Trauma exposure, PTSD, and suboptimal HIV medication adherence among marginalized individuals connected to public HIV care in Miami

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Abstract

Individuals living with HIV report disproportionately high levels of trauma exposure and PTSD symptoms, both which have been associated with suboptimal ART adherence. Often conflated, the question arises as to which construct is driving subsequent HIV self-care behavior. Given the HIV disparities among Black and Hispanic/Latinx individuals, and that Miami is a geographic region with a high racial/ethnic minority make up and a unique socioeconomic environment, it is important to explore factors related to HIV outcomes in Miami to mitigate its uncontrolled epidemic. This study aimed to examine the association of trauma exposure, PTSD symptoms, and relevant additional key factors with adherence to ART among a sample of majority Black and Hispanic/Latinx individuals who are economically marginalized receiving public HIV care in Miami, FL (*N*=1,237) via a cross-sectional survey. Sequential linear regression was used to examine the study aim in four blocks: 1) trauma, 2) PTSD symptoms, and key covariates of ART adherence including 3) depression and substance use (potential psychological covariates), and 4) indicators of socioeconomic status (potential structural covariates). In the first block, trauma exposure was associated with worse adherence. However, in the second block, the association with

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Declarations

Conflict of interest: The authors declare that they have no conflict of interest.

Ethics approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (University of Miami Institutional Review Board) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate: Informed consent was obtained from all individual participants included in the study.

trauma dropped and PTSD was significantly associated with worse adherence. Of note, for those experiencing high levels of trauma exposure, adherence was negatively impacted regardless of PTSD. When other key factors associated with adherence were entered in the third and fourth blocks, neither trauma exposure nor PTSD were uniquely significant. In this final model, depression, substance use, and unstable housing were uniquely associated with worse adherence. Trauma-informed models of HIV care that holistically address co-occurring factors are warranted to cater to communities with HIV health disparities and keep them from falling off the HIV care continuum.

Keywords

trauma; PTSD; HIV; antiretroviral therapy; adherence

Introduction

The most recent data from the CDC reported that the overall HIV incidence in the United States (US) remained stable in 2018 (Centers for Disease Control and Prevention, 2020a), yet some geographic regions and subgroups of people continue to be disproportionately impacted. Specifically, Miami, FL continues to see increasing rates of new HIV infections and ranks first as the US city with the highest HIV incidence in the country (Centers for Disease Control and Prevention, 2020b). Contextualizing this HIV epidemic, Miami has high racial/ethnic diversity (Miami Matters, 2020a), an important consideration given the disparities in HIV infection and care among Black and Hispanic/Latinx individuals. Across the US, 70% of new infections in 2018 were among Black individuals (42%) and Hispanic/ Latinx individuals (28%)(Centers for Disease Control and Prevention, 2020a). Specifically, in Miami, 93% of new infections were among people of color, specifically, 43% Black, 49% Hispanic/Latinx, and 1% other (Florida Department of Health Bureau of Communicable Diseases, 2019a). Further, Black and Hispanic/Latinx individuals have less linkage to HIV medical care and lower proportion of viral suppression compared to White counterparts across the US (Centers for Disease Control and Prevention, 2020c). Notably, in Miami, only 61% of Black individuals and 69% of Hispanic/Latinx individuals living with HIV were retained in HIV care and only 53% of Black individuals and 66% of Hispanic/Latinx individuals are virally suppressed (Florida Department of Health Bureau of Communicable Diseases, 2019a, 2019b).

Such disparities among Black and Hispanic/Latinx communities are rooted in social and structural marginalization, such as racism and low access to resources, which then affect individual level issues like mental health, substance use, and health behaviors (e.g., medication adherence)(Kennedy, 2009; Pellowski et al., 2013; Whittle et al., 2020). This is especially pertinent in Miami which has a unique socioeconomic context including high immigration, high economic inequities, politically mixed population, and relatively low resources compared to the rest of the country (American Immigration Council, 2020; Miami Matters, 2020b; Miami Urban Future Initiative, 2019; Miami-Dade County Elections Department, 2020). Further, when an individual has multiple marginalized identities, like being a person of color living with HIV, this intersection of marginalization can exacerbate

disparities in connection to HIV care, and HIV disease progression (Logie et al., 2019; Turan et al., 2017). Given the HIV disparities among Black and Hispanic/Latinx individuals, and that Miami is a geographic region with a high racial/ethnic minority make up and a unique sociopolitical environment, it is important to explore factors related to HIV outcomes in Miami to mitigate its uncontrolled epidemic.

