

Gender Differences in Psychosocial Factors Associated with HIV Viral Suppression Among African–American Injection Drug Users

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Abstract Research suggests gender differences exist in achieving undetectable viral load (UVL) among persons living with HIV (PLHIV), and that psychosocial health factors may play a role. The present study examined these factors among African-American PLHIV enrolled in the BEACON study. Participants completed self-report surveys and gave biomarker data. Poisson regression with robust standard errors was implemented. Men with moderate religious activity had 1.3 times the likelihood of UVL as men with low religious activity ($p < 0.10$; $N = 199$). Men with 1–2 mental illness diagnoses had 1.3 times the likelihood of UVL as men with none ($p < 0.05$). Women using 1–2 substances had 28 % lower likelihood of UVL than non-using women ($N = 122$; $p < 0.10$). Finally, women with frequent doctor-patient communication had 35 % higher likelihood of UVL as women with less doctor-patient communication ($p < 0.05$). Results suggest that social support, substance use, and mental illness function differently among men and women. Healthcare professionals should employ gender-specific interventions to address and improve HIV health outcomes.

Resumen Investigaciones recientes sugieren que hay diferencias entre los géneros en el logro de carga viral indetectable del VIH (CVi). Esta investigación evaluó esto en afroamericanos con el VIH. Los datos fueron del estudio BEACON. Los participantes completaron encuestas y

pruebas de biomarcadores. En análisis estadísticos, regresión de Poisson con errores estándar robustos fueron utilizados. Hombres que participaron en actividades religiosas fueron 1.3 veces más probable lograr la CVi, que los hombres con menos actividades religiosas ($p < 0.10$; $N = 199$). Hombres con 1-2 enfermedades mentales fueron 1.3 veces más probable lograr la CVi, que los hombres sin estos ($p < 0.05$). Mujeres que usaron 1-2 sustancias fueron 30 % menos probable lograr la CVi, que las mujeres que no usaron sustancias ($N = 122$; $p < 0.10$). Mujeres que comunicaron más con sus médicos fueron 1.4 veces más probable lograr la CVi, que mujeres que comunicaron menos con sus médicos. El apoyo social, el uso de sustancias, y las enfermedades mentales se diferan entre los géneros. Los médicos deben considerar esto para mejorar la salud de los afroamericanos con el VIH.

Keywords HIV/AIDS · Viral suppression · Injection drug use · Gender · Health disparities · African–Americans

Introduction

At the end of 2009, an estimated 1.1 million Americans aged 13 and over were persons living with HIV (PLHIV) in the United States [1]. Among these individuals, eighteen percent were undiagnosed, and unaware of their HIV status [1]. In 2010, there were approximately 47,500 new HIV infections, nearly half of which were among African–Americans [1]. In addition to race differences in HIV infection, gender differences exist in HIV-related outcomes. Compared to men, women are more likely to delay getting tested for HIV, lack access to regular medical care, and are more likely to convert from HIV to AIDS within a year of diagnosis [1, 2].

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Due to race and gender disparities, African–American women are estimated to have an HIV incidence approximately eight times that of White-American women [1, 3]. In addition to higher incidence and prevalence of HIV, African–American women also have lower rates of achieving viral suppression than other groups, despite the advent of highly active antiretroviral therapy (ART) in the United States [1, 4, 5]. More research is needed to illuminate the factors which place African–Americans, and more specifically African–American women at increased risk of negative HIV-related health outcomes.

Race and Gender Disparities in HIV Outcomes

Comprehensive consideration of HIV-related disparities illuminates macro-level (e.g. race and gender), mezzo-level (e.g. interpersonal relationships), and micro-level risk factors (e.g. individual health behaviors) [6]. At the macro level, African–Americans are often subjected to institutional racism, which predicts differential access to good and services on the basis of race [7]. Institutional racism has also predated less medical care access among African–American PLHIV. Moreover, due to cultural and communication barriers between patients and providers, even when care is accessed, African–American PLHIV receive inferior care compared to other races [1, 7–9]. These disparities are seen in conditions distinct from, yet comorbid with HIV, including mental illness, cancer, cardiovascular disease, and chronic pain conditions [1, 8, 10].

