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Neighborhood-level and individual-level correlates of cannabis use among young persons living with HIV/AIDS

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Abstract

Introduction—In addition to individual characteristics, there may be a wide range of environmental or neighborhood stressors that contribute to elevated cannabis use in groups of youth living with HIV/AIDS (YLHIV); however, the effects of social disorganization on cannabis use in YLHIV to date have not been studied.

Methods—We examined the effects of individual-level and neighborhood-level factors by developing hierarchical generalized linear models estimating odds of current cannabis use (any use during the past 3 months) and daily cannabis use among a sample of YLHIV (N=1921) currently receiving medical care.

Results—The final model for daily cannabis use in the past 3 months included significant positive effects associated with hostility (O.R.=1.08, 95% C.I.: 1.05, 1.11), being older (O.R.= 1.12, 95% C.I.: 1.05, 1.20), being a bisexual male (O.R.=1.72, 95% C.I.: 1.10, 2.70), and residing in a community with a murder rate in the highest quartile (O.R.= 1.91, 95% C.I.: 1.27, 2.87), second highest quartile (O.R.=1.62, 95% C.I.: 1.06, 2.46), or third highest quartile (O.R.=1.52, 95% C.I.: 1.01, 2.30).

Discussion—This paper advances our knowledge of the multilevel factors associated with elevated cannabis use among groups of YLHIV and furthers our understanding of social and structural determinants of health in this population. Future research into cannabis use among YLHIV should consider, not only cannabis use within the context of the adjustment of living with

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HIV/AIDS, but also the stressors that characterize the environments in which groups of YLHIV live.

Keywords

youth; cannabis (marijuana); social disorganization; neighborhood; bisexual; HIV/AIDS

1. INTRODUCTION

Public views on the use of marijuana or cannabis in the United States and internationally are undergoing currently a profound shift that coincides with emerging evidence of its use in the treatment of selected health conditions (Tramer et al., 2001; Watson et al., 2000), including HIV/AIDS (Abrams et al., 2003; Woolridge et al., 2005). “Medical marijuana” (including cannabinoids such as tetrahydrocannabinol (THC), cannabidiol (CBD), and their derivatives) is increasingly the focus of legislation in states in the U.S., and is already legal in Canada and several European countries. Decriminalization and legalization of recreational use of cannabis in selected jurisdictions has occurred recently, both domestically and internationally. Within this changing public sphere and clinical environment, it is important to understand the multiple influences on cannabis use among young persons living with HIV/AIDS (YLHIV). We adapted Bonfenbrenner’s (1979) ecologic model to examine potential individual-level and neighborhood-level factors associated with cannabis use in this population within an ecologic framework.

1.1. Cannabis and HIV/AIDS

There are consistent findings that cannabis plays a role in symptoms management in HIV/AIDS, especially the alleviation of pain and nausea in adult PLHIV (Abrams et al., 2007; Braitstein et al., 2001; Corless et al., 2009; Woolridge et al., 2005). Stress management and alleviation among adult PLHIV have been shown to be facilitated through cannabis use, although there may be significant overlap between “recreational” use and “medicinal” use when considering cannabis, stress and HIV/AIDS (D’Souza et al., 2013; Furler et al., 2004). Data are somewhat equivocal when considering the role of cannabis in facilitating adherence to HIV treatment through improved symptom management (Corless et al., 2009; DeJong et al., 2005). Few studies have investigated the role of cannabis use among YLHIV. Elevated marijuana use among HIV-positive young men who have sex with men (YMSM) has been associated with stress reduction, adjustment to an HIV/AIDS diagnosis, and relief from medication side effects (Bruce et al., 2013). Intervention studies among YLHIV have documented reductions in cannabis use via participant self-efficacy and social support, but cannabis use has proven more difficult to reduce than alcohol use in these interventions (Murphy et al., 2012; Naar-King et al., 2006).

