FOOD INSECURITY:
Implications for ART Adherence and HIV Health Outcomes

Adherence 2014; June 10, 2014

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OVERVIEW

1. Background on Food Insecurity & HIV
2. Food Insecurity, Adherence & Patterns of Health Care Utilization
3. Food Insecurity & HIV Clinical Outcomes and Morbidity
4. Next Steps
BACKGROUND
FOOD INSECURITY: Definition

Limited or uncertain availability of nutritionally adequate, safe foods\(^1\)

- **Components:**
  - Insufficient quantity of foods
  - Insufficient quality and diversity of available foods
  - Feelings of deprivation/anxiety
  - Inability to procure food in a socially acceptable manner

- Hunger and malnutrition are potential consequences
- **Food insecurity distinct from socioeconomic status**\(^2\)

HIV AND FOOD INSECURITY: SYNDROMIC ISSUES


Food Insecurity Kcal/per/day

Adult HIV Prevalence


Adult HIV prevalence %
APPROXIMATELY HALF OF HIV-INFECTED INDIVIDUALS IN NORTH AMERICA ARE FOOD INSECURE

64.7%, Vancouver ²

63%, Boston ⁴

51%, Atlanta ⁵

48%, British Columbia ¹

48%, San Francisco ³

¹ Normen, J Nutrition, 2005; ² Anema, Subs Abuse Tx, 2010; ³ Weiser, JGIM, 2012; ⁴ McMahon JAIDS, 2011; ⁵Kalichman J Urban Health, 2010
MEASURING FOOD INSECURITY

Most widely used tools:
- USDA Household Food Security Survey Module
- FANTA Household Food Insecurity Access Scale (HFIAS)

Other measures:
- Radimer/Cornell Measure\(^1\)
- Coping Strategies Index
- Dietary Diversity Scale\(^2\)

Structural Drivers

- Ecological factors: drought, flooding
- Economic factors: poverty, education
- Social factors: gender, stigma

Food Insecurity

- Nutritional pathways: insufficient quality/quantity of food
- Mental Health pathways: anxiety, deprivation, alienation
- Behavioral pathways: poor coping strategies

HIV/AIDS

- Risk of HIV acquisition and transmission
- HIV/AIDS morbidity and mortality

Weiser, Kushel, Cohen & Bangsberg, AJCN 2012
Transactional Sex/ unprotected sex:

- “Women are having sex because they are hungry. If you give them food, they would not need to have sex to eat.”

- “Either my children and I starve tomorrow, or I have sex with someone today, and maybe get HIV, and will then die 5-10 years later.” ¹

- “Most of the time, when I’m desperate for something to eat...And then the devil tempts you, and then you see a man...and you ask yourself, If I slept with him, couldn’t I get 10,000 shillings [approx. $5.00 US] to buy maybe a sack of charcoal?” ²

¹ Epidemic of Inequality, PHR Report, 2008; ² Miller et al. AIDS and Behavior, 2010
# Food Insecurity & Risky Sex across diverse settings

<table>
<thead>
<tr>
<th></th>
<th>Botswana/Swaziland ¹</th>
<th>Brazil ²</th>
<th>San Francisco ³</th>
<th>Vancouver ⁴</th>
<th>Nepal ⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unprotected sex</td>
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<tr>
<td>Sex exchange</td>
<td></td>
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<td></td>
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<tr>
<td>Consistent condom use</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Multiple partners</td>
<td></td>
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<td></td>
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<tr>
<td>STI Symptoms</td>
<td></td>
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</tr>
</tbody>
</table>

*Models adjusted for demographic, socioeconomic and clinical variables.

FOOD INSECURITY, ADHERENCE & TREATMENT RETENTION
NUTRITIONAL PATHWAY
• Macronutrient, Micronutrient Deficiency

MENTAL HEALTH PATHWAY
• Anxiety
• Worse Mental Health Status
• Drug and alcohol use

BEHAVIORAL PATHWAY
• Non-Adherence
• Treatment Interruptions
• Missed Clinic Visits

WORSE VIRAL SUPPRESSION
LOWER CD4

HIV MORBIDITY & MORTALITY
HIV TREATMENT CASCADE
IMPACT OF FOOD INSECURITY

- More likely to be infected
- More likely to miss clinic visits and be lost to f/u
- Lower ART adherence
- Earlier death from HIV/AIDS
- Lower VL suppression
- Lower ART
- Undetected VL
- Longevity

In Atlanta:

- Food insecure individuals less likely to achieve high adherence (AOR=0.3, 95% CI=0.1-0.8)

- Food insecurity was independently associated with lacking access to ART and poor ART adherence after adjusting for multiple SES measures.

