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## Mechanisms Linking Gender-Based Violence to Worse HIV Treatment and Care Outcomes among Women in the United States

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**Author Contribution Statement:** JPJ, AC, and SW conceptualized the study. JPJ drafted the manuscript and analyzed the data. LS assisted with data analysis. AC, TW, AR, AA, SK, AS, MF, AA, JT, PT, and SW contributed to study design and data collection and revised the paper. All authors approved the final version of the paper.

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## Abstract

**Objective:** To test whether substance use mediates the associations between gender-based violence (GBV) and suboptimal adherence to antiretroviral therapy (ART), and GBV and poor engagement in care, among women living with HIV (WLHIV) in the United States (US).

**Design:** We analyzed longitudinal data collected among 1,717 WLHIV in the Women's Interagency HIV Study (WIHS).

**Methods:** From 2013–2016, WLHIV completed semi-annual assessments on GBV, substance use, and HIV treatment and care. Adjusted multilevel logistic regression models were built to estimate the impact of GBV on; suboptimal (<95%) adherence and at least one missed HIV care appointment without rescheduling in the past six months. Mediation analyses were performed to test whether heavy drinking and illicit drug use mediated the associations between GBV and the two HIV outcomes.

**Results:** The mean age was 47 (SD=9), 5% reported experiencing GBV, 17% reported suboptimal adherence and 15% reported at least one missed appointment in the past six months. Women who experienced GBV had a significantly higher odds of suboptimal adherence (adjusted odds ratio aOR=1.99; 95% CI=1.40–2.83) and missed appointments (aOR=1.92, 95% CI=1.32–2.33). Heavy drinking and illicit drug use mediated 36% and 73% of the association between GBV and suboptimal adherence and 29% and 65% of the association between GBV and missed appointments, respectively.

**Conclusions:** Substance use is an underlying mechanism through which GBV affects outcomes along the HIV care continuum among WLHIV in the US. To optimize HIV treatment and care among women, interventions should address the combined epidemics of substance use, violence, and HIV.

## Keywords

Women; HIV; Gender-based violence; drug use; heavy drinking and HIV treatment and care

## INTRODUCTION

Optimal adherence to antiretroviral therapy (ART) is essential to achieving viral suppression and preventing the onward transmission of HIV [2]. However, despite the promise of ART use, significant gaps in the HIV care continuum persist among women living with HIV (WLHIV) in the United States (US) [33,39]. For example, in 2018 only 58% of WLHIV were retained in care and just 63% were virally suppressed [8,39]. WLHIV tend to have lower rates of optimal adherence to ART, are less likely to attain viral suppression and have a higher cumulative plasma viral burden compared to males [2,23,52]. Often, these disparities are reinforced by harmful social and behavioral factors, including gender-based violence (GBV) and substance use, which tend to overlap and potentiate the likelihood of failing to engage in HIV care and treatment [18,44,49,52].

GBV, defined as any physical, sexual, psychological or emotional violence directed toward an individual based on their gender identity (e.g., being female) [38,47], is highly prevalent among WLHIV and associated with interruptions along the HIV care continuum

[11,16,24,30,46]. Among WLHIV in the US, 55% reported ever experiencing intimate partner violence, a common type of GBV, which is more than twice the rate among the general population of women in the US [32]. Further, a history of experiencing GBV and high levels of trauma-related sequelae such as post-traumatic stress disorder, depression, and anxiety are associated with poor HIV treatment and care outcomes, including suboptimal adherence to ART and viral non-suppression among WLHIV in the US [4,10,43,45,48].

Substance use has been identified as a coping mechanism to deal with trauma and other poor mental health conditions (e.g., depression and anxiety) that stem from experiences with GBV. Further, substance use has been linked to accelerated HIV disease progression and worse HIV treatment and care outcomes [7,52]. For example, injection drug use among people living with HIV has been associated with increased incidence of AIDS defining illness and mortality [7,36,41]. In addition, among WLHIV who use drugs, the proportion achieving viral suppression has been recorded to be as low as 35% compared to roughly 53% among all WLHIV who do not use drugs, and WLHIV who use drugs have an 87% higher prevalence of suboptimal adherence to ART compared to their counterparts [6,34,52]. Thus, it is evident that GBV and substance use are critical barriers to HIV care engagement that require urgent attention in order to optimize HIV treatment among WLHIV in the US.