Both African-American race, and woman gender, independently correlate with higher risk of HIV-related burden at the micro level [1, 3, 10]. Thus, African–American women represent PLHIV at high risk for non-adherence to ART, detectable viral load, and faster progression to AIDS [1, 3, 10–12]. At the mezzo level, research suggests that reasons for these gender disparities include women perceiving greater HIV stigma, and less HIV-specific social support than men. Compared to men, women are also more likely to have competing priorities that interfere with their HIV medical regimens, such as having an HIV-positive significant other for whom they provide care [13–15]. More research is needed to disentangle the multi-level complexities among race, gender, and psychosocial correlates of HIV-related outcomes.

Barriers to Viral Suppression Among PLHIV: Co-morbidities

Compared to the general population, PLHIV experience higher rates of several co-morbidities which impede viral suppression (Undetectable viral load—UVL) [16]. First, depression is at least twice as prevalent among PLHIV, as compared to non-infected individuals [16–18]. Compared to men, adult women are more likely to be diagnosed with serious mental illnesses, which include major depression,

bipolar disorder, post-traumatic stress disorder (PTSD), and schizophrenia [19, 20]. Women are also less likely to achieve UVL than men, with larger disparities between African–American men and their women counterparts [1, 3, 11].

Similarly, mental illness and substance use often co-occur. Hartz and colleagues [21] found that those with severe mental illnesses were between three to five times more likely to engage in substance use. Among PLHIV, between 2004 and 2007, nearly sixty percent of injection drug users (IDUs) who were newly HIV-positive were African–American, and up to thirty percent of non-injection drug abusers are PLHIV [1]. Adherence to ART is the single best predictor of achieving UVL; therefore UVL often serves as a proxy for measuring ART adherence [22–26]. However, a further complication in achieving UVL is that medications used to treat mental illness and/or substance use may interact with ART regimens and reduce their effectiveness [27, 28].

Finally, substance use, mental illness, and HIV are all factors which may create tension in the PLHIV' social environment, resulting in familial conflict. Familial conflict refers to disagreements between family members, often immediate family who are same household residents, which can be either acute or chronic [29–31]. Literature on familial conflict suggests that HIV diagnosis represents a chronic stressor, which may reinforce substance use and/or mental illness among PLHIV [27, 28, 30, 32].

Facilitators of Viral Suppression Among PLHIV: Social Support

Extant research has shown that social support is predictive of health behaviors [13, 14, 33–37]. Social support generally refers to perceived and/or enacted instrumental, informational, or emotional support [38–41]. Within the context of serious chronic illnesses including HIV, informal (unpaid) care (emotional or instrumental assistance) provided by family, partners or friends may also be important to ART and other health outcomes [7, 13, 42–44]. A previous study found informal care correlated with ART adherence among male PLHIV, but only if they reciprocated, or mutually exchanged, support to their caregivers [14].

Research suggests that social support, specifically health-related support and reciprocity (mutual exchange) of support, may facilitate PLHIVs' achievement of UVL [13, 14, 45, 46]. African–American PLHIV are more likely than other racial/ethnic groups to report informal care receipt [14, 47, 48]. However, they are still more likely than other racial groups to have low ART adherence, and detectable viral loads. The same trend is seen with women PLHIV, such that they report higher levels of social support in general, yet tend to be less adherent to ART or achieve viral suppression than men PLHIV [49, 50]. Therefore, differentiating types and

amounts of social support and informal care is necessary to understanding their role in PLHIVs' ART adherence, and their facilitation of viral suppression [39, 51].

Purpose

In sum, African–American PLHIV are at highest risk for negative HIV outcomes such as detectable viral load, compared to other racial/ethnic groups. Moreover, evidence suggests risk and protective factors of UVL may differ between men and women PLHIV. Therefore, the purpose of this study was to identify correlates of viral suppression among predominantly low-income, African–American injection drug-using PLHIV. Specifically, the study sought to: (a) identify correlates of viral suppression among these individuals; and (b) assess sex differences in the relationship between these correlates and UVL. Findings have implications for interventions to improve health outcomes among disadvantaged PLHIV.

