

THE LINK BETWEEN FOOD SECURITY AND HEALTH AMONG PEOPLE  
LIVING WITH HIV/AIDS IN DELHI, INDIA

BY

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THESIS

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## Table of Contents

1. Introduction.....	1
2. Nutrition and HIV .....	4
2.1. <i>Weight Loss and Wasting</i> .....	4
2.2. <i>Micronutrients</i> .....	6
2.3. <i>Nutrition and ART</i> .....	7
3. The Socioeconomic Context of HIV and Nutrition .....	9
3.1. <i>Food Security</i> .....	9
3.2. <i>Food Security and HIV</i> .....	9
4. Methods.....	12
4.1. <i>Measuring Food Insecurity</i> .....	12
4.2. <i>Study Design</i> .....	14
5. Descriptive Statistics.....	16
5.1. <i>EHA Data Summary</i> .....	16
5.2. <i>Prevalence of Food Insecurity</i> .....	27
5.3. <i>Relations with Other Variables</i> .....	33
5.4. <i>Comparison with NFHS Data</i> .....	37
6. Food Security and Health – the Link .....	53
6.1. <i>Health Production</i> .....	53
6.2. <i>Estimation Issues for Food Security and Health</i> .....	59
6.3. <i>The Model</i> .....	61
6.4. <i>Results and Discussion</i> .....	67
6.4.1. <i>Determinants of Food Insecurity</i> .....	67
6.4.2. <i>Mental Illness Production Function</i> .....	69
6.4.3. <i>Tuberculosis Production Function</i> .....	72
6.4.4. <i>Opportunistic Infection Production Function</i> .....	75
6.4.5. <i>“Too Sick to Work” Production Function</i> .....	77
7. Conclusion .....	80
Appendix A: The Survey Instrument.....	83
Appendix B: Staging Criteria.....	97
Works Cited .....	99

## **1. Introduction**

While HIV/AIDS is well-known as a devastating disease, there is less agreement over the proper care for people with HIV. Much of the current discussion revolves around the importance of specific medical treatments, especially antiretroviral therapy, and the methods for increasing access to these medications. Without denigrating the role of medical treatment for people with HIV, however, many practitioners and researchers are becoming increasingly concerned that care for people living with HIV (PLWHA) should be more comprehensive, taking into account the social and economic context in which the disease affects individuals, households and communities. UNAIDS (2006) notes that care for PLWHA entails adequate nutrition, treatment of tuberculosis and opportunistic infections, managing the side effects of treatment, and psychosocial support. In a similar spirit, Kadiyala and Gillespie (2003, 17) advise that home-based care for PLWHA

be a holistic package that includes (1) health (basic drugs and hygiene), nutritional, and psychological support to the sick individual; (2) guidance to caregivers in taking care of the sick, HIV prevention, and nutrition education; and (3) linking household members to other types of programs, such as food for training and education, that could improve their income-generating capacity.

In light of the need for a more expansive concept of care, Gillespie and Kadiyala (2005, 2) warn that, “[w]hatever the effectiveness of the highly publicized but slow-moving roll-out of antiretroviral therapy, a much larger and more comprehensive response is needed from many quarters”.

In the absence of widely-available medical treatment, and alongside what is currently available, communities and NGOs are providing this more comprehensive care for those in their midst suffering with HIV/AIDs. Important in the implementation of such care is nutritional support. One example of a program offering nutritional support

was the (currently discontinued) Interinstitutional Alliance for the Improved Nutrition of People Living with HIV/AIDS (IMANAS) Project in Honduras. This project supplied people receiving antiretroviral therapy with a monthly food basket. Those who received the food basket appeared to be healthier than before the initiation of the program, but it was not clear whether this was due to the food or to the medications, counseling and other services (McNamara 2005). Another example of a food assistance program is a World Food Programme (WFP) project in Kenya. The project provides a daily ration to households that are both affected by HIV and food insecurity, and intends to complement “other mitigation activities such as ARV provision, treatment of opportunistic diseases, psychosocial support activities, and longer-term efforts to improve the food security of HIV/AIDS-affected households” (World Food Programme 2005, 2). A report found that participation in the program significantly increased the likelihood of meeting caloric intake requirements, and participants’ health improved from before the program (World Food Programme 2005). While these studies are suggestive, there is as yet little quantitative evidence that links access to food and health outcomes in the context of HIV.

There is also little research into the dynamics of care for people with HIV in India. Although most of the attention regarding HIV has focused on the impact on Sub-Saharan Africa, India also has significant numbers of people with HIV that need care. According to the latest Indian National AIDS Control Organisation (NACO)/UNAIDS estimates (UNAIDS 2007), India has approximately 2.5 million people living with HIV infection. The complexity of the disease in India makes care and treatment difficult. HIV prevalence in India is concentrated in six states in the south, west, and northeast, where the prevalence is four to five times higher than in other Indian states. Most of the

transmission seems to be between sex workers and their clients, and then between the clients and their sexual partners such as spouses. Thus many of the women who are infected have been infected by their partners. In the northeast, however, intravenous drug use is a major risk factor for infection, and this dimension is increasingly seen in the HIV epidemics in major cities such as Delhi (UNAIDS 2006).

Due to the growing understanding of nutrition and food security, I will look at whether reductions in food security are related (in a statistically significant manner) with improvements in health outcomes for people living with HIV. Since less is known about care for people with HIV in India, I will focus on a study conducted in Delhi, India. I will first summarize current knowledge on the medical and socioeconomic linkages between food security and HIV. Then I introduce the research study and data used in this analysis, describing the nature of food security in this sample as well as comparing these data with other data from India. I then turn to quantifying the relationship between food security and mental health, presence of tuberculosis, presence of opportunistic infections, and being too sick to work. Finally, I conclude with implications of the results and directions for further research.

## **2. Nutrition and HIV**

### *2.1. Weight Loss and Wasting*

Obtaining sufficient amounts of nutritious food is essential in caring for PLWHA. Before looking directly at why this is so, it is necessary to understand the progression of HIV/AIDS. HIV starts out as an acute infection, in which the disease causes symptoms that clear up within one to six weeks after infection. The body then starts producing antibodies to HIV in the stage called seroconversion. After this is a prolonged period, usually lasting several years, in which the individual experiences no symptoms. However, HIV gradually eats away at the immune system, decreasing its ability to fight off infection. In time, the immune system becomes so weakened that symptoms of infection appear. When the immune system is sufficiently weakened, the condition is officially known as AIDS.

Wasting and weight loss is perhaps the most obvious effect of HIV. This condition begins in the asymptomatic period and occurs as the result of three processes: reduction in food intake, nutrient malabsorption, and metabolic alterations (Piwoz and Preble 2000). First, PLWHA experience a decrease in the food intake. This can occur for a variety of reasons. For example, the weakening of the immune system can lead to sores in the mouth, making it painful to eat. In addition, the individual may experience a loss of appetite due to psychological factors, or may not be able to obtain the necessary food because of, for example, the inability to work. Reduction in food intake is often the most important causes of gradual weight loss associated with HIV (Piwoz and Preble 2000).

Even if the individual can eat, however, it is not certain that the food will be able to nourish the body, because with HIV/AIDS the body often does not properly absorb the

nutrients. HIV/AIDS infection also increases the nutritional requirements of PLWHA, and so decreases the time in which nutrients are used up. This change in the metabolism of PLWHA increases the need for food and proper nutrition at the same time that food intake is decreasing and the body is not fully taking in the nutrition from the food. These processes contribute to a decline in weight and strength for PLWHA, which can be exacerbated by secondary infections (Piwoz and Preble 2000).

The malnutrition and wasting caused by HIV/AIDS infection can be devastating for PLWHA as well as the entire family. Studies have shown that protein-energy malnutrition lowers the chances of survival for PLWHA (Gillespie and Kadiyala 2005). While the individual is alive, malnutrition introduces the individual to a vicious cycle in which the disease leads to decreased physical activity, and this in turn leads to a lack of resources to pay for food and care, causing PLWHA to be weakened further (Baylies 2002; Murphy et al. 2005). Not only then are PLWHA unable to “provide for themselves and their dependents”, but they also require care, decreasing the ability of their caretakers to provide for themselves and the PLWHA (Piwoz and Preble 2000).

Management of the weight loss due to HIV/AIDS is dependent on the source of this weight loss. In order to counter reductions in food intake, it may be necessary to treat the cause of the reduction. This could entail, for example, treating sores in the mouth. In addition, the requisite food to which the PLWHA is unable to obtain access could be provided. Food and nutrition supplementation programs aim to do exactly this. Effective treatments that reduce weight loss and wasting include oral nutrition supplements combined with dietary counseling (Berneis et al. 2000), recombinant human growth

hormone, testosterone and anabolic steroids (Moyle et al. 2004), and nutritional counseling (Tabi and Vogel 2006).

However, it is important to note some caveats related to supplementation programs aimed at reducing weight loss. If the weight loss is due to metabolic changes, Piwoz and Preble warn that “weight loss and wasting...cannot be reversed by feeding alone.” As noted above, however, reductions in food intake are the most important cause of weight loss. Feeding programs also tend to increase body fat, and do not always build body cell mass or muscle, which is vital for survival (Piwoz and Preble 2000; Gillespie and Kadiyala 2005). These factors constrain the possible benefits of feeding programs for the survival and healthy living of PLWHA.

## *2.2. Micronutrients*

In addition to causing wasting, malnutrition can also contribute to the progression of HIV. The lack of sufficient food intake and proper nutrient absorption leads to a lack of the proper micronutrients necessary for the proper functioning of the immune system. This can lead to advanced progression of HIV and increased morbidity (Semba and Tang 1999). While this suggests that micronutrient supplementation could be useful in caring for PLWHA in resource-poor settings where access to ARTs is limited, the results of supplementation trials have been mixed (Piwoz and Preble 2000).

Furthermore, Loevinsohn and Gillespie (2003, 24) caution against an “overly reductionist” view that would emphasize micronutrients over macronutrients such as protein and energy. They stress that, while “micronutrient supplementation may have an important role within the overall nutritional response to HIV/AIDS, *food* is a crucial



requirement – not least because the disease significantly raises energy and protein requirements that cannot be met by pills alone.” This research on the role of micronutrients in fighting HIV does, however, underscore the importance for PLWHA of obtaining proper food diversity as well as the needed food quantity.

### *2.3. Nutrition and ART*

Not only does malnutrition lead to weight loss in PLWHA, but it also influences the effectiveness of ART. Without elaborating on the causes of malnutrition, a recent study in Singapore found evidence that lower body weight and body mass index were associated with decreased survival in patients receiving ART (Paton et al. 2006).

Commenting on the causes for the relationship between food security and ART efficacy in developing nations, Loevinsohn and Gillespie (2003) note that the treatment often needs to be taken on a full stomach, which could be problematic for many who are food insecure. In addition, different ARTs need to be taken with different types of foods.

However, those living in resource-poor settings “may often be unable to follow optimal food and nutrition recommendations for ARVs due to lack of access to the foods required” (Castleman et al. 2004, 12). Thus those who adhere to the ART regimen will receive less benefit if they cannot obtain the necessary food.

Lack of food can also lead to the individual not adhering to the drug regimen, which for obvious reasons would significantly reduce ART efficacy. Indeed, Marston and DeCock (2004) report that focus groups conducted in a Nairobi slum listed the most likely cause of nonadherence to antiretroviral drug therapy as lack of food. They further note that “there truly is irony, not captured in the language of treatment advocacy, in

providing antiretroviral drugs to populations that lack access to safe water or food”

(Marston and DeCock 2004, 79). The degree that nutrition and food security contribute to treatment efficacy, however, is still largely unknown (Loevinsohn and Gillespie 2003).

### **3. The Socioeconomic Context of HIV and Nutrition**

#### *3.1. Food Security*

*Food security* is often defined as “When all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life” (USAID 1992, 1). Barrett (2002) observes that malnutrition and hunger are consequences of food insecurity, but one may be food insecure without experiencing these effects. While hunger is a physiological sensation related to food insufficiency, malnutrition is not a uniform concept. Deficiencies in macronutrient consumption lead to protein energy malnutrition, while insufficient micronutrient consumption leads to micronutrient malnutrition. Piwoz and Preble (2000) observe that protein energy malnutrition is almost always associated with micronutrient malnutrition, but the opposite is not true. Thus, food security is a complex variable and many factors contribute to a household’s or an individual’s food security (Barrett 2002).

#### *3.2. Food Security and HIV*

Food insecurity is not only detrimental to those who already have HIV, but to those who are at risk in contracting the disease. Gillespie and Kadiyala (2005) detail how food insecurity makes one more susceptible to contracting HIV by compromising the immune system, leading to higher transmission rates, as well as by leading people to undertake riskier actions. For example, Weiser et al. (2007) find in a study of Botswana and Swaziland adults that women who report food insufficiency are much more likely to report risky sexual behaviors. On the basis of these results, Rollins (2007) suggests that food or hunger interventions may be essential components of HIV prevention strategies.

A household that experiences food insecurity, therefore, is at greater risk of being affected by HIV.

While several studies have documented these interactions of HIV and food insecurity, it is not clear how prevalent food insecurity is for households with HIV. Wiig and Smith (2007) find that over half of a sample of 50 HIV-positive patients in Ghana report that food security was a problem. Bukusuba, Kikafunda, and Whitehead (2007) measure food insecurity for a random sample of 144 households in Uganda in which an adult member had HIV. They find that most of the households eat less preferred foods, reduce the meal portion sizes, borrow food or money, skip meals, and many also skip eating the whole day. Since these coping strategies occur when a household is unable to obtain sufficient food, their prevalence is a good indicator that food security is a significant problem for these households affected by HIV. Normén et al. (2005) find that almost half of a sample of HIV-positive individuals eligible for ART in British Columbia, Canada were food insecure as identified by a modified Radimer/Cornell questionnaire (Kendall et al., 1995). Around 20 percent of the sample reported hunger, the most severe result of food insecurity. These studies suggest that food security is an issue for households in the Sub-Saharan African context, but to my knowledge no study has looked at food security among households affected by HIV in India.

By improving the food security situation of households affected by HIV, therefore, the hope is that health outcomes for PLWHA will be improved as well. If food and nutrition supplementation can mitigate the detrimental effects of HIV on health outcomes, individuals with the disease might live longer and more productive lives (Loevinsohn and Gillespie 2003). Future generations will benefit from people with HIV

living longer, as the people with HIV will be able “to pass on important skills and knowledge to their children, plan for their children’s future, prepare their children psychologically, and delay their orphanhood” (Kadiyala and Gillespie 2003, 17). They may also be better able to provide for themselves and their families, ensuring that their children do not suffer from malnutrition. Thus food and nutrition supplementation may enable households and PLWHA to break the vicious cycle of disease and malnutrition. Given the potential benefits of increased food security for PLWHA, Kadiyala and Gillespie (2003, 17) optimistically observe that “[f]ood indeed may very well be their most important medicine.”

While these are big claims for food supplementation programs, there is little information on size of the relationship between food insecurity, and the remedy of food assistance, and health outcomes for PLWHA. Recent evidence from Boston suggests that food and nutrition supplementation can restore to natural levels the weight and BMI of those with HIV who are also taking some type of ART (Mangili et al. 2006). However, less is known about the effects in developing nations where ART is not prevalent. Piwoz and Preble (2000, 13) lament that, in the case of Africa, although many have noted that malnutrition can be caused by HIV/AIDS, “the extent to which nutrition therapy can positively alter the course of HIV disease among PLWHA...is largely unknown.” Given the importance of nutrition for PLWHA, as well as the recent interest in providing this care, understanding the size of this relationship would have important implications for policy priorities in caring for PLWHA.

## 4. Methods

### 4.1. *Measuring Food Insecurity*

A first step in estimating the relationship between food insecurity and health for PLWHA is measuring food insecurity. Due to its complex nature, food insecurity is often measured using directly observable indicators of food insufficiency, hunger, or malnutrition. These include physiological measures or information from respondents on food insufficiency or intake. However, the physiological indicators measure *ex post* outcomes and should not be confused with the *ex ante* condition of food insecurity. Also, information from respondents on food insufficiency or intake is often of questionable reliability and is expensive and time consuming to gather (Barrett 2002; Hoddinott and Yohannes 2002). Taking into account its complex nature, recent research by the USAID-funded Food and Nutrition Technical Assistance Project (FANTA) has attempted to develop an indicator that directly measures household food insecurity. This research has developed a Household Food Insecurity Access Scale (HFIAS), and has also identified other indicators of household food insecurity including the Household Dietary Diversity Score (HDDS) (Swindale and Bilinsky 2006a).

