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How food insecurity contributes to poor HIV health outcomes: Qualitative evidence from the San Francisco Bay Area

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ABSTRACT

Rationale: Food-insecure people living with HIV/AIDS (PLHIV) consistently exhibit worse clinical outcomes than their food-secure counterparts. This relationship is mediated in part through non-adherence to antiretroviral therapy (ART), sub-optimal engagement in HIV care, and poor mental health. An in-depth understanding of how these pathways operate in resource-rich settings, however, remains elusive.
Objective: We aimed to understand the relationship between food insecurity and HIV health among low-income individuals in the San Francisco Bay Area using qualitative methods.
Methods: Semi-structured in-depth interviews were conducted with 34 low-income PLHIV receiving food assistance from a non-profit organization. Interviews explored experiences with food insecurity and its perceived effects on HIV-related health, mental health, and health behaviors including taking ART and attending clinics. Thematic content analysis of transcripts followed an integrative inductive-deductive approach.
Results: Food insecurity was reported to contribute to poor ART adherence and missing scheduled clinic visits through various mechanisms, including exacerbated ART side effects in the absence of food, physical feelings of hunger and fatigue, and HIV stigma at public free-meal sites. Food insecurity led to depressive symptoms among participants by producing physical feelings of hunger, aggravating pre-existing struggles with depression, and nurturing a chronic self-perception of social failure. Participants further explained how food insecurity, depression, and ART non-adherence could reinforce each other in complex interactions.
Conclusion: Our study demonstrates how food insecurity detrimentally shapes HIV health behavior and outcomes through complex and interacting mechanisms, acting via multiple socio-ecological levels of influence in this setting. The findings emphasize the need for broad, multisectoral approaches to tackling food insecurity among urban poor PLHIV in the United States.

1. Introduction

Food insecurity is "the limited or uncertain availability of nutritionally adequate, safe foods, or the inability to acquire personally acceptable food in socially acceptable ways" (Anema et al., 2009). This definition incorporates overlapping challenges, including insufficient quantity, poor quality, limited diversity, or compromised safety of food; inadequate access to food, leading to hunger or anxiety; and the need for socially unacceptable procurement of food, including begging, relying on charity, exchanging

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sex for food, stealing food, and other illicit activities (Anema et al., 2009). Food insecurity affects hundreds of millions of people globally, and remains a major challenge in many high-income countries. The United States is a prominent example: 48 million Americans (15.4% of the population) were food-insecure in 2014 (Coleman-Jensen et al., 2015).

The link between food insecurity and HIV/AIDS is well characterized. In this bidirectional relationship, the two impact each other by heightening vulnerability to and worsening the severity of each condition (Weiser et al., 2011). On the one hand, people living with HIV/AIDS (PLHIV) and their families are put at risk of food insecurity from the loss of labor, wages, assets, and productivity associated with HIV-related morbidity, stigma, and treatment costs (Weiser et al., 2011). At the same time, food insecurity increases the risk of both horizontal and vertical transmission, and food-insecure PLHIV consistently exhibit worse clinical outcomes than their food-secure counterparts (Weiser et al., 2015a).

1.1. Effects of food insecurity on HIV clinical outcomes

In resource-rich settings, food insecurity has been associated with higher viral loads (Feldman et al., 2015; Wang et al., 2011; Weiser et al., 2013), lower CD4 counts (Weiser et al., 2013), and HIV-related morbidity (Weiser et al., 2012) and mortality (Anema et al., 2013). Quantitative data suggest that food insecurity worsens patients' HIV-related health through three interrelated pathways—nutritional, behavioral, and mental health (Fig. 1) (Weiser et al., 2011, 2015a). While the nutritional pathway operates exclusively at the physiological level, with micro- and macronutrient deficiencies leading to immunologic decline and faster disease progression (Weiser et al., 2015a), the behavioral and mental health pathways represent biopsychosocial processes through which food insecurity contributes to poor HIV health. Extensive evidence from resource-rich as well as resource-poor settings shows that food-insecure PLHIV have poorer adherence to ART and are more likely to miss scheduled clinic visits than their food-secure counterparts (Singer et al., 2014; Young et al., 2014). Food insecurity has also been associated with depression (Anema et al., 2011; Palar et al., 2015; Vogenthaler et al., 2011; Weiser et al., 2009) and increased alcohol and substance use (Anema et al., 2011; Weiser et al., 2009) among PLHIV in the United States and Canada, all of which are predictors of ART non-adherence (Chander et al., 2006; Uthman et al., 2014; Vagenas et al., 2015). Depression is additionally associated with poor immunologic outcomes independent of ART adherence (Evans et al., 2002; Ickovics et al., 2001).

