

# HIV Risk Characteristics Associated with Violence Against Women: A Longitudinal Study Among Women in the United States

Brooke E.E. Montgomery, PhD, MPH,<sup>1</sup> Paula M. Frew, PhD, MA, MPH,<sup>2-4</sup> James P. Hughes, PhD,<sup>5</sup>  
Jing Wang, MS,<sup>6</sup> Adaora A. Adimora, MD, MPH,<sup>7</sup> Danielle F. Haley, PhD, MPH,<sup>8</sup> Irene Kuo, PhD, MPH,<sup>9</sup>  
Larissa Jennings, PhD, MPH,<sup>10</sup> Nabila El-Bassel, PhD,<sup>11</sup> and Sally L. Hodder, MD,<sup>12</sup>  
for the HPTN 064 Study Team

## Abstract

**Background:** Using data from HIV Prevention Trials Network 064, a multisite, observational cohort study conducted to estimate HIV incidence rates among women living in areas of high poverty and HIV prevalence in the United States, we examined the use of HIV risk characteristics to predict emotional abuse, physical violence, and forced sex.

**Methods:** Participants included 2099 women, 18–44 years of age, who reported unprotected vaginal or anal sex with a male partner and an additional personal or perceived male partner HIV risk characteristic in the past 6 months. Adjusting for time-varying covariates, generalized estimating equations were used to assess the ability of HIV risk characteristics to predict violence 6 months later.

**Results:** Reported analyses were limited to the 1980 study participants who reported having a male sex partner at that assessment. Exchanging sex, perceived partner concurrency, and perceived partner incarceration were significantly predictive of emotional abuse 6 months later (adjusted odds ratio [AOR]: 1.60; 1.59; 1.34, respectively). Prior sexually transmitted infection diagnosis, exchanging sex, and binge drinking were significantly predictive of physical violence 6 months later (AOR: 1.62; 1.71; 1.47, respectively). None of the variables measured was significantly predictive of forced sex.

**Conclusions:** Strategies that address reducing violence against women should be studied further in the context of HIV prevention programs.

**Keywords:** violence against women, longitudinal analysis, HIV risk factors

## Introduction

ALMOST A QUARTER of adults living with HIV in the United States are women.<sup>1</sup> HIV among United States women is concentrated in small geographic pockets of the

South and Northeast that also have high rates of poverty, violence, substance use, and unmet healthcare, and social service needs.<sup>1,2</sup> Violence, particularly interpersonal violence, has received attention as a risk factor for HIV acquisition through direct pathways between experiencing violence and

<sup>1</sup>Department of Health Behavior and Health Education, Fay W. Boozman College of Public Health, University of Arkansas for Medical Sciences, Little Rock, Arkansas.

<sup>2</sup>Department of Medicine, Emory University School of Medicine, Atlanta, Georgia.

<sup>3</sup>Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, Georgia.

<sup>4</sup>Department of Behavioral Sciences and Health Education, Rollins School of Public Health, Emory University, Atlanta, Georgia.

<sup>5</sup>Department of Biostatistics, University of Washington, Seattle, Washington.

<sup>6</sup>Vaccine and Infectious Disease Division, Fred Hutchinson Cancer Research Center, Seattle, Washington.

<sup>7</sup>UNC School of Medicine and UNC Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

<sup>8</sup>Institute for Global Health and Infectious Diseases, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

<sup>9</sup>Department of Epidemiology and Biostatistics, Milken Institute School of Public Health, George Washington University, Washington, District of Columbia.

<sup>10</sup>Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland.

<sup>11</sup>Columbia University School of Social Work, New York, New York.

<sup>12</sup>West Virginia Clinical and Translational Science Institute, Morgantown, West Virginia.

participation in behaviors that increase risk of HIV acquisition, such as drug and alcohol use during sex, sex work, and condomless sex.<sup>3-7</sup> Additionally, violence increases HIV risk through theoretical and psychosocial pathways, such as supporting traditional gender norms that disempower women, impairing communication skills to negotiate safe sex behaviors that reduce HIV acquisition, and experiencing higher rates of depression and posttraumatic stress disorder symptomatology.<sup>4,6-17,18</sup> Despite strong support for a cross-sectional association between violence against women (VAW) and HIV acquisition,<sup>7,9,11,15,19-26</sup> longitudinal evidence of this relationship, especially among study populations in the United States, is still lacking.

Of the studies that have investigated the relationship between VAW and HIV risk with longitudinal designs, several have limited generalizability due to narrowly defined study populations, relatively small sample sizes, and measurement errors caused by combining different types of violence.<sup>4,10,27-33</sup> Most of these studies typically examine only the predictive ability of violence on HIV risk and acquisition rather than using HIV-related variables to predict violence. This one-sided analysis of the relationship between violence and HIV has resulted in a knowledge gap, with little research examining the predictive ability of HIV-related factors on experiencing violence. Evidence of HIV risk being predictive of VAW would be particularly valuable for several reasons, including: (1) nearly 20% of new HIV cases in the United States are among women, with heterosexual contact being the primary route of transmission; (2) African American and Latina women experience disproportionately high rates of both HIV and VAW; (3) the relative abundance of HIV prevention efforts compared with violence prevention; (4) the promise of using HIV programming as an entry point for addressing VAW; and (5) the evidence of a strong relationship between experiencing violence and acquiring HIV.<sup>1,6,34</sup> Moreover, temporal evidence of the ability of personal and perceived partner HIV risk characteristics to predict subsequent violence is necessary to develop effective interventions that promote context-specific HIV risk reduction among vulnerable women.<sup>35-38</sup>

