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Exploring Antiretroviral Therapy Adherence, Competing Needs, and Viral Suppression among People Living with HIV and Food Insecurity in the Dominican Republic

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Abstract

Understanding factors related to suboptimal adherence to antiretroviral therapy (ART) and detectable viral load (VL), especially among vulnerable populations, is needed to improve HIV outcomes. The Caribbean is highly impacted by HIV and socioeconomic inequalities, but few studies have been conducted there to explore food insecurity among people with HIV and factors associated with viral suppression in this vulnerable population. Using baseline data from a pilot intervention trial among people living with HIV and food insecurity in the Dominican Republic, we examined psychosocial and behavioral factors associated with viral suppression, ART adherence, and competing needs. Among participants (n=115), 61% had a detectable VL; the strongest factor associated with detectable VL was having missed taking ART in the last six months due to not having food (OR=2.68, p=0.02). Greater odds of reporting missed ART doses due to not having food were associated with severe food insecurity (OR=4.60, p=0.006), clinical depression (OR=2.76, p=0.018), Haitian background (OR=6.62 p=0.017), and internalized HIV

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DECLARATIONS OF INTEREST STATEMENT

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stigma (OR=1.09, p=0.041), while lower odds were associated with social support (OR=0.89, p=0.03) and having health insurance (OR=0.27, p=0.017). Ensuring that people with HIV and food insecurity have food to take with their ART is essential for viral suppression.

Keywords

HIV; food insecurity; viral suppression; competing needs

INTRODUCTION

Antiretroviral therapy (ART) is key for the survival and longevity of people living with HIV (PLHIV), but also for HIV prevention by reducing infectiousness and viral load (Yombi & Mertes, 2018). Suboptimal HIV care retention and ART non-adherence are major challenges (Bezabhe et al., 2016; Brittain et al., 2018; Ehlers & Tshisuyi, 2015; Fonsah et al., 2017; Ortego et al., 2011). In December 2018, an estimated 62% of adults living with HIV globally were receiving ART and 53% were virally suppressed ((WHO), 2019). Among those who receive ART, meta-analyses have found that 62% report 90% adherence but with wide variation across countries and regions (Ortego et al., 2011). In the Dominican Republic (DR), studies among female sex workers found that 36% report ART interruptions and 26% report missing ART doses (Donastorg et al., 2014; Zulliger, Barrington, et al., 2015; Zulliger, Maulsby, et al., 2015), while clinic-based studies among of PLHIV have found 24% had suboptimal adherence to ART (Harris et al., 2011; Winter et al., 2014). As of December 2018, viral suppression among all ages in the DR was estimated at 37% (UNAIDS). However, there are few published studies on the factors associated with suboptimal adherence and viral suppression in the DR and Latin America and the Caribbean (LAC).

Food insecurity, defined as “the limited or uncertain availability of nutritionally adequate, safe foods or the inability to acquire personally acceptable foods in socially acceptable ways” (Anderson, 1990; Ivers & Cullen, 2011), is highly prevalent among PLHIV (Derose et al., 2018; Franke et al., 2011; Marcellin et al., 2008; Weiser et al., 2012; Weiser et al., 2010) and is conceived to affect viral suppression and other HIV outcomes through nutritional, psychosocial, and behavioral pathways (Weiser et al., 2011). Food insecurity among PLHIV across various settings has been found to be related consistently to ART non-adherence (Singer et al., 2015), worse virologic and immunologic outcomes (Alexy et al., 2013; McMahon et al., 2011), higher morbidity (Weiser et al., 2012) and mortality (Anema et al., 2013; Weiser et al., 2009), and increased likelihood of depression (Palar et al., 2014; Tsai et al., 2012).

Competing needs among PLHIV who experience food insecurity could contribute to the consistent negative effects of food insecurity on adherence (Palar, Wong, et al., 2018). A study in Uganda found that severe food insecurity was associated with making tradeoffs between obtaining ART and/or HIV care and getting food (Weiser et al., 2012). Among vulnerable PLHIV in the U.S., competing needs were associated with missed appointments, emergency department visits, lack of receipt of ART, and greater incidence of

detectable viral load (Palar, Wong, et al., 2018). Further understanding of the relationship between competing needs, adherence, and viral suppression is needed among food-insecure populations across various settings.

