



Resilience, Anxiety, Stress, and Substance Use Patterns During COVID-19 Pandemic in the Miami Adult Studies on HIV (MASH) Cohort

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Abstract

We evaluated mental health and substance use during the COVID-19 pandemic in 196 participants from the Miami Adult Studies on HIV (MASH) Cohort. A survey was administered between July–August of 2020, including validated measures of resilience and anxiety, a scale to measure COVID-19-related worry, and self-reported substance use. Compared to HIV-uninfected participants ($n = 80$), those living with HIV ($n = 116$) reported fewer anxiety symptoms, less COVID-19-related worry, and higher resilience. Those with more anxiety symptoms and lower resilience engaged in more frequent alcohol consumption, binge drinking, and cocaine use. Alcohol misuse was more common among HIV-uninfected participants. Cocaine use was reported by 21% fewer participants during the pandemic compared with 7.3 ± 1.5 months earlier. Possibly due to their experiences with HIV, PLWH responded with higher resilience and reduced worry and anxiety to the adversities brought by the COVID-19 pandemic.

Keywords HIV · COVID-19 · Resilience · Mental health · Substance use

Introduction

The circumstances generated by the COVID-19 pandemic and the response to mitigate the spread of the infection have had immense psychological impacts on mental health on a global scale [1, 2]. A recent systematic review and meta-analysis concluded that the COVID-19 pandemic can increase the prevalence of stress, anxiety, and depression in the general population [2]. COVID-19 could impose greater psychological effects on vulnerable communities affected

by health disparities [3, 4]. The pandemic may particularly adversely affect people living with HIV (PLWH) who are already disproportionately impacted by racial and psychosocial hardships, including stigma and isolation [5]. In addition, PLWH suffer from high rates of multiple comorbidities including diabetes, hypertension, liver disease, and elevated rates of alcohol and substance use disorders (SUDs) [6–9].

On the other hand, PLWH are considered a resilient population [10]. Resilience has been described as a dynamic process influenced by biological, social, and environmental factors [11]. In a systematic review of literature, Windle defined resilience as “the process of effectively negotiating, adapting to, or managing significant sources of stress or trauma” [12]. Resilience may ameliorate psychological distress after traumatic events [13]. For example, higher levels of resilience were associated with lower anxiety and depression among COVID-19 patients in Wuhan, China [14]. Nonetheless, the psychological status of PLWH and their ability to cope during the COVID-19 pandemic has not yet been sufficiently explored.

Limited scientific evidence is available on how the COVID-19 pandemic could lead to changes in substance use patterns [15], which could ultimately heighten the

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risks for the infection and lead to adverse outcomes. The National Institute on Drug Abuse (NIDA) has declared that the COVID-19 pandemic presents unique challenges for people with SUDs, such as interfering with recovery. NIDA, therefore, has urged the research community to collect and share data on drug use trends and their relationship with COVID-19 [16].

South Florida suffers from multiple epidemics. In addition to the current COVID-19 crisis, South Florida has one of the highest HIV incidence rates in the nation [17], an epidemic that has been strongly linked to drug use in Miami, Florida [18–20]. The clinical impact of HIV infection on the natural history of COVID-19 is uncertain, although limited evidence suggests that PLWH are not at greater risk of infection, severe disease, or death than the general population, if they are effectively treated with antiretroviral therapy (ART) [21, 22]. Therefore, the impact of the COVID-19 epidemic on vulnerable and marginalized communities, and the intricate relationship between mental health and drug use in the context of HIV and the COVID-19 pandemic warrants examination. The objectives of this study were to evaluate resilience, mental health and substance use patterns during the COVID-19 pandemic among people living with and without HIV from the Miami Adult Studies on HIV (MASH) Cohort.

Methods

Data was collected during July and August of 2020 from participants in the Miami Adult Studies on HIV (MASH) cohort, which follows over 1000 people living with and without HIV. The MASH cohort is largely comprised of Black and Hispanic, middle-aged individuals who live in a poor urban sector of Miami, FL. Participants are recruited from neighboring clinics, particularly the Borinquen Health Care Center (<https://www.borinquenhealth.org/>), as well as nearby food banks and shelters. Participation in the MASH cohort is contingent on confirmation of HIV status (e.g. rapid antigen/antibody test, nucleic acid test) confirmed with name and date of birth or from medical records with participants' signed release of medical information. Participants are followed every 6 months for a range of data, including morbidity, healthcare access and utilization, medication adherence, socioeconomic factors, and use of alcohol, tobacco, and illicit substances.

All MASH cohort participants were eligible to participate in the survey. A convenience sample of 200 MASH cohort participants were randomly contacted by telephone and invited to participate in a supplemental study of the impact of the COVID-19 epidemic on their lives. In total, 232 participants were called, 200 were reached, and all of those that were reached agreed to participate. Four participants were excluded from the analyses due to missing data.

