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The interactive effects of social support and physical functioning on HIV medical outcomes among African-Americans whom inject drugs

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Abstract

Introduction: Research suggests a syndemic of substance use, mental illness, and familial conflict is associated with poor HIV medical outcomes among African American persons living with HIV (PLHIV). Social support, may facilitate positive health outcomes. This study explores these correlates of HIV medical outcomes, defined as undetectable viral load (UVL) and acute care minimization.

Methods—Data were from baseline of the BEACON study ($N=351$). UVL was 40 copies/mL. Acute care minimization was no ER visits and/or hospitalizations in 6 months. Descriptive statistics, and Poisson regression was implemented ($N=351$).

Results: Moderate syndemic burden was associated with viral suppression. Individuals with main partner caregivers had 35% higher likelihood of viral suppression, as individuals whose main supporters was neither kin nor main partners (Adjusted Point-Prevalence Rate Ratio [APR] = 1.35; 95% CI = 1.05, 1.74). Individuals with frequent health-related support had nearly 30 percent lower likelihood of avoiding acute care use, compared to individuals with low health-related support (APR = 0.73; 95% CI = 0.55, 0.97). Finally, interaction tests showed that physical functioning modified the relationship between main supporter type and acute care minimization.

Discussion: Results suggest that social support receipt was not consistently associated with HIV medical outcomes. Conversely, higher syndemic burden may have facilitated positive outcomes, through necessitating increased rates of healthcare engagement. Healthcare professionals should elicit discussion of social support to strengthen PLHIVs' and their supporters' relationships to improve their health. Results highlight the need for culturally-tailored interventions to improve HIV medical outcomes African American PLHIV substance users.

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Keywords

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INTRODUCTION

Widespread availability of antiretroviral therapy has increased life expectancy of persons living with HIV (PLHIV). Despite these advancements, only twenty-eight percent of PLHIV are aware of their status, on antiretroviral therapy (ART), and managing their illness (CDC, 2010). In a prospective study of HIV clinic patients, less than ten percent of patients were ninety-five percent adherent, which is the optimal adherence level for HIV viral suppression (Golin et al., 2002). A hospital-based clinical trial of ART adherence found patients were seventy to eighty percent adherent on average (Mannheimer, Friedland, Matts, Child, & Chesney, 2002). These rates are considerably lower among substance users; ART-adherence is estimated as low as 50 percent among injection drug users in urban areas (Arnsten et al., 2001). Previous studies have also documented adherence rates of less than seventy percent among those with serious mental illness (Wagner, Kanouse, Koegel, & Sullivan, 2003). More research is needed to understand factors associated with positive HIV medical outcomes in these populations (Wolf et al., 2007).

HIV medical outcomes among PLHIV

Extant literature identifies several key dimensions of HIV medical outcomes among PLHIV, including both viral suppression and acute care minimization. The primary biomarker of physical health among PLHIV (and of ART adherence) is viral suppression, defined as HIV viral load as less than forty copies per milliliter of blood (Aidala et al., 2016). Achievement of undetectable HIV viral load is key to slowing progression to AIDS, lowering transmission of HIV to sexual partners, and minimizing risk of HIV co-infections (Mannheimer et al., 2002; Aidala et al., 2016; Blank et al., 2015; Howe et al., 2014). Rates of viral suppression among African American substance users and/or those with mental illnesses are not well-established. Irrespective of mental illness or substance use, however, less than thirty percent of African American PLHIV are virally suppressed (CDC, 2016). Barriers to care among this population include less access to HIV testing, enrollment in primary care, and lower rates of insurance than other racial/ethnic groups (CDC, 2010; Mannheimer et al., 2002; Blank et al., 2015). More research is needed to understand medical outcomes among African Americans PLHIV, particularly if their HIV care is complicated by co-morbidities such as substance use and mental illnesses (Howe et al., 2014; Hightow-Weidman et al., 2011; Giordano et al., 2010).

The HIV Cost and Service Utilization Study defines minimization of emergency department (ED) visits, and prompt enrollment in care after HIV diagnosis as markers of successful management of HIV illness (Fremont et al., 2007). Of particular interest in the African American PLHIV population is acute care (ED) minimization, as a means of gaining insight on factors such as disease progression, physical health, and the impact of insurance status on preventable hospitalizations via engagement in outpatient and/or primary care (Billings et

al., 1993). For this reason, the present study recruited individuals who were all African American substance users, publicly insured, and in HIV care. As such, “HIV medical outcomes” considers aspects of both physical health and healthcare utilization, yet is contextualized to this under-researched population.