This article makes a unique contribution to the current literature by conducting analyses of longitudinal data from an observational cohort study to explore the predictive ability of participation in HIV risk-related behaviors and experiencing violence among women living in selected cities in the United States who have male sex partners and are at risk for HIV. Our hypothesis was that selected personal HIV risk characteristics and selected perceived partner HIV risk characteristics would be predictive of emotional abuse, physical violence, or forced sex 6 months later. Characteristics were selected based on evidence of a potential relationship with violence in the extant literature and/or behavioral theory as well as their availability in the dataset used.

## Methods

### *Study population*

Methodological details and the primary analysis of the HIV Prevention Trials Network (HPTN) 064 Study have been published elsewhere.<sup>39</sup> HPTN 064 was a multisite, observational cohort study conducted to estimate HIV incidence rate among women at risk for HIV acquisition in 10 United

States communities from six geographic areas that were selected based on their high rates of poverty and HIV prevalence. HPTN 064 was approved by the Institutional Review Boards at each of the study sites and collaborating institutions, and a certificate of confidentiality was obtained. Venue-based recruitment with time-space sampling was used to recruit more than 2000 participants between May 2009 and July 2010. Based on time of enrollment, the study followed participants for either 6 or 12 months. Participants had to: (1) self-identify as a woman (female by birth) or transgender (male-to-female) woman; (2) be 18-44 years of age; (3) accept HIV testing and subsequent results; (4) report unprotected vaginal or anal sex with a male partner in the 6 months before enrollment, and (5) have at least one additional personal HIV risk characteristic or have a male sex partner believed to have at least one HIV risk characteristic in the past 6 months, except for incarceration of the participant or their partner, which could have occurred in the past 5 years to meet the additional risk characteristic criteria. Interviewer-administered screening forms were used to assess eligibility. An audio computer-assisted self-interview (ACASI) system was used to collect participant-reported data at baseline and follow-up assessments (at 6 and 12 months).

### *Measures*

Data from the HPTN 064 baseline, 6-, and 12-month assessments were used for the current study. Outcome variables were measured at the 6- and 12-month follow-up visits using three yes/no questions, designed by team experts based on the needs of the overall study, that succinctly assessed experiences of emotional abuse, physical violence, and forced sex in the previous 6 months. To assess emotional abuse, participants were asked, "In the last 6 months, have you been emotionally abused by your partner or someone important to you? Examples of emotional abuse include: When someone makes you feel bad about yourself by calling you names, making you think you are crazy, humiliating you, making you feel guilty." Experiencing physical violence was determined by a "yes" response to the question: "In the last 6 months, have you been hit, slapped, kicked, or physically hurt by someone important to you?" Forced sex was defined as a "yes" response to the question: "In the last 6 months, have you been forced to have any type of sex?"

Personal and male partner HIV risk characteristics measured at baseline and at the 6-month follow-up served as the predictor variables, resulting in a 6-month interval between the measurement of all the predictor and outcome variables. Predictor variables were assessed by self-report as occurring in the past 6 months, unless otherwise noted, and included the following items: (1) "Unknown or positive HIV status of last sex partner," defined as the last time the participant had vaginal or anal sex with a man whose HIV status was unknown or was positive. (2) "Multiple sex partners," defined as having more than one male sex partner. (3) "Concurrent male sex partners," defined as the participant reporting that she had sex with a man while involved in a sexual relationship with another man during the same time period. (4) "History of sexually transmitted infection (STI) diagnosis," defined as the participant's self-report that a doctor or nurse had told her she had a gonorrhea, syphilis, or chlamydia infection. (5) "Exchanging sex," defined as the participant

reporting that she had sex with a man because she needed food, shelter, housing, drugs, or money. (6) “Weekly drug use,” defined as at least weekly use of illicit or unprescribed drugs (excluding marijuana) in the past 6 months, as assessed using a modified version of the World Health Organization’s Alcohol, Smoking, and Substance Involvement Screening Test. (7) “Weekly binge drinking,” defined as having four or more drinks at one time in the past 6 months.<sup>40</sup>

Participants were also asked at baseline and at the 6-month follow-up about the perceived risk characteristics of their last three male sex partners in the previous 6 months. Partner HIV risk characteristics were reported by participants and included the following items: (1) “Perceived partner concurrency,” defined as the participant reporting that at least one of her male sex partners definitely had sex with another man or woman at the same time he was in a sexual relationship with her. (2) “Partner injection drug use,” defined as the participant reporting that she believed at least one male sex partner had injected drugs. (3) “Partner incarceration,” defined as the participant reporting that she believed that at least one of her male sex partners had been imprisoned for more than 24 hours in the past 5 years. (4) “Reported age difference,” defined as the difference between the participant’s age and the median of the partner’s age category with the difference then dichotomized into (a) greater than or (b) less than or equal to a 10-year age difference.