The study protocol was approved by the Institutional Review Board at Florida International University. Verbal consent was obtained, witnessed, and documented by two members of our research staff. A survey was administered by phone and participants were given an incentive of \$20 for their participation. The survey was designed by the Collaborating Consortium of Cohorts Producing NIDA Opportunities (C3PNO), which coordinates U01 cohort studies funded by the National Institutes for Drug Abuse (NIDA). The C3PNO COVID-19 Survey includes original and validated questionnaires; survey and sources available at <https://www.c3pno.org>.

Data from the COVID-19 Survey

The General Anxiety Disorder-7 (GAD-7) is a 7-item screening tool used to assess symptoms of anxiety [23, 24]. The total score ranges from 0 to 21; scores of 10 or more are indicative of the presence of anxiety symptoms.

COVID-19-related worry was assessed by asking participants “On a scale of 1 to 10, how worried are you about the COVID-19 pandemic? 1 being not worried at all and 10 being extremely worried.” Scores of ≥ 6 were considered high levels of worry.

The Brief Resilience Scale (BRS) was used to assess resilience [25, 26]. Scores range from 0 to 6. High resilience was defined as scores above the median value for our study sample (> 3.4).

The Alcohol Use Disorder Identification Test-Consumption (AUDIT-C) questionnaire was used to assess alcohol consumption [27]. Scores of ≥ 4 for men and ≥ 3 for women are indicative of alcohol misuse. Binge drinking was determined with the third item of the AUDIT-C and defined as “monthly or more” consumption of ≥ 5 or ≥ 4 drinks on one occasion for males and females, respectively.

Data Collected Pre-pandemic

Data from participants' last cohort visit was used to supplement this analysis, with a mean range of 7.3 ± 1.5 months between the two assessments. Sociodemographic characteristics (age, gender, race/ethnicity, income), AUDIT-C, and substance use (30-day frequency) were self-reported. Anthropometric and blood pressure measurements and fasting blood draws were performed by trained research staff and used to determine body mass index (BMI), hypertension (systolic ≥ 130 or diastolic ≥ 85 mm Hg), and hyperglycemia (fasting glucose ≥ 100 mg/dL).

Statistical Analysis

Descriptive statistics are reported as mean \pm standard deviation (SD) or as No. (%). The primary independent variable

was HIV status, and the primary outcomes were anxiety symptoms, COVID-19-related worry, resilience, and drug use. T-tests and Chi square tests were performed to test for group differences in continuous and categorical outcomes, respectively. Within group differences in frequencies were tested with McNemar's test. Correlation analyses included Pearson product-moment correlations for two continuous variables and Spearman's rank correlations when at least one variable was ordinal. Logistic regressions were performed to calculate odds ratios (OR) and 95% confidence intervals (CI) for anxiety symptoms, high levels of COVID-19-related worry, and high resilience for PLWH compared to HIV-uninfected participants. Adjusted odds ratios (AOR) were calculated by adjusting for sociodemographic characteristics (age, sex, race/ethnicity, income, education, housing, and employment). Results were considered statistically significant at two-tailed $P < 0.05$. The data analysis for this paper was generated using SAS software, version 9.4. Copyright © 2002–2012 SAS Institute Inc.

Results

Sample Characteristics

Table 1 displays the socioeconomic and clinical characteristics of the participants. The study sample included a total of 196 participants, including 116 (59.2%) PLWH and 80 (40.8%) HIV-uninfected participants. A total of 69 (35.2%) participants reported having been tested for COVID-19 by nasopharyngeal swabs and only 4 (2.0%) had tested positive. Participants had a mean age of 56.6 ± 6.7 , 51.0% were female, 75.5% Black non-Hispanic, and 16.8% Hispanic. The vast majority earned below \$15,000 annually per household (76.3%), were unemployed (including disability, 90.3%), and had a high-school education or less (72.4%). Prior to the pandemic, most participants reported having health insurance (87.2%), Medicare or Medicaid coverage (80.5%), and had received primary care in the past 12 months (93.3%), but less than half (47.7%) reported having received mental health care. Only 13 (6.6%) participants reported having health insurance without Medicare or Medicaid coverage.