Individual-level factors and HIV medical outcomes

Informed by a socio-ecological perspective, research suggests that individual and interpersonal-level factors may impact HIV medical outcomes (Kaufman et al., 2014; Carrico et al., 2011). Personal, or individual-level characteristics, are often associated with HIV-related health outcomes. Race- and sex-based health disparities place African Americans, particularly if they are substance users, at higher risk of poor HIV medical outcomes such as viral non-suppression than Whites and/or non-substance users (CDC, 2010; Reynolds et al., 2004). Reasons for poor HIV medical outcomes in this population may be partly due to pervasive HIV-related stigma in the African American community (Vyavaharkar et al., 2010). HIV-related stigma may impede engagement in care among PLHIV, foster medical mistrust, and may result from moral judgments and stereotypes of PLHIV (Jeffries, Marks, Lauby, Murrill, & Millet, 2013; Katz et al., 2013).

Additionally, Singer proposes that a synergistic epidemic (syndemic) refers to individual-level co-morbidities which are mutually reinforcing and increase disease burden (Singer, 1996; Singer & Clair, 2003). Subsequent studies establish substance use and mental illness as syndemic factors among PLHIV which, combined with racial disparities in HIV, place African American PLHIV at greatest risk of poor HIV medical outcomes (CDC, 2012; Ryff et al. 2006; Ware et al., 1995). However, more research is needed to understand the impact of individual-level factors on HIV medical outcomes, including syndemic factors, physical functioning, and demographics (Smit et al., 2015; Shah et al., 2015; Rai, Dutta, & Gulati, 2010; Cunningham, Crystal, Bozzette, & Hays, 2005; Levy, 1998; Barclay et al., 2007).

Interpersonal-level and HIV medical outcomes

Interpersonal-level, or socio-contextual, factors refer to norms and laws that may impede positive HIV medical outcomes (UNAIDS, 1998). Research suggests that as HIV rates increase among low-income African Americans, health-related support from social support networks may be predictive of HIV medical outcomes. Consequently, low-income African American PLHIV may rely on their social networks for health-related support, which may potentially reduce HIV-related stigma and facilitate positive health outcomes (Knowlton & Latkin, 2007; Kalichman, Cherry, & Browne-Sperling, 1999; Edwards, 2006). HIV diagnosis, substance use, and mental illness are all factors which may strain social support relationships between PLHIV and their caregivers (Robinson, Knowlton, Gielen, & Gallo, 2015). Such strain may engender familial disagreements or conflict, which may represent another syndemic-related factor contributing to poor HIV medical outcomes among low-income African Americans substance users with mental illness (Katz et al., 2013). Familial conflict may be particularly problematic for PLHIV who rely on open communication with their social support and caregivers (Robinson et al., 2015; Straus, 1979). More research is needed to understand the role social support dimensions (e.g. familial conflict, health-related support) in a highly stigmatized context.

Purpose

African American PLHIV may be at risk of poor HIV medical outcomes, due to syndemic disadvantage, HIV stigma, and poor physical functioning. Social support may mitigate these factors. Therefore, the objective of this study was to identify psychosocial correlates of HIV medical outcomes among African American PLHIV. Informed by a socio-ecological framework, we sought to: (a) identify individual and interpersonal correlates of HIV medical outcomes; and (b) assess the association between social support and HIV medical outcomes. Given the known association between social support and HIV-related health outcomes, we hypothesized that individuals with main partner supporters may be more engaged in care, and therefore less likely to utilize acute care.

METHOD

Procedure

The present study utilized data from the baseline of the Being Active and Connected (BEACON) study, which was a longitudinal project to explore pathways through which psychosocial factors and substance use influence HIV-related outcomes among HIV-positive current and former injection drug users ($N=383$). Inclusion criteria were: (a) age of 18 years or older; (b) HIV seropositivity; (c) current or former injection drug use; (d) use of ART in the prior month; and (e) willingness to invite supporter(s) to the study. Main participants were required to meet all inclusion criteria, were recruited by the study team. These individuals were referred to 'Index' participants (as opposed to main supporters whom Indexes recruited to the study themselves). Index participants were recruited mainly from an HIV clinic at a large urban teaching hospital, as well as via targeted recruitment and community sampling. Participants completed study questionnaires with trained interviewers, and were paid \$35.00 per assessment. All participants (e.g. Indexes and main supporters) completed baseline (Time 1), a 6-months follow-up assessment (Time 2), and 12-months follow-up assessment (Time 3). The present study utilized data from African American Index participants only ($N=351$). Plasma viral load, and CD4 count data were used to verify viral suppression, and were collected at baseline and 6 month visits for all Index participants. Recall periods for survey questions ranged from one week to six months. The Johns Hopkins Bloomberg School of Public Health Institutional Review Board approved all study activities.