1.2. Individual-level factors

Developmental and identity-related stressors also may contribute to differing levels of cannabis use among youth. Panel data has shown that cannabis use among populations in the U.S. spikes during late adolescence and emerging adulthood, with daily use among persons aged 18–24 estimated at 4–6% (Johnson et al., 2013). The effects of peer norms and social networks (Bell et al., 1998; Kuntsche and Jordan, 2006), and identity development processes

and stressors associated with emerging adulthood (Arnett, 2005) have been proposed as developmental mechanisms that may explain elevated use of cannabis during this period, with subsequent declines in use as individuals age over time (Johnson et al., 2013). In addition, stressors associated with sexual identity and sexual orientation may drive cannabis use among groups of YMSM (Bruce et al., 2014; Traube et al., 2013; Wong et al., 2010). Across studies, lesbian gay and bisexual youth have been more likely to report past month cannabis use than heterosexual youth (Marshall et al., 2009).

Associations between mental health and substance use disorders have been documented theoretically (Wills and Shiffman, 1985), epidemiologically (Armstrong and Costello, 2002; Compton et al., 2007), and neurobiologically (Brady and Sinha, 2005), and populations living with HIV/AIDS have been characterized by increased risk for psychiatric and substance use co-morbidities (Bing et al., 2001; Chandler et al., 2006; Walkup et al., 2008). High levels of stress and co-morbid mental health or substance use disorders associated with disease management have been found among adults living with HIV/AIDS (Brown and Vanable, 2008), yet the precise relationship between cannabis and different mood disorders is not well understood (Crippa et al., 2009). There is evidence of cannabis use by PLHIV to alleviate depression and anxiety (Prentiss et al., 2004). Among those newly diagnosed with HIV across all ages, cannabis use is higher among depressed patients while for adolescents living with HIV cannabis use is more likely among those experiencing anxiety (Bhatia et al., 2010; Korthuis et al., 2008). Health anxiety, in particular, has been found to be associated with elevated cannabis use among YLHIV (Murphy et al., 2001).

1.3. Neighborhood-level factors

Social disorganization and neighborhood disadvantage have been theorized to be related to substance use through a number of stress mechanisms, including social interactions and discrimination, decreased social resources available to individuals, the undermining of individuals' psychological resources, and increased psychological distress (Boardman et al., 2001). Multiple studies have linked neighborhood disadvantage, disorganization, or disorder to increased drug use among adults (Boardman et al., 2001; Karriker-Jaffe, 2013; Latkin et al., 2007) as well as adolescents (Furr-Holden et al., 2011; Tucker et al., 2013; Winstanley et al., 2008).

Examination of National Longitudinal Study of Adolescent Health (Add Health) panel data has shown high neighborhood unemployment to be the most consistent predictor of initiation of cannabis use, with stronger associations than individual and social network factors (Tucker et al., 2013). A significantly greater prevalence of cannabis use has been found among sexual minority youth living in neighborhoods with higher prevalence of LGBT assault hate crimes (Duncan et al., 2014). Among African American youth, perceived neighborhood violence has been shown to be significantly associated with greater cannabis use, while perceived control is correlated with less cannabis use (Lambert et al., 2004). For YLHIV, in addition to developmental, identity-related, and HIV-related stressors, as well as associated mental health issues, there may be a wide range of environmental or neighborhood stressors that contribute to elevated cannabis use in groups of YLHIV from

disadvantaged communities; however, the effects of social disorganization on cannabis use in YLHIV to date have not been studied.

1.4. Aims of Current Study

In light of the evidence that cannabis use may be associated with individual-level and neighborhood-level factors, we aimed to examine the effects of these multiple factors by developing hierarchical generalized linear models estimating odds of current cannabis use (any use in the past 3 months) and daily cannabis use among YLHIV. We hypothesized that (1) lesbian gay or bisexual sexual orientation, higher levels of mental health symptomology, and recent HIV diagnosis and (2) greater social disorganization as indicated by higher levels of poverty, unemployment, crime, and housing vacancy would be positively associated with current and daily use.

