



Unmet Social Needs are Associated with Lower Adherence to Antiretroviral Therapy (ART) Medication Among a Sample of Black People Living with HIV (PLHIV)

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Abstract

The current study examined the prevalence and typology of unmet needs and the association between unmet needs and HIV antiretroviral therapy (ART) medication adherence among a sample of Black people living with HIV (PLHIV) (N=304) in Los Angeles, CA. We found a high prevalence of unmet needs, with 32% of participants reporting having two or more unmet needs. The most common unmet needs category was basic benefits needs (35%), followed by subsistence needs (33%), and health needs (27%). Significant correlates of unmet needs included food insecurity, history of homelessness, and history of incarceration. A greater number of unmet needs and any unmet basic benefits needs were each significantly associated with lower odds of HIV ART medication adherence. These findings provide further evidence linking the social determinants of health and social disenfranchisement to ART medication adherence among Black PLHIV.

Keywords Unmet needs · Social determinants of Health · People living with HIV · Medication Adherence · ARTs

Introduction

Black/African Americans account for a higher proportion of new HIV diagnoses and people living with HIV (PLHIV) compared to other races and ethnicities in the United States (U.S.). They represented 42% of all new HIV infections in 2019, with Black gay, bisexual, and other sexual minority men (SMM) making up 26% of all new infections in the same year [1]. If HIV infection rates remain the same, Black

SMM have a 1 in 2 lifetime risk of receiving an HIV diagnosis—the highest of any group [2]. Black PLHIV are less likely to be engaged and retained in HIV care and less likely to achieve HIV viral load suppression compared to other racial/ethnic groups [3].

Intersecting structures of oppression and disenfranchisement are the root causes of suboptimal access and utilization of HIV prevention and care services among Black people in the U.S. Empirical studies have shown that factors stemming from structural racism such as unstable housing, neighborhood disadvantage, incarceration, police brutality, violence, limited access to social services, and suboptimal healthcare coverage are major barriers to accessing HIV prevention and care services in the Black community [4]. In addition, gender and sexual minority individuals within Black communities experience further discrimination including sexism, homophobia, transphobia, and HIV criminalization laws, contributing to further marginalization. A study of Black SMM found that experiencing homophobic events was associated with increased odds of engaging in condomless anal intercourse among HIV-negative participants and increased odds of HIV transmission risk behavior among PLHIV [5]. There is evidence of a link between

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societal-level discriminatory practices and health outcomes among marginalized groups, specifically racial and sexual minority communities [6, 7].

According to the U.S. Department of Health and Human Services, social determinants of health (SDOH) are defined as the “conditions in the environments where people are born, live, learn, work, play, worship, and age that affects a wide range of health, functioning, and quality-of-life outcomes and risks.” Examples of SDOH include housing, transportation, and neighborhoods, discrimination, violence, economic opportunities, access to nutritious foods and physical activity opportunities, and air and water quality. Several studies have demonstrated a link between SDOH and HIV care outcomes. While there is a body of scientific evidence linking the SDOH to HIV outcomes, a vast majority of those studies examine the association between a single factor (i.e., food insecurity, homelessness, poverty, food insecurity, or limited access to food insecurity) and HIV-related clinical outcomes. One study that examined multilevel indicators (ten dimensions including poverty, food insecurity, gaps in health coverage, homelessness, criminal justice involvement, etc.) of SDOH, found that cumulative exposure to multiple social and economic disadvantaging factors was associated with a higher likelihood of missed medical appointments and a lower likelihood of medication adherence and viral load suppression in a national study of PLHIV in the U.S. [8].

There exists a dearth in the literature on how the combination of multiple SDOH factors influences HIV care outcomes among Black PLHIV, who are confronted with several challenges related to SDOH that significantly impact their ability to be engaged in HIV care, adhere to antiretroviral medications, and attain HIV viral load suppression. The aims of the current study were two-fold: (1) to explore characteristics associated with a higher number and different types of unmet needs; and (2) to investigate the associations between quantity (i.e., increasing number of SDOH factors) and quality (i.e., different types of SDOH factors including unmet subsistence, health, and basic benefits needs) with antiretroviral therapy (ART) medication adherence among a sample of Black PLHIV. We hypothesized that higher numbers of unmet needs would be significantly associated with lower odds of ART adherence.