However, despite the significant burden of GBV and substance use among WLHIV and their adverse impact on HIV treatment and care, little is known about the mediating role of substance use in the relationship between GBV and outcomes along the HIV care continuum among WLHIV in the US. For example, findings from a recent systematic review on GBV and engagement in biomedical HIV prevention and treatment identified the need for more longitudinal research focused on quantifying underlying mechanisms linking GBV to worse HIV treatment and care outcomes. Furthermore, according to a recent scoping review on GBV and biomedical HIV prevention and treatment, no quantitative studies to date have examined the relationship between GBV and engagement in care among women who use drugs [30]. Thus, little remains known about the interplay between GBV, substance use and engagement in HIV treatment and care among women. To reduce this gap in knowledge research is needed to test substance use as a mechanism through which GBV impedes engagement in care among WLHIV.

To extend our knowledge in this area, we leveraged longitudinal data from the Women's Interagency HIV Study (WIHS) to test whether illicit drug use and heavy drinking were separate mediators in the associations between; (1) GBV and suboptimal adherence to ART, and (2) GBV and poor engagement in HIV care. We hypothesized that the relationship between GBV and these two HIV outcomes would be mediated by illicit drug use and heavy drinking. As such, findings from this work may contribute to our understanding of how GBV and substance use function as critical barriers to engagement in HIV care and treatment among WLHIV in the US.

## MATERIALS AND METHODS

### Study Population and Procedures.

Longitudinal data for the present study were drawn from the WIHS, a multisite prospective cohort study of cisgender women (i.e., individuals who identified as being female and being assigned female sex at birth) living with and without HIV in the US [1]. Details on study procedures and protocols have been described elsewhere [1]. Briefly, participants were recruited from the following nine US clinical research sites across five recruitment waves (0–4): Bronx, NY; Brooklyn, NY; Washington, D.C.; Chicago, IL; San Francisco, CA; Chapel Hill, NC; Miami, FL; Birmingham, AL/Jackson, MS; Atlanta, GA. Data analyzed in this study were collected between 2013 and 2017 across nine semiannual research visits (38–46). Visit 38 represents the 38<sup>th</sup> semiannual visit from the inception of the WIHS in 1993. For this analysis, one’s baseline visit was considered their first visit on record during the study period. Please refer to the WIHS website for survey instruments corresponding to visits 38–46 (<https://statepi.jhsph.edu/wihs/wordpress/data-collection-forms>).

During the study period, there were 11,892 person-visits in total in the WIHS among 1,846 unique WLHIV and 10,848 person visits among 1,756 unique WLHIV on ARTs. Of these person-visits, 507 were “abbreviated” WIHS visits at which participants only contributed laboratory specimens and “core” WIHS measurements, no additional measures were collected. Further, 568 (5.2%) person-visits were missing data on our primary predictor of interest. Thus, the data presented are from 10,280 person-visits among 1,717 unique women. Of these women, 71% were recruited prior to visit 38, and the remaining 29% were recruited during visits 39–42 as part of the Southern recruitment wave occurring contemporaneously.

## MEASURES

### Outcome Variables.

The first outcome of interest was self-reported suboptimal adherence to ART, defined as reporting less than 95% adherence in the past six months (yes/no). Adherence to ART was captured by asking participants how often they took their HIV medications as prescribed during the past six months (100% of the time; 95–99% of the time; 75–94% of the time; <75% of the time; I haven’t taken any of my prescribed medications). Based on these responses, we created a dichotomous measure of suboptimal adherence to ART defined as reporting less than 95% adherence in the past six months (yes/no). This cutoff was used because it represents an optimal level of adherence [13,28]. Data on adherence were collected from 2013–2016 across eight visits (38–45). The second outcome of interest was poor engagement in care defined as having missed at least one scheduled HIV care appointment without rescheduling in the past six months (yes/no). Data on visit attendance were collected from 2013 to 2015 across six visits (39–44).