2. METHODS

2.1. Study procedures

From December, 2009 to June, 2012, 2,225 YLHIV receiving primary care at 20 geographically diverse clinics within the Adolescent Medicine Trials Network for HIV/AIDS Interventions (ATN) were recruited to participate in a cross-sectional survey (see Acknowledgements for the 17 metropolitan areas represented). To be eligible, youth had to be: 1) between 12 and 26 years of age (inclusive); 2) living with HIV/AIDS; 3) aware they were HIV-infected; 4) engaged in care in one of the ATN's clinical sites or affiliates; and 5) able to understand English or Spanish.

Written informed consent or assent was obtained from all participants to (1) an audio-computer assisted self-interview (ACASI) to assess psychosocial factors, and (2) medical record abstraction to extract clinical data such as antiretroviral therapy (ART) usage and viral load (HIV RNA) assay results. Most sites did not require parental consent for participants younger than 18, in order to protect the confidentiality of participants and their HIV status, although parental consent was obtained at sites where it was required by the local institutional review board (IRB). Participants were given a small incentive the amount determined by each IRB based on previous history of research with YLHIV at each site. The study was reviewed by community advisory boards at each site and approved by the IRBs at each site as well as those from the members of the protocol team. It is the policy of the ATN for protocol teams to write a lay summary of findings to be distributed to study participants at each site.

2.2. Measures

2.2.1. Cannabis Use—We used the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) (WHO ASSIST Working Group, 2002) to assess cannabis use, including (1) ever using cannabis during the past 3 months, and (2) frequency of use among current cannabis users during the past three months. Current use was defined as any use during the past 3 months. Frequency of current use was assessed with a four-point scale: once or twice, monthly, weekly, daily or almost daily. To analyze daily use, we dichotomized the frequency variable into "daily (or almost daily)"/"less than daily."

2.2.2. Mental Health Symptoms—Mental health symptoms were assessed with the Brief Symptom Inventory (BSI; DeRogatis and Spencer, 1982) which yields nine primary symptom scales, and a global severity index (GSI). For the purposes of descriptive and multivariate analyses, mean scores were calculated for the anxiety, depression, hostility subscales, and GSI. Subscale reliability in the current study was high: anxiety (α =.86), depression (α=.88), and hostility (α=.84).

2.2.3. HIV-related Measures—Participants who reported being on ART and had a current regimen identified during medical chart review were classified as "on ART." Participants who had been diagnosed with HIV/AIDS within the past 12 months were classified as "newly diagnosed." Participants' plasma HIV RNA obtained within the last six months and type of assay were abstracted from medical records, and a dichotomous variable was created to designate virologic detectability (non-suppressed) vs. non-detectability (suppressed).

2.2.4. Neighborhood-level Data—Geographically dependent neighborhood-level variables were collected from a number of existing sources and appended to the data collected at clinical sites using participant residential zip code as a geographical identifier. We included the following variables in our analysis: percent of persons unemployed (from 2010 U.S. Census), percent of persons below federal poverty rate (from 2010 U.S. Census), murder rate index in 2010 (from Esri Crime database), assault rate index in 2010 (from Esri Crime database), percent of housing units that are vacant (from 2011 American Community Survey). To align census-derived data with participant residential zip codes we used the 2010 Zip Code Tabulation Area (ZCTA), a spatial unit developed by the U.S. Census Bureau to be comparable to zip codes (http://www.census/gov/geo/reference/zctas.html). Consistent with prior studies (Kim et al., 2010; Steptoe and Feldman, 2001), neighborhood-level variables were modeled as quartiles, with the lowest quartile serving as the reference category in all analyses.

2.3. Data Analysis

Descriptive analyses were conducted using PASW (SPSS), version 18.0. We computed frequencies, means and other measures of central tendency of use of cannabis, mental health, HIV-related, demographic, and neighborhood-level factors (see Tables 1 and 2). Quartile distributions of unemployment, poverty, and vacant housing percentages, and murder and assault rates were converted to four-point categorical ordinal variables.