### Study design

Based on findings from other published studies,<sup>3</sup> covariates of the relationship between VAW and HIV risk were selected *a priori* and controlled for in the initial analysis. These covariates were time dependent, unless otherwise noted, and included the following: (1) baseline demographic variables, (2) incarceration in the past 5 years measured at baseline, (3) food insecurity, (4) childhood abuse, (5) experiencing depressive symptoms, (6) experiencing symptoms of posttraumatic stress disorder (PTSD), (7) social support, and (8) stable housing (*i.e.*, owning or renting your own home). Demographic variables included race, ethnicity, marital status, age, education, income, number of children living in the household and for which the participant is responsible, and employment. Participants were classified as food insecure if they reported concern about having enough food for themselves or their family in the past 6 months. Unstable housing was determined by the participant’s self-report of living in a halfway house, treatment center, homeless shelter, motel, hotel, boarding house, park, abandoned building, car, or on the street. A participant’s self-report of physical, sexual, or emotional violence before the age of 18 was considered childhood abuse. Depressive symptoms were assessed using a version of the Center for Epidemiologic Studies Depression Scale, on which a total score of  $\geq 7$  on eight items using a 4-point scale response (ranging from 0 to 3) indicated depressive symptoms in the past week.<sup>41,42</sup> PTSD symptoms were assessed using the Primary Care PTSD Screen, which uses a score of three on a 4-item binary PTSD scale.<sup>43</sup> Emotional support was defined as having at least one close friend or relative who the participant thought would help her deal with her feelings or any emotional problems if she needed it. Financial support was defined as at least one close friend or relative who the participant thought would help her financially if she needed it.

### Statistical analysis

To analyze the repeated measures of individual women in the dataset in this longitudinal study, violence variables were the outcomes of interest and HIV risk characteristics were the predictors. HIV predictors were used instead of HIV acquisition because few women seroconverted over the course of the study.<sup>39</sup> We used generalized estimating equations with a logistic regression (logit) link clustered on the participant identification and a robust variance estimate. Estimates of odds ratios and 95% confidence intervals (CIs) were calculated. Specifically, unadjusted models included violence at 6 or 12 months as the outcome and HIV risk variables measured 6 months before the outcome measurement as predictors (*e.g.*, the enrollment data served as the baseline for all subjects for the 6-month assessment; for subjects with 12-month assessments, their 6-month assessment served as their baseline). Adjusted models controlled for the effects of covariates measured at the same time point as the predictor variables. Significance was set at  $p < 0.05$  and statistical analysis was performed using SAS 9.2.<sup>44</sup> Table 1 details the demographic characteristics of all 2099 participants enrolled in HPTN 064. Analyses reported in Table 2 were limited to the 1980 study participants who reported having a male sex partner at that assessment.

### Results

The most frequent type of violence was emotional abuse, although all types of abuse declined by similar relative amounts over time (Table 1). Nearly 23%, 12%, and 4% of participants reported emotional abuse, physical violence, and forced sex, respectively, at the 6-month follow-up, whereas approximately 19%, 11%, and 4% reported those respective types of abuse at the 12-month follow-up. A new report of experiencing more than one type of violence at the same assessment was rare (*i.e.*,  $< 3\%$ ), except for new reports of experiencing both emotional abuse and physical violence, which 9% and 8% of participants reported at the 6- and 12-month follow-ups, respectively.

Nearly all bivariate relationships between HIV risk characteristics and violence were statistically significant (Table 2). Multivariate analyses adjusting for covariates resulted in fewer significant associations (Models A2, B2, and C2 in Table 2). After adjustment, women who reported exchanging sex (adjusted odds ratio [AOR]: 1.60; 95% CI: 1.20–2.13), perceived partner concurrency (AOR: 1.58; 95% CI: 1.22–2.05), or at least one partner who had been incarcerated (AOR: 1.34; 95% CI: 1.03–1.74) were significantly more likely to report emotional abuse at follow-up assessment 6 months later. Additionally, multivariate analysis revealed that women who had a previous STI diagnosis (AOR: 1.62; 95% CI: 1.06–2.48), exchanged sex (AOR: 1.71; 95% CI: 1.21–2.42), or reported binge drinking (AOR: 1.47; CI: 1.03–2.09) were significantly more likely to report physical violence 6 months later. None of the HIV risk characteristics measured was significantly predictive of forced sex 6 months later.

### Discussion

This longitudinal study found that certain HIV risk characteristics of either the participant or her sex partner(s) increased risk of violence occurring over a 6-month period. Our

