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COVID-19 Stress Is Associated with Increased Smoking among People with HIV in Western Washington: A Cross-Sectional Survey

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Abstract: ***Background.*** People living with HIV (PWH) frequently have co-morbid substance use disorders that may have been impacted by the COVID-19 pandemic. This study examined associations between COVID-related stress and increased substance use among PWH in Washington State. ***Methods.*** Between August 2020 and March 2021, we conducted an online survey of 397 PWH in western Washington. Logistic regression was used to analyze associations between a COVID-19 stress score and four self-reported outcomes: increased alcohol use, increased cigarette smoking, increased marijuana use, and increased use of illicit substances. ***Results.*** Thirty-five (38.0%) of 92 participants who smoked, 61 (23.4%) of 261 participants who used alcohol, 15 (14.6%) of 103 participants who used marijuana, and 35 (33.0%) of 102 participants who used illicit substances reported increased use of these substances. Higher COVID-19 stress scores were associated with higher odds of increased cigarette smoking (adjusted odds ratio [aOR] = 1.15, 95% confidence interval [CI]: 1.04–1.27), even after adjustment for anxiety and depressive symptoms (aOR 1.14, 95%CI: 1.03–1.27). COVID-19 stress was not associated with an increased use of alcohol, marijuana, or illicit substances. ***Conclusions.*** COVID-19-related stress was associated with self-reported increased cigarette smoking among PWH in western Washington during the pandemic.

Keywords: COVID-19 pandemic; tobacco use; alcohol drinking; marijuana use; illicit drugs; HIV infection

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1. Background

The use of substances including tobacco, alcohol, cannabis, opioids, and stimulants can negatively impact health in many ways and often co-occurs with chronic health conditions. For example, the Centers for Disease Control and Prevention's Medical Monitoring Project found that among people living with HIV (PWH) in the United States, the estimated prevalence of current use was 32% for smoking, 61% for alcohol use, 32% for non-injection drug use, and 3% for injection drug use [1]. Substance use can accelerate the progression of HIV [2] and is associated with early mortality in this population [3,4]. Moreover, substance use can negatively impact HIV treatment outcomes by decreasing engagement and retention in care, reducing adherence to antiretroviral therapy (ART), and increasing sexual behaviors associated with the transmission of HIV and sexually transmitted infections [5]. Substance use by PWH has been associated with failure to maintain viral suppression [6,7], AIDS

progression, and HIV-associated death [8]. As a result, the treatment of co-occurring substance use disorders (SUD) in PWH can have significant positive impacts on most HIV treatment outcomes [9]. Hence, understanding substance use patterns among PWH is important to optimizing care and developing effective interventions to support PWH who use substances.

After the COVID-19 pandemic emerged in the United States in early 2020, quarantine and stay-at-home orders were put in place to mitigate transmission. Studies of previous pandemics have shown that the psychological impacts of quarantine can be substantial and long lasting [10], and the COVID-19 pandemic was no exception [11]. When individuals experience such distress, they may adopt maladaptive coping mechanisms, leading to increased smoking, drinking, and use of other substances [12]. In addition, the disruption of in-person substance use treatment and recovery programs caused by COVID-19 may have increased the likelihood of substance misuse and relapse. Due to their high prevalence of substance use before the pandemic [1], PWH were among the most vulnerable populations in the United States to experience SUD exacerbation during the COVID-19 pandemic.

To date, few published studies have examined substance use among PWH during the COVID-19 pandemic in the US. In 2020–2021, we conducted an online survey of the impact of COVID-19 on PWH in western Washington State. In a prior quantitative analysis of survey participants, we found that COVID-19 stress was associated with elevated depression and anxiety symptoms in the entire population and that in the subset of respondents with pre-pandemic mental health data, COVID-19-related stress remained associated with elevated depression and anxiety scores after adjusted for baseline mental health and other confounders [13]. In a qualitative analysis of interviews conducted with a subset of survey participants, we found that while participants experienced acute pandemic-related stressors, adaptive coping strategies helped promote mental health for many, while others engaged in maladaptive coping behaviors [14].

Our aims for the current analysis were to estimate the prevalence of self-reported increased smoking, drinking, marijuana use, and illicit substance use in our study population and to examine the association between COVID-related stress and increased use of each category of substances. We hypothesized that higher levels of COVID-related stress would be associated with increased tobacco, alcohol, marijuana, and illicit substance use, regardless of the level of pre-pandemic use of that substance.

2. Methods

2.1. Study Design

This cross-sectional study was conducted from August 2020 to March 2021 using a computer-assisted personal interview (CAPI) survey taken online via REDCap (Research Electronic Data Capture) tools hosted at the University of Washington. Of note, mask mandates and social distancing restrictions were in place throughout this period in Washington State. Study methods and results are reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement for cross-sectional studies [15]. The target sample size was 400 participants, given available funding, and the survey was designed to close after 400 completions.

2.2. Participants

All participants were patients receiving HIV care at the University of Washington's Madison Clinic in Seattle or one of its four satellite clinics in western Washington (Federal Way, Olympia, Kitsap, and Snohomish). Inclusion criteria were as follows: diagnosed with HIV, 18 years of age or older, enrolled in HIV care at a Madison Clinic site, able to speak English, and able to complete an online survey.

2.3. Procedures

Eligible patients who had consented to be contacted for research studies before the COVID-19 pandemic by enrolling in the University of Washington HIV Patient Registry

(UWHIS) were invited to participate via email or telephone starting in August 2020; in-person procedures were not allowed due to the pandemic. Electronic informed consent was obtained from all participants included in the study via REDCap, after which they were linked to the CAPI survey; individuals could consent or participate on their cell phone or on a personal computer. The CAPI survey covered COVID-19 impact, social support, coping, mental health symptoms, quality of life, substance use, sexual behavior, intimate partner violence, medication adherence and care engagement, and sociodemographic characteristics. Participants received a $20 electronic gift card for completing the survey. Ethical review and approval of the study protocol were provided by the University of Washington Human Subjects Division (STUDY00010385).

