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The Role of At-Risk Alcohol/Drug Use and Treatment in Appointment Attendance and Virologic Suppression Among HIV$^+$ African Americans

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Abstract

The causes of poor clinic attendance and incomplete virologic suppression among HIV$^+$ African Americans (AAs) are not well understood. We estimated the effect of at-risk alcohol/drug use and associated treatment on attending scheduled appointments and virologic suppression among 576 HIV$^+$ AA patients in the University of Alabama at Birmingham (UAB) 1917 Clinic Cohort who contributed 591 interviews to the analysis. At interview, 78% of patients were new to HIV care at UAB, 38% engaged in at-risk alcohol/drug use or received associated treatment in the prior year, while the median (quartiles) age and CD4 count were 36 (28; 46) years and 321 (142; 530) cells/μl, respectively. In the 2 years after an interview, half of the patients had attended at least 82% of appointments while half had achieved virologic suppression for at least 71% of RNA assessments. Compared to patients who did not use or receive treatment, the adjusted risk ratio (aRR) for attending appointments for patients who did use but did not receive treatment was 0.97 (95% confidence limits: 0.92, 1.03). The corresponding aRR for virologic suppression was 0.94 (0.86, 1.03). Compared to patients who did not receive treatment but did use, the aRR for attending appointments for patients who did receive treatment and did use was 0.86 (0.78, 0.95). The corresponding aRR for virologic suppression was 1.07 (0.92, 1.24). Use was negatively associated with attendance and virologic suppression among patients not in treatment. Among users, treatment was negatively associated with attendance yet positively associated with virologic suppression. However, aRR estimates were imprecise.

Introduction

In 2009, African Americans (AAs) accounted for 12% of the United States population. However, compared to other racial and ethnic groups, AAs continue to be overrepresented among cases of adverse HIV-related outcomes at all stages of HIV disease.[1] Specifically, AAs are more likely than non-AAs to become HIV infected[2] and suffer disproportionally from poor HIV-related outcomes, including virologic failure[3,4] and death.[2,5] Reduced access to and use of medical services have been indicated as key determinants of racial disparities in HIV-related morbidity and mortality.[5,6]

Among patients in HIV care, AAs are more likely than whites to miss scheduled clinic appointments.[4,7–9] Missing scheduled clinic appointments may be a marker of reduced access to and engagement in care and has been linked to a greater burden of virologic failure,[4,10,14] AIDS-defining illnesses,[15] and death.[16–18] Mugavero *et al*.[4] demonstrated that the proportion of scheduled appointments that were missed partially explained why AAs were less likely to suppress plasma HIV-1 RNA levels while on antiretroviral therapy (ART) compared to whites in the University of Alabama at Birmingham (UAB) 1917 Clinic Cohort.

The link between missed scheduled clinic appointments and poor HIV-related outcomes may be due to lower receipt and less timely modification of as well as nonadherence to ARTs among those who frequently miss scheduled appointments.[4] However, the reasons for less frequent scheduled

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clinic attendance among AAs are not well characterized. Guided by the Anderson[19] and Messeri[20] models for health services access and use as well as observed lower use or completion of abuse treatment services among AAs compared to whites, drug and alcohol use may play a role in racial disparities in clinic attendance.[21,22] To add to the limited, but critical literature on alcohol/drug use, scheduled appointment attendance, and HIV virologic responses among AAs, we used data on 576 AA patients in the UAB 1917 Clinic Cohort to estimate the effect of at-risk alcohol/drug use and associated treatment on attending scheduled clinic appointments and achieving virologic suppression.