Method

Procedure

Data were from baseline of the Being Active and Connected (BEACON) study, which examined social factors associated with health outcomes among disadvantaged PLHIV ($N = 383$). Participants (Indexes) were former and/or current injection drug users residing in Baltimore. Inclusion criteria included being: (a) adult; (b) HIV-positive; (c) on antiretroviral therapy (ART); (d) a Baltimore City resident; (e) a current or former injection drug user; and (f) willing to invite one's main supportive tie(s) to participate in the study. BEACON participants were mainly recruited through an HIV clinic affiliated with Johns Hopkins Hospital, and via street outreach in East Baltimore. Participants completed self-report psychosocial surveys with a trained interviewer, and also provided biomarker specimens (e.g. HIV viral load, CD4 count). Total time to complete data collection during visits (e.g. survey and specimen collection) was 60–90 min per participant. Finally, the BEACON study data collection was completed between 2008 and 2012, and was fully approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Measures

Dependent Variable

Viral suppression was defined as up to 40 copies per mL, as measured by the Roche Cobas Amplicor [52]. Viral load

was dichotomized, where 0 = detectable viral load, and 1 = undetectable viral load (UVL).

Independent Variables

Predictor variables included active substance use, mental illnesses diagnoses, familial conflict, patient-provider communication, and social support (e.g. main supporter relationship, religious activity, health-related support, and support reciprocity). Active substance use was coded as use of opiates, marijuana, heroin, cocaine or crack, hallucinogens, and/or prescription drug use in the past month, where 0 = no active substance use, 1 = 1–2 substances used, and 2 = 3 or more substances used. Alcohol, medical marijuana, and prescription drugs prescribed by a healthcare provider were excluded from all analyses due to theoretical importance of assessing gender differences in the use of illicit substances and viral suppression. Also, due to very small rates of active use, the following illicit substances were excluded from analyses: barbiturates, stimulants. Mental illness was coded as having ever been diagnosed by a doctor with major depression, bipolar disorder, anxiety or post-traumatic stress disorder (PTSD), schizophrenia, and/or any other psychiatric condition, where 0 = no mental illness diagnoses, 1 = 1–2 diagnoses, and 2 = 3 or more diagnoses.

Familial conflict was coded as family members rarely discussing problems, problem-solving together, and/or show caring for one another, where 0 = low familial conflict, 1 = moderate familial conflict, and 2 = frequent familial conflict. Familial conflict questions were based on the Conflict Tactics Scale, which assesses constructs of intra-family aggression, violence, and conflict resolution [53]. Patient-provider communication was assessed by a ten-item scale based on the Engagement with Healthcare Provider Scale [54]. These items included “My doctor involves me in decisions”, and “My doctor respects my choices.” Responses were on a 4-point Likert scale, ranging from “Never” to “Always”. Responses were dichotomized at the median, where 0 = low patient/provider communication and 1 = high patient-provider communication [55].

Main supporter relationship to Indexes was coded as 0 = other relationship/or no main supporter identified, 1 = main partner, and 2 = kin. Religious activity was assessed by, “How often do you go to religious services?” Responses were on a 6-point Likert scale, from “Never” to “More than once a week”. Categories trichotomized at the tertiles, such that 0 = low attendance, 1 = moderate attendance, 2 = frequent attendance [56]. Health-related support refers to support that Indexes have which assists them in engagement in health-related behaviors. Items were based on the Arizona Social Support Inventory [57],

and included “In the last year, has anyone gone with you to a doctor’s appointment or to the ER to get medical care?” Responses were dichotomized at the median, where 0 = low health-related support, and 1 = high health-related support [55].

Support reciprocity was assessed with items based on the scale by Pearlin et al. [47], which assessed activities that Indexes reported providing to their main supporters in the past 12 months. The items included “How much have you helped your main supporter around the house in the past year?”, and “How much have you expressed affection and appreciation for your main supporter in the past year?” Participants’ responses were on a 3-point Likert scale, ranging from “None” to “A lot”. Responses were trichotomized at the tertiles, where 0 = low reciprocity, 1 = medium reciprocity, and 2 = high reciprocity [55].

