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## Recent Trauma is Associated with Antiretroviral Failure and HIV Transmission Risk Behavior Among HIV-Positive Women and Female-Identified Transgenders

E. L. Machtinger · J. E. Haberer · T. C. Wilson ·  
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**Abstract** Trauma and posttraumatic stress disorder disproportionately affect HIV-positive women. Studies increasingly demonstrate that both conditions may predict poor HIV-related health outcomes and transmission-risk behaviors. This study analyzed data from a prevention-with-positives program to understand if socio-economic, behavioral, and health-related factors are associated with antiretroviral failure and HIV transmission-risk behaviors among 113 HIV-positive biological and transgender women. An affirmative answer to a simple screening question for recent trauma was significantly associated with both outcomes. Compared to participants without recent trauma, participants reporting recent trauma had over four-times the odds of antiretroviral failure (AOR 4.3; 95% CI 1.1–16.6;  $p = 0.04$ ), and over three-times the odds of reporting sex with an HIV-negative or unknown serostatus partner (AOR 3.9; 95% CI 1.3–11.9;  $p = 0.02$ ) and <100% condom use with these partners (AOR 4.5; 95% CI 1.5–13.3;  $p = 0.007$ ). Screening for recent trauma in HIV-positive biological and transgender women identifies patients at high risk for poor health outcomes and HIV transmission-risk behavior.

**Resumen** Trauma y el trastorno de estrés postraumático afectan desproporcionalmente a mujeres VIH positivas. Una creciente literatura sugiere que ambas condiciones pueden predecir salud pobre y comportamientos de riesgo de transmisión de VIH. Este estudio analizó datos de un programa de prevención con personas VIH positivas para entender si los factores socioeconómicos, conductuales y de salud están asociados a fracaso antirretroviral y comportamiento de riesgo de transmitir VIH en 113 mujeres biológicas y transexuales VIH positivas. La respuesta afirmativa a una simple pregunta de detección de trauma reciente fue asociada significativamente a ambos resultados. En comparación con los participantes sin trauma reciente, aquellos que reportaron reciente trauma tienen una tasa cuatro veces más alta de fracaso antirretroviral (ORA 4.3; 95% IC 1.1–16.6;  $p = 0.04$ ), y tres veces más alta de reportar sexo con una pareja VIH negativo o desconocido estado serológico (ORA 3.9; 95% CI 1.3–11.9;  $p = 0.02$ ) y < 100% de uso de condones con estas parejas (ORA 4.5; 95% CI 1.5–13.3;  $p = 0.007$ ). La detección de trauma reciente en mujeres biológicas y transexuales identifica a los pacientes con alto riesgo de resultados de salud pobres y comportamiento de riesgo de transmisión de VIH.

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### Background

In the United States (US), the prevalence of HIV in women has more than tripled since 1985. Women now account for at least 27% of all new HIV/AIDS diagnoses, up from 8% in 1985 and 14% in 1992 [1–3]. Globally, women now

represent 50% of those living with HIV/AIDS [4]. Women of color are disproportionately affected. More than three-quarters (77%) of women recently diagnosed with HIV/AIDS in the US are Black or Latina, despite these groups representing only 25% of the population [1].

Women face unique barriers to timely HIV diagnosis [5], engaging in care [6–11], being prescribed and adhering to antiretroviral medications [12–14], and achieving optimal health outcomes [15, 16]. As such, despite the existence of effective antiretroviral therapy (ART), women with HIV have surprisingly high rates of morbidity and mortality. HIV/AIDS is a leading cause of death for Black and Hispanic women aged 15–54 in the US [3]. Numerous calls have been made to identify and respond to factors associated with the high prevalence and poor outcomes of HIV in women [17, 18].

HIV-positive women are disproportionately affected by sexual and physical trauma in both childhood and adulthood as well as by posttraumatic stress disorder (PTSD) compared to the general population of women [19]. Studies increasingly demonstrate that trauma and PTSD are likely significant factors contributing to the high prevalence and poor outcomes of HIV in women. For example, both trauma and PTSD are known to predispose women to becoming infected with HIV [20–25]. Once infected, both trauma and PTSD are increasingly recognized as contributors to poor health outcomes, such as poor health-related quality of life, medication non-adherence, and increased mortality [26–31], as well as higher transmission risk behavior [21, 32–37].