Methods

Participants and Procedures.

The current analysis used baseline data from a randomized controlled trial of an adherence counseling intervention; full details on the study protocols and procedures have been published elsewhere [9]. Participants were enrolled

between January 2018 and July 2020. All study activities were conducted at APLA Health & Wellness, a community-based and federally qualified health center providing HIV services in Los Angeles, California. Recruitment strategies included: community outreach at local events, social media posting, and internal recruitment of existing clients. Inclusion criteria were: (1) being 18 years or older, (2) being Black/African American, (3) living with HIV, (4) having been prescribed ART for 6 months or higher, (5) having self-reported difficulties with medication adherence, (6) open to utilizing electronic medication adherence device, and (7) being able to speak and write in English.

Participants completed 1.5–2 hours of quantitative assessments utilizing Questionnaire Development Survey audio computer-assisted interview software (Lumina Corps) and received a Medication Event Monitoring System (MEMS) bottle cap (AARDEX, Inc.) for continuous HIV medication adherence monitoring. The study was approved by the institutional review board at RAND Corporation.

Measures

Sociodemographics

We assessed age (in years), time since HIV diagnosis (in years), birth-assigned sex (male, female), gender (male, female, transgender male/transgender man, transgender female/transgender woman, gender queer/gender nonconforming, different identity), race (American Indian, Native American, Alaskan Native, Asian/Asian American, Black/African American, White/Caucasian, other), sexual orientation (straight/heterosexual, gay/homosexual, lesbian/homosexual woman, bisexual, not sure/in transition, something else), educational attainment (1st through 6th grade, 7th through 11th grade, high school diploma or GED, some college, but no degree, college degree, some graduate coursework, but no degree, graduate degree), yearly income (I currently have no income, more than \$0 but less than \$10,000, \$10,000–\$20,000, \$20,001–\$30,000, \$30,001–\$40,000, over \$40,000) and employment status (employed and working 40 or more hours per week, employed working 1–39 h per week, not employed and looking for work, not employed and not looking for work, retired, disabled and not able to work, student).

Social Marginalization

We assessed history of adult incarceration (yes/no), drug use in the previous month (yes/no), homelessness in the previous 12 months (yes/no), and current food insecurity (the count of responses other than “never” to, [1] how often participant worried whether food would run out before

getting money to buy more, [2] couldn't afford to eat balanced meals, [3] cut the size of meals or skip meals because there wasn't enough money for food, or [4] did not eat for a whole day because there wasn't enough money for food; operationalized as 0–1, 2, 3, or 4).

Unmet Needs

We measured unmet needs using ten questions assessing social services needs in the previous 6 months and, for each service needed, an additional question about whether the service was received (e.g., “Did you need counseling or mental health treatment in the last 6 months?” and if “yes,” “Did you get counseling or mental health treatment in the last 6 months?”). A participant reporting that a service was needed but not received was operationalized as an unmet need and was assigned the value ‘1,’ resulting in a total possible score of 0–10 unmet needs, which for analytic purposes was collapsed to 0, 1, or at least 2 unmet needs. The domains of possible social needs assessed were: (1) mental health services, (2) substance use treatment, (3) housing, (4) employment assistance, (5) transportation assistance, (6) food, (7) public benefit, (8) childcare, (9) medical case management, and (10) domestic violence services. To reduce the number of variables and improve the interpretability of any results, we created indicators of any unmet needs within three categories: subsistence needs (housing and food resources), health needs (counseling/mental health services), and basic benefits needs (employment, transportation, public benefits, and childcare resources).