Measures

Dependent variables—Viral suppression was measured as ≤ 40 copies per mL, by the Roche Cobas Amplicor, where 0 = viral non-suppression, and 1 = viral suppression (Schumacher et al., 2007). Acute care minimization was measured by "In the past 6 months, how many times have you gone to an emergency room (ER) for your health care?", and "In the past 6 months, how many times were you admitted to a hospital, that means that you stayed there overnight?" Responses were summed and dichotomized such that the outcome of interest was minimization of acute care (i.e. 0 = 1 or more ER visits and/or hospitalizations in the last 6 months, and 1 = none (Fremont et al., 2007; MacCallum, Zhang, Preacher, & Rucker, 2002).

Independent variables—Predictors included individual-level factors (Syndemic class, physical functioning, age, sex, education) and interpersonal-level factors (HIV stigma, negative social exchange, main supporter relationship, ART-related support, health-related support). As mentioned, syndemic factors refer to mutually-reinforcing issues which exacerbate health burden (Singer, 1996). Previous research by Robinson et al (2015) identified a syndemic of active substance use (*SU*), mental illness (*MI*), and familial conflict non-resolution (*C*) among this study population. Substance use was defined as reported use of opiates, marijuana, heroin, cocaine or crack, hallucinogens, and/or prescription drugs, where 0 = no substance use, 1 = use in the past month.

Mental illness was coded as reporting having ever been diagnosed with depression, bipolar disorder, anxiety or post-traumatic stress disorder, schizophrenia, and/or any other condition, where 0 = not diagnosed, and 1 = diagnosed. Familial conflict non-resolution was assessed via the Family Conflict Tactics Scale (Strauss, 1979), and was coded as family members rarely discussing problems, problem-solving together, and/or show caring for one another, where 0 = no, and 1 = yes. Previous analyses of the *SUMIC* Syndemic identified that greater syndemic burden was associated with poor HIV medical outcomes; however, these findings did not explore the role of social support and interpersonal-level factors with a solely African American sample (Robinson et al., 2015). In the present analyses, a 4-level categorical variable representing *SUMIC* syndemic classes was used, to assess its relationship to HIV medical outcomes while adjusting for multiple dimensions of social support.

Physical health (physical functioning and ADLs) was assessed by a ten-item scale based on the Medical Outcomes Study Physical Functioning Measure (McDowell & Newell, 1996). These Likert-scale 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 do moderate activities like moving a table, carrying groceries, or walking a mile?” Responses ranged from “None” to “A lot.” Responses were reverse-scored, summed, and trichotomized, where 0 = low physical functioning, 1 = moderate physical functioning, and 2 = high physical functioning; (Cronbach’s $\alpha = 0.77$; Wight, Aneshensel, Murphy, Miller-Martinez, & Beals, 2006). Age was dichotomized at the median, where 0 = less than 49 years, and 1 = age 49 years and older (MacCallum et al., 2002).

Educational attainment was assessed with one item: “What is the highest level of education you’ve had?” Responses were collapsed, where 0 = 8th grade or less, 1 = some high school, 2 = high school diploma or GED, 3 = some college or above. Sex was coded as 1 = males, and 2 = females. HIV stigma was assessed via a six-item scale of items by Wight and colleagues (2006). Items included, “Thinking about having HIV, how much do you feel that you need to hide it?” and “Thinking about having HIV, how much do you fear your family will reject you?” Responses were on a 4-point Likert scale, ranging from “Not at all” to “Very much” [36]. Responses was summed and trichotomized, where 0 = low stigma, 1 = medium stigma, and 2 = high stigma (Cronbach’s $\alpha = 0.75$; Fong, 2014).

Negative social exchange was assessed with items developed by Newsom and colleagues (2003). Items included, “Thinking about having HIV, how much do you feel blamed by

others?” Participants’ responses were on a 3-point Likert scale, ranging from “None of the time” to “All of the time” (Newsom, Nishishiba, Morgan, Rook, & 2003). Responses were trichotomized, where 0 = low negative exchange, 1 = moderate negative exchange, and 2 = frequent negative exchange (Cronbach’s $\alpha = 0.80$; Fong, 2014). Main supporter relationship was coded as 0 = Other/No main supporter/Paid supporter, 1 = main partner, and 2 = kin. Of interest was the closeness of relationship between Index and main supporter; thus, the few individuals with paid, none, or other forms of support were combined. ART-related support was assessed via one item: “How often does your main supporter talk to you about your HIV medications or side effects?” (Barrera, Jr. & Gottlieb, 1981). Responses were on a 4-point Likert scale, from “Never” to “Very often”, and trichotomized, where 0 = low ART-related support, 1 = moderate ART-related support, and 2 = high ART-related support (Fong, 2014). Health-related support was assessed with six items from the Arizona Social Support Inventory (Barrera, Jr. & Gottlieb, 1981), including “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 (Cronbach’s $\alpha = 0.81$; MacCullum et al., 2002).