The mechanism(s) by which trauma and PTSD impact HIV-related health outcomes and transmission risk behavior have been the subject of increasing analysis. Prior studies demonstrate an association between trauma and/or PTSD and non-adherence to ART [38–45]. Drug abuse and mental health problems (e.g., depression) have also been identified as potential, often interrelated, mediating factors between trauma, medication non-adherence, and poor HIV-related health outcomes [41, 46–48].

One prior study reported a positive association between past trauma and ART failure in a cohort of HIV-positive men and women [27]. Additional studies are needed to better understand the complex relationship between trauma exposure and HIV-related health and transmission risk outcomes, including an examination of the timing of the trauma exposure.

To better understand which factors are significantly associated with ART failure and HIV transmission risk behavior, a cross-sectional exploratory analysis of socio-economic, behavioral, and health-related data was performed within an existing prevention-with-positives program that serves a population of predominately minority, HIV-positive women and female-identified transgenders in San Francisco.

## Methods

### Recruitment

Study participants included the first 113 HIV-positive female-identified individuals enrolled in a prevention-with-positives program called The Sexual Health and Empowerment Program (+SHE). The program started in 2006 and is ongoing. Participants for +SHE are recruited on-site at the two principal clinical programs caring for HIV-positive women and female-identified transgenders in San Francisco. All women receiving care at these sites are recruited for the program regardless of perceived characteristics, behaviors, or clinical status.

### Survey Instrument and Measures

As part of routine enrollment in +SHE, a trained female harm-reduction counselor conducts a semi-structured, detailed, 97-question intake interview to collect information about an array of characteristics and behaviors potentially associated with health outcomes and secondary HIV transmission. The questionnaire covers a variety of subject domains including socio-economic characteristics, sexual behaviors, substance use, health-related history, and emotional experiences. The interviews by the harm reduction counselor are done in person; verbal responses to the stated questions are recorded on a standardized data collection form.

Information about health outcomes was derived from a review of medical records. HIV viral load and CD4 cell count data were included as long as the values were determined <5 months prior to the interview or within one month afterwards. Values determined within one-month after the intake interview were allowed given that all interventions started at least one-month after such interviews. The results closest to the interview date were utilized for the study.

### Independent and Dependent Variables

Independent variables utilized in the study analyses were collected by the intake interview or a review of the medical records, described above and included: age, race, CD4 count, depression, drug use, recent and lifetime trauma exposure, recent and lifetime coerced sex, self-efficacy, social support, and transgender status. Dependent variables were similarly obtained from the intake interview or medical records review and included: sex with partners who are HIV-negative or unknown status, <100% condom use with HIV-negative or unknown status partners, and ART failure. ART adherence data, obtained from the intake

interview, was analyzed both as an independent and dependent variable.

Interview questions were drawn from standardized instruments where available, but were condensed due to time limitations in an active clinical program. Self-efficacy (a person's belief about his or her capabilities to produce levels of performance sufficient to influence the events that affect his or her life) was measured using nine questions drawn from the Empowerment Scale, a validated 28-question scale designed for use among those with mental health disorders [49]. The nine questions were selected because they specifically addressed the aspects of empowerment related to self-efficacy. Questions about social support were drawn from the California Health Interview Survey Adult Questionnaire Version 5.1 [50]. ART adherence over the past 30-days was assessed using a visual analog scale; participants taking ART pointed to the percentage of doses taken over the past month [51]. The time frame for all sexual and substance-related behavioral variables was recent ("within the past 6 months"). Condom use within the past six months for vaginal and/or anal intercourse was assessed separately for partners who were: (1) HIV-negative or of unknown serostatus or (2) HIV-positive. The interview also included two simple screening questions for current and past traumatic events: "In the past 30 days, have you been abused, threatened, or the victim of violence?" and "Have you ever been abused, threatened, or the victim of violence?" Standardized scales to measure traumatic events or posttraumatic symptoms were not included because the questionnaire was designed as a broad and exploratory survey for clinical use prior to our knowledge of the impact of trauma on the outcomes and behaviors of participants.

