

# COVID-19 Testing and the Impact of the Pandemic on the Miami Adult Studies on HIV Cohort

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**Background:** Socioeconomic disadvantages and potential immunocompromise raise particular concerns for people living with HIV (PLWH) and other marginalized communities during the COVID-19 pandemic. In this study, we explored COVID-19 testing and the impact of the pandemic among participants from the Miami Adult Studies on HIV cohort, predominantly composed of low-income minorities living with and without HIV.

**Methods:** Between July and August 2020, a telephone survey was administered to 299 Miami Adult Studies on HIV participants to assess COVID-19 testing, prevention behaviors, and psychosocial stressors. Health care utilization, antiretroviral adherence, food insecurity, and substance use during the pandemic were compared with those of their last cohort visit ( $7.8 \pm 2.9$  months earlier).

**Results:** Half of surveyed participants had been tested for COVID-19, 8 had tested positive and 2 had been hospitalized. PLWH ( $n = 183$ ) were 42% times less likely than HIV-uninfected participants to have been tested. However, after adjustment for age, employment, COVID-19 symptoms, mental health care, and substance use, the effect of HIV status was no longer significant. PLWH were more likely to have seen a health care provider, use face coverings, and avoid public transportation and less likely to be food insecure and drink hazardously. There were significant changes in substance use patterns during the pandemic when compared with those before.

**Conclusion:** PLWH, compared with their HIV-uninfected peers, were more likely to engage in preventive measures and health care during the pandemic, potentially reducing their exposure to COVID-19. There were no reported changes in antiretroviral adherence or health care utilization, but there were changes in substance use; these need to be monitored as this crisis progresses.

**Key Words:** COVID-19, HIV, health care disparities, vulnerable populations, food insecurity, substance abuse

(*J Acquir Immune Defic Syndr* 2021;87:1016–1023)

## INTRODUCTION

The emergence of the novel coronavirus disease 2019 (COVID-19) pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and the contingencies placed to mitigate the spread of the disease have had far-reaching effects, impacting economies,<sup>1</sup> increasing mental health concerns,<sup>2</sup> and straining health care systems globally.<sup>3</sup> In the United States, the pandemic has highlighted and exacerbated preexisting social inequities that have long been documented among racial-ethnic minorities and make them more vulnerable to the disease.<sup>4–8</sup> Standing disparities, such as poverty, food insecurity, and substance abuse, may further perpetuate disparities in COVID-19 outcomes.<sup>6</sup> As a result, Black and Hispanic communities have been disproportionately burdened by the pandemic.<sup>9</sup>

People living with HIV (PLWH) may be particularly vulnerable to the consequences of the pandemic. In the United States, HIV infections are mostly concentrated in poor communities and racial-ethnic minorities are overrepresented, particularly Black Americans.<sup>10</sup> There is also the concern of PLWH being immunocompromised, thus potentially more susceptible to the disease and adverse sequelae. In general, PLWH do not seem to be at increased risk of contracting COVID-19 than the general population, possibly related to antiretroviral therapy (ART).<sup>11</sup> Consequently, poor adherence to or not taking ART not only is a significant risk factor of HIV-related outcomes but also could increase risk for SARS-CoV-2 infection and outcomes. On the other hand, even in settings where ART is readily available, PLWH seem to be at increased risk for severe COVID-19 illness and mortality, partly, because of sociodemographic factors and high proportions of comorbidities and multimorbidity.<sup>12–14</sup>

The COVID-19 pandemic is a rapidly evolving public health emergency; thus, it is imperative to understand how vulnerable groups of the population are being affected. Understanding the impacts of social disparities and the psychosocial consequences of the pandemic has broad policy implications, especially for the acceptance of testing and vaccination uptake once a COVID-19 vaccine is available. This observational research aimed to explore COVID-19

Received for publication November 25, 2020; accepted February 16, 2021.  
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 The research reported in this publication was supported by the National Institute on Drug Abuse of the National Institutes of Health under award number U01DA040381, U01DA040381-05S1, and U24-DA044554-04S1. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.  
 The authors have no conflicts of interest to disclose.  
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testing and the impact of the pandemic among participants from the Miami Adult Studies on HIV (MASH) cohort. The following issues were addressed: COVID-19 testing, COVID-19–related behaviors, health care utilization and ART adherence, food insecurity, and substance use.

## METHODS

### Participants

A survey was administered through telephone to a convenience sample of 299 participants from the MASH cohort, which follows underserved people living with and without HIV from the downtown area of Miami, FL. Participants were eligible for the MASH cohort if they were 40 years or older and had proof of HIV status from medical records. The COVID-19 survey used (available at <https://www.c3pno.org>) was developed by the National Institute on Drug Abuse–funded Collaborating Consortium of Cohorts Producing National Institute on Drug Abuse Opportunities (C3PNO). Data were collected between July and August 2020. Verbal consent was obtained, witnessed, and documented by 2 members of the research staff. The protocol for this study was approved by the Institutional Review Board of Florida International University.

Data from participants' last visit for the cohort study ( $7.8 \pm 2.9$  months earlier) were used to compare the following factors from before the COVID-19 pandemic with responses to this survey: ART adherence, health care visits in the past 6 months, food insecurity (using the USDA Household Food Security Survey), and self-reported data for substance use in the previous month. The Alcohol Use Disorder Identification Test–Consumption (AUDIT-C) questionnaire was used to assess hazardous alcohol drinking (scores of  $\geq 4$  for men and  $\geq 3$  for women).<sup>15</sup> Binge drinking was determined with the AUDIT-3 (third item in AUDIT-C) and defined as “monthly or more” consumption of  $\geq 5$  or  $\geq 4$  drinks on one occasion for men and women, respectively.