Individuals living with HIV report disproportionately high levels of exposure to traumatic events compared to their HIV-uninfected counterparts (Brezing et al., 2015; Brief et al., 2004; Machtinger et al., 2012). The types of trauma experienced at higher rates than the general population are across both childhood and adulthood and include emotional, verbal, physical, and sexual abuse/violence (LeGrand et al., 2015). Compounding this for people of color living with HIV, Black and Hispanic/Latinx individuals experience greater exposure to some types of trauma compared to their White counterparts (McLaughlin et al., 2019; Roberts et al., 2011). Exposure to trauma has been associated with worse physical health outcomes in the general population (D'Andrea et al., 2011; Schnurr & Green, 2004; Spitzer et al., 2009). Considering the significantly higher rates of trauma in individuals living with HIV, and especially among Black and Hispanic/Latinx individuals living with HIV, several studies have examined the sequelae of trauma including HIV health outcomes. Exposure to trauma has been associated with poorer physical functioning, greater HIV symptomology, and AIDS mortality among individuals with HIV (Anderson et al., 2018; Brief et al., 2004; LeGrand et al., 2015; Leserman, 2008; Mugavero et al., 2007; Pence, 2009).

Pathways from trauma to HIV health outcomes are complex and operate via physiological, psychological, and behavioral mechanisms (Glynn, Llabre, et al., 2019; LeGrand et al., 2015; Neigh et al., 2016). Given that many individuals living with HIV achieve viral suppression through antiretroviral treatment (ART), and viral suppression is associated with better health outcomes (Lundgren et al., 2015; Teeraananchai et al., 2017), adherence to ART continues to be an important behavioral factor to consider in the trauma to HIV health outcomes relationship. Indeed, individuals living with HIV/AIDS with trauma histories show higher likelihood of ART nonadherence (Brezing et al., 2015; Mugavero et al., 2006; Mugavero et al., 2007; Mugavero et al., 2009; Pence, 2009).

Post-traumatic stress disorder (PTSD) is a psychological disorder resulting from trauma characterized by enduring alterations in the physiological, psychological, and behavioral stress response. Compared to the estimated 4.7% (past year) and 6.1% (lifetime) prevalence of PTSD in the general population in the United States (Goldstein et al., 2016), people living with HIV have higher rates of PTSD, with an estimated 38% global prevalence (Tang et al., 2020). For example, a meta-analysis found that 30% of women with HIV in the studies reviewed met criteria for PTSD, five times the rate of HIV-uninfected counterparts (Machtinger et al., 2012). Additionally, Black and Hispanic/Latinx individuals develop PTSD at higher rates and experience more severe symptoms than White individuals (Sibrava et al., 2019). Belonging to both groups (i.e., being Black and/or Hispanic/Latinx living with HIV) significantly increases risk of developing PTSD. Indeed, recent research found that Black women living with HIV had 3-fold higher prevalence of lifetime PTSD and 11-fold higher prevalence of current PTSD compared to the general population (Hutton et al., 2020). PTSD is important to consider as it has been associated with suboptimal ART adherence,

HIV disease progression, greater symptomology, higher viral load, and lower CD4+ T-cell count (Delahanty et al., 2004; Leserman, 2008; Leserman et al., 2005; Reilly et al., 2009; Taggart Wasson et al., 2018; Vranceanu et al., 2008).

Although often conflated, trauma exposure and PTSD are separate constructs with PTSD being a potential result of trauma. However, not all individuals exposed to trauma develop PTSD. Studies have found a wide range in the prevalence of exposure to traumatic events in the United States, reaching percentages as high as 90% (Kilpatrick et al., 2013), yet the prevalence of PTSD still remains below 7% (Goldstein et al., 2016). Given that trauma exposure is associated with suboptimal ART adherence (and subsequent HIV disease progression) and that PTSD is also associated with these outcomes, the question arises as to which construct is driving the implications for self-care/adherence: trauma exposure or symptoms meeting diagnostic criteria for PTSD? Studies examining both constructs together, which would aid in parsing out these relationships, are not yet integrated into the literature as these constructs are often conflated or used interchangeably.