TABLE 1. CHARACTERISTICS OF ALL HIV PREVENTION TRIALS NETWORK 064 STUDY PARTICIPANTS

|   | Baseline (n=2099) | 6 Month (n=1953) | 12 Month (n=1525) |
|---|-------------------|------------------|-------------------|
|   | n (%)             | n (%)            | n (%)             |
| Potential confounding variables   |                   |                  |                   |
| Age   |                   |                  |                   |
| 18–26   | 837 (40%)         | 786 (40%)        | 565 (37%)         |
| 27–33   | 502 (24%)         | 458 (23%)        | 369 (24%)         |
| 34+   | 760 (36%)         | 709 (36%)        | 591 (39%)         |
| Race  |                   |                  |                   |
| White   | 143 (7%)          | 125 (6%)         | 102 (7%)          |
| Other race  | 100 (5%)          | 91 (5%)          | 67 (4%)           |
| Mixed race  | 54 (3%)           | 47 (2%)          | 34 (2%)           |
| Black   | 1802 (86%)        | 1690 (87%)       | 1322 (87%)        |
| Latino  |                   |                  |                   |
| No  | 1854 (88%)        | 1727 (88%)       | 1369 (90%)        |
| Yes   | 245 (12%)         | 226 (12%)        | 156 (10%)         |
| Marital status  |                   |                  |                   |
| Missing   | 51 (2%)           | 19 (1%)          | 11 (1%)           |
| Married   | 159 (8%)          | 149 (8%)         | 115 (8%)          |
| Not married, living together  | 479 (23%)         | 505 (26%)        | 387 (25%)         |
| Nonpartnered  | 1410 (67%)        | 1280 (66%)       | 1012 (66%)        |
| Education   |                   |                  |                   |
| Less than high school   | 550 (26%)         | 508 (26%)        | 377 (25%)         |
| High school graduate or equivalent                                      | 772 (37%)         | 735 (38%)        | 599 (39%)         |
| More than high school graduate  | 777 (37%)         | 710 (36%)        | 549 (36%)         |
| Unemployed  |                   |                  |                   |
| No  | 742 (35%)         | 569 (29%)        | 465 (30%)         |
| Yes   | 1357 (65%)        | 1384 (71%)       | 1060 (70%)        |
| Incarceration in past 5 years   |                   |                  |                   |
| No  | 1251 (60%)        | 1179 (60%)       | 909 (60%)         |
| Yes   | 848 (40%)         | 774 (40%)        | 616 (40%)         |
| Childhood abuse   |                   |                  |                   |
| Missing   | 29 (1%)           | 24 (1%)          | 18 (1%)           |
| No  | 1136 (54%)        | 1152 (59%)       | 899 (59%)         |
| Yes   | 934 (44%)         | 777 (40%)        | 608 (40%)         |
| Concerned about having enough food for you/family in the last 6 months? |                   |                  |                   |
| Missing   | 27 (1%)           | 24 (1%)          | 14 (1%)           |
| No  | 1101 (52%)        | 1165 (60%)       | 951 (62%)         |
| Yes   | 971 (46%)         | 764 (39%)        | 560 (37%)         |
| Housing   |                   |                  |                   |
| Missing   | 30 (1%)           | 22 (1%)          | 15 (1%)           |
| Owns or rents home  | 832 (40%)         | 854 (44%)        | 726 (48%)         |
| Living with partner, friend, or parent                                  | 880 (42%)         | 833 (43%)        | 623 (41%)         |
| Unstable housing  | 256 (12%)         | 181 (9%)         | 108 (7%)          |
| Other   | 101 (5%)          | 63 (3%)          | 53 (3%)           |
| CES-D depression scale score  |                   |                  |                   |
| Missing   | 157 (7%)          | 132 (7%)         | 74 (5%)           |
| Less than 7   | 1250 (60%)        | 1280 (66%)       | 1076 (71%)        |
| Greater than or equal to 7  | 692 (33%)         | 541 (28%)        | 375 (25%)         |
| PTSD  |                   |                  |                   |
| Missing   | 52 (2%)           | 49 (3%)          | 33 (2%)           |
| PTSD symptom negative   | 1447 (69%)        | 1505 (77%)       | 1192 (78%)        |
| PTSD symptom positive   | 600 (29%)         | 399 (20%)        | 300 (20%)         |
| Number of emotional supports  |                   |                  |                   |
| Missing   | 22 (1%)           | 17 (1%)          | 10 (1%)           |
| ≥1  | 1750 (83%)        | 1630 (83%)       | 1252 (82%)        |
| 0   | 168 (8%)          | 151 (8%)         | 161 (11%)         |
| Do not know/not sure  | 159 (8%)          | 155 (8%)         | 102 (7%)          |
| Number of financial supports  |                   |                  |                   |
| Missing   | 31 (1%)           | 28 (1%)          | 19 (1%)           |
| ≥1  | 1578 (75%)        | 1521 (78%)       | 1207 (79%)        |
| 0   | 320 (15%)         | 260 (13%)        | 205 (13%)         |
| Do not know/not sure  | 170 (8%)          | 144 (7%)         | 94 (6%)           |
| At least weekly binge drinking  |                   |                  |                   |
| Missing   | 32 (2%)           | 21 (1%)          | 19 (1%)           |
| No  | 1569 (75%)        | 1635 (84%)       | 1287 (84%)        |
| Yes   | 498 (24%)         | 297 (15%)        | 219 (14%)         |

(continued)

TABLE 1. (CONTINUED)