1.2. The socio-ecological model of HIV heath behavior

These quantitative associations support the design of interventions and policies aimed at addressing food insecurity to improve HIV clinical outcomes. Doing so, however, requires a deeper understanding of how such associations arise in different populations, in order that interventions are optimally tailored to the underlying causal processes shaped by patients' complex needs and broader social contexts. While qualitative research is the best approach for obtaining such an understanding, few qualitative studies have investigated the relationship between food insecurity and HIV health. Importantly, no such studies have been conducted in high-income countries, where the mechanisms may be different compared with resource-poor settings. It has been theorized that HIV health behaviors are influenced by factors operating across individual, interpersonal/network, community, institutional/health system, and structural levels, which interact both within and between these levels to shape patterns of health behavior (Kaufman et al., 2014). This socio-ecological model includes diverse factors such as motivation, emotions, knowledge/information, and reactions to stress (individual level), social networks and social capital (interpersonal/network level), stigma and cultural norms (community level), culturally and structurally competent healthcare providers and appropriate services (institutional/health system level), and structural factors such as poverty and food insecurity. Here we aimed to understand how food insecurity exerts its influence on HIV-related health behaviors and outcomes across the different levels of the socio-ecological model by studying a population of low-income PLHIV in San Francisco and Alameda County, California.

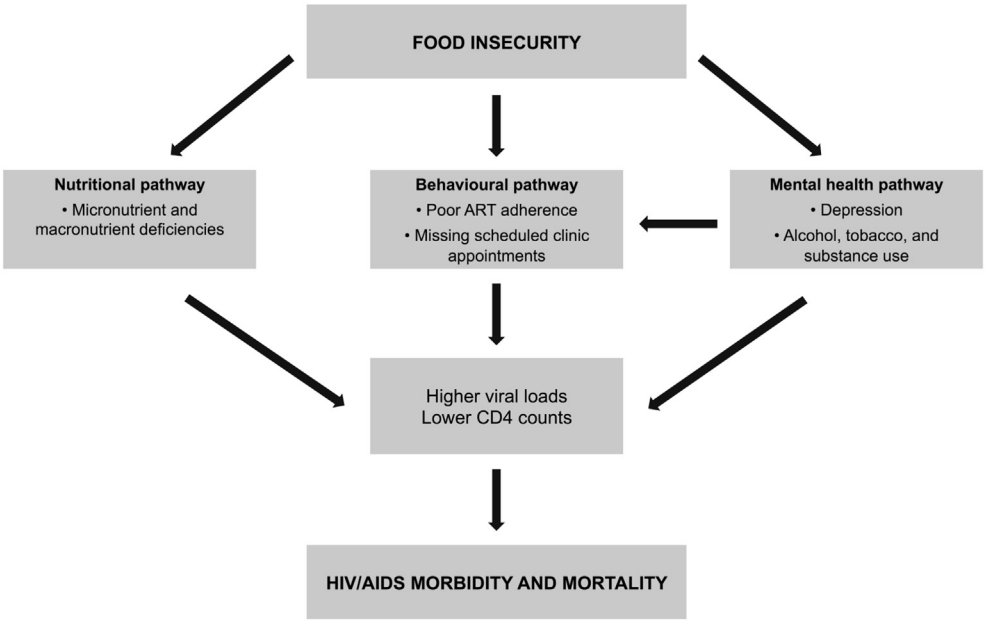

Fig. 1. Effects of food insecurity on HIV/AIDS morbidity and mortality. Adapted from Weiser et al. *Am J Clin Nutr* 2011.

2. Methods

2.1. Research setting

The San Francisco Bay Area has high rates of both food insecurity and HIV/AIDS. In 2013, 16.7% of the population of San Francisco (~136,000 individuals) and 15.3% of the population of Alameda County (~235,000 individuals) were estimated to be food-insecure (Gundersen et al., 2015). Around 200 food pantries and other non-profits were providing close to 100,000 citizens of San Francisco with direct food provision that year, serving at capacity and unable to meet demand (San Francisco Food Security Task Force, 2013). San Francisco has also been an epicenter of the HIV/AIDS epidemic since its origins in the United States. At the end of 2014, there were 15,979 PLHIV in San Francisco, making up 2% of cases nationwide (San Francisco Department of Public Health, 2015). In Alameda County at the close of 2013, there were 5590 PLHIV, making up 0.6% of cases nationwide (California Department of Public Health, 2013). These statistics raise the possibility of the syndemic axis between food insecurity and HIV/AIDS operating in a region notorious for both its wealth and concentration of urban poverty (Whittle et al., 2015a)—corroborated by studies in San Francisco that indicate a high prevalence of food insecurity among homeless and marginally housed PLHIV (Weiser et al., 2009, 2013).