In addition to trauma exposure and PTSD showing a predictive relationship with suboptimal ART adherence, there are other factors that have been shown to have a similar relationship. Specifically, suboptimal adherence has been associated with depression (J. S. Gonzalez et al., 2011; Langebeek et al., 2014), substance use (A. Gonzalez et al., 2011; Langebeek et al., 2014; Zhang et al., 2018), and socioeconomic marginalization (unstable housing [Milloy et al., 2012; Smith & Cook, 2019], low education [Golin et al., 2002; Peltzer & Pengpid, 2013], and unemployment [Nachega et al., 2015; Smith & Cook, 2019]). Of note, due to social and structural marginalization, Black and Hispanic/Latinx individuals often experience depression, substance use, and socioeconomic marginalization (Bailey et al., 2017). Thus, not only do these factors influence ART adherence among individuals living with HIV, but the intersection of marginalized identities, being a Black and/or Hispanic/ Latinx individual living with HIV, also bolsters these associations. Of note, although both depression and PTSD have been consistently associated with adherence as discussed, research has been mixed when considering these two predictors together. Some studies have shown that, while controlling for each other, depression, and not PTSD, was associated with poor ART adherence (Sledjeski et al., 2005; Vranceanu et al., 2008) while at least one study has found the opposite (Ebrahimzadeh et al., 2019). Additionally, it is unclear the effect of substance use and socioeconomic status on ART adherence when also controlling for PTSD/ trauma given the paucity in the literature examining these constructs in one model. Not only are these additional factors associated with suboptimal ART adherence, the sequelae of trauma often includes depression, substance use, and socioeconomic marginalization alongside PTSD (Afzali et al., 2017; Chilcoat & Breslau, 1998; Leeies et al., 2010; María-Ríos & Morrow, 2020; Stander et al., 2014). Thus, the aim of the current study was to examine if PTSD symptoms and trauma exposure are associated with ART adherence, a supported mechanism of HIV health outcomes, while controlling for each other and the additional key factors that have been shown to affect adherence and are a part of the sequelae of trauma. Additionally, given the racial/ethnic disparities in HIV and related factors and the uncontrolled HIV epidemic particularly impacting Black and Hispanic/ Latinx individuals in Miami, a geographic location with both high racial/ethnic and

economic diversity, the study examines this aim within the context of individuals receiving care at the public HIV clinic in Miami.

Methods

Participants

From April 2017 through February 2020, 1,237 persons living with HIV/AIDS in a public, non-profit tertiary care hospital in downtown Miami completed a one-time interviewer-administered psychosocial assessment in either English (n = 964, 78%), Spanish (n = 264, 21%), or Haitian Creole (n = 9, 1%). All measures were forward and back translated by certified translators for this study. This clinic is an urban safety-net clinic serving the socially marginalized and underserved individuals not consistently connected to care (Glynn, Safren, et al., 2019; Wawrzyniak et al., 2015). Inclusion criteria included: (a) clinic patient receiving HIV care, (b) able to give consent, (c) 18 years of age or older, and (d) able to speak and understand either English, Spanish, or Haitian Creole. Trained study staff allowed time for participant to read consent form and then discussed the form with the participant. All study procedures received approval from the University of Miami Institutional Review Board prior to study onset.

Measures

ART adherence.—Wilson et al.'s validated 3-item adherence measure (Wilson et al., 2016) was used to assess level of ART adherence. For the past 30 days, items assess: 1) number of missed medication days; 2) how "good of a job" one did at taking medications as prescribed on 6-point Likert-scale from 0 (very poor) to 5 (excellent); and 3) frequency of taking medications as prescribed on a 6-point scale from 0 (never) to 5 (always). Per original scale validation, given that the three items are measured on different scales, each item was linearly transformed to be on a scale from 0 (worst adherence) to 100 (perfect adherence). A mean score was calculated from the 3 items. Adherence was then reversed scored (due to left skew) and a log10 transformation was done which allowed variable to meet assumptions for linear regression. Due to transformation, adherence interpretation changes from originally scaled variable – higher scores indicate worse ART adherence.

Trauma exposure.—The Brief Trauma Questionnaire (BTQ; Schnurr et al., 1999) assessed lifetime trauma exposure. The BTQ is a 10-item scale that asks about exposure (yes/no) to traumatic events that would meet Criterion A for PTSD (person was exposed to death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence; i.e., trauma) according to the Diagnostic and Statistical Manual of Mental Disorders (DSM–V)(American Psychiatric Association, 2013). A dichotomous dummy variable was created representing whether or not they endorsed any of these Criterion A traumas.

PTSD.—The 4-item Primary Care PTSD Screen was used to assess past month PTSD symptoms (PC-PTSD; Prins et al., 2003). According to the validated clinical cut-off, patients who met Criterion A from BTQ (i.e., trauma exposure) and endorsed at least 3 out of the 4 symptoms were considered screening in for PTSD symptoms.

Depression.—The 9-item Patient Health Questionnaire (Kroenke et al., 2001) was used to assess past 2 week symptoms of depression per the DSM-V criteria. Each item is on a 4-point frequency scale from 0 (not at all) to 3 (nearly every day). A total score is derived by summing items with higher scores representing more severe depression (range 0 to 27). Validated clinical cut-offs for interpretation include: 0 to 4 (minimal depression), 5 to 9 (mild depression), 10 to 14 (moderate depression), 15 to 19 (moderately severe depression), and 20+ (severe depression). A dichotomous dummy variable was created representing moderate depression or higher. This measure has been validated in both Spanish speaking and Haitian Creole speaking samples (Diez-Quevedo et al., 2001; Marc et al., 2014).