Materials and Methods

Study population

The UAB 1917 Clinic Cohort is an HIV clinical cohort established in 1992 that collects sociodemographic, psychosocial, and clinical information from all patients who receive care at the UAB 1917 HIV/AIDS Clinic. The UAB institutional review board approved all study forms and protocols. Relevant patient information was obtained from medical records and an administered interview introduced in January 2007. Additional details regarding data collection for this clinic cohort are provided elsewhere.[23]

Of the 892 new or returning (after more than 12 months out of care) AA patients who were seen and completed an interview at the UAB 1917 HIV/AIDS clinic between January 1, 2007 and July 29, 2012, five patients were excluded from the analysis due to the absence of information on one or more characteristics at the first clinic visit. An additional 166 patients were excluded due to the inclusion of a nonresponse (i.e., no answer) for information on alcohol/drug use or treatment in the prior year at the time of their interview. Another 145 patients were excluded due to the absence of information on relevant characteristics at the interview or on either of the outcomes in the 2 years after the interview.

Assessment of alcohol/drug use and treatment as well as other patient characteristics

Both the effect of at-risk alcohol/drug use and treatment for use in the year prior to an administered interview were examined. Specifically, the effect of use in the last year among those who did and did not receive treatment in the same time period was examined. In addition, the effect of treatment in the last year among those who did and did not use in the same time period was assessed.

At-risk alcohol/drug use in the year prior to an administered interview was obtained from patient medical records and self-reports during the interview. A patient was considered to have engaged in at-risk alcohol use if an alcohol-related diagnosis appeared in their medical record or if they reported behavior consistent with ''at-risk alcohol use'' as defined by the Alcohol Use Disorders Identification Test-Consumption [AUDIT-C] instrument[24] in the year prior to their interview. A patient was considered to have used drugs if a drug-related diagnosis appeared in their medical record in the year prior to their interview or if they reported at interview any use during the preceding 3 months of injection drugs, crack/cocaine, amphetamines, or opioids that were not prescribed by a physician. Marijuana use was excluded to be consistent with prior work.[25] Patients who did not have an alcohol or drug-related diagnosis in the year prior to an interview and did not report (or meet the criterion for) use at an interview were considered to not have engaged in at-risk alcohol/drug use in the year prior to the interview.

Treatment for alcohol or drugs in the year prior to an administered interview was obtained from patient medical records and self-reports during the interview. A patient was considered to have received treatment for alcohol or drugs if the medical record documented the patient's attendance at an alcohol or drug abuse counseling appointment or a patient reported receiving treatment for alcohol or drugs in the year prior to an interview. Patients without an attended alcohol or drug abuse counseling appointment included in their medical record in the year prior to an interview and who did not report treatment receipt in the prior year at an interview were considered to have not received alcohol or drug use treatment in the year prior to an interview. Information on characteristics such as calendar dates, age, sex, clinical AIDS diagnoses, CD4 cell count, ART history, education, insurance status, long-term alcohol/drug use, and mental health history (i.e., diagnoses, self-reported symptoms, and treatment) were also obtained from patient medical records or self-reports during an interview.

Ascertainment of scheduled appointment attendance and virologic suppression

The two primary outcomes of interest in this analysis were attendance of a scheduled appointment and achieving virologic suppression at a given HIV-1 RNA assessment during the 2 years following an administered interview. A 2-year post-interview window was selected to assess more recent effects of use and treatment while ensuring a sufficient amount of time for multiple scheduled appointments and RNA assessments.

The primary outcomes corresponded to all scheduled clinic appointments with a primary HIV provider and RNA assessments that occurred in the 2-year period after an administered interview between January 1, 2007 and July 29, 2012. As done previously,[4,18] scheduled appointments that were canceled or rescheduled by the patient or provider were excluded from the analysis as well as scheduled urgent care or subspecialty appointments (e.g., dermatology). Walk-in visits were also excluded from the definition of a scheduled appointment given that all patients who walked in were assigned an urgent care appointment.

To harmonize HIV-1 RNA data across time, all RNA values < 400 copies/ml were set to 200 copies/ml and regarded as undetectable. Virologic suppression was defined as achieving an undetectable plasma HIV-RNA (e.g., ≤ 200 copies/ml) at a given RNA level assessment. Patients were not required to have initiated ART by a given RNA level assessment. Patients not observed for any period of more than 1 year during the 2 years subsequent to an interview were censored at the minimum of their death date (if applicable) and 1 year after the date of their last contact with the HIV/AIDS clinic. Patients who were known to be alive and had their last contact with the clinic within the 2 years after an interview as well as within a year of July 29, 2012 or within the second year after an interview were administratively censored at the minimum of July 29, 2012 and 2 years after an interview. Patients observed to be alive and had their last contact with the clinic beyond 2 years after an interview and

more than a year before July 29, 2012 were administratively censored at 2 years subsequent to an interview.