Survey questions with answer options in scales were dichotomized for analysis. Adherence measures using the visual analog scale were analyzed as being <90% versus  $\geq 90\%$ , which reflects a level of adherence likely adequate for viral suppression across current antiretroviral regimens [52, 53]. For self-efficacy, the cumulative results of four-item Likert scales were dichotomized to high (strongly or somewhat agree) or low self-efficacy (strongly or somewhat disagree) using a composite score of the nine questions. Similarly, for social support, the cumulative results of five-item Likert scales were dichotomized to high (most or all of the time) or low social support (none, a little, or some of the time) using a composite score of the five questions. The point of dichotomization was chosen such that the degree of the variable endorsed by the participant was likely to have a meaningful clinical impact on health outcomes and/or transmission risk behavior. ART failure was defined as having a detectable viral load ( $\geq 75$  copies/mm) with self-reported antiretroviral use.

Data from the interviews and chart reviews were entered into a computer database using unique patient identifiers. Participants were incentivized by the +SHE program with a \$10.00 grocery gift certificate to complete the approximately one-hour structured interview. The protocol for this study was approved by the University of California, San Francisco Committee for Human Research.

### Statistical Analysis

The study is a cross-sectional analysis of survey and laboratory data acquired in the course of a clinical program. Data were explored and assessed descriptively. Bivariate analysis to compare biological versus transgender women was conducted using Fisher Exact and Wilcoxon tests. Standard univariate and multivariate linear and logistic regressions were performed to assess correlates of ART adherence, ART failure, and HIV transmission risk behavior. Age and number of sexual partners of HIV negative or unknown serostatus were treated as continuous variables. All other variables were analyzed dichotomously with the referent category being the absence of the variable (e.g., African-American vs. not African-American,  $CD4 < 200$  cells/ml vs.  $CD4 \geq 200$  cells/ml). Multivariate logistic regressions were performed only when more than one independent variable was found on univariate analysis to be significantly associated with the dependent variable. Analyses involving ART adherence and ART failure were performed separately and only included those participants on ART. Multicollinearity was assessed through bivariate correlation of independent variables. Statistical significance was considered  $p \leq 0.05$ . All statistical tests were done using SAS 8.0 software (SAS Inc., Cary, NC).

### Results

#### Socio-Economic, Health-Related, and Behavioral Characteristics

Table 1 describes the socio-economic characteristics of the study population. The mean age was 44.6 (SD 9.1) years. The majority were biologically female (71.7%), African-American (64.6%), low income (89.3% made <\$1,000.00 per month), and marginally housed (58.4% did not rent or own an apartment or house).

Table 2 describes the health-related characteristics of the study participants. Recent trauma (within the past 30 days) was reported by 17.3% participants; lifetime trauma was reported by 71.8%. Recent coercion to have sex (within the past 30 days) was reported by 8.2%; lifetime sexual coercion was reported by 64.5%.

**Table 1** Socio-economic characteristics

Description	Sample size	Number (%) of participants with each characteristic
Gender	113	
Biological female		81 (71.7%)
Transgender female		32 (28.3%)
Mean age	113	44.6 ( $\pm$ 9.1) years; range 20.2–61.9
Race/ethnicity	113	
African-American		73 (64.6%)
White		23 (20.4%)
Latina		8 (7.1%)
Asian/Pacific Islander		3 (2.7%)
Native American		2 (1.8%)
Other/mixed		4 (3.5%)
Monthly income	113	
<\$500		17 (15.0%)
\$500–\$1,000		84 (74.3%)
\$1,001–\$2,000		8 (7.1%)
\$2,001–\$3,000		2 (1.8%)
>\$3,000		2 (1.8%)
Housing (in the past 30 days)	113	
Home or apartment		47 (41.6%)
With friend, family, or partner		11 (9.7%)
Single room occupancy hotel		25 (22.1%)
Residential program or shelter		24 (21.2%)
Street		3 (2.7%)
Other		3 (2.7%)

Over half of the study population reported an active mental health diagnosis, most commonly depression in 47.7%. Low social support was reported by nearly half (48.7%) of participants. Just over 16% of participants reported low self-efficacy. The median CD4 cell count nearest to the time of the enrollment interview was 387 (interquartile range [IQR] 270–599 cells/ml). The majority (56.3%) reported being on ART. A significant minority (18.9%) had a detectable viral load despite reporting ART use (i.e., “ART failure”). Among those on ART, adherence <90% was reported by 23.8%.