2.2. Research collaboration

Our study was part of a research collaboration between the University of California, San Francisco (UCSF) and Project Open Hand (POH), a food assistance non-profit organization based in the Bay Area. POH provides take-home meals and groceries free of charge to ~3800 chronically ill residents of San Francisco and Alameda County, including ~3000 PLHIV. After referral by a provider, clients with a physician-certified diagnosis of HIV/AIDS are provided differential food assistance services depending on symptomatology and life situation (criteria set by POH and arrived at after consultation with a medical board). Clients classified as “mildly ill” by POH may receive either a weekly bag of groceries or up to seven frozen meals each week; “severely ill” clients may receive both these services.

2.3. Study population

In June 2014, POH initiated a pilot program named *Food=Medicine* that provided selected clients three meals per day plus snacks for a period of five to six months. Our study population was drawn from HIV-positive POH clients newly recruited into the *Food=Medicine* pilot program. POH selected PLHIV into the program from their overall client base with the criteria that they be HIV-positive, adult (over 18 years of age), English- or Spanish-speaking, and low-income, with a history of good adherence to POH services. Participant selection also aimed to maximize diversity of race/ethnicity, illness severity, and geographical location in the program population. POH's goal was to recruit 30–35 PLHIV on a rolling basis between April and June 2014.

2.4. Recruitment strategy

We invited all clients to participate in the *Food=Medicine* program who had given permission to be approached for inclusion in our study; there were no exclusion criteria. We recruited on a rolling basis throughout data collection until saturation of ideas. Study participants received standard POH services prior to and during data collection.

2.5. Data collection

Semi-structured in-depth interviews were conducted with 34 participants between April and June 2014. Only one individual enrolled in the *Food=Medicine* program declined to participate (for logistical reasons). Participants additionally completed the validated US Department of Agriculture complete (18-item) Core Food Security Module, which showed that 24 of the 34 participants had low food security at the time of interview, and 17 of the 34 had very low food security. After collecting demographic information on gender, race/ethnicity, education, housing, and marital status, interviews were conducted in English by a medical/graduate student (HJW) trained in qualitative methods by a PhD-level public health researcher (KP) and the study principal investigator and senior author (SDW), an HIV physician and epidemiology researcher. One of three graduate-level research assistants (including TN) was also present to take field notes during 15 of the interviews. Aside from the researcher(s) and the respondent, no one else was present during the interviews. It was made clear prior to each interview that the researchers were separate from and independent of POH, and none of the interviewers were previously known to the study participants. The primary interviewer (HJW) was simultaneously undertaking voluntary work for POH delivering meals in the low-income neighborhood in San Francisco where many participants lived. This work, which was not a long-term commitment, started a few weeks prior to data collection in order to increase familiarity with the study population and its social context, and facilitate rapport between interviewer and respondent. Interviews took place either at POH's offices in San Francisco or Oakland, or at participants' homes.

Interviews loosely followed an interview guide based on pre-identified domains of interest informed by previous quantitative studies (Fig. 1) (Weiser et al., 2011). The guide explored finances, life situation, food security, health, sexual behavior, health behavior, engagement in care, and perceptions of POH among participants. Questions related to food insecurity explored typical diets and eating habits, periods of inadequate quantity or quality of food, and management strategies employed during such times. Questions related to health explored general health, HIV-related health, and mental health including times of stress, anxiety, and depressive symptoms. If participants described experiences with food insecurity that fit with our operational definition (provided in the introduction) (Anema et al., 2009), we then probed generally for adverse effects of food insecurity, including potential health effects. Questions related to health behavior and engagement in care explored access to clinics and experiences with keeping appointments, adhering to dietary recommendations, and taking medications including ART. Similarly, we probed for the effects of food insecurity on each of these if appropriate. The guide was developed by five researchers (including HJW, KP, TN, and SDW) and underwent numerous iterations for fine-tuning. In addition to the guide, interviews allowed room to follow unanticipated directions of enquiry. Interviews lasted between 45 and 165 min (average 90 min) and were audio-recorded with permission from participants. Recordings were transcribed verbatim. Participants were reimbursed $20 cash at the interview's conclusion.