### Statistical Analysis

The data analysis for this study was generated using SAS software, version 9.4, Copyright 2012 SAS Institute Inc. Descriptive statistics are reported as mean  $\pm$  SD or as No. (%). The  $\chi^2$  tests were performed for cross-sectional comparisons between PLWH and HIV-uninfected participants; the Fisher exact test was used in cases with small cell counts. McNemar tests were performed to compare differences in frequencies before and during the pandemic. The Cohen kappa correlation coefficient ( $\kappa$ ) was calculated to determine interrater reliability when comparing reports before and during the pandemic. In other words, the Kappa statistic was used to determine how consistently individuals maintained the same status;  $\kappa$  values were considered as slight (0.0–0.2), fair (0.2–0.4), moderate (0.4–0.6), high (0.6–0.8), and very high ( $\geq 0.8$ ) agreement. Logistic regressions were performed to identify factors associated with COVID-19 testing. Univariate regressions were performed to obtain crude odds ratios (ORs) and 95% confidence intervals (CIs).

A multiple regression model with a backward elimination method was used to identify the most important factors after adjustment for covariates. Variables were kept in the model if  $P < 0.1$  after adjustment for covariates. The results were considered statistically significant at 2-tailed  $P < 0.05$ .

## RESULTS

### Characteristics

Table 1 contains the characteristics of the cohort. A total of 183 PLWH and 116 HIV-uninfected participants were surveyed. Participants were mostly non-Hispanic Black ( $n = 231$ , 77.3%) and 56.9  $\pm$  316.8 years old. Most participants were unemployed ( $n = 252$ , 84.3%) and lived below the federal poverty level ( $n = 229$ , 76.6%). Eight percent of participants, or half of those who were employed ( $n = 24$ , 51.0%), had been furloughed or had their hours reduced because of the pandemic. On the other hand, most participants ( $n = 286$ , 95.6%) had stable housing (slept in a house or apartment), whereas 4.4% ( $n = 13$ ) reported sleeping in shelters, in transitional housing, in hotels/motels, or on the street. Approximately 40% ( $n = 118$ ) of participants reported some level of food insecurity. Almost all PLWH ( $n = 182$ , 99.5%) were taking ART, and 3 HIV-uninfected participants were taking ART for preexposure prophylaxis (PrEP).

### Substance Use

Overall, 144 (48.2%) participants smoked cigarettes, 103 (34.5%) engaged in hazardous drinking, 45 (15.1%) engaged in binge drinking, 71 (23.8%) used cannabis, 37 (12.4%) used cocaine, and 2 (0.7%) used heroin or fentanyl. The only significant difference in substance use during the COVID-19 pandemic was a higher prevalence of hazardous drinking among HIV-uninfected participants than PLWH (43.1% vs. 29.0%;  $P = 0.012$ ), with higher binge drinking as well, although the difference was not statistically significant (19.8% vs. 12.0%;  $P = 0.066$ ). Data are summarized in Table 1.

A total of 46 (15.4%) study subjects were participating in a 12-step program, and 42 of those (76.4%) reported cancellations of these services. Those who reported hazardous drinking, compared with those who did not, were significantly less likely to be participating in a 12-step program (19.5% vs. 6.8%;  $P = 0.004$ ). However, we found no other relationships between substance use and participation in or cancellations of 12-step programs (data not shown). Among the 37 participants who reported the use of cocaine, 6 (16.2%) reported using more of it during the pandemic, whereas 21 (56.8%) reported using less, 21 (56.8%) reported that it was of worse quality, and 23 (62.2%) reported its prices had increased (data not shown).

### COVID-19–Related Outcomes

Participants were asked whether they were currently experiencing symptoms that are associated with COVID-19. Forty-two participants (14.1%) reported the following symptoms: subjective fever ( $n = 2$ , 0.7%), muscle aches or pain