### Primary Exposure Variable.

The primary exposure of interest was experiencing any GBV including, physical, sexual, psychological violence in the past six months (yes/no). Sexual violence was assessed

by asking participants: “Since your (month) study visit, has anyone pressured or forced you to have sexual contact? By sexual contact, I mean them touching your sexual parts, you touching their sexual parts, or sexual intercourse.” Physical violence was assessed by asking participants: “Since your (month) study visit, have you experienced serious physical violence (physical harm by another person)? By that I mean were you ever hurt by a person using an object or were you ever slapped, hit, punched, kicked.” Response options for these questions included yes, no, don’t know (categorized as “no”), and declined to answer (excluded from analysis). Women who responded yes were categorized as having experienced sexual or physical violence. Experiencing psychological violence by a “current or previous partner” was assessed using seven items with yes or no response options. Example items include, has your partner; “threatened to hurt you or kill you”, “prevented you from leaving or entering the house,” and “prevented you from seeing your friends.” Women who responded yes to any items were coded as having experienced psychological violence. Data on gender-based violence were collected from 2013–2016 across eight visits (38–45).

### **Mediating Variables.**

Mediators of interest were heavy alcohol use and illicit drug use. We defined heavy drinking as consuming more than 7 drinks per week in the past six months (yes/no) [37]. Illicit drug use (yes/no) included participants who reported the use of any of the following drugs in the past six months: methamphetamine, cocaine, crack cocaine, heroin, non-prescribed prescription opioids, ecstasy, phencyclidine/PCP or angel dust, psychedelics, “poppers” (alkyl nitrites), non-prescribed benzodiazepines or barbiturates. Data on alcohol and drug use were collected from 2013–2016 across eight visits (38–45).

### **Covariates.**

Covariates included in the multivariable models included: age in years, average annual household income (>24,000 versus <\$24,000), race/ethnicity (non-Hispanic white, Hispanic, non-Hispanic black/African American, or other), education (<high school degree or equivalent vs. high school degree), and marital status (married/cohabitating vs. unmarried which includes; widowed, divorced/separated, and never married), and the total number of years one has been on ART. Data for time on ART, age, and marital status were collected from 2013–2016 across nine visits (38–46), and data on income, race/ethnicity and education were collected across eight visits (38–45).

## **STATISTICAL ANALYSIS**

To describe the study sample overall and by each outcome of interest (suboptimal adherence and engagement in care), we computed percentages and frequencies or, depending on distributional assumptions (i.e., normally distributed data vs. non-normally distributed data), means and standard deviations (SD) or medians and interquartile ranges (IQR). The sample characteristics presented are drawn from participants first visit during the study period which serves as their baseline visit (Table 1).

We leveraged longitudinal data and applied mixed-effects logistic regression for binary outcomes with a random intercept to account for repeated measures per person to examine associations between experiences of GBV in the past six months and outcomes along the HIV care continuum (suboptimal adherence to ART and engagement in care). We tested the association of both GBV in the past six months measured at the same visit that each outcome was measured, which we refer to as *recent GBV* and GBV measured at the visit prior to when each outcome was measured, which we refer to as *prior or lagged GBV* in separate models. Prior or lagged GBV was not significantly associated with either outcome, nor did it improve model fit; therefore, we used recent GBV in our models which also enabled us to take advantage of all longitudinal data available. Analyses included data from approximately 1,717 at study baseline. In order to avoid committing a table two fallacy [5,51], multivariable models were built to examine each exposure (i.e., GBV) and potential mediator (i.e., heavy alcohol consumption and illicit drug use) separately. Thus, the estimates presented in Table 2 represent the total effect of GBV, heavy alcohol use, and illicit drug use on suboptimal adherence to ART and engagement in care. To adjust for potential confounding, all multivariable models controlled for correlates of HIV treatment and care outcomes among US women that were identified in previous WIHS studies [9,50] including: age in years, employment status, income, level of education, marital status, race/ethnicity and length of time in years on ART (Table 2).