Substance use.—Substance use was assessed using a measure adapted from the Addiction Severity Index – Lite (McLellan et al., 1980). Frequency of use in the past 30 days was assessed for marijuana, crack, cocaine, heroin, other opioids, amphetamines, hallucinogens, ecstasy/MDMA, sedatives/tranquilizers, and other drugs. Although research has shown marijuana acts as an anti-inflammatory and could potentially be beneficial to physical health among people living with HIV (Manuzak et al., 2018), other research has shown that marijuana use negatively impacts ART adherence (Bonn-Miller et al., 2014; Montgomery et al., 2019). Thus, a dichotomous variable representing those reporting any drug use, including marijuana, in the past 30 days was created.

Demographics.—Age, race/ethnicity, sex assigned at birth, gender identity, sexual orientation, education level, housing status, and employment status were assessed. Individuals endorsing homelessness or temporary/transitional housing in the past 12 months were considered unstably housed.

Data Analysis

Statistical analyses were conducted using SAS Studio 9.4 (SAS Institute, 2014). Descriptive statistics were obtained for all variables included in the analyses and tests for normality indicated outcome of adherence did not meet assumptions. Adherence was reversed scored (due to left skew) and a log10 transformation was done which allowed variable to meet assumptions for linear regression. Due to transformation, adherence interpretation changes from originally scaled variable – higher scores indicate worse ART adherence. Initially, bivariate associations between all variables were examined (Pearson, point-biserial, and phi). Next, sequential linear regression was used to test the association between predictors and ART adherence. This allows for evaluating predictors of ART adherence above and beyond previously entered predictors. Variables were entered in four blocks. First, trauma was entered to examine any independent association with adherence. Second, PTSD was added to the model to examine the association with adherence while controlling for trauma. Third, mental health constructs that are supported as key influencers of ART adherence, depression and substance use, were entered to examine the role of PTSD on adherence while controlling for such important covariates. Fourth, indicators of socioeconomic status (unemployment, unstable housing, low education [less than high school]) were entered to examine the effects of PTSD and mental health constructs in the context of supported structural influencers of ART adherence. Additionally, in this fourth block, race/ethnicity was added to account for supported disparities. Given that separating out all minority identities would result in

numerous categories with less than 1% frequency, a dummy variable for identifying as a person of color (referent = White, Non-Hispanic/Latinx) was entered. Collinearity diagnostics were examined for all models which indicated no issues. Alpha was set to .05.

Results

Patient characteristics are presented in Table 1. Overall, the sample was 50 years old (SD = 12), a person of color (95%, n = 1,173) with the majority being Black, non-Hispanic/Latinx (60%, n = 737), cisgender male (59%, n = 727), and heterosexual (74%, n = 920). Additionally, 43% (n = 526) screened in for at least mild depression, 19% (n = 228) for at least moderate depression, 77% reported trauma exposure (n = 943), 21% (n = 256) screening in for current PTSD, and 27% (n = 332) reported past 30-day substance use. The sample also reported high socioeconomic marginalization including unstable housing (n = 278, 23%), less than a high school education (n = 436, 35%), and unemployment (n = 830, 67%). In examining bivariate associations, almost all constructs were significantly associated with one another and with ART adherence (see Table 2).

In examining the first block of the sequential linear regression (see Table 3), trauma was significantly associated with worse ART adherence ($\beta = 0.08$, $p = .007$). However, when screening in for PTSD symptoms was entered in the second block, the association with trauma dropped in size by about 1/3 and became nonsignificant ($p = .074$). Notably, PTSD, while controlling for trauma, was significantly associated with worse ART adherence ($\beta = 0.08$, $p = .005$).

When depression and substance use, additional key factors potentially associated with adherence, were entered in the third block, PTSD was no longer significant ($p = .381$). However, depression ($\beta = 0.11$, $p = .0001$) and substance use ($\beta = 0.21$, $p < .0001$) were significantly associated with worse ART adherence. In the final fourth block adding indicators of socioeconomic status [low education, unemployment, unstable housing]) and race/ethnicity, trauma and PTSD remained nonsignificant. In this final model, unstable housing ($\beta = 0.12$, $p < .0001$), depression ($\beta = 0.11$, $p = .0002$), and substance use ($\beta = 0.20$, $p < .0001$) were significantly associated with worse adherence.