2.6. Data analysis

Transcripts were coded and analyzed according to thematic content analysis methods (Weber, 1990), following an integrative inductive-deductive approach (Bradley et al., 2007). A team of five researchers (including HJW, KP, TN, and SDW) developed a list of codes during data collection, drawing from both the quantitative findings underpinning our interview guide (Weiser et al., 2011) and

the data as it was being gathered. This approach allowed us to organize codes around previous empirical findings while also leaving room for new codes to emerge from interview transcripts, which were read and discussed by the same five researchers as the interviews proceeded. This initial list of codes was then discussed and refined into a final codebook consisting of primary codes and one level of sub-codes. All transcripts were independently double-coded using the qualitative text management software Dedoose, with discrepancies discussed and resolved by consensus to validate the codebook and maximize coding reliability. Excerpts were then reviewed in light of their original context. The study team discussed the data until consensus to identify salient themes; selected quotations were chosen to illustrate key themes and sub-themes.

2.7. Ethics statement

UCSF's Committee on Human Research granted the study approval in January 2014. Study participation was entirely voluntary and had no effect on either the receipt of POH services or participation in the *Food=Medicine* program. Written informed consent was obtained from all participants.

3. Results

The majority of the 34 participants were men, aged between 45 and 65 years, well educated, and never married or divorced (Table 1), broadly representative of POH's HIV-positive client base. During the interviews, almost all participants described personal episodes of food insecurity, and these experiences collectively encompassed every aspect of food insecurity. Individuals described living through times of insufficient quantity of food, reported long-term struggles with diet quality, regularly worried about where food was coming from, and explained that they had been forced to use personally and socially unacceptable strategies to procure food, including long-term dependence on charity, exchanging sex for food, and selling controlled substances to raise money for food. These experiences stemmed almost exclusively from severely limited finances, and the vast majority of participants described receiving disability benefits, most commonly Supplemental Security Income (SSI), as their sole source of income.

Table 1
Participant demographics.

	n	%
Age:		
39–45	4	12
46–55	16	47
56–65	11	32
66–70	3	9
Gender:		
Male	28	82
Female	6	18
Disease severity:		
Mildly ill	17	50
Severely ill	17	50
Residence:		
San Francisco	21	62
Alameda County	13	38
Race/ethnicity[a]**:**		
White/Caucasian	17	50
Black/African American	16	47
Asian	0	0
Hispanic	6	18
Other	5	15
Highest level of education completed:		
Primary school	4	12
High school	3	9
General educational development	2	6
Some college	14	41
College - undergraduate	7	21
College - graduate	4	12
Current housing status:		
Apartment or house	26	76
Single room occupancy or nightly hotel	6	18
Staying with friends	2	6
Marital status:		
Married	2	6
Widowed	3	9
Divorced	9	26
Separated	1	3
Never married	15	44
Living with partner	3	9
Other	1	3

[a] Participants could self-identify as multiple categories.

Participants also described how they perceived that experiences of food insecurity could lead to, and had led to, a variety of negative impacts on their HIV-related health, articulating the mechanisms underlying these links. Four key themes emerged. Participants described direct negative impacts of food insecurity on adherence to ART, keeping clinic appointments, and mental health, and also elucidated several interactions between mental health and HIV-related health and care that were shaped by experiences with food insecurity.

3.1. Impacts of food insecurity on adherence to ART

The interactions between taking antiretroviral medications and food insecurity were a major theme among participants. While several individuals described experiencing few side effects regardless of how or when they took their regimens, many participants explained how they preferred to take ART pills with food in order to avoid or ease the severity of side effects. These commonly included nausea, vomiting, and fatigue, which were exacerbated when taking regimens in the absence of food:

> "You know, I try to take [my ART pills] with food and milk because I've got a esophagus problem, the reflux. And that medicine starts churning around and it comes back up and burns the hell out of my throat, you know?… An empty stomach with all that medication and the result is not good."
>
> (Participant #8, male)

The behavioral reactions to such experiences among participants were variable. Knowledge of both HIV pathophysiology and the biomedical importance of ART adherence were high across the sample. Accordingly, most individuals prioritized taking ART regardless of struggles with food shortages, opting to suffer the consequences of exacerbated side effects. Nevertheless, several participants described how such experiences, particularly if occurring repeatedly throughout a prolonged stretch of food insecurity, could undermine adherence:

> "You have to eat when you take [ART and other medications]. If I don't have any food when I take my medication, then I'll get sick and I'll get mad, then I don't want to take the pills."
>
> (Participant #25, male)

Sub-optimal adherence during long-term struggles with food insecurity could have profound consequences for participants' HIV-related health:

> "[When I wasn't getting enough to eat] my T cell [count] dropped, everything, my viral load went up and I wasn't taking my medication, I literally wasn't taking care of myself. I was

dwindling away. You know, I would have one, both foot in the grave, basically. All I needed to do is just lay on down."

(Participant #24, female)

"I'd take them [ART pills] without food and that's when [I] had the weak stomach and throwing up. . . . I was not taking my pills, and my [CD4] count got low."