Table 3 describes the behavioral characteristics of study participants. Sexual activity within the past 6 months was reported by 54.0% of participants. For sexually active participants, the median number of main sexual partners was 1 (IQR 0–1); the median number of casual sexual partners, if such partners were reported, was 1 (IQR 0–1). Of those who were sexually active, the great majority (83.6%) reported having sex with an HIV-negative or unknown-serostatus partner. Of those who were sexually active with an HIV-negative or unknown-serostatus partner, over half did not always disclose their HIV-status

**Table 2** Health-related characteristics

Description	Sample size	Number (%) of participants with each characteristic
Mental health	111	
Depression		53 (47.7%)
Bipolar		8 (7.2%)
Anxiety		9 (8.1%)
Schizophrenia/psychosis		3 (2.7%)
Other		4 (3.6%)
Low self-efficacy	109	18 (16.5%)
Low social support	113	55 (48.7%)
Trauma		
Abused, threatened, and/or victim of violence in the past 30 days	110	19 (17.3%)
Abused, threatened, and/or victim of violence in lifetime	110	79 (71.8%)
Coerced to have sex in the past 30 days	110	9 (8.2%)
Coerced to have sex in lifetime	110	71 (64.5%)
Median CD4 count (cells/ $\mu$ l)	93	387 (range 0–1363)
Viral load (copies/ml)	90	
<75		33 (36.7%)
75–9,999		30 (33.3%)
10,000+		27 (30.0%)
Antiretroviral therapy		
On ART	112	63 (56.3%)
On ART and detectable viral load	90	17 (18.9%)
Self-reported adherence <90%	63	15 (23.8%)

ART highly active antiretroviral therapy

(56.9%), did not always use condoms (60.8%), or had a detectable viral load while on ART (58.8%). A significant minority of those who were sexually active with an HIV-negative or unknown-serostatus partners (16 of 51; 31.4%) reported all three of these key transmission risk behaviors (i.e., did not always disclose their status, did not always use condoms, and had a detectable viral load).

Crack cocaine, heroin, and/or methamphetamine-use within the past 6 months were reported by 40.5% of participants. Injection drug use within the past 6 months was reported by 9.8% of participants, almost half of whom (45.5%) reported sharing needles and over half (54.5%) had detectable virus.

#### Correlates of ART Failure, ART Adherence, and Transmission Risk Behavior

Table 4 describes the correlates of ART failure and ART adherence among the subset of participants on ART. Recent trauma was the single statistically significant

**Table 3** Behavioral characteristics

	Sample size	Number (%) of participants with each characteristic
<b>Sexual activity</b>		
Any sexual activity in the past 6 months	113	61 (54.0%)
With a main partner	61	43 (70.5%)
Median number of main partners (if any)		1 (range 1–2)
With casual partners	61	23 (37.7%)
Median number of casual partners (if any) <sup>b</sup>		1 (range 1–25)
Sex with any HIV negative or unknown serostatus partners (if sexually active) in the last 6 months	61	51 (83.6%)
Disclosure of HIV status less than all of the time with these partners	51	29 (56.9%)
Using condoms less than all of the time with these partners	51	31 (60.8%)
Detectable viral load	51	30 (58.8%)
Disclosure of HIV status less than all of the time, and using condoms less than all of the time, and a detectable viral load	51	16 (31.4%)
<b>Substance use (any, recent)</b>		
Cigarettes	110	71 (64.5%)
Alcohol	111	50 (45.0%)
Marijuana	111	39 (35.1%)
Crack/cocaine, heroin, and/or methamphetamines	111	45 (40.5%)
IDU <sup>b</sup>	112	11 (9.8%)
IDU who share needles	11	5 (45.5%)
IDU who have a detectable viral load	11	6 (54.5%)

<sup>a</sup> One participant had a very high number of sexual partners ( $N = 250$ ) and was excluded from the analysis

<sup>b</sup> IDU injection drug use(r)

correlate of ART failure on univariate analysis. Participants reporting recent trauma had greater than four times the odds of ART failure than those who did not report recent trauma (OR 4.3, 95% confidence interval [CI] 1.1–16.6;  $p = 0.04$ ). Low social support was the only statistically significant correlate of ART adherence on univariate analysis (OR 5.6, 95% confidence interval [CI] 1.4–22.5;  $p = 0.02$ ). The correlation of low self-efficacy and recent coerced sex with medication non-adherence approached statistical significance (OR 4.4, 95% CI 0.9–20.7;  $p = 0.06$  and OR 6.1, 95% CI 0.9–41.3;  $p = 0.06$ , respectively). Multivariate analysis for correlates of ART failure and ART adherence was not performed because only one variable was statistically significant on univariate analysis.