The HFIAS is an adaptation of the U.S. Household Food Security Survey Module (US HFSSM). The US HFSSM is an eighteen-question survey that elicits responses describing the behaviors and attitudes of respondents relating to different aspects of the food insecurity experience. Field testing the US HFSSM approach in developing nations and using and adapting the revised versions in developing nation contexts resulted in a nine-question survey covering three aspects of the food insecurity experience (Swindale and Bilinsky 2006a). Coates et al. (2006) provide evidence of the applicability of the

HFIAS measure across cultures to measure access to food at the household level in different international settings. Table 1 shows the food insecurity domains and questions covered by the HFIAS. The generic survey questions can be adapted to specific contexts. Categorical answers (never, rarely, sometimes, often) are given numerical values and summed to yield a score indicating the level of food insecurity. Households can also be classified as food secure, mildly food insecure, moderately food insecure, and severely food insecure based on combinations of their responses to all of the questions (Coates, Swindale, and Bilinsky 2006).

Table 1: HFIAS Domains and Generic Questions

For each of the following questions, consider what has happened in the past 30 days.
A. Anxiety and uncertainty about household food access:
1. Did you worry that your household would not have enough food?
B. Insufficient quality (includes variety, preferences, and aspects of social acceptability):
2. Were you or any household members not able to eat the kinds of foods you preferred because of a lack of resources?
3. Did you or any household member eat just a few kinds of food day after day because of a lack of resources?
4. Did you or any household member eat food that you did not want to eat because of a lack of resources to obtain other types of food?
C. Insufficient food intake and its physical consequences:
5. Did you or any household member eat a smaller meal than you felt you needed because there was not enough food?
6. Did you or any household member eat fewer meals in a day because there was not enough food?
7. Was there ever no food at all in your household because there were no resources to get more?
8. Did you or any household member go to sleep at night hungry because there was not enough food?
9. Did you or any household member go a whole day without eating anything because there was not enough food?

*Adapted from Swindale and Bilinsky (2006)*

#### 4.2. *Study Design*

The data used in this study are the product of a research partnership between researchers from the University of Illinois at Urbana-Champaign and researchers and physicians with Emmanuel Hospital Association (EHA). Founded as a network of former mission hospitals, EHA developed into a respected provider of health care in north India with a focus on providing care to the poor. Shalom Delhi is an EHA clinic in Delhi that cares for people with HIV/AIDS from Delhi as well as surrounding states. The Shalom clinic offers inpatient and outpatient medical care, as well as a home-based care program providing emotional, spiritual and often livelihood support such as food baskets or assistance in finding a job. Patients usually come to the Shalom clinic because they are referred to Shalom by a government hospital for further care. The government provides testing and ARTs at government hospitals to anyone with HIV who meets the ART initiation criteria. Therefore, the Shalom clinic does not provide ARTs, but instead provides care in managing opportunistic infections and other health problems. If a patient is very sick, often the clinic will admit him or her into the ward until the patient is well enough to return home. The patients usually pay part of the cost of medications and services, based on what the physician thinks the family can pay.

We collected surveys among patients and home care recipients starting from April 2007. Any patient who was HIV-positive and over 18 years of age was eligible and was asked to participate in the survey. As of March, 2008, 258 surveys had been completed. The surveys included questions on the participant's health, household food security, household characteristics and other dimensions of their household's socioeconomic status. The second part of the survey was filled out by the enumerator while discussing



the questions with the patient in Hindi. The enumerator then filled out the first part of the survey from the patient's medical records after the patient's visit. Thus the survey consisted of matching the patient's medical records with their responses to the questions in the second part of the survey. The survey instrument can be found in Appendix A.

## **5. Descriptive Statistics**

### *5.1. EHA Data Summary*

Table 2 presents basic social and demographic information on the 258 respondents who answered the survey. Over half of the respondents were male. Approximately half of the respondents were under 33 years of age. Almost one quarter were either illiterate or had no schooling at all, and most of the respondents had an education level no higher than Grade 9. One in four participants was a single parent, and most of the single parents were women. One fifth of the respondents' households had no children at all, while around the same percent had one child. Almost 30 percent of the households had two children, and a comparable percent had three or more children.

The respondents reported a variety of sources of livelihood for their households (see Table 3). Salaried employment and private transfers including from family members were stated most frequently, followed closely by casual labor. A number of respondents reported multiple sources of household livelihood. For example, twenty-nine persons indicated both salaried employment and private transfers as sources of household livelihood.

Table 2: Sociodemographic Characteristics

		Frequency	Percentage
<b>Sex</b>			
n=258	Male	150	58.1
	Female	108	41.9
<b>Age</b>			
n=254	18-28	59	23.2
	29-33	69	27.2
	34-37	62	24.4
	38+	64	25.2
<b>Education</b>			
n=255	Illiterate	24	9.4
	Literate, no schooling	39	15.3
	Less than Grade 5	15	5.9
	Grade 5 - Grade 9	94	36.9
	Matriculate	51	20.0
	Intermediate	20	7.8
	B.A./B.Sc.	9	3.5
	M.A./M.Sc.	3	1.2
<b>Single parents</b>			
n=257	Female	50	19.5
	Male	14	5.4
	Total	64	24.9
<b>Number of children in household</b>			
n=258	0	55	21.3
	1	51	19.8
	2	74	28.7
	3	42	16.3
	4	26	10.1
	5+	10	3.9

At the individual level, many of the respondents reported sickness, disability and unemployment. Of 257 usable responses to the individual activity question, 54 (21.0 percent) stated they were too sick to work, 2 (0.8 percent) reported being disabled, and 11 (4.3 percent) indicated being institutionalized at a drug rehabilitation center. For people reporting paid-employment, salaried employment (21.0 percent) was the most frequent response, followed by casual labor at 17.1 percent of respondents. Of the 108 female respondents to the individual activity question, 48 (44.4 percent of the women) reported domestic work within the household as their primary activity. The remaining responses for both men and women were 10 (3.9 percent) unemployed and looking for work, 6 (2.3 percent) in agriculture, 11 (4.3 percent) in petty business, 3 (1.2 percent) retired or too old, and 4 (1.6 percent) as other.

To measure household wealth, income and relative economic position, we used an asset index. A similar asset index is used by Filmer and Pritchett (2001) as a measure of wealth in the absence of household consumption data. They use principal components analysis to construct an asset index from data on consumer durables owned by the household, household dwelling characteristics, and household landownership. Filmer and Pritchett then verify its utility using Indian data from the National Family Health Survey (NFHS).

Table 3: Sources of Household Livelihood

Activity	Frequency	Percent*
Casual labor	62	24.0
Salaried employment	121	46.9
Agriculture	13	5.0
Petty business	21	8.1
Charity/alms	12	4.7
Property, land rentals	4	1.6
Public transfers/pensions	14	5.4
Private transfers (incl. family support)	70	27.1
Other	5	1.9

n=258

*Note* : Some individuals reported multiple livelihood sources

\*Percent of total households (258), not of total positive responses

Using the approach implemented by Filmer and Pritchett, the asset index was created using principal components analysis to determine the weights on the positive responses to the question “Does your household own any of these items?” The assets were as follows: radio/cassette/cd player; camera/camcorder; bicycle; motorcycle/scooter; motorcar; refrigerator or freezer; washing machine; fan; heater or cooler; black and white television; color television; pressure lamp; telephone or mobile phone; sewing machine; pressure cooker; watches; and air conditioning. Unlike the index created by Filmer and Pritchett, our asset index does not include household dwelling characteristics or landownership. Table 4 displays the weights from the first component obtained using principal components analysis. The first component explains 23 percent of the variation in asset ownership. The median of the 244 useable responses that form this

index is 0.10, and the mean is zero. At the 75<sup>th</sup> percentile the value of the index was 1.19 and at the 25<sup>th</sup> percentile the asset index value was -1.58. Figure 1 shows in more detail the distribution of the asset index. Some of the most common assets held by the households include: watches (208 households); pressure cookers (235 households); fans (238 households); heaters/coolers (146 households); color televisions (158 households); pressure lamps (142 households); and, telephones/mobile phones (133 households).

Table 5 displays further socioeconomic data on the sample. We asked a series of household monthly expenditure questions to the respondents in order to gauge household spending on broad budget categories such as food, health, and housing. The largest budget category for spending proved to be the food expenditure category where the median monthly expenditure was 2,000 rupees. Health expenditures were significant for many households in the survey, with the median spending at 300 rupees per month and the value at the 75<sup>th</sup> percentile at 500 rupees per month. While more than half of the households in the survey did not spend money on a house payment or rental payment for housing (165 out of 250 respondents owned their housing), at the 75<sup>th</sup> percentile the spending was 700 rupees per month on housing.

Table 4: Asset Index Weights

Asset	Weight
Color television	0.36
Radio/cassette/CD player	0.32
Camera/camcorder	0.21
Pressure lamp	-0.19
Telephone/mobile	0.32
Bicycle	0.03
Motorcycle	0.24
Sewing machine	0.13
Motor car	0.23
Pressure cooker	0.14
Refrigerator	0.34
Watches	0.24
Air conditioning	0.23
Fan	0.17
Heater/cooler	0.33
Black and white TV	-0.13

Figure 1: Asset Index Histogram

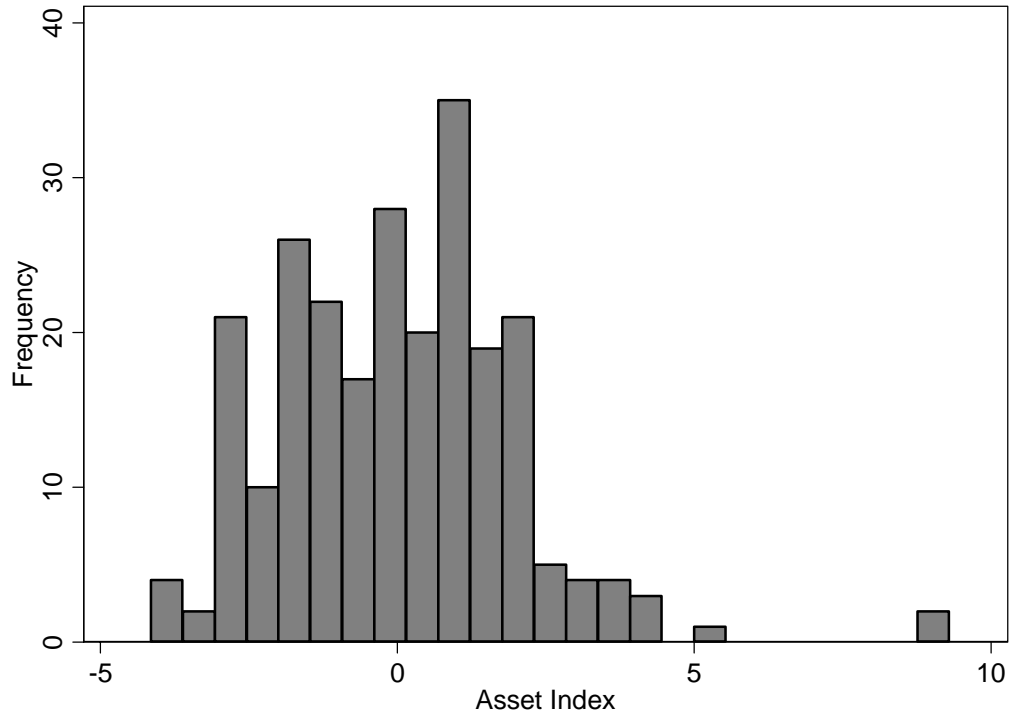


Table 5 also reports on measures of health status for the respondents. While all of the respondents were HIV-positive, around half of the respondents reported taking antiretroviral drugs at the time of the survey. Slightly less than half of the respondents with available opportunistic infection data had tuberculosis within the past six months, and over one-fifth had no opportunistic infections. One in three respondents had one opportunistic infection, one quarter had two opportunistic infections, while almost one-fifth had three or more. Although height measures are not available for many of the survey respondents, height and weight was present for 208 of the study participants. The median BMI for the study participants was 19.4 and at the 25<sup>th</sup> percentile the BMI was 17.4.



The World Health Organization defines the normal BMI range as 18.5 to 24.99 (WHO 2008). Underweight is defined as a BMI under 18.50 and overweight is defined as 25.0 and over. Thus the median patient in our sample has a BMI on the lower end of normal, and the patient at the 25<sup>th</sup> percentile is underweight. This can also be seen in Figure 2, the histogram of the BMI. Most of the patients have a BMI towards the lower end of the normal range and in the underweight range. Specifically, 76 (36.5 percent) are underweight while 30 (14.4 percent) are overweight.

In addition to physical health measures, we measured the general mental health of the participants. We used an instrument for measuring nonspecific mental illness developed by Kessler et al. (2003) called the K6. The instrument asks respondents how often in the past 30 days he or she has felt nervous, hopeless, restless, depressed, worthless and that everything was an effort. Summing the responses to these questions yields a score ranging from zero (mentally healthy) to 24 (very probable serious mental illness). In addition to its use in studies of mental illness in the U.S., the K6 and its longer cousin the K10 have been used in estimates of the prevalence of non-specific mental illness in Canada (Veldhuizen et al. 2007), Australia (Baillie 2005), Burkina Faso (Baggaley et al. 2007) and India (Patel et al. 2008). It is also being used in the World Health Organization World Mental Health Surveys (Kessler and Üstün 2004). Figure 3 shows the distribution of the score for our sample. Most of the sample has a score between 10 and 15. Both the median and mean score is 12. Kessler et al. (2003) suggest an optimal cut-point of 13 (a score over 13 indicates serious mental illness) to estimate the prevalence of serious mental illness in the U.S. population. No cut-off points have been estimated for the context of developing nations, but if we assume similar rates of

mental illness, this would suggest that 105 patients out of 248 with full mental health data (42.3 percent) are at risk for serious mental illness. Even with different rates and a different cut-point, mental illness appears to be a serious problem in this sample.

Thus, the survey respondents represent a mix of predominantly urban-dwelling HIV-positive adults. Based upon the asset index measure and the monthly expenditures evidence, it is evident that poverty is the reality of the majority of study participants. In addition, the health measures suggest that illness and undernutrition are prevalent in this sample.

Figure 2: Body Mass Index Histogram

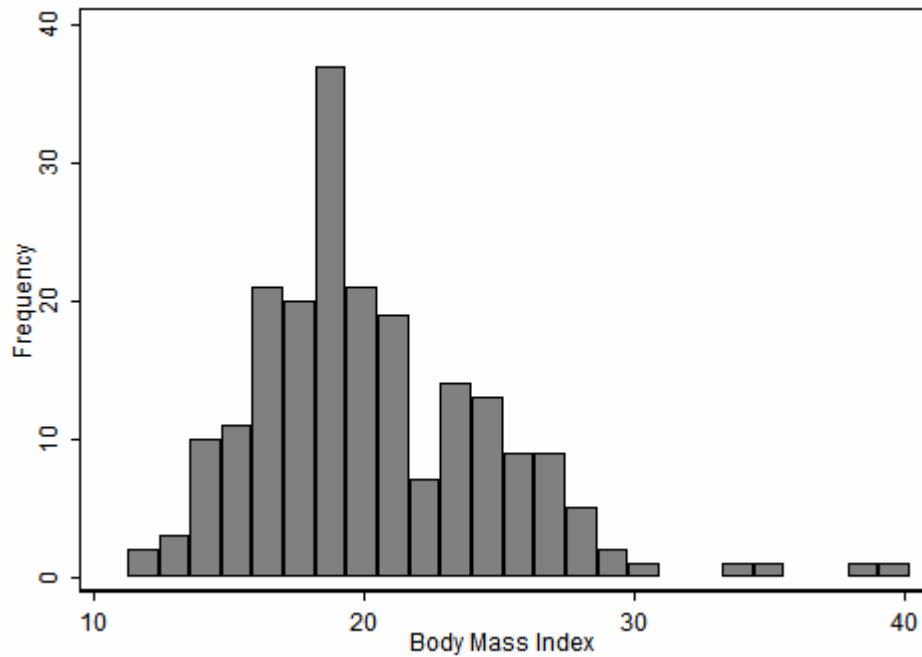


Figure 3: Mental Illness Scale

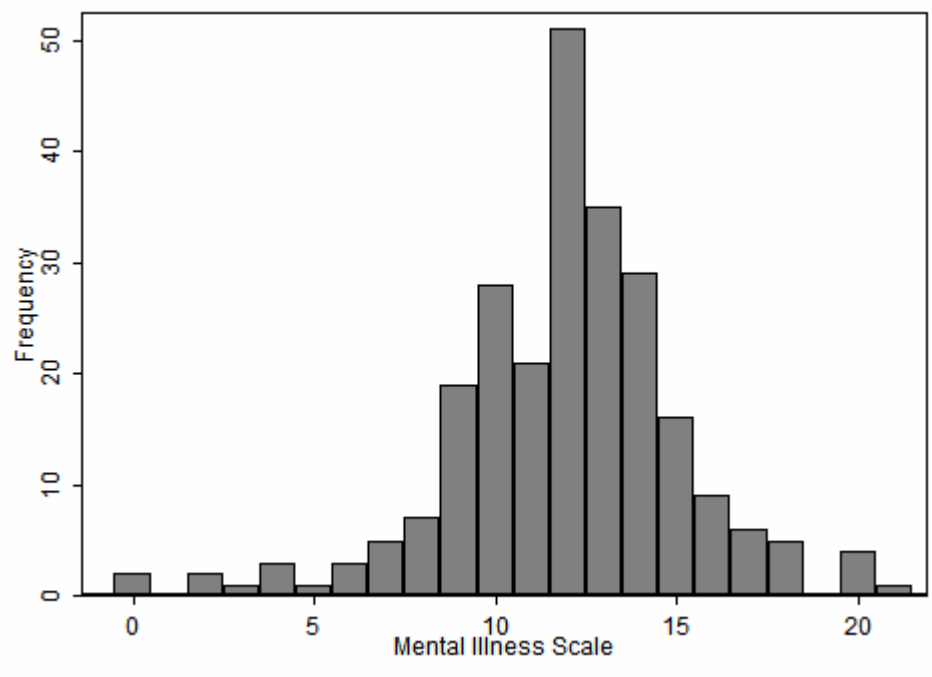


Table 5: Select Economic and Health Variables

Monthly Food Expenditures (Rs.)