Physical functioning and educational attainment were included as sociodemographic control variables. Physical functioning was assessed by a nine-item scale based on the Medical Outcomes Study Physical Functioning Measure [58]. These items included “How much does your health affect your ability to bend, lift, or squat down?”, and “How much does your health affect your ability to eat, dress, or bathe?” Responses were trichotomized at the tertiles, where 0 = low physical functioning, 1 = moderate physical functioning, and 2 = high physical functioning [56]. Educational attainment was assessed by a single item, “What is the highest level of education you’ve had?” Responses were collapsed into categories, where 0 = 8th grade or less, 1 = some high school, 2 = high school diploma or GED, and 3 = some college or above. All analyses were conducted separately by gender due to evidentiary support which suggests that correlates of interest may function differently by gender [1, 10]. Gender was assessed by a single item, and coded 1 = Men, and 2 = Women.

Data Analyses

Univariate frequencies were generated for the dependent and independent variables, on the total sample ($N = 383$) and also separately by gender (men/women). Next, unadjusted incidence rate ratios were calculated. Variables marginally significant at the bivariate level ($p < 0.10$) [59], in at least one group, were entered into a multivariate Poisson regression, to regress UVL on correlates separately by gender. Poisson regression is appropriate for binary outcomes for non-rare events. Robust standard errors accounted for heteroskedasticity (inconstant variation) [60]. The same model was run on both groups. Regression analyses were only run with African–American participants, due to lack of statistical variation in race, and also theoretical significance. Educational attainment and

physical functioning were retained as control variables in the final model, despite non-significance. Finally, post hoc analyses were conducted to test for potential interactions between control variables and social support variables, and substance use, mental illness, and/or familial conflict. Analyses were conducted on complete cases only, due to acceptable missingness ($\leq 10\%$) [61]. All analyses were conducted in STATA Version 11.2 SE [62].

Results

Descriptive Statistics

Table 1 reports demographic characteristics of all study participants ($N = 383$). Participants were predominantly Men (61.4 %), African–American (91.6 %), with a monthly income ranging from \$500–\$999 (57.2 %). The vast majority of participants also saw a usual healthcare provider at a hospital clinic (70.5 %), were heterosexual (85.4 %), and had a lifetime history of incarceration (84.1 %). Regarding gender differences, women were marginally less likely than men to have at least a high school education (32.4 vs. 41.3 %, $p < 0.10$). Women were also less likely than men to report good health in the past 6 months (29.1 vs. 40 %, $p < 0.05$). Women were also younger than men on average (45.6 vs. 49.6 years, $p < 0.001$).

Poisson Regression Results: African–American Men

In adjusted analyses, men with 1–2 mental illness diagnoses had 1.3 times the likelihood of UVL as men with no mental illness diagnoses (Adjusted Incidence Rate Ratio [AIR] = 1.28; 95 % Confidence Interval [95 % CI] = 1.00, 1.63; $p < 0.05$). Similarly, men with high rates of familial conflict had 1.4 times the likelihood of UVL, as men with no familial conflict, though this was only marginally significant ($p < 0.10$). Next, also marginally statistically significant, men who had attended or completed college each had 1.9 times the likelihood of UVL, as compared to men who completed 8th grade or less (AIR = 1.89; 95 % CI = 0.94, 3.79; $p < 0.10$).

Results also indicated that men who reported moderate or high physical functioning had 1.3 times the likelihood of UVL, as compared to men with low physical functioning ($p < 0.05$). While marginally statistically significant, men who reported moderate religious activity had 1.3 times the likelihood of UVL as men who reported low religious activity (AIR = 1.26; 95 % CI = 0.98, 1.62; $p < 0.10$). Finally, men who reported having a main partner or kin as their main supporter had 1.3–1.4 times the likelihood of UVL, as men who reported having a main supporter who was a friend or a paid supporter ($p < 0.05$).