ART Adherence

ART adherence was measured continuously from the baseline to the 1-month follow-up period using MEMS (AARDEX, Inc., Zurich, Switzerland). MEMS records the time and date when the medication bottle is opened, and data are automatically saved in the software to produce reports of daily medication-taking patterns. At the 1-month follow-up visit, MEMS data for each participant were downloaded. Participants also completed a questionnaire about how often they (1) opened the bottle without removing a dose, (2) took a dose from another source other than the MEMS bottle, and (3) removed more than one dose at a time from the bottle over the past month. A continuous adherence measure (percentage of prescribed doses taken in the past month) was derived for the 30 days between baseline and 1-month follow-up, and this was adjusted based on responses to the questionnaire items listed above.

Data Analysis

Missing data for participant characteristics (not including unmet needs or adherence) were imputed to avoid potential bias; characteristics, other than time since HIV diagnosis, was missing for 0–2% of participants; time since HIV diagnosis was missing for 4%. We assessed the distribution (percentages) of all variables by the number and type of unmet needs. Bivariate and multivariable ordinal logistic regression models were constructed to examine the relationship between all variables and an increasing number of unmet needs. For all ordinal logistic regression models, a Score test was performed to confirm the proportional odds assumption was appropriate. Variables that were significant at $p < .10$ in the bivariate models were retained in the multivariable model assessing this outcome. Bivariate and multivariable logistic regression models were constructed to examine the relationship between all variables and the different types of unmet needs (subsistence, health, and basic benefits). Variables that were significant at $p < .10$ in the bivariate models were retained in the multivariable model assessing these outcomes. To avoid issues with multicollinearity, if two variables that were significant at the bivariate level ($p < .10$) were highly correlated ($r > .50$) then only one was retained in the multivariable model. Lastly, we conducted multivariable linear and logistic regression models predicting ART adherence for variables that had significant bivariate associations with ART adherence at $p < .10$. Because MEMS data were not available for all participants, nonresponse weights were derived to account for any bias that may be introduced by excluding participants without MEMS data. Weights were developed as the inverse of the predicted probability of having MEMS baseline data from a logistic regression model including a variety of baseline characteristics. All analyses involving MEMS data used these weights; all other analyses are unweighted. Data were analyzed using SAS v9.4 (SAS Institute Inc., Cary, NC).

Results

Participant Socio-Demographic Characteristics and Correlations with Unmet Needs

Participants' sociodemographic characteristics are provided in Table 1. Almost a third (32%) of the sample reported having two or more unmet needs, more than a quarter (26%) had one unmet need, and 42% reported no unmet needs. Moreover, 33% of participants reported having unmet subsistence needs, 27% reported having unmet health needs, and 35% reported having unmet basic benefits needs.

Table 1 Distribution of sociodemographic characteristics, social marginalization, and antiretroviral adherence by increasing number of unmet needs among Black people living with HIV in Los Angeles, CA (N = 304)