2.4. Study Measures

The main predictor for this analysis was a COVID-19 stress score calculated based on seven questions selected from among COVID-19-related stress measures at the time this study was designed that were later published [16]. These seven questions assessed the extent to which participants agreed with the following statements: "COVID-19 impacted my day-to-day life", "I am afraid of getting COVID-19", "I am afraid of spreading COVID-19", "I am afraid of being an asymptomatic carrier", "I fear stigma/discrimination from other people", "Social distancing has resulted in increased mental stress", and "I feel that I am contributing to the greater good by practicing social distancing." Possible responses and assigned points for each response were "not at all" (0), "a little" (1), "much" (2), "a lot" (3), and "extremely" (4). Scoring for the question on social distancing as a social good was reverse coded. Scores ranged from 1 to 28. Cronbach's alpha for this measure was 0.763, indicating acceptable reliability. This score was positively correlated with anxiety and depressive symptoms in our prior work [13].

Each participant was asked a series of questions about substance use. We assessed current smoking of tobacco, current drinking of alcoholic beverages, and current use of substances other than tobacco or alcohol in the past 3 months, including marijuana, cocaine/crack, methamphetamines, heroin, fentanyl hallucinogens, goofballs (methamphetamine and heroin), speedballs (cocaine and heroin), pain medications, sedative medications, prescription stimulants, and inhalants (e.g., poppers). Among participants who endorsed smoking tobacco, we asked about the number of cigarettes smoked per day and the use of e-cigarettes or nicotine vaping. Among participants who endorsed drinking alcohol, we asked about current drinking and the number of drinks containing alcohol on a typical day. Among users of substances other than alcohol and tobacco, we asked about injection drug use.

The primary outcomes for this analysis were self-reported increases in the use of each substance assessed, based on REDCap survey data. Change in use was assessed in the CAPI based on the following questions: (1) "Has your smoking decreased, increased, or not changed during the COVID-19 pandemic?", (2) "Has your drinking decreased, increased, or not changed during the COVID-19 pandemic?", and (3) "Has your substance use decreased, increased, or not changed during the COVID-19 pandemic?" Response options for each type of substance were "Decreased", "No change", "Increased", and "Prefer not to answer." Responses were dichotomized as increased if the participant answered "increased" (coded as 1) and not increased if the participant answered "decreased" or "no change" (coded as 0). For participants who selected "prefer not to answer", this variable was considered missing. Of note, to decrease participant burden, we did not ask about changes in other substance use individually for each specific substance used, with the exception of alcohol and tobacco. In addition, no specific level of use of each substance was required; the question on change in use was asked of each participant who endorsed current use of each substance.

Potential confounders (i.e., age, race/ethnicity, gender identity, job loss due to COVID, housing loss due to COVID, and current use of substances other than the one being measured) were identified based on a review of the literature and additional hypothesized associations unique to COVID. Factors hypothesized to be related to both COVID-19 stress

and substance use but potentially in the causal pathway included anxiety (measured by the general anxiety disorder-7 [GAD-7] screening tool [17], Cronbach's alpha = 0.931) and depressive symptoms (measured with the patient health questionnaire-8 [PHQ-8] screening tool [18], Cronbach's alpha = 0.892). Age was obtained from the UWHIS patient registry; all other variables were obtained via the CAPI survey.

2.5. Data Analysis

Participants who only endorsed marijuana use with no other substance were analyzed separately from those who endorsed use of substances other than marijuana (with or without concomitant marijuana use). Logistic regression was used to analyze associations between the continuous COVID-19 stress score described above and each of the four self-reported substance use outcomes: increased tobacco use, increased alcohol use, increased marijuana use, and increased use of illicit substances, relative to no increased use (i.e., no change or decreased use) of each substance among participants who endorsed using that substance.

An initial multivariable model (Model 1) adjusted for confounding, with age and gender identity included a priori and additional potential confounders included in the model only if associated with the outcome at $p < 0.20$. This model-building strategy was adopted to preserve power given small numbers in some categories of several variables. A subsequent model (Model 2) added the GAD-7 and PHQ-8 scores to Model 1 to evaluate the association of COVID-19 stress score with each outcome that was independent of these mental health symptoms. Stata version 14.2 was used for analysis.

3. Results

Table 1 presents the characteristics of the study population, including responses to the questions on change in use of each substance among current users. A total of 400 PWH completed the survey between 6 September 2020 and 19 March 2021, of whom 3 were excluded due to incomplete documentation of electronic consent. The majority of the 397 included participants were male (81.6%), gay or lesbian (66.0%), and non-Latinx white (64.5%). Age ranged from 18 to 76, with a mean of 46 and standard deviation of 12. The mean COVID-19 stress score was 13.1, with a standard deviation of 5.2 and a range of 1 to 24. Overall, 92 (23.2%) reported smoking tobacco, 261 (65.7%) reported drinking alcohol, and 208 (52.4%) reported other substance use. Marijuana and methamphetamine were the most commonly used substances other than tobacco and alcohol, at 85.1% and 38.0% of the 208 substance users, respectively. Among these 208 participants, 103 (49.5%) used marijuana only, and 105 (50.5%) used one or more illicit substances. In response to questions about changes in substance use, 35 (38.0%) of 92 participants who smoked, 61 (23.4%) of 261 participants who used alcohol, 15 (14.6%) of 103 participants who used marijuana as the only substance other than tobacco and alcohol, and 35 (33.0%) of 102 participants who used illicit substances reported increased use of these substances during the pandemic.

Table 1. Characteristics of 397 study participants during the COVID-19 pandemic.