**TABLE 1.** Characteristics of Miami Adult Studies on HIV (MASH) Cohort Participants During the COVID-19 Pandemic

|  | Total       | HIV+        | HIV-        | P            |
|--|-------------|-------------|-------------|--------------|
|  | (N = 299)   | (N = 183)   | (N = 116)   |              |
|  | N (%)       | N (%)       | N (%)       |              |
| Age (mean ± SD)  | 56.9 ± 6.8  | 56.5 ± 6.5  | 57.6 ± 7.1  | 0.161        |
| Sex (women)  | 153 (51.2)  | 91 (49.7)   | 62 (53.5)   | 0.531        |
| Race/ethnicity   |             |             |             |              |
| Black, non-Hispanic                                    | 231 (77.3)  | 141 (77.1)  | 90 (77.6)   | 0.795        |
| White, Hispanic  | 34 (11.4)   | 19 (10.4)   | 15 (12.9)   |              |
| White, non-Hispanic                                    | 21 (7.0)    | 14 (7.7)    | 7 (6.0)     |              |
| Multiracial/other                                      | 13 (4.4)    | 9 (4.9)     | 4 (3.5)     |              |
| Annual income (per \$1000, mean ± SD)                  | 13.1 ± 11.1 | 12.8 ± 10.0 | 13.6 ± 12.8 | 0.553        |
| Below poverty level                                    | 229 (76.6)  | 143 (78.1)  | 86 (74.1)   | 0.426        |
| Unstable housing*                                      | 13 (4.4)    | 7 (3.8)     | 6 (4.2)     | 0.578        |
| Employment   |             |             |             |              |
| Unemployed   | 252 (84.3)  | 159 (86.9)  | 93 (84.3)   | 0.296        |
| Employed, but furloughed or reduced hours              | 24 (8.0)    | 12 (6.6)    | 12 (10.3)   |              |
| Employed, no change                                    | 23 (7.7)    | 12 (6.6)    | 11 (9.5)    |              |
| Food insecurity  |             |             |             |              |
| I have not had enough money to buy food                | 51 (17.1)   | 26 (14.2)   | 25 (21.6)   | 0.152        |
| I have had to ration my food, so I do not run out      | 46 (15.4)   | 25 (13.7)   | 21 (18.1)   |              |
| I have not been able to find foods I need in the store | 21 (7.0)    | 12 (6.6)    | 9 (7.8)     |              |
| Substance use  |             |             |             |              |
| Cigarette smoking                                      | 144 (48.2)  | 86 (47.0)   | 58 (50.0)   | 0.612        |
| Hazardous drinking                                     | 103 (34.5)  | 53 (29.0)   | 50 (43.1)   | <b>0.012</b> |
| Binge drinking   | 45 (15.1)   | 22 (12.0)   | 23 (19.8)   | 0.066        |
| Cannabis   | 71 (23.8)   | 41 (22.4)   | 30 (25.9)   | 0.494        |
| Cocaine  | 37 (12.4)   | 20 (10.9)   | 17 (14.7)   | 0.340        |
| Heroin and/or fentanyl                                 | 2 (0.7)     | 1 (0.6)     | 1 (0.9)     | 1.000†       |

\*Sleeping in shelters, in transitional housing, in hotels/motels, or on the street, when compared with sleeping in a house or apartment.

†Fisher exact test.

Bold values denote statistical significant at P < 0.05.

(n = 12, 4.0%), runny nose (n = 6, 2.0%), sore throat (n = 2, 0.7%), new onset cough or worsening of chronic cough (n = 4, 1.3%), shortness of breath (n = 6, 2.0%), nausea or vomiting (n = 1, 0.3%), headache (n = 3, 1.0%), abdominal pain (n = 1, 0.3%), diarrhea (n = 3, 1.0%), or sudden loss of taste or smell (n = 2, 0.7%). PLWH tended to have fewer of these symptoms (P = 0.054); Table 2.

Most participants reported engaging in preventive practices, such as social distancing (n = 291, 97.3%), following media coverage related to COVID-19 (n = 281, 94.0%), increased handwashing or use of hand sanitizers (n = 286, 96.7%), and use of face coverings in public

(n = 294, 98.3%), as summarized in Table 2. In addition, 36.5% (n = 109) reported self-isolation or self-quarantining, and 41.1% (n = 123) avoided public transportation. PLWH were more likely than uninfected participants to use face coverings in public (100% vs. 95.7%, respectively; P = 0.008) and avoid public transportation (47.0% vs. 31.9%; P = 0.010) and tended to report more handwashing or use of hand sanitizers (97.3% vs. 93.1%; P = 0.085). There were no significant differences in social distancing, isolation, or self-quarantining or following media coverage related to COVID-19, but PLWH had higher odds for all these compared with HIV-uninfected participants.

Participants were asked, “How much has the COVID-19 pandemic impacted your day-to-day life?” More than half (n = 185, 61.9%) reported being impacted “much,” “very much,” or “extremely,” with no significant difference between PLWH and uninfected participants (Table 2).

### Food Insecurity

Overall, 39.5% (n = 118) of participants reported some level of food insecurity, which was significantly less prevalent among PLWH than uninfected participants (34.4% vs. 47.4%; P = 0.026), as summarized in Table 2.

### Health care and ART Adherence

Nearly all participants (n = 282, 94.3%) had seen a health care provider in the previous 6 months; however, this was significantly more common among PLWH than uninfected participants (97.3 vs. 89.7%; P = 0.010). In addition, 20.2% (n = 37) of PLWH and 32.8% (n = 38) of uninfected participants had avoided health care in the past month because of the coronavirus (P = 0.016).

Among PLWH, 11 (6.0%) had missed an appointment with their HIV care provider in the past month and 6 (54.6%) of those were due to cancellations. In addition, 24 (13.2%) PLWH had avoided picking up their ART because of the pandemic, and 15 (8.2%) had missed at least 1 dose in the past month. Among HIV-uninfected participants, 2 of 3 (66.7%) had missed a dose of PrEP in the past month.

### Changes During the Pandemic

Table 3 compares ART adherence, health care utilization, food insecurity, and substance use before and during the pandemic. There were no significant changes in ART adherence or health care utilization. There was only slight agreement among those who reported missing a dose of ART between the 2 periods (κ = 0.158) and no agreement among those who did not seek health care (κ = -0.031). None of the uninfected participants taking PrEP during the pandemic reported the use of PrEP before the pandemic. Similarly, there was no significant change in the prevalence of food insecurity before and during the pandemic (P = 0.157). However, those who experienced food insecurity before and during the pandemic were, for the most part, different individuals (κ = 0.157).