The majority of PLWH were receiving ART (99.1%), 86.2% were virally suppressed (< 200 HIV RNA copies/mL) and had a mean CD4 lymphocyte count of 652.7 ± 333.9 cells/ μ L at their last clinic visit. Compared to PLWH, HIV-uninfected participants were slightly older (55.7 ± 6.5 vs. 57.8 ± 6.8 , respectively; $t = 2.16$, $P = 0.032$) and were more likely to be homeless (2.6% vs. 10.0%, respectively; $\chi^2 = 4.91$, $P = 0.026$). Additionally, prior to the pandemic, a greater proportion of PLWH reported having health insurance (92.1% vs. 80.3%; $\chi^2 = 5.96$, $P = 0.015$), Medicare or Medicaid coverage (85.1% vs. 74.1%; $\chi^2 = 3.66$, $P = 0.056$),

and receiving primary (97.4% vs. 87.7%; $\chi^2 = 7.18$, $P = 0.007$) and mental health care (51.8% vs. 42.0%; $\chi^2 = 1.82$, $P = 0.178$) in the past 12 months, although the difference was only statistically significant for insurance and primary care. No other sociodemographic or clinical characteristic significantly differed between PLWH and HIV-uninfected participants.

The characteristics of the participants in this study were representative of the overall characteristics of the MASH cohort, with the exception that, compared to the overall cohort, Hispanics were under-sampled (16.8% vs. 29.0%, respectively) and Black non-Hispanics were over-sampled (75.5% vs. 61.7%, respectively).

Mental Health and Substance Use

We performed correlation analyses between GAD-7, COVID-19-related worry, BRS, and substance use (Table 2). Anxiety symptoms were directly correlated with COVID-19-related worry ($r = 0.33$, $P < 0.0001$), and these were both inversely correlated with resilience ($r = -0.40$ and $r = -0.14$, respectively; $P < 0.0001$ for both). Additionally, anxiety symptoms correlated with alcohol misuse, binge drinking, and cocaine use. Resilience was inversely correlated with binge drinking.

Stratifying the sample by HIV status showed several differences related to substance use patterns. Among PLWH, anxiety symptoms directly correlated with binge drinking and cocaine use. On the other hand, among HIV-uninfected participants, COVID-19-related worry correlated with alcohol misuse.

Resilience, Anxiety, and Stress

Anxiety symptoms, COVID-19-related worry, and high resilience were reported by 18.9%, 71.4% and 49% of participants, respectively. PLWH, compared to HIV-uninfected participants, had lower mean GAD-7 (measure for anxiety) (3.6 ± 5.1 vs 6.8 ± 6.2 ; $t = 3.92$, $P < 0.001$) and COVID-19-related worry (6.8 ± 3.2 vs 7.9 ± 3.0 ; $t = 2.30$, $P = 0.023$), and higher BRS (measure for resilience) (3.5 ± 0.6 vs 3.3 ± 0.7 ; $t = 2.17$, $P = 0.031$), respectively (Table 3). Similar results were obtained when comparing the risk for anxiety symptoms, high levels of COVID-19-related worry, and high resilience (Table 3). Compared to HIV-uninfected participants, PLWH had lower odds of having anxiety symptoms (OR = 0.39, 95% CI 0.18–0.81; $\chi^2 = 6.31$, $P = 0.012$) and lower odds of high levels of COVID-19-related worry (OR = 0.42, 95% CI 0.21–0.83; $\chi^2 = 6.21$, $P = 0.013$), as well as twofold higher odds of high resilience (OR = 2.01 95% CI 1.13–3.60; $\chi^2 = 5.59$, $P = 0.018$). These relationships remained largely unchanged after adjusting for

Table 1 Socioeconomic and clinical characteristics of MASH cohort participants during the COVID-19 pandemic