Table 1 Demographic characteristics of all participants by gender

Characteristic	Men (<i>N</i> = 235) <i>N</i> (%) or Mean (SD)	Women (<i>N</i> = 148) <i>N</i> (%) or Mean (SD)	Total (<i>N</i> = 383) <i>N</i> (%) or Mean (SD)
Race			
African–American/Black	219 (93.2)	132 (89.2)	351 (91.6)
White	12 (5.1)	15 (10.1)	27 (7.0)
Other	4 (1.7)	1 (0.7)	5 (1.4)
Education			
8th grade or less	15 (6.4)	11 (7.4)	26 (6.8)
Some high school	81 (34.4)	69 (46.6)	150 (39.2)
High school diploma/GED	97 (41.3)	48 (32.4)	145 (37.9)
Some college/above	42 (17.9)	20 (3.5)	62 (16.1)
Active substance use			
0 substances	130 (55.3)	79 (53.4)	209 (54.6)
1–2 substances	81 (34.5)	46 (31.1)	127 (33.2)
3 or more substances	24 (10.2)	23 (15.5)	47 (12.2)
Mental illness			
0 diagnoses	90 (38.3)	32 (21.6)	122 (31.9)
1–2 diagnoses	90 (38.3)	69 (46.6)	159 (41.5)
3 or more diagnoses	55 (23.4)	47 (31.8)	102 (26.6)
Familial conflict			
None	144 (61.3)	98 (66.2)	242 (63.2)
Low	28 (11.9)	16 (10.8)	44 (11.5)
Medium	45 (19.1)	28 (18.9)	73 (19.1)
High	18 (7.7)	6 (4.1)	24 (6.3)
Religious activity			
Low	46 (19.6)	25 (16.9)	71 (18.5)
Medium	104 (44.3)	68 (45.9)	172 (44.9)
High	85 (36.1)	55 (37.2)	140 (36.5)
Physical functioning			
Low	78 (33.2)	57 (38.5)	135 (35.2)
Medium	69 (29.4)	47 (31.8)	116 (30.3)
High	88 (37.4)	44 (29.8)	132 (34.5)
Main supporter type			
Other	65 (27.7)	24 (16.2)	89 (23.3)
Main partner	66 (28.0)	55 (37.2)	121 (31.6)
Kin	104 (44.3)	69 (46.6)	173 (45.2)
Doctor-patient communication			
Low	138 (60.3)	77 (53.5)	215 (57.6)
High	91 (39.7)	67 (46.5)	158 (42.4)
Support reciprocity			
Low	76 (34.7)	31 (22.1)	107 (29.8)
Medium	65 (29.7)	61 (43.6)	126 (35.1)
High	78 (35.6)	48 (34.3)	126 (35.1)
Health-related support			
Low	141 (60.0)	59 (39.9)	200 (52.2)
High	94 (40.0)	89 (60.1)	183 (47.8)
Viral suppression	156 (66.4)	96 (64.9)	252 (65.8)
Age (years)	49.6 (5.7)	45.9 (6.4)	48.2 (6.3)

Poisson Regression Results: African–American Women

While marginally statistically significant, in adjusted analyses, results indicated that women who were actively using 1–2 substances had a 30 % lower likelihood of UVL, as compared to women were not actively using substances (Table 2; Adjusted Incidence Rate Ratio [AIR] = 0.73;

95 % Confidence Interval [95 % CI] = 0.52, 1.03; $p < 0.10$). Results also indicated that women with 1–2 mental illness diagnoses had a 40 % higher likelihood of UVL, as compared to women with no mental illness diagnoses (AIR = 1.39; 95 % CI = 0.99, 1.94; $p < 0.10$). Women with moderate familial conflict had 50 % higher likelihood of UVL as women with no familial conflict ($p < 0.05$).