Analyses—First, univariate frequencies were generated for all variables on the African American Index participants only, due to theoretical importance ($N=351$). Next, utilizing latent class analyses, study individuals were classified based on their unique patterns of *SUMIC* Syndemic risk. The syndemic classes were identified via latent class regression, where individuals were classified into classes based on their posterior probability of endorsing *SUMIC* items; these analyses are described in detail elsewhere (Robinson et al., 2015). These analyses yielded four latent classes of syndemic risk, which were applied to the present analyses using a 4-level categorical variable. Third, bivariate statistics determined which variables would remain in multivariate analyses. Marginally-significant variables ($p < .10$; Gordon, 2012), and/or theoretically-significant variables were entered into a Poisson regression model, which is appropriate for binary, non-rare outcomes (McNutt, Wu, Xue, & Hafner, 2003). Robust standard errors accounted for inconstant variation (Long, 1997). Finally, hypothesis testing was conducted to assess whether the role of social support on with acute care minimization outcomes. Interactions were tested between social support variables (main supporter relationship, ART-related support, health-related support) and demographic variables (sex, physical functioning). Parameter tests were conducted to assess model fit with interactive effects. Analyses were conducted on complete cases due to acceptable missingness (up to 10%; Bennett, 2001), using STATA Version 11.2 (StataCorp, 2009).

RESULTS

Descriptive statistics

Table 1 reports the demographic characteristics of all study participants ($N=351$). Mean age was 48.5 years (Standard Deviation = 6.0 years). Nearly half reported high rates of HIV stigma (45%), and kin main supporters (45.9%). Most participants had attended high school and/or earned a high school diploma or GED (77.2%), and were predominantly males (62.4%). Half of the participants achieved acute care minimization (51.9%). Two-thirds

achieved viral suppression (66.7%). Regarding *SUMIC* Syndemic classes, the four syndemic classes' prevalence were: Class 1 – Moderate Substance Use/Mental illness (43.3%); Class 2 – High Mental Illness (24.8%); Class 3 – Moderate Substance Use/Mental Illness/Familial Conflict Non-resolution (22.8%); Class 4 – High Substance Use/Mental Illness (9.1%).

Poisson regression results: Correlates of viral suppression

In adjusted analyses, Syndemic Class 3 (Moderate SU/MI/C) had 40% higher likelihood of viral suppression as compared to Class 1 (Moderate SU/MI; Adjusted Point-Prevalence Rate Ratio [APR] = 1.38; 95% Confidence Interval [95% CI] = 1.15, 1.67; Table 2). Individuals with high physical function had 20% higher likelihood of viral suppression as those with low physical function (APR = 1.23; 95% CI = 1.01, 1.51). Individuals whose supporter was their main partner had 35% higher likelihood of viral suppression, as those whose supporter was neither kin nor a main partner (APR = 1.35; 95% CI = 1.05, 1.74; $N=331$). Finally, older individuals had a marginally significantly higher likelihood of viral suppression as compared to younger individuals (APR = 1.15; 95% CI = 0.97, 1.36). No differences were found by sex in likelihood of viral suppression.

Poisson regression results: Correlates of acute care minimization

In adjusted analyses, individuals in Classes 2 (High MI) and 4 (High SU/MI) had between 30 to 70% lower likelihood of acute care minimization (e.g. were more likely to use acute care; Table 3 Model 1). Individuals with frequent ART-related support had 26% lower likelihood of acute care minimization as compared to individuals reporting rare ART-related support (APR = 0.74; 95% CI = 0.57, 0.95). Individuals with frequent health-related support had 30% lower likelihood of acute care minimization as individuals with low health-related support (APR = 0.73; 95% CI = 0.55, 0.97). No differences were found by age or sex in likelihood of acute care minimization.