| | Total (N = 196) % or Mean ± SD | HIV+ (N = 116) % or Mean ± SD | HIV– (N = 80) % or Mean ± SD | Test | P |
|---------------------------------------|---|--|---------------------------------------|------------------|--------------|
| Age, years | 56.6 ± 6.7 | 55.7 ± 6.5 | 57.8 ± 6.8 | $t = 2.16$ | 0.032 |
| Sex, male | 49.0% | 50.0% | 47.5% | $\chi^2 = 0.118$ | 0.730 |
| Race/ethnicity | | | | | |
| Black non-Hispanic | 75.5% | 77.6% | 72.5% | $\chi^2 = 2.07$ | 0.358 |
| White non-Hispanic | 7.7% | 8.6% | 6.2% | | |
| Hispanic | 16.8% | 13.8% | 21.2% | | |
| Household income | | | | | |
| \$15,000 or less | 76.3% | 74.1% | 79.7% | $\chi^2 = 3.86$ | 0.143 |
| \$15,000–\$30,000 | 20.4% | 24.1% | 14.9% | | |
| \$30,000 or more | 3.2% | 1.8% | 5.4% | | |
| Education | | | | | |
| Less than high-school | 45.9% | 46.6% | 45.0% | $\chi^2 = 0.099$ | 0.951 |
| High-school or GED | 26.5% | 26.7% | 26.3% | | |
| More than high-school | 27.6% | 26.7% | 28.7% | | |
| Housing | | | | | |
| House/apartment | 94.4% | 97.4% | 90.0% | $\chi^2 = 4.91$ | 0.026 |
| Homeless | 5.6% | 2.6% | 10.0% | | |
| Employment | | | | | |
| Unemployed | 90.3% | 93.1% | 86.3% | $\chi^2 = 2.54$ | 0.111 |
| Employed | 9.7% | 6.9% | 13.7% | | |
| Healthcare | | | | | |
| Insured | 87.2% | 92.1% | 80.3% | $\chi^2 = 5.96$ | 0.015 |
| Medicare or medicaid | 80.5% | 85.1% | 74.1% | $\chi^2 = 3.66$ | 0.056 |
| Received primary care ^a | 93.3% | 97.4% | 87.7% | $\chi^2 = 7.18$ | 0.007 |
| Received mental care ^b | 47.7% | 51.8% | 42.0% | $\chi^2 = 1.82$ | 0.178 |
| Metabolic | | | | | |
| Obesity | 45.9% | 46.6% | 45.0% | $\chi^2 = 0.046$ | 0.830 |
| Hypertension (SBP ≥ 130 OR DBP ≥ 85) | 44.9% | 44.9% | 45.0% | $\chi^2 = 0.001$ | 0.981 |
| Hyperglycemia (Fasting glucose ≥ 100) | 19.9% | 16.5% | 25.0% | $\chi^2 = 2.12$ | 0.145 |

Data are presented as the mean ± standard deviation (using t test for comparison) and percentages (using Pearson Chi square test for comparison). Bolded values denote statistical significance ($P < 0.05$).

^aDuring the past 12 months, have you seen or talked to any of the following health care providers about your own health? A primary care physician or general physician (M.D. or D.O.)

^bDuring the past 12 months, have you seen or talked to any of the following health care providers about your own health? A mental health professional such as a psychiatrist, psychologist, psychiatric nurse, or clinical social worker

sociodemographic factors (age, gender, education, employment, income, housing status) and metabolic parameters (Table 3).

Additionally, we performed linear regressions to examine whether resilience confounded the relationship between HIV and anxiety symptoms and COVID-19-related worry (Table 4). In univariate regressions (Model 1), both HIV and resilience were independently associated with lower anxiety symptoms and COVID-19-related worry. When the model included both HIV and resilience, the effect of HIV on anxiety symptoms was attenuated, with a tendency to

attenuate the effect of HIV on COVID-19-related worry as well (Model 2). On the other hand, we found no evidence of a significant interaction effect between HIV and resilience (Model 3).

Substance Use Patterns

Table 5 compares substance use between PLWH and HIV-uninfected participants before and during COVID-19 pandemic. Before the COVID-19 pandemic, HIV-uninfected participants were more likely to use cocaine than PLWH

Table 2 Correlation coefficient values among mental health scores and substance use during the COVID-19 pandemic in the Miami Adult HIV Studies (MASH) cohort

| | Total (N = 196) | | | PLWH (N = 116) | | | HIV-uninfected (N = 80) | | |
|-----------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|----------------------------|-------------------------------|-----------------------------|---------------------------|-------------------------------|
| | GAD-7 | Worry | BRS | GAD-7 | Worry | BRS | GAD-7 | Worry | BRS |
| GAD-7 ^a | – | 0.33 ^{****} | – 0.40 ^{****} | – | 0.31 ^{***} | – 0.31 ^{****} | – | 0.30 ^{**} | – 0.46 ^{****} |
| COVID-19 worry ^a | – | – | – 0.14 ^{****} | – | – | – 0.02 | – | – | – 0.26 ^{****} |
| Tobacco ^a | 0.09 | 0.06 | 0.01 | 0.14 | 0.05 | 0.02 | – 0.03 | 0.02 | 0.04 |
| Alcohol misuse ^b | 0.16 [*] | – 0.03 | 0.06 | 0.09 | 0.09 | 0.03 | 0.13 | 0.30 ^{**} | 0.19 |
| Binge drinking ^b | 0.43 ^{****} | 0.09 | – 0.35 ^{**} | 0.32 ^{**} | 0.20 | – 0.27 [^] | 0.54 ^{****} | 0.01 | – 0.41 ^{**} |
| Cannabis ^b | 0.12 | – 0.05 | – 0.08 | 0.11 | 0.01 | – 0.11 | 0.03 | – 0.21 | – 0.001 |
| Cocaine ^b | 0.19 ^{**} | – 0.06 | 0.05 | 0.24 ^{**} | – 0.10 | 0.03 | – 0.13 | 0.03 | 0.04 |