	Total sample (N=304)	Number of unmet needs		
		0 (n=129, 42.4%)	1 (n=78, 25.7%)	2+ (n=97, 31.9%)
Age (in years) (Mean (Standard deviation))	47.6 (12.5)	51.5 (11.3)	47.0 (12.9)	43.0 (12.0)
Time since HIV diagnosis (in years) (Mean (Standard deviation))	16.7 (9.7)	19.4 (8.9)	15.7 (10.0)	13.9 (9.7)
Sex (assigned at birth)				
Male	247 (81.3%)	102 (79.1%)	65 (83.3%)	80 (82.5%)
Female	57 (18.7%)	27 (20.9%)	13 (16.7%)	17 (17.5%)
Gender				
Cisgender male	231 (76.0%)	96 (74.4%)	61 (78.2%)	74 (76.3%)
Cisgender female	56 (18.4%)	27 (20.9%)	13 (16.7%)	16 (16.5%)
Other (Transgender/Queer)	17 (5.6%)	6 (4.7%)	4 (5.1%)	7 (7.2%)
Race				
Black	248 (83.5%)	108 (86.4%)	68 (88.3%)	72 (75.8%)
Hispanic	30 (10.1%)	10 (8.0%)	4 (5.2%)	16 (16.8%)
Multiracial/Other	19 (6.4%)	7 (5.6%)	5 (6.5%)	7 (7.4%)
Sexual Orientation				
Gay/Homosexual	175 (57.6%)	64 (49.6%)	46 (59.0%)	65 (67.0%)
Heterosexual	80 (26.3%)	43 (33.3%)	18 (23.1%)	19 (19.6%)
Bisexual/Other	49 (16.1%)	22 (17.1%)	14 (18.0%)	13 (13.4%)
Educational attainment				
Less than high school	44 (14.5%)	15 (11.6%)	11 (14.1%)	18 (18.6%)
High school diploma/GED	88 (29.0%)	41 (31.8%)	23 (29.5%)	24 (24.7%)
Some college education	99 (32.6%)	47 (36.4%)	27 (34.6%)	25 (25.8%)
College degree or higher	73 (24.0%)	26 (20.2%)	17 (21.8%)	30 (30.9%)
Yearly income (in dollars)				
No income	46 (15.4%)	10 (8.0%)	14 (18.0%)	22 (22.9%)
\$1-\$10,000	104 (34.8%)	42 (33.6%)	28 (35.9%)	34 (35.4%)
\$10,000-\$20,000	116 (38.8%)	57 (45.6%)	30 (38.5%)	29 (30.2%)
>\$20,000	33 (11.0%)	16 (12.8%)	6 (7.7%)	11 (11.5%)
Marital status (Married)				
Yes	33 (10.9%)	18 (14.1%)	4 (5.1%)	11 (11.3%)
No	270 (89.1%)	110 (85.9%)	74 (94.9%)	86 (88.7%)
Employment status				
Employed	47 (15.5%)	16 (12.4%)	14 (18.0%)	17 (17.7%)
Not employed	256 (84.5%)	113 (87.6%)	64 (82.1%)	79 (82.3%)
History of incarceration				
Yes	155 (51.0%)	57 (44.2%)	39 (50.0%)	59 (60.8%)
No	149 (49.0%)	72 (55.8%)	39 (50.0%)	38 (39.2%)
Drug Use (in previous month)				
Yes	111 (36.9%)	37 (29.1%)	26 (33.3%)	48 (50.0%)
No	190 (63.1%)	90 (70.9%)	52 (66.7%)	48 (50.0%)
Homelessness in previous 12 months				
Yes	122 (40.1%)	31 (24.0%)	33 (42.3%)	58 (59.8%)
No	182 (59.9%)	98 (76.0%)	45 (57.7%)	39 (40.2%)
Food Insecurity				
0–1	81 (26.7%)	54 (42.2%)	22 (28.2%)	5 (5.2%)
2	32 (10.6%)	14 (10.9%)	10 (12.8%)	8 (8.3%)
3	67 (22.1%)	29 (22.7%)	18 (23.1%)	20 (20.6%)
4	123 (40.6%)	31 (24.2%)	28 (35.9%)	64 (66.0%)
ART Adherence	0.75 (0.25)	0.78 (0.24)	0.77 (0.18)	0.68 (0.27)

*=p < .05, **p < .01, ***p < .001

Both age and time since HIV diagnosis were significantly associated at $p < .10$ with all four unmet needs outcomes, but they are highly correlated ($r = .66$). To avoid multicollinearity issues, only the ‘time since HIV diagnosis’ variable was retained in multivariable models since this variable is more relevant to this analysis. Similarly, both sex and gender were associated with unmet basic benefits needs; only sex was retained for the multivariable model.

For the multivariable model for the overall number of unmet needs, the Score test was non-significant ($\chi^2_{18} = 18.4$, $p = .43$), indicating that the proportional odds assumption was adequately met.