Table 2 Correlates of viral suppression by gender among African–American Indexes

	Men (<i>N</i> = 199)				Women (<i>N</i> = 122)			
	IRR	CI	AIR	CI	IRR	CI	AIR	CI
Active substance use								
1–2 substances	0.87	(0.70, 1.08)	0.88	(0.70, 1.09)	0.69*	(0.51, 0.94)	0.73 [‡]	(0.52, 1.03)
3 or more substances	0.99	(0.74, 1.33)	0.91	(0.65, 1.28)	0.61*	(0.37, 1.00)	0.71	(0.45, 1.14)
(ref: 0 substances)	1.00		1.00		1.00		1.00	
Mental illness								
1–2 diagnoses	1.16	(0.94, 1.44)	1.28*	(1.00, 1.63)	1.22	(0.87, 1.72)	1.39 [‡]	(0.99, 1.94)
3 or more diagnoses	1.12	(0.86, 1.45)	1.24	(0.98, 1.91)	1.10	(0.75, 1.62)	1.38	(0.92, 2.08)
(ref: 0 diagnoses)	1.00		1.00		1.00		1.00	
Familial conflict								
Low	0.79	(0.53, 1.17)	0.73	(0.49, 1.09)	0.83	(0.50, 1.37)	1.10	(0.67, 1.80)
Medium	1.15	(0.94, 1.42)	1.18	(0.96, 1.45)	1.22	(0.94, 1.60)	1.48*	(1.08, 2.04)
High	1.13	(0.83, 1.54)	1.37 [‡]	(0.98, 1.91)	1.25	(0.78, 1.99)	1.40	(0.76, 2.60)
(ref: None)	1.00		1.00		1.00		1.00	
Education								
Some high school	1.37	(0.74, 2.53)	1.64	(0.82, 3.29)	1.72	(0.69, 4.30)	2.05	(0.80, 5.30)
High school/GED	1.54	(0.84, 2.82)	1.75	(0.88, 3.48)	1.74	(0.69, 4.37)	2.03	(0.76, 5.39)
Some college/above	1.57	(0.85, 2.92)	1.89 [‡]	(0.94, 3.79)	2.25 [‡]	(0.90, 5.63)	2.60*	(1.00, 6.77)
(ref: 8th grade/less)	1.00		1.00		1.00		1.00	
Physical function								
Med physical func	1.31*	(1.02, 1.69)	1.38*	(1.07, 1.77)	1.00	(0.72, 1.39)	0.94	(0.69, 1.29)
High physical func	1.28*	(1.00, 1.63)	1.27 [‡]	(0.99, 1.64)	1.21	(0.91, 1.61)	1.04	(0.77, 1.41)
(ref: Low phys func)	1.00		1.00		1.00		1.00	
Religious activity								
Medium	1.29*	(1.04, 1.61)	1.26 [‡]	(0.98, 1.62)	1.31	(0.90, 1.92)	1.38 [‡]	(0.96, 1.98)
High	1.05	(0.82, 1.35)	0.98	(0.75, 1.29)	1.46*	(1.03, 2.08)	1.45*	(1.01, 2.08)
(ref: Low)	1.00		1.00		1.00		1.00	
Main support rel'n								
Partner	1.06	(0.82, 1.36)	1.41*	(1.01, 1.99)	1.26	(0.82, 1.93)	1.59*	(1.01, 2.51)
Kin	1.02	(0.81, 1.29)	1.33 [‡]	(0.98, 1.80)	1.24	(0.82, 1.89)	1.51*	(0.98, 2.33)
(ref: Other/No supp)	1.00		1.00		1.00		1.00	
Support reciprocity								
Medium	0.95	(0.75, 1.21)	0.91	(0.70, 1.19)	0.96	(0.74, 1.25)	0.94	(0.72, 1.24)
High	0.93	(0.74, 1.18)	0.92	(0.70, 1.22)	0.69*	(0.48, 0.99)	0.69 [‡]	(0.47, 1.01)
(ref: Low)	1.00		1.00		1.00		1.00	
Dr-Patient comm	0.96	(0.79, 1.17)	0.88	(0.71, 1.07)	1.15	(0.90, 1.48)	1.35*	(1.06, 1.72)
Health-rel support	0.93	(0.77, 1.14)	0.95	(0.76, 1.19)	0.80 [‡]	(0.63, 1.02)	0.78	(0.58, 1.06)

IRR incidence rate ratio, AIR adjusted incidence rate ratio, CI 95 % confidence interval

‡ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Next, women who attended religious activities frequently had 1.5 times the likelihood of UVL as women who rarely attended religious activities ($p < 0.05$). Women who had either a kin or partner main supporter had 1.5–1.6 times the likelihood of UVL, compared to women with another type of main supporter ($p < 0.05$). While marginally statistically significant, women who reciprocated support often to their main supporters had one-third the likelihood of UVL as compared to women who rarely reciprocated support (AIR = 0.69; 95 % CI = 0.47, 1.01; $p < 0.10$). Finally, women who reported high doctor-patient communication had nearly 1.3 times the likelihood of UVL as women who reported low doctor-patient communication (AIR = 1.35; 95 % CI = 1.06, 1.72; $p < 0.05$).