n=217

25th percentile	2,000
50th percentile	2,000
75th percentile	3,000

Monthly Health Expenditures (Rs.)

n=218

25th percentile	100
50th percentile	300
75th percentile	500

Monthly Housing Expenditures (Rs.)

n=238

25th percentile	0 (owned)
50th percentile	0 (owned)
75th percentile	700

Participants Taking ARVs (self reported)

n=254

Number	Percent of Total
123	48.4

Participants with Tuberculosis in past 6 months

n=232

Number	Percent of Total
111	47.8

Number of Opportunistic Infections

n=232

	Frequency	Percent of Total
0	53	22.8
1	81	34.9
2	62	26.7
3	25	10.8
4	5	2.2
5	6	2.6

Body Mass Index

n=208

25th percentile	17.4
50th percentile	19.4
75th percentile	23.3

---

## *5.2. Prevalence of Food Insecurity*

As introduced above, one measure we use to estimate food insecurity is the HFIAS. The HFIAS can be summed to yield a raw score, or households can be classified as food secure, mildly food insecure, moderately food insecure or severely food insecure based on the responses to individual questions. As can be seen in Table 6, of the 244 respondents who had sufficient HFIAS information, over 20 percent of the respondents were severely food insecure while over 65 percent of the respondents were moderately food insecure. Just over 3 percent were mildly food insecure, and slightly less than 10 percent were food secure. We can also sum the responses to form a continuous scale, shown in Figure 4. Of the total respondents, 241 had sufficient data for the continuous scale. Except for 22 respondents with no food insecurity (scale value of zero), the scores were centered around 10.

Table 7 details the individual HFIAS questions and their responses. Most of the respondents reported that the situations in the first five questions presented at least a slight problem, but the number drops off after the fifth question. This is illustrated in Figure 5. The initial questions involve some subjective judgment on the part of the respondent regarding worrying about having enough food or thinking that the available food is somehow undesirable. A smaller number actually experienced food shortages, as is evident from the drop in positive responses after the fifth question in Figure 5. This suggests that, for the large majority of the respondents, access to food was something they thought about and that hindered them from eating the way that they preferred, although food access problems rarely lead to acute and chronic food shortages.

Table 6: Classification of Food Security Status

	Total	Percent
Food Secure	24	9.8
Mildly Food Insecure	8	3.3
Moderately Food Insecure	163	66.8
Severely Food Insecure	49	20.1

n=244

Figure 4: Household Food Insecurity Access Scale Score Histogram

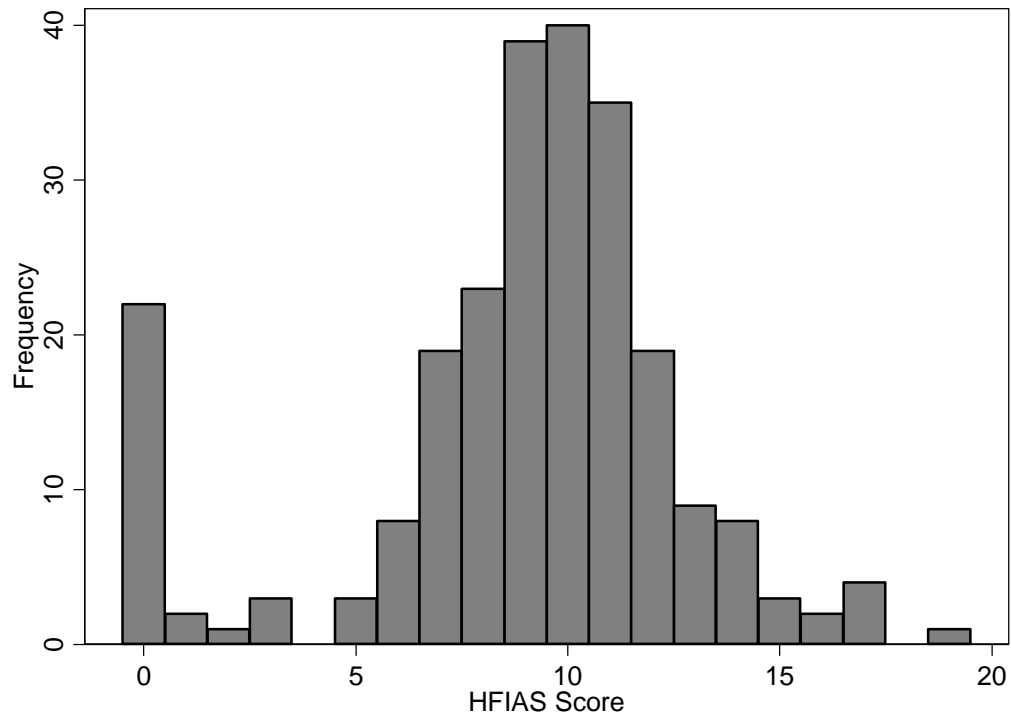


Table 7: Household Food Insecurity Access Scale Questions

		Number of Positive Responses	Percentage of Total Responses
1	Did you worry that your household would not have enough food? (n=247)	221	89.5
	If "Yes", how often did this happen?		
	Rarely	50	20.2
	Sometimes	59	23.9
	Often	112	45.3
2	Were you or any household members not able to eat the kinds of foods you preferred because of a lack of resources? (n=245)	215	87.8
	If "Yes", how often did this happen?		
	Rarely	48	19.6
	Sometimes	132	53.9
	Often	35	14.3
3	Did you or any household member eat just a few kinds of food day after day because of a lack of resources? (n=245)	216	88.2
	If "Yes", how often did this happen?		
	Rarely	99	40.4
	Sometimes	78	31.8
	Often	39	15.9
4	Did you or any household member eat food that you did not want to eat because of a lack of resources to obtain other types of food? (n=242)	205	84.7
	If "Yes", how often did this happen?		
	Rarely	69	28.5
	Sometimes	106	43.8
	Often	30	12.4
5	Did you or any household member eat a smaller meal than you felt you needed because there was not enough food? (n=242)	196	81.0
	If "Yes", how often did this happen?		
	Rarely	78	32.2
	Sometimes	96	39.7
	Often	22	9.1

Table 7(continued): Household Food Insecurity Access Scale Questions

		Number of Positive Responses	Percentage of Total Responses
6	Did you or any household member eat fewer meals in a day because there was not enough food? (n=244)	81	33.2
	If "Yes", how often did this happen?		
	Rarely	52	21.3
	Sometimes	25	10.2
	Often	4	1.6
7	Was there ever no food at all in your household because there were no resources to get more? (n=246)	30	12.2
	If "Yes", how often did this happen?		
	Rarely	16	6.5
	Sometimes	13	5.3
	Often	1	0.4
8	Did you or any household member go to sleep at night hungry because there was not enough food? (n=246)	9	3.7
	If "Yes", how often did this happen?		
	Rarely	4	1.6
	Sometimes	5	2.0
	Often	0	0.0
9	Did you or any household member go a whole day without eating anything because there was not enough food? (n=246)	9	3.7
	If "Yes", how often did this happen?		
	Rarely	5	2.0
	Sometimes	4	1.6
	Often	0	0.0



Figure 5: Positive Responses to HFIAS Questions

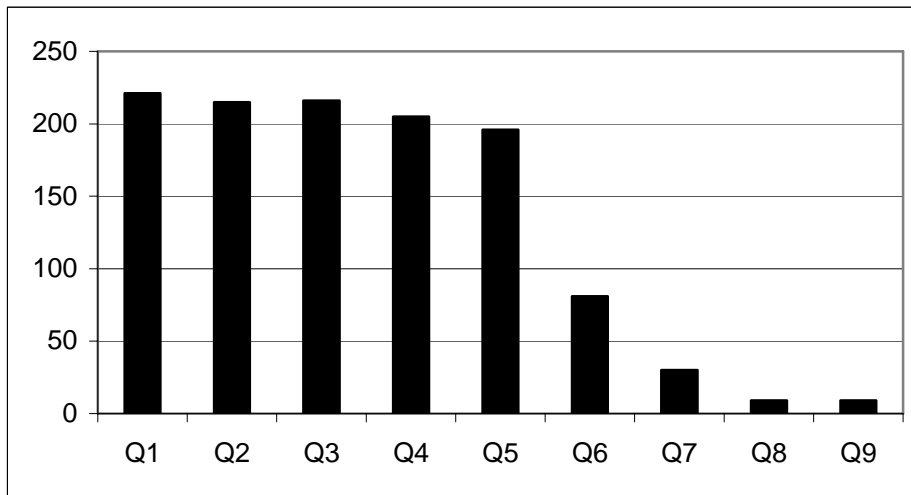


Table 8: Dietary Diversity

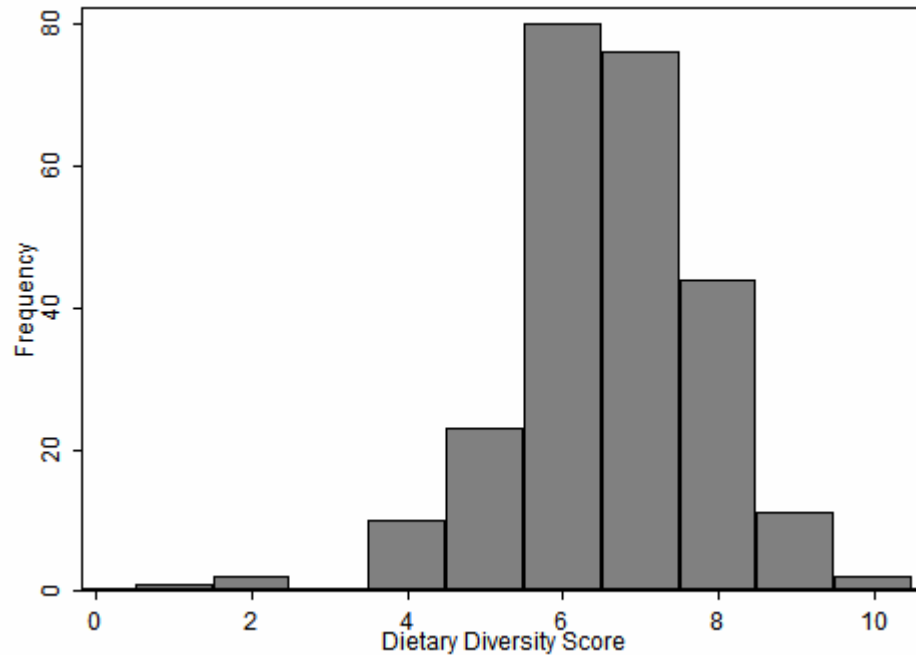
Food Item	Frequency
Chapati, rice, bread, noodles etc.	248
Potatoes, yams etc.	239
Vegetables	242
Fruits	185
Meat	13
Eggs	75
Fish	10
Lentils, beans, peas etc.	217
Yoghurt, cheese, milk etc.	114
Oil, fat, butter	25
Sugar, honey	31
Other (tea, coffee, condiments)	244

*Note* : Dietary diversity data are available for 249 respondents

Another indicator to measure the extent of food insecurity that we included in the survey was the Dietary Diversity Score, as discussed in Swindale and Bilinsky (2006b). Table 8 shows the information on the frequency of food groups eaten by the respondents that went into the calculation of the score. Most common foods eaten were chapatti/rice, potatoes, vegetables, lentils/beans and other (tea). The dietary patterns shown by the participants exhibit a wide variety. Of the 249 participants with available dietary diversity data, 235 people stated they ate chapatti/rice, potatoes, vegetables and other (tea). Similarly, 207 people reported eating chapatti/rice, potatoes, vegetables, other (tea), and lentils/beans. Other popular combinations involved fruit and yoghurt/milk/cheese: 181 people stated they ate chapatti/rice, potatoes, vegetables, other (tea), and fruit, while 106 people ate chapatti/rice, potatoes, vegetables, other (tea), and yoghurt/milk/cheese. To obtain the Dietary Diversity Score, we summed the total number of food groups eaten by each participant. Figure 6 displays the histogram for the score. The most common number of food groups eaten was six, while seven and eight were also prevalent.

In addition to the HFIAS questions and the dietary diversity questions, participants were asked if there were any months in the past 12 months in which there was not enough food to meet the family's needs. Of 249 respondents who answered this question, for 21 (8.4 percent) there were months in which there was not enough food. Many of the 21, however, could not remember which months they experienced this food insecurity.

Figure 6: Dietary Diversity Score



### 5.3. Relations with Other Variables

To provide a more informative picture of food insecurity in this sample, we can examine the relationship between food security and other variables. Table 9 reports the food security status for males and females. Males were more likely to live in households that are food secure, while females were more likely to experience each grade of food insecurity, notably moderate food insecurity.

Table 9: Household Food Security and Gender

	Female		Male	
	Total	Percent	Total	Percent
Food Secure	6	5.7	18	12.9
Mildly Food Insecure	4	3.8	4	2.9
Moderately Food Insecure	73	69.5	90	64.7
Severely Food Insecure	22	21.0	27	19.4

n=244

Table 10 shows the respondent's education level for each category of food insecurity. In each education level, the majority of respondents reported that their households were moderately food insecure. Those that have education levels higher than secondary school were more likely to be food secure than those without a formal education or those who have completed only a one of Grade 1-9. Similarly, those with no formal education and those who have completed up a secondary level experienced more moderate food insecurity than those who have at least matriculated. The respondents with no formal education or just a primary level were more likely to be severely food insecure. In general, then, a relationship exists between higher education and less severe food insecurity.

Table 10: Household Food Security and Highest Education Levels

	No formal or primary		Secondary		Higher	
	Total	Percent	Total	Percent	Total	Percent
Food Secure	7	7.1	11	9.7	6	19.4
Mildly Food Insecure	1	1.0	7	6.2	0	0.0
Moderately Food Insecure	63	64.3	80	70.8	19	61.3
Severely Food Insecure	27	27.6	15	13.3	6	19.4

n=242

If household food security is related with greater education, a relationship may also exist between household's source of livelihood and its food security situation. Table 11 displays the food security situation for three of the most common sources of household livelihood. A household can have multiple livelihood sources. Households for whom private transfers were a source of livelihood were more likely to be severely food insecure than households for whom salaried employment and casual labor were livelihood sources. Alternatively, households who supported themselves with salaried employment and casual labor were more likely to be moderately food insecure. Households who supported themselves with casual labor were more likely to be severely food insecure than those whose livelihood came from salaried employment.

Table 11: Household Food Security and Household Livelihood Source

	Salaried employment		Casual labor		Private transfers	
	Total	Percent	Total	Percent	Total	Percent
Food Secure	6	5.1	2	3.5	4	5.8
Mildly Food Insecure	4	3.4	1	1.8	1	1.4
Moderately Food Insecure	86	73.5	41	71.9	45	65.2
Severely Food Insecure	21	17.9	13	22.8	19	27.5

n=244

We can also examine the connection between household food security and a respondent's ability to work. Almost 70 percent of the respondents who reported that they were too sick to work lived in moderately food insecure households, while 66 percent of the rest lived in moderately food insecure households. One-quarter of the respondents who were too sick to work lived in severely food insecure households, whereas 19 percent of the rest lived in severely food insecure households.

These relationships between household food security and sex, education, household livelihood source and respondent activity suggest that a further relationship between household food security and wealth may exist. To investigate this, Table 12 shows the results of a regression of the HFIAS continuous score on the asset index. The asset index is negatively related to the food insecurity score, indicating that more assets are related to a low score and hence better food security. This relationship is statistically

significant, and makes intuitive sense as wealthier households will have greater ability to buy sufficient food.

Table 12: Simple Regression

Dependant Variable	Independent Variable	Coefficient	R <sup>2</sup>	N
HFIAS Score	Asset Index	-0.69 ***	0.15	232

*Note:* \*\*\* denotes significant at 1%

#### 5.4. Comparison with NFHS Data

While examination of the EHA data is fruitful, it remains unclear what exactly the data are telling us regarding the socioeconomic status of the respondents. We cannot tell how this sample compares to others with HIV, as well as their neighbors who remain unaffected by the disease. In order to provide a fuller picture, we can compare what we see in the EHA data to information from a nationally representative dataset.