**TABLE 2.** COVID-19–Related Outcomes, Food Insecurity, and Health Care Utilization in PLWH Compared with HIV-Uninfected Participants During COVID-19 Pandemic

|   | N   | Total (N = 299) | HIV+ (N = 183) | HIV– (N = 116) | OR (95% CI)          | P             |
|---|-----|-----------------|----------------|----------------|----------------------|---------------|
|   |     | N (%)           | N (%)          | N (%)          |                      |               |
| COVID-19 symptoms (nonspecific)*                | 299 | 42 (14.1)       | 20 (10.9)      | 22 (19.0)      | 0.52 (0.27 to 1.01)  | 0.054         |
| COVID-19–related behaviors                      |     |                 |                |                |                      |               |
| Social distancing                               | 299 | 291 (97.3)      | 180 (98.4)     | 111 (95.7)     | 2.70 (0.63 to 11.5)  | 0.179         |
| Isolating or quarantining                       | 299 | 109 (36.5)      | 70 (38.3)      | 39 (33.6)      | 1.22 (0.75 to 1.99)  | 0.418         |
| Following media coverage related to COVID-19    | 299 | 281 (94.0)      | 174 (95.1)     | 107 (92.2)     | 1.63 (0.63 to 4.23)  | 0.318         |
| Increased handwashing and use of hand sanitizer | 299 | 286 (95.7)      | 178 (97.3)     | 108 (93.1)     | 2.64 (0.84 to 8.27)  | 0.085         |
| Face covering                                   | 299 | 294 (98.3)      | 183 (100)      | 111 (95.7)     | NC†                  | <b>0.008‡</b> |
| Avoiding public transportation                  | 299 | 123 (41.1)      | 86 (47.0)      | 37 (31.9)      | 1.89 (1.16 to 3.08)  | <b>0.010</b>  |
| Impact of pandemic on day-to-day life§          | 299 | 185 (61.9)      | 111 (60.7)     | 74 (63.4)      | 0.88 (0.54 to 1.42)  | 0.586         |
| Food insecurity                                 | 299 | 118 (39.5)      | 63 (34.4)      | 55 (47.4)      | 0.58 (0.36 to 0.94)  | <b>0.026</b>  |
| Health care utilization                         |     |                 |                |                |                      |               |
| Visit to a health care provider within 6 mo     | 299 | 282 (94.3)      | 178 (97.3)     | 104 (89.7)     | 4.11 (1.41 to 12.0)  | <b>0.010</b>  |
| Avoided health care in the past month           | 299 | 75 (25.1)       | 37 (20.2)      | 38 (32.8)      | 0.52 (0.31 to 0.88)  | <b>0.016</b>  |
| Mental health care was interrupted§             | 299 | 174 (58.2)      | 108 (59.0)     | 66 (56.9)      | 1.09 (0.68 to 1.75)  | 0.747         |
| Tested for COVID-19                             |     |                 |                |                |                      |               |
| PCR test  | 299 | 123 (41.1)      | 62 (33.9)      | 61 (52.6)      | 0.46 (0.29 to 0.74)  | <b>0.002</b>  |
| Antibodies test                                 | 299 | 45 (15.1)       | 30 (16.4)      | 15 (12.9)      | 0.78 (0.40 to 1.48)  | 0.416         |
| PCR and/or antibody test                        | 299 | 148 (49.5)      | 81 (44.3)      | 67 (57.8)      | 0.58 (0.36 to 0.93)  | <b>0.023</b>  |
| Positive result¶                                | 142 | 8 (5.6)         | 6 (7.6)        | 2 (3.2)        | 2.51 (0.49 to 12.9)  | 0.271         |
| Hospitalized because of COVID-19                | 299 | 2 (0.7)         | 1 (0.6)        | 1 (0.9)        | 0.26 (0.002 to 31.3) | 0.923‡        |

Bold values denote statistical significant at P < 0.05.

\*At least one of the following: subjective fever, muscle aches or pain, runny nose, sore throat, new onset cough or worsening of chronic cough, shortness of breath, nausea or vomiting, headache, abdominal pain, diarrhea, or sudden loss of taste or smell.

†OR (95% CI) could not be computed because of n = 0 HIV-positive participants who did not use face coverings.

‡Exact logistic regression performed because of small N or 0 cell count.

§“Much,” “very much,” or “extremely” vs. “not at all” or “a little.”

||Food insecurity was defined as an affirmative response to any of the following: “I have not had enough money to buy food,” “I have had to ration my food so I do not run out,” or “I have not been able to find foods I need in the store.”

¶Six participants had not received results.

NC, not computed.

Compared with before the pandemic, rates of cigarette smoking and cocaine use were significantly lower during the pandemic, whereas the rate of binge drinking significantly increased. However, when stratified by HIV status, the reduction in smoking was only significant among PLWH (53.0% to 47.0%; P = 0.016) and the increase in binge drinking was only significant among uninfected participants (9.5% to 19.8%; P = 0.010). The reduction in cocaine use was significant for both PLWH (30.6% to 10.9%; P < 0.0001) and uninfected participants (38.8% to 14.7%; P < 0.0001). No significant change in the use of cannabis was observed, with 26.8% and 23.8% prevalence before and during the pandemic, respectively (P > 0.1). There was moderate-to-high interrater agreement for most substances, for the exception of binge drinking that showed mild agreement. In other words, those who used substances before the pandemic were generally likely to continue using those substances, but most of those who engaged in binge drinking during the pandemic were not doing so before the pandemic.