Continuous Variables	**Mean (SD)**
COVID-19 stress score	13.1 (5.2)
Age (in years)	46.0 (12.0)
GAD-7 score	7.0 (5.9)
PHQ-8 score	7.8 (5.7)
Categorical Variables	**N (%)**
Race/ethnicity	
White	256 (64.5)
Black	52 (13.1)
Latinx [a]	34 (8.6)

Table 1. *Cont.*

Categorical Variables	N (%)
Asian American/Pacific Islander	35 (8.8)
Native American	16 (4.0)
Missing	4 (1.0)
Gender identity	
Female	59 (14.9)
Male	324 (81.6)
Non-binary/genderqueer [b]	14 (3.5)
Sexual orientation	
Gay, homosexual, or lesbian	262 (66.0)
Straight or heterosexual	70 (17.6)
Bisexual	40 (10.1)
Queer	15 (3.8)
Other/don't know	10 (2.5)
Occupational status	
Work full-time	147 (37.0)
Work part-time	38 (9.6)
Student	19 (4.8)
Casual or temp worker	14 (3.5)
Unemployed/disabled	152 (38.3)
Retired	26 (6.6)
Missing	1 (0.2)
Lost job during the pandemic	
Yes	110 (27.7)
No	286 (72.0)
Missing	1 (0.3)
Lost housing during the pandemic	
Yes	18 (4.5)
No	377 (95.0)
Missing	2 (0.5)
Living situation more crowded than before COVID	
Yes	47 (11.8)
No	350 (88.2)
Currently smokes tobacco	
Yes	92 (23.2)
No	303 (76.3)
Missing	2 (0.5)
Change in tobacco use [c]	
Decrease	17 (18.5)
No change	40 (43.5)
Increase	35 (38.0)
Number of cigarettes per day [c]	
Vaping only (not quantified)	3 (3.3)
1–5	36 (39.1)
6–10	23 (25.0)
11–15	15 (16.3)
16–20	11 (12.0)
21+	4 (4.3)
Currently drinks alcohol	
Yes	261 (65.7%)
No	134 (33.8%)
Missing	2 (0.5%)
Change in alcohol use [d]	
Decrease	41 (15.7%)
No change	159 (60.9%)
Increase	61 (23.4%)

Table 1. *Cont.*

Categorical Variables	N (%)
Number of drinks per day [d]	
1	86 (33.0)
2	91 (34.9)
3	43 (16.5)
4	19 (7.3)
5	10 (3.8)
6+	12 (4.6)
Currently uses other substances	
Yes	208 (52.4)
No	179 (45.1)
Missing	10 (2.5)
Change in other substance use [e]	
Decrease	26 (12.5)
No change	129 (62.0)
Increase	50 (24.0)
Prefer not to answer	3 (1.4)
Other substances used [e,f]	
Cocaine	22 (10.6)
Methamphetamines	79 (38.0)
Heroin	9 (4.3)
Fentanyl	5 (2.4)
Hallucinogens	42 (20.2)
Goofball	4 (1.9)
Speedball	2 (1.0)
Marijuana	177 (85.1)
Other substance use type [e]	
Marijuana only	103 (49.5)
Illicit substance use (with or without marijuana use	105 (50.5)
Change in marijuana use [g]	
Decrease	8 (7.8)
No change	79 (76.7)
Increase	15 (14.6)
Prefer not to answer	1 (1.0)
Change in illicit substance use (with or without marijuana use) [h]	
Decrease	18 (17.1)
No change	50 (47.6)
Increase	35 (33.3)
Prefer not to answer	2 (1.9)
Injection drug use	
No	295 (74.3)
Yes, but not in past 3 months	64 (16.1)
Yes, in past 3 months	31 (7.8)
Prefer not to answer	7 (1.8)
History of alcohol or substance use treatment	
Never	259 (65.2)
Over one year ago	107 (27.0)
Within past year but before the COVID pandemic	9 (2.3)
During the COVID pandemic	22 (5.5)

GAD-7 = general anxiety disorder-7; PHQ-8 = patient health questionnaire-8; [a] All Latinx participants reported White race. [b] All non-binary/genderqueer participants reported male sex at birth. [c] Among 92 current smokers [d] Among 261 current drinkers [e] Among 208 users of other substances [f] Participants could report using multiple substances other than tobacco and alcohol. [g] Among 103 marijuana users with no illicit substance use [h] Among 105 users of illicit substances (with or without marijuana use).

Among the 92 participants who reported smoking tobacco, each one-point increase in COVID-19 stress score was associated with higher odds of increased smoking, with an unadjusted odds ratio (OR) of 1.17 and 95% confidence interval (CI) of 1.06–1.28 (Table 2). The association between COVID-19 stress and increased smoking remained

significant when adjusted for age and gender identity (adjusted odds ratio [aOR] 1.15, 95%CI: 1.04–1.27) and after further adjustment for GAD-7 score and PHQ-8 score (aOR 1.14, 95%CI: 1.03–1.27). No other factor analyzed was associated with increased smoking during the COVID-19 pandemic.

Table 2. Factors associated with increased smoking among participants who reported currently smoking tobacco (N = 92).

Variable	Odds Ratio (95% CI)	*p*-Value	Model 1 Adjusted Odds Ratio (95% CI)	*p*-Value	Model 2 Adjusted Odds Ratio (95% CI)	*p*-Value
			Hosmer–Lemeshow GOF	0.522	Hosmer–Lemeshow GOF	0.616
COVID-19 stress score	**1.17 (1.06–1.28)**	**0.002**	**1.15 (1.04–1.27)**	**0.008**	**1.14 (1.03–1.27)**	**0.013**
Age (in years)	0.95 (0.91–1.00)	0.054	0.97 (0.92–1.02)	0.199	0.97 (0.92–1.02)	0.275
GAD-7 score	1.07 (0.99–1.15)	0.072			1.02 (0.90–1.15)	0.774
PHQ-8 score	1.05 (0.97–1.13)	0.220			1.00 (0.89–1.13)	0.954
Race/ethnicity		0.555				
White	Reference					
Black	1.56 (0.45–5.38)					
Latinx	*					
Asian American/Pacific Islander	2.08 (0.43–10.1)					
Native American	*					
Missing	*					
Gender identity		0.101		0.274		0.285
Female	Reference		Reference		Reference	
Male	0.29 (0.10–0.90)		0.37 (0.11–1.24)		0.38 (0.11–1.26)	
Non-binary/Genderqueer	0.30 (0.02–4.06)		0.46 (0.30–7.04)		0.43 (0.03–6.84)	
Lost job during the pandemic [a]	0.90 (0.38–2.14)	0.808				
Lost housing during the pandemic [b]	1.07 (0.29–3.97)	0.918				
Currently drinks alcohol	1.12 (0.46–2.70)	0.804				
Currently uses other substances						
No	Reference	0.541				
Marijuana only	1.45 (0.45–4.66)					
Illicit substance (with or without marijuana use)	0.80 (0.29–2.18)					