In San Francisco, severely food insecure patients were less likely to achieve 80% adherence (Fig 1).

In France: Food privation led to increased odds of ART non-adherence (AOR=2.4; 95% CI=1.5-3.7).

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1) Kalichman, Prevention Science, 2011
2) Kalichman et al. J Community Health 2014
4) Weiser, JGIM, 2009
<table>
<thead>
<tr>
<th>Location</th>
<th>Population Sample size</th>
<th>Food Insecurity Measure</th>
<th>Evidence for ART non-adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameroon¹</td>
<td>Rural &amp; urban N= 2381</td>
<td>&lt;2 meals/day</td>
<td>1.93 (1.44-2.57)* AOR</td>
</tr>
<tr>
<td>DRC²</td>
<td>Urban N=898</td>
<td>HFIAS (mild, moderate, severe)</td>
<td>1.99 (1.36–2.90)***</td>
</tr>
<tr>
<td>Zambia³</td>
<td>Rural N=96</td>
<td>inadequate food in household over previous month</td>
<td>5.02 (1.81-13.76)* AOR</td>
</tr>
<tr>
<td>Ethiopia⁴</td>
<td>Rural N=348</td>
<td>&lt;3 meals/day</td>
<td>10.9 (1.3-81.4)*</td>
</tr>
</tbody>
</table>

• p< 0.05, ** p<0.01, ***p<0.001
Food insecurity & non-adherence (<90%)

Longitudinal Evidence: Uganda, San Francisco

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UGANDA&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Any food insecurity</td>
<td>1.56 (1.10 – 2.10)*</td>
</tr>
<tr>
<td>Homeless</td>
<td></td>
</tr>
<tr>
<td>Illicit drug use</td>
<td></td>
</tr>
<tr>
<td>Heavy drinking</td>
<td>2.56 (1.41-4.66)**</td>
</tr>
<tr>
<td>Employed</td>
<td>0.58 (0.45-0.76)**</td>
</tr>
<tr>
<td>Asset index</td>
<td>0.92 (0.85-0.99)*</td>
</tr>
<tr>
<td>CD4 nadir</td>
<td>0.99 (0.99 – 1.00)*</td>
</tr>
</tbody>
</table>

p< 0.05, ** p<0.01, *** p<0.001;

Uganda models also control for gender, age, and ART at baseline.

<sup>1</sup> Weiser, Palar, Frongillo et al. AIDS; 2014  
<sup>2</sup> Weiser, Yuan, Guzman et al, AIDS 2013
FOOD INSECURITY & ADHERENCE
SYSTEMATIC REVIEW

Global Evidence of Association between food Insecurity and ART non-adherence

Significant in Unadjusted analysis
Significant in Adjusted analysis

Wheeler A, Weiser SD, McCoy SI, 2013, Under review
## NON-ADHERENCE MECHANISMS: QUALITATIVE EVIDENCE

<table>
<thead>
<tr>
<th>Competing demands</th>
<th>Sometimes there is stress between my medical needs and my food needs, because I have to spend a lot on food, but for medications I must spend on them also and it's stressing me. – Patient, Uganda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intractable Hunger</td>
<td>The ARVs made me hungrier, even like you want to eat all the time... And two hours after taking ARVs, you're very hungry and feel like taking something. – Patient, Uganda</td>
</tr>
<tr>
<td>Meds without food lead to side effects</td>
<td>When I swallow medicine before I've had food, I feel dizzy in my eyes, but when I have eaten, there is no side effect... I also get slashing pains in my stomach when I take medicine without food. – Patient, Uganda</td>
</tr>
</tbody>
</table>

Weiser & Bangsberg Plos One 2010; Tuller & Weiser, AIDS & Beh 2009
Food insecurity is also a barrier to adherence and HIV outcomes in pediatric populations.

Mechanisms similar including competing demands, increased appetite on ARVs and worsened ARV side effects.

Caregiver disease burden may also affect adherence and care.