Statistical analysis

Characteristics of included and excluded patients were examined and compared based on percentages for discrete characteristics or medians and quartiles for continuous characteristics. Unadjusted and adjusted modified Poisson regression models[26] were used to estimate risk ratios (RRs) for the effect of at-risk alcohol/drug use and associated treatment on scheduled appointment attendance and virologic suppression where the time scale was years since the last attended scheduled appointment (or years since the last virologic suppression). An indicator of at-risk alcohol/drug use, an indicator of alcohol/drug treatment, and the product term of these two indicators were included in all unadjusted and adjusted models. Based on prior literature[20] a product term was included to allow for potential effect measure modification of the effect of use by treatment and vice versa. The outcome in these models was either an indicator of whether a patient attended a given scheduled appointment or an indicator of whether a patient achieved virologic suppression during a plasma HIV-1 RNA assessment in the 2 years after an interview. An independent working correlation structure was specified for the modified Poisson regression models.

Models were adjusted for age, calendar date, gender, an AIDS diagnosis, and CD4 cell count at first clinic visit as well as time since first clinic visit in addition to CD4 cell count, time on ART, highest education level attained, insurance, history of mental health issues and/or treatment, and long-term drug/alcohol use at interview. The first clinic visit was defined as the minimum of the first primary HIV provider visit and the first interview between January 1, 1995 and July 29, 2012. Adjustment for long-term alcohol and drug use excluded use history in the year prior to an interview.

Adjustment was used to correct for bias due to confounding as well as selection bias potentially induced by analysis sample restrictions, pattern of clinic attendance, and censoring due to dropout or death.[27–29] Predictors in all models were included as either indicator variables for categories or restricted quadratic splines with knots at the 5, 35, 65, and 95th percentiles[30] for continuous characteristics. All analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC).

Results

Among the 576 patients in the UAB 1917 Clinic Cohort that were included in the analysis and followed for 932 person-years after an interview, as of July 29, 2012, 47 dropped out, 6 died, and 523 were alive and under follow-up 2 years after their interview. These patients contributed 591 interviews to the analysis. Table 1 shows the characteristics of the 591 included interviews along with characteristics of those patients that were excluded from the analysis due to lack of information after the first clinic visit.

Among the 591 included interviews, 78% of patients were new to HIV care at UAB at the time of their interview. Seventy-five percent of interviews were contributed by men and 33% were contributed by patients who previously had received a clinical AIDS diagnosis at the time of their first clinic visit. The median (quartiles) age and CD4 count at the first clinic visit were 34 (27; 44) years and 331 (147; 529) cells/μl, respectively. Thirty-eight percent of interviews were contributed by a patient who engaged in at-risk alcohol/drug use or had received alcohol or drug treatment in the year prior to an interview.

The median number of scheduled appointments within the 2 years after an interview was 7 (4; 9), while the median number of HIV-1 RNA measures taken within the 2 years after an interview was 4 (2; 6). The median proportion of scheduled appointments attended within the 2 years after an interview was 0.82 (0.67; 1), while the median proportion of HIV-1 RNA measures taken within the 2 years after an interview that achieved virologic suppression was 0.71 (0.33; 1). Compared to patients who were excluded from the analysis due to a nonresponse about alcohol/drug use or treatment, patients who were included tended to have a later first clinic visit calendar date as well as be younger and have less advanced HIV disease at the first clinic visit. Included patients also tended to have a later first clinic visit calendar date yet have more advanced HIV disease at the first clinic visit than patients excluded from the analysis due to a lack of information on characteristics at interview or on the outcomes.