This paper explores ART adherence, competing needs, and viral suppression among food-insecure individuals in the DR participating in a pilot intervention to address food insecurity. Previous work in the DR has found high levels of food insecurity (58% severe and 11% moderate) among PLHIV and significant associations between severe food insecurity and increased body mass index and body fat (Derose, Rios-Castillo, et al., 2017) However, the associations between severe food insecurity and HIV-related outcomes in the DR have not been examined. Additionally, food insecurity among PLHIV in LAC is understudied, and we know of no previous studies in the region that have examined viral suppression among people living with HIV *and* food insecurity. We were guided by 2 overall research questions:

1. To what extent does viral suppression correlate with self-reported adherence and competing needs among food-insecure individuals living with HIV?
2. What are the psychosocial and behavioral factors associated with self-reported adherence and competing needs that do correlate with viral suppression?

Because our intervention focused on people with food insecurity and adherence difficulties, our purpose was not to test the definitive relationships among food insecurity, adherence, and viral suppression. Instead, we aimed to understand the correlates of viral suppression at baseline and explore potential pathways through which our intervention may influence optimal adherence and undetectable viral load (VL).

METHODS

Data source

Data for our analyses came from an ongoing pilot intervention (Clinical Trials Identifier: [NCT03568682](#)), which aimed to reduce food insecurity and thereby improve ART adherence and viral suppression. We used data collected at baseline (n=115) to explore the extent to which viral suppression correlated with self-reported adherence measures, competing needs, and various behavioral and psychosocial factors.

Setting and Recruitment

The study took place in two government-sponsored HIV clinics in the northern central region. Participants were recruited when they came to the clinic for their routine appointments. Eligibility criteria included: 1) aged 18+ years; 2) registered at the HIV clinic and having been prescribed ART for at least six months; 3) evidence of ART adherence problems or lack of engagement in care (having missed at least one clinic appointment or ART refill in the past 6 months) and/or a detectable HIV VL at most recent assay; 4) moderate or severe household food insecurity (see Food Security measure below); 5) resident of the catchment area of the clinic and an urban or peri-urban area; and 6) physically able to plant and maintain an urban garden (subjectively assessed by participants). The study was approved by institutional review boards of the RAND Corporation, the

UASD, and the Ministry of Public Health. Written informed consent was obtained from all participants.

Measures

Detectable VL was determined through testing by the Dominican National Laboratory of Public Health using the Roche Cobas HIV-1 assay (Roche Molecular Diagnostics, Branchburg NJ, USA). Participants were coded “detectable” if VL was ≥ 20 copies of HIV per mL of blood (reference group: undetectable VL).

Self-reported adherence was measured using several standard measures. 1) Participants rated their adherence ranging from 0–100% over the past month using a visual analog scale (Simoni et al., 2006); 2) Participants were asked how rigorously they had taken their antiretroviral medications (“perfectly,” “closely” or “not closely”) using a timeframe of the previous 4 days (Chesney et al., 2000); and 3) Participants were asked how many HIV appointments they had missed in the previous 6 months (Mugavero et al., 2010). Given the tendency for self-report to overestimate adherence (Simoni et al., 2006), a binary indicator of 100% adherence was used for each measure to define “optimal adherence.”

Competing needs related to adherence were measured using two standard measures: “During the last 6 months, how frequently did: 1) you or your household not get adequate food because you needed the money for medical care, including money for transportation to the clinic or your antiretroviral medications?” and 2) “you not get needed medical care, including your antiretroviral medications, because you needed the time or money to get adequate food for you or your household?” Additionally, we developed an item from formative, qualitative research (Wallace et al., 2020), “During the last 6 months, how often did you not take your medication or did not take them on time because you didn’t have food to take with your medications?” All the competing needs questions were answered on a 4-point scale and dichotomized as “always, frequently, or sometimes” vs. “never.”

Food insecurity.—We used the validated Latin American and Caribbean Food Security Scale (Cronbach’s $\alpha = 0.91$ – 0.96 across LAC countries) (Melgar-Quiñonez et al., 2010; Tsai et al., 2012), which assesses household food security over the past 90 days using 8 questions that cover relevant domains (worry, quality, and quantity), plus 7 additional questions for households with children < 18 years, and classifies households into 4 categories: “food secure” and “mild,” “moderate,” and “severe” food insecurity ($\alpha = 0.73$ for 15-item scale, $\alpha = 0.54$ for 8-item scale). Only those with moderate to severe household food insecurity qualified for enrollment.