The national dataset that will serve as a comparison is the third round of the National Family Health Survey (NFHS-3). The NFHS-3 was conducted in 2005-2006 by the Indian Ministry of Health and Family Welfare in conjunction with the International Institute for Population Sciences as well as other institutions. It was designed to be a nationally representative survey of households throughout India. The NFHS-3 consisted of a household questionnaire, a women's questionnaire for women age 15-49, and a men's questionnaire for men age 15-54. All never-married and ever-married women were

surveyed, and the men's questionnaire was conducted in a subsample of the sampled households.

Like the two previous NFHS surveys, the NFHS-3 was intended to provide measures of indicators of household socioeconomic status, welfare and health. In addition to these goals, the NFHS-3 provides measures of new topics such as sexual behavior, family planning, conditions among slum and non-slum dwellers, and HIV prevalence estimates. Towards the latter purpose, in addition to the questionnaires, a smaller sample of households was asked to give blood for HIV testing. This sample was chosen in order to give both accurate estimates of the prevalence in six high-prevalence states as well as Uttar Pradesh, and accurate national estimates. Thus the NFHS-3 presents a unique opportunity whereby the HIV status of many participants can be matched with their individual questionnaire responses (where available), as well as their household's characteristics (International Institute for Population Sciences "NFHS-3"). I use the sample weights available when using the NFHS data, so the results should be representative of India in general.

Table 13 presents summary information on the NFHS respondents for whom HIV data and individual questionnaire data are available. In urban areas almost 60% of those with HIV are males, and in rural areas this male-female burden is even more pronounced. In contrast, the population that is HIV-negative has a more even male-female distribution. Both urban and rural individuals with HIV are on average slightly older than the population without HIV, but all average ages are close to 30. Urban individuals with and those without HIV have similar household size distributions, whereas rural individuals with HIV tend to live in households of three to six members more often than those



without HIV. Likewise, rural individuals without HIV are more likely to live in households with greater than 6 members. While females in general are most likely to be currently married, in both rural and urban areas females with HIV are much less likely to have never been married, and are much more likely to be widows, than the general population without HIV. This is most pronounced in rural areas, where around one in four women with HIV are widows.

Table 13: Demographic Summary of NFHS Respondents\*

	Urban		Rural	
	HIV Positive	HIV Negative	HIV Positive	HIV Negative
<b>Sex</b>				
Males	58.8%	50.1%	61.5%	47.2%
Females	41.3%	49.9%	38.5%	52.9%
<b>Avg Age</b>				
	32.9	30.2	33.8	30.0
<b># Members In Household</b>				
	5.19	5.75	4.99	6.18
	1	4.0%	1.1%	0.9%
	2	10.7%	4.4%	7.8%
	3-6	62.1%	66.5%	75.3%
	6+	23.2%	28.0%	15.9%
<b>Female marital status</b>				
never married	5.1%	25.0%	1.8%	18.1%
currently married	71.1%	70.1%	61.4%	77.1%
widowed	18.2%	3.3%	26.5%	3.2%
divorced	0.0%	0.3%	3.5%	0.3%
not living together	5.6%	1.3%	6.7%	1.3%

\*Calculated using survey weights

Table 14 shows ownership information on 11 representative assets. This set of assets will allow a comparison with the EHA data in the next section. Individuals with HIV from urban areas are less likely to own all of these assets than their urban counterparts without HIV. In contrast, those with HIV in rural areas are not so different from those without HIV. Indeed, a higher percentage of rural individuals with HIV own electric fans, black and white televisions, and watches than those without HIV. These data suggest that individuals with HIV in urban areas are poorer in general than the urban population without HIV, whereas in rural areas this trend is much less pronounced.

Table 14: Ownership of 11 Representative Assets for NFHS Respondents (%)\*

	Urban		Rural	
	HIV positive	HIV negative	HIV positive	HIV negative
Pressure cooker	65.2	72.6	20.1	26.1
Electric fan	82.8	87.2	48.2	43.6
Black and white TV	24.9	27.8	32.1	22.6
Color TV	36.0	54.2	11.8	15.0
Sewing machine	17.5	36.0	13.3	16.2
Refrigerator	14.7	35.4	5.8	7.5
Bicycle	35.3	56.8	39.8	60.3
Motorcycle / scooter	19.5	33.0	9.8	14.2
Motor car	4.4	5.7	1.9	1.4
Watch	88.4	93.3	79.9	78.6
Telephone / mobile	27.9	48.7	13.6	15.6

\* Calculated using survey weights

As well as looking at ownership of individual assets, I sum the 11 assets to yield an asset index (different from the index introduced above). Each asset therefore has a weight of one in this index. The asset index indicates the total number of assets out of the 11 that an individual's household owns, and so ranges from zero to 11. As is evident in Table 15, in urban areas those with HIV tend to own slightly fewer assets than those without HIV. This can be seen at each percentile of the distribution, and the mean value of the asset index for HIV-positive individuals (4.2) is slightly smaller than the mean value for HIV-negative individuals (5.5). In rural areas, however, this is not so noticeable. At the 25<sup>th</sup> and 75<sup>th</sup> percentiles the asset index for the rural population is the same for individuals with and without HIV. At the 50<sup>th</sup> percentile level of the distribution, rural HIV-positive individuals even have a higher asset index level by one asset. On the whole, however, the mean asset index for rural HIV-positive individuals (2.8) is marginally smaller than those without HIV (3.0). These results bear out what we saw above: urban individuals with HIV appear to be poorer than their urban neighbors without HIV, while rural individuals who are HIV-positive are as poor as their rural counterparts who do not have HIV. Anyone, however, from the rural areas is poorer in terms of these assets than even the urban population with HIV.

Education levels can also give an informative picture of the differences between those with HIV and those who are HIV-negative. Table 16 displays information on the highest education level attained by the HIV-positive individual. Many more urban HIV-positive individuals have either no education or a primary school level of education compared to others in urban areas without HIV. There is a somewhat higher percentage

of those without HIV who have obtained a secondary education, and a much higher percentage of those without HIV have obtained a higher education level. A similar trend can be seen in the rural data: A higher percentage of those with HIV have either no education or a primary level of education as compared to those without HIV. Similarly, a noticeably higher percentage of those without HIV have a secondary education. In terms of education higher than secondary, however, there is little significant difference between rural populations – very few rural individuals, whether HIV-positive or negative, have higher education. Comparable to what we saw with assets, the rural population in general has less education than even the HIV-positive urban population.

Table 15: Asset Index for NFHS Respondents\*

	Urban		Rural	
	HIV positive	HIV negative	HIV positive	HIV negative
25th percentile	3	4	1	1
50th percentile	4	6	3	2
75th percentile	6	7	4	4
Mean	4.2	5.5	2.8	3.0

\*Calculated using survey weights

With these data as background, we can also look at the living conditions of the urban population with HIV and compare it to the population in general. Table 17 displays the sources of drinking water for those living in urban areas. Around 32 percent of the

households of individuals without HIV have water piped into the dwelling, whereas just over 22 percent of households of individuals living with HIV get water from public taps or standpipes. The other significant difference is that a greater percent of the HIV-negative population gets water from tube wells or boreholes. These data seem to indicate that relatively fewer of those who have HIV can afford to have water pumped directly into the dwelling, and instead rely on public taps and standpipes.

Table 18 shows the toilet facilities for the households of urban HIV-positive and HIV-negative individuals. Almost 70 percent of both HIV-positive and HIV-negative households use toilets that flush to a piped sewer system. The only notable difference is that people with HIV appear to be slightly more likely to have no formal facilities – 20 percent of households with HIV have no formal facilities, while only 16 percent of HIV-negative households have no formal facilities. Thus HIV-positive households are slightly more likely to have fewer resources for a formal toilet facility, but the difference is not great.

Table 16: Highest Education Levels of NFHS Respondents (%)\*

	Urban		Rural	
	HIV Positive	HIV Negative	HIV Positive	HIV Negative
No education	26.8	15.8	41.6	36.4
Primary	24.1	12.7	25.6	18.3
Secondary	47.1	52.9	28.5	40.4
Higher	2.0	18.6	4.2	5.0

\*Calculated using survey weights

Table 17: Drinking Water Source for Urban NFHS  
Respondents (%)\*

Water Source	HIV positive	HIV negative
Piped into dwelling	22.3	31.8
Piped to yard/plot	20.3	19.3
Public tap/standpipe	34.0	19.2
Tube well or borehole	8.7	22.6
Protected well	2.9	1.6
Unprotected well	2.8	2.8
Protected spring	0.0	0.1
Unprotected spring	0.0	0.1
River/dam/lake/etc.	0.6	0.8
Rainwater	0.0	0.0
Tanker truck	5.6	0.9
Cart with small tank	0.1	0.0
Bottled water	0.9	0.7
Other	1.9	0.2

\* Calculated using survey weights

Table 18: Toilet Facilities for NFHS Urban Respondents (%)\*

	HIV Positive	HIV Negative
Flush - to piped sewer system	31.1	28.2
Flush - to septic tank	36.6	40.0
Flush - to pit latrine	5.1	6.8
Flush - to somewhere else	3.9	4.4
Flush - don't know where	0.5	0.1
Pit latrine - ventilated improved pi	0.0	0.5
Pit latrine - with slab	2.0	2.1
Pit latrine - without slab/open pit	0.1	0.7
No facility/uses bush/field	20.2	16.2
Composting toilet	0.0	0.1
Dry toilet	0.2	0.5
Other	0.4	0.4

\*Calculated using survey weights

We can compare the picture of HIV-positive and negative urban individuals with information from the EHA survey of HIV clinic patients in Delhi. Table 19 shows a summary of demographic information for the 258 respondents. Over 58 percent of the survey respondents were male, mirroring the almost 59 percent in the NFHS data compared to 50 percent amongst HIV-negative individuals. The average age for EHA survey respondents was 34, about one year older than the NFHS average age for urban individuals with HIV. More HIV-positive individuals live in households with three to six members than the NFHS urban HIV-positive individuals. In addition, almost one-quarter of households are headed by a single parent who is most often a single mother. If many of these mothers are widowed, this suggests a higher proportion of widows than in the general urban HIV-positive population shown in the NFHS data. One in five households has no children under 18 years of age, and close to the same proportion have one child.

Almost 30 percent of households have 2 children, and around 30 percent have over 3 children. Thus the EHA survey respondents are generally slightly older, and come from mid-sized households that have one to three children, many of which are headed by single parents.

Table 19: Demographic Summary of EHA Respondents

Sex	
Males	58.1%
Females	41.9%
Avg Age	34.0
# Members in Household	
1	4.7%
2	8.1%
3-6	70.9%
7+	16.3%
Respondent a Single Parent	24.9%
# Children under 18	
0	21.3%
1	19.8%
2	28.7%
3	16.3%
4+	14.0%

Table 20 displays ownership information for 11 representative assets. These assets correspond to the 11 assets summarized above with the NFHS data. Comparison



with Table 14 shows that a higher percent of EHA survey respondents owned many of the assets than did either the NFHS urban HIV-positive or urban HIV-negative population. EHA respondents were much more likely to own a pressure cooker, fan, color television and sewing machine than either urban population. Conversely, a noticeably smaller proportion of EHA respondents owned transportation assets such as bicycles, motorcycles and scooters, and motor cars. In terms of individual asset ownership, the EHA respondents are better off than much of the urban HIV-positive population, as well as some of the urban HIV-negative population.

A similar observation can be made when looking at the asset index. In Table 21, the 11 assets summarized in Table 20 are summed to an index that ranges from zero to 11, for the 244 respondents who had usable asset information. The values of 4 and 5 for the 25<sup>th</sup> and 50<sup>th</sup> percentile indicate that the lower end of the asset index distribution has one more asset than the lower end of the distribution for the urban HIV-positive population. The upper end of the distribution at the 75<sup>th</sup> percentile, however, has the same number of assets as the upper end of the total urban HIV-positive population. Thus the poorer of the EHA respondents are slightly better off than the poorest of the HIV-positive population, while the wealthier are at about the same level. On average, the EHA respondents have almost one more asset than the population of those with HIV in urban areas. The EHA respondents, however, are often still less wealthy than the total HIV-negative urban population. At the 25<sup>th</sup> percentile the EHA respondents have the same number of assets as the HIV-negative population, while at the 50<sup>th</sup> and 75<sup>th</sup> percentiles the population without HIV has one more asset than the EHA respondents. On average, the EHA respondents have almost one less asset than the HIV-negative population. Thus the

poorest of the EHA respondents are about at the same level in terms of ownership of these 11 assets as the poorest of the population in general. However, the wealthier EHA respondents still lag behind the wealthier in the general population.

Table 20: 11 Representative Assets for EHA Respondents

Asset	Number	%
Pressure cooker	235	95.1
Electric fan	238	96.4
Black and white TV	27	10.9
Color TV	158	64.0
Sewing machine	100	40.5
Refrigerator	92	37.1
Bicycle	26	10.5
Motorcycle / scooter	17	6.9
Motor car	8	3.2
Watch	208	84.2
Telephone / mobile	133	53.9

Since wealth and education tend to be positively related, we can also look at the highest education levels reached by the EHA respondents. Table 22 displays these education levels for the 255 respondents with full education information. These education levels can be compared to those of the NFHS population in Table 16. A similar proportion of EHA respondents have had no education as compared to the urban HIV-positive population. Thus, relatively more EHA respondents are uneducated than the general HIV-negative population. Likewise, relatively fewer of the EHA respondents

reached secondary school as compared to the HIV-negative population, mirroring the urban HIV-positive population. On the other hand, a smaller proportion of EHA respondents reached only primary school, and a larger proportion reached higher levels of education, than the urban HIV-positive population. While relatively greater than the urban HIV-positive population, still a smaller percent of EHA respondents reached higher levels of education than the HIV-negative population. Thus, while the EHA respondents are in general not as educated as the population without HIV, they have also had more education than many others in the HIV-positive urban population.

Table 21: Asset Index for EHA Respondents

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25th percentile	4
50th percentile	5
75th percentile	6
Mean	5.0

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Living standards can also be measured more directly than assets and education. Table 23 summarizes the source of drinking water for the EHA respondents. While these categories do not correspond directly with those of the NFHS estimates in Table 17, some comparisons can be made. Over 70 percent of the EHA respondents get water from some sort of plumbing. Likewise, a form of plumbing is most common amongst both HIV-

positive and HIV-negative urban populations. Bore wells are not as common among the EHA respondents as among the urban HIV-negative population, but water from tanks of different sorts replace bore wells in popularity. Table 24 shows the toilet facilities of the EHA respondents. These also do not correspond directly to the information from the NFHS in Table 18, but some general observations can be made. A similar percent of EHA respondents have latrines in the house as urban HIV-positive and HIV-negative populations have flush systems to either piped sewer systems or septic tanks. The “Other” category in the EHA data is comprised mostly of those who have no formal facilities, and instead use anywhere that is available. Relatively fewer EHA respondents thus have no formal facilities than is the case for the urban HIV-positive population. In terms of source of drinking water and toilet facilities, the EHA respondents appear to be slightly better off than many of the urban HIV-positive population, and at some of the same standard of living as the urban HIV-negative population.

Table 22: Highest Education Levels of EHA Respondents

	Total	%
No education	63	24.7
Primary	39	15.3
Secondary	121	47.5
Higher	23	9.0

n=255

Table 23: Water Source for EHA Respondents

	Total	%
Plumbing (faucet)	183	72.33
Tank	55	21.74
Open well	3	1.19
Bore well	12	4.74

n=253

Table 24: Latrine Facilities for EHA Respondents

	Total	%
Latrine in house	177	70.24
Latrine in yard	18	7.14
Common latrine	21	8.33
Other	36	14.29

n=252

The comparison between the information provided by the NFHS and the data from the EHA survey suggests that the EHA survey respondents, and thus many of those who are helped by the organization's Delhi clinic, are better off than much of the urban population with HIV. They generally have more assets, higher education, and somewhat better living standards than many others with HIV. On the other hand, they are not quite as wealthy or educated as the urban HIV-negative population.

It would thus be a mistake to imply that the survey respondents do not need the medical and livelihood assistance provided by an organization such as EHA. As the stories of many of the patients can attest to, there are a great many valid recipients of this care among the EHA patients. However, as an organization with the stated goal of caring for the poor of India, for EHA it is still worth considering where the poorest of the HIV-positive population are and why they are not being reached by this program.

This comparison also has implications for the results of the analysis on the relationship between food security and health. Since the population of patients who receive health services from the Shalom clinic is different from the general population of people with HIV, we cannot say that these results are valid for people with HIV who do not seek care at Shalom. It is possible, however, that the patients at Shalom are similar to those with HIV who do seek out medical treatment. Thus the results from the analysis are likely valid for urban patients with HIV who are seeking medical treatment for their opportunistic infections.