Table 5 describes the correlates of transmission risk behavior among all study participants. On univariate analysis, recent trauma, recent coerced sex, age, transgender status, and low self-efficacy were significantly correlated with one or more transmission risk behaviors. On multivariate analyses controlling for variables that were statistically significant on univariate analyses, participants reporting recent trauma had almost four times the odds of sex with HIV-negative or unknown serostatus partners (OR 3.9, 95% CI 1.3–11.9;  $p = 0.02$ ) and over four times the

odds of not always using condoms with HIV-negative or unknown serostatus partners (OR 4.5, 95% CI 1.5–13.3;  $p = 0.007$ ) compared to those who did not report recent trauma. Participants reporting recent trauma may also be more likely to have a greater number of partners who are HIV-negative or unknown serostatus, but this association did not reach statistical significance ( $1.5 \pm 0.8$ ;  $p = 0.07$ ). Low self-efficacy was associated with an increased number of HIV-negative or unknown serostatus partners ( $1.9 \pm 0.8$ ;  $p = 0.02$ ). Older age was associated with a modest decrease in the odds of reporting sex with HIV-negative or unknown serostatus partners OR 0.9 (0.9–0.96;  $p < 0.001$ ) and not always using condoms with HIV-negative or unknown serostatus partners (OR 0.9, 95% CI 0.9–0.98;  $p = 0.004$ ). Coerced sex was not included in the multivariate model due to multicollinearity with trauma. Specifically, all participants reporting recent coerced sex also reported recent trauma; these two variables had a high degree of correlation (Pearson's  $r = 0.65$ ,  $p < 0.001$ ).

#### Comparison of Biological and Transgender Women

Biological and transgender women were compared on all variables in Tables 1, 2, and 3 given the potential for

**Table 4** Univariate regression analyses for predictors of ART failure among participants on ART ( $N = 63$ )

	Detectable viral load on ART <sup>a</sup>	<90% ART adherence <sup>a</sup>
Age (increase of 1 year)	OR 1.0 (0.93–1.1; $p = 0.96$ )	OR 1.0 (0.9–1.1; $p = 0.92$ )
African-American	OR 1.8 (0.6–6.1; $p = 0.32$ )	OR 0.7 (0.2–2.2; $p = 0.53$ )
CD4 count <200 cells/ $\mu$ l	OR 2.1 (0.7–6.5; $p = 0.20$ )	OR 0.7 (0.2–2.4; $p = 0.57$ )
Depression	OR 0.8 (0.3–2.7; $p = 0.78$ )	OR 0.7 (0.2–2.3; $p = 0.55$ )
Drug use	OR 1.1 (0.4–3.4; $p = 0.88$ )	OR 1.5 (0.5–4.7; $p = 0.53$ )
Lifetime coerced sex	OR 1.2 (0.4–3.8; $p = 0.78$ )	OR 1.3 (0.4–4.4; $p = 0.66$ )
Lifetime trauma	OR 1.2 (0.3–4.5; $p = 0.77$ )	OR 0.9 (0.2–3.2; $p = 0.82$ )
Low self-efficacy	OR 1.7 (0.4–8.1; $p = 0.50$ )	OR 4.4 (0.9–20.7; $p = 0.06$ )
Low social support	OR 2.2 (0.6–6.9; $p = 0.18$ )	<b>OR 5.6</b> <b>(1.4–22.5; <math>p = 0.02</math>)</b>
Recent coerced sex	OR 1.8 (0.3–12.0; $p = 0.53$ )	OR 6.1 (0.9–41.3; $p = 0.06$ )
Recent trauma	<b>OR 4.3</b> <b>(1.1–16.6; <math>p = 0.04</math>)</b>	OR 2.3 (0.6–9.4; $p = 0.25$ )
Transgender	OR 0.9 (0.2–3.2; $p = 0.84$ )	OR 0.4 (0.07–1.9; $p = 0.23$ )
<90% ART adherence	OR 1.0 (0.3–3.6; $p = 0.97$ )	–

Bold =  $p \leq 0.05$

OR odds ratio; values include 95% confidence intervals

<sup>a</sup> Analyses conducted using logistic regression models

differences in these populations. Biological women were significantly older (46.9 vs. 43.8 years;  $p = 0.03$ ), and more biological women had stable housing (49% vs. 22% had a home or apartment;  $p = 0.01$ ) and had sex with a main partner in the past 6 months (81% vs. 50%;  $p = 0.02$ ). Additionally, as shown in the univariate regression analysis, transgender status was associated with an increase in the number of sexual partners of HIV-negative or unknown status ( $1.3 \pm 0.7$ ,  $p = 0.049$ ); however, this finding was not significant on multivariate analysis. No other statistically significant differences were observed between biological and transgender women in this study.