### COVID-19 Testing

As seen in Table 2, half of participants (n = 148, 49.5%) had been tested for COVID-19: 123 (41.1%)

participants were tested for SARS-CoV-2 viral material by polymerase chain reaction (PCR) with nasal/oral swabs, and 45 (15.1%) were tested for antibodies with blood; 20 participants reported both modalities. Overall, PLWH were significantly less likely than uninfected participants to have been tested (44.3 vs. 57.8%; P = 0.02). That said, between the 2 modalities of testing, the difference was driven by fewer PCR tests among PLWH compared with those among HIV-uninfected participants. A total of 8 participants had tested positive (6 HIV-positive and 2 uninfected), and 2 had been hospitalized because of COVID-19 (1 HIV-positive and 1 uninfected); 6 participants had not received results for the COVID-19 test.

We performed analyses to explore which factors might predict COVID-19 testing (Table 4). In univariate regressions, living with HIV (OR = 0.58, 95% CI: 0.36 to 0.93; P = 0.023) and interrupted mental health care were significantly associated with reduced COVID-19 testing, whereas having at least one COVID-19–related symptom and cigarette smoking were associated with increased COVID-19 testing. In multivariable regression, having been furloughed from employment (OR = 0.28, 95% CI: 0.10 to 0.74; P = 0.013) and interruptions in mental health care (OR = 0.58, 95% CI: 0.35 to 0.94; P = 0.027) were

**TABLE 3.** Comparisons of ART Adherence, Health care Utilization, Food Insecurity, and Substance Use Before and During the COVID-19 Pandemic

|  | N   | Before     | During     | P*                | κ      |
|--|-----|------------|------------|-------------------|--------|
|  |     | N (%)      | N (%)      |                   |        |
| ART adherence (missed at least 1 dose in the past 7 d) |     |            |            |                   |        |
| HIV-positive   | 183 | 19 (10.4)  | 15 (8.2)   | 0.433             | 0.158  |
| Health care utilization (in the past 6 mo)†            |     |            |            |                   |        |
| HIV-positive   | 183 | 176 (96.2) | 178 (97.3) | 0.763             | -0.031 |
| Uninfected   | 116 | 104 (89.7) | 103 (88.8) | 0.835             | -0.031 |
| Total  | 299 | 279 (93.6) | 281 (94.3) | 0.732             | -0.031 |
| Food insecurity  |     |            |            |                   |        |
| HIV-positive   | 183 | 55 (30.1)  | 63 (34.4)  | 0.310             | 0.226  |
| Uninfected   | 116 | 49 (42.2)  | 55 (47.4)  | 0.423             | 0.027  |
| Total  | 299 | 104 (34.8) | 118 (39.5) | 0.198             | 0.157  |
| Cigarette smoking                                      |     |            |            |                   |        |
| HIV-positive   | 183 | 97 (53.0)  | 86 (47.0)  | <b>0.016</b>      | 0.771  |
| Uninfected   | 116 | 61 (52.6)  | 58 (50.0)  | 0.439             | 0.741  |
| Total  | 299 | 158 (52.8) | 144 (48.2) | <b>0.020</b>      | 0.760  |
| Hazardous drinking                                     |     |            |            |                   |        |
| HIV-positive   | 183 | 55 (30.1)  | 53 (29.0)  | 0.739             | 0.527  |
| Uninfected   | 116 | 43 (37.1)  | 50 (43.1)  | 0.178             | 0.517  |
| Total  | 299 | 98 (32.8)  | 103 (34.5) | 0.529             | 0.528  |
| Binge drinking   |     |            |            |                   |        |
| HIV-positive   | 183 | 15 (8.2)   | 22 (12.0)  | 0.162             | 0.251  |
| Uninfected   | 116 | 11 (9.5)   | 23 (19.8)  | <b>0.010</b>      | 0.258  |
| Total  | 299 | 26 (8.7)   | 45 (15.1)  | <b>0.006</b>      | 0.256  |
| Cannabis   |     |            |            |                   |        |
| HIV-positive   | 183 | 47 (25.7)  | 41 (22.4)  | 0.201             | 0.671  |
| Uninfected   | 116 | 33 (28.5)  | 30 (25.9)  | 0.366             | 0.761  |
| Total  | 299 | 80 (26.8)  | 71 (23.8)  | 0.117             | 0.708  |
| Cocaine  |     |            |            |                   |        |
| HIV-positive   | 183 | 56 (30.6)  | 20 (10.9)  | <b>&lt;0.0001</b> | 0.404  |
| Uninfected   | 116 | 45 (38.8)  | 17 (14.7)  | <b>&lt;0.0001</b> | 0.385  |
| Total  | 299 | 101 (33.8) | 37 (12.4)  | <b>&lt;0.0001</b> | 0.398  |
| Heroin and/or fentanyl                                 |     |            |            |                   |        |
| HIV-positive   | 183 | 3 (1.6)    | 1 (0.6)    | 0.157             | 0.496  |
| Uninfected   | 116 | 1 (0.9)    | 1 (0.9)    | 1.000             | 1.00   |
| Total  | 299 | 2 (0.7)    | 4 (1.3)    | 0.157             | 0.664  |

Bold values denote statistical significant at P < 0.05.