Logistic regression was used to analyze bivariable and multivariable associations with the outcome (i.e., increased smoking) relative to the reference category (i.e., no increase in smoking). In Model 1, age and gender identity were included as a priori confounders, and additional confounders were included if associated with the outcome at $p < 0.20$. In Model 2, GAD-7 score and PHQ-8 score were added to Model 1 to evaluate the association of COVID-19 stress score with each outcome that was independent of mental health symptoms. Wald tests were used to provide p values for categorical variables. Hosmer–Lemeshow goodness-of-fit tests were used to assess model fit, with Model 1's p value = 0.522 and Model 2's p value = 0.616; p values > 0.05 mean the model has adequate fit and cannot be rejected. GAD-7 = general anxiety disorder-7; GOF = goodness-of-fit; PHQ-8 = patient health questionnaire-8. * Estimates could not be obtained for Latinx or Native American participants and for participants with missing data on race/ethnicity because their outcomes did not vary. [a] Missing for one participant [b] Missing for two participants.

Among the 261 participants who reported alcohol use, for each one-point increase in COVID-19 stress score, there were slightly higher odds of increased alcohol use (OR 1.05, 95%CI: 0.99–1.11), but this association was not statistically significant and attenuated further on adjustment for confounders and the inclusion of potential mental health variables in the model (Table 3). There was a significant association between gender identity and increased alcohol use in bivariable analysis such that male-identifying (cis- and transgender) participants had 1.75-fold higher odds (95%CI: 0.64–4.75) and non-binary/genderqueer participants had 6.96-fold higher odds (95%CI: 1.52–31.8) of increased drinking, compared to female-identifying (cis- and transgender) participants. The higher odds of increased alcohol use among non-binary/genderqueer individuals who drank alcohol (n = 11) was attenuated but still significantly different from the odds for female-identifying participants in Model 1 (aOR 6.40, 95%CI: 1.38–29.8) and in Model 2 (aOR 6.02, 95%CI: 1.29–28.1).

Table 3. Factors associated with increased drinking among participants who reported currently drinking alcohol (N = 261).

Variable	Odds Ratio (95% CI)	*p*-Value	Model 1 Adjusted Odds Ratio (95% CI)	*p*-Value	Model 2 Adjusted Odds Ratio (95% CI)	*p*-Value
			Hosmer–Lemeshow GOF	0.795	Hosmer–Lemeshow GOF	0.331
COVID-19 stress score	1.05 (0.99–1.11)	0.098	1.04 (0.98–1.10)	0.199	1.03 (0.97–1.10)	0.286
Age (in years)	0.98 (0.95–1.00)	0.056	0.98 (0.96–1.00)	0.115	0.98 (0.95–1.01)	0.108
GAD-7 score	1.03 (0.98–1.08)	0.227			0.97 (0.89–1.06)	0.487
PHQ-8 score	1.04 (0.99–1.09)	0.083			1.05 (0.97–1.14)	0.215
Race/ethnicity		0.862				
White	Reference					
Black	0.98 (0.41–2.32)					
Latinx	0.93 (0.35–2.47)					
Asian American/Pacific Islander	1.43 (0.47–4.30)					
Native American	1.14 (0.22–5.88)					
Missing	3.42 (0.47–25.1)					
Gender identity		**0.039**		0.059		0.074
Female	Reference		Reference		Reference	
Male	**1.75 (0.64–4.75)**		1.87 (0.68–5.14)		1.89 (0.68–5.24)	
Non-binary/Genderqueer	**6.96 (1.52–31.8)**		**6.40 (1.38–29.8)**		**6.02 (1.29–28.1)**	
Lost job during the pandemic	0.72 (0.39–1. 33)	0.298				
Lost housing during the pandemic [a]	3.51 (0.44–27.8)	0.234				
Currently smokes tobacco [a]	1.02 (0.51–2.02)	0.956				
Currently uses other substances		0.908				
No	Reference					
Marijuana only	1.16 (0.59–2.30)					
Illicit substance (with or without marijuana use)	1.10 (0.54–2.24)					

Logistic regression was used to analyze bivariable and multivariable associations with the outcome (i.e., increased drinking) relative to the reference category (i.e., no increase in drinking). In Model 1, age and gender identity were included as a priori confounders, and additional confounders were included if associated with the outcome at $p < 0.20$. In Model 2, GAD-7 score and PHQ-8 score were added to Model 1, to evaluate the association of COVID-19 stress score with each outcome that was independent of mental health symptoms. Wald tests were used to provide p values for categorical variables. Hosmer–Lemeshow goodness-of-fit tests were used to assess model fit, with Model 1's p value = 0.795 and Model 2's p value = 0.331; p values > 0.05 mean the model has adequate fit and cannot be rejected. GAD-7 = general anxiety disorder-7; GOF = goodness-of-fit; PHQ-8 = patient health questionnaire-8. [a] Missing for one participant.

Among the 102 participants who reported marijuana as the only substance used other than tobacco or alcohol, COVID-19 stress was not a significant predictor of increased use (Table 4). Having lost a job during the pandemic was associated with lower odds of increased marijuana use in bivariable analysis (OR 0.32, 95%CI: 0.10–0.99), but no variables were significant in either multivariable model.