To test whether substance use mediated the association between GBV and suboptimal adherence and GBV and poor engagement in care, we employed a mediation method previously used in the WIHS [10,29,50]. We fit a series of fully adjusted regression models to estimate the total effect of GBV on each outcome (i.e., suboptimal adherence to ART and poor engagement in care), the direct effect of GBV on each outcome while controlling for each mediator and the indirect effect of GBV on each outcome through heavy drinking and non-prescription drug use. These estimates were calculated by taking the products of the regression coefficients from each path in the adjusted models described above. We also calculated the proportion of the total effect of GBV on each outcome that was mediated by heavy drinking and illicit drug use (Table 3). To ensure the integrity of our final models, we confirmed that no statistically significant interaction was present between each mediator and GBV in relation to each outcome assessed. Analyses were performed on complete cases. Overall, there was a small amount of missing data (<10%) and individuals who were excluded due to missing data did not differ on key variables of interest. P-values are two-sided, and significance was set at  $P<0.05$ . All analyses were conducted in Stata 16.

## RESULTS

### Sample characteristics.

This study included a total of 1,717 women living with HIV. At study baseline meaning the first recorded visit during this study period. On average, women were 48 years old ( $SD=9$ ), identified as Black or African American (71%), and the majority were living in households with an annual income of less than \$24,000 (75%). Approximately one-third were employed (32%) and married (29%). At baseline, 5% of women reported experiencing GBV recently or within the last six months and 61% reported ever experiencing GBV. Approximately 17%

reported suboptimal adherence (<95%) to ART in the past six months and 15% reported poor engagement in HIV care defined as missing at least one HIV care appointment without rescheduling in the past six months. Among those with suboptimal adherence or poor engagement in care, the proportion with heavy alcohol use or illicit drug use was higher (18% and 22%, respectively) than the study average (11% and 10%, respectively). Further, among those with suboptimal adherence or poor engagement in care the proportion with undetectable viral load was lower (35% and 50%, respectively) compared to the overall sample (66%) (Table 1).

### **Suboptimal adherence to ART.**

In unadjusted models, factors associated with suboptimal adherence to ART defined as a self-reported adherence rate of <95% were any recent GBV in the past six months (OR=1.90, 95% CI=1.34–2.70,  $p<0.001$ ), heavy drinking (OR=2.36, 95% CI=1.82–3.05,  $p<0.001$ ), and any illicit drug use (OR=4.72, 95% CI=3.53–6.31,  $p<0.001$ ). In adjusted models, all of these factors remained significantly associated with suboptimal adherence to ART: current GBV (adjusted odds ratio [aOR]= 1.99, 95% CI=1.40–2.83,  $p<0.001$ ); heavy drinking (aOR=2.39, 95% CI=1.84–3.10,  $p<0.001$ ); and any illicit drug use (aOR=5.41, 95% CI=4.02–7.27,  $p<0.001$ ) (Table 2).

### **Poor Engagement in Care.**

In unadjusted models, the same factors were associated with poor engagement in care, defined as reporting at least one missed HIV care appointment without rescheduling in the past six months: any recent GBV in the past six months (OR=2.07, 95% CI=1.42–3.03,  $p<0.001$ ), heavy drinking (OR=1.91, 95% CI=1.47–2.47,  $p<0.001$ ) and any illicit drug use (OR=2.75, 95% CI=2.06–3.68,  $p<0.001$ ). In adjusted models, these factors remained significantly associated with poor engagement in care: recent GBV (aOR=1.92, 95% CI=1.32–2.81,  $p<0.001$ ), heavy drinking (aOR=1.80, 95% CI=1.39–2.33,  $p<0.001$ ) and any illicit drug use (aOR=2.78, 95% CI=2.08–3.72,  $p<0.001$ ) (Table 2).