(Participant #23, male)

The latter participant further described how this particular stretch of poor adherence had ended with him hospitalized for severe pneumonia. His regimen was then changed upon discharge to one that he could take on an empty stomach without suffering such debilitating side effects. He explained that his adherence and clinical outcomes had improved as a result.

While this interaction between food shortages and medication side effects was the most direct mechanism through which food insecurity compromised ART adherence among participants, we identified other mechanisms. These were intertwined with the day-to-day lived experience of food insecurity in our sample, which required participants to be resourceful in procuring sufficient and desirable food under the constraints of severely limited finances. Given the relative abundance of food pantries and free-meal programs in the Bay Area—and San Francisco in particular—participants often described spending much of the day during periods of severe food insecurity visiting different institutions throughout the area, commonly on foot, in order to obtain enough to eat (in addition to their food assistance from POH). Participants who described this type of situation explained how such preoccupation with obtaining food could lead to them forgetting to take their ART medications. One individual put it this way:

"You're hungry, you're trying to figure out, 'Where am I getting my next meal?' And yeah, all other train of thought is out the window."

(Participant #28, male)

While all but two participants were living in their own rented accommodation at the time of interview, many had experienced periods of homelessness in their lives. Such individuals described how housing instability and destitution could further reinforce this mechanism, combining with experiences of hunger to amplify the chaotic nature of living on a low-income budget. One individual described his experiences during a three-year period of homelessness while on the wait-list for low-income housing as follows:

"If I wasn't physically situated in a place sometimes, even though they [ART medications] were in my backpack or something like [that], I didn't end up taking them. Either maybe because I was sleeping all day because I hadn't slept or whatever the night before, or not eating that morning, even though I tried to have cereal or something. If I was, you know, walking or not someplace I could be then yeah, I didn't take them."

(Participant #10, male)

Finally, a dislike of taking ART medications at public free-meal sites emerged from the interviews. Two on-site free-meal programs in San Francisco were frequented by several participants living in the city, but were mostly described in unfavorable terms. In addition to reservations about the food provided, participants articulated worries about stigma when attending these institutions. These fears concerned both revealing one's dependence on charity for food and inadvertently disclosing one's HIV status by taking ART medications with the meals served. This latter perception of HIV stigma could undermine adherence:

"If you go to maybe one of these places where they give you your food [for free], and you take these [ART pills] out, you know, you're not in the privacy of your home taking the medications. People will look at you like … you know? Or you think they do. In your head they do."

(Participant #7, male)

3.2. Impacts of food insecurity on keeping clinic appointments

Several participants also described how experiences with food insecurity had contributed to them missing scheduled visits to HIV clinics. Similar to perceptions regarding the importance of good ART adherence, individuals across the sample were generally well engaged in HIV care, explaining how they prioritized attending check-ups to assess their clinical outcomes including CD4 counts and viral loads. Certain narratives, however, revealed how food insecurity could undermine such intentions, and, again, the mechanisms described were heterogeneous. At the most direct end, it was explained that physical feelings of hunger and exhaustion could dissuade the individual from going out to their appointments:

"If I ain't eating right and I am not feeling good, I ain't going nowhere. You know, say if it's a follow-up or something, I be like, 'Forget that.' Especially if I don't have no ride, you know?"

(Participant #13, female)

Linking in with the mechanisms outlined in the previous section, participants also described how the debilitating side effects of taking ART pills on an empty stomach could erode motivation to keep appointments. One individual put it this way:

"When you don't eat, and you take your medication, you feel woozy and tired, you don't want to do nothing."

(Participant #25, male)

As with ART adherence, it also emerged that food insecurity could undermine engagement in care in subtler ways. Again, these were embedded in the day-to-day lived experience of food insecurity and destitution, and included missing appointments because of preoccupation with food struggles. One participant, for example, explained how experiences of hunger and exhaustion after searching for food during a long stretch of homelessness contributed to an overriding sense of personal insecurity and anxiety, which, in turn, reduced his desire to attend clinic appointments:

"If I was hungry, you know, I didn't feel like … Okay, look, maybe I was up all night walking around. I didn't want anybody to see me. I wasn't willing to go to a place that's so public and so busy, you know, hungry and walking—you know? Fortunately I could go to my storage, like I said, sometimes, if I'd paid my rent. And they had a bathroom there so I could go and freshen up there. Sometimes I could do that. But if I wasn't able to get in that place to do that, then no, I'm not going to go to the doctor. Because he's going to see me and then something is really going to be wrong, you know?"