Among 103 participants who reported use of one or more illicit substances, COVID-19 stress was not a significant predictor of increased use (Table 5). In bivariable analysis, both GAD-7 score (OR 1.11, 95%CI: 1.03–1.20) and PHQ-9 score (OR 1.10, 95%CI: 1.02–1.18) were associated with increased substance use in this group. In multivariable analysis, current alcohol use was associated with significantly lower odds of reporting increased substance use in this group in Model 1 (aOR 0.37, 95%CI: 0.14–0.97) and Model 2 (aOR 0.34, 95%CI: 0.13–0.92). No other variable was significant in either multivariable model, although loss of housing had a borderline association with lower odds of increased substance use (aOR 0.18, 95%CI: 0.03–1.05) in Model 1.

Table 4. Factors associated with increased marijuana use among participants who reported marijuana as the only substance used other than tobacco and alcohol and who responded to the question on change in use (N = 102) [a].

Variable	Odds Ratio (95% CI)	*p*-Value	Model 1 Adjusted Odds Ratio (95% CI)	*p*-Value	Model 2 Adjusted Odds Ratio (95% CI)	*p*-Value
			Hosmer–Lemeshow GOF	0.281	Hosmer–Lemeshow GOF	0.555
COVID-19 stress score	1.03 (0.93–1.14)	0.579	1.00 (0.89–1.13)	0.978	1.01 (0.87–1.17)	0.930
Age (in years)	1.00 (0.96–1.04)	0.945	1.01 (0.96–1.05)	0.755	1.01 (0.96–1.05)	0.763
GAD-7 score	1.01 (0.92–1.11)	0.860			0.99 (0.82–1.19)	0.912
PHQ-8 score	1.02 (0.91–1.13)	0.751			1.00 (0.83–1.21)	0.964
Race/ethnicity		0.985				
White	Reference					
Black	1.50 (0.27–8.23)					
Latinx	1.20 (0.22–6.40)					
Asian American/Pacific Islander	0.75 (0.08–6.74)					
Native American	1.20 (0.13–11.5)					
Missing	*					
Gender identity		0.760		0.967		0.971
Female	Reference		Reference		Reference	
Male	1.28 (0.26–6.32)		1.03 (0.19–5.71)		1.03 (0.19–5.70)	
Non-Binary/Genderqueer	*		*		*	
Lost job during the pandemic	**0.32 (0.10–0.99)**	**0.049**	0.35 (0.10–1.27)	0.112	0.35 (0.09–1.30)	0.117
Lost housing during the pandemic [b]	0.15 (0.02–1.20)	0.074	0.24 (0.02–2.66)	0.244	0.24 (0.02–2.87)	0.260
Currently smokes tobacco	0.24 (0.03–1.93)	0.180	0.25 (0.03–2.18)	0.210	0.25 (0.03–2.38)	0.227
Currently drinks alcohol	1.46 (0.30–7.14)	0.637				

Logistic regression was used to analyze bivariable and multivariable associations with the outcome (i.e., increased marijuana use) relative to the reference category (i.e., no increase in marijuana use). In Model 1, age and gender identity were included as a priori confounders and additional confounders were included if associated with the outcome at $p < 0.20$. In Model 2, GAD-7 score and PHQ-8 score were added to Model 1, to evaluate the association of COVID-19 stress score with each outcome that was independent of mental health symptoms. Wald tests were used to provide *p* values for categorical variables. Hosmer–Lemeshow goodness-of-fit tests were used to assess model fit, with Model 1's *p* value = 0.281 and Model 2's *p* value = 0.555; *p* values > 0.05 mean the model has adequate fit and cannot be rejected. GAD-7 = general anxiety disorder-7; GOF = goodness-of-fit; PHQ-8 = patient health questionnaire-8. * Estimates could not be obtained for participants with missing data on race/ethnicity and for non-binary/genderqueer individuals because their outcomes did not vary. [a] Three participants who reported other substance use did not report whether this use had changed during the COVID-19 pandemic. [b] Missing for two participants.

Table 5. Factors associated with increased use among participants who reported currently using illicit substances (with or without marijuana use) and who reported on change in use (N = 103) [a].

Variable	Odds Ratio (95% CI)	*p*-Value	Model 1 Adjusted Odds Ratio (95% CI)	*p*-Value	Model 2 Adjusted Odds Ratio (95% CI)	*p*-Value
			Hosmer–Lemeshow GOF	0.563	Hosmer–Lemeshow GOF	0.227
COVID-19 stress score	1.05 (0.96–1.13)	0.282	1.06 (0.97–1.16)	0177	1.04 (0.95–1.14)	0.369
Age (in years)	0.98 (0.94–1.02)	0.226	0.97 (0.93–1.02)	0.214	0.98 (0.94–1.02)	0.350
GAD-7 score	**1.11 (1.03–1.20)**	**0.008**			1.07 (0.95–1.21)	0.266
PHQ-8 score	**1.10 (1.02–1.18)**	**0.018**			1.03 (0.91–1.16)	0.647
Race/ethnicity		0.689				
White	Reference					
Black	0.61 (0.15–2.44)					
Latinx	1.02 (0.23–4.46)					
Asian American/Pacific Islander	2.72 (0.56–13.2)					
Native American	1.02 (0.09–11.9)					
Missing	*					

Table 5. *Cont.*

Variable	Odds Ratio (95% CI)	*p*-Value	Model 1 Adjusted Odds Ratio (95% CI)	*p*-Value	Model 2 Adjusted Odds Ratio (95% CI)	*p*-Value
Gender identity		0.927		0.713		0.796
Female	Reference		Reference		Reference	
Male	1.21 (0.29–5.01)		2.00 (0.37–10.9)		1.76 (0.33–9.25)	
Non-Binary/Genderqueer	1.56 (0.17–14.7)		1.49 (0.12–17.9)		1.83 (0.14–23.6)	
Lost job during the pandemic	0.58 (0.26–1.33)	0.202				
Lost housing during the pandemic [b]	0.28 (0.06–1.25)	0.096	0.18 (0.03–1.05)	0.057	0.29 (0.05–1.83)	0.189
Currently smokes tobacco	1.32 (0.60–2.90)	0.491				
Currently drinks alcohol	0.48 (0.20–1.17)	0.106	**0.37 (0.14–0.97)**	**0.044**	**0.34 (0.13–0.92)**	**0.034**