## **6. Food Security and Health – the Link**

### *6.1. Health Production*

With this knowledge of what poverty and food insecurity means for the sample of people with HIV, and how this might compare with others who do not have HIV, we can turn to the issue of estimating the relationship between food security and health. In economics, much literature has focused on estimating how individuals or households produce health. “Health”, however, like food security, is a multifaceted and complex phenomenon that is related to but different from medical care, nutrition, and other inputs.

Auster et al. (1969) present an early attempt to look at the role of health care in the production of health. Grossman (1972) relates health and health inputs in his seminal paper on the demand for health. In this model, a person derives utility directly from health and another commodity. He begins with an initial stock of health which deteriorates over time. The individual, however, can increase his stock of health at any time with investments in health. These investments are health input goods which enter into a household production function that produces health. So it is not the health inputs per se which are demanded, but health: the demand for health inputs is derived from the demand for health. Grossman further explicates that health is demanded by consumers for two reasons. First, it directly serves to increase utility, since sickness is inherently unpleasant. As such it is a consumption commodity. An individual secondly demands health as an investment commodity in order to have more time to work and therefore greater income. This would increase his consumption of the other good appearing in the utility function, bringing additional utility.

In this framework, we are interested in estimating the household health production function. Abstracting from the case where health is a consumption commodity, Grossman (2000) uses the pure investment model to generate a system of three structural equations. The demand for health is determined by the wage rate, the marginal cost of health investment, and the health stock depreciation rate. The current depreciation rate is determined by the initial depreciation rate and the percentage change in the depreciation rate. Gross investment is determined by the individual's human capital excluding health capital (primarily seen as education), medical care, and time allocated to health activities. Since health and medical care are the endogenous variables in the system, this system yields two reduced form demand equations in which health and medical care are functions of the exogenous variables wage, price of medical care, human capital (excluding health capital), the individual's age, and the rate of depreciation in the initial period. This last variable is unobserved, and thus is subsumed in the error term. From the gross investment structural equation, Grossman (2000) derives the health production function in which health is a function of medical care, human capital (excluding health capital), the amount of depreciation, and the initial rate of depreciation which is inherently unobservable.

This model, however, cannot be estimated using Ordinary Least Squares regression. Unobservable differences in the initial depreciation rate likely influence both the health of an individual as well as the amount of medical care which an individual receives, causing the medical care variable to be correlated with the error term and resulting in biased coefficient estimates. Based on the exogenous variables in his model, Grossman (2000) suggests instrumenting for medical care using wealth, wage rates, and



the price of medical care. Empirically estimating the determinants of self-reported health status using data from a U.S. survey, he finds substantial differences between the OLS coefficients and instrumental variables, suggesting that the bias is potentially nontrivial.

Much work in estimating health production functions has focused on the production of child health. A classic study by Rosenzweig and Schultz (1983) constructs a model for child health and estimates the effects of delaying a visit to the doctor, smoking, total number of births, and mother's age on birth weight using U.S. data. The model assumes that the household derives utility from child health, goods that affect child health, and other goods. Child health is determined by a household production function into which enters the goods that affect child health directly and which enter also in the utility function, other health inputs which do not directly impact utility, and exogenous family-specific traits. Utility can be maximized subject to this child health production function and a budget constraint. This maximization yields demand functions for the commodities and for child health which are determined by prices, income and family-specific traits.

Rosenzweig and Schultz then estimate the household child health production function. Mirroring Grossman (2000), they observe that unobservable heterogeneity in mothers' health is likely to impact both the level of health inputs as well as health, resulting in the health inputs being correlated with the error term. Thus they use information from the reduced form health demand function to identify each of the health inputs (doctor visit delay, smoking, total births, and mother's age). This information includes parental characteristics such as education and income, and metropolitan area or state-level data on health care infrastructure, prices, and labor market characteristics.

Thus instrumenting for the health inputs, they then use a translog production function to estimate the effects of the health inputs on birth weight. They find evidence that the heterogeneity bias is significant. Akin et al. (1992) use Rosenzweig and Schultz's model and similar methods to estimate the determinants of different infant health indicators for a sample of Philippine infants.

The determinants of non-child health indicators have also been estimated using health production functions. Chen et al. (2002) attempt to bridge the epidemiological literature and the economic health production function literature by estimating the impacts of various nutritional choices, exercise and medication on blood pressure using an individual health production function. The individual health production function is functionally similar to the household health production function but adapted to the relevant level of analysis. In this function, an individual produces health which is determined by his consumption of different nutrients, his exercise time, his level of medication, and observable and unobservable personal and environment characteristics. Chen et al. (2002) note that unobservable individual characteristics may influence behavioral choices as well as health, resulting in food intake, exercise and medication being correlated with the error term. Using U.S. data, they estimate the reduced form nutrient, exercise, and medication equations using the prices of all food groups, wages, income, and demographic characteristics. Blood pressure is then regressed on the predicted nutrient, exercise and medication values as well as exogenous demographic variables. The two stage approach yields very different coefficient estimates than does regular OLS on the blood pressure equation.

Another branch of the health production literature attempts to specifically estimate the effectiveness of medical care. Stratmann (1999) tests Grossman's (1972) model of health care as an investment which leads to greater income by looking at the effect of doctor visits on work day losses for US data. Similar to the previous papers, he takes into account unobserved heterogeneity in initial health endowment and illness severity, which would plausibly influence both doctor visits and work days lost. His health outcome variable is work days lost, he includes as exogenous variables education, income, race and gender, and he instruments for his doctor visit variable using type of health insurance. He concludes that the bias from unobserved heterogeneity is significant, and that doctor's visits reduce work days lost. Thus medical care can be seen as an investment commodity, as Grossman (1972) posits.

Healy et al. (2000) take a different approach in estimating the effectiveness of mental health care services in Italy. Since they estimate the marginal effects of more than one type of medical care, they regard the data requirements of the two stage approach as prohibitive. Therefore they attempt to solve for the unobserved heterogeneity problem by exploiting the longitudinal nature of their data and estimating a fixed-effects model. Although this may preclude the inclusion of some variables relevant to policy, Healy et al. do not see this as a problem given the specific goal of estimating the effectiveness of mental health services.

Related to the consideration of estimating the effectiveness of medical care is estimating the impact of public policies. Stifel and Alderman (2006) estimate the impact of the Vaso de Leche ("Glass of Milk") feeding program in Peru on child nutrition. Instead of specifically estimating the household health production function, they estimate

the reduced form demand equation for health, which includes as explanatory variables individual and community characteristics that determine child nutrition. In order to separate the effect of the program's direct role in determining child nutrition from the program's role as an income transfer (indirectly determining child nutrition), participation in the program is included as an explanatory variable. In a study of the role of public infrastructure in determining anthropometric outcomes in the Côte d'Ivoire, Thomas et al. (1996) similarly estimate the reduced form demand equation for health instead of the underlying health production function. The rationale behind this is to estimate the total impact of public infrastructure instead of simply the impact through the household health production technology.

With the exception of the studies estimating the impact of public policies, overwhelmingly these studies have paralleled Grossman (2000) in using market-determined health input prices as instruments for health input. However, Schultz (2004) warns that these choices of instruments are only valid if health input prices do not influence migration between regions. This is an acceptable assumption if health input prices have a negligible influence on lifetime utility, or if prices cannot be anticipated prior to migration. If prices do influence migration they cannot be considered exogenous to the model. Evidence from Colombia (Rosenzweig and Wolpin, 1988) suggests that an evaluation of a public policy that does not take into account the endogeneity of spatial population characteristics is likely to incorrectly estimate the impact of the policy. This indicates that, at least in a region where the population is highly mobile, population characteristics may be correlated with local prices. Thus the researcher must be aware of

the specific situation and be cautious in using health input prices as instruments for health inputs.

### *6.2. Estimation Issues for Food Security and Health*

While nutrition has played an important role in many of these health production studies, none have looked specifically at the phenomenon of food insecurity. From the above review of the health production literature, a few considerations arise for estimating the impact of food security on health outcomes for PLWHA. Following the model of Rosenzweig and Schultz (1983), a household food security measure could be added into the household health production function as a health input similar to a “medical care” measure. The health outcome variable could be a measure of HIV severity such as the presence of an opportunistic infection to test whether food security contributes to a slower progression of HIV. Other variables which would enter into the health production function could include other individual and household characteristics. However, a household’s past (unobserved) food security status is likely closely related with both its current food security status as well as the health of its members. This could cause present food security to be correlated with the error term in a model estimating the determinants of health. Likewise, the other medical inputs and behavioral choices are likely to also be correlated with the error term. Thus the regular OLS estimates would be biased, necessitating either using two stage regression or utilizing longitudinal data to difference away the unobserved heterogeneity.

If longitudinal data are not available, specifying a reduced form demand equation for each of the endogenous variables involves careful consideration. Possible instruments

could include prices for important foods and other health inputs, wages, and wealth. While these would not estimate the totality of the food security experience, they may serve as appropriate proxies. The use of prices as instruments is, of course, only possible if there is spatial variation that can be matched with household data. Schultz's criticism of using prices is also important to consider: migration between regions based on food or health input prices may confound the results of an analysis. It is not clear if this is an issue for PLWHA, as they may also be sickly and less likely to engage in an energy-intensive activity such as moving.

Following Stratmann's (1999) test of Grossman's pure investment model, one could also measure the productivity effect of household food security. This could directly test the claims of Loevinsohn and Gillespie (2003) that greater food security would enable PLWHA to lead more productive lives and be better able to provide for families. It is also an important question considering the observation of Piwoz and Preble (2000) that food supplementation programs often add fat and do not contribute to body cell mass or muscle. Some measure of work (or work loss) could serve as the dependent variable; similar estimation issues then arise as discussed above.

Unfortunately, most PLWHA in developing nations find out about their HIV status late in the disease progression (Piwoz and Preble, 2000). Therefore any sample of PLWHA in developing nations may consist of a considerable number who can no longer work, making estimation of "productivity" difficult. In addition, basing policy simply on potential productivity gives little consideration for the sick and the elderly who have little hope for future productivity (Schultz, 2004). While important to consider, there are other reasons for food and nutrition interventions than future productivity.

### 6.3. The Model

To estimate the relationship between food security and health, I estimate a food insecurity production function and four health outcome production functions. The household food insecurity ( $FI$ ) is a function of individual and household characteristics,  $Y$ :

$$FI = f(Y).$$

An individual's health is, in turn, a function of his or her food insecurity status ( $FI$ ) and other factors such as income, living standards, medical inputs and human capital ( $X$ ):

$$H = f(FI, X).$$

To measure health, I use several health outcomes: mental health, whether the participant has had tuberculosis in the past 6 months, and whether the participant has had any opportunistic infections over the past 6 months. I also estimate food security's contribution to the determinants of whether the participant is too sick to work.

This model yields two equations that I will estimate:

$$\begin{aligned} FS &= f(Y) + \varepsilon_1 \\ H &= f(FS, X) + \varepsilon_2 \end{aligned}$$

If the error terms are uncorrelated, OLS or probit regression can be used to separately estimate each equation in this system. However, if the error terms are correlated, then the usual regression methods are inappropriate to estimate the health equation because food security will be correlated to  $\varepsilon_2$ . Past food security is likely related to both present food security and present health. If so, past food security would be subsumed in both error terms, causing them to be correlated.

To correct for the possible endogeneity of food security I use instrumental variables regression. The instruments in this analysis are whether the patient's household has received recent food support, and the price of the household's last purchase of rice.

The correlation coefficient between the HFIAS Score and the price of rice is -0.23, and the correlation coefficient between the asset index and the price of rice is 0.42. Since wealthier and more food secure households pay a higher price for rice, it appears that the price of rice serves as a proxy for the food quality preferences. In order to use this as an instrument, we will assume that the price of rice is not related to health outcomes except through variables that we already control for, notably wealth. We make a similar assumption for the relationship between whether the patient's household received food support and health outcomes. Table 25 displays the results of exogeneity tests using these instruments. The exogeneity tests do not indicate at conventional confidence levels that endogeneity of food insecurity is a problem in this analysis.

Although we cannot support the hypothesis of the endogeneity of food insecurity in a statistical sense with the exogeneity tests, weak instruments and a small sample size limit the power of these tests. In all of the instrumental variables regressions, the F-statistic of their joint significance in the first stage regression is under 0.56, indicating that they are never jointly significant in predicting food insecurity. The presence of weak instruments and small sample size not only limit the usefulness of exogeneity tests, but also mean that IV regression is less useful. Bound et al. (1995) show that large samples do not eliminate finite sample biases in the presence of weak instruments, and illustrate this using a large dataset from the U.S. Census. Thus the IV regressions may not have actually solved the problems inherent in having an endogenous regressor, and the IV estimation may not lead to better results than the non-IV estimation. I therefore report both the non-IV and IV regression results to allow comparison.



Due to missing data, I estimate the production functions on a common sample size of 180. Table 25 shows the definitions of the independent variables in the regressions, and Table 26 shows the means/proportions, medians and ranges for these variables. Similarly, Table 27 displays the definitions of the dependent variables, and Table 28 gives their means/proportions, medians and ranges for the common sample size of 180.

Table 25: Tests for Exogeneity  
(Instruments: price of rice, recent food support)

	Test Statistic	Reject Exogeneity?
Mental Health	0.11 <sup>†</sup>	No
Tuberculosis	0.76*	No
Opportunistic Infections	1.19*	No
Too Sick	0.09*	No

<sup>†</sup> = Wu-Hausman test

\* = Wald test

Table 26: Definitions of Independent Variables

Variable	Definition
Asset index	Index of asset ownership from principal components analysis
No formal or primary education	Patient has had no formal educ or just a primary level
Age	Age of patient
Recent food support	Patient's household has received food support in past 12 months
Price of rice	Price (Rs./kg.) of household's last rice purchase
Household size	Total number of members of household
Male	Patient is male
Just casual labor	Household gains livelihood through just casual labor
Minutes to the clinic	Number of minutes patient takes to reach clinic/100
Single parent	Patient is a single parent
Presence of children	Whether household has children
Early or mild stage	Patient falls into either early or mild stage of disease progression
Moderate stage	Patient falls into moderate stage of disease progression
Number of children	Number of children in household
Number in household working	Number of household members working in gainful employment

Table 27: Descriptive Statistics of Independent Variables

Variable	Mean/Proportion	Median	Range	
			Lowest	Highest
Asset index	0.00	-0.03	-4.04	9.90
No formal or primary education	41%			
Age	33.67	32	21	73
Recent food support	24%			
Price of rice	15.29	16	11	24
Household size	4.79	4	1	16
Male	56%			
Just casual labor	15%			
Minutes to the clinic	1.24	0.75	0.1	18
Single parent	27.2%			
Presence of children	80%			
Early or mild stage	34.4%			
Moderate stage	34.4%			
Number of children	1.89	2	0	8
Number in household working	0.65	0	0	4

Table 28: Definitions of Dependent Variables

Variable	Definition
HFIAS Score	Raw HFIAS score
Mental health scale	Sum of responses to the K-6 Mental Health Scale
Tuberculosis	Whether patient has had TB in past 6 months
Opportunistic infections	Whether patient has had any OIs in past 6 months
Too sick to work	Whether patient is currently too sick to work

Table 29: Descriptive Statistics of Dependent Variables

Variable	Mean/Proportion	Median	Range	
			Lowest	Highest
HFIAS Score	8.87	9	0	17
Mental health scale	11.93	12	0	20
Tuberculosis	47.8%			
Opportunistic infections	77.2%			
Too sick to work	21.0%			

## 6.4. *Results and Discussion*

### 6.4.1. Determinants of Food Insecurity

First I estimate the food security production function in the sample of patients. Food security is defined as the raw HFIAS score, where a higher level indicates greater food insecurity. I use heteroskedasticity-robust standard errors to calculate the reported p-values. The results of this regression are displayed in Table 28. Standard errors are in parentheses.

The relationships with food insecurity follow intuition. Households with more assets are more likely to be food secure. Participants with low education levels are more likely to be food insecure than those with higher than primary education levels. Older participants experience greater food insecurity, while men are less food insecure than women. Controlling for these variables, whether the household has received recent food support, the household size and the household's source of livelihood are not related with food insecurity. We can compare these results with those of Garrett and Ruel (1999), who find using data from urban Mozambique that assets and household size are significant determinants of calorie availability, while education does not play a role.

Table 30: Food Insecurity Production Function

Variable	Coefficient
Asset index	-0.50 *** (0.14)
No formal or primary education	0.76 * (0.47)
Age	0.07 *** (0.03)
Recent food support	-0.08 (0.54)
Household size	0.13 (0.09)
Male	-1.68 *** (0.52)
Just casual labor	0.53 (0.66)
Constant	6.32 *** (1.01)
$R^2$	0.24
$N$	180
* = significant at 10% ** = significant at 5%, *** = significant at 1%	

#### 6.4.2. Mental Illness Production Function

The first health outcome I look at is mental illness. Mental illness is defined using the raw score of the K6 mental health scale, introduced above. The K6 measures nonspecific mental illness including depression. Higher values of the score indicate greater mental illness. I use heteroskedasticity-robust standard errors, which are shown in parentheses.