### **Mediating Effects of Heavy Drinking and Illicit Drug Use.**

The path between recent GBV and heavy drinking was marginally significant ( $p=0.05$ ). However, we continued to test heavy drinking as a mediator because; (1) it is associated with GBV and worse HIV treatment and care outcomes among WLHIV [46] and, (2) all of the other paths in the mediation analysis were significant ( $p<0.05$ ). Heavy drinking mediated a moderate proportion (36%) of the association between GBV and suboptimal adherence and the association between GBV and poor engagement in care (29%). Any illicit drug use mediated a larger proportion (73%) of the association between GBV and suboptimal adherence to ART and the association between GBV and poor engagement in care (65%), respectively (Table 3).

## **DISCUSSION**

This longitudinal study examining substance use related mechanisms linking GBV to worse HIV treatment and care outcomes among a large cohort of WLHIV in the US identified several important findings. First, we found that the association between GBV and worse



HIV treatment and care outcomes was mediated by heavy drinking and illicit drug use. Second, we found that illicit drug use accounted for a greater proportion of the associations between GBV and the two HIV outcomes. These findings confirm our central hypothesis that the association between GBV and worse HIV treatment and care outcomes is partially explained by substance use. This study is one of the first quantitative studies to explicitly highlight substance use as a mediator between GBV and engagement in HIV treatment and care among women in the US. As such, findings from this study may help build a rigorous evidence base to support the development of future interventions that address the combined epidemics of substance use, violence, and HIV among women.

The strong associations between recent GBV and suboptimal adherence and recent GBV poor engagement in care were anticipated as prior studies have documented the pervasive nature of GBV among women and its relationship to worse HIV treatment and care outcomes [11,14,20,26,30,40,43]. Results from our study add to this mounting body of evidence and extend our understanding of this relationship by showing that substance use is a key process through which recent GBV leads to interruptions along the HIV care continuum among US women. However, while the mediating role of substance use is of interest it does not alter the persistent need for interventions for both GBV and substance use among WLHIV. Regardless, our examination of substance use as a mediating mechanism may help reduce persisting knowledge gaps among WLHIV who engage in substance use and advance HIV intervention science for this population by showing clear linkages between GBV, substance use and worse HIV treatment and care outcomes [30,34].

This study shows that substance use functions as a key underlying mechanism linking GBV to worse HIV treatment and care outcomes among US women. Specifically, heavy drinking and illicit drug use mediated the associations between GBV and outcomes along the HIV care continuum, and interestingly, drug use mediated a greater proportion of these relationships. One possible explanation for why drug use mediated a greater proportion of these relationships is that WLHIV who use drugs, compared to alcohol alone, may experience more individual and socioenvironmental barriers to care including involvement in the criminal justice system, engagement in sex work, and poor mental health [25,34]. Nevertheless, results from this study show that recent GBV and substance use are enduring barriers to engagement in HIV treatment and care, and support the need for comprehensive interventions that address the unique needs of WLHIV who are impacted by substance use and GBV [16,18,21].

Promising intervention efforts aim to empower women to seek and utilize services including, trauma-informed substance use and HIV prevention and treatment programs that are based in harm reduction [3,4,12,15,17,19,20,22,31,42]. Further, it is important that these services consider the needs of women who are pregnant, planning to become pregnant and or have children, by incorporating specialized reproductive health care into existing female-centered models [4]. Together, findings from this study may help inform the development of female-centered interventions that address GBV and substance use among WLHIV in order to optimize HIV treatment and care.

## Limitations.

This study has limitations. Although the use of longitudinal data with lagged associations and mediators would have strengthened our ability to identify causal links, it is still possible that GBV is a consequence rather than a cause of substance use and poor engagement in HIV treatment and care. This may also be true for the relationship between substance use and suboptimal adherence and engagement in care. Other studies have documented bidirectional relationships between violence, substance use, and HIV treatment and care outcomes [27,35]. Further, it is possible that the experience of GBV, which then leads to substance use and subsequent poor adherence, occurs in intervals smaller than when the WIHS data were collected (every six months). Future studies using daily diary or ecological momentary assessment methods may help to parse out the temporal ordering of these events, as this was not possible given the WIHS data structure.