Hypothesis testing

We hypothesized that individuals with main partner supporters may be more engaged in care, and therefore less likely to utilize acute care. Interactions were tested between social support variables (main supporter relationship, ART-related support, health-related support) and demographic variables (sex, physical functioning). We found that physical functioning modified the relationship between main supporter type and acute care minimization. A parameter test of the interaction term was marginally-significant (Chi-square statistic [χ^2] = 9.00; $p=.06$; Ai & Norton, 2003). Model 2 reports a categorical variable, denoting each of the nine variable combinations (e.g. 1 = Low physical functioning and Main supporter is non-kin and non-partner). While traditional interactive effects are demonstrated by stratifying by variable levels, the present analyses replicated an approach by Gaskin and colleagues (2014), whereby a categorical variable denoted each of the nine interaction variable combinations, in order to simultaneously interpret main and interactive effects. Thus, in Model 2 in Table 3 details a single categorical variable, differentiating combined main and interactive effects by level (Gaskin et al., 2014). Compared to those with low physical functioning, individuals with high functioning and an “Other” supporter had 2.5 times the likelihood of acute care minimization (APR = 2.49; 95% CI = 1.19, 5.19). Figure 1 depicts marginal effects of the interaction on probability of acute care minimization, holding

all other covariates at their means ($N=331$; StataCorp, 2009). Probability of acute care minimization was highest for individuals with high physical functioning and an “Other” supporter, and lowest for those with low physical functioning and an “Other” supporter (0.67 vs. 0.27, respectively).

DISCUSSION

The purpose of the present study was to assess HIV medical outcomes among African American PLHIV whom inject drugs. Informed by social-ecological model, the present study was unique in its assessment of individual and interpersonal factors which impact HIV medical outcomes, among an under-researched population. The present study population was low-income, African American, with a history of syndemic substance use, mental illness, and familial conflict non-resolution. Study findings suggest that all of these factors function uniquely in their associations with HIV medical outcomes. This is congruent with the HIV literature, as PLHIV have complex personal and socio-contextual characteristics impacting their health. Mechanisms which may explain these relationships, however, differ by HIV medical outcome (Tables 3 and 4).

Surprisingly, we found that individuals with moderate *SUMIC* Syndemic burden (Class 3) had 1.4 times the likelihood of viral suppression as individuals with low syndemic burden (Class 1). It is possible that higher rates of concurrent substance use and mental illness requires more engagement in healthcare, thereby promoting consistent use of HIV medications and facilitating viral suppression. Given that the main difference between the classes was higher presence of familial conflict non-resolution in Class 3, future research should explore factors associated with familial conflict non-resolution, healthcare engagement, and medical outcomes (Robinson et al., 2015).

Highly physically functioning individuals had a twenty percent higher likelihood of viral suppression as low physically functioning individuals, which is consistent with previous research among PLHIV (Cunningham et al., 2005). Higher education was also associated with increased likelihood of viral suppression; thus, healthcare providers should address educational and/or literacy factors among African American PLHIV (Osborn, Paasche-Orlow, Davis, & Wolf, 2007). Individuals with kin or main partner supporters had higher likelihood of viral suppression, suggesting that social supporters are critical to engage in health interventions (Mosack & Petroll, 2009). Correlates of acute care minimization included physical functioning, main supporter relationship, and *SUMIC* Syndemic class. Contrary to viral suppression, and as expected, higher *SUMIC* Syndemic burden predicted lower likelihood of acute care minimization, which is consistent with previous HIV health services research (Meyer, Springer, & Altice, 2011). A novel finding was that higher levels of health-related support was associated with lower likelihood of acute care minimization. It is possible health-related support is being provided to PLHIV, without clear communication about expectations with main supporters, particularly if these Indexes are also in poor physical health.

Hypothesis testing revealed that physical functioning modified the relationship between main supporter type and acute care minimization (Table 3 and Figure 1). Research suggests

that highly physically-functional individuals should have had the least reason to utilize acute care; yet, this was only true for individuals with non-kin and non-partner supporters. For all other levels of physical functioning, having a kin or partner supporter promoted acute care utilization. Thus, this finding suggests that a complicated relationship exists when partners or kin are main supporters. It is plausible that these individuals may worry more about participants, and show caring by encouraging their use of acute care services more than other caregivers.

Limitations

This study has several limitations. First, data were cross-sectional, which prevents assessment of causality. Second, other correlates may have merited inclusion in statistical models, such as psychiatric medication adherence, which many participants reported using. Third, participants were African Americans whom inject drugs, were enrolled in medical care, and on HIV medication. While this population is underrepresented in research, findings may differ by race/ethnic groups, or among African Americans who live in suburban/rural areas. Next, acute care minimization was an outcome of interest, yet it is possible that individuals were using acute care services appropriately, for issues that could not have been managed with primary care. Last, the marginal significance of the interaction between main supporter type and level of physical functioning on acute care minimization may be because interactions are less powered than main effects. While the term was retained for theoretical meaning (Greenland, 1993), future research should investigate this relationship with a larger sample.