Post-hoc Analyses

Marginal effects of the predicted probability of UVL were calculated holding the other covariates at their means, to assess the relationship between social support and viral suppression among African-American Indexes [63]. Figure 1 depicts the marginal effects UVL by gender, as a function of all four social support variables, (i.e. main supporter relationship, religious activity, health-related support and support reciprocity; $N = 321$). Compared to women, men had higher probability of UVL when engaging in moderate religious activity (0.75 vs. 0.65, respectively), as well as frequent religious activity (0.59 vs. 0.47, respectively). For men and women, probability of UVL was higher when main supporters were main partners. Though marginally significant, neither frequent health-

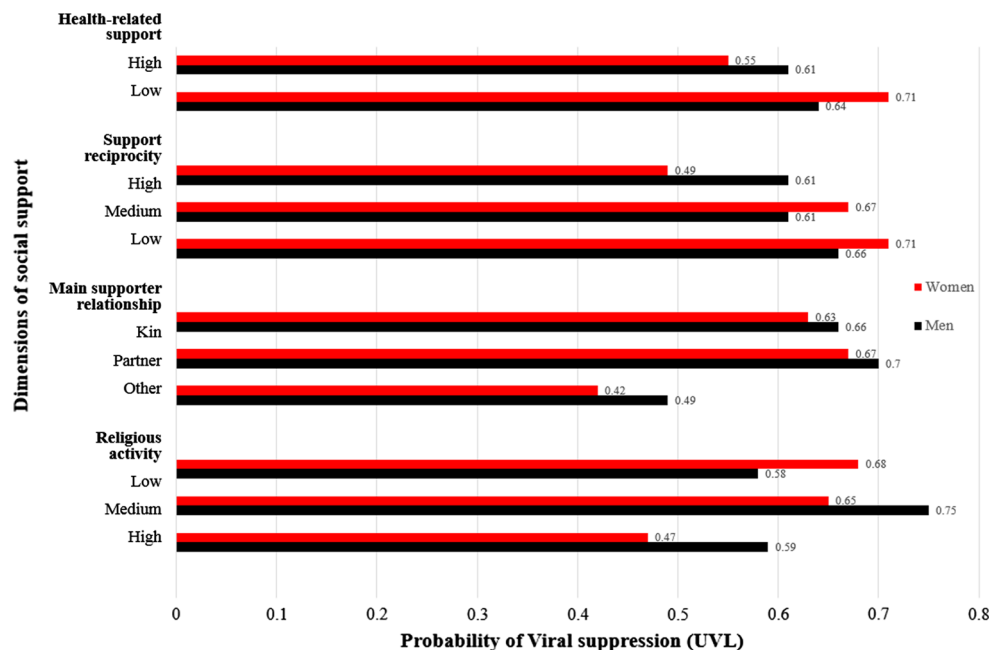
related support nor frequent support reciprocity were associated with viral suppression, such that both correlated with lower probability of UVL for men and women.

Discussion

The study results demonstrated evidence of gender differences in the effects of substance use, mental illness, and social support on viral suppression. This is consistent with previous literature, which suggests that men and women differ in their access of health services, risk for HIV infection, and their utilization of informal caregivers and social support networks to engage in health behaviors. While some findings were marginally statistically significant, results suggest that among African-American PLHIV, contrary to expectation, social support was often associated with lower likelihood of viral suppression (Table 2). Specific mechanisms which explain this, however, may differ by gender (Fig. 1).

First, findings indicated reciprocating support to informal caregivers was non-protective for women, such that high reciprocity of support was associated with only one-third the likelihood of undetectable viral load, as compared to women reporting low reciprocity to caregivers. While this finding was marginally statistically significant, it suggests that female care recipients were more likely to be the caregivers in their relationships, and therefore reciprocated support to their main partners to their own detriment, thereby complicating reciprocity expectations. Similarly, higher rates of health-related support predicted lower

Fig. 1 Marginal effects of social support dimensions on probability of UVL by gender among African-American Indexes ($N = 321$)



likelihood of UVL among women. One reason for this may be that accessing health-related support is non-normative for women, as they are more likely than men to report providing informal care, rather than receiving it [64].