|   | Baseline (n=2099) | 6 Month (n=1953) | 12 Month (n=1525) |
|---|-------------------|------------------|-------------------|
|   | n (%)             | n (%)            | n (%)             |
| At least weekly drug use  |                   |                  |                   |
| Missing   | 16 (1%)           | 12 (1%)          | 5 (<1%)           |
| No  | 1624 (77%)        | 1654 (85%)       | 1320 (87%)        |
| Yes   | 459 (22%)         | 287 (15%)        | 200 (13%)         |
| Mean number of dependents   |                   |                  |                   |
| Median  | 1                 | 1                | 1                 |
| 25th, 75th percentile   | 0, 2              | 0, 2             | 0, 2              |
| Occurrence of violence in past 6 months                             |                   |                  |                   |
| Emotional abuse   | 656 (31%)         | 444 (23%)        | 293 (19%)         |
| Physical violence   | 401 (19%)         | 227 (12%)        | 172 (11%)         |
| Sexual violence   | 148 (7%)          | 83 (4%)          | 61 (4%)           |
| Emotional abuse + physical violence                                 | 314 (15%)         | 177 (9%)         | 119 (8%)          |
| Emotional abuse + sexual violence                                   | 111 (5%)          | 56 (3%)          | 47 (3%)           |
| Physical violence + sexual violence                                 | 96 (5%)           | 48 (3%)          | 34 (2%)           |
| Emotional abuse + physical violence + sexual violence               | 84 (4%)           | 43 (2%)          | 30 (2%)           |
| Personal and partner HIV risk variables                             |                   |                  |                   |
| Unprotected vaginal or anal sex at last intercourse                 |                   |                  |                   |
| Missing   | 5 (<1%)           | 136 (7%)         | 191 (13%)         |
| No  | 312 (15%)         | 547 (28%)        | 425 (28%)         |
| Yes   | 1782 (85%)        | 1270 (65%)       | 909 (60%)         |
| Unknown or positive HIV status of last male sex partner             |                   |                  |                   |
| Missing   | 7 (<1%)           | 137 (7%)         | 189 (12%)         |
| No  | 1196 (57%)        | 1256 (64%)       | 962 (63%)         |
| Yes   | 896 (43%)         | 560 (29%)        | 374 (25%)         |
| Concurrent sex partners   |                   |                  |                   |
| Missing   | 9 (<1%)           | 136 (7%)         | 191 (13%)         |
| No  | 1314 (63%)        | 1285 (66%)       | 1002 (66%)        |
| Yes   | 776 (37%)         | 532 (27%)        | 332 (22%)         |
| Number of male sex partners in past 6 months                        |                   |                  |                   |
| Missing   | 21 (1%)           | 25 (1%)          | 19 (1%)           |
| 0   | 8 (<1%)           | 120 (6%)         | 170 (11%)         |
| 1   | 842 (40%)         | 985 (50%)        | 821 (54%)         |
| ≥2  | 1228 (59%)        | 823 (42%)        | 515 (34%)         |
| Previous STI diagnosis  |                   |                  |                   |
| Missing   | 33 (2%)           | 25 (1%)          | 16 (1%)           |
| No  | 1834 (87%)        | 1806 (92%)       | 1441 (94%)        |
| Yes   | 232 (11%)         | 122 (6%)         | 68 (4%)           |
| Exchanged sex   |                   |                  |                   |
| Missing   | 21 (1%)           | 25 (1%)          | 19 (1%)           |
| No  | 1302 (62%)        | 1369 (70%)       | 1113 (73%)        |
| Yes   | 776 (37%)         | 559 (29%)        | 393 (26%)         |
| Perceived partner concurrency                                       |                   |                  |                   |
| Missing   | 0 (0%)            | 0 (0%)           | 1 (<1%)           |
| No  | 1336 (64%)        | 1476 (76%)       | 1222 (80%)        |
| Yes   | 763 (36%)         | 477 (24%)        | 302 (20%)         |
| At least one partner is believed to have injected drugs             |                   |                  |                   |
| Missing   | 148 (7%)          | 270 (14%)        | 279 (18%)         |
| No  | 1776 (85%)        | 1573 (81%)       | 1150 (75%)        |
| Yes   | 175 (8%)          | 110 (6%)         | 96 (6%)           |
| At least one partner incarcerated                                   |                   |                  |                   |
| Missing   | 113 (5%)          | 226 (12%)        | 269 (18%)         |
| No  | 552 (26%)         | 579 (30%)        | 443 (29%)         |
| Yes   | 1434 (68%)        | 1148 (59%)       | 813 (53%)         |
| Greater than 10-year age difference between participant and partner |                   |                  |                   |
| Missing   | 7 (<1%)           | 139 (7%)         | 191 (13%)         |
| No  | 1440 (69%)        | 1257 (64%)       | 954 (63%)         |
| Yes   | 652 (31%)         | 557 (29%)        | 380 (25%)         |

HIV, human immunodeficiency virus; PTSD, posttraumatic stress disorder; STI, sexually transmitted infections (*i.e.*, gonorrhea, syphilis, or chlamydia infection); CES-D, Center for Epidemiologic Studies Depression Scale; HPTN, HIV Prevention Trials Network.

TABLE 2. PREDICTIVE VALUE OF HIV RISK BEHAVIORS ON EMOTIONAL ABUSE, PHYSICAL VIOLENCE, AND FORCED SEX AMONG HIV PREVENTION TRIALS NETWORK 064 PARTICIPANTS WITH SEX PARTNERS (N=1980)