Post-hoc Sensitivity Analysis

Given that the trauma measure used assessed number of trauma domains experienced (vs. actual number of traumas experienced; e.g., an individual could experience the same type of trauma multiple times), the primary analysis collapsed trauma into the dichotomous variable representing screening positive for DSM-V diagnostic criteria for trauma exposure. However, some research indicates that individuals living with HIV not only experience higher prevalence of trauma, but also experience multiple traumas (Koehn et al., 2019; Reif et al., 2011). Although not able to speak to number of traumas, the current sample experienced an average of about two trauma domains ($M = 1.9$; $SD = 1.7$; range = 0 – 9). To explore if experiencing a certain number of trauma domains (vs. the dichotomous trauma or not) would be predictive of suboptimal ART adherence when controlling for PTSD, a post-hoc sensitivity analysis was done. The count variable representing number of trauma domains experienced was collapsed into five categorical dummy codes indicating having

experienced one ($n = 310$, 25.2%), two ($n = 258$, 20.9%), three ($n = 170$, 13.8%), four ($n = 98$, 8.0%), and five or more ($n = 107$, 8.7%) types of trauma. Individuals experiencing five to nine trauma domains were collapsed into one category due to the lower frequency in the upper tail of number of trauma domains experienced (five $n = 63$, 5.1%; six $n = 28$, 2.3%; seven $n = 7$, 0.6%; eight $n = 8$, 0.7%; nine n = 1, 0.1%).

These five categorical dummy codes were entered (referent = those experiencing no trauma) into the same sequential models of the primary analysis (see Table 4). Unlike the first set of analyses, when trauma and PTSD were entered into the same model (see Step 2 in Table 4) results showed that even when controlling for screening positive for PTSD, experiencing five or more trauma exposures was significantly associated with worse ART adherence compared to those experiencing no trauma ($\beta = 0.10$, $p = .003$). Additionally, within this model, and parallel to the primary analysis, having screened positive for PTSD was a significant predictor of worse ART adherence ($\beta = 0.07$, $p = .030$), but in this case, along with five or more trauma exposures as a significant predictor. Also paralleling the primary analysis, when depression and substance use were entered in the third block, PTSD and trauma exposure were not significant but depression ($\beta = 0.11$, $p = .0002$) and substance use ($\beta = 0.21$, $p < .0001$) were significantly associated with worse ART adherence. In the final fourth block adding indicators of socioeconomic status, results also paralleled the primary analysis such that trauma and PTSD remained nonsignificant and unstable housing ($\beta = 0.12$, $p < .0001$), depression ($\beta = 0.10$, $p = .0004$), and substance use ($\beta = 0.20$, $p < .0001$) were significantly associated with worse adherence.

Discussion

The findings from the current study contributes to the literature by examining the impact of both trauma exposure and PTSD on ART adherence to parse out the effects of each while also examining the role of previously established key factors in adherence. Additionally, the study examined this within the context of a racially and ethnically diverse sample of individuals most at risk for falling off the care cascade amid an uncontrolled HIV epidemic. In other words, this sample from the public HIV clinic in Miami is representative of Black and Hispanic/Latinx individuals and those economically marginalized – groups, often intersecting, that have significant disparities in HIV health outcomes due to structural and social discrimination. The sample aligned with past studies in that there was high prevalence of trauma (77%) and screening positive for PTSD (21%). Although individuals living with HIV/AIDS have increased exposure to trauma, findings suggest that, of these two psychosocial problems, developing PTSD may be the construct driving implications for self-care (adherence) versus exposure to trauma itself. However, the post-hoc analysis revealed that for those experiencing multiple trauma domains, specifically five or more, trauma exposure was associated with worse ART adherence over and above PTSD. In other words, for those experiencing high levels of multiple traumas, self-care (e.g. adherence) is impacted regardless of development of PTSD symptoms. This finding is especially important given that Black and Hispanic/Latinx individuals have high rates of experiencing multiple types of traumas (Graham et al., 2017) and higher rates of HIV (Centers for Disease Control and Prevention, 2020a). Findings indicate a need to regularly screen for trauma exposure within HIV care serving Black and Hispanic/Latinx and other marginalized individuals.

The finding that PTSD is important to consider in HIV care over and above trauma exposure at certain levels has several important clinical implications. Clinics caring for individuals living with HIV/AIDS should not only assess for trauma, but also PTSD to preemptively address potential medication adherence issues. Additionally, improving upon interventions to facilitate resilience and coping post-trauma within HIV care may mitigate disease progression through better medication adherence. Indeed, scholars and clinicians have advocated for a trauma-informed model of HIV care (Brezing et al., 2015; Brief et al., 2004). However, the majority of interventions tested in the literature focus on trauma-informed primary HIV prevention with limited studies examining such interventions for those already infected and their unique care needs (Cuca et al., 2019; Sales et al., 2016; Seedat, 2012; Verhey et al., 2016). Although, recently, initial steps were completed for adapting an evidence-based trauma treatment, Cognitive Processing Therapy, for individuals living with HIV (López et al., 2019) and Prolonged Exposure, another evidenced-based trauma treatment, has shown initial results for decreasing PTSD symptoms among individuals living with HIV (Junglen et al., 2017).