Logistic regression was used to analyze bivariable and multivariable associations with the outcome (i.e., increased illicit substance use) relative to the reference category (i.e., no increase in illicit substance use). In Model 1, age and gender identity were included as a priori confounders and additional confounders were included if associated with the outcome at $p < 0.20$. In Model 2, GAD-7 score and PHQ-8 score were added to Model 1, to evaluate the association of COVID-19 stress score with each outcome that was independent of mental health symptoms. Wald tests were used to provide p values for categorical variables. Hosmer–Lemeshow goodness-of-fit tests were used to assess model fit, with Model 1's p value = 0.563 and Model 2's p value = 0.227; p values > 0.05 mean the model has adequate fit and cannot be rejected. GAD-7 = general anxiety disorder-7; GOF = goodness-of-fit; PHQ-8 = patient health questionnaire-8. * Estimates could not be obtained for participants with missing data on race/ethnicity because their outcomes did not vary. [a] Three participants who reported other substance use did not report whether this use had changed during the COVID-19 pandemic. [b] Missing for one participant.

4. Discussion

The COVID-19 pandemic and associated quarantine and social restrictions posed sociological, psychological, and economic challenges for many individuals [10,19] and raised concerns about the pandemic's effects on mental health and substance use among PWH. In this cross-sectional study of 397 PWH residing in western Washington, the first state to report a COVID-19 case, participants reported a range of COVID-19 stress levels using our seven-item questionnaire. Increases in substance use were common and reported by 38% of tobacco users, 33% of illicit substance users, 23% of alcohol users, and 15% of marijuana users. COVID-19 stress levels were associated with increased smoking, with and without adjustment for potential confounders, including mental health measures. We did not find that the COVID-19 stress score was associated with either alcohol use or the use of other substances.

Our estimate of increased smoking among PWH during the pandemic, at 38%, was higher than that reported in a systematic review and meta-analysis of tobacco smoking changes in the early pre-vaccination phase of COVID-19 (2020), which found that 27% of smokers increased smoking during this time [20]. There are limited studies on smoking behaviors of PWH during the COVID-19 pandemic, despite their known higher rate of tobacco use [1]. In a study by Focà and colleagues conducted between December 2020 and February 2021 at the HIV and oncological clinics of a medical center in Italy, 10.8% of PWH said they smoked "a lot" during the COVID pandemic, compared to only 1.3% of cancer patients [21]. As anxiety about the COVID-19 pandemic and its effects increased during 2020–2021 [10], the resultant stress exacerbated baseline mental health symptoms, which so often co-occur with and exacerbate substance use [13,14,22]. However, the association we found was present even after adjustment for mental health symptoms, suggesting that something about the effect of COVID-19-related stress and social distancing (e.g., more time spent at home, less time spent in places where smoking is prohibited) may have played a role. Of note, smokers were at higher risk for adverse outcomes from COVID-19 [23], and PWH faced heightened COVID-19-related risks due to their HIV, their high rates of comorbidities, and barriers related to social determinants of health [24]. The implications of increased smoking during a respiratory virus pandemic merit further investigation to identify ways to effectively address this risk among PWH and among other groups at high risk for adverse outcomes.

Although other types of substance use were not associated with COVID-19 stress in our study, increased use was common, at 33% for illicit substances (with or without

marijuana use), 23% for alcohol use, and 15% for marijuana use alone. Increased drinking and other substance use have been documented during the COVID-19 pandemic in other studies. For example, in a study of 1958 university students who reported using alcohol in the past 30 days, alcohol consumption increased over time in amount and frequency after campus closure, with greater increases among students reporting more symptoms of depression and anxiety [25]. Additionally, an online survey of 353 US adults found that over one-third of participants increased cannabis use and over half either started using or increased use of medications or substances (mostly alcohol and sleep aids) "because of the COVID-19 pandemic" [26]. We did find a few significant associations between potential confounder variables and these outcomes, which should be considered exploratory and need to be validated in other studies. Specifically, there were higher odds of increased alcohol use among non-binary/genderqueer individuals in our sample, and the lower odds of increased illicit substance use among individuals who currently drank alcohol were intriguing and may warrant further investigation. Of interest, depressive symptoms and anxiety were only associated with increased illicit substance use in bivariable analysis, suggesting that other factors, including factors unmeasured in our survey, were more important.

In general, our results highlight the need for continued efforts to mitigate unhealthy tobacco, alcohol, and other substance use among PWH, both as the COVID-19 pandemic recedes and in future pandemics. Longitudinal studies could provide additional insights into the long-term effect of pandemic-related stressors on increases in smoking, alcohol, and other substances and whether individuals return to their pre-pandemic consumption levels. Given the higher prevalence of disordered substance use among PWH [2] and its possible exacerbation by the COVID-19 pandemic, support for tobacco cessation, alcohol use reduction, harm-reduction services, and access to medications for opioid use disorder, among others, should be key components of comprehensive HIV care. HIV patients also need access to mental health counseling and treatment, ideally in an integrated service model [27]. Access to such services is critical and should be assured, particularly during stressful events, whether a global pandemic like COVID-19 or a more localized event such as gun violence impacting a specific community.