(Participant #10, male)

3.3. Impacts of food insecurity on mental health

A highly salient theme emerging from the interviews was the erosion of mental wellbeing by experiences of food insecurity. Participants frequently evoked the sense of stress and anxiety inherent to food insecurity that is captured in its definition, and, moreover, described how experiences with food insecurity directly contributed to periods of depression. Again, we identified multiple mechanisms. In the first mechanism, participants explained how periods of absolute food shortage could cause acute symptoms of depression, which were described as a short-term consequence of the physical feeling of hunger:

> "If you don't have enough food of course you're going to get depressed, you know? You get headaches, you get fatigued, you know? If you don't feel good you get depressed."
>
> (Participant #14, female)

A second mechanism involved interactions between food insecurity and pre-existing struggles with depressive symptoms, often formally diagnosed. The following quote is from an individual who had experienced difficulties with depression for many years, which were exacerbated by severe food insecurity during a long stretch of homelessness in San Francisco:

> "There's been times… that depression that I might have had about something might have set a little heavier because I didn't have resources, I didn't have food, I didn't have nothing to help it feel better, a Band-Aid for it, you know?"
>
> (Participant #1, male)

Several participants described similar experiences, and in some cases the depression was associated with the individual's diagnosis of HIV/AIDS. Without food, that is, participants' depression about living with HIV/AIDS became all the more salient. This mechanism is illustrated by the following quotes, both from individuals with histories of depressive symptoms primarily focused around living with HIV/AIDS:

> "When you don't eat properly, then all of the negative things come to the surface. Okay? But when you're eating properly, then your body stays in a much more stable situation. Because when you're not eating properly, the HIV starts to affect the emotional and the psychological side of your life. Because your body is starving for more. . . . And if you have the economics to give it more, then it's more stable; if not, then it becomes a psychological problem. Do you follow what I'm saying? And I'm not the type that wants to go to a psychiatrist to get a whole bottle full of pills, because pills is not food."
>
> (Participant #33, male)

> "If I'm eating healthy, if I'm eating well-rounded, if I'm eating three squares a day, my thinking is much better, much clearer. But when I'm not eating healthy and I'm not eating regular meals, that's when I get bombarded by all this giving up and oh-woe-is-me and, you know, just want to go to sleep and not wake up, that kind of crap. So I have to really do a lot of talk self-talk to myself."
>
> (Participant #13, female)

The third mechanism described by participants was a more chronic process, characterized by the negative psychosocial implications of living long-term with food insecurity in a region and society of wealth. Participants often expressed internalized feelings of failure, humiliation, or shame regarding their perceived inability to obtain enough food for themselves or realize a sufficiently healthy diet:

> "Not being able to be self-sufficient is depressing. You know? You are your own person, and you should have acquired some kind of life skills, you know, if you are still on the planet. So not being self-sufficient, not [being] stable, not being able to buy food—all those things are very high anxiety stressors, you know what I mean? Some people don't make it through to the other side. "
>
> (Participant #20, male)

3.4. Interactions between mental health and HIV-related health and care

The final theme that emerged from the interviews was the relationship between mental health issues and HIV-related health and care, which, in turn, was mediated by food insecurity. Many participants described how long-term food insecurity negatively affected their health, and several explicitly explained how their experiences with stress, anxiety, and depression—either arising directly from food insecurity or exacerbated through the mechanisms described above—had led to poor HIV clinical outcomes:

> "Just the worry of whether one's going to have enough food or not, just that worry alone takes a factor in how their health is going to turn out. Whether or not they actually get what they need, just that worry about it beats down, I guess, T cells."
>
> (Participant #1, male)

Finally, participants described how experiences with food insecurity, depressive symptoms, and non-adherence to ART could reinforce each other in more complex ways, highlighting the dangers of interplay between the different mechanisms identified here:

> "I get sick, to put it bluntly. And that's very extreme, but I mean I get sick, I really do. Sick. Sick to the point I cannot take my medications, because I can't eat, because I'm so irate and agitated and upset. And that doesn't happen, like I said, very often, but when it does, I go down, what I describe as going down, in my down period, and I am in bed. I could be in bed for a week, two weeks. It's like a depression, almost, you know? Depression feeds off itself, and it's kind of like that."
>
> (Participant #18, male)

> "I wouldn't eat for a long time. I couldn't eat, but then I got to the point where I wouldn't eat because I just didn't want to look for any food and just get depressed. And then the next thing to go would be the [ART] medication and then I'm totally not adherent, and I was in real trouble then. "
>
> (Participant #7, male)

4. Discussion

The PLHIV in this study described how food insecurity contributed to sub-optimal adherence to ART, missing scheduled clinic visits, and depressive symptoms, the last of which they perceived could both further erode ART adherence and worsen