Recent findings by Drabe et al. [65] suggest that female patients' depression and quality of life were much more associated with their male partners' resources, as compared to men, among whom depression and quality of life were much less associated. We found that African–American women Indexes were more likely than African–American men Indexes to report that their main supporters were their main partners (36 vs. 28 %, $p < 0.05$), and also less likely to achieve viral suppression than men (67.1 vs. 65.9 %, n.s.). It is possible that communication is complicated when men main partners provide care, and that communication may be more important to women PLHIV. Communication also appears more important to women than men in the healthcare setting, as high patient-provider communication was associated with a 35 % increase in likelihood of UVL among women. Similar findings on this association were also found by Bakken et al. [54] and Schneider et al. [66].

Finally, a few similarities can be identified between men and women' correlates of viral suppression. First, physical and mental health are quality of life measures which are often included in analyses of HIV-related outcomes. In the present study, both factors were at least marginally statistically significant correlates of increased likelihood of viral suppression among men (physical health and mental illness), and women (mental illness). Among men, for example, physical functioning was highly associated with viral suppression, such that men who reported moderate to high physical function had 1.3 times the likelihood of UVL, as men who reported low physical functioning.

Also, for both genders, it was protective to have main supporters who were either main partners or kin, as compared to having some other type of main supporter, or no main supporter. Therefore, while interpersonal communication challenges barriers are great, healthcare providers should include these individuals in treatment recommendations for PLHIV, given that closer personal relationships were associated with viral suppression in the present study. Finally, religious activity was protective for both men and women, which supports previous findings that religiosity is a common coping mechanism among PLHIV [67].

Post-hoc analyses revealed that two-thirds of men achieved viral suppression (67.1 %). Among these virally-suppressed men, nearly 30 % reported low physical functioning (27.9 %). Therefore, future research should consider health-related physical functioning, quality of life, and UVL outcomes, such that interventions with men and women PLHIV should account for improving relevant dimensions of health-related quality of life. Next, religious

activity was associated with viral suppression for both men and women ($p < 0.10$ and $p < 0.05$, respectively), while increased health-related support and reciprocal support were associated lower likelihood of UVL (n.s. and $p < 0.10$, respectively).

Limitations

Several limitations exist in consideration of study findings. First, viral suppression cannot be considered a direct measure of ART adherence. Second, the data were cross-sectional, which prevents the ascertainment of causal direction of associations among the variables of interest, and potential temporal fluctuations. Third, other correlates may have fit the data better, such as adherence to medications to treat disorders such as mental illnesses, which were common in this study population. Fourth, running analyses separately by gender among African–American Indexes may have led to a loss of statistical power to detect significant findings. Fifth, “male” and “men”, (e.g. gender and sex) were considered equivalent both theoretically and analytically, which may be simplistic given that sex is biological while gender is sociocultural and more subjective. Sixth, participants were African–American injection drug users enrolled in medical care and on ART. Thus, while this population is underrepresented in research, these characteristics limit the generalizability of our findings. Finally, several of the relevant findings were marginally statistically significant due to small sample size, and therefore must be interpreted with caution.

Conclusions

Despite these limitations, results support the need for further exploration of social factors in the health outcomes of PLHIV. Specifically among the African–American participants, attention should be paid to their social relationships to improve an understanding of variations in the role of health-related support in viral suppression and other HIV outcomes. Social support and informal caregiving ties have been found to affect care recipients' chronic illness outcomes, and ultimately, achievement of viral suppression [37].

This study is one of few to examine gender differences in psychosocial correlates of viral suppression [14]. Despite marginal statistical significance of some findings, study results lend credence to need for further exploration of gender differences in behavioral predictors of viral suppression. Moreover, results support the need for interventions to improve ART outcomes by addressing family and patient-provider factors as well as substance use and mental illness.

Another important contribution of this study was the simultaneous examination of purported facilitators of viral suppression (e.g. patient-provider communication and dimensions of social support), and barriers (e.g. mental illness and active substance use). Results suggest the following factors impact viral suppression, among both men and women: (1) physical and/or mental health; (2) active substance use; and (3) social dynamics of the caregiver-care recipient dyad. This lends support for promoting ART outcomes by conducting interventions to improve caregiver that focus on both individual and dyad-level factors. Comprehensive interventions could directly benefit PLHIV' health, indirectly improve their caregivers' health, and reduce future likelihood of care cessation.

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Compliance with Ethical Standards

Conflict of interest None.

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