Our study has several strengths. First, it is one of a small number of studies to evaluate the impact of the COVID-19 pandemic on substance use among PWH. Second, the survey was administered between August 2020 to March 2021, beginning only a few months after the COVID-19 pandemic was declared by the World Health Organization in June 2020 [28]. As such, we captured most of the pre-vaccination phase of the pandemic when mandatory quarantine, travel restriction, and stay-at-home orders were emphasized by local governments [29], causing high levels of stress and uncertainty [30]. Despite these strengths, there are several limitations of this study. First, we did not have data on pre-pandemic substance use with which to compare current levels of use and so relied on participants' subjective assessments of their change in smoking, drinking, and other substance use. Such assessments can be impacted by social desirability bias, and increased use was likely underestimated. However, the use of CAPI for survey administration may have mitigated this problem, as such methods can lead to more reporting of sensitive behaviors than face-to-face interviews [31]. Second, our survey was administered online and was available only in English. Therefore, we were unable to reach non-English speakers or individuals with poor or no internet access. Third, our use of the UWHIS as a recruitment platform may limit the generalizability of our results, since this registry consists of patients who have volunteered for research participation; however, this platform enabled data collection at a time when pandemic restrictions made other forms of recruitment a challenge. In addition, our results may have limited generalizability to other patient populations, locations, or contexts other than the COVID-19 pandemic. Fourth, our study population included fewer Black and Latinx PWH compared to the demographic characteristics of PWH in Washington State (13% vs. 17% for Black and 8% vs. 15% for Latinx individuals) [32], and we have no HIV-negative group for comparison. Fifth, our study was not designed to evaluate

the impact of different biomedical or counseling interventions to improve mental health or reduce substance use in this study population. That said, relatively few (22 or 5.5%) participants reported ongoing substance use treatment during the pandemic. Finally, we were underpowered to detect small effect sizes due to our limited sample size.

5. Conclusions

In this cross-sectional study of the impact of COVID-19 stress on smoking, drinking, and other substance use among PWH in western Washington, we found that over one-third of smokers reported increased smoking, one-third of persons using illicit substances increased use, and nearly a quarter of those reporting alcohol use increased drinking during the COVID-19 pandemic. Individuals with higher COVID-19 stress were more likely to report an increase in smoking, potentially increasing their risk of poor COVID-19 outcomes. Our results highlight the importance of interventions to reduce substance use and support mental health for PWH in times of increased stress.

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Abbreviations

aOR	adjusted odds ratio
ART	antiretroviral therapy
CAPI	computer-assisted personal interview
CI	confidence interval
COVID-19	coronavirus disease 2019
GAD-7	general anxiety disorder-7
HIV	human immunodeficiency virus
OR	odds ratio
PHQ-8	patient health questionnaire-8

PWH	person(s) living with HIV
REDCap	Research Electronic Data Capture
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
SUD	substance use disorder(s)
UWHIS	University of Washington HIV Patient Registry

References

1. CDC. Behavioral and Clinical Characteristics of Persons with Diagnosed HIV Infection—Medical Monitoring Project, United States, 2019 Cycle (June 2019–May 2020). HIV Surveillance Special Report 28. August 2021. Available online: https://stacks.cdc.gov/view/cdc/110355 (accessed on 25 July 2023).
2. NIDA. Part 3: The Connection between Substance Use Disorders and HIV. 13 April 2021. Available online: https://nida.nih.gov/publications/research-reports/common-comorbidities-substance-use-disorders/part-3-connection-between-substance-use-disorders-hiv (accessed on 25 July 2023).
3. DeLorenze, G.N.; Satre, D.D.; Quesenberry, C.P.; Tsai, A.-L.; Weisner, C.M. Mortality after diagnosis of psychiatric disorders and co-occurring substance use disorders among HIV-infected patients. *AIDS Patient Care STDS* **2010**, *24*, 705–712. [CrossRef] [PubMed]
4. DeLorenze, G.N.; Weisner, C.; Tsai, A.-L.; Satre, D.D.; Quesenberry, C.P. Excess mortality among HIV-infected patients diagnosed with substance use dependence or abuse receiving care in a fully integrated medical care program. *Alcohol Clin. Exp. Res.* **2011**, *35*, 203–210. [CrossRef]
5. Mimiaga, M.J.; Reisner, S.L.; Grasso, C.; Crane, H.M.; Safren, S.A.; Kitahata, M.M.; Schumacher, J.E.; Mathews, W.C.; Mayer, K.H. Substance use among HIV-infected patients engaged in primary care in the United States: Findings from the Centers for AIDS Research Network of Integrated Clinical Systems cohort. *Am. J. Public Health* **2013**, *103*, 1457–1467. [CrossRef] [PubMed]
6. Arnsten, J.H.; Demas, P.A.; Grant, R.W.; Gourevitch, M.N.; Farzadegan, H.; Howard, A.A.; Schoenbaum, E.E. Impact of active drug use on antiretroviral therapy adherence and viral suppression in HIV-infected drug users. *J. Gen. Intern. Med.* **2002**, *17*, 377–381. [CrossRef]
7. Jacquet, J.-M.; Peyriere, H.; Makinson, A.; Peries, M.; Nagot, N.; Donnadieu-Rigole, H.; Reynes, J. Psychoactive substances, alcohol and tobacco consumption in HIV-infected outpatients. *AIDS* **2018**, *32*, 1165–1171. [CrossRef]
8. Cohn, S.E.; Jiang, H.; McCutchan, J.A.; Koletar, S.L.; Murphy, R.L.; Robertson, K.R.; Maurice, A.M.d.S.; Currier, J.S.; Williams, P.L. Association of ongoing drug and alcohol use with non-adherence to antiretroviral therapy and higher risk of AIDS and death: Results from ACTG 362. *AIDS Care* **2011**, *23*, 775–785. [CrossRef] [PubMed]
9. Low, A.J.; Mburu, G.; Welton, N.J.; May, M.T.; Davies, C.F.; French, C.; Turner, K.M.; Looker, K.J.; Christensen, H.; McLean, S.; et al. Impact of opioid substitution therapy on antiretroviral therapy outcomes: A systematic review and meta-analysis. *Clin. Infect. Dis.* **2016**, *63*, 1094–1104. [CrossRef]
10. Brooks, S.K.; Webster, R.K.; Smith, L.E.; Woodland, L.; Wessely, S.; Greenberg, N.; Rubin, G.J. The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *Lancet* **2020**, *395*, 912–920. [CrossRef]
11. Wang, C.; Pan, R.; Wan, X.; Tan, Y.; Xu, L.; Ho, C.S.; Ho, R.C. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* **2020**, *17*, 1729. [CrossRef]
12. Alexander, A.C.; Ward, K.D. Understanding Postdisaster Substance Use and Psychological Distress Using Concepts from the Self-Medication Hypothesis and Social Cognitive Theory. *J. Psychoact. Drugs* **2018**, *50*, 177–186. [CrossRef]
13. Wang, L.; Slaughter, F.; Nguyen, A.T.; Smith, S.; Prabhu, S.; Beima-Sofie, K.; Wallace, S.; Crane, H.M.; Simoni, J.M.; Graham, S.M. Impact of the COVID-19 pandemic on mental health and viral suppression among persons living with HIV in western Washington. *AIDS Care* **2024**, *36*, 885–898. [CrossRef]
14. Smith, S.; Beima-Sofie, K.; Naveed, A.; Bhatia, N.; Micheni, M.; Nguyen, A.T.; Slaughter, F.; Wang, L.; Prabhu, S.; Wallace, S.; et al. Impact of the COVID-19 pandemic on persons living with HIV in western Washington: Examining lived experiences of social distancing stress, personal buffers, and mental health. *AIDS Behav.* **2024**, *28*, 1822–1833. [CrossRef]
15. von Elm, E.; Altman, D.G.; Egger, M.; Pocock, S.J.; Gotzsche, P.C.; Vandenbroucke, J.P. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *BMJ* **2007**, *335*, 806–808. [CrossRef]
16. Taylor, S.; Landry, C.A.; Paluszek, M.M.; Fergus, T.A.; McKay, D.; Asmundson, G.J.G. Development and initial validation of the COVID Stress Scales. *J. Anxiety Disord.* **2020**, *72*, 102232. [CrossRef] [PubMed]
17. Spitzer, R.L.; Kroenke, K.; Williams, J.B.W.; Löwe, B. A brief measure for assessing generalized anxiety disorder: The GAD-7. *Arch. Intern. Med.* **2006**, *166*, 1092–1097. [CrossRef]
18. Kroenke, K.; Spitzer, R.L.; Williams, J.B. The PHQ-9: Validity of a brief depression severity measure. *J. Gen. Intern. Med.* **2001**, *16*, 606–613. [CrossRef] [PubMed]
19. Gostin, L.O.; Wiley, L.F. Governmental public health powers during the COVID-19 pandemic: Stay-at-home orders, business closures, and travel restrictions. *JAMA* **2020**, *323*, 2137–2138. [CrossRef]