1. Vreeman, Qual Health Res, 2009; Fetzer, AIDS Patient Care & STDs, 2011
2. Mendoza et all 2013
3. Skovdal et al AIDS Care 2011
FI & ADHERENCE TO CARE among Pregnant PLHIV*

- Food insecurity may impede\(^1,2\): 
  - Adherence to weight gain recommendations 
  - Access to antenatal clinic visits 
  - Adherence to peri-natal/post-natal ARV prophylaxis and testing of infants 
  - All increase risk of vertical transmission 

- More research needed in this vulnerable population \(^2,3\)

2. Young& Weiser 2013
<table>
<thead>
<tr>
<th>Competing Demands</th>
<th>All participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 406)</td>
</tr>
<tr>
<td></td>
<td>(N (%))</td>
</tr>
<tr>
<td>Giving up medical care for food</td>
<td></td>
</tr>
<tr>
<td>Giving up ART for food</td>
<td>71 (17%)**</td>
</tr>
<tr>
<td>Giving up other medications for food</td>
<td>98 (24)</td>
</tr>
<tr>
<td>Giving up needed outpatient care for food</td>
<td>122 (30%)</td>
</tr>
<tr>
<td>Giving up needed inpatient care for food</td>
<td>131 (32%)</td>
</tr>
<tr>
<td>Giving up food for medical care</td>
<td></td>
</tr>
<tr>
<td>Giving up food for ART</td>
<td>349 (86%)</td>
</tr>
<tr>
<td>Giving up food to access outpatient care</td>
<td>325 (80%)*</td>
</tr>
<tr>
<td>Giving up food to access inpatient care</td>
<td>197 (49%)**</td>
</tr>
</tbody>
</table>

\(^1\) Weiser, Tsai, Frongillo Kawuma, Senkugu, Hunt, Martin & Bangsberg, AIDS 2012
NUTRITIONAL PATHWAY

- Malnutrition hastens progression to AIDS and death*

- Nutritional status (low BMI, weight loss and low albumin) predicts
  - opportunistic infections
  - immunologic decline
  - shorter survival time

- Food insecurity also associated with obesity which predisposes to cardiovascular risk **

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Food Insecurity linked with depression\textsuperscript{1,2} and worse overall mental health\textsuperscript{3}

Effects may be more pronounced in women\textsuperscript{2}

Depression and poor mental health status associated with worse virologic and immunologic outcomes
FOOD INSECURITY & HIV HEALTH OUTCOMES
### Food Insecurity & HIV Outcomes: Cross Sectional Evidence

<table>
<thead>
<tr>
<th>Population</th>
<th>Unsuppressed Viral Load</th>
<th>Low CD4 count (&lt;200 cells/μL)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>US National</strong> 1</td>
<td>1.37 (1.09 – 1.73) AOR</td>
<td>1.45 (1.14, 1.86) OR</td>
</tr>
<tr>
<td>Veteran HIV+ men &amp; women; n= 2353</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Atlanta</strong> 2, 3</td>
<td>1.7 (1.1–3.0) OR</td>
<td>2.2 (1.2–4.2) OR</td>
</tr>
<tr>
<td>HIV+ minority men &amp; women; n=268</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIV+ w/ alcohol use, n=183</td>
<td>2.96 (1.0–8.00) OR</td>
<td>--</td>
</tr>
<tr>
<td><strong>Houston</strong> 4</td>
<td>4.07(1.02-13.92) AOR</td>
<td>−0.23, (−0.40, −0.01) β (linear CD4)</td>
</tr>
<tr>
<td>HIV+ children; n=62</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>San Francisco</strong> 5, 6</td>
<td>72% lower odds of VL suppression</td>
<td>2.08 (1.09, 3.94)</td>
</tr>
<tr>
<td>HIV+ men &amp; women</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## FOOD INSECURITY & HIV HEALTH OUTCOMES

### Longitudinal Evidence:

<table>
<thead>
<tr>
<th>Location, Follow-up</th>
<th>Population</th>
<th>Unsuppressed Viral Load</th>
<th>Low CD4 count (&lt;200 or &lt;350 cells/μL)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uganda</strong>&lt;sup&gt;1&lt;/sup&gt; over 4 years</td>
<td>HIV+ men &amp; women; n=438</td>
<td>1.52 (1.18-1.96)** AOR</td>
<td>1.47 (1.24 – 1.74)** AOR</td>
</tr>
<tr>
<td><strong>San Francisco</strong>&lt;sup&gt;2&lt;/sup&gt; over 2 years</td>
<td>HIV+ minority men &amp; women; n=284</td>
<td>1.29 (1.04 –1.61)** AOR</td>
<td>1.26 (1.01 – 1.56)* AOR</td>
</tr>
<tr>
<td><strong>Boston</strong>&lt;sup&gt;3&lt;/sup&gt; over 10 years</td>
<td>HIV+ men &amp; women; n=592</td>
<td>Fl had less gains in CD4 count: 94 cell vs. 194 cell in food secure***</td>
<td></td>
</tr>
</tbody>
</table>