Table 2 provides the unadjusted and adjusted association between at-risk alcohol/drug use and scheduled appointment attendance among those who did and did not receive alcohol and drug treatment. Compared to patients who did not use but did receive treatment in the prior year, the unadjusted RR for attending scheduled appointments after an interview for patients who did use and did receive treatment was 0.85 (95% confidence limits: 0.72, 0.99). Compared to patients who did not use and did not receive treatment in the prior year, the unadjusted RR for attending scheduled appointments after an interview for patients who did use, but did not receive treatment was 0.94 (0.90, 0.99). The corresponding adjusted RRs for attending scheduled appointments after an interview were 0.89 (0.77, 1.04) and 0.97 (0.92, 1.03), respectively.

Table 3 shows the unadjusted and adjusted association between at-risk alcohol/drug use and virologic suppression among those who did and did not receive alcohol and drug treatment. Compared to patients who did not use but did receive treatment in the prior year, the unadjusted RR for virologic suppression after an interview for patients who did use and did receive treatment was 1.05 (0.82, 1.35). Compared to patients who did not use and did not receive treatment in the prior year, the unadjusted RR for virologic suppression after an interview for patients who did use, but did not receive treatment was 0.91 (0.84, 0.99). The corresponding adjusted RRs for virologic suppression after an interview were 1.17 (0.94, 1.45) and 0.94 (0.86, 1.03), respectively.

Table 4 provides the unadjusted and adjusted association between alcohol/drug treatment and scheduled appointment attendance among those who did and did not engage in at-risk alcohol and drug use. Compared to patients who did not receive treatment but did use in the prior year, the unadjusted RR for attending scheduled appointments after an interview for patients who did receive treatment and did use was 0.87 (0.78, 0.97). Compared to patients who did not receive treatment and did not use in the prior year, the unadjusted RR for attending scheduled appointments after an interview for patients who did receive treatment, but did not use was 0.97 (0.86, 1.09). The corresponding adjusted RRs for attending scheduled appointments after an interview were 0.86 (0.78, 0.95) and 0.93 (0.84, 1.04), respectively.

Table 1. Characteristics of HIV-Infected African American Patients, UAB 1917 Clinic Cohort, 1995–2012

Characteristic[a]	*Included*[b] *N = 591 interviews*	*Excluded*[c] *N = 185 interviews*	*Excluded*[d] *N = 166 patients*
Date at first clinic visit	2010 (2008; 2011)	2008 (2007; 2011)	2009 (2008; 2010)
Date of interview	2010 (2009; 2011)	2010 (2009; 2012)	—
Age at first clinic visit, years	34 (27; 44)	34 (28; 43)	40 (30; 47)
Age at interview, years	36 (28; 46)	—	—
Male sex, % (*n*)	75 (443)	74 (137)	72 (119)
Prior clinical AIDS diagnosis at first clinic visit, % (*n*)	33 (193)	25 (46)	38 (63)
CD4 count at first clinic visit, cells/μl	331 (147; 529)	371 (219; 538)	277 (118; 526)
CD4 count at interview, cells/μl	321 (142; 530)	—	—
Time on antiretroviral therapy at interview, years	0 (0; 0.88)	—	—
Highest education level attained at interview, % (*n*)			
College graduate or greater	18 (104)	—	—
High school diploma or GED/other[e]	65 (383)	—	—
Less than high school diploma or GED	17 (104)	—	—
Insurance at interview, % (*n*)			
Private	26 (155)	—	—
Public[f]	24 (140)	—	—
Uninsured	50 (296)	—	—
History of mental health issues at interview, % (*n*)	64 (377)	—	—
History of mental health treatment at interview, % (*n*)	5 (31)	—	—
History of long-term at-risk alcohol or drug use at interview,[g] % (*n*)	19 (115)	—	—
At-risk alcohol or drug use in year prior to interview, % (*n*)	34 (202)	42 (77)	—
Alcohol or drug treatment in year prior to interview, % (*n*)	13 (74)	17 (31)	—
Number of scheduled appointments within 2 years after an interview	7 (4; 9)	—	—
Number of RNA measures taken within 2 years after an interview	4 (2; 6)	—	—
Proportion of scheduled appointments attended within 2 years after an interview	0.82 (0.67; 1)	—	—
Proportion of HIV-1 RNA measures taken within 2 years after an interview achieving virologic suppression	0.71 (0.33; 1)	—	—