\*McNemar test.

†Saw a health care provider (doctor, nurse, or other health care provider) in the past 6 months compared with no health care in the past 6 months.

significantly associated with reduced COVID-19 testing, whereas older age (OR = 1.21, 95% CI: 1.01 to 1.45; P = 0.036), having at least one COVID-19–related symptom (OR = 2.18, 95% CI: 1.08 to 4.43; P = 0.030), and cigarette smoking (OR = 1.95, 95% CI: 1.18 to 3.21; P = 0.009) were associated with increased COVID-19 testing. HIV status, however, was no longer associated with COVID-19 testing (P > 0.1). In the multivariable model, the use of cannabis was associated with lower odds of testing, although it did not reach statistical significance (OR = 0.57, 95% CI: 0.32 to 1.02; P = 0.059).

## DISCUSSION

This research explored how the COVID-19 pandemic has affected participants living with and without HIV from the MASH cohort. These participants, followed up for up to 12 years, are members of a vulnerable population predominantly comprising socioeconomically disadvantaged Black and Hispanic individuals with high rates of substance use. In the United States, Black and Hispanic communities have been disproportionately affected by the pandemic, with increased rates of COVID-19 infections, hospitalizations, and mortality.<sup>9</sup> Additional concerns arise regarding those infected with HIV due to potentially immunocompromised status<sup>14</sup> and those with substance use disorders.<sup>16,17</sup> Our goal was to show how this population has been affected by the pandemic to generate research questions and hypotheses. The data were collected from July to August 2020, a time when COVID-19 rates were starting to decline in South Florida after an earlier spike in cases.<sup>18</sup> In fact, Florida has been one of the hardest-hit states, with more than 784,000 cases and more than 16,700 deaths (at the time of this writing).<sup>18</sup> In particular, Miami-Dade County, where the MASH cohort resides, accounts for nearly a quarter of all cases and has the highest death rate in the state.<sup>18</sup>

In general, our findings point to several potentially protective factors among PLWH compared with those among uninfected participants, including higher use of face coverings in public, increased hand hygiene, and avoidance of public transportation, while being less likely to report COVID-19 symptoms, food insecurity, and hazardous drinking. In addition, PLWH were 4 times as likely to have seen a health care professional and about half as likely to report avoiding health care because of the pandemic. Our findings indicate that in this population, PLWH might be benefitting from increased engagement in preventive measures and health care. Moreover, we found no significant changes in ART adherence, health care utilization, or food insecurity during the pandemic compared with 7.8 ± 2.9 months earlier—just before the first cases reported in the United States—indicating that this population has not experienced major changes in access to food or health care. It is possible that PLWH may be better equipped to protect themselves against COVID-19 because of their experiences with HIV, a potentially deadly infectious disease.<sup>19</sup> In addition, PLWH need to be closely monitored for HIV disease progression<sup>20</sup> and have had an established health care system through the Ryan White HIV/AIDS Program<sup>21</sup> and the Affordable Care Act of 2010.<sup>22</sup> These factors may account for the behavioral differences seen between HIV-infected and HIV-uninfected participants in the MASH cohort during the COVID-19 pandemic.

Approximately 50% of the participants had been tested for COVID-19 (41% PCR and 15% antibodies), 8 of those (5.6%) had tested positive, and 2 had been hospitalized because of the disease. Interestingly, PLWH were about 40% less likely than uninfected participants to have been tested for COVID-19. Other factors associated with decreased testing included having been furloughed or hours reduced at work and having interruptions in mental health care. By contrast, older age, COVID-19–related symptoms, and cigarette