p< 0.05, ** p<0.01, ***p<0.001

### Food Insecurity & Acute Health Care Utilization, San Francisco

<table>
<thead>
<tr>
<th>Food security (HFIAS)</th>
<th>Hospitalizations AOR (95% CI)</th>
<th>ED Visits AOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food secure</td>
<td>REF</td>
<td>REF</td>
</tr>
<tr>
<td>Mild/moderately food insecure</td>
<td>1.56 (1.06, 2.30)*</td>
<td>1.57 (1.22, 2.03)***</td>
</tr>
<tr>
<td>Severely food insecure</td>
<td>2.16 (1.50, 3.09)***</td>
<td>1.71 (1.30, 2.25)***</td>
</tr>
<tr>
<td>Homeless</td>
<td>--</td>
<td>1.53 (1.03, 2.27)*</td>
</tr>
<tr>
<td>Illicit drug use</td>
<td>--</td>
<td>1.56 (1.18, 2.07)**</td>
</tr>
<tr>
<td>Months on ARV</td>
<td>--</td>
<td>1.06 (1.04; 1.07)***</td>
</tr>
<tr>
<td>CD4 nadir (in 100 cells/µL)</td>
<td>1.22 (1.38, 1.07)**</td>
<td>1.11 (1.22, 1.01)**</td>
</tr>
<tr>
<td>Depression (BDI score)</td>
<td>1.02 (1.01, 1.04)**</td>
<td>1.02 (1.01, 1.03)**</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01, ***p<0.001

1 Weiser, Hatcher, Frongillo, Riley & Bangsberg, Kushel, JGIM 2012
# Food Insecurity & Mortality

**British Columbia**\(^1,2\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Anema et al 2013 AHR (95% CI)</th>
<th>Weiser et al 2009 AHR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food insecure</td>
<td>1.95 (1.07–3.53)</td>
<td>1.51 (1.01-2.27)</td>
</tr>
<tr>
<td>Age (10yr increase)</td>
<td>1.27 (0.98–1.65)</td>
<td>1.05 (1.03-1.07)</td>
</tr>
<tr>
<td>Baseline CD4 (+100 cells)</td>
<td>0.96 (0.87–1.06)</td>
<td>0.80 (0.73-0.87)</td>
</tr>
<tr>
<td>History of IDU</td>
<td>n/a</td>
<td>3.30 (2.25-4.85)</td>
</tr>
<tr>
<td>Stable housing</td>
<td>--</td>
<td>0.89 (0.48-1.65)</td>
</tr>
<tr>
<td>Viral Load (Log10)</td>
<td>1.42 (1.12–1.80)</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Both models also controlled for sociodemographic factors, Weiser model also controlled for adherence, alcohol use

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\(^1\) Weiser et al., JAIDS 2009; \(^2\) Anema et al 2013 PLOS One
Food insecurity associated with:
- Worse ART adherence, missed clinic visits
- Worse virologic outcomes
- Worse immunologic response
- Increased hospitalizations
- Higher mortality
NEXT STEPS:

FOOD INSECURITY AND HIV/AIDS,
ADDRESSING THE CYCLE
INVESTIGATING MECHANISMS
NEED FOR LONGITUDINAL STUDIES

Longitudinal studies needed to assess pathways for how food insecurity contributes to:

- HIV acquisition
- Worse HIV treatment outcomes
- HIV co-morbidities (ex: diabetes, hypertension, cardiovascular disease)
- Inflammation/immune activation
POSSIBLE INTERVENTIONS

Targeted food supplementation

Livelihood/Vocational Training Programs

Food stamps/vouchers

Cash transfers
## Intervention and Policy Options by Pathway

<table>
<thead>
<tr>
<th>NUTRITIONAL PATHWAYS</th>
<th>BEHAVIORAL PATHWAYS</th>
<th>MENTAL HEALTH PATHWAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Obesity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNAP/food banks:</td>
<td>SNAP/food banks:</td>
<td>Adherence counseling</td>
</tr>
<tr>
<td>fruits, vegetables</td>
<td>high calorie/ nutrient dense food</td>
<td>Social work services or transport vouchers (to address competing demands)</td>
</tr>
<tr>
<td>Diet counseling:</td>
<td>Diet counseling:</td>
<td>Mental health counseling and referral</td>
</tr>
<tr>
<td>decreasing fat intake</td>
<td>Increasing caloric nutrient intake</td>
<td>Substance abuse counseling and referral</td>
</tr>
<tr>
<td>Exercise program for weight loss</td>
<td>Improved access to soup kitchens, meal delivery</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Undernutrition</th>
<th></th>
<th></th>
</tr>
</thead>
</table>