The relationship between PTSD and HIV outcomes is more complex for individuals with multiple and intersecting marginalized identities, like being a Black and/or Hispanic/Latinx individual living with HIV. For example, discrimination has been found to mediate the relationship between PTSD and poor ART adherence among Black men living with HIV (Wagner et al., 2012). Mechanisms of ART adherence, like discrimination, need to be considered when addressing PTSD among Black and Hispanic/Latinx individuals and other marginalized individuals living with HIV. For example, a promising cognitive-behavioral intervention for Black women living with HIV who have trauma histories showed increased medication adherence. The intervention targeted not only trauma and HIV care, but also resilient coping for HIV- and race-based discrimination (Dale & Safren, 2018). Although important steps in the field, much more work is needed for development and testing of trauma-informed HIV care, especially among subgroups of individuals living with HIV that experience significant prevalence of trauma and social and structural inequities (e.g., Black women [Dale & Safren, 2018], transgender women [Empson et al., 2017]).

The findings that trauma and PTSD symptoms were associated with suboptimal ART adherence, however, are contextualized by the further findings that additional key factors previously associated with ART adherence made PTSD symptoms no longer significant both in the primary analysis and the post-hoc analysis. Specifically, substance use, depression, and unstable housing were associated with worse adherence. Interpreting this finding becomes complex given that these constructs have bivariate and bidirectional associations with PTSD symptoms. For example, substance use is often a subsequent behavior after experiencing symptoms of PTSD (Chilcoat & Breslau, 1998; Leeies et al., 2010; María-Ríos & Morrow, 2020). Additionally, PTSD has overlapping symptoms with depression (Afzali et al., 2017) and/or may lead to subsequent comorbid depression (Stander et al., 2014). Further, PTSD symptoms have been shown to precede unstable housing (Martijn & Sharpe, 2006) likely due to functional impairment (e.g., unable to retain employment; Rodriguez et al., 2012), yet, being unstably housed is traumatic in itself (Deck & Platt, 2015; Taylor & Sharpe, 2008) which could lead to the onset or exacerbation of PTSD symptoms. Overall, the causal pathways to suboptimal ART adherence involving these constructs are complex

and need clarification via longitudinal research. Regardless of temporality, development of trauma-informed models of HIV care are needed and should consider the role of depression, substance use, and unstable housing.

Although the relationships between PTSD, depression, substance use, unstable housing, and ART adherence are complex in general, the complexity is exacerbated for those with intersectional marginalized identities, like people of color living with HIV. According to recent frameworks addressing HIV health disparities (Logie et al., 2019; Turan et al., 2017), experiencing structural stigma (i.e., macro level attitudes, laws, policies, services, etc. that facilitate disadvantage for minorities) and intersectional stigma (e.g., based on HIV-status, race, class, gender, sexual orientation, and other marginalized identities) lead to mental health and substance use issues which in turn lead to suboptimal ART adherence. Indeed, the current sample, which is made up of economically marginalized Black and Hispanic/Latinx individuals living with HIV, had comorbidity between PTSD symptoms and substance use (38% of those screening in for PTSD also endorsed past 30-day substance use; significant phi coefficient = 0.13), PTSD symptoms and depression (44% of those screening positive of PTSD met criteria at least moderate depression; significant phi coefficient = 0.33), and PTSD symptoms and unstable housing (43% of those screening positive for PTSD endorsed unstable housing; significant phi coefficient = 0.25). These comorbidities are indicative of the interconnecting nature of these factors among communities with HIV health disparities. Trauma-informed HIV care should not only consider this synergy, but also needs to address the intersectional stigma and discrimination faced by those most at risk for falling off the HIV treatment care cascade.

Although this study is among the first to examine how the experience of trauma vs. PTSD impact ART adherence, especially in the context of key factors that influence adherence among marginalized individuals in an HIV epidemic, there are several limitations to consider. Measures were self-report, including medication adherence, which can be inflated based on social desirability bias or inaccurate reporting. Also, PTSD was not measured by a clinical diagnostic tool, but rather self-report, which introduces error in detection of those screening in for PTSD. The measure used to assess for trauma assesses trauma domains experienced (i.e., types of trauma) and does not take into account individuals experiencing the same trauma multiple times; thus, estimates of the prevalence of trauma may be underestimated, especially in individuals living with HIV who have been shown to experience a chronic cycle of trauma. Future research is needed to explore a potential dose-response relationship with ART adherence. The majority of measures are not validated in Spanish and Haitian Creole samples; thus, measure validity and reliability may be affected when not delivered in English. In order to adequately measure and address HIV disparities, psychometric work needs to be done. Further, this is a cross-sectional study, which limits the conclusions of temporality. Generalizability is limited given that participants were patients receiving care and may not reflect those not connected to HIV care. Limitations in the field should also be noted when considering the limited extant evidence for trauma-informed HIV care. There may be such programs that are being done in the community, but since they have not been tested for efficacy or effectiveness, they have not been integrated into the literature nor considered evidence-based practice limiting dissemination. For example, Tavakkoli and colleagues (2014) developed a curriculum for HIV clinicians to be able to integrate

assessment of trauma, diagnose PTSD, and formulate treatment approaches to bolster medication adherence and HIV disease outcomes among patients with PTSD; however, this curriculum has not been evaluated. Researchers should consider rigorously evaluating current community programs to add them to the body of evidence.