We constructed a correlation matrix to assess bivariate relationships and examine possible collinearity between variables of interest. Hierarchical generalized linear models (HGLM) were then developed using HLM7® software (SSI, Inc.) to examine individual- and neighborhood-level factors associated with (1) any cannabis use during the past 3 months and (2) daily cannabis use during the past 3 months. In accordance with standard practices in the development of hierarchical linear models (Raudenbush and Bryk, 2002), we first ran unconditional models to examine the variance of the two outcome variables. Each unconditional model assumed a Bernoulli distribution that specified:

$$\begin{aligned} &\text{Level 1} \quad \text{Prob}(Y=1/\beta)=P \\ &\qquad\qquad \text{Log}[P/(1-P)]=\beta_0 \\ &\text{Level 2} \qquad \beta_0=\gamma_{00}+\mu_0 \end{aligned}$$

After the initial variance was determined in the unconditional models, individual-level variables of interest were entered as fixed effects at Level 1. Variables were first entered as fixed effects for two reasons. First, due to our use of secondary data, we did not assume that we were modeling all variables that could possibly explain the nature of cannabis use in this population, which is often seen as criteria for random effects models (Allison, 2009). Second, we would include a random variance term in each equation, and based on the results of the model iterations determine whether there was a sufficient change in variance across models that would merit including random effects in future model iterations.

Level 1 variables were entered in the following ordered blocks: (1) personal demographics (race/ethnicity, sexual orientation, age), (2) mental health variables (depression, anxiety, hostility, GSI), (3) HIV-related markers (new diagnosis in past 12 months, being on antiretroviral therapy, having an undetectable viral load). Variables that demonstrated statistical significance ($p<.05$) were retained in successive model iterations until all variables remaining in the model were statistically significant at Level 1. We then modeled quartiles of neighborhood-level factors (murder, poverty, and unemployment quartiles) as dummy variables and entered them as fixed effects at Level 2 (with the lowest quartile serving as referent). Neighborhood-level factors that demonstrated statistical significance at Level 2 were retained in successive model iterations until all variables remaining in the model were statistically significant.

3. RESULTS

3.1. Participant Characteristics

Participants who did not report zip codes (n=219) were removed from the data set prior to analysis. We deleted participants cases from the Puerto Rico ATN site (n=25) as neighborhood-level variables were not available for ZCTAs in Puerto Rico, leaving a final dataset (N=1921) for analyses. We assessed missing data with variables to be entered into our models using chi-square and t-tests and determined that the missing data was missing completely at random (MCAR). Fifty percent of participants (n=954) had used cannabis in the past 3 months, and 20% (n=381) used cannabis daily. Only 3% (n=68) had used alcohol daily during the same period, and similar low proportions had used other drugs at any time during the past 3 months (amphetamines, 11%; cocaine, 7%; hallucinogens, 2%). Participant characteristics of the total sample, as well as those who used any cannabis during the past 3 months, and those who used cannabis daily appear in Table 1.

3.2. Neighborhood-level Characteristics

There were 784 ZCTAs represented among the 1921 participants remaining after initial data cleaning. The number of participant observations within the ZCTAs ranged from 1 to 22. The means and quartile distribution of the community characteristics appear in Table 2.

3.3. Bivariate Analyses

We examined bivariate correlations among the variables of interest with the two outcomes (any cannabis use during past 3 months, daily cannabis use during past 3 months) to assess collinearity. Results of correlational analysis appear in Table 3. Since there was a high level of collinearity (1) among the BSI-subscales and the GSI, and (2) between neighborhood-level murder rate quartiles and assault rate quartiles, we chose to enter these variables one at a time in their respective blocks in the hierarchical models below. Due to our interest in differentiating possible effects of a range of mental health symptoms on cannabis use, we retained the BSI-subscales and the GSI as possible predictors to be entered into the models. We selected the murder rate quartiles as the crime variable of interest to be entered at Level 2, and did not include assault rates, as the murder rate quartiles demonstrated significant bivariate correlations with both of the two cannabis use outcomes. Similarly, we did not enter housing vacancy percentage quartiles in the HGLM models due to the lack of significance with the cannabis outcomes in the bivariate analysis.

