09	.06	
Gender Minority (ref: Cisgender Woman)	.04	.38	.07	.15	.15	.14	-.61	.37	-.03	.10	-.04	.13	.07	.29	-.01	.04	-.08	.12	
Discrimination	-.02	.07	-.02	.03	<.01	.03	-.07	.06	-.04*	.02	.02	.02	<.01	.05	<.01	.01	.04*	.02	

Note:

\*  $p < .05$ ,

\*\*  $p < .01$ ,

\*\*\*  $p < .001$ ;

<sup>1</sup> Substance use frequency outcomes were measured in spring 2020 and indicated use since the onset of the coronavirus/COVID-19 crisis;

<sup>2</sup> The change outcomes, both increase and decrease, combined frequency measures at two time points (spring 2020 - spring 2019). During spring 2019, frequency of use was measured in the past year for alcohol and cannabis and in the past month for nicotine.