Conclusions

Although a history of trauma has previously been shown to predict lower HIV medication adherence (Brezing et al., 2015; Mugavero et al., 2006; Mugavero et al., 2007; Mugavero et al., 2009; Pence, 2009), findings indicate that the development of PTSD might be a critical factor that determines suboptimal adherence. While individuals who experienced trauma may be at higher risk for suboptimal medication adherence, the prevention or treatment of subsequent PTSD might be most important in order to improve HIV health outcomes. However, for those experiencing high levels of multiple traumas, self-care (such as ART adherence) is impacted regardless of development of PTSD symptoms. It is also important to implement a trauma-informed model of care that considers depression, substance use, and unstable housing. Of note, bivariate associations indicated that almost every construct of mental health, substance use, and socioeconomic status were associated with each other and with ART adherence indicating the significant complexity in optimizing HIV care.

It is important to consider these findings and implications in the context of the sample, which is representative of Black and Hispanic/Latinx individuals and those economically marginalized – groups, often intersecting, that have significant disparities in HIV health outcomes due to structural and social discrimination. Additionally, this research takes place in a geographic area with an uncontrolled HIV epidemic, likely influenced by its unique social and structural context such as having high immigration, high wealth disparities, and low resources compared to the rest of the country. Taken together, the onus for improving ART adherence should first be placed on macro-level interventions (e.g., changing of laws, policies, public services) to address these structural and social issues, like discrimination and accessibility of resources, that influence HIV self-care. However, given the complexity and length of time macro-level interventions take to implement, individual-level interventions are needed to immediately support and empower individuals to achieve optimal HIV self-care. Research is needed to identify resiliency mechanisms in order to begin to extend evidence-based cognitive-behavioral and stress-coping interventions that can promote such resiliency factors. Efforts to holistically address the multilevel factors impacting individuals living with HIV across systemic, organizational, community, and intrapersonal levels are needed in order to cater to communities with HIV epidemics and disparities and keep them from falling off the HIV care continuum.

Acknowledgments

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Table 1.

Patient characteristics (N = 1,237)

	M or *n*	(*SD* or %)
Age	49.80	(11.91)
Race/ethnicity		
Black, non-Hispanic/Latinx	737	(59.68%)
Black, Hispanic/Latinx	56	(4.53%)
White, non-Hispanic/Latinx	62	(5.02%)
White, Hispanic/Latinx	327	(26.48%)
Asian, non-Hispanic/Latinx	4	(0.32%)
Asian, Hispanic/Latinx	1	(0.08%)
Native Hawaiian/Pacific Islander, non-Hispanic/Latinx	2	(0.16%)
Native Hawaiian/Pacific Islander, Hispanic/Latinx	1	(0.08%)
Indigenous, non-Hispanic/Latinx	1	(0.08%)
Indigenous, Hispanic/Latinx	2	(0.16%)
multi-racial, non-Hispanic/Latinx	4	(0.32%)
multi-racial, Hispanic/Latinx	17	(1.38%)
another race not listed, non-Hispanic/Latinx	3	(0.24%)
another race not listed, Hispanic/Latinx	18	(1.46%)
declined to answer	2	(0.16%)
Gender		
cisgender male	727	(58.82%)
cisgender female	494	(39.97%)
transgender male	2	(0.16%)
transgender female	13	(1.05%)
non-binary	1	(0.08%)
Sexual orientation		
straight/heterosexual	920	(74.37%)
gay/lesbian/homosexual	202	(16.33%)
bisexual	100	(8.08%)
different identity	8	(0.65%)
don't know	5	(0.40%)
declined to answer	2	(0.16%)
ART adherence[1]	88.69	(21.71)
Screened positive for PTSD	256	(20.76%)
Trauma	943	(76.54%)
Moderate depression or higher	228	(18.55%)
Substance use	332	(26.84%)
Unstable housing	278	(22.53%)
Less than a high school education	436	(35.25%)
Unemployed	830	(67.26%)

	M or n	*(SD or %)*
Being a person of color	1173	(94.98%)

Notes.

[1]Scale from 0 (worst) to 100 (perfect)

Table 2.