Multivariable models indicated several socio-demographic characteristics were associated with an increasing number of unmet needs. Specifically, time since HIV diagnosis (OR 0.97; 95% CI: 0.95–1.00) and having food insecurity [3 compared to 0–1 (OR 2.62; 95% CI: 1.31–5.23) & 4 compared to 0–1 (OR 5.03; 95% CI: 2.59–9.76)] were the only statistically significant predictor variable of overall number of unmet needs (Table 2). Moreover, time since HIV diagnosis (OR 0.96; 95% CI: 0.93–0.99), experiencing homelessness in the previous year (OR 2.99; 95% CI: 1.63–5.47) and having food insecurity [3 compared to 0–1 (OR 3.39; 95% CI: 1.30–8.86) & 4 compared to 0–1 (OR 5.63; 95% CI: 2.27–13.98)] were the only statistically significant predictors of unmet subsistence needs; being of Hispanic ethnicity (OR 2.26; 95% CI: 1.02–4.98), having a history of incarceration (OR 1.85; 95% CI: 1.07–3.18), and having food insecurity [2 compared to 0–1 (OR 2.82; 95% CI: 1.04–7.64 & 4 compared to 0–1 (OR 2.40; 95% CI: 1.11–5.22)] were the only statistically significant predictors of unmet health needs; and food insecurity [2 compared to 0–1 (OR 3.01; 95% CI: 1.08–8.35, 3 compared to 0–1 (OR 2.90; 95% CI: 1.20–7.04) & 4 compared to 0–1 (OR 7.07; 95% CI: 3.07–16.3)] were the only statistically significant predictors of unmet basic benefits needs (Table 3).

Association of Unmet Needs with Adherence

In the bivariate models, having a greater number of unmet needs and having any unmet basic benefits needs were associated with lower ART adherence. In multivariable models, reporting two or more unmet needs ($b [se] = -0.09 [0.05]$, $p = .04$) and identifying as bisexual/other ($b [se] = -0.11 [0.06]$, $p = .046$), were the only statistically significant predictors of lower ART adherence.

Discussion

This study examined the prevalence and typology of unmet needs among a sample of Black PLHIV and the association between unmet needs and ART adherence. We found a high prevalence of unmet needs with 32% of participants reporting having two or more unmet needs and 26% reporting having one unmet need. The most common unmet needs category was basic benefits needs (35%) followed by subsistence needs (33%) and health needs (27%). The most significant predictors of unmet needs included food insecurity, history of homelessness, and history of incarceration. Lastly, an increasing number of unmet needs and any unmet basic benefits needs were significantly associated with lower odds of ART medication adherence. These findings provide further evidence linking the SDOH and social disenfranchisement to ART medication adherence among Black PLHIV.

We found a high prevalence of food insecurity in the previous 12 months in the sample and food insecurity was a significant predictor of both the increasing number of unmet needs and all types of unmet needs (subsistence, health, and basic benefits) in the previous 6 months. This finding is consistent with previous studies that have found sexual and gender minority individuals are more likely than heterosexual individuals to experience food insecurity [10–13]. Additionally, prior research has established a bidirectional relationship between food insecurity and risk for HIV acquisition and disease progression, through other factors such as nutritional, mental health, and behavioral pathways at various levels (individual, household, community) [14, 15]. It has been hypothesized that food insecurity among sexual and gender minority populations can be attributed to structural stigma and discrimination that serve as roadblocks to employment, housing, social support, and other subsistence life necessities [12]. A review article found that food insecurity is a major barrier to HIV antiretroviral medication adherence among PLHIV [16].

Public health interventions must prioritize addressing food insecurity among PLHIV. A recently published randomized controlled trial (RCT) addressing food insecurity through peer nutritional counseling, urban gardening, and a cooking workshop among PLHIV in the Dominican Republic found a significant reduction in detectable HIV viral load and missed clinic appointments, and an increase in ART adherence among participants in the treatment group [17]. An example of a possible intervention prototype is a partnership between a community-based clinic and a local food bank conducted in Massachusetts to address food insecurity as a result of the coronavirus pandemic, which provided 384 recipients with food monthly for 10 months [18]. While this intervention did not report on health-specific outcomes, it