20. Sarich, P.; Cabasag, C.J.; Liebermann, E.; Vaneckova, P.; Carle, C.; Hughes, S.; Egger, S.; O'Connell, D.L.; Weber, M.F.; da Costa, A.M.; et al. Tobacco smoking changes during the first pre-vaccination phases of the COVID-19 pandemic: A systematic review and meta-analysis. *eClinicalMedicine* **2022**, *47*, 101375. [CrossRef] [PubMed]
21. Focà, E.; Fornari, C.; Arsuffi, S.; Vetrano, M.C.; Calza, S.; Renzetti, S.; Copeta, S.; Berruti, A.; Castelli, F.; Compostella, S.; et al. Psychological and emotional impact of COVID-19 pandemic on people living with chronic disease: HIV and cancer. *AIDS Behav.* **2022**, *26*, 2920–2930. [CrossRef] [PubMed]
22. Smith, J.P.; Book, S.W. Anxiety and substance use disorders: A review. *Psychiat. Times* **2008**, *25*, 19–23.
23. Zhang, H.; Ma, S.; Han, T.; Qu, G.; Cheng, C.; Uy, J.P.; Shaikh, M.B.; Zhou, Q.; Song, E.J.; Sun, C. Association of smoking history with severe and critical outcomes in COVID-19 patients: A systematic review and meta-analysis. *Eur. J. Integr. Med.* **2021**, *43*, 101313. [CrossRef] [PubMed]
24. Miller, K.W.; Gandhi, R.T. The severity of COVID-19 across the spectrum of HIV. *Curr. Opin. HIV AIDS* **2023**, *18*, 119–125. [CrossRef] [PubMed]
25. Lechner, W.V.; Laurene, K.R.; Patel, S.; Anderson, M.; Grega, C.; Kenne, D.R. Changes in alcohol use as a function of psychological distress and social support following COVID-19 related University closings. *Addict. Behav.* **2020**, *110*, 106527. [CrossRef] [PubMed]
26. Boehnke, K.F.; McAfee, J.; Ackerman, J.M.; Kruger, D.J. Medication and substance use increases among people using cannabis medically during the COVID-19 pandemic. *Int. J. Drug Policy* **2021**, *92*, 103053. [CrossRef]
27. Remien, R.H.; Stirratt, M.J.; Nguyen, N.; Robbins, R.N.; Pala, A.N.; Mellins, C.A. Mental health and HIV/AIDS: The need for an integrated response. *AIDS* **2019**, *33*, 1411–1420. [CrossRef] [PubMed]
28. Director-General's Opening Remarks at the Media Briefing on COVID-19-29 June 2020. 29 June 2020. Available online: https://www-who-int.offcampus.lib.washington.edu/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---29-june-2020 (accessed on 25 July 2023).
29. CDC. CDC Museum COVID-19 Timeline. Available online: https://www.cdc.gov/museum/timeline/covid19.html (accessed on 25 July 2023).
30. Pfefferbaum, B.; North, C.S. Mental health and the COVID-19 pandemic. *N. Engl. J. Med.* **2020**, *383*, 510–512. [CrossRef]
31. Brown, J.; Swartzendruber, A.; DiClemente, R. Application of audio computer-assisted self-interviews to collect self-reported health data: An overview. *Caries Res.* **2013**, *47*, 40–45. [CrossRef]
32. Infectious Disease Assessment Unit, Washington State Department of Health. Washington State HIV Surveillance Report, 2020 Edition. Available online: https://doh.wa.gov/sites/default/files/legacy/Documents/Pubs//150-030-WAHIVSurveillanceReport2020.pdf (accessed on 25 July 2023).