Social support was measured with an adapted social support scale (Sherbourne & Stewart, 1991) that assesses how often different types of support are available if needed (5-point Likert scale from “none” to “all” of the time). We used 6 items from the original scale and added 2 items from our formative research: 1) help retrieving HIV medications and 2) receiving financial support. We included an item on general satisfaction with the support received from family and friends (4-point Likert scale from very unsatisfied to very satisfied) as done previously in the DR (Harris et al., 2011). All item responses were

rescaled to a 20-point scale. Our adapted scale could take values from 0 (no social support) to 20 (highest social support), $\alpha=0.76$.

Depression was assessed using the 9-item depression module of the Patient Health Questionnaire (PHQ) (Kroenke et al., 2001). Items ask how often a specific symptom is present during the prior two weeks [not at all (0), for several days (1), more than half the days (2), or nearly every day (3)], resulting in a possible score of 0 to 27 ($\alpha=0.81$); scores above 9 represent clinical depression.

Internalized HIV stigma was assessed using an 8-item scale validated previously in the DR (8 items using 4-pt. Likert scale, $\alpha =0.87$) (Donastorg et al., 2014), which was adapted from other validated HIV stigma scales (Berger et al., 2001; Zelaya et al., 2008). Answers used a 4-point Likert scale (strongly disagree to strongly agree) assessing agreement with statements measuring negative self-perceptions related to HIV; higher scores indicated worse internalized stigma, range 0–32, $\alpha = 0.84$.

Hazardous drinking was measured using the Alcohol Use Disorders Identification Test Consumption (AUDIT-C) questions (Bradley et al., 2007), with hazardous drinking thresholds of 4 (men) and 3 (women).

Health insurance.—Although HIV care is provided free of charge by the Dominican government, some expenses (e.g., medications for opportunistic infections, labs for chronic disease management, non-HIV care visits) are not, so we asked participants if they had health insurance (yes/no).

Haitian background.—We asked participants, “What is your nationality?” with Dominican, Haitian, or “other” as response options.

Control variables.—Sociodemographic characteristics controlled for: 1) age (continuous); sex (male or female); poverty (household income <5000 pesos or approximately \$100/month, or equivalent to the lower middle-income poverty line of \$3.20 per day) (World Bank, 2020), and number of children in the household.

Analysis

We conducted descriptive analysis to examine the differences between participants with detectable versus undetectable VL in adherence and competing needs measures, psychosocial and behavioral study factors, and control variables. We performed t-tests for continuous variables and Pearson’s Chi-squared tests for categorical or binary variables to examine whether the differences were statistically significant at the 5% level.

Next, we fitted logistic regressions to explore VL correlates, adjusting for controls. Due to the small sample size, we were not able to simultaneously examine all measures in a single model, instead fitting a set of logistic models where each examined the marginal relationship between one measure and detectable VL, while adjusting for controls. The marginal modeling approach is a special instance of supervised subset variable selections

(Morozova et al., 2015) to handle the issue of a small sample size and a large number of predictors.

Lastly, we focused on the adherence or competing needs measure that was significantly related to detectable VL. We proceeded to examine the associations between this measure and various psychosocial and behavioral factors, fitting logistic regressions to examine the marginal relationships, while adjusting for controls.

RESULTS

Table 1 provides an overview of participant socio-demographic characteristics, adherence, and competing needs, comparing those with detectable and undetectable VL. Of 115 participants, 70 (61%) had a detectable VL, average age was 43 years, 52% were women, and 19% were living in poverty. The only sociodemographic characteristics that were significantly different were the number of children < 18 years old in the household (1.7 vs 0.9, $p=0.01$) and internalized HIV stigma (19.5 vs. 17.2, $p=0.03$). The only adherence/competing need factor associated with detectable VL was having missed taking ART in the last 6 months because of not having food to take it with (71% vs. 47%, $p=0.01$).

To explore further these associations, we provide odds ratios and confidence intervals, adjusting for controls (Table 2). Indicating missed ART doses in the last 6 months due to not having food was significantly related to detectable VL (OR=2.7, $p=0.02$).