[a]Median (quartiles), unless noted otherwise.
[b]591 interviews from 576 patients included in analysis.
[c]185 interviews from 172 patients excluded from analysis where 27 of 172 patients included in analysis for a different interview; interview excluded due to no information available on characteristics at interview or on outcomes in the 2 years after interview.
[d]No information available on alcohol/drug use and treatment in year prior to interview due to nonresponse.
[e]Some college, associates degree, or training at technical school.
[f]Medicaid, Medicare, or temporary public maternity insurance.
[g]Excludes use history in the year prior to interview.

Table 2. Association Between At-Risk Alcohol and Drug Use and Scheduled Appointment Attendance Among 576 African American Patients Contributing 591 Interviews by Potential Effect Measure Modifier, Alcohol and Drug Treatment Status, UAB 1917 Clinic Cohort, 1995–2012

Alcohol and drug[a]		*Attended scheduled appointments after interview/scheduled appointments after interview*	*Unadjusted*		*Adjusted*	
Treatment	*Use*		*Risk ratio*	*95% CL*[b]	*Risk ratio*[c]	*95% CL*[b]
Yes	Yes	193/297	0.85	0.72, 0.99	0.89	0.77, 1.04
	No	139/179	1.	—	1.	—
No	Yes	786/1,048	0.94	0.90, 0.99	0.97	0.92, 1.03
	No	2,078/2,606	1.	—	1.	—
Total		3,196/4,130				

[a]In the year prior to interview based on medical record and self-report at interview.
[b]CL, confidence limits.
[c]Adjusted for age, date, gender, CD4 cell count, and an AIDS diagnosis at first clinic visit as well as time since first clinic visit in addition to CD4 cell count, time on antiretroviral therapy, education, insurance, history of mental health issues, history of mental health treatment, and long-term history of at-risk alcohol and drug use at interview. Long-term at-risk alcohol and drug use excluded use history in the year prior to interview.

Table 3. Association Between At-Risk Alcohol and Drug Use and Virologic Suppression Among 576 African American Patients Contributing 591 Interviews by Potential Effect Measure Modifier, Alcohol and Drug Treatment Status, UAB 1917 Clinic Cohort, 1995–2012

Alcohol and drug[a]		*Virologic suppression for HIV-1 RNA measure taken after interview/HIV-1 RNA measures taken after interview*	*Unadjusted*		*Adjusted*	
Treatment	*Use*		*Risk ratio*	*95% CL*[b]	*Risk ratio*[c]	*95% CL*[b]
Yes	Yes	92/148	1.05	0.82, 1.35	1.17	0.94, 1.45
	No	67/110	1.	—	1.	—
No	Yes	425/730	0.91	0.84, 0.99	0.94	0.86, 1.03
	No	1,179/1,804	1.	—	1.	—
Total		1,763/2,792				

[a]In the year prior to interview based on medical record and self-report at interview.
[b]CL, confidence limits.
[c]Adjusted for age, date, gender, CD4 cell count, and an AIDS diagnosis at first clinic visit as well as time since first clinic visit in addition to CD4 cell count, time on antiretroviral therapy, education, insurance, history of mental health issues, history of mental health treatment, and long-term history of at-risk alcohol and drug use at interview. Long-term at-risk alcohol and drug use excluded use history in the year prior to interview.