HIV clinical outcomes. The overlapping, interacting, and mutually reinforcing nature of the mechanisms involved demonstrates the complex manner in which food insecurity shapes the health behavior and outcomes of low-income PLHIV, exerting its effects via different levels of influence as described in the socio-ecological model (Kaufman et al., 2014). At the individual level, food insecurity compromised the physical health of participants because of side effects arising from taking ART medications on an empty stomach, prompting participants to miss doses and clinic visits. Moreover, exhaustion, physical feelings of hunger, and the continuous threat of not having sufficient food overshadowed participants' concerns about taking care of their health. Feelings of self-doubt, insecurity, anxiety, and depressive symptoms precluded regular routine, led to pre-occupation searching for food, and eroded the physical and mental ability to take ART medications regularly and attend HIV clinics. Many of these effects occurred via multiple levels. At the institutional/health system level, participants felt unable to access clinics when hungry, exhausted, or physically ill, and felt insecure and anxious about seeing their provider when hungry. At the community level, participants described HIV stigma at public free meal sites, while cultural norms of wealth and self-sufficiency exacerbated and contributed to depressive symptoms. Our results therefore demonstrate how food insecurity, a factor on the structural level, filters down through the different layers of the socio-ecological model via numerous interacting mechanisms to converge on the individual, negatively affecting their HIV health behaviors and, ultimately, outcomes.

Qualitative studies in sub-Saharan African countries have previously described mechanisms for how food insecurity undermines ART adherence and engagement in HIV care. These were categorized by a recent review (Young et al., 2014) as (1) intractable hunger after taking ART, (2) exacerbated side effects of ART in the absence of food, (3) the need to sell or trade ART medications to obtain food, and (4) competing resource demands between food needs and the time and costs of travel to clinics. The studies in this analysis, however, all took place in resource-poor settings shaped by social, cultural, and structural characteristics vastly different to those in high-income societies. Our data extend this literature by (a) demonstrating how urban poor PLHIV in one of the wealthiest regions in the United States are similarly constrained by exacerbated ART side effects because they are unable to obtain enough food, and (b) elucidating interacting mechanisms in this setting not previously described. With regard to the first, the persistence of hunger that exacerbates ART side effects to the point of non-adherence highlights the dangerous consequences of enduring structural inequalities and socioeconomic polarization in the United States for HIV treatment and prevention efforts (Pellowski et al., 2013). At the same time, it emphasizes, as a bare minimum, the need for clinicians to broaden their “clinical gaze” to consider, in addition to biomedical disease processes and individual behavioral factors, the patient's social context within its full structural constraints (Holmes, 2012). Specifically, HIV physicians should enquire about food security, prioritize linking patients with available food resources, and consider, where possible, selecting ART regimens that minimize gastrointestinal side effects (which may be particularly challenging for food-insecure patients). Our finding that exacerbated ART side effects could also undermine participants' attendance at HIV clinic appointments gives further weight to these arguments.

As described above, however, the results also show that the broader lived experience of food insecurity in this resource-rich context may be contributing to poor ART adherence and missing clinic visits. Food insecurity here was characterized by high dependence on charity and the employment of a multitude of resourceful strategies aimed at procuring food (also further described elsewhere; Whittle et al., 2015a; Whittle et al., 2015b). It imposed a chaotic lifestyle of hunger and exhaustion on our participants, which, in turn, both prevented them from managing their own eating schedules in accordance with the requirements of their ART regimens and undermined motivation to attend clinic appointments. Moreover, HIV stigma, a well-documented barrier to ART adherence (Katz et al., 2013), may be magnified at public free-meal sites when inadvertent public disclosure becomes a danger for PLHIV needing to take their ART medications with food. These mechanisms are driven primarily by the nature of the social safety net in our research setting—and indeed the United States at large—which, being heavily reliant on direct food assistance administered by non-profits, is determined largely by the delivery models of private organizations (Daponte and Bade, 2006; San Francisco Food Security Task Force, 2013). Short of more fundamental structural change, certain forms of private food assistance may be better at facilitating ART adherence and reducing stigma than others. These include home delivery of meals and bulk provision of take-home meals that can be individually managed in privacy. Such approaches, however, require various assets of the recipient, including an address or a minimum capacity for food storage and preparation, rendering them inappropriate for many homeless and marginally housed individuals. Accordingly, these findings also support that approaches to tackling food insecurity among PLHIV in high-income countries must extend beyond food-specific solutions, addressing, for example, issues of housing and financial support for chronically ill and destitute individuals (Whittle et al., 2015a).