BRS Brief Resilience Scale, GAD-7 General Anxiety Disorder-7, PLWH people living with HIV

Bolded values denote statistical significance ($P < 0.05$)

^aPearson correlation test

^bSpearman correlation test

* P value < 0.05 ; ** P value < 0.01 ; *** P value < 0.001 ; **** P value < 0.0001

[^]Tendency to statistical significance, P value < 0.10 for a two-sided test

(41.2% vs. 26.7%; $\chi^2 = 4.54$, $P = 0.033$) and showed a trend towards higher alcohol misuse as well (43.7% vs. 30.4%; $\chi^2 = 3.64$, $P = 0.056$). During the pandemic, there was a higher proportion of HIV-uninfected participants who reported alcohol misuse compared to PLWH (50.0% vs 29.3%; $\chi^2 = 8.62$, $P = 0.003$), but there was no difference in rates of cocaine use (15.0% vs. 13.8%; $\chi^2 = 0.06$, $P = 0.8$). In fact, the frequencies of cocaine use significantly dropped by 12.9% and 26.5% among PLWH and HIV-uninfected participants, respectively. No between- or within-group differences were seen for cigarette smoking and use of cannabis.

When participants were asked “What have you noticed about the price of (cocaine) in the past month?” 19 (9.7%) reported that prices of cocaine had gone up. When asked “What changes, if any, have you noticed regarding your ability to get (cocaine) in the past month?” 14 (7.14%) reported that cocaine was harder to obtain.

Discussion

The COVID-19 pandemic generated a global crisis and a rapid implementation of extraordinary changes that have disproportionately impacted marginalized populations [28]. The aim of this study was to examine resilience, mental health and substance use patterns during the COVID-19 pandemic among people living with and without HIV from the MASH cohort. The data used in this analysis was collected between July and August of 2020, in the midst of rising COVID-19 cases and deaths in Florida after easing of restrictions that were placed to mitigate the spread of the disease. Our findings revealed that PLWH reported higher resilience and less anxiety symptoms and COVID-19-related worry than

HIV-uninfected peers. Our findings also suggest that higher resilience partially explains why PLWH displayed lower anxiety and worry. Significant relationships were found between mental health, particularly anxiety, and substance use. Our results indicate that, compared to their peers, many PLWH may be protected from psychosocial stressors during the COVID-19 pandemic via psychological resilience, which they have built over time through the management of the HIV infection [10]. Our study emphasizes that public health efforts to promote resilience in vulnerable populations may enable such groups to cope with and overcome the adversities generated by the COVID-19 pandemic.

Resilience can be considered a positive adaptation to challenges and is comprised of both internal (e.g. self-efficacy, coping skills) and external factors (e.g. social support). Our findings suggest that PLWH have higher resilience than HIV-uninfected peers. People living with HIV, due to their effort to manage a chronic and potentially fatal disease, have developed resilient characteristics [10]. This, in turn, might have equipped PLWH with coping mechanisms that allow them to adapt and manage their anxiety and worry about the COVID-19 pandemic to a greater degree than individuals with the same race/ethnicity and similar socioeconomic status who are uninfected with HIV. PLWH have been living with HIV for an average of 16 ± 9 years and are highly engaged in HIV care and are adherent to treatment, as evidenced by the great majority of them (86.2%) having suppressed HIV viral load. As such, the resilience observed among PLWH in this study may be a result of their many years living with and managing HIV disease, as well as their unfettered access to medical care and support services.

Resilience was inversely correlated with anxiety and worry. Furthermore, only 13% of PLWH reported anxiety

Table 3 Comparison of anxiety symptoms, worry, and resilience between PLWH and HIV-uninfected participants during the COVID-19 pandemic^a

| | HIV status ^b | | <i>t</i> | <i>P</i> | OR, 95% CI ^{c,d} | χ^2 | <i>P</i> | AOR, 95% CI ^{c,d} | χ^2 | <i>P</i> |
|----------------------|-------------------------|-------------------|----------|--------------|---------------------------|----------|--------------|----------------------------|----------|--------------|
| | Total (N = 196) | Negative (N = 80) | | | | | | | | |
| GAD-7 | 4.9 ± 5.8 | 3.6 ± 5.1 | 3.92 | < 0.0001 | – | – | – | – | – | – |
| Anxiety symptoms | 18.9% | 12.9% | – | – | 0.39, 0.18–0.81 | 6.31 | 0.012 | 0.38, 0.17–0.85 | 5.51 | 0.018 |
| COVID-19 worry | 7.2 ± 3.2 | 6.8 ± 3.2 | 2.30 | 0.023 | – | – | – | – | – | – |
| High levels of worry | 71.4% | 64.7% | – | – | 0.42, 0.21–0.83 | 6.21 | 0.013 | 0.37, 0.18–0.80 | 6.42 | 0.011 |
| BRS | 3.4 ± 0.6 | 3.5 ± 0.6 | 2.17 | 0.031 | – | – | – | – | – | – |
| High Resilience | 49.0% | 56.0% | – | – | 2.01, 1.13–3.60 | 5.59 | 0.018 | 1.97, 1.05–3.73 | 4.41 | 0.035 |