We sought to address potential confounding by controlling for known correlates of ART adherence and engagement in care among US women; however, it is possible that residual or unmeasured confounding affected our results. Non-probability sampling methods were used to recruit women into the WIHS, which limits the generalizability of our findings to women outside of the WIHS. In addition, as a result of having regular access to HIV care and treatment and being retained in a long-term cohort WLHIV in the WIHS may not reflect the general population of WLHIV in the US. We relied on self-reported data of several sensitive behaviors including, GBV, substance use, adherence to ART, and HIV care appointment attendance, which may be subject to social desirability bias. Lastly, we did not collect data among women's partners, thus future studies should consider examining the relationship between substance use and engaging in violent behavior in this population.

## Conclusions.

This study among a large cohort of WLHIV in the US, highlights key underlying mechanisms linking GBV to interruptions along the HIV care continuum. Specifically, heavy drinking and illicit drug use both mediated a substantial proportion of the relationships between GBV and suboptimal adherence and GBV and poor engagement in care. Altogether, findings from this study underscore the need to develop, adapt and rapidly implement comprehensive female-centered interventions that target the combined epidemics of violence and substance use among WLHIV to optimize HIV treatment and care.

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**Table 1.** Baseline Characteristics of Women Living with HIV Enrolled in the Women's Interagency HIV Study Between 2013 and 2016, (N=1,717)

<u>Variable</u>	Overall (N=1,717)	Suboptimal adherence to ART (n=297)	Poor engagement in HIV care (n=265)
	N (%), Mean (SD) or Median (IQR)	n (%), Mean (SD) or Median (IQR)	n (%), Mean (SD) or Median (IQR)
<b><u>Sociodemographic Factors</u></b>			
Mean age in years (standard deviation=SD)	47.7 (9.1)	45.8 (8.5)	45.9 (8.7)
Race/ethnicity			
Non-Hispanic White	191 (11.1%)	22 (7.4%)	17 (6.4%)
Black or African American	1218 (70.9%)	234 (78.8%)	204 (77.0%)
Hispanic	257 (15.0%)	34 (11.4%)	37 (14.0%)
Other	51 (3.0%)	7 (2.4%)	7 (2.6%)
Average annual household income			
>\$24,000	404 (24.6%)	75 (26.3%)	33 (12.9%)
\$24,000	1237 (75.4%)	210 (73.7%)	223 (87.1%)
Employed	556 (32.4%)	94 (31.6%)	63 (23.8%)
Attained a high school education or more	1149 (67.0%)	194 (65.3%)	161 (61.0%)
Married	504 (29.4%)	87 (29.3%)	68 (25.7%)
<b><u>HIV-Related Clinical Indicators</u></b>			
Undetectable viral load (<40 copies/mL)	1099 (66.2%)	100 (35.2%)	125 (49.6%)
Median time on ART (interquartile range=IQR)	8.0 (3.0, 14.7)	10.7 (3.7, 15.2)	7.2 (2.5, 14.1)
Median CD4 cell count (IQR)	560.0 (369.0, 774.0)	445.0 (269.0, 657.0)	516.0 (269.0, 720.0)
<b><u>Gender-Based Violence</u></b>			
Any lifetime gender-based violence (physical/sexual or psychological/emotional)	1,018 (61.7%)	188 (65.7%)	171 (67.6%)
Physical or sexual violence in the past six months	57 (3.3%)	18 (6.1%)	16 (6.2%)
Psychological or emotional violence in the past six months	61 (3.6%)	17 (5.7%)	12 (4.6%)
Any gender-based violence (physical/sexual or psychological/emotional) in the past six months	88 (5.1%)	25 (8.4%)	20 (7.7%)
<b><u>Substance Use</u></b>			
Heavy drinking	201 (11.7%)	54 (18.2%)	43 (16.2%)
Any illicit drug use, not including Marijuana	177 (10.3%)	66 (22.2%)	51 (19.2%)

Notes:

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- Suboptimal adherence to ART was defined as <95% self-reported adherence in the past six months
- Poor engagement in care was defined as having missed at least one HIV care appointment in the past six months without rescheduling
- Heavy drinking is defined as consuming more than 7 drinks per week
- Illicit drug use did not include Marijuana
- Medians are reported for data that are not normally distributed
- Means are reported for data that are normally distributed
- Descriptive statistics are reported for participants at their first visit on record which serves as their baseline visit



**Table 2.**

Bivariate and Multivariable Logistic Regression Models Examining Factors Associated with Outcomes Along the HIV Care Continuum among Women Living with HIV Enrolled in the Women’s Interagency HIV Study Between 2013 and 2016 (N=1,717)

	Unique Women (person visits)	Unadjusted Odds Ratio (95% CI)	P	Unique Women (person visits)	Adjusted Odds Ratio (95% CI)	P
<b>Outcome 1: Suboptimal adherence to ART</b>						
<b>Explanatory Variable</b>						
Any gender-based violence in the past six months	1,717 (10,275)	<b>1.90 (1.34–2.70)</b>	<b>&lt;0.001</b>	1,697 (9,983)	<b>1.99 (1.40–2.83)</b>	<b>&lt;0.001</b>
<b>Potential Mediators</b>						
Heavy drinking	1,717 (10,334)	<b>2.36 (1.82–3.05)</b>	<b>&lt;0.001</b>	1,697 (10,038)	<b>2.39 (1.84–3.10)</b>	<b>&lt;0.001</b>
Any illicit drug use, not including Marijuana	1,757 (10,803)	<b>4.72 (3.53–6.31)</b>	<b>&lt;0.001</b>	1,697 (10,039)	<b>5.41 (4.02–7.27)</b>	<b>&lt;0.001</b>
<b>Outcome 2: Poor engagement in HIV care</b>						
<b>Explanatory Variable</b>						
Any gender-based violence in the past six months	1,743 (7,939)	<b>2.07 (1.42–3.03)</b>	<b>&lt;0.001</b>	1,717 (7,714)	<b>1.92 (1.32–2.81)</b>	<b>0.001</b>
<b>Potential Mediators</b>						
Heavy drinking	1,743 (7,980)	<b>1.91 (1.47–2.47)</b>	<b>&lt;0.001</b>	1,717 (7,755)	<b>1.80 (1.39–2.33)</b>	<b>&lt;0.001</b>
Any illicit drug use, not including Marijuana	1,743 (7,980)	<b>2.75 (2.06–3.68)</b>	<b>&lt;0.001</b>	1,717 (7,755)	<b>2.78 (2.08–3.72)</b>	<b>&lt;0.001</b>

Notes:

Adjusted models controlled for: age in years, employment status, income, education, race/ethnicity, marital status and time on ART

Suboptimal adherence to ART was defined as <95% self-reported adherence in the past six months and was measured at visits 38–45

Poor engagement in care was defined as having missed at least one HIV care appointment in the past six months without rescheduling and was measured at visits 39–44

**Table 3.** The Mediating Effects of Substance Use in the Association between Recent Gender-Based Violence and Outcomes Along the HIV Care Continuum among Women Living with HIV Enrolled in the Women’s Interagency HIV Study Between 2013 and 2016 (N=1,717)

	<b>Total Effect</b>	<b>Direct Effect</b>	<b>Indirect Effect</b>	<b>Proportion Mediated</b>
<b>Analysis 1: Suboptimal adherence to ART</b>				
<i>Mediators:</i>				
Heavy drinking	1.04	0.67	0.37	36%
Any illicit drug use, not including Marijuana	2.09	0.56	1.53	73%
<b>Analysis 2: Poor engagement in Care</b>				
<i>Mediators:</i>				
Heavy drinking	0.84	0.60	0.24	29%
Any illicit drug use, not including Marijuana	1.37	0.48	0.89	65%

Notes:

All models controlled for: age in years, employment status, income, education, race/ethnicity, marital status and time on ART

Suboptimal adherence to ART was defined as <95% self-reported adherence in the past six months and was measured at visits 38–45

Poor engagement in care was defined as having missed at least one HIV care appointment in the past six months without rescheduling and was measured at visits 39–44