Table 3 presents the marginal relationships between missing ART doses in the last 6 months due to not having food and various psychosocial and behavioral study factors. Greater odds of missing ART due to not having food was associated with severe food insecurity (OR=4.603, $p=0.006$), clinical depression (OR=2.755, $p=0.018$), Haitian background (OR=6.616 $p=0.017$), and higher internalized HIV stigma (OR=1.087, $p=0.041$). Lower odds of missing ART due to not having food was associated with more social support (OR=0.888, $p=0.030$) and having health insurance (OR=0.268, $p=0.017$).

DISCUSSION

Among people with HIV and food insecurity receiving HIV clinical care and ART in the DR, a majority (61%) had a detectable VL, similar to estimates of detectable VL among all PLHIV in the DR, including those who do not know their HIV status and those who are not on ART (UNAIDS). We did not find strong associations between our self-reported adherence measures and VL, possibly because self-reported adherence is often overestimated (Simoni et al., 2006; Stirratt et al., 2015). We did find that not having food to take with the ART medications was strongly associated with VL, confirming quantitatively among a clinic-based population findings from a qualitative study with sex workers in the DR that not having food is important for medication adherence (Zulliger et al., 2018). A US-based study found that being on an ART regimen that required food was a risk factor for non-adherence and viral non-suppression, suggesting that access to food should be assessed and considered when prescribing ART (Kalichman et al., 2015). Our survey question about not taking ART because of lack of food could be a useful screening question,

since admitting non-adherence for this reason may be socially acceptable given DR clinic policies that suspend treatment for those believed to be non-adherent (Brooks et al., 2014).

Among behavioral and psychosocial factors, nearly all were significantly related to non-adherence to ART because of lacking food. The strongest factor was Haitian nationality, reflecting the vulnerability of Haitians in the DR, who tend to have low socio-economic and undocumented status and face language barriers and perceived and experienced discrimination, which negatively affect their mental health and access to healthcare (Keys et al., 2015). The next largest effect sizes were for severe food insecurity, which affected over three-quarters of our participants, and clinical depression, which affected over half of our participants. Food insecurity and depression are known to be independently associated with poor HIV outcomes as well as interlinked psychological phenomena (Palar, Frongillo, et al., 2018).

Internalized HIV stigma was also related to food insecurity and depression and associated with a greater likelihood of missing ART due to lack of food. Previous research among women living with HIV in the DR found that internalized stigma is positively associated with depression, perceived community stigma, and perceived family stigma (Rael & Hampanda, 2016). Research in Uganda has shown how internalized stigma leads to food insecurity through social withdrawal from family and community support networks that facilitated increased access to food (Tsai et al., 2011). The relationships among food insecurity, internalized stigma, and depression have been found to be interrelated among PLHIV, especially women (Palar, Frongillo, et al., 2018). Internalized stigma was our only study factor related strongly to both viral load and missed ART due to lack of food, suggesting that further exploration is important. A study among women in India found that food insecurity was a strong mediator of the association between internalized stigma and opportunistic infections, primarily through nutritional pathways not adherence (Shin et al., 2018). Additional mediation analyses are important among diverse populations to understand the relationships among internalized stigma, food insecurity, and mental health and design effective interventions.

Social support and health insurance were associated with a lower likelihood of having missed ART due to lack of food. Social and economic support could enable food-insecure PLHIV to obtain food to take with their medications, as found by a qualitative study among women in the DR (Derose, Payan, et al., 2017). Interventions to increase social support among food-insecure PLHIV with adherence difficulties could be considered. Finally, although most HIV care is covered by the National HIV/AIDS program, for other types of health tests, health insurance is a policy intervention that could alleviate financial stressors for food-insecure PLHIV, thereby improving adherence.

The only study factor not associated with missing ART due to lack of food was hazardous drinking. Previous studies in Latin America have found alcohol use disorders to be associated with self-reported adherence (Ferro et al., 2015) and viral suppression (Rich et al., 2018) among men who have sex with men and transgender women. In our more general population, this factor was not key.

Limitations

As a small, exploratory study, we had limited power to detect statistically significant associations and thus used a marginal relations analytic approach and examined associations one study factor at a time, while adjusting for controls. Larger studies are needed to model the associations simultaneously. In addition, several of our measures were self-reported and subject to recall and social desirability biases. Finally, given that we enrolled only individuals who met criteria for moderate or severe household food insecurity, our findings do not generalize to all ART patients, and we could have underestimated the effects of food insecurity on viral load and missing ART due to not having food.