Nonetheless, the present study has several strengths. This study simultaneously examined multiple socio-ecological levels of correlates of HIV medical outcomes (individual and interpersonal). To date, latent class syndemic analysis and secondary HIV prevention has only been evaluated in four previous studies (Robinson et al., 2015; Blashill et al., 2014; Mizuno et al., 2015; Sullivan, Messer, & Quinlivan, 2015). Next, HIV medical outcomes, defined as both viral suppression and acute care minimization comprises a nuanced, contextualized definition of HIV health outcomes, in a study population of mostly-insured PLHIV with access to primary and HIV specialty care. Moreover, this study was the first to apply the newly defined *SUMIC* Syndemic to assess among different dimensions of HIV health outcomes among a completely African American sample (Robinson et al., 2015). The present also applied novel statistical analyses of syndemic classes, by using class membership as a categorical predictor in regression analyses. Finally, study analyses found a novel interactive effect between physical functioning and type of supportive relationship, and investigated this finding with a new statistical approach (Gaskin et al., 2014).

Conclusions

This study supports the importance of examining syndemic factors as correlates of HIV medical outcomes. Even among individuals enrolled in HIV primary care, on ART, and covered by health insurance, use of emergency (acute) health care was still high (48%). The surprising relationship between health-related support and acute care minimization, and interaction between main supporter and physical functioning on acute care minimization, suggest that interpersonal-level factors may be important for acute care minimization.

Moreover, post-hoc *SUMIC* Syndemic analyses show that nearly seventy percent of the class with highest burden were females. Therefore, it is possible that socio-context may differ by sex. African American females may have more familial and financial demands on them and less access to social support, in addition to increased HIV prevalence (Vyavaharkar et al., 2010). Reynolds et al., (2004) and Schneider, Kaplan, Greenfield, Li, and Wilson (2004) found interventions to increase self-efficacy among African-American females were predictive of increased ART adherence and increased engagement in care with HIV health care providers. Future health programs should specifically target African-American women, and include activities to increase their health self-efficacy.

Findings suggest that contrary to existing HIV literature, social support was not a clear correlate of both viral suppression and minimization of acute care use among African American PLHIV whom inject drugs. This research supports the need for continued prioritization of research to understand the social supportive care needs of low-income African American PLHIV, whom represent a vulnerable population at risk of poor HIV health outcomes (Knowlton & Latkin, 2007; Kalichman, Cherry, & Browne-Sperling, 1999; Edwards, 2006).

Moreover, given the level of syndemic substance use, mental illness, and familial conflict non-negotiation in our study sample, positive health outcomes may be facilitated by integrated mental healthcare in HIV primary care. Zea, Reisen, Poppen, Bianchi, and Echeverry (2005), Rotheram-Borus et al. (2011) and Tolle (2009) cite integrated HIV and family therapy as reducing rates of mental illness and substance use among participants, irrespective of age and/or type of familial conflict (e.g. inter-spousal disagreement, parent-child, sibling). Encouragingly, the Affordable Care Act has expanded coverage of mental illness and substance abuse treatment (Beronio, Po, Skopec, & Glied, 2013). However, future programs must consider the unique needs of African American women, who are becoming the new face of HIV/AIDS in the United States and have less access to care, irrespective of insurance status (CDC, 2010).

Medical mistrust is a long-standing factor which has been associated with poor health outcomes among African Americans; existing literature also supports cross-cultural medical education as a means to reduce aforementioned HIV disparities experienced in this population (Saha et al., 2013). As such, healthcare provider education may serve as a crucial pathway to improving outcomes among these individuals. A possible intervention may be with healthcare providers, to train them in skills beyond cultural competence via implementation of structural competence training (Metzl & Hansen, 2014). While closely related to cultural competency, structural competence acknowledges health-related factors beyond patient ethnicity, such as food access, institutional racism, and political infrastructure (Metzl & Hansen, 2014). This type of training may better prepare providers to understand the etiology of syndemic factors in PLHIV patients, as well as the larger impact of structural factors such as wealth disparities.

Finally, this study tested statistical models to assess two dimensions of HIV medical outcomes. The generalizability of these differing effects of *SUMIC* Syndemic class on viral suppression (HIV health biomarker) and acute care minimization (healthcare utilization)

should be addressed by future studies, with other racial/ethnic and/or non-substance using PLHIV populations. The importance of mental and physical health in HIV medical outcomes merit further research to improve the health and quality of life among African Americans whom inject drugs.