### Immunologic Mediators

- Interventions to decrease immune activation/inflammation;
- (e.g., pre or probiotics, nutritional supplementation, earlier initiation of ART among food insecure individuals)

### Both Behavioral and Mental Health

- Improve access to SNAP (income transfer for food) to decrease competing demands and anxiety over food supply
- Skills and vocational training to decrease reliance on any type of food support
NEED FOR INTERVENTION RESEARCH TO UNDERSTAND:

- Whether improving food insecurity improves HIV outcomes, and which outcomes will be effected?
- How long to continue food support programs?
- Which programmatic options will be most effective/cost-effective?

Expected to vary with country/context
IMPACT ON ADHERENCE OF FOOD SUPPORT INTERVENTIONS

Zambia: 70% of patients in food supplementation group vs. 48% in controls achieved >95% adherence (RR 1.5; 95% CI 1.2-1.8)\(^1\)

Kenya: Qualitative study found greater ART adherence and fewer treatment side effects among patients enrolled in food support program \(^2\)

Haiti: In a cohort study, food assistance associated with fewer missed clinic visits and reported fewer problems taking ART up to 12 months after the intervention, in addition to experiencing improved food security and BMI.\(^3\)

Honduras: Monthly food basket led to 19.6% greater improvement in on-time prescription refills at 6 months over nutritional education (NE) alone.\(^4\)

5 out of 6 studies among adults and children in 5 countries found that provision of food can improve ART adherence.

De Pee et al. AIDS and Behavior 2014
SOCIAL PROTECTION APPROACHES: MOVING TOWARD LONG-TERM STRATEGIES

Interventions

- Macronutrient/Micronutrient supplement
- Social Transfers or Incentives
- Livelihoods

Scope

- Short-term
- Medium-term
- Long-term
ENGAGING MULTIPLE SECTORS
SOCIAL PROTECTION APPROACHES TO FOOD SECURITY

Interventions
- Direct Food Aid
- Food/ Cash Transfer, or Incentives
- Livelihoods
- Assessing Impact

Sectors
- Health, NGOs
- Health, NGOs
- Health, NGO, Agriculture Microfinance
- Policy

Food Insecurity
- Agricultural systems, poverty, gender

Malnutrition

Food insecurity
“Farm Life” in Kiswahili
Targets poverty & agriculture
2 clusters; n=140 people

**Intervention components:**
- Microfinance
- Agricultural/finance training
- Micro irrigation pump
SHAMBA MAISHA: IMPROVING FOOD SECURITY OF HIV-INFECTED KENYANS
PRELIMINARY QUALITATIVE RESULTS
SHAMBA MAISHA, KENYA (NIMH R34)

Behavioral:
- Improved clinic attendance
- ART adherence

Nutritional:
- More fruits and vegetables
- Gaining weight

Mental health:
- Less stress/depression, more hope

Empowerment:
- Self-sufficiency increased
- Decision making power among women improved
SHAMBA MAISHA:
REDUCED HOUSEHOLD FOOD INSECURITY

Trial Time, Month

Household Food Insecurity

-1.06, p=0.142
-2.31, p=0.002
-2.572, p<0.001
-3.69, <0.001

- Control
- Intervention

Household Food Insecurity - 1.06, p=0.142
-2.31, p=0.002
-2.572, p<0.001
-3.69, <0.001
SHAMBA MAISHA:
INCREASED CD4 COUNT

Trial Time, Month

59.13, p=0.18
170.0, p<0.001
SHAMBA MAISHA:
INCREASED VIRAL SUPPRESSION (VL<40)

Proportion with VL<40

Trial Time, Month

Control
Intervention

1.85, p=0.003
2.03, p=0.002
SUMMARY

- Food insecurity and HIV interact in vicious cycle
  - Many points of intervention to interrupt cycle
  - Ensuring food security can enable, multiply, and sustain benefits
- Upstream/midstream/downstream interventions:
  - Food support needs to be linked to longer-term livelihood supports
Addressing fundamental human rights, such as access to food, should be an integral component of HIV programs serving impoverished populations worldwide.
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**Research Coordinator:** Manali Nekkanti