3.4. Hierarchical Generalized Linear Models

Cases with missing data were deleted when entering the datasets into HLM, resulting in final samples analyzing associations with current use/no current use (n=1840) and associations with daily use/less than daily use among current users (n=916). Analyses of the unconditional model for any current cannabis use during the past 3 months demonstrated significant variance at Level 2 ($p<.05$), and there was also significant variance at Level 2 in the daily cannabis use unconditional model ($p<.001$), suggesting rates of both current and daily marijuana usage differed between ZCTAs.

3.4.1. Current Cannabis Use—When demographic variables were entered into the current cannabis use model, significant associations at Level 1 were found with identifying as gay male, bisexual male, or bisexual female, as well as with older age. Hostility demonstrated the only significant association among the mental health variables, and when the mental health variables were entered at Level 1, being transgender no longer retained statistical significance. ART use produced a significant negative association with current cannabis use, but the other HIV-related markers entered into the model did not. None of the neighborhood-level variables entered at Level 2 demonstrated statistical significance. The final model for current cannabis use in the pasts 3 months included significant positive fixed effects associated with increased hostility (O.R.=1.10, 95% C.I.: 1.08, 1.13), older age (O.R.=1.13, 95% C.I.: 1.08, 1.17), identifying as a gay male (O.R.=1.63, 95% C.I.: 1.30, 2.04), identifying as a bisexual male (O.R.=2.43, 95% C.I.: 1.72, 3.42), and identifying as a bisexual female (O.R.=2.34, 95% C.I.: 1.41, 3.90), with significant negative fixed effects associated with ART use (O.R.=0.67, 95% C.I.: 0.55, 0.81). Results including fixed effect coefficients, odds ratios, and confidence intervals from the population-average model using robust standard errors are depicted in Table 4.

3.4.2. Daily Cannabis Use—As in the current use model, bisexual males and older participants reported higher odds of being daily cannabis users; however, no other demographic variables were significantly associated with daily use. Similar to the current use model, hostility was significantly associated with daily cannabis use. None of the HIV-

related variables were statistically significant when entered at Level 1. When neighborhood-level quartiles were entered at Level 2, the highest poverty quartile and highest unemployment quartile demonstrated significant associations with daily use, as did the top three murder quartiles, in separate models. When multiple neighborhood-level variables were entered at Level 2 simultaneously, none retained their significance, which may be a function of their significant correlations with one another. We chose to retain the model with murder quartiles entered at Level 2, as this model demonstrated the best model fit compared to the poverty or unemployment models based on comparison of log likelihood statistics. The final model for daily cannabis use included significant positive effects associated with hostility (O.R.=1.08, 95% C.I.: 1.05, 1.11), being older (O.R.= 1.12, 95% C.I.: 1.05, 1.20), being a bisexual male (O.R.=1.72, 95% C.I.: 1.10, 2.70), and residing in a community with a murder rate in the highest quartile (O.R.= 1.91, 95% C.I.: 1.27, 2.87), second highest quartile (O.R.=1.62, 95% C.I.: 1.06, 2.46), or third highest quartile (O.R.=1.52, 95% C.I.: 1.01, 2.30). Results from the population-average model using robust standard errors are depicted in Table 4.

4. DISCUSSION

This paper presents the first analysis that simultaneously estimates individual-level and neighborhood-level factors of daily cannabis use among YLHIV. Our findings help to disentangle a range of factors that are associated with elevated cannabis use among this population, identifying important factors to consider regarding the role of cannabis in the lives of YLHIV. Current and daily cannabis use appear to be highly prevalent in this population, with proportions greatly exceeding those of daily alcohol use or other current drug use in the sample, and prevalence of daily use was over three times that of similarly aged youth in national population-based samples (Johnson et al., 2013). None of the neighborhood-level variables entered at level 2 of the “current use” HLM models demonstrated statistical significance, suggesting that current or more casual cannabis use is significantly associated with individual level factors and not community level factors among this population.

Participants living in communities with the first, second, and third highest quartiles of murder rates were significantly more likely to use cannabis daily, with YLHIV living in communities in the highest quartile almost twice as likely to use daily as those living in communities in the lowest quartile. We found significant associations with daily use and living in communities in the highest poverty quartile and the highest unemployment quartile, although these associations were not significant when all neighborhood-level variable quartiles were entered simultaneously. These relationships between living in socially disorganized and disadvantaged neighborhoods and elevated cannabis use confirm previous findings in the literature, and point to significant stressors in the lives of groups of YLHIV above and beyond stress associated with living with HIV/AIDS.