The first regression in Table 31 shows Ordinary Least Squares regression using the HFIAS score. As suggested by the simple regressions above, food insecurity is positively and very significantly related with mental illness. Older participants also have greater mental illness. Participants from wealthier households, those who live farther away from the clinic, those who are single parents, those whose households have children or who are male are more likely to be mentally healthy. The significance of the time distance to the clinic suggests that there is an important difference between those who come from Delhi and those who come from outside of Delhi to access the clinic. Although the relationship between being a single parent and mental health is puzzling, as presumably single parents would be under greater stress, it could be the case that single parents who come in for treatment have more supportive extended families than even the married people who seek treatment. Table 31 also reports the instrumental variables results, where the relationship between food insecurity and mental illness loses statistical significance. This finding suggests using caution in interpreting the OLS regression, as the endogeneity of food insecurity may contribute to the relationship.

Others studies have linked food insecurity and mental illness (Hadley and Patil 2006; Heflin et al. 2005; Laraia et al. 2006), but not in the context of HIV. This analysis links food insecurity with mental illness for people with HIV. Research shows that

mental illness can be a significant problem for people with HIV. Antelman et al. (2007) show that depression was related to increased disease progression and mortality in a sample of HIV-positive Tanzanian women. Pence et al. (2007) find that patients with HIV who exhibit mental illness in general or specifically depression have a higher likelihood of a poor response to antiretroviral treatment. While I have not definitively established that food insecurity causes mental illness, the outcomes associated with mental illness should serve to highlight this topic for further research.

Although possibly indicative of an important relationship, this link is also not entirely surprising in these data because of the inherently subjective nature of both the food security and mental health questions. Gundersen and Ribar (2005) note that, while the food security measures may incorporate some objective dimensions of well-being, these measures also capture an individual's expectations regarding appropriate food standards. Gundersen and Ribar then use data from the U.S. to find that this subjective component is very significant. Hamermesh (2004) regards with some suspicion the use of subjective measures in economics, and cautions against using subjective outcomes to explain other subjective measures in empirical analysis. Further research would be needed to determine the validity of subjective measures in capturing objective dimensions of food security for people with HIV.



Table 31: Mental Illness Production Function

Variable	OLS	Instrumental Variables
HFIAS Score	0.18 ** (0.7)	-0.10 (0.87)
Asset index	-0.40 *** (0.13)	-0.55 (0.47)
Age	0.23 ** (0.11)	0.26 (0.16)
Age squared	-0.003 ** (0.001)	-0.003 (0.002)
Just casual labor	0.17 (0.55)	0.28 (0.67)
Minutes to the clinic	-0.13 * (0.07)	-0.09 (0.14)
Single parent	-0.53 (0.47)	-0.6 (0.51)
Presence of children	-0.86 * (0.45)	-0.69 (0.73)
Male	-0.95 ** (0.42)	-1.49 (1.70)
Constant	7.36 *** (2.24)	9.13 (6.03)
$R^2$	0.21	0.13
$N$	180	180

\* = significant at 10%, \*\* = significant at 5%, \*\*\* = significant at 1%

### 6.4.3. Tuberculosis Production Function

Tuberculosis (TB) is one of the leading causes of death among people living with HIV (Chaisson and Martinson 2008). Malnutrition acts as an important factor in susceptibility to tuberculosis (Schaible and Kaufmann 2007). Thus it is hard to overstate the importance of understanding the factors related to TB in patients with HIV. Unfortunately, we know very little about the link between food security and TB.

In order to help fill in this dearth of information, I estimate a production function for whether a patient has had TB in the past 6 months. I define TB as any form of TB, whether non-disseminated or disseminated. The dependent variable is therefore binary, and I run the regression using probit estimation. I include in the regression the disease stage of the patient. This is the physician-evaluated stage of disease progression based on the patient's history of opportunistic infections as well as the most recent CD4 count. A more detailed description of the staging can be found in Appendix B. There are four stages (early, mild, moderate and severe) and I exclude severe stage from the regression. Although the types of opportunistic infections partly determine what stage a person falls into, someone with TB could be in any one of mild, moderate or severe stages. The stage thus provides information regarding the severity of the participant's situation beyond simply what opportunistic infections he or she recently had, and so is different from the dependent variable. Table 32 provides the results of this estimation. Standard errors are in parentheses, and marginal effects evaluated at the average values of the variables are to the side of the coefficient.

The first column shows the probit regression. Food insecurity is not significantly related to having TB. Older patients have a lower chance of having tuberculosis, perhaps

due to the fact that sicker patients often die at a younger age. Men in this sample are much more likely to have TB. Not surprisingly, patients in early, mild or moderate stages are less likely to have TB than patients in the severe stage.

When I estimate the relationship using IV probit regression, surprisingly food security becomes statistically significant, as does asset index. Greater food insecurity is related to a higher probability of having TB. Counter-intuitively, greater wealth is related with higher chance of having TB. The stages, however, lose their significance. Thus food insecurity appears to have an important relationship with having TB.

Table 32: Tuberculosis Production Function

Variable	Probit		IV Probit	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect
HFIAS Score	0.06 (0.04)	0.02	0.32 *** (0.12)	0.13
Asset index	0.04 (0.07)	0.01	0.16 ** (0.07)	0.06
Age	-0.03 * (0.02)	-0.01	-0.04 *** (0.01)	-0.02
Household size	0.03 (0.05)	0.01	-0.02 (0.06)	-0.001
Just casual labor	0.11 (0.31)	0.04	-0.08 (0.29)	-0.03
No formal or primary education	0.18 (0.27)	0.07	-0.12 (0.32)	-0.05
Early or mild stage	-2.12 *** (0.32)	-0.66	-1.33 (1.28)	-0.48
Moderate stage	-1.07 *** (0.28)	-0.39	-0.74 (0.65)	-0.28
Male	0.70 *** (0.26)	0.27	0.85 *** (0.28)	0.33
Constant	0.75 (0.69)		-1.22 (1.46)	
Pseudo $R^2$	0.30			
$N$	180		180	

\* = significant at 10%, \*\* = significant at 5%, \*\*\* = significant at 1%

#### 6.4.4. Opportunistic Infection Production Function

We can expand the analysis of the factors associated with TB to those of having opportunistic infections (OIs) in general. Here the difference is between those who are asymptomatic and those who have had any opportunistic infection over the past 6 months. Thus, as with TB, I estimate the factors related to having an OI using probit regression. Similarly to the TB regression, I include disease stage as a determinant of having an OI. This is possible because anyone who is in mild, moderate or severe stages can have an opportunistic infection, and so the stages give different information than does the dependent variable. Table 33 presents the results of this analysis, with standard errors in parentheses and marginal effects to the side.

The results here mirror those of having TB. Food insecurity is not related to having an OI when I do not account for the endogeneity of food insecurity. Instead, the stages are unsurprisingly related, as is being male. On average, men are almost 20 percent more likely to have an OI than women in this sample. However, when I corrected for the possibility of endogenous food insecurity, I find that food insecurity is related with a greater probability of having an OI. At the average HFIAS Score, an increase by one is correlated with an increase in the likelihood of having an OI by 12 percent. Curiously, after controlling for education, food security and other variables, wealthier households have a higher chance of having an OI. Older patients are less likely to have an OI. Men are almost 30 percent more likely to have an OI.

Table 33: Opportunistic Infection Production Function

Variable	Probit		IV Probit	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect
HFIAS Score	0.01 (0.04)	0.003	0.32 *** (0.10)	0.12
Asset index	-0.02 (0.07)	-0.004	0.15 * (0.08)	0.05
Age	-0.02 (0.02)	-0.004	-0.03 *** (0.01)	-0.01
Household size	0.03 (0.06)	0.01	-0.03 (0.05)	-0.01
Just casual labor	0.16 (0.34)	0.04	-0.09 (0.28)	-0.03
No formal or primary education	-0.14 (0.27)	-0.04	-0.30 (0.20)	-0.11
Early or mild stage	-1.35 *** (0.36)	-0.41	-0.74 (0.72)	-0.28
Moderate stage	-0.70 * (0.36)	-0.21	-0.44 (0.41)	-0.17
Male	0.62 ** (0.26)	0.17	0.77 *** (0.26)	0.28
Constant	1.60 ** (0.77)		-1.06 (1.50)	
<i>Pseudo R</i> <sup>2</sup>	0.17			
<i>N</i>	180		180	

\* = significant at 10%, \*\* = significant at 5%, \*\*\* = significant at 1%

#### 6.4.5. “Too Sick to Work” Production Function

Finally I turn to an immediate effect of having poor mental health, low body mass index and having OIs, especially TB: a very sick patient often finds himself or herself unable to work. Thus I ask whether better food security is associated with a person’s ability to work. Strauss (1986) addresses a similar issue in the context of agriculture, and finds a significant effect of nutrition on labor productivity. In the context of HIV, Thirumurthy et al. (2006) estimate that patients on ART are much more likely to participate in the labor market, Goldman and Bao (2004) find that patients on HAART are more likely to remain employed, and Galarraga et al. (2006) find that HIV-positive women who take antidepressants are more likely to work. In light of these studies, I would like to see if there is a relationship between food insecurity and being too sick to work.

Thus I estimate the determinants of a binary dependent variable: whether the patient reports that they are currently (at the time of the survey) too sick to work. I distinguish this from other reasons for not being in the labor market (being unemployed due to the inability to find a job, and being retired, disabled or a house wife). While being very sick is in large part not a conscious choice of the patient, the decision not to work may be determined partly by intrahousehold factors. Therefore I include in the regression additional household characteristics: the number of children and the number of other household members working.

As can be seen from the results in Table 34, food insecurity has no significant relationship with being too sick to work in either of the regressions. The disease stage is related to being too sick to work: patients in the severe stage are much more likely than

patients in early, mild or moderate stages to be too sick to work. No other variables are significantly related with being too sick to work.



Table 34: "Too Sick to Work" Production Function

Variable	Probit		IV Probit	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect
HFIAS Score	0.03 (0.04)	0.01	0.18 (0.42)	0.05
Asset index	0.00 (0.07)	-0.001	0.06 (0.21)	0.02
Household size	-0.02 (0.10)	-0.01	-0.05 (0.11)	-0.01
Number of children	0.06 (0.15)	0.02	0.06 (0.14)	0.02
Number in household working	0.28 (0.20)	0.08	0.29 (0.20)	0.08
Just casual labor	-0.46 (0.37)	-0.11	-0.51 (0.35)	-0.12
No formal or primary education	0.15 (0.28)	0.04	0.003 (0.55)	0.001
Early or mild stage	-1.40 *** (0.33)	-0.31	-1.29 *** (0.93)	-0.31
Moderate stage	-0.74 *** (0.27)	-0.18	-0.70 *** (0.45)	-0.18
Male	0.01 (0.27)	0.002	0.21 (0.63)	0.06
Constant	-0.59 (0.56)		-1.80 (3.38)	
<i>Pseudo R</i> <sup>2</sup>	0.17			
<i>N</i>	180		180	

\* = significant at 10%, \*\* = significant at 5%, \*\*\* = significant at 1%

## **7. Conclusion**

The purpose of this analysis has been to see if there is a relationship between food insecurity and health production for people with HIV. Food insecurity is related to mental illness when I do not account for endogeneity issues, and food insecurity is related with a greater chance of having TB and OIs when I try to correct for the endogeneity of food insecurity. I find no evidence, however, of a relationship between food insecurity and being too sick to work. Thus, while these results are suggestive of a link, they also caution against simply equating more food security with better health. There is more that goes into the production of health in people with HIV than food security.

For programs which address the food insecurity dimension of HIV, the food insecurity production function offers suggestions for targeting. Assets, education, age and the sex of the patient are all related with food insecurity. Thus, instead of households being either food secure or food insecure, it is better to speak of different levels of food insecurity. Programs might therefore want to consider different gradations of assistance to households at different levels of food insecurity.

This research highlights the context of the disease in caring for those with HIV. Proper medication and access to ARVs is important, but these results suggest that we must also pay attention to giving households the means to care for people with HIV through programs that deal with broader themes as education and livelihood strategies. In addition, we should pay attention to the role that other members of the household play in the health production of patients with HIV. Instead of attempting to supplant them with medical professionals, we might consider empowering them with the knowledge and resources to care for those with HIV within the context of the household.

While the results are suggestive, the analysis has a number of drawbacks. Due to the sample size and study design we cannot say much definitively on causality. A larger sample and a longitudinal study design could allow for stronger statements about the impact of food insecurity on health. In addition, using the HFIAS to measure food insecurity imposes the assumption that a change from a score of, for example, 0 (perfectly food secure) to 2 is the same as a change from 17 to 19. This might not be a realistic assumption, given the difference between food secure households and food insecure households of varying severity.

In addition, the sample represents only those patients who seek treatment at a particular clinic in Delhi. Section 6.4, which compares this sample with nationally representative data, suggests that the EHA patients are better-off than the average urban individual with HIV. However, we do not know how representative the EHA patients are of individuals with HIV who seek treatment. Thus in the absence of further information we should be cautious in generalizing these results to the rest of the population with HIV.

In addition to improving the study design in order to answer the question of causality, this analysis points to some directions for further research. Important factors to understand in the generalizability of any results would be how individuals with HIV who seek treatment with EHA differ from those who seek treatment elsewhere and those who do not seek treatment at all. In addition, since men in our data were more likely to have TB and OIs than women even after controlling for disease stage, we need more research into the factors that contribute to this difference. For example, behaviors such as smoking which are culturally bounded to men may explain much of the increased sickness among men. Furthermore, the data presented here look at households at one particular point in

time. Thus we do not see how HIV contributes to changes in socioeconomic status and food security over time, and how this dynamic corresponds to the relationships examined in this analysis. Further research in these directions could lead to a more full understanding of food security and the socioeconomic context of HIV, enabling practitioners to care for those with HIV more effectively and comprehensively.

# Appendix A: The Survey Instrument

## Survey Form Nutrition and Health Project

Form Filled by: \_\_\_\_\_

Sex:

Date:

Participant's code:

Household Code:

**I. Section I: Obtain the following data from the medical record**

**For the most recent visit in the medical record, record as much as possible of the following information:**

Date of HIV diagnosis:

Date of first visit with Shalom/Home Based Care:

Date of the record:

Stage at Diagnosis:

**I.A. Anthropometric Data**

Height (cm):

Weight (lb):

**I.B. Clinical Assessment at Time of Survey**

In which stage of HIV disease progression can the patient currently be classified (please check)?

Early	<input type="checkbox"/>
Mild	<input type="checkbox"/>
Moderate	<input type="checkbox"/>
Severe	<input type="checkbox"/>

**I.C. Laboratory Data**

Date	T-CD4 Level
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

**I.D. Therapeutic Management**

**I.D.1. Is the patient currently taking ARV drugs?**

When were ARVs initiated?

Have ARVs been discontinued for any reason?

Yes	No	
Day	Month	Year
Yes	No	

**I.D.1.a. If ARVs have been discontinued:**

**Discontinued ARVs**

Name of the drug used	Duration of the use (months)	Reason(s) for stopping use
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>

**I.D.1.b. If ARVs are currently being used:**

**Prescribed anti-retroviral drugs:**

Name of the Drug	Frequency of use
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

**I.E. Opportunistic infections or other associated problems**

I.E.1. Has the patient had opportunistic infections or other associated problems over the past 6 months?

Yes	No
-----	----

I.E.1.a. If "Yes", please fill in the following table:

Infection	Number of Episodes	Treatment	Duration of Treatment Use

**I.F. Nutritional Support**

I.F.1. Is the patient receiving any type of nutritional support?

Yes	No
-----	----

I.F.1.a. If "Yes", how often?

only once	several times	more than 5 times	each month	Other
-----------	---------------	-------------------	------------	-------

I.F.1.b. What foods and how much of each are given?

Food	Amount (kg.)

**I.G. Drug Side Effects**

Data

Adherence to medications	Yes	No
Fatigue	Yes	No
Arthralgia	Yes	No
Migraine	Yes	No
Skin Eruptions	Yes	No
Hyperlipidemia	Yes	No
Hypersensitivity	Yes	No
Jaundice	Yes	No
Lipodystrophy	Yes	No
General Unwellness	Yes	No
Myalgia	Yes	No
Gastrointestinal unwellness	Yes	No
Nephrolithiasis	Yes	No
Peripheral neuropathy	Yes	No
Excessive Sleep	Yes	No
Vivid dreams	Yes	No
Others	Yes	No

Please specify: \_\_\_\_\_

**I.H. Prophylactic Treatment**

I.H.1. Is the patient taking any prophylactic treatment?