| HIV risk factor                                    | Emotional abuse  |         |                  |       |                  |         | Physical violence |       |                  |         |                   |       | Forced sex       |         |                   |       |  |  |
|--|------------------|---------|------------------|-------|------------------|---------|-------------------|-------|------------------|---------|-------------------|-------|------------------|---------|-------------------|-------|--|--|
|  | Model A1         |         | Model A2         |       | Model B1         |         | Model B2          |       | Model C1         |         | Model C2          |       | Model C1         |         | Model C2          |       |  |  |
|  | OR (95% CI)      | P       | AOR (95% CI)     | p     | OR (95% CI)      | p       | AOR (95% CI)      | p     | OR (95% CI)      | p       | AOR (95% CI)      | p     | OR (95% CI)      | p       | AOR (95% CI)      | p     |  |  |
| Unprotected vaginal or anal sex                    | 1.22 [0.99–1.49] | 0.060   | 1.09 [0.82–1.46] | 0.55  | 1.38 [1.06–1.80] | 0.020   | 1.23 [0.84–1.81]  | 0.290 | 1.15 [0.75–1.77] | 0.530   | 0.99 [0.561–1.74] | 0.98  | 1.15 [0.75–1.77] | 0.530   | 0.99 [0.561–1.74] | 0.98  |  |  |
| Unknown or positive HIV status of last sex partner | 1.34 [1.13–1.59] | 0.001   | 0.98 [0.76–1.24] | 0.838 | 1.47 [1.18–1.83] | 0.001   | 1.10 [0.81–1.50]  | 0.554 | 2.47 [1.70–3.57] | <0.0001 | 1.68 [0.99–2.87]  | 0.055 | 2.47 [1.70–3.57] | <0.0001 | 1.68 [0.99–2.87]  | 0.055 |  |  |
| partner status unknown to you                      |                  |         |                  |       |                  |         |                   |       |                  |         |                   |       |                  |         |                   |       |  |  |
| Concurrent sex                                     | 1.62 [1.36–1.92] | <0.0001 | 1.02 [0.77–1.34] | 0.915 | 1.39 [1.11–1.73] | 0.004   | 0.93 [0.64–1.34]  | 0.687 | 2.05 [1.43–2.94] | <0.0001 | 0.86 [0.51–1.45]  | 0.567 | 2.05 [1.43–2.94] | <0.0001 | 0.86 [0.51–1.45]  | 0.567 |  |  |
| Multiple male sex partners                         | 1.61 [1.36–1.91] | <0.0001 | 0.99 [0.73–1.33] | 0.931 | 1.33 [1.08–1.64] | 0.008   | 0.77 [0.52–1.14]  | 0.193 | 2.40 [1.62–3.56] | <0.0001 | 1.39 [0.66–2.90]  | 0.385 | 2.40 [1.62–3.56] | <0.0001 | 1.39 [0.66–2.90]  | 0.385 |  |  |
| History of STI                                     | 1.20 [0.91–1.58] | 0.197   | 0.83 [0.57–1.22] | 0.341 | 1.83 [1.33–2.51] | 0.000   | 1.62 [1.06–2.48]  | 0.026 | 1.04 [0.56–1.91] | 0.909   | 0.59 [0.26–1.37]  | 0.220 | 1.04 [0.56–1.91] | 0.909   | 0.59 [0.26–1.37]  | 0.220 |  |  |
| Exchange sex                                       | 2.09 [1.76–2.50] | <0.0001 | 1.60 [1.20–2.13] | 0.001 | 2.10 [1.68–2.61] | <0.0001 | 1.71 [1.21–2.42]  | 0.002 | 3.15 [2.18–4.55] | <0.0001 | 1.69 [0.95–2.99]  | 0.074 | 3.15 [2.18–4.55] | <0.0001 | 1.69 [0.95–2.99]  | 0.074 |  |  |
| Binge drinking                                     | 1.56 [1.29–1.89] | <0.0001 | 1.07 [0.80–1.42] | 0.651 | 1.80 [1.41–2.30] | <0.0001 | 1.47 [1.04–2.09]  | 0.032 | 1.86 [1.28–2.70] | 0.001   | 1.31 [0.78–2.20]  | 0.313 | 1.86 [1.28–2.70] | 0.001   | 1.31 [0.78–2.20]  | 0.313 |  |  |
| Drug use   | 1.49 [1.21–1.82] | 0.000   | 0.97 [0.70–1.34] | 0.839 | 1.50 [1.17–1.93] | 0.001   | 0.85 [0.57–1.27]  | 0.423 | 1.82 [1.23–2.67] | 0.003   | 0.73 [0.41–1.31]  | 0.290 | 1.82 [1.23–2.67] | 0.003   | 0.73 [0.41–1.31]  | 0.290 |  |  |
| Perceived partner concurrency                      | 1.84 [1.55–2.17] | <0.0001 | 1.59 [1.22–2.05] | 0.001 | 1.40 [1.11–1.77] | 0.005   | 1.07 [0.74–1.55]  | 0.720 | 1.66 [1.18–2.32] | 0.003   | 1.07 [0.61–1.88]  | 0.811 | 1.66 [1.18–2.32] | 0.003   | 1.07 [0.61–1.88]  | 0.811 |  |  |
| Partner injects drugs                              | 1.49 [1.09–2.04] | 0.013   | 0.82 [0.51–1.32] | 0.422 | 1.37 [0.91–2.07] | 0.135   | 0.94 [0.51–1.74]  | 0.838 | 2.66 [1.59–4.44] | 0.000   | 1.61 [0.72–3.60]  | 0.249 | 2.66 [1.59–4.44] | 0.000   | 1.61 [0.72–3.60]  | 0.249 |  |  |
| Partner has been imprisoned                        | 1.58 [1.29–1.93] | <0.0001 | 1.34 [1.03–1.74] | 0.030 | 1.63 [1.25–2.12] | 0.000   | 1.17 [0.82–1.65]  | 0.387 | 1.64 [1.08–2.48] | 0.019   | 1.12 [0.65–1.91]  | 0.691 | 1.64 [1.08–2.48] | 0.019   | 1.12 [0.65–1.91]  | 0.691 |  |  |
| Partner with >10 years age difference              | 1.35 [1.12–1.63] | 0.002   | 1.09 [0.84–1.41] | 0.525 | 0.99 [0.77–1.28] | 0.955   | 0.92 [0.64–1.32]  | 0.661 | 1.86 [1.27–2.74] | 0.002   | 1.38 [0.79–2.41]  | 0.252 | 1.86 [1.27–2.74] | 0.002   | 1.38 [0.79–2.41]  | 0.252 |  |  |