Bivariate correlations between all study variables

		1	2	3	4	5	6	7	8
1	log10 ART adherence[1]	-							
2	PTSD symptoms	0.09***	-						
3	Trauma	0.08**	0.28****	-					
4	Depression	0.17****	0.33****	0.15****	-				
5	Substance use	0.24****	0.13****	0.12****	0.18****	-			
6	Unstable housing	0.19****	0.25****	0.16****	0.20****	0.23****	-		
7	Less than a high school education	0.06*	0.03	0.02	0.08**	0.04	0.06*	-	
8	Unemployed	−0.004	0.13****	0.04	0.13****	0.06*	0.12****	0.15****	-
9	Being a person of color	−0.01	−0.01	−0.04	−0.06	−0.12****	−0.12****	0.12****	−0.03

Notes.

*
$p < .05$

**
$p < .01$

***
$p < .001$

****
$p < .0001$; for correlations between two binary variables, phi coefficient was used; for correlations between two continuous variables, Pearson's *r* was used; for correlations between continuous and binary variable, point-biserial correlation was used

[1] due to transformation, interpretation is reversed from raw scale – higher scores indicate worse adherence

Table 3.

Sequential regression predicting log10 ART adherence[1]

	Block 1 $F(1, 1230) = 7.27, p = .007$ $R^2 = .006$				Block 2 $F(2, 1229) = 7.65, p = .001$ $R^2 = .012$				Block 3 $F(4, 1222) = 24.78, p < .0001$ $R^2 = .075$				Block 4 $F(8, 1213) = 15.37, p > .0001$ $R^2 = .095$			
	b	*SE*	*β*	*p*	*b*	*SE*	*β*	*p*	*b*	*SE*	*β*	*p*	*b*	*SE*	*β*	*p*
Intercept	0.45	0.04	0.00	< .0001	0.45	0.04	0.00	< .0001	0.37	0.04	0.00	< .0001	0.31	0.10	0.00	.0013
Trauma	0.12	0.05	0.08	.007	0.08	0.04	0.05	.074	0.04	0.05	0.03	.368	0.03	0.05	0.02	.461
PTSD symptoms					0.14	0.05	0.08	.005	0.04	0.05	0.03	.381	0.01	0.05	0.01	.831
Depression									0.20	0.05	0.11	.0001	0.19	0.05	0.11	.0002
Substance use									0.33	0.04	0.21	< .0001	0.30	0.04	0.20	< .0001
Unstable housing													0.20	0.05	0.12	< .0001
< High school education													0.06	0.04	0.04	.149
Unemployed													−0.07	0.04	−0.05	.101
Being a person of color													0.07	0.09	0.02	.434

Notes.

[1] due to transformation, interpretation is reversed from raw scale – higher scores indicate worse adherence

Table 4.

Post-hoc analysis - sequential regression predicting log10 ART adherence[1]

	Block 1				Block 2				Block 3				Block 4			
	$F_{(5, 1226)} = 3.61, p = .003$				$F_{(6, 1225)} = 3.80, p = .001$				$F_{(8, 1218)} = 13.11, p < .0001$				$F_{(12, 1209)} = 11.13, p < .0001$			
	$R^2 = .01$				$R^2 = .02$				$R^2 = .08$				$R^2 = .10$			
	b	*SE*	*β*	*p*	*b*	*SE*	*β*	*p*	*b*	*SE*	*β*	*p*	*b*	*SE*	*β*	*p*
Intercept	0.45	0.04	0.00	<.00010	0.45	0.04	0.00	<.0001	0.38	0.04	0.00	<.0001	0.30	0.10	0.00	.001
Trauma (REF = 0)																
1	0.09	0.05	0.06	.111	0.07	0.06	0.05	.178	0.03	0.05	0.02	.577	0.03	0.05	0.02	.634
2	0.13	0.06	0.08	.027	0.10	0.06	0.06	.074	0.08	0.06	0.05	.146	0.08	0.06	0.05	.161
3	0.06	0.06	0.03	.353	0.02	0.07	0.01	.768	−0.03	0.07	−0.01	.693	−0.04	0.07	−0.02	.529
4	0.12	0.08	0.05	.136	0.07	0.08	0.03	.413	0.01	0.08	0.003	.916	−0.01	0.08	−0.004	.884
5+	0.31	0.08	0.13	<.0001	0.24	0.08	0.10	.003	0.14	0.08	0.06	.081	0.13	0.08	0.05	.110
PTSD symptoms					0.11	0.05	0.07	.030	0.04	0.05	0.02	.500	0.01	0.05	0.004	.895
Depression									0.19	0.05	0.11	.0002	0.18	0.05	0.10	.0004
Substance use									0.33	0.04	0.21	<.0001	0.30	0.04	0.20	<.0001
Unstable housing													0.20	0.05	0.12	<.0001
< High school education													0.06	0.04	0.04	.109
Unemployed													−0.07	0.04	−0.05	.081
Being a person of color													0.07	0.09	0.02	.407

Notes.

[1] due to transformation, interpretation is reversed from raw scale – higher scores indicate worse adherence; REF = reference group; trauma represents number of trauma domains experienced