**TABLE 4.** Predictors of COVID-19 Testing

| Parameter                                       | N   | Univariate          |              | Multivariable*      |              |
|---|-----|---------------------|--------------|---------------------|--------------|
|   |     | OR (95% CI)         | P            | OR (95% CI)         | P            |
| Age (per 5 yr)                                  | 299 | 1.16 (0.98 to 1.38) | 0.083        | 1.21 (1.01 to 1.45) | <b>0.036</b> |
| Sex   |     |                     |              |                     |              |
| Women   | 153 | 0.91 (0.58 to 1.44) | 0.689        |                     |              |
| Men   | 146 | Reference           | —            |                     |              |
| Race/ethnicity                                  |     |                     |              |                     |              |
| White non-Hispanic                              | 21  | 0.92 (0.38 to 2.24) | 0.850        |                     |              |
| White Hispanic                                  | 34  | 1.01 (0.49 to 2.07) | 0.891        |                     |              |
| Multiracial/other                               | 13  | 0.87 (0.28 to 2.65) | 0.800        |                     |              |
| Black non-Hispanic                              | 231 | Reference           | —            |                     |              |
| HIV   | 183 | 0.58 (0.36 to 0.93) | <b>0.023</b> |                     |              |
| HIV-uninfected                                  | 116 | Reference           | —            |                     |              |
| Income (below poverty)                          | 229 | 0.84 (0.49 to 1.43) | 0.521        |                     |              |
| Above poverty                                   | 70  | Reference           | —            |                     |              |
| Housing   | 286 | 0.83 (0.27 to 2.54) | 0.749        |                     |              |
| Unstable housing†                               | 13  | Reference           | —            |                     |              |
| Employment                                      |     |                     |              |                     |              |
| Unemployed                                      | 252 | 0.44 (0.13 to 1.45) | 0.438        | 0.46 (0.13 to 1.58) | 0.770        |
| Employed, but furloughed or reduced hours       | 24  | 0.40 (0.16 to 1.00) | 0.123        | 0.28 (0.10 to 0.74) | <b>0.013</b> |
| Employed, no change                             | 23  | Reference           | —            |                     |              |
| COVID-19 symptoms (nonspecific)‡                | 42  | 1.80 (0.92 to 3.51) | 0.086        | 2.18 (1.08 to 4.43) | <b>0.030</b> |
| No symptoms                                     | 257 | Reference           | —            |                     |              |
| COVID-19–related behaviors                      |     |                     |              |                     |              |
| Social distancing                               | 291 | 1.12 (0.71 to 1.78) | 0.619        |                     |              |
| Isolating or quarantining                       | 109 | 1.00 (0.63 to 1.61) | 0.991        |                     |              |
| Following media coverage related to COVID-19    | 281 | 0.98 (0.38 to 2.54) | 0.965        |                     |              |
| Increased handwashing and use of hand sanitizer | 286 | 1.15 (0.38 to 3.51) | 0.806        |                     |              |
| Face covering                                   | 294 | 0.65 (0.11 to 3.94) | 0.638        |                     |              |
| Avoiding public transportation                  | 123 | 1.12 (0.71 to 1.78) | 0.619        |                     |              |
| Impact of pandemic on day-to-day life§          | 185 | 1.29 (0.81 to 2.05) | 0.292        |                     |              |
| Food insecurity                                 | 118 | 1.16 (0.73 to 1.84) | 0.540        |                     |              |
| Health care                                     |     |                     |              |                     |              |
| Visit to a health care provider within 6 mo     | 282 | 1.86 (0.67 to 5.17) | 0.234        |                     |              |
| Avoided health care (in the past month)         | 75  | 0.84 (0.51 to 1.45) | 0.572        |                     |              |
| Mental health care was interrupted              | 174 | 0.60 (0.38 to 0.96) | <b>0.033</b> | 0.58 (0.35 to 0.94) | <b>0.027</b> |
| Substance use                                   |     |                     |              |                     |              |
| Cigarette smoking                               | 144 | 1.60 (1.01 to 2.53) | <b>0.044</b> | 1.95 (1.18 to 3.21) | <b>0.009</b> |
| Hazardous drinking                              | 103 | 0.79 (0.49 to 1.27) | 0.333        |                     |              |
| Binge drinking                                  | 45  | 0.79 (0.42 to 1.49) | 0.463        |                     |              |
| Cannabis  | 71  | 0.74 (0.43 to 1.26) | 0.261        | 0.57 (0.32 to 1.02) | 0.059        |
| Cocaine   | 37  | 1.09 (0.55 to 2.17) | 0.810        |                     |              |
| Heroin and/or fentanyl                          | 2   | 1.02 (0.06 to 16.5) | 0.989        |                     |              |

Bold values denote statistical significant at P < 0.05.

\*A multiple regression model with a backward elimination method was used to identify the most important predictors of COVID-19 testing after adjustment for covariates. Variables were kept in the model if P < 0.1 after adjustment for covariates.

†Sleeping in shelters, in transitional housing, in hotels/motels, or on the street, when compared with sleeping in a house or apartment.

‡At least one of the following: subjective fever, muscle aches or pain, runny nose, sore throat, new onset cough or worsening of chronic cough, shortness of breath, nausea or vomiting, headache, abdominal pain, diarrhea, or sudden loss of taste or smell.

§“Much,” “very much,” or “extremely” vs. “not at all” or “a little.”

||Food insecurity was defined as an affirmative response to any of the following: “I have not had enough money to buy food,” “I have had to ration my food so I do not run out,” or “I have not been able to find foods I need in the store.”

smoking were associated with increased testing. We found that once these factors were accounted for, HIV status was no longer associated with COVID-19 testing. In particular, reporting at least one COVID-19 symptom was associated

with more than twice the odds of having been tested, and nearly half as many PLWH than HIV-uninfected participants reported COVID-19 symptoms. As such, the data suggest that PLWH were tested less frequently because of demographic,

social, and behavioral factors that may have reduced their exposure to COVID-19 and subsequently decreased their need for testing. Antiretroviral therapy may offer an additional layer of protection from infection with the virus.<sup>11</sup> Notably, most PLWH in the MASH cohort have been engaged in HIV care and adherent to ART before and during the COVID-19 epidemic. Nonetheless, 8% had missed at least one dose and 13% had avoided picking up ART, leaving room for improvement. Longitudinal follow-up of these participants will help us determine whether HIV viral loads and viral suppression are being affected.