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Figure 1. Marginal effects depicting interaction of physical functioning on association between main supporter relationship and acute care minimization among African American Indexes ($N=331$)

Table 1.Demographic characteristics of participants ($N=351$)

Demographic Characteristic	Total <i>N</i>(%) or Mean (SD)
<i>SUMIC</i> Syndemic class	
Moderate SU/MI (C1)	152 (43.3)
High Mental illness (C2)	87 (24.8)
Moderate SU/MI/C (C3)	80 (22.8)
High Sub use/Men ill (C4)	32 (9.1)
Education	
8 th grade or less	21 (6.0)
Some high school	138 (39.3)
High school diploma/GED	133 (37.9)
Some college/above	59 (16.8)
HIV stigma	
Low	102 (29.1)
Medium	91 (25.9)
High	158 (45.0)
Negative social exchange	
Low	148 (42.2)
Medium	116 (33.1)
High	87 (24.8)
Health-related support	
Low	140 (39.9)
Medium	96 (27.4)
High	115 (32.8)
Main supporter type	
Other	80 (22.8)
Main partner	110 (31.3)
Kin	161 (45.9)
ART-related support	
Rarely	41 (12.4)
Sometimes	119 (36.0)
Often	171 (51.7)
Physical functioning	
Low	120 (34.2)
Medium	103 (29.3)
High	128 (36.5)
Acute care minimization	
Suboptimal	169 (48.1)
Optimal	182 (51.9)
Viral suppression	

Demographic Characteristic	Total N(%) or Mean (SD)
Detectable viral load	117 (33.3)
Undetectable viral load	234 (66.7)
Sex	
Males	219 (62.4)
Females	132 (37.6)
Age (years)	48.5 (6.0)

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Table 2.Correlates of viral suppression - African American Indexes (*N*=331)

	Unadjusted		Adjusted	
	<u>PRR^a</u>	<u>CI^c</u>	<u>APR^b</u>	<u>CI</u>
SUMIC Syndemic class				
High Mental illness (C2)	1.31 ^{**}	(1.10, 1.55)	1.35 ^{***}	(1.12, 1.62)
Moderate SU/MI/C (C3)	1.29 ^{**}	(1.09, 1.54)	1.38 ^{***}	(1.15, 1.67)
High Sub use/Men illness (C4)	0.68 [#]	(0.44, 1.05)	0.81	(0.53, 1.24)
(ref: Moderate SU/MI (C1))	1.00		1.00	
Physical functioning				
Moderate physical functioning	1.18 [#]	(0.97, 1.44)	1.16	(0.96, 1.40)
High physical functioning	1.25 [*]	(1.04, 1.50)	1.23 [*]	(1.01, 1.51)
(ref: Low physical functioning)	1.00		1.00	
HIV stigma				
Moderate stigma	0.99	(0.81, 1.21)	0.96	(0.78, 1.18)
High stigma	1.01	(0.84, 1.20)	1.01	(0.84, 1.22)
(ref: Low stigma)	1.00		1.00	
Education				
Some high school	1.49	(0.89, 2.47)	1.52 [#]	(0.93, 2.48)
High school diploma/GED	1.61 [#]	(0.97, 2.68)	1.52 [#]	(0.93, 2.47)
Some college or above	1.78 [*]	(1.06, 2.98)	1.72 [*]	(1.04, 2.85)
(ref: 8 th grade or less)	1.00		1.00	
Negative social exchange				
Medium exchange	1.02	(0.86, 1.20)	1.05	(0.88, 1.24)
High exchange	0.92	(0.75, 1.12)	1.02	(0.82, 1.28)
(ref: Low exchange)	1.00		1.00	
Main supporter relationship				
Main partner	1.11	(0.90, 1.37)	1.35 [*]	(1.05, 1.74)
Kin	1.08	(0.88, 1.31)	1.27 [*]	(1.00, 1.62)
(ref: Other/No supporter)	1.00		1.00	
ART-related support				
Sometimes	0.91	(0.74, 1.13)	0.85	(0.69, 1.04)
Often	0.82 [#]	(0.66, 1.01)	0.79 [*]	(0.64, 0.97)
(ref: Rarely)	1.00		1.00	
Health-related support				
Medium support	1.16 [#]	(0.98, 1.36)	1.16 [#]	(0.97, 1.39)
High support	0.91	(0.75, 1.11)	1.00	(0.82, 1.23)

	Unadjusted		Adjusted	
	<u>PRR^a</u>	<u>CI^c</u>	<u>APR^b</u>	<u>CI</u>
(ref: Low support)	1.00		1.00	
Age (49 years & up)	1.12	(0.96, 1.30)	1.15 [‡]	(0.97, 1.36)
Sex (Females)	0.98	(0.84, 1.15)	1.07	(0.91, 1.27)

[‡] marginally significant $p < .10$,

* $p < .05$,

** $p < .01$,

*** $p < .001$

^a PRR = Point-Prevalence Rate Ratio

^b APR = Adjusted Point-Prevalence Rate Ratio

^c CI = 95% Confidence Interval

Table 3.Correlates of acute care minimization - African American Indexes (*N*=331)