Table 5 shows the unadjusted and adjusted association between alcohol/drug treatment and virologic suppression among those who did and did not engage in at-risk alcohol and drug use. Compared to patients who did not receive treatment but did use in the prior year, the unadjusted RR for virologic suppression after an interview for patients who did receive treatment and did use was 1.12 (0.94, 1.33). Compared to patients who did not receive treatment and did not use in the prior year, the unadjusted RR for virologic suppression after an interview for patients who did receive treatment, but did not use was 0.97 (0.79, 1.18). The corresponding adjusted RRs for virologic suppression after an interview were 1.07 (0.92, 1.24) and 0.87 (0.74, 1.01), respectively.

Discussion

Among 576 new or returning AA HIV$^+$ patients enrolled and followed for 932 person-years in the UAB 1917 Clinic Cohort, engagement in at-risk alcohol or drug use was sizable and on par with estimates from a largely AA HIV clinic cohort at Johns Hopkins.[31] Treatment for alcohol or drugs was somewhat more common in our analysis compared to the largely white Fenway Community Health Center HIV clinic cohort.[32] Attendance of scheduled appointments and virologic suppression in the 2 years after an interview was largely consistent with combined data from six academic HIV clinics where the majority of the data were contributed by HIV$^+$ AA patients.[33]

Adjusted analyses indicated that at-risk alcohol or drug use in the prior year was negatively associated with attending scheduled appointments in the subsequent 2 years regardless of treatment occurrence in the prior year. However, at-risk alcohol or drug use appeared to be negatively associated with achieving virologic suppression solely among those not also receiving treatment. Patients who received treatment in the prior year appeared to be less likely to attend scheduled appointments in the subsequent 2 years regardless of whether they used in the prior year as well. Patients who received treatment and used appeared to be more likely to achieve virologic suppression compared to patients who did not receive treatment but did use. In contrast, patients who received treatment, but did not use were less likely to achieve virologic suppression compared to patients who did not receive treatment and did not use. Nonetheless, many estimates were imprecise.

Prior work, which did not explore potential effect measure modification by alcohol and drug treatment, has shown that use/abuse of alcohol and drugs lowers scheduled appointment attendance as well as increases the likelihood of virologic

Table 4. Association Between Alcohol and Drug Treatment and Scheduled Appointment Attendance Among 576 African American Patients Contributing 591 Interviews by Potential Effect Measure Modifier, At-Risk Alcohol and Drug Use Status, UAB 1917 Clinic Cohort, 1995–2012

Alcohol and drug[a]		*Attended scheduled appointments after interview/scheduled appointments after interview*	*Unadjusted*		*Adjusted*	
Use	*Treatment*		*Risk ratio*	*95% CL*[b]	*Risk ratio*[c]	*95% CL*[b]
Yes	Yes	193/297	0.87	0.78, 0.97	0.86	0.78, 0.95
	No	786/1,048	1.	—	1.	—
No	Yes	139/179	0.97	0.86, 1.09	0.93	0.84, 1.04
	No	2,078/2,606	1.	—	1.	—
Total		3,196/4,130				

[a]In the year prior to interview based on medical record and self-report at interview.
[b]CL, confidence limits.
[c]Adjusted for age, date, gender, CD4 cell count, and an AIDS diagnosis at first clinic visit as well as time since first clinic visit in addition to CD4 cell count, time on antiretroviral therapy, education, insurance, history of mental health issues, history of mental health treatment, and long-term history of at-risk alcohol and drug use at interview. Long-term at-risk alcohol and drug use excluded use history in the year prior to interview.

Table 5. Association Between Alcohol and Drug Treatment and Virologic Suppression Among 576 African American Patients Contributing 591 Interviews by Potential Effect Measure Modifier, At-Risk Alcohol and Drug Use Status, UAB 1917 Clinic Cohort, 1995–2012

Alcohol and drug[a]		*Virologic suppression for HIV-1 RNA measure taken after interview/HIV-1 RNA measures taken after interview*	*Unadjusted*		*Adjusted*	
Use	*Treatment*		*Risk ratio*	*95% CL*[b]	*Risk ratio*[c]	*95% CL*[b]
Yes	Yes	92/148	1.12	0.94, 1.33	1.07	0.92, 1.24
	No	425/730	1.	—	1.	—
No	Yes	67/110	0.97	0.79, 1.18	0.87	0.74, 1.01
	No	1,179/1,804	1.	—	1.	—
Total		1,763/2,792				