Table 2 Unadjusted and adjusted associations between sociodemographic characteristics, social marginalization, and antiretroviral adherence and increasing number of unmet needs among Black people living with HIV in Los Angeles, CA (N = 304)

	Ordered logistic regression for increasing number of unmet needs	
	Unadjusted logistic regression	Adjusted logistic regression
Age (in years)	0.96 (0.94–0.97)***	
Time since HIV diagnosis (in years)	0.95 (0.93–98)***	0.97 (0.95–1.00)*
Sex (assigned at birth)		
Male	Ref	
Female	0.82 (0.48–1.41)	
Gender		
Cisgender male	Ref	
Cisgender female	0.80 (0.46–1.37)	
Other (Transgender/Queer)	1.40 (0.56–3.47)	
Race		
Black	Ref	Ref
Hispanic	2.40 (1.19–4.85)*	1.33 (0.62–2.87)
Multiracial/Other	1.39 (0.59–3.28)	1.25 (0.48–3.27)
Sexual Orientation		
Gay/Homosexual	1.98 (1.20–3.27)**	1.59 (0.92–2.76)
Heterosexual	Ref	Ref
Bisexual/Other	1.33 (0.68–2.59)	1.19 (0.58–2.43)
Educational attainment		
Less than high school	Ref	
High school diploma/GED	0.57 (0.29–1.11)	0.67 (0.32–1.40)
Some college education	0.54 (0.28–1.04)	0.53 (0.26–1.10)
College degree or higher	0.97 (0.49–1.94)	0.84 (0.38–1.84)
Yearly income (in dollars)		
No income	Ref	Ref
\$1–\$10,000	0.48 (0.25–0.92)*	0.62 (0.31–1.24)
\$10,000–\$20,000	0.34 (0.18–0.64)**	0.68 (0.33–1.42)
>\$20,000	0.38 (0.17–0.88)*	0.65 (0.25–1.71)
Marital status (Married)		
Yes	0.71 (0.36–1.40)	
No	Ref	
Employment status		
Employed	1.39 (0.78–2.48)	
Not employed	Ref	
History of incarceration		
Yes	1.68 (1.11–2.56)*	1.51 (0.95–2.41)
No	Ref	Ref
Drug Use (in previous month)		
Yes	2.02 (1.30–3.12)**	1.19 (0.73–1.94)
No	Ref	Ref
Homelessness in previous 12 months		
Yes	3.37 (2.17–5.25)***	1.34 (0.79–2.29)
No	Ref	
Food Insecurity		
0–1	Ref	Ref
2	2.55 (1.16–5.60)*	2.25 (0.99–5.11)
3	3.00 (1.58–5.70)***	2.62 (1.31–5.23)**
4	7.57 (4.22–13.60)***	5.03 (2.59–9.76)***

* $p < .05$, ** $p < .01$, *** $p < .001$. Note: The estimates in the adjusted model are adjusted for all the other terms presented

Table 3 Unadjusted and adjusted associations between sociodemographic characteristics, social marginalization, and antiretroviral adherence and type of unmet needs among Black people living with HIV in Los Angeles, CA (N = 304)