Models A1, B1, and C1 are bivariate models. Models A2, B2, and C2 are multivariate models that have been adjusted for age, race, marital status, ethnicity, education, income, employment, incarceration, food insecurity, owning or renting your own home, depression, PTSD, emotional support, financial support, number of dependents, and childhood abuse. Perceived partner concurrency defined as participant believing that at least one male sex partner had sex with another male or female at the same time he was in a sexual relationship with her. CI, confidence interval; OR, odds ratio; AOR, adjusted odds ratio.

findings provide critical temporal evidence to support existing cross-sectional evidence. Emotional abuse has been associated with poorer mental health.<sup>3,45</sup> This study found that participants who reported exchanging sex, having partners they perceived to be nonmonogamous, or having at least one male sex partner with a history of incarceration were more likely to subsequently report emotional abuse. To date, the harmful effects of emotional abuse and psychological aggression on mental and physical health have been underestimated and underresearched.<sup>3,45</sup> Despite the importance of emotional abuse in HIV research due to its potential relationship with poorer mental health and greater HIV risk behaviors, few studies have separately examined the relationship between HIV risk and emotional abuse.<sup>3,46</sup> This study is one of the first to examine this relationship longitudinally with a large group of women. More research is necessary to continue to explore these important relationships. Exchanging sex was also predictive of physical violence. Our finding that women who exchange sex were more likely to report physical violence and emotional abuse 6 months later confirms previous work demonstrating a strong association between exchanging sex and violence.<sup>27,35</sup> Although few participants considered themselves commercial sex workers (6%), exchanging sex was a relatively common practice (37%) that increased vulnerability to violence. Most researchers posit that drug use is a major reason for this relationship. However, even after adjusting for drug use, the relationship remained in this population. Other posited reasons for the relationship between violence and exchanging sex include financial dependence on male sex partners (both clients and intimate partners), the use of violence as initiation into sex work, psychological distress from past violent or abusive experiences, and limited access to quality healthcare compromising women's ability to receive mental health and addiction treatment.<sup>27,35</sup>

None of the HIV risk characteristics we measured predicted forced sex within the 6-month period. It is possible that there are no associations between examined HIV risk characteristics and forced sex. However, this is contrary to findings of other studies.<sup>47</sup> Another possibility for the lack of significant association during multivariate analysis was that examined variables were tightly associated, as shown in univariate analysis, but after adjustment, no independent associations maintained statistical significance. Yet, another possibility for the lack of association was that the question used to create the forced sex variable was not specific enough, and thereby differences in how participants defined forced sex may have diluted the findings related to this question. Future studies should continue to examine this relationship.

Our results should be interpreted with several limitations in mind. First, we were limited to the data items used in the HPTN 064 study, which was designed to be succinct and easily understood by a diverse group of at-risk women. The survey questions did not ask the women to specify the perpetrator of the violence or abuse. Previous research suggests that most occurrences of VAW are perpetrated by intimate partners.<sup>46</sup> Because HPTN 064 was limited to women who reported having a male sex partner, we believe that intimate partners perpetrated much of the violence measured, but we cannot conclusively state that all the violence reported was intimate-partner violence, as specific information on the perpetrators of the reported violence was not collected. Another limitation to our study was the use of three brief

questions to assess violence. In addition, use of the word "abuse" in the emotional abuse question might have also resulted in underreporting due to the stigmatizing nature of responding "yes" to "abuse." Future research should build on the results from our secondary data analysis by using more robust measures of violence and abuse. Furthermore, despite controlling for many covariates that were selected based on empirical and theoretical evidence, there may be unrecognized, unmeasured covariates, which may explain or change the relationships presented. Lastly, the information used in this analysis was very sensitive and personal. Therefore, our data may have been vulnerable to social desirability bias and recall bias. Trained interviewers and ACASI technology were used to reduce these biases.

## Conclusions

All of the women who participated in the HPTN 064 Study were members of a United States subpopulation whose HIV risk was dramatically higher than the national average.<sup>2,39</sup> The relationships over time between violence variables and HIV risk characteristics (*i.e.*, exchanging sex, alcohol abuse, and partner incarceration) may reflect the impact of structural and environmental influences on behavior. Regular medical monitoring of subpopulations who are vulnerable to HIV and STIs is one recommended strategy to facilitate early responses by public health agencies<sup>48</sup> and could be particularly relevant for United States women living in areas with high HIV and poverty burdens. Furthermore, HIV prevention must be developed with consideration to the conditions of the population of interest. One of the most promising female-controlled, biomedical options currently available to women is the use of preexposure prophylaxis (PrEP), as it has potential to reduce HIV acquisition by up to 92%.<sup>49–52</sup> Despite mixed efficacy findings for products such as tenofovir gel<sup>53,54</sup> and the Phase III randomized placebo-controlled FEM-PrEP clinical trial of a daily oral dose of tenofovir disoproxil fumarate and emtricitabine,<sup>55</sup> microbicides may offer additional HIV prevention options for women with strong acceptability.<sup>56–58</sup> Yet, there remains a challenge to educate and offer PrEP to women experiencing violence.