Hostility as measured by the BSI was significantly associated with both current and daily cannabis use in this paper, while anxiety and depression were not. In HIV clinical practice the hostility symptom dimension may not be captured by standard screening tools or clinical inquiry. Current clinical practice could be improved with the use of appropriate tools and

procedures to screen and diagnose not only the most common mental health disorders, such as depression and anxiety but also to capture experiences such as irritability, outbursts of temper and frequent arguments. Previous research has identified initiation of cannabis use during adolescence as an outcome of hostility and aggression experienced during childhood (Fite et al., 2008; Hampson et al., 2010) and early adolescence (Ohannessian and Hesselbrock, 2009). There is mixed evidence that links antisocial behavior as an outcome of elevated cannabis use in prospective studies, but most effects are substantially reduced when adjusted for confounding psychosocial factors (Macleod et al., 2004).

Although multiple LGBT sexual orientation identities (gay male, bisexual male, bisexual female) were significantly associated with current cannabis use compared to heterosexual youth, only being a bisexual male significantly increased the likelihood of daily use. These results align with previous research showing health disparities among bisexual male youth compared to gay-identified male youth (Agronick et al., 2004; Gwadz et al., 2006), and such findings underscore the importance of future research into disparities within LGBT populations. Emerging research suggests that bisexual males may have fewer social support resources, and experience more isolation, stigma and identity-related stressors than gay-identified males (Dodge and Sandfort, 2007; Friedman et al., 2014), but the unique stressors that place HIV-positive bisexual male youth at risk for elevated cannabis use are not well understood and merit further investigation.

Current and daily cannabis use in our study was not significantly associated with a recent HIV diagnosis suggesting that cannabis may not serve specifically as a coping response to the stress of an HIV diagnosis, and we found no significant associations between either level of cannabis use and having an undetectable viral load. Being on ART produced a significant negative association with current cannabis use compared to non-users, but there was no significant difference between current and daily users and being on ART. Future research may help explain differences in providers' perception of casual cannabis use and prescription of ART, although confounding factors may be at work that were not available for this analysis (e.g., assessment of patient readiness for ART, providers' adherence to ART guidelines).

Given the high prevalence of daily cannabis use in this sample, and the use of cannabis among other groups of persons living with HIV/AIDS, it will become increasingly important to study the long-term effects of cannabis use among PLHIV. While cannabis use has been shown not to have an adverse effect on viral load or CD4 among persons living with HIV/AIDS (Abrams et al., 2003), long-term effects of chronic cannabis use have been shown to include increased risk in adults for pulmonary diseases (Wu et al., 1988), and cognitive dysfunction (Solowij et al., 2002). A significant concern regarding cannabis use in adolescents and young adults in general is its impact on the central nervous system, particularly in light of ongoing brain development (Lenroot and Giedd, 2006; Lebel and Beaulieu, 2011). The implications for YLHIV may be even greater. Existing studies demonstrate significant neurocognitive impairments among YLHIV (Nichols, 2013); however, the role of cannabis use in these impairments is not well understood. Studies of the impact of this widely used substance on the neurology and immunology of YLHIV are needed.

Our study is not without limitations. The cross-sectional data in this study limits our ability to infer causality from our multilevel model, and our assessment of community level factors was restricted in a number of ways. We did not know how long each participant had been living in their current neighborhood, and were unable to assess how effects of social disorganization might be differentiated by length of exposure. Further, our analyses are limited by the use of zip-code level data for neighborhood-level factors, as zip codes may not always be congruent with neighborhoods. The generalizability of our findings to all YLHIV may be limited due to participants in this study being recruited as part of their participation in ATN trials, and thus represent YLHIV in care at selected adolescent medicine clinics. We relied on self-reported data (except for HIV-related measures abstracted from participant charts), but we believe that the use of an ACASI to gather data may have lessened the inclination of participants to underreport levels of cannabis use and mental health symptomology. Measures of social support, characteristics of substance use within social networks, and physiological and self-reported stress measures, may help further explain from an ecologic perspective potential relationships between community-level, interpersonal and individual-level factors and elevated cannabis use in this population.