Testing is a cornerstone of public health efforts to mitigate the spread of communicable diseases, yet many sectors of the US population continue to have inadequate access to COVID-19 testing.<sup>23–25</sup> Because PLWH reported more preventive measures and were nearly half as likely to report COVID-19–related symptoms than their HIV-uninfected peers, it is possible that reduced exposure to COVID-19 led to a lesser perceived need for testing. Further research is needed to examine perceptions and attitudes about COVID-19 testing in this population. Nonetheless, disparities in testing can lead to increased infection rates.<sup>26</sup> Many individuals infected with SARS-CoV-2 are pre-symptomatic, asymptomatic, or mildly symptomatic with non-specific symptoms but have similar viral loads to symptomatic patients, thus may be unwitting viral carriers.<sup>27</sup> There is also mounting evidence that reinfection is possible, in some cases with worse disease outcomes.<sup>28</sup> Thus far, PLWH do not seem to be at increased risk of COVID-19, but once infected, PLWH are at increased risk for severe course of illness.<sup>12–14</sup> In addition, there may have been unaccounted factors that contributed to the disproportionate testing. For example, anticipated COVID-19 stigma, or the expectation of experiencing discrimination related to COVID-19, has been identified as a barrier to testing.<sup>29</sup> This may particularly affect PLWH, a marginalized population that already struggles with HIV-related stigma.<sup>10,30</sup> Continued research is necessary to understand trends, behaviors, and barriers related to COVID-19 testing among PLWH.

The COVID-19 pandemic has resulted in a significant increase of food insecurity in the United States.<sup>31,32</sup> However, in the MASH cohort, the prevalence of food insecurity did not significantly increase during the pandemic. Still, the prevalence of food insecurity was approximately 40%, an alarming rate reflective of the disadvantages that this population faces. Indeed, we suspect that the lack of change in food security status is related to their socioeconomic conditions before the pandemic, namely that this population was already mostly unemployed and receiving government assistance, with drastically high rates of poverty and other social disparities. On the other hand, we observed a lower prevalence of food insecurity among PLWH than HIV-uninfected participants. This could be related to many food assistance programs in the area that are exclusive to PLWH and more access to disability benefits because of their HIV status. The higher rate of food insecurity among the HIV-uninfected participants may also be related to the higher rate of hazardous drinking; because of competing interests, they may use the money for alcohol instead of food.

Alternatively, we observed several changes in substance use patterns. Similar results were observed in a smaller sample of MASH cohort participants (J. Diaz-Martinez,

unpublished data, 2020). The pandemic has affected the availability of illicit substances, with a subsequent spike in drug prices that may make it more difficult for low-income individuals to obtain these drugs.<sup>33,34</sup> Consistent with these reports, cocaine use in the MASH cohort drastically declined from 33.8% to 12.4% of participants, with more than half of current users reporting that they used it less frequently, it was of worse quality, and its prices had increased. It is also possible that social distancing and isolation may have also played a role in reducing the use of cocaine. With reduced availability of illicit drugs, many drug users may resort to more easily obtained substances, such as alcohol.<sup>35</sup> A recent survey of US adults found significantly increased rates of alcohol consumption and binge drinking during the COVID-19 pandemic.<sup>36</sup> Although we found no significant changes in rates of hazardous drinking, binge drinking significantly increased among HIV-uninfected participants. In addition, HIV-uninfected participants were more likely to report hazardous drinking than PLWH during the pandemic, with a trend for more binge drinking as well. Those who reported hazardous drinking were less likely to participate in a 12-step program, but this relationship was not seen with binge drinking or any other substance. There was also a small but significant decrease in cigarette smoking among PLWH, which was also associated with increased testing. It is possible that individuals are responding to news that smokers are at increased risk for COVID-19–related mortality.<sup>37</sup>

This study is limited by exclusive use of self-reported data. The findings of this study are not meant to be generalized to the general population. Indeed, the MASH cohort is a highly vulnerable population composed of US minorities who experience many social disparities, including increased rates of poverty, food insecurity, and substance abuse. That said, the HIV-infected participants in the MASH cohort represent individuals who are highly engaged in HIV care and adherent to treatment. Nearly all PLWH in the MASH cohort are taking ART and approximately 85% of PLWH in the MASH cohort have been virally suppressed (HIV viral load < 200 copies/mL) since 2016. The Centers for Disease Control and Prevention reports that 76% of all US PLWH received HIV medical care in 2018 and 85% of those engaged in HIV care were virally suppressed.<sup>38</sup> Therefore, regarding HIV care, the MASH cohort resembles most PLWH in the United States, but our findings may not be generalizable to the subset of PLWH who are not receiving or engaged in HIV care. A strength of the study is that these participants are part of a longitudinal cohort study, allowing for future investigations. The survey used in this study is being used across several C3PNO cohorts, allowing for future cross-cohort comparisons. Future research could consider beliefs and attitudes about COVID-19 testing and vaccinations.

## CONCLUSIONS

In this study, we explored the impact of the COVID-19 pandemic on the MASH cohort, a group comprising predominantly low-income, middle-aged minorities living with and without HIV. Our findings suggest that PLWH, compared with their HIV-uninfected peers, are more likely to engage in preventive measures and health care during the pandemic, potentially reducing their

exposure to COVID-19. That said, PLWH reported fewer COVID-19 tests, and although confounding factors such as COVID-19-related symptoms explained the difference, gaps in testing within vulnerable communities may increase the risk of spread of the disease because many individuals may be unwitting viral carriers (ie, presymptomatic or asymptomatic). Testing for COVID-19 within this population needs to be further investigated, along with potential barriers, facilitators, beliefs, and attitudes to testing. There were no reported changes in ART adherence or health care utilization during when compared with those before the pandemic. Investigating changes in HIV viral loads and CD4<sup>+</sup> cell counts is warranted to corroborate these findings. On the other hand, there were changes in substance use behaviors, including an overall decline in cocaine use, which need to be continually monitored as this crisis progresses.

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