	Unadjusted		Model 1 ^d		Model 2 ^e	
	<u>PRR^a</u>	<u>CI^c</u>	<u>APR^b</u>	<u>CI</u>	<u>APR</u>	<u>CI</u>
SUMIC Syndemic class						
High Mental illness (C2)	0.63 ^{**}	(0.47, 0.84)	0.66 ^{**}	(0.48, 0.89)	0.63 ^{**}	(0.46, 0.86)
Moderate SU/MI/C (C3)	1.05	(0.85, 1.30)	1.10	(0.87, 1.38)	1.03	(0.82, 1.30)
High Sub use/Men ill (C4)	0.31 ^{**}	(0.15, 0.65)	0.35 ^{**}	(0.16, 0.77)	0.34 ^{**}	(0.16, 0.72)
(ref: Moderate SU/MI (C1))	1.00		1.00		1.00	
ART-related support						
Sometimes	0.89	(0.68, 1.17)	0.89	(0.70, 1.13)	0.93	(0.73, 1.18)
Often	0.65 ^{**}	(0.49, 0.86)	0.74 [*]	(0.57, 0.95)	0.77 [*]	(0.60, 1.00)
(ref: Rarely)	1.00		1.00		1.00	
HIV stigma						
Moderate stigma	0.93	(0.72, 1.20)	0.92	(0.72, 1.18)	0.94	(0.74, 1.20)
High stigma	0.81 [‡]	(0.64, 1.02)	0.83	(0.66, 1.05)	0.87	(0.69, 1.09)
(ref: Low stigma)	1.00		1.00		1.00	
Education						
Some high school	0.91	(0.59, 1.42)	1.08	(0.70, 1.66)	1.04	(0.68, 1.59)
High school diploma/GED	1.08	(0.70, 1.66)	1.23	(0.81, 1.88)	1.19	(0.79, 1.81)
Some college or above	0.97	(0.60, 1.57)	1.17	(0.72, 1.88)	1.07	(0.66, 1.74)
(ref: 8 th grade or less)	1.00		1.00		1.00	
Negative social exchange						
Medium exchange	0.94	(0.74, 1.20)	0.87	(0.69, 1.11)	0.86	(0.68, 1.08)
High exchange	1.06	(0.83, 1.35)	1.07	(0.83, 1.38)	1.05	(0.81, 1.35)
(ref: Low exchange)	1.00		1.00		1.00	
Health-related support						
Medium support	0.76 [*]	(0.60, 0.97)	0.83	(0.66, 1.06)	0.83	(0.66, 1.05)
High support	0.61 ^{***}	(0.47, 0.79)	0.73 [*]	(0.55, 0.97)	0.70 [*]	(0.53, 0.93)
(ref: Low Support)	1.00		1.00		1.00	
Sex (Females)	0.90	(0.73, 1.12)	1.11	(0.88, 1.39)	1.14	(0.90, 1.44)
Age (49 years & older)	1.14	(0.93, 1.40)	1.12	(0.91, 1.39)	1.11	(0.89, 1.37)
Physical functioning						
Medium physical function.	1.60 ^{**}	(1.19, 2.14)	1.53 ^{**}	(1.14, 2.07)	---	
High physical functioning	1.74 ^{***}	(1.33, 2.30)	1.45 ^{**}	(1.08, 1.94)	---	
(ref: Low physical function.)	1.00		1.00		---	
Main supporter relationship						
Main partner	0.93	(0.71, 1.23)	1.09	(0.80, 1.49)	---	
Kin	0.97	(0.74, 1.25)	1.05	(0.80, 1.38)	---	

	Unadjusted		Model 1 ^d		Model 2 ^e	
	PRR ^a	CI ^c	APR ^b	CI	APR	CI
(ref: Other/No supporter)	1.00		1.00		---	
Phys func × Main supporter						
Low phys func × Partner					1.59	(0.69, 3.66)
Low phys func × Kin					1.32	(0.61, 2.86)
Med phys func × Other					1.33	(0.54, 3.27)
Med phys func × Partner					2.13 [#]	(0.99, 4.59)
Med phys func × Kin					2.20 [*]	(1.05, 4.61)
High phys func × Other					2.49 [*]	(1.19, 5.19)
High phys func × Partner					1.83	(0.87, 3.85)
High phys func × Kin					1.72	(0.83, 3.55)
(ref: Low phys func × Other)					1.00	

[#] marginally significant $p < .10$,

^{*} $p < .05$,

^{**} $p < .01$,

^{***} $p < .001$

^a PRR = Point-Prevalence Rate Ratio

^b APR = Adjusted Point-Prevalence Rate Ratio

^c CI = 95% Confidence Interval

^d =Main effects model

^e =Model with main effects and interaction term (Main supporter×Physical Functioning)