AOR adjusted odds ratio, BRS Brief Resilience Scale, GAD-7 General Anxiety Disorder-7, PLWH people living with HIV

Bolded values denote statistical significance (*P* < 0.05)

^aAnxiety symptoms were measured by the GAD-7, with scores ≥ 10 considered the presence of anxiety symptoms. COVID-19-related worry was measured with a scale of 1 to 10, with scores of ≥ 6 considered high levels of worry. Resilience was measured with the BRS, with scores of ≥ 3.4 considered as high resilience

^bT-test were performed to compare distribution of GAD-7, worry (1 to 10), and BRS scores

^cLogistic regressions were performed with HIV-uninfected individuals set as reference group

^dEstimates are adjusted for sociodemographic characteristics (age, sex, race/ethnicity, income, education, housing, and employment)

symptoms as compared to 28% of the HIV-uninfected participants. In comparison, a population-based study of PLWH reported a 19% prevalence of anxiety symptoms during 2015-2016, also using the GAD-7 [29]. Among the general U.S. population, the rate of anxiety reported in 2019 was 8.2% and rose to approximately 30% during the COVID-19 pandemic [30], similar to the rate observed among HIV-uninfected participants in the MASH cohort. Likewise, the proportion of participants who reported high levels of COVID-19-related worry was significantly lower among PLWH (64.7%) than among the HIV-uninfected participants (81.3%). Higher resilience among PLWH may in part explain the lower prevalence of anxiety symptoms and COVID-19 related worry when compared to HIV-uninfected participants. Indeed, resilience attenuated the effect of HIV status on mental health, particularly anxiety symptoms. These findings are consistent with prior reports. A large multicenter study of PLWH in the United Kingdom found that resilience was inversely related to the prevalence of depression and anxiety [31]. Resilience has been found to be a protective factor for the mental health of HIV + men who have sex with men [32, 33].

Additionally, our study shows that the COVID-19 pandemic has impacted substance use in the MASH cohort. Cocaine use is a major cause of drug-related deaths in South Florida [34]; yet, we found a significant decline in its use during the COVID-19 pandemic as compared to 7.3 ± 1.5 months earlier, prior to lockdowns. While cocaine use was higher among HIV-uninfected participants than PLWH prior to the pandemic, the frequency of use during the pandemic did not differ between the two groups. We did not observe significant changes in alcohol consumption, but alcohol misuse was more prevalent among the HIV-uninfected participants during the pandemic. Interestingly, the prevalence of alcohol misuse during the pandemic among PLWH was 29%, similar to what has been reported for PLWH in the U.S. before the pandemic (27%) [35].

The reduction of cocaine use follows a reduction in the supply chain of the drug, imposed by the measures to contain the pandemic, rather than individual decisions or circumstances [36, 37]. In fact, the participants reported that the drug had become more expensive and harder to obtain. During the pandemic, cocaine prices have sharply increased in Miami [36], and 76.3% of our study population earned \$15,000 or less annually, which made the existing illicit market too expensive to sustain with their income. A report prepared by the United Nations Office on Drug Crime Global Research Network showed that new patterns of drug use have emerged during the pandemic [37]. While there has been an overall decrease in consumption of drugs, there are concerns about increased use of more easily obtained substances (e.g. alcohol) and more harmful patterns of drug use among people with SUDs [15, 37].

Table 4 Resilience as a potential confounder between HIV and mental health^a

| Model | Parameter | Anxiety symptoms | | | | COVID-19 worry | | | |
|----------------------|----------------|------------------|------|----------|--------------------|----------------|------|----------|--------------|
| | | β | SE | <i>t</i> | <i>P</i> | β | SE | <i>t</i> | <i>P</i> |
| 1a (univariate) | HIV | − 3.17 | 0.81 | − 3.92 | 0.0001 | − 1.05 | 0.46 | − 2.30 | 0.023 |
| 1b (univariate) | Resilience | − 3.39 | 0.55 | − 6.14 | < 0.0001 | − 0.66 | 0.33 | − 2.01 | 0.046 |
| 2 (multiple) | HIV | − 2.50 | 0.76 | − 3.30 | 0.001 | − 0.93 | 0.46 | − 2.02 | 0.045 |
| | Resilience | − 3.11 | 0.54 | − 5.72 | < 0.0001 | − 0.56 | 0.33 | − 1.69 | 0.093 |
| 3 (with interaction) | HIV | − 8.29 | 3.81 | − 2.18 | 0.031 | − 4.37 | 2.31 | − 1.89 | 0.060 |
| | Resilience | − 0.67 | 1.66 | − 0.40 | 0.687 | − 0.89 | 1.01 | − 0.88 | 0.378 |
| | HIV*Resilience | − 1.70 | 1.09 | − 1.55 | 0.123 | − 1.01 | 0.66 | − 1.52 | 0.131 |