[a]In the year prior to interview based on medical record and self-report at interview.
[b]CL, confidence limits.
[c]Adjusted for age, date, gender, CD4 cell count, and an AIDS diagnosis at first clinic visit as well as time since first clinic visit in addition to CD4 cell count, time on antiretroviral therapy, education, insurance, history of mental health issues, history of mental health treatment, and long-term history of at-risk alcohol and drug use at interview. Long-term at-risk alcohol and drug use excluded use history in the year prior to interview.

failure.[4,9,12,31] The results of the current study are largely consistent with this prior work. However, the decrease in virologic suppression associated with use was solely observed among those patients who also did not receive treatment in the prior year, potentially indicating that the detrimental effect of use on virologic suppression may be more pronounced among those who use in the absence of treatment.

The observed inverse association between alcohol/drug treatment and scheduled appointment attendance is inconsistent with prior work.[20,32,34,35] Using data from the Community Health Advisory and Information Network (CHAIN), Messeri *et al.*[20] showed that among HIV-infected participants reporting a current alcohol/drug problem those who reported participating in a therapeutic or self-help alcohol or drug program were more likely to enter as well as be retained (i.e., regularly in contact with provider and receiving appropriate services) in HIV medical care. However, the observed association was significant only for self-help alcohol and drug programs. Ashman *et al.*[35] as well as Lo and colleagues[32] similarly found positive associations between treatment for substance abuse and retention in care (i.e., regular contact with medical provider) while only Ashman *et al.* showed statistically significant evidence of a link between receiving treatment and a higher number of visits to a primary care medical provider.

Differences between prior work and our results may be due to differences in the study population where prior studies either included few or were not solely comprised of AAs. In addition, the measure of engagement or retention in care in prior studies was how regularly a participant received care rather than adherence to scheduled appointments. The influence of alcohol and drug treatment on adherence to scheduled appointments may be distinct from regular receipt of appropriate HIV care.[33,36] Specifically, while alcohol and drug treatment may increase receipt of regular care among those engaged in at-risk alcohol/drug use by facilitating any clinic attendance in a defined time interval via scheduled or walk-in/urgent care visits, treatment may be a marker of more severe use and in turn decrease the likelihood of appointment adherence given the unstable lifestyle often associated with at-risk alcohol and drug use.[20] Treatment as a marker of more severe alcohol and drug use among users is consistent with the fact that the inverse association between use and scheduled appointment attendance that was observed in our study was somewhat more pronounced among those who had received treatment in the prior year. Among those who were considered to be nonusers, treatment may be a marker of use that the medical record and self-report data did not capture or residual social and economic instability.

Among patients who used in the same period, the higher likelihood of virologic suppression experienced by those in treatment compared to patients not in treatment may be due to the greater receipt and more timely modification of ARTs by those in treatment due to more regular receipt of care despite poorer appointment adherence. However, among patients who did not use in the same period, the lower likelihood of virologic suppression experienced by those in treatment compared to patients not in treatment may be due to lower receipt and less timely modification of as well as poorer adherence to ARTs by patients in treatment. Non-at-risk alcohol and drug users in treatment may include former users who suffer from residual social and economic instability that hinders ART use. Alternatively, patients we considered to be non-at-risk alcohol and drug users in treatment may include at-risk alcohol and drug users. Although imprecise, additional analyses among at-risk alcohol and drug users indicated that those in treatment were more likely to initiate ART at a given visit subsequent to interview than patients not in treatment. In contrast, among non-at-risk-alcohol and drug users, those in treatment were less likely to initiate ART compared to patients not in treatment (results not shown).

Our results, however, contradict previous work by Smith-Rohrberg *et al.*[37] that showed an inverse, but imprecise association between referral to drug abuse services and virologic suppression among a cohort of HIV^+ active drug users in New Haven, Connecticut receiving directly administered ART. This unexpected inverse association may have been due to the small sample size, limited follow-up, and/or residual confounding bias. Furthermore, referral to drug abuse services may not always correspond to receipt of such services.