This paper advances our knowledge of the multilevel factors associated with elevated cannabis use among groups of YLHIV and furthers our understanding of social and structural determinants of health behaviors in this population. Future research into cannabis use among YLHIV should consider, not only cannabis use within the context of the adjustment of living with HIV/AIDS, but also the stressors that characterize the environments in which groups of YLHIV live. The prevalence of daily use in this sample is of concern, given emergent research on effects of elevated cannabis use on the neurological development of young persons. The connections between violence, trauma, stress, sexual identity development, and cannabis use that emerge from this study merit further investigation to more fully understand how this substance may be used by populations of at-risk youth within rapidly changing legal and medicinal landscapes.

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- Hierarchical generalized linear models estimated odds of daily cannabis use.
- Hostility, being older, and being a bisexual male increased the odds of daily use.
- Residing in a community with a murder rate increased odds of daily use.
- Multiple stressors influence elevated cannabis use among youth living with HIV (YLHIV).

Table 1

Participant Characteristics

	Total Sample (N=1921)		**Ever Used Cannabis, past 90 days (N=954)**		**Used Cannabis Daily, past 90 days (N=381)**	
	n	*%*	*n*	*%*	*n*	*%*
Heterosexual Cisgender Male	316	16.4	143	15.0	54	14.2
Heterosexual Cisgender Female	527	27.4	180	18.9	57	15.0
Gay/Homosexual Cisgender Male	702	36.5	396	41.5	160	42.0
Bisexual Cisgender Male	170	8.9	115	11.7	55	14.4
Cisgender Lesbian	27	1.4	10	1.0	5	1.3
Bisexual Cisgender Female	72	3.7	47	4.9	16	4.2
Heterosexual Transgender	14	0.7	9	0.9	4	1.0
Gay/Homosexual Transgender	26	1.3	16	1.7	10	2.6
Other/Did not respond	67	3.5	38	4.0	20	5.2
Black/African American	1348	70.2	660	69.2	253	66.4
White/Caucasian	221	11.5	113	11.8	47	12.3
Native American/American Indian	15	0.8	7	0.7	4	1.0
Asian American/Pacific Islander	17	0.9	8	0.8	2	0.5
Mixed/Multiracial	184	9.6	101	10.6	42	11.0
Other/Did not respond	136	6.3	65	6.8	33	8.7
Latino/Hispanic	347	18.1	178	18.7	71	18.6
On Antiretroviral Therapy (ART)	1137	59.2	498	52.2	186	48.8
New Diagnosis within Past 12 Months	578	30.1	336	35.2	130	34.1
Most Recent Viral Load Assay						
Undetectable	582	30.3	252	26.4	88	23.1
Detectable	1308	68.1	689	72.2	288	75.6
Missing data	31	1.6	13	1.4	5	1.3
	M	*SD*	*M*	*SD*	*M*	*SD*
Age	20.33	2.67	20.81	2.22	21.15	2.02
BSI-Anxiety	4.53	5.06	5.60	5.44	6.60	5.65
BSI-Depression	6.26	6.02	7.54	6.31	8.58	6.45
BSI-Hostility	5.35	4.92	6.51	5.16	7.58	5.47
GSI (General Severity Index)	0.95	0.78	1.13	0.82	1.29	0.84

Table 2

Neighborhood-level Characteristics (N=1921)

	Central Tendency					
	M	**SD**	**Quartile 1 M**	**Quartile 2 M**	**Quartile 3 M**	**Quartile 4 M**
Pct. of residents living in poverty, 2010	24.54	11.36	10.14	20.54	28.02	39.45
Pct. of residents unemployed, 2010	8.22	3.08	4.60	7.01	8.91	12.37
Pct. of housing units vacant, 2010	15.25	7.93	6.76	11.38	16.65	26.24
Murder rate index, 2010*	142.79	149.64	37.59	111.99	215.27	473.28
Assault rate index, 2010*	128.26	94.89	43.28	115.56	181.57	297.85

*ESRI crime rate indices compare the average local crime level to that of the United States as a whole (i.e., an index of 100 is average, a crime index of 120 indicates that crime in that area is 20 percent above the national average).