Please list:

Drug	Primary/Secondary?	Duration

**I.I. Other Illnesses**

diarrhea	Yes	No
cough	Yes	No
malaria	Yes	No
parasitic illness	Yes	No
conjunctivitis	Yes	No
tuberculosis	Yes	No
whooping cough	Yes	No
cholera	Yes	No
typhoid	Yes	No
encephalitis	Yes	No
dengue	Yes	No
other	Yes	No

Please specify: \_\_\_\_\_

**Participant Form (Participant and Household Information) - Section 2  
Nutrition and Health Project**

Form Filled by: \_\_\_\_\_

Sex:

Date

Participant's code

**Section II: Instructions for the Volunteer: Obtain the following data from the survey participant**

**II.A. Anthropometric Data:** fill the cells with data from the respondent (Person Living with HIV/AIDS (PLWHA))  
Patient

Height (cm)	
Weight (if participant survey filled out on different day than above medical report)	

**II.B.** Is the respondent a mother? If "Yes", fill in the following. If "No", skip to II.C.

- II.B.1.** Do you have any children younger than 6 months?
- II.B.1.a.** If "Yes", is the child breastfed only? (maternal lactancy)
- II.B.2.** Besides maternal lactancy, does the child receive any other food?
- II.B.2a.** If "Yes", which food does he/she receives?:

Yes	No
Yes	No
Yes	No
Yes	No
Yes	No

**II.C.** Please provide information about your family

**II.C.1.** Number of people in the household\*

**II.C.2.** Number of people in your family who are living with you now

*adults    children (under 18 years)*


\*Note: A household is a group of people who normally live and eat their meals together.

For the purposes of this survey, "normally" is taken to mean that the person concerned has lived in the household for at least 3 of the past 12 months.

**II.C.3.** Is the household head a single mother or single father?

Yes	No
-----	----

**II.C.4.** Instruction: Please fill the table by marking the requested information

- Education levels:  
 Illiterate (1)  
 Literate, but without formal schooling (2)  
 Less than Grade 1 (3)  
 Grade 1 (4)  
 Grade 2 (5)  
 Grade 3 (6)  
 Grade 4 (7)  
 Grade 5 (8)  
 Grade 6 (9)  
 Grade 7 (10)  
 Grade 8 (11)  
 Grade 9 (12)  
 Matriculate (13)  
 Intermediate (14)  
 B.A./B.Sc. (15)  
 M.A./M.Sc. (16)  
 Professional degree (17)  
 Diploma (18)

	Age	Gender	Education
<i>Household Members</i>	(years)	Male...1 Female...2	<i>What is the highest level that the member passed?</i>
Person 1			
Person 2			
Person 3			
Person 4			
Person 5			
Person 6			
Person 7			
Person 8			
Person 9			
Person 10			
Person 11			
Person 12			
Person 13			



Over the past 12 months, what work did each person who lives in the household do?

- Activity Codes:  
 Casual labor (1)  
 Salaried employment (2)  
 Farming (3)  
 Driver (4)  
 Petty business/trade/manufacturing (5)  
 Major business/trade/manufacturing (6)  
 Collection/foraging (7)  
 Rickshaw operator (8)  
 Garbage collector (9)  
 Sex worker (10)  
 Charity/alms (11)  
 Unemployed (12)  
 Student (13)  
 Domestic duties only (14)  
 Retired/too old (15)  
 Disabled/handicapped (16)  
 Sick (17)  
 Institutionalized (18)  
 Other (19)

During which months did you do this activity?  
 How many days in each of these months did you  
 do this activity?

Household Members	Description of Activity	Code	May 2006	Jun 2006	Jul 2006	Aug 2006
Person 1						
Person 2						
Person 3						
Person 4						
Person 5						
Person 6						
Person 7						
Person 8						
Person 9						
Person 10						
Person 11						
Person 12						
Person 13						

	Month in which participant surveyed							
	Sept 2006	Oct 2006	Nov 2006	Dec 2006	Jan 2007	Feb 2007	Mar 2007	Apr 2007
Person 1								
Person 2								
Person 3								
Person 4								
Person 5								
Person 6								
Person 7								
Person 8								
Person 9								
Person 10								
Person 11								
Person 12								
Person 13								

How many hours per day did you typically do this activity?

	(Hours)
Person 1	
Person 2	
Person 3	
Person 4	
Person 5	
Person 6	
Person 7	
Person 8	
Person 9	
Person 10	
Person 11	
Person 12	
Person 13	

**II.D. Income**

II.D.1. Which are the current sources of livelihood for your household (both in cash and in kind)?  
CHECK ALL THE RELEVANT BOXES AT LEFT. THEN ASK FOR THE THREE MOST IMPORTANT SOURCES AND WRITE CODES IN BOXES AT RIGHT.

<input type="checkbox"/>	Casual labor (1)	<input type="text"/>
<input type="checkbox"/>	Salaried employment (2)	<input type="text"/>
<input type="checkbox"/>	Farming/Agriculture (3)	<input type="text"/>
<input type="checkbox"/>	Petty business/trade/manufacturing (4)	<input type="text"/>
<input type="checkbox"/>	Major business/trade/manufacturing (5)	<input type="text"/>
<input type="checkbox"/>	Collection/foraging (6)	<input type="text"/>
<input type="checkbox"/>	Charity/alms (7)	<input type="text"/>
<input type="checkbox"/>	Interest income, property, land rentals, etc. (8)	<input type="text"/>
<input type="checkbox"/>	Public transfers/pensions (9)	<input type="text"/>
<input type="checkbox"/>	Private transfers/remittances (incl. family support) (10)	<input type="text"/>
<input type="checkbox"/>	Selling of Assets (11)	<input type="text"/>
<input type="checkbox"/>	Other (12)	<input type="text"/>

II.D.2. Can you help us identify what amount of income you use for:

Type of expense	Weekly	Monthly	Yearly	Annualized
Food				
Clothing				
Housing				
Education				
Recreation/leisure				
Transportation				
Health care				
Utilities (water, telephone, electricity)				
Others				

**II.E. Illnesses and Drugs**

II.E.1. How many times were you sick in the last 3 months? Times

II.E.1.a. What was/were your illness(es)? \_\_\_\_\_

II.E.2. How many times did you get medical assistance in the last 3 months? Times

II.E.3. Usually how long does it take for you to reach the Shalom clinic?

Hours	Minutes
<input type="text"/>	<input type="text"/>

II.E.4. What medications besides ARV did you take for these illnesses, and how much did they cost?

Medication	Cost
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

--	--

**II.E.5.** What are the most commons illnesses for your family?

diarrhea	
cough	
malaria	
parasitic illnesses	
conjunctivitis	
tuberculosis	
jaundice	
whooping cough	
cholera	
typhoid	
encephalitis	
dengue	
Other (please specify) _____	

**II.E.6.** Are you taking ARV drugs?

Yes	No
Yes	No

**II.E.6.a.** If "No", have you taken other ARV drugs before?

**II.E.6.b.** If "Yes" to II.E.1, do you take them at the time indicated by the physician?

Always	Sometimes	Never

**II.E.6.c.** If you answered "Sometimes" or "Never", what have been the main reasons for not taking them as indicated?

- Lack of money
- Forgot
- Secondary Symptoms
- Depression
- Other

Yes	No
Yes	No
Yes	No
Yes	No
Yes	No

Please specify: \_\_\_\_\_

**II.E.6.d** Is there a person making sure that you take your ARV medications?

Yes	No
-----	----

**II.E.6.e.** If "Yes", please specify your relationship to that person: \_\_\_\_\_

**II.E.6.f.** How much do the ARV medications cost you? \_\_\_\_\_

**II.E.6.g.** From whom do you obtain the ARV medications?

- Government medical clinic
- Private medical clinic
- Other please specify:

please specify: \_\_\_\_\_

please specify: \_\_\_\_\_

\_\_\_\_\_

**II.E.6.h.** How long does it take to reach the location where you obtain ARV drugs?

Hours	Minutes

**II.E.7.** In the last few months, have you sold assets to pay for ARV drugs?

Yes	No
-----	----

**II.E.7.a.** May we know which assets?: \_\_\_\_\_

**II.F. Food Insecurity**

*For each of the following questions, consider what has happened in the past 30 days*

*Note: Rarely = once or twice in the past 30 days  
 Sometimes = three to ten times in the past 30 days  
 Often = more than ten times in the past 30 days*

		Code
<b>II.F.1</b>	Did you worry that your household would not have enough food?	0 = No (skip to 11.F.2), 1 = Yes
<b>II.F.1.a</b>	If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often
<b>II.F.2</b>	Were you or any household members not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to 11.F.3), 1 = Yes
<b>II.F.2.a</b>	If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often
<b>II.F.3</b>	Did you or any household member eat just a few kinds of food day after day because of a lack of resources?	0 = No (skip to 11.F.4), 1 = Yes
<b>II.F.3.a</b>	If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often
<b>II.F.4</b>	Did you or any household member eat food that you did not want to eat because of a lack of resources to obtain other types of food?	0 = No (skip to 11.F.5), 1 = Yes
<b>II.F.4.a</b>	If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often
<b>II.F.5</b>	Did you or any household member eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to 11.F.6), 1 = Yes
<b>II.F.5.a</b>	If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often
<b>II.F.6</b>	Did you or any household member eat fewer meals in a day because there was not enough food?	0 = No (skip to 11.F.7), 1 = Yes
<b>II.F.6.a</b>	If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often

<b>II.F.7</b> Was there ever no food at all in your household because there were no resources to get more?	0 = No (skip to 11.F.8), 1 = Yes	
<b>II.F.7.a</b> If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often	
<b>II.F.8</b> Did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to 11.F.9), 1 = Yes	
<b>II.F.8.a</b> If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often	
<b>II.F.9</b> Did you or any household member go a whole day without eating anything because there was not enough food?	0 = No, 1 = Yes	
<b>II.F.9.a</b> If "Yes", how often did this happen?	1 = Rarely, 2=Sometimes, 3=Often	

**II.G. Types of Food and Dietary Diversity**

**II.G.1.** *Now I would like to ask you about the types of foods that you or anyone else in your household ate yesterday during the day and at night.*

Read the list of foods. Place a ONE in the box if anyone in the household ate the food in question, place a ZERO in the box if no one in the household ate the food.

- a Any chapati, rice, bread, noodles, biscuits, or any other foods made from maize, sorghum, millet, wheat, or any other locally available grain?
- b Any potatoes, yams, manioc, cassava or any other foods made from roots and tubers?
- c Any vegetables?
- d Any fruits?
- e Any chicken, lamb, goat, or any other meat?
- f Any eggs?
- g Any fresh or dried fish or shellfish?
- h Any foods made from lentils, beans, peas, or nuts (such as dal)?
- i Any cheese, yogurt, milk, or other milk products?
- j Any foods made with oil, fat, or butter?
- k Any sugar or honey?
- l Any other foods, such as condiments, coffee, tea?

**Food Shortages**

**II.H.** Now I would like to ask you about your household's food supply during different months of the year. When responding to these questions please think back over the last 12 months.

**II.H.1.** In the past 12 months, were there months in which you did not have enough food to meet your family's needs?

Yes	No	If "No", go to II.N.2
-----	----	-----------------------

**II.H.1.a.** If "Yes", for each of the past 12 months indicate "Yes" if you did NOT have enough food to meet your family's needs, "No" otherwise.

Apr. 2007	Yes	No
Mar. 2007	Yes	No
Feb. 2007	Yes	No
Jan. 2007	Yes	No
Dec. 2006	Yes	No
Nov. 2006	Yes	No
Oct. 2006	Yes	No
Sept. 2006	Yes	No
Aug. 2006	Yes	No
Jul. 2006	Yes	No
Jun. 2006	Yes	No
May 2006	Yes	No

**II.H.2.** Circle the strategies to obtain food in periods of shortages (within the last year)

- Spending of savings
- Temporal migration
- Street soliciting
- Job search
- Permanent migration
- Soliciting institutions
- Larger number of people working
- Selling of assets
- Selling of forest products
- Donations/gifts from outside the family
- Selling of land
- Family support
- Other

**II.I. Food support**

**II.I.1.** In the last 12 months have you received any type of food support from neighbors, families, friends or institutions?

Yes	No
-----	----

**II.I.1.a.** If "Yes", please fill in the following table

From whom do you receive the food support?	How often?	What type did you receive?

**II.J. Food Prices**

**II.J.1** How much did you spend on your last purchase of:  
 rice  
 lentils  
 corn flour  
 wheat flour  
 milk

Cost	Amount (kg)

type of lentil: \_\_\_\_\_

**II.J.2** How long does it take you to reach the primary market where you buy food?

Hours	Minutes

**II.K. Transportation Means**

**II.K.1.** How do you get to Shalom clinic?

- Walking (1)
- Animal (2)
- Bicycle (3)
- Motorcycle (4)
- Bus (5)
- Train (6)
- Rickshaws (7)
- Other (8)

Code

**II.L. Main features of the house.**

**II.L.1.** Your house and land/yard are:

- Owned (1)
- Lent (2)
- Rented (3)
- Other (4)

Code

**II.L.2.** The main material of the roof of your house is:

- Tile (1)
- Wood (2)
- Brick (3)
- Concrete (4)
- Asbestos (5)
- Thatched (6)
- Other (7)

Code

**II.L.3.** The main material of the walls of your house is:

- Brick (1)
- Wood (2)
- Plywood (3)
- Cardboard (4)
- Mud (5)
- Other (6)

Code

**II.L.4.** The main material of the floor of your house is:

- Cement (1)
- Tile (2)
- Ground (3)
- Stone (4)
- Wood (5)
- Other (6)

Code

**II.L.5.** How many rooms does your house have?

Total Number	<input style="width: 60px; height: 20px;" type="text"/>
Number of bedrooms (separated)	<input style="width: 60px; height: 20px;" type="text"/>
Number of bathrooms (separated)	<input style="width: 60px; height: 20px;" type="text"/>

**II.L.6.** Does your house have:

One Living-Dining-room	Yes	No
Living room (separated)	Yes	No
Dining-room (separated)	Yes	No
Kitchen	Yes	No

**II.L.7** Does your household own any of these items?

Radio/Cassette/CD player	Yes	No
Camera/camcorder	Yes	No
Bicycle	Yes	No
Motorcycle/scooter	Yes	No
Motorcar etc.	Yes	No
Refrigerator or freezer	Yes	No
Washing machine	Yes	No
Fan	Yes	No
Heater/Cooler	Yes	No
Black-and-white television	Yes	No
Color television	Yes	No
Pressure lamp (lantern)	Yes	No
Telephone/mobile phone	Yes	No
Sewing machine	Yes	No
Pressure cooker	Yes	No
Watches	Yes	No
Air Conditioning	Yes	No

**II.M. Water Treatment**

**II.M.1** Do you treat the water that you drink?

Yes	No
-----	----

**II.M.1.a.** If "Yes", which method do you use?

- Apply chlorine (1)
- Boil (2)
- Filter (3)
- Buy purified (4)
- Solar disinfection (5)
- Water purifier (6)
- Other (7)

Code

**II.M.2.** The water you drink or that you use for other things is from:

- Plumbing (faucet) (1)
- Tank (2)
- River/Canal/Lake/Pond (3)
- Open well (4)
- Bore well (5)
- Other (6)

Code



**II.N. Basic Sanitation** (circle)

**II.N.1.** *In your house or in the yard do you have:*

- Latrine in house (1) Code
- Latrine in yard (2)
- Common latrine (3)
- Other (4)

**II.N.2.** *The most common way of disposing trash is:*

- Trash collector (1)
- Burn it (2)
- Bury it (3) Code
- Dump it on street (4)
- Dump it in water (river) (5)
- Dump it in yard (6)
- Other (7)

**II.O. The Kitchen**

**II.O.1.** *Your house kitchen is located in:*

- In the same place where you sleep (1) Code
- Inside the house (not where you sleep) (2)
- Outside the house (3)

**II.O.2.** *What type of fuel do you use most often for cooking?*

- LPG or piped gas (1)
- Locally produced gas (2)
- Electricity (3)
- Kerosene (4) Code
- Coal (5)
- Firewood (6)
- Cow dung cakes (7)
- Leaves/Straw/Thatch (8)
- Other (9)

**II.O.3.** *Do you store food in your house?*  Yes  No

**II.O.3.a.** *If "Yes", how do you store your food?*

	In Cans	In bags	Plastic containers	In baskets	Refrigerated	In any place
Grains (rice, corn, coarse wheat flour, lentils)						
Vegetables (tomatoes, onions)						
Dairy (milk, cheese)						
Groceries (noodles, butter, etc)						
Meats						
Meats are prepared and canned	Yes	No				
Do you consume iodized salt?	Yes	No				

**II.P. Mental Health**

The next questions are about how you have been feeling during the past 30 days

**II.P.1.** *About how often during the past 30 days did you feel nervous? Would you say all of the time, most of the time, some of the time, a little of the time, or none of the time?*

All (4)  
Most (3)  
Some (2)  
A little (1)   
None (0)  
Don't know (8)  
Refused to answer (9)

**II.P.2.** *During the past 30 days, about how often did you feel hopeless? -- all of the time, most of the time, some of the time, a little of the time, or none of the time?*

All (4)  
Most (3)  
Some (2)  
A little (1)   
None (0)  
Don't know (8)  
Refused to answer (9)

**II.P.3.** *During the past 30 days, about how often did you feel restless or fidgety?*

All (4)  
Most (3)  
Some (2)  
A little (1)   
None (0)  
Don't know (8)  
Refused to answer (9)

**II.P.4.** *How often did you feel so depressed that nothing could cheer you up?*

All (4)  
Most (3)  
Some (2)  
A little (1)   
None (0)  
Don't know (8)  
Refused to answer (9)

**II.P.5.** *During the past 30 days, about how often did you feel that everything was an effort?*

All (4)  
Most (3)  
Some (2)  
A little (1)   
None (0)  
Don't know (8)  
Refused to answer (9)

**II.P.6.** *During the past 30 days, about how often did you feel worthless?*

All (4)  
Most (3)  
Some (2)  
A little (1)   
None (0)  
Don't know (8)  
Refused to answer (9)

## **Appendix B: Staging Criteria**

The stages used in the regression analysis are physician-evaluated stages for each person who had medical records available. The main physician in the clinic provided these staging criteria and classified the patients into stages. Patients who were not receiving ART were classified into four stages using the WHO staging criteria. WHO stage I corresponds to our early stage, WHO stage II corresponds to our mild stage, WHO stage III corresponds to our moderate stage, and WHO stage IV corresponds to our severe stage. Patients who were on ART, however, could not be classified using the WHO criteria, and we needed to develop another set of criteria. These are as follows:

If a patient had a recent (within one year) CD4 count of above 500 and/or was asymptomatic (over the past 6 months), he or she fell into the Early stage.