This challenge is also an enormous opportunity for critically needed future research on how best to identify women experiencing violence who may benefit from PrEP, educate them about the risks and advantages of PrEP, and determine optimal ways to deliver PrEP to this population. Previous recommendations have advocated for community and clinic-based interventions that incorporate expanded dialog addressing VAW as a broader social norm and provide PrEP information and outreach to women who may be quietly grappling with challenging situations.<sup>50,59</sup> Based on our study findings, current HIV prevention research in the United States should consider and address additional approaches to strengthening community agency capacity and healthcare system integration to more effectively address structural and environmental factors affecting impoverished at-risk women. In fact, the Institute of Medicine, the United States Department of Health and Human Services, and the United States Preventive Services Task Force have all recommended such an approach. These national agencies have advocated that providers throughout the United States healthcare system screen and counsel female patients on interpersonal violence to identify survivors and connect them with supportive services that promote their safety and wellbeing.<sup>60,61</sup>

This study contributes to the literature in several ways, including the use of advanced analytic techniques to assess repeated longitudinal data derived from a large sample of at-risk United States women. Another major strength of this study is that we adjusted for covariates measured at the same time point as the investigated predictors to examine personal and partner HIV risk characteristics and specific types of violence. The longitudinal nature of data and the temporal ordering of the predictors and outcomes help to address a major gap in the literature regarding HIV risk and VAW. In summary, having certain personal and/or perceived partner HIV risk characteristics was predictive of violence occurring over the next 6 months among women living in areas of the United States with high prevalence of poverty and HIV. Our longitudinal data support the development of comprehensive HIV prevention efforts that combat these complex public health issues in a contextually meaningful way.

### Acknowledgments

The authors thank the study participants, community stakeholders, and staff from each study site. In particular, they acknowledge Katharine E. Stewart, Emily A. Whittington, Martha M. Phillips, Christine Oots, Kerry Evans, Wairimu Chege, Nirupama Sista, Kathy Hinson, Elizabeth DiNunno, Ann O'Leary, Catherine Fogel, Waheedah Shabaaz-El, Sam Griffith, Sarah Artis, Erica Hamilton Quarraisha Abdool-Karim, Sten Vermund, Edward E. Telzak, Rita Sondengam, Cheryl Guity, Tracy Hunt, Manya Magnus, Christopher Chauncey Watson, Christin Root, Ilene Wiggins, Laurel Borkovic, Sharon Parker, Oluwakemi Amola, and LeTanya Johnson-Lewis. The authors also thank Vincent Fenimore, PhD for his editorial assistance. The primary author's work on this article was supported by the HIV Prevention Trials Network (HPTN) Scholars Program. Overall support for the HPTN is provided by the National Institute of Allergy and Infectious Diseases (NIAID) of the National Institutes of Health (NIH) under Award Numbers UM1AI068619 (HPTN Leadership and Operations Center), UM1AI068617 (HPTN Statistical and Data Management Center), and UM1AI068613 (HPTN Laboratory Center). Additional funding for the primary author was provided by the Translational Research Institute (TRI), which is supported by the NIH National Center for Research Resources and the National Center for Advancing Translational Sciences, grant KL2TR000063 and UL1TR000039. Additional funding for the co-author's was received through the National Institute of Allergy and Infectious Diseases, National Institute on Drug Abuse, and National Institute of Mental Health (cooperative agreement numbers UM1 AI068619, UM1AI068617, and UM1-AI068613); Centers for Innovative Research to Control AIDS, Mailman School of Public Health, Columbia University (5U1AI069466); University of North Carolina Clinical Trials Unit (AI069423); University of North Carolina Clinical Trials Research Center of the Clinical and Translational Science Award (RR 025747); University of North Carolina Center for AIDS Research (AI050410); Emory University HIV/AIDS Clinical Trials Unit (5U01AI069418), Center for AIDS Research (P30 AI050409), and Clinical and Translational Science Award (UL1 RR025008); The Terry Bein Community Programs for Clinical Research on AIDS Clinical Trials Unit (5 UM1 AI069503-07); The National Institute of General Medical Sciences (U54GM104942); and The Johns Hopkins Adult AIDS Clinical Trial Unit (AI069465).

### Author Disclosure Statement

Dr. S.L.H. provides consultation for the following companies: Bristol-Myers Squibb, Gilead Sciences, Janssen, and ViiV Healthcare. Her spouse has a financial interest in Merck (stock options) and consults for Johnson and Johnson and ILiAD Biotech. The remaining authors have no competing financial interests.

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Address correspondence to:

*Brooke E.E. Montgomery, PhD, MPH*  
*Department of Health Behavior and Health Education*  
*Fay W. Boozman College of Public Health*  
*University of Arkansas for Medical Sciences*  
*4301W. Markham Street #820*  
*Little Rock, AR 72205*

*E-mail: bemontgomery@uams.edu*