There are limitations to the present research. The limited sample size among those using or in treatment resulted in imprecise estimates in many cases and also increased the chances of random error. Although adjustment was used to correct for measured sources of confounding and selection bias, such as bias stemming from differences in the characteristics shown in Table 1 between patients who were and were not included in

our analysis,[27–29] unmeasured potential sources of these biases related to factors such as prison history as well as receipt of other ancillary services (e.g., case management, transportation, housing assistance) may exist. Residual sources of confounding and selection bias may also be present due to potential measurement error of patient characteristics included in Table 1 that were used to control for such biases.

Bias related to measurement error stemming from potential underascertainment of at-risk alcohol and drug use or associated treatment based on the use of UAB 1917 Clinic Cohort medical records and self-reports may also have been present. This measurement error is likely independent with respect to both outcomes given that alcohol/drug use and treatment were ascertained based on reports by the patient or information included in the medical record by the clinician, while scheduled appointment attendance was ascertained from an administrative database and virologic suppression was based on HIV RNA assay data included in the patient medical record by laboratory personnel. However, to the extent that measurement error of patient characteristics existed, potential measurement error of alcohol/drug use and treatment may have been differential by both outcomes of interest. Such independent, yet differential measurement error, if present, could have biased the effect estimate away, toward, or through the null.[38] Bias can also occur in the presence of model misspecification, nonpositivity, or lack of consistency.[39]

Despite these limitations, there are several noteworthy strengths of this study. This study is among the first to examine the role of alcohol/drug use and treatment on scheduled appointment attendance and virologic suppression in an effort to explain rather than solely describe observed racial disparities in engagement in care and virologic response. Attempting to explain rather than solely describing such disparities responds to the need for the research community to prioritize identification of the sources of racial health disparities.[40–43] Identifying the sources of racial disparities in HIV/AIDS is critical to implementing interventions to minimize barriers to care among AAs and in turn reduce substantial and longstanding racial disparities in HIV disease. Although at-risk alcohol and drug use was modestly lower and treatment was negligibly higher among AA patients compared to white patients in the UAB 1917 Clinic Cohort (results not shown), in other settings AAs have been shown to be less likely than whites to complete treatment services. This lower likelihood of completing treatment services may indicate more persistent at-risk alcohol and drug use among AA compared to white patients that may contribute to racial disparities in clinic attendance.[21,22] However, data on completion of treatment services by race were not available for this analysis.

Furthermore, unlike prior work, we account for potential effect measure modification by treatment when assessing the influence of alcohol/drug use on attendance and virologic response. Also important to note is that in some prior studies[9,18,20,34] the measure of association used was the odds ratio. However, when the outcome is not rare, the odds ratio is prone to overestimate the risk ratio, which is the effect measure of interest. In this study we directly estimate risk ratios using modified Poisson regression.[26] In addition, use of both medical records and self-report helped to minimize measurement error given that self-report in this setting has been shown in previous work[25] to enhance the accuracy of medical record data alone in capturing at-risk alcohol and drug use. Lastly, correct model specification was facilitated by including indicator variables for categories and restricted quadratic splines for continuous predictors.

In summary, our study found that among new or returning to care HIV$^+$ AAs in the UAB 1917 Clinic Cohort, at-risk alcohol/drug use in the prior year was negatively associated with scheduled appointment attendance overall, but negatively associated with virologic suppression only among those not in treatment for alcohol/drugs. Receipt of treatment in the prior year was also negatively associated with attending appointments yet positively associated with achieving virologic suppression only among patients who engaged in at-risk alcohol or drug use. Unfortunately, many of the observed associations were imprecise. Therefore, future studies should thoroughly collect relevant information on and examine the influence of alcohol/drug use and treatment on scheduled appointment attendance and virologic response among a larger sample of AA HIV$^+$ clinic cohort patients.

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