## Discussion

This study showed that an affirmative answer to a simple screening question for recent trauma is associated with key

HIV-related health outcomes and transmission risk behaviors among HIV-positive women and female-identified transgenders. To the authors' knowledge, this study is the first that identifies a significant association between recent trauma and ART failure. The magnitude of this relationship was strikingly high: recent trauma was associated with greater than fourfold increased odds of ART failure and greater than threefold increased odds of key transmission risk behaviors (e.g., sex with HIV-negative or unknown serostatus partners and not always using condoms with these partners).

These results are consistent with prior literature demonstrating an association between different types of recent and lifetime trauma and/or PTSD and HIV transmission risk behavior in both HIV-negative and HIV-positive women [20–25, 32–36]. This study adds to an emerging body of literature demonstrating an association between trauma and key HIV-related health outcomes in both men and women [26–31].

**Table 5** Univariate and multivariate regression analyses for predictors of HIV transmission risk behavior among all participants ( $N = 113$ )

	Sex with partners who are HIV(-) or unknown status <sup>a</sup>		<100% condom use with HIV(-) or unknown status partners <sup>a</sup>		Number of sexual partners of HIV(-) or unknown status <sup>b</sup>	
	Univariate	Multivariate	Univariate	Multivariate	Univariate	Multivariate
Age (increase of 1 year)	<b>OR 0.9</b> (0.9–0.96; $p < 0.001$ )	<b>OR 0.9</b> (0.9–0.96; $p < 0.001$ )	<b>OR 0.5</b> (0.3–0.7; $p = 0.002$ )	<b>OR 0.9</b> (0.9–0.98; $p = 0.004$ )	<b>-0.08</b> (±0.03; $p = 0.02$ )	-0.05 (±0.03; $p = 0.16$ )
African-American	OR 0.9 (0.4–1.9; $p = 0.71$ )	-	OR 0.8 (0.3–1.9; $p = 0.65$ )	-	-0.9 (±0.6; $p = 0.14$ )	-
Transgender	OR 1.9 (0.8–4.3; $p = 0.14$ )	-	OR 1.6 (0.7–3.9; $p = 0.30$ )	-	<b>1.3</b> (±0.7; $p = 0.049$ )	<b>0.9</b> (±0.7; $p = 0.21$ )
CD4 count <200 cells/μL	OR 1.1 (0.5–2.3; $p = 0.87$ )	-	OR 1.6 (0.7–3.6; $p = 0.31$ )	-	0.31 (±0.6; $p = 0.63$ )	-
Depression	OR 1.5 (0.7–3.1; $p = 0.32$ )	-	OR 1.0 (0.5–2.4; $p = 0.93$ )	-	0.8 (± 0.6; $p = 0.21$ )	-
Drug use	OR 1.0 (0.5–2.0; $p = 0.90$ )	-	OR 1.6 (0.7–3.7; $p = 0.25$ )	-	1.0 (±0.6; $p = 0.10$ )	-
Low self-efficacy	OR 2.3 (0.8–6.5; $p = 0.12$ )	-	OR 2.7 (0.9–7.6; $p = 0.07$ )	-	<b>2.3</b> (±0.8; $p = 0.005$ )	<b>1.9</b> (± 0.8; $p = 0.02$ )
Low social support	OR 1.0 (0.5–2.2; $p = 0.18$ )	-	OR 1.4 (0.6–3.2; $p = 0.42$ )	-	OR 0.8 (±0.6; $p = 0.17$ )	-
Recent trauma	<b>OR 3.2</b> (1.1–9.2; $p = 0.03$ )	<b>OR 3.9</b> (1.3–11.9; $p = 0.02$ )	<b>OR 4.0</b> (1.4–11.2; $p = 0.008$ )	<b>OR 4.5</b> (1.5–13.3; $p = 0.007$ )	<b>1.6</b> (±0.8; $p = 0.04$ )	<b>1.5</b> (±0.8; $p = 0.07$ )
Lifetime trauma	OR 2.0 (0.9–4.9; $p = 0.11$ )	-	OR 1.8 (0.7–5.0; $p = 0.25$ )	-	0.5 (±0.7; $p = 0.44$ )	-
Recent coerced sex	OR 2.7 (0.6–11.4; $p = 0.18$ )	-	<b>OR 6.4</b> (1.5–27.6; $p = 0.01$ )	<sup>c</sup>	<b>3.3</b> (±1.1; $p = 0.003$ )	<sup>c</sup>
Lifetime coerced sex	OR 1.9 (0.8–4.1; $p = 0.12$ )	-	OR 2.5 (0.99–6.6; $p = 0.05$ )	-	0.7 (± 0.6; $p = 0.24$ )	-