Conclusion

Ensuring that food-insecure patients on ART have adequate food to take with their medicines is essential for reaching viral suppression. This study's findings suggest that our intervention needs to consider not only ways to address food insecurity (e.g., gardens, peer nutritional counseling), but also psychosocial issues such as depression, internalized stigma, and marginalized identities. Our peer-based intervention aimed to not only educate but also enhance social support and solidarity. Ultimately, broader structural interventions such as universal health insurance and policies aimed at decreasing discrimination towards PLHIV and individuals of Haitian backgrounds living in the DR are important for enhancing resiliency and diminishing the tradeoffs that PLHIV often face.

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TABLE 1:

Participant characteristics, adherence, and competing needs by viral load status (n=115)

	TOTAL (n=115) Mean or % [range]	Has Detectable Viral Load (n= 70)	Has Undetectable Viral Load (n=43)	p
CHARACTERISTICS				
Age (years)	43.4 [18, 68]	42.5	44.7	0.34
Sex				
Female	52.2%	52.9%	51.2%	0.86
Male	47.8%	47.1%	48.8%	0.86
Poverty (<5000 pesos or \$100/month)	19.1%	18.6%	18.6%	1.00
Number of children <18 yrs in household				
	1.3 [0, 8]	1.7	0.9	0.01
Household food insecurity				
Moderate	18.3%	14.3%	23.3%	0.23
Severe	81.7%	85.7%	76.7%	0.23
Social support (scale 0–20)	12.8 [3.6, 20]	12.3	13.8	0.05
Internalized stigma (scale 0–32)	18.6 [8, 32]	19.5	17.2	0.03
Clinical depression (moderate to severe)	52.2%	60.0%	41.9%	0.06
Hazardous drinking (yes)	34.8%	30.0%	39.5%	0.30
Has health insurance	74.8%	68.6%	83.7%	0.07
Haitian background	17.4%	21.4%	11.6%	0.19
SELF-REPORTED ADHERENCE MEASURES				
Took 100% of ART as prescribed in last month	48.7%	47.1%	51.2%	0.68
Took ART perfectly over past 4 days	57.4%	57.1%	55.8%	0.89
Missed 1+ medical appointments in past 6 months	32.2%	31.4%	32.6%	0.90
COMPETING NEEDS				
Skipped meals for medical attention in past 6 months	85.2%	82.9%	88.4%	0.43
Missed medical attention due to lack of food in past 6 months	50.4%	50.0%	51.2%	0.90
Missed taking ART due to not having food to take it with in the last 6 months	61.7%	71.4%	46.5%	0.01

TABLE 2:

Estimated associations^a between detectable viral load and self-reported adherence and competing needs measures

SELF-REPORTED ADHERENCE MEASURES	DETECTABLE VIRAL LOAD		
	OR	Confidence Interval	p
Took 100% of ART as prescribed in last month	0.911	(0.403, 2.056)	0.822
Took ART perfectly over past 4 days	1.113	(0.496, 2.496)	0.796
Missed 1+ medical appointments in past 6 months	0.796	(0.331, 1.911)	0.609
COMPETING NEEDS			
Skipped meals for medical attention in past 6 months	0.544	(0.171, 1.733)	0.303
Missed medical attention due to lack of food in past 6 months	0.855	(0.385, 1.897)	0.699
Missed taking ART due to not having food to take it with in the last 6 months	2.681	(1.155, 6.223)	0.022

^acontrolling for age, sex, poverty, and number of children living in the home

TABLE 3:

Estimated associations^a between missing ART due to not having food to take it with and social and behavioral study factors

STUDY FACTOR	MISSED ART DUE TO NOT HAVING FOOD		
	OR	Confidence Interval	p
Severe food insecurity (vs. moderate)	4.603	(1.560, 13.582)	0.006
Social support (0–20)	0.888	(0.798, 0.989)	0.030
Clinical depression (PHQ9 10+ vs. <10)	2.755	(1.188, 6.390)	0.018
Internalized stigma (0–32)	1.087	(1.003, 1.177)	0.041
Hazardous drinking (yes vs. no)	0.628	(0.269, 1.463)	0.281
Has health insurance (yes vs. no)	0.268	(0.091, 0.793)	0.017
Haitian background (yes vs. no)	6.616	(1.404, 31.173)	0.017

^acontrolling for age, sex, poverty, and number of children living in the home