	Type of unmet needs					
	Subsistence needs		Health needs		Basic benefits Needs	
	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR
Age (in years)	0.94 (0.92–0.96)***		0.98 (0.96–1.00)		0.95 (0.93–0.97)***	
Time since HIV diagnosis (in years)	0.94 (0.91–0.96)***	0.96 (0.93–0.99)*	0.97 (0.95–1.00)	0.98 (0.95–1.01)	0.96 (0.93–0.98)***	0.97 (0.95–1.00)
Sex (assigned at birth)						
Male	Ref		Ref		Ref	Ref
Female	1.03 (0.56–1.89)		1.17 (0.62–2.20)		0.55 (0.29–1.06)	0.88 (0.33–2.33)
Gender						
Cisgender male	Ref		Ref		Ref	
Cisgender female	1.05 (0.57–1.94)		1.30 (0.68–2.47)		0.52 (0.26–1.02)	
Other (Transgender/Queer)	0.85 (0.29–2.50)		2.65 (0.98–7.19)		1.53 (0.57–4.11)	
Race						
Black	Ref		Ref	Ref	Ref	
Hispanic	1.57 (0.73–3.36)		3.03 (1.42–6.49)**	2.26 (1.02–4.98)*	2.16 (1.02–4.58)*	
Multiracial/Other	1.27 (0.48–3.34)		2.35 (0.90–6.12)	1.97 (0.70–5.51)	0.93 (0.34–2.54)	
Sexual Orientation						
Gay/Homosexual	1.66 (0.93–2.98)		1.50 (0.81–2.77)		2.14 (1.18–3.89)*	1.63 (0.67–3.98)
Heterosexual	Ref		Ref		Ref	Ref
Bisexual/Other	1.12 (0.51–2.49)		1.12 (0.48–2.58)		1.71 (0.78–3.73)	1.64 (0.61–4.40)
Educational attainment						
Less than high school	Ref		Ref		Ref	
High school diploma/GED	0.79 (0.37–1.65)		0.55 (0.25–1.20)		0.54 (0.25–1.16)	
Some college education	0.46 (0.22–0.99)*		0.62 (0.29–1.33)		0.72 (0.35–1.50)	
College degree or higher	0.85 (0.39–1.82)		0.66 (0.30–1.47)		1.07 (0.55–2.28)	
Yearly income (in dollars)						
No income	Ref	Ref	Ref		Ref	Ref
\$1–\$10,000	0.45 (0.22–0.90)*	0.60 (0.27–1.33)	0.61 (0.29–1.25)		0.39 (0.19–0.79)**	0.48 (0.23–1.04)
\$10,000–\$20,000	0.32 (0.16–0.64)**	0.81 (0.35–1.86)	0.47 (0.22–0.97)*		0.30 (0.15–0.61)***	0.59 (0.27–1.31)
>\$20,000	0.44 (0.17–1.10)	0.67 (0.21–2.16)	0.48 (0.18–1.29)		0.37 (0.15–0.93)*	0.57 (0.21–1.60)
Marital status (Married)						
Yes	0.73 (0.32–1.63)		1.16 (0.53–2.56)		0.91 (0.42–1.96)	
No	Ref		Ref		Ref	
Employment status						
Employed	2.04 (1.09–3.85)*	2.17 (0.95–4.93)	0.89 (0.44–1.82)		1.34 (0.71–2.54)	
Not employed	Ref	Ref	Ref		Ref	
History of incarceration						
Yes	1.43 (0.89–2.32)		2.06 (1.23–3.47)**	1.85 (1.07–3.18)*	1.12 (0.70–1.80)	
No	Ref		Ref	Ref	Ref	
Drug Use (in previous month)						
Yes	1.62 (0.99–2.65)	1.03 (0.58–1.83)	1.85 (1.11–3.10)*	1.35 (0.77–2.35)	1.87 (1.15–3.04)*	1.22 (0.71–2.10)
No	Ref	Ref	Ref	Ref	Ref	Ref
Homelessness in previous 12 months						

Table 3 (continued)

	Type of unmet needs					
	Subsistence needs		Health needs		Basic benefits Needs	
	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR
Yes	5.50 (3.27–9.24)***	2.99 (1.63–5.47)***	1.47 (0.89–2.45)		2.24 (1.38–3.63)**	0.94 (0.51–1.72)
No	Ref	Ref	Ref		Ref	Ref
Food Insecurity						
0–1	Ref	Ref	Ref	Ref	Ref	Ref
2	2.92 (0.99–8.60)	3.09 (0.98–9.72)	3.18 (1.21–8.34)*	2.82 (1.04–7.64)*	3.09 (1.14–8.35)*	3.01 (1.08–8.35)*
3	4.17 (1.70–10.2)**	3.39 (1.30–8.86)*	2.71 (1.19–6.17)*	2.28 (0.97–5.37)	3.02 (1.30–7.03)*	2.90 (1.20–7.04)*
4	9.58 (4.26–21.6)***	5.63 (2.27–13.98)***	3.18 (1.52–6.66)**	2.40 (1.11–5.22)*	8.22 (3.88–17.42)***	7.07 (3.07–16.30)***

*=p < .05, **p < .01, ***p < .001. Note: The estimates in the adjusted model are adjusted for all the other terms presented

can be adapted and tailored to the needs of PLHIV, including possible effects on unmet needs and HIV care outcomes.