^a Resilience was measured with the Brief Resilience Scale (BRS); anxiety symptoms were measured with the Generalized Anxiety Disorder-7 (GAD-7); COVID-19-related worry was measured with a scale of 1 to 10

Bolded values denote statistical significance (*P* < 0.05)

Table 5 Comparison of substance use by HIV status and time of assessment (before and during the COVID-19 pandemic)

| Substances | | Total N = 196 | PLWH N = 116 | HIV-uninfected N = 80 | χ^2 | <i>P</i> ^a |
|-----------------------------|-----------------------|-------------------|-----------------|--------------------------|----------|-----------------------|
| Alcohol misuse ^c | Before | 35.9% | 30.4% | 43.7% | 3.64 | 0.056 |
| | During COVID-19 | 37.8% | 29.3% | 50.0% | 8.62 | 0.003 |
| | χ^2 | 0.24 | 0.22 | 1.32 | | |
| | <i>P</i> ^b | 0.622 | 0.637 | 0.251 | | |
| Binge drinking ^d | Before | 17.3% | 14.8% | 21.3% | 1.37 | 0.242 |
| | During COVID-19 | 15.8% | 12.9% | 20.0% | 1.78 | 0.183 |
| | χ^2 | 0.31 | 0.33 | 0.06 | | |
| | <i>P</i> ^b | 0.578 | 0.564 | 0.808 | | |
| Smoker (tobacco) | Before | 51.0% | 47.4% | 56.2% | 1.48 | 0.223 |
| | During COVID-19 | 48.0% | 43.1% | 55.0% | 2.68 | 0.101 |
| | χ^2 | 1.64 | 2.78 | 0.08 | | |
| | <i>P</i> ^b | 0.201 | 0.096 | 0.782 | | |
| Cannabis | Before | 26.0% | 23.3% | 30.0% | 1.11 | 0.291 |
| | During COVID-19 | 25.5% | 21.5% | 31.2% | 2.34 | 0.125 |
| | χ^2 | 0.07 | 0.40 | 0.20 | | |
| | <i>P</i> ^b | 0.796 | 0.5271 | 0.6547 | | |
| Cocaine | Before | 32.65% | 26.7% | 41.2% | 4.54 | 0.033 |
| | During COVID-19 | 14.3% | 13.8% | 15.0% | 0.06 | 0.812 |
| | χ^2 | 36.00 | 15.00 | 21.00 | | |
| | <i>P</i> ^b | < 0.001 | 0.0001 | < 0.001 | | |

AUDIT-C Alcohol Use Disorders Identification Test-Consumption, PLWH people living with HIV

Bolded values denote statistical significance (*P* < 0.05)

^aChi square tests were performed for between groups comparisons of PLWH vs. HIV-uninfected

^bMcNemar’s tests were performed for within group comparisons of before vs. during COVID-19 pandemic

^cAlcohol misuse was determined by AUDIT-C ≥ 4 in men, ≥ 3 in women

^dBinge drinking was determined by self-reported monthly or higher consumption of ≥ 5 or ≥ 4 drinks on one occasion for males and females, respectively, on the AUDIT-3

When we examined the relationship between resilience, mental health, and substance use during the pandemic, we found that anxiety symptoms correlated with alcohol misuse, binge drinking, and cocaine use. Resilience was inversely correlated with binge drinking. COVID-19-related worry was correlated with alcohol misuse only among HIV-uninfected participants. Mental health disorders, such as mood and anxiety disorders, often co-occur with SUDs [38–40]. In the general U.S. adult population, almost 20% of all persons with a diagnosis of SUD had at least one co-occurring anxiety disorder [38]. These connections underscore the crucial role of mental health in the successful treatment of SUDs and in preparing and supporting populations for dealing with crises, such as pandemics and natural and man-made disasters. Some have called for a larger emphasis on resilience in the treatment of SUDs, as it may have behavioral and biological benefits [41]. Because psychological resilience may offer a level of protection against mental health disorders [42, 43], strategies to promote resilience at the individual and community levels may offer substantial benefits during and after the COVID-19 pandemic.