Many studies have now associated food insecurity with depression among PLHIV, with several conducted in the United States and Canada (Anema et al., 2011; Palar et al., 2015; Vogenthaler et al., 2011; Weiser et al., 2009). Our data provide qualitative insight into this link. The mechanisms we describe underscore the development of depression as a biopsychosocial phenomenon (Engel, 1977; Schotte et al., 2006) to which food insecurity likely contributes across all three domains. While a healthy diet seems to reduce the risk of depression (Lai et al., 2014), our findings shed light on psychological and socio-cultural processes through which food insecurity may give rise to depressive symptoms. Participants described how experiences with food insecurity, including hunger and poor quality food, could trigger depressive symptoms and exacerbate pre-existing struggles with depression. These narratives fall in line with insights from cognitive theory, which describes how “stimulus situations” act as triggers for the maladaptive cognitive patterns and coping strategies that characterize depressive episodes (Beck and Haigh, 2014). Stimulus situations include bodily sensations and stressful life events that negatively affect one's wellbeing and identity (Beck and Haigh, 2014)—criteria that broadly capture the lived experience of food insecurity as it is described in our data, as well as in qualitative studies of non-HIV-infected individuals (Chilton and Booth, 2007; Hamelin et al., 2002). Furthermore, the self-perception of social failure articulated by our participants, stemming from their inability to uphold the American ideal of self-sufficiency, demonstrates the influence of social and cultural factors on the pathogenesis of depression (Schotte et al., 2006). That is, such negative self-perceptions are only made possible by juxtaposition between chronic food insecurity and widespread, culturally celebrated wealth. The impact of this highly visible socioeconomic disparity may be especially damaging for low-income, chronically ill PLHIV like our participants, who are at risk of internalizing intersecting stigmas in the United States attached to HIV status, poverty, and the receipt of disability

benefits since the welfare reforms of 1996 (Hansen et al., 2014; Mahajan et al., 2008).

Most importantly, the experiences of ART non-adherence, missed clinic visits, and depressive symptoms driven by food insecurity in this study were interrelated and overlapping, operating and interacting across multiple levels of influence. This nuanced picture highlights the complexity and heterogeneity of the pathways linking food insecurity to poor HIV clinical outcomes, and emphasizes the need for broad, multisector approaches to intervention in resource-rich settings. To date, food interventions among PLHIV have focused primarily on nutritional supplementation, with mixed results (Tang et al., 2015). Our findings support the design of multifaceted approaches to tackling food insecurity among PLHIV in resource-rich settings, which might include the collaborative provision of appropriate food assistance, housing support, mental health referral services, and "structurally competent" (Metzl and Hansen, 2014) clinical care sensitive to the full social context of patients' ill health. This recommendation is in line with a growing body of literature recognizing the complexity of food disparities and their downstream effects, and the need for broad solutions that engage with multiple aspects of human behavior and the socio-political environment (Brown and Brewster, 2015). Such multifaceted approaches to tackling food insecurity among PLHIV have previously proven successful in improving both food insecurity and HIV clinical outcomes in resource-poor countries (Weiser et al., 2015b).

4.1. Limitations

Our study has several limitations. First, there are various sources of selection bias in our sample. We recruited from individuals already accessing community food assistance, and the strategy that POH used to recruit PLHIV into the *Food=Medicine* program required that participants had a history of good adherence to POH services. We were therefore unable to recruit the most vulnerable and severely food-insecure individuals living in the Bay Area, who likely include those with recent histories of homelessness, substance dependency, and other unstable life situations linked with food insecurity. Our data may not therefore capture the full range of mechanisms by which food insecurity can shape HIV health behaviors and outcomes. Second, in order to receive POH services HIV-positive individuals must present the organization with a physician-certified diagnosis of HIV/AIDS annually. Thus, by recruiting from POH's client base we selected for individuals who, by definition, were engaged in HIV care. Again, this practice may have biased our findings towards a more positive description of HIV health and care.

4.2. Conclusion

Our participants collectively described a nuanced picture of living with food insecurity and HIV/AIDS that incorporated hunger, exhaustion, destitution, exacerbated ART side effects, intersecting stigmas of HIV and poverty, recurring depressive symptoms, and long-term self-perceptions of social failure. In doing so, they demonstrated how complex associations between food insecurity, ART non-adherence, sub-optimal engagement in HIV care, and depression can arise and play out in a resource-rich setting. This kind of in-depth understanding is essential for the design of well-targeted interventions and policies that do not oversimplify the problems they purport to solve. Among urban poor PLHIV in the United States, broad, nuanced, creative approaches are needed that operate at multiple levels, going beyond nutritional interventions and acontextual clinical care to address the behavioral, psychosocial, and structural dimensions of persistent food insecurity amid a society of significant wealth.

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