We found that a higher number of unmet needs (related to housing, psychosocial health, employment assistance, transportation, public benefits, childcare, and medical case management) and basic benefits needs specifically were associated with lower ART adherence. This finding is in line with previous studies that have shown that lack of access to basic resources negatively impacts ART adherence in PLHIV [8, 19–21]. Our results suggest that addressing unmet needs may help to improve ART adherence among Black PLHIV in the U.S., a group that has been historically marginalized and continue to experience structural discrimination that results in economic disenfranchisement and social vulnerability. Addressing SDOH in conjunction with the delivery of HIV care services might remove barriers to ART adherence and improve HIV care continuum outcomes. An intervention that provided immediate housing for homeless and unstably housed PLHIV found an improvement in access to transportation, public benefits, and childcare resources, mental health [22]. Another RCT that provided peer navigation services for PLHIV recently released from jail found that the program prevented expected declines in HIV viral load suppression that was observed in the standard of care group [23, 24].

The role of structural racism, homophobia, and HIV stigma must be underscored in the conceptualization of our study findings. As noted earlier, intersecting structures of oppression and disenfranchisement are the root causes of suboptimal access and utilization of HIV prevention and care services among Black people in the U.S. Our finding of unmet—especially housing, transportation, public benefits, and childcare—being associated with lower ART medication adherence, is a poignant example of how

structural racism, thorough inequitable access to life necessities, impacts health outcomes for Black people in the U.S. [25]. Experience of homophobia can also be another major barrier to treatment adherence. A recently published meta-analysis of sexual minority men found that experiencing homophobia was associated with poorer HIV care outcomes [26]. Lastly, HIV stigma has been demonstrated to impede adherence to ARTs [27]. Taken together, the overlaying of structural racism, homophobia, and HIV stigma are mutually reinforcing structural systems that can impede optimal engagement in HIV care. Interventions aimed at improving HIV care outcomes, especially among racial and sexual minority communities, should be informed by these factors and, if possible, be designed to address these structural systems.

Our findings should be interpreted in the context of some study limitations. The study utilized convenience sampling, limiting our ability to generalize study findings to participants not represented in this sample. Also, the self-reported nature of the participant responses, especially related to SDOH, might be underestimated due to desirability bias and participants' discomfort with disclosing social needs. Additionally, while the current analysis utilized baseline data, the original study was designed as a RCT, which might select for a specific type of participant that might not be representative of other Black PLHIV. Lastly, we included food insecurity and homelessness as predictors of unmet needs when it is plausible that they can also be operationalized as unmet needs and could function as dependent variables. While there were some limitations, it is vital to also highlight study strengths, which included utilizing a longitudinal study design, and objectively and electronically measuring ART medication adherence.

Conclusion

We found that experiences of unmet needs were associated with lower adherence to ART among Black PLHIV. Public health programs and interventions aimed at improving HIV medication adherence among PLHIV must ensure that life necessities (related to housing, psychosocial health, employment assistance, transportation, public benefits, childcare, and medical case management) are assessed and clients who are in need are referred to the appropriate social service agencies. Additionally, these clients should be followed up with to ensure these needs were met adequately. Future research should investigate the impact of an intervention that provides the basic necessities described above on ART medication adherence and general quality of life for PLHIV.

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Declarations

Conflicts of interest/Competing interests The authors have no relevant financial or non-financial interests to disclose and have no conflicts of interest to declare that are relevant to the content of this article.

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