**Bold** =  $p \leq 0.05$

OR odds ratio; values include 95% confidence intervals

<sup>a</sup> Analyses conducted using logistic regression models

<sup>b</sup> Analyses conducted using linear regression models

<sup>c</sup> Variable not used to avoid multicollinearity

The study's findings help better understand the impact of trauma on health outcomes and HIV transmission risk behaviors for several reasons. First, the study identified very simple screening questions for recent and lifetime trauma which can be readily used in clinical practice. Second, the outcome variables included ART failure in addition to other key transmission risk behaviors. Third,

the study found a significant association between recent, rather than lifetime, trauma and ART failure, as well as with other transmission risk behaviors. Fourth, data was collected by female interviewers with training and experience discussing trauma, sexuality, and drug use. Because female respondents may feel more comfortable disclosing violence to other women [54, 55], the study's measurement



of trauma and other potentially stigmatizing issues, such as sexual behavior and drug use, may have been particularly sensitive.

The study findings suggest that screening for recent trauma among HIV-positive biological and transgender women may effectively identify patients at high risk for poor health and transmission risk outcomes. Identifying such patients may allow for a more effective allocation of scarce clinic and/or community resources, such as safety assessment, trauma-related therapy, ART adherence support, and transmission-prevention counseling. The study's findings also offer a focus—recent trauma—for new interventions designed to improve health and transmission outcomes of women with HIV.

This exploratory study was not designed nor powered to clarify the mechanism by which recent trauma is associated with ART failure. Notably, the study did not demonstrate an association between self-reported poor ART adherence and ART failure. While other possible biologic mechanisms have been reported by which trauma could lead to ART failure, such as cortisol levels [56] or pituitary adenylate cyclase-activating polypeptide [57], the measure of adherence utilized by this study was likely not sensitive enough to effectively measure the multifaceted realities of ART adherence. For example, the visual analog scale did not measure regimen concordance (i.e., if the patient was adherent to each antiretroviral medication as it was prescribed) or the use of interfering medications. Moreover, traumatized patients may be less comfortable self-reporting non-adherence.

Prior studies have indeed demonstrated an association between trauma and/or PTSD and ART non-adherence [38–45]. One prior study of HIV-positive women also demonstrated that a history of trauma was associated with reporting not being on ART despite it being medical indicated [58]. While our study did not ascertain the appropriate use of ART (i.e., being on ART when medically indicated), and rather looked at self-reported adherence, a poor relationship with medical providers may partially explain why women who experience trauma have trouble self-reporting non-adherence. Literature from the general population of women supports this possibility; one prior study of African-American women demonstrates that those currently experiencing intimate partner violence were less likely to report that they felt respected and accepted during a medical encounter, and they provided lower ratings of the quality of communication with their providers [59].

The significant or near significant associations of low social support, low self-efficacy, and recent coerced sex with poor ART adherence in our study suggest additional potential mediating and/or moderating factors. Prior studies of HIV-positive women have, in fact, demonstrated an

association between poor social support and/or self-efficacy and poor adherence to ART [60, 61]. Additional studies with larger sample sizes and more in depth adherence measures are needed fully understand the role of poor adherence in the impact of trauma on health outcomes and transmission risk behavior.