Chandra et al. described psychological (and physical) health as one of the core components of community resilience [44] and how health promotion is a key lever to enhance community resilience [45]. Not surprisingly, PLWH in the MASH cohort report healthcare access and utilization in greater proportions than HIV-uninfected participants. Federally-funded programs like the Ryan White HIV/AIDS Program support PLWH with insufficient financial resources with medical and support services including mental health and treatment for SUDs. This type of support may contribute to resilience among PLWH and may partially explain the results of this study. Consequently, increased access to mental health and substance use services could play a role in increasing resilience, mitigating anxiety and stress, and addressing social needs that may arise during the COVID-19 pandemic among HIV-uninfected people who may not have access to medical care and other support services. While the COVID-19 pandemic has presented with significant challenges to public mental health, it is also an opportunity for improvements in mental health services [46]. To mitigate the impact of the pandemic, health systems should facilitate the continuation of mental health services for those with pre-existing conditions, as well as increase access to those who develop mental health problems during the pandemic whether they are HIV-infected or not [46]. Community outreach, through partnerships between healthcare providers and other social services, can help promote mental health literacy, identify stressors in the community, and encourage vulnerable individuals to seek care [46].

Community resilience is considered fundamental to the preparedness, response, and recovery to major traumatic events [47]. In order to achieve community resilience,

social, economic, structural, and health inequities must be addressed. Targeted strategies to enhance and strengthen individual and community resilience may help vulnerable populations to adapt to the challenges of the COVID-19 pandemic and aid in their post-pandemic recovery. In addition to health promotion, Chandra et al. delineate education as a way to improve risk communication [44, 45]. Tailored educational materials can raise awareness, encourage protective behaviors, and relieve stress and anxiety by informing and empowering the community. The integration and collaboration of governmental and non-governmental entities are essential to building and strengthening community resilience [44] and build trust with minorities that often mistrust government and medical systems [48–50]. Moreover, the relationships between organizations and individuals can play a significant role in building social connectedness, further contributing to the resilience of a community [44].

Several strengths and limitations of our study must be acknowledged. Our study was conducted in a well-characterized cohort of an underserved and vulnerable population living in South Florida, largely comprised of low-income minorities living with and without HIV and high rates of comorbidities. As mentioned earlier, PLWH in the MASH cohort have been living with HIV for nearly two decades on average and are highly engaged with HIV care. Subsequently, our findings may not be generalizable to some groups of PLWH within the U.S., such as those recently diagnosed and those that may not be receiving treatment. On the other hand, the MASH cohort resembles a large portion of the U.S. population of PLWH in that they are on average middle-aged, Black non-Hispanic, and receiving HIV care [17, 51]. The HIV-uninfected participants from the MASH cohort were recruited from the same community as their HIV + peers, therefore representing middle-aged, low-income minorities with several social and economic disadvantages. Validated and frequently used measures of resilience and anxiety symptoms were used, allowing for comparisons to other communities and populations. However, the data was self-reported, thus subject to bias and under-reporting of substance use. Nonetheless, surveys were administered by trained research staff working with these participants every 6 months, which limits potential misunderstanding of the questions from the respondents. Lastly, the cross-sectional study design does not allow for causation to be inferred. Thus, longitudinal follow-up of the MASH cohort based on this study's findings may help us identify the unique social disparities and mental health challenges of a highly vulnerable community and inform public health practices to improve mental health relief during times of crises. The dissemination of our results can increase the public visibility and awareness of the mental health vulnerabilities faced by marginalized communities amid the

COVID-19 pandemic and unify efforts to eliminate mental health inequities.

Conclusions

The COVID-19 pandemic generated a global crisis, which has disproportionately impacted marginalized communities. Our findings support the assertion that PLWH, by chronically dealing with a potentially deadly disease (i.e. HIV infection), have acquired tools to build resilience, worry less about COVID-19, and experience fewer anxiety symptoms than their HIV-uninfected peers. Nonetheless, the high prevalence of anxiety and worry during the COVID-19 pandemic warrants improved public health efforts for mental health relief. A decline in cocaine use was observed; however, the decline is likely due to reduced availability and higher cost of the drug rather than personal choices. There is much to be learned from exploring how vulnerable communities are affected by the COVID-19 pandemic and the emerging changes on their mental health and substance use patterns. Research is needed to identify psychosocial factors that can improve the ability of marginalized communities to cope with the pandemic by providing strategies to build resilience to better prepare populations before, during, and after broadly impacting crises.

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Availability of Data Data described in the manuscript, code book, and analytic code will be made available upon request pending application and approval by the principal investigator (baumm@fiu.edu).

Declarations

Conflict of interest The authors have no conflicts of interest to report.

Consent to Participate All participants provided written informed consent.

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