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Table 3

Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Ever used marijuana, past 3 mos													
2. Used marijuana daily, past 3 mos	.[a]												
3. BSI-anxiety	.21**	.15**											
4. BSI-depression	.21**	.13**	.77**										
5. BSI-hostility	.23**	.17**	.68**	.68**									
6. General Severity Index	.23**	.15**	.90**	.89**	.82**								
7. Currently on ART	-.14**	-.05	-.12**	-.12**	-.10**	-.12**							
8. Undetectable viral load	-.09**	-.06	-.11**	-.09**	-.11**	-.11**	.51**						
9. HIV diagnosis within past 12 mos	.11**	-.02	.11*	.10**	.06**	.09**	-.31**	-.23**					
10. Murder rate quartiles	.07**	.10**	-.01	-.02	.02	-.01	-.07*	-.05*	.04				
11. Assault rate quartiles	.04	.09**	.03	-.01	.03	.01	-.03	-.01	.03	.62**			
12. Pct living in poverty quartiles	.06*	.12**	.03	.013	.05*	.04	-.07*	-.04	.01	.49**	.29**		
13. Pct unemployed quartiles	.06*	.07*	.01	-.01	.03	.01	-.05	-.03	-.01	.46**	.38**	.56**	
14. Pct vacant housing quartiles	.00	.06	-.01	-.04	.02	-.01	-.05	-.05	.02	.47**	.34**	.51**	.42**

*$p<.05$

**$p<.01$

[a]. cannot be computed as at least one variable is constant

Table 4

Final estimates of fixed effects of current use of cannabis and daily use of cannabis (Population-average model with robust standard errors)

	Any current use of cannabis (N=1840)		Daily Use of cannabis (N=916)	
	Coefficient	**O.R. (95% CI)**	**Coefficient**	**O.R. (95% CI)**
For Intercept1, B_0				
Intercept2, γ_{00}	−3.08***	0.05 (0.02, 0.10)	−3.87***	0.02(.01, .09)
Murder, 2nd quartile, γ_{01}	§	§	0.48*	1.62 (1.06, 2.46)
Murder, 3rd quartile, γ_{02}	§	§	0.42*	1.52 (1.01, 2.30)
Murder, 4th quartile, γ_{03}	§	§	0.65**	1.91 (1.27, 2.87)
For Gay Male slope, B_1 Intercept2, γ_{10}	0.49***	1.63 (1.30, 2.04)	0.12	1.12 (.83, 1.53)
For Lesbian slope, B_2 Intercept2, γ_{20}	−0.40	0.67 (.23, 1.91)	0.69	1.99 (.48, 8.16)
For Bisexual Male slope, B_3 Intercept2, γ_{30}	0.89***	2.43 (1.72, 3.42)	0.54*	1.72 (1.10, 2.70)
For Bisexual Female slope, B_4 Intercept2, γ_{40}	0.85**	2.34 (1.41, 3.90)	−0.18	0.83 (.44, 1.57)
For Transgender slope, B_5 Intercept2, γ_{50}	0.66	1.94 (.93, 3.99)	0.69	1.99 (.79, 5.03)
For Age slope, B_6 Intercept2, γ_{60}	0.12***	1.13 (1.08, 1.17)	0.12***	1.12 (1.05, 1.20)
For BSI-Hostility slope, B_7 Intercept2, γ_{70}	0.99***	1.10 (1.08, 1.13)	0.079***	1.08 (1.05, 1.11)
For ART slope, B_8 Intercept2, γ_{80}	−0.40***	0.67 (0.55, 0.81)	§	§

* $p<.05$

** $p<.01$

*** $p<.001$

§ not included in final model due to lack of statistical significance