Other potential mediating factors between trauma, medication adherence, and HIV-related health outcomes are drug abuse and mental illness, as has been described in prior studies [41, 46–48]. For example, one study found that depression, but not PTSD, was independently associated with a higher viral load in HIV-positive men and women, and the combination of depression and PTSD was most predictive [41]. Another study reported that PTSD was significantly associated with ART non-adherence only in individuals reporting high levels of dissociative symptoms [40]. While our study did not find an association between drug abuse or mental health problems and ART failure, it was not designed to detect such relationships or clarify the many likely correlated factors (e.g., trauma, PTSD, depression, substance use, poor adherence) associated with poor outcomes in HIV-positive women. Additional studies with longitudinal follow-up are needed to fully elucidate the mechanism(s) by which recent trauma is associated with antiretroviral failure and transmission risk behavior in HIV-positive individuals. Such studies would likely benefit from using a hypothesis based on an appropriate conceptual model (e.g., self-efficacy, social cognitive theory) [62–64].

This study has a number of additional limitations given the nature of an exploratory study performed using cross-sectional, clinically-acquired, data. First, the study lacked a validated measure of trauma and instead used single questions asking about recent and lifetime trauma exposure. Although the results of this study suggest that a single screening item may identify those most at risk for the sequelae of trauma, this single item does not provide a full understanding of the nature of the traumatic event, its sequelae, or whether the patient has symptoms of PTSD. For example, it was not possible to determine whether the recent trauma reported by some participants was coerced sex that led to the reported transmission risk behavior. The trauma-screening item also did not address whether the trauma and/or transmission risk occurred in the setting of trading sex for money or support. Prior studies have demonstrated that prostitution is associated with higher rates of trauma and PTSD [65, 66]. Further studies are required to validate this simple trauma screening item alongside previously validated and detailed measures of trauma that include the sexual situations in which trauma often occurs. If validated, the simple trauma screening items used in this study could be readily integrated into clinical practice and provide a time-efficient and evidence-based method to

identify those patients at high risk for poor health and transmission-risk outcomes.

Second, the study relies on self-report for all measures of behavior, which is known to underestimate medication non-adherence and other activities potentially considered to be socially undesirable [67]. The high rates of trauma, active drug use, and unprotected sex disclosed by the participants, however, suggest a high level of trust in the trained harm-reduction counselors who administered the interviews. Furthermore, this limitation would likely underestimate the rates and implications of trauma. Third, transgender and non-transgender women may have differences that influence their health outcomes and risk behaviors. Indeed, the univariate regression analysis indicates that transgender women in the study have more sexual partners of unknown or negative HIV status than the biological women. However, this finding lost significance on multivariate analysis, no significant differences were seen between the two populations in the prevalence of trauma or substance use, and transgender status did not impact any of the other univariate or multivariate analyses. Nonetheless, given the potential for unmeasured differences in these two groups, further study with larger sample sizes will be important. Fourth, the prevention-with-positives program from which the data was obtained did not track the numbers of people who declined to participate or the reasons why they declined, which may limit the generalizability of the study results. Fifth, while we would expect to find a similar correlation between recent trauma and health and transmission risk outcomes among HIV-positive men and other sub-populations of individuals with HIV, the generalizability of the study's findings are limited because data was collected only from HIV-positive women and female-identified transgenders receiving care in San Francisco. Lastly, the cross-sectional nature of the study makes it impossible to draw causal or time-ordering inferences from the identified associations among variables.

## Conclusion

Despite these limitations, the study has important and immediate clinical implications. HIV/AIDS has become a serious health issue for minority women and female-identified transgenders in the United States. Trauma and PTSD are emerging as key, largely unaddressed, factors that contribute to the high prevalence and poor outcomes of HIV in these populations, and may also be the case for men. Screening for recent trauma in HIV-positive women and female-identified transgenders identifies patients at high risk for ART failure and HIV transmission risk behavior. Identifying such patients may allow for a more

effective allocation of scarce clinic and/or community resources. Interventions addressing trauma and/or PTSD have shown promise in reducing risk behaviors and improving mental health among men and women with, or at risk for, HIV [68–70]. For example, one study demonstrated that a 12-session group therapy intervention targeting skills building and self-efficacy among women with co-occurring substance abuse and PTSD led to a significant reduction in unprotected sexual experiences (90). The findings of our study call for an invigorated focus on trauma screening in clinical practice and for new interventions that focus on trauma-prevention and trauma-recovery among women with HIV.

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