If a patient had a recent CD4 count of above 350 and/or was asymptomatic (over the past 6 months), had minor mucocutaneous lesions, or had an upper respiratory infection, he or she was classified as Mild.

If a patient had either (1) a recent CD4 count of less than 200 and/or was stabilized on medications for WHO stage III opportunistic infections (or lymph node TB), or (2) a recent CD4 count of less than 200 and/or was on prophylaxis for a WHO Stage IV opportunistic infection, or (3) a recent CD4 of above 200 with WHO Stage II opportunistic infections, he or she was classified as Moderate.

If a patient had a recent CD4 count of less than 200 and was symptomatic with a WHO stage III or IV opportunistic infection, or was on medications for WHO Stage III or IV opportunistic infections, he or she fell into the Severe stage.

## Works Cited

- Akin, J. S. and The Cebu Team. 1992. "A child health production function estimated from longitudinal data" *Journal of Development Economics* 38(2): 323-351.
- Antleman, Gretchen, Sylvia Kaay, Ruilan Wei, Jessie Mbwambo, Gernard I. Msamanga, Wafaie W. Fawzi, and Mary C. Smith Fawzi. 2007. "Depressive symptoms increase risk of HIV disease progression and mortality among women in Tanzania." *Journal of Acquired Immune Deficiency Syndromes* 44(4): 470-477.
- Auster, Richard, Irving Leveson, and Deborah Sarachek. 1969. "The production of health: an exploratory study." *The Journal of Human Resources* 4(4): 411-436.
- Baillie, Andrew J. 2005. "Predictive gender and education bias in Kessler's psychological distress Scale (K10)." *Social Psychiatry and Psychiatric Epidemiology* 40(9): 743-748.
- Baggaley, R.F., R. Ganaba, V. Filippi, M. Kere, T. Marshall, I. Sombié, K. T. Storeng, and V. Patel. 2007. "Detecting depression after pregnancy: the validity of the K10 and K6 in Burkina Faso." *Tropical Medicine and International Health* 12(10): 1225-1229.
- Barrett, Christopher B. 2002. "Food security and food assistance programs." In *Handbook of Agricultural Economics*, edited by B. L. Gardner and G. C. Rausser, Volume 2B, Agricultural and Food policy (pp. 2103-2190), *Handbooks in Economics*, vol. 18. Amsterdam, London and New York: Elsevier Science, North-Holland.
- Baylies, C. 2002. "The impact of AIDS on rural households in Africa: a shock like any other?" *Development and Change*, 33(4): 611-632.
- Berneis, K., M. Battegay, S. Bassetti, R. Nuesch, A. Leisibach, S. Bilz, and U. Keller. 2000. "Nutritional supplements combined with dietary counselling diminish whole body protein catabolism in HIV-infected patients." *European Journal of Clinical Investigation* 30: 87-94.
- Blaylock, James R. and W. Noel Blisard. 1995. "Food security and health status in the United States." *Applied Economics* 27: 961-966.
- Bound, John, David A. Jaeger, and Regina M. Baker. 1995. "Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak." *Journal of the American Statistical Association* 90(430): 443-450.

- Bukusuba, John, Joyce Kikafunda, and Roger Whitehead. 2007. "Food security status in households of people living with HIV/AIDS (PLWHA) in a Ugandan urban setting." *British Journal of Nutrition* 98: 211-217.
- Castleman, T., E. Seumo-Fosso, and B. Cogill. 2004. "Food and nutrition implications of antiretroviral therapy in resource limited settings" Technical Note No. 7, Washington, D.C.: Food and Nutrition Technical Assistance Project, Academy for Educational Development.
- Chaisson, Richard E. and Neil A. Martinson. 2008. "Tuberculosis in Africa – Combating an HIV-Driven crisis." *The New England Journal of Medicine* 358(11): 1089-1092.
- Chen, S., J. Shogren, P. Orazem, and T. Crocker. 2002. "Prices and health: Identifying the effects of nutrition, exercise, and medication choices on blood pressure." *American Journal of Agricultural Economics* 84(4): 990-1002.
- Coates, Jennifer, Edward A. Frongillo, Beatrice Lorge Rogers, Patrick Webb, Parke E. Wilde, and Robert Houser. 2006. "Commonalities in the experience of household food insecurity across cultures: what are measures missing?" *Journal of Nutrition* 136: 1438S–1448S.
- Coates, Jennifer, Anne Swindale and Paula Bilinisky. 2006. "Household food insecurity access scale (HFIAS) for measurement of food access: Indicator guide, Version 2." Washington, D.C.: Food and Nutrition Technical Assistance Project, Academy for Educational Development.
- Filmer, Deon and Lant Pritchett. 2001. "Estimating wealth effects without expenditure data – or tears: an application to educational enrollments in India." *Demography* 38(1): 115-132.
- Gallaraga, Omar, David S. Salkever, Judith A. Cook, and Stephen J. Gange. 2006. "An instrumental evaluation of antidepressant use on employment among HIV-infected women using highly-active antiretroviral therapy in the United States 1996-2004." National Bureau of Economic Research Working Paper 12619.
- Garret, James L. and Marie T. Ruel. 1999. "Are determinants of rural and urban food security and nutritional status different? Some insights from Mozambique." *World Development* 27(11): 1955-1975.
- Gillespie, Stuart and Suneetha Kadiyala. 2005. "HIV/AIDS and food and nutrition security: From evidence to action." Food Policy Review No. 7. Washington, D.C.: International Food Policy Research Institute.
- Goldman, Dana P. and Yuhua Bao. 2004. "Effective HIV treatment and the employment of HIV+ adults." *Health Services Research* 39(6): 1691-1712.

- Grossman, M. 1972. "On the concept of health capital and the demand for health." *Journal of Political Economy* 80(2): 223-255.
- Grossman, M. 2000. "The human capital model." In *Handbook of health economics*, edited by A. J. Culyer and J. P. Newhouse. Volume 1A (pp. 347-408), *Handbooks in Economics*, vol. 17. Amsterdam; New York and Oxford: Elsevier Science, North-Holland.
- Gundersen, Craig and David C. Ribar. 2005. "Food insecurity and insufficiency at low levels of food expenditures." *Forschungsinstitut zur Zukunft der Arbeit*, Discussion Paper No. 1594.
- Hadley, Craig and Crystal Patil. 2006. "Food insecurity in rural Tanzania is associated with maternal anxiety and depression." *American Journal of Human Biology* 18: 359-368.
- Hamermesh, Daniel S. 2004. "Subjective outcomes in economics." *Southern Economic Journal* 71(1): 2-11.
- Healey, A., M. Mirandola, A. Francesco, P. Bonizzato, and M. Tansella. 2000. "Using health production functions to evaluate treatment effectiveness: an application to a community mental health service." *Health Economics* 9(5): 373-383.
- Heflin, Colleen M., Kristine Siefert and David R. Williams. 2005. "Food insufficiency and women's mental health: findings from a 3-year panel of welfare recipients." *Social Science & Medicine* 61: 1971-1982.
- Hoddinott, J. and Y. Yohannes. 2002. "Dietary diversity as a food security indicator." FCND Discussion Paper No. 136. Washington, D.C.: International Food Policy Research Institute.
- International Institute for Population Sciences. "NFHS-3" [www.nfhsindia.org](http://www.nfhsindia.org) (accessed 2 Feb 2008).
- Kadiyala, Suneetha and Stuart Gillespie. 2003. "Rethinking food aid to fight AIDS." FCND Discussion Paper No. 159, Washington, D.C.: International Food Policy Research Institute.
- Kendall, A., C. M. Olson, and E. A. Frongillo. 1995. "Validation of the Radimer/Cornell measures of hunger and food insecurity." *Journal of Nutrition* 125(11): 2793-2801.

- Kessler, R.C., P.R. Barker, L.J. Colpe, J.F. Epstein, J.C. Gfroerer, E. Hiripi, M.J. Howes, S-L.T. Normand, R.W. Manderscheid, E.E. Walters, and A.M. Zaslavsky. 2003. "Screening for serious mental illness in the general population." *Archives of General Psychiatry* 60(2): 184-189.
- Kessler, Ronald C. and T. Bedirhan Üstün. 2004. "The World Mental Health (WMH) survey initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI)." *International Journal of Methods in Psychiatric Research* 13(2): 93-121.
- Laraia, Barbara A., Anna Maria Siega-Riz, Craig Gundersen, and Nancy Dole. 2006. "Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women." *The Journal of Nutrition* 136: 177-182.
- Loevinsohn, M. and S. Gillespie. 2003. "HIV/AIDS, food security and rural livelihoods: understanding and responding." RENEWAL Working Paper No. 2. Washington, D.C.: International Food Policy Research Institute.
- Mahal, Ajay and Bhargavi Rao. 2005. "HIV/AIDS epidemic in India: an economic perspective." *Indian Journal of Medical Research* 121: 582-600.
- Mangili, A., D. H. Murman, A. M. Zampini and C. A. Wanke. 2006. "Nutrition and HIV infection: review of weight loss and wasting in the era of highly active antiretroviral therapy from the nutrition for healthy living cohort." *Clinical Infectious Diseases* 42(6): 836-842.
- Marston, B. and K. M. De Cock. 2004. "Multivitamins, nutrition, and antiretroviral therapy for HIV disease in Africa." *New England Journal of Medicine* 351(1): 78-80.
- McNamara, P. E. 2005. "Using agricultural economics to strengthen nongovernmental organizations' food security programs for people living with HIV/AIDS: an example from Honduras." *American Journal of Agricultural Economics* 87(5): 1304-1309.
- Moyle, Graeme J., Karen Schoelles, Kyle Fahrbach, Diana Frame, Kimberly James, Rachel Scheye, and Nancy Cure-Bolt. 2004. "Efficacy of selected treatments of HIV wasting: a systematic review and meta-analysis." *Journal of Acquired Immune Deficiency Syndromes* 37(Supplement 5): S262-S276.
- Murphy, L. L., P. Harvey and E. Silvestre. 2005. "How do we know what we know about the impact of AIDS on food and livelihood insecurity? A review of empirical research from rural Sub Saharan Africa." *Human Organization* 64(3): 265-275.
- National Family Health Survey (NFHS). "2005-2006 Delhi Fact Sheet," [www.nfhsindia.org](http://www.nfhsindia.org) (accessed 3 October, 2007)



- Normén, Lena, Keith Chan, Paula Braitstein, Aranka Anema, Greg Bondy, Julio S.G. Montaner, and Robert S. Hogg. 2005. "Food insecurity and hunger are prevalent among HIV-positive individuals in British Columbia, Canada." *Journal of Nutrition* 135(4): 820-825.
- Patel, V., R. Araya, N. Chowdhary, M. King, B. Kirkwood, S. Nayak, G. Simmon, and H.A. Weiss. 2008. "Detecting common mental disorders in primary care in India: a comparison of five screening questionnaires." *Psychological Medicine* 38(2): 221-228.
- Paton, NI, S Sangeetha, A Earnest, and R Bellamy. 2006. "The impact of malnutrition on survival and the CD4 count response in HIV-infected patients starting antiretroviral therapy." *HIV Medicine* 7(5): 323–330.
- Pence, Brian Wells, William C. Miller, Bradley N. Gaynes, and Joseph J. Eron. 2007. "Psychiatric illness and virologic response in patients initiating highly active antiretroviral therapy." *Journal of Acquired Immune Deficiency Syndromes* 44(2): 159-166.
- Piwoz, E. G. and E. A. Preble. 2000. "HIV/AIDS and nutrition: a review of the literature and recommendations for nutritional care and support in sub-Saharan Africa." Washington, D.C.: Support for Analysis and Research in Africa (SARA) Project: Bureau for Africa, Office of Sustainable Development, US Agency for International Development.
- Rollins, Nigel. 2007. "Food Insecurity—A Risk Factor for HIV Infection." *PLoS Medicine* 4(10): e301.
- Rosenzweig, M. R. and T.P. Schultz. 1983. "Estimating a household production function: heterogeneity, the demand for health inputs, and their effects on birth weight." *Journal of Political Economy* 91(5): 723-746.
- Rosenzweig, M. R. and K.I. Wolpin. 1988. "Migration selectivity and the effects of public programs." *Journal of Public Economics* 37(3): 265-289.
- Ruel, M. T. 2003. "Operationalizing dietary diversity: a review of measurement issues and research priorities." *Journal of Nutrition* 133(11): 3911S-3926S.
- Schaible, Ulrich E. and Stefan H. E. Kaufmann. 2007. "Malnutrition and infection: complex mechanisms and global impacts." *PLoS Medicine* 4(5): e115.
- Schultz, T. P. 2004. "Health economics and applications in developing countries." *Journal of Health Economics*, 23(4): 637-641.

- Semba, R. D. and A. M. Tang. 1999. "Micronutrients and the pathogenesis of human immunodeficiency virus infection." *The British Journal of Nutrition* 81(3): 181-189.
- Stifel, D. and H. Alderman, 2006. "The 'glass of milk' subsidy program and malnutrition in Peru." *World Bank Economic Review* 20(3): 421-448.
- Stratmann, T. 1999. "What do medical services buy? Effects of doctor visits on work day loss." *Eastern Economic Journal* 25(1): 1-16.
- Strauss, John. 1986. "Does better nutrition raise farm productivity?" *Journal of Political Economy* 94(2): 297-320.
- Swindale, Anne and Paula Bilinsky. 2005. "Household dietary diversity score (HDDS) for measurement of household food access: indicator guide." Washington, D.C.: Food and Technical Assistance Project, Academy for Educational Development.
- Swindale, Anne and Paula Bilinsky. 2006a. "Development of a universally applicable household food insecurity measurement tool: process, current status, and outstanding issues." *Journal of Nutrition* 136(5): 1449-1452.
- Swindale, Anne and Paula Bilinsky. 2006b. "Household dietary diversity score (HDDS) for measurement of household food access: Indicator guide, Version 2." Washington, D.C.: Food and Technical Assistance Project, Academy for Educational Development.
- Tabi, Marian and Robert L. Vogel. 2006. "Nutritional counselling: an intervention for HIV-positive patients." *Journal of Advanced Nursing* 54(6): 676-682.
- Thomas, Duncan, Victor Lavy, and John Strauss. 1996. "Public policy and anthropometric outcomes in the Cote d'Ivoire." *Journal of Public Economics* 61(2): 155-192.
- Townsend, Marilyn S., Janet Pearson, Bradley Love, Cheryl Achterberg, and Suzanne P. Murphy. 2001. "Food insecurity is positively related to overweight in women." *Journal of Nutrition* 131: 1738-1745.
- UNAIDS. 2006. "Report on the global AIDS epidemic." Geneva: UNAIDS.
- UNAIDS. 2007. "2.5 million people living with HIV in India," [www.unaids.org](http://www.unaids.org) (accessed 4 Feb, 2008).
- United States Agency for International Development (USAID). 1992. "Policy determination 19, definition of food security, April 13, 1992." Washington, DC.

- Veldhiuzen, Scott, John Cairney, Paul Kurdyak, and David L Streiner. "The sensitivity of the K6 as a screen for any disorder in community mental health surveys: a cautionary note." *La Revue Canadienne de Psychiatrie* 52(4): 256-259.
- Weiser, Sheri D., Karen Leiter, David R. Bangsberg, Lisa M. Butler, Fiona Percy-de Kortel, Zakhe Hlanze, Nthabiseng Phaladze, Vincent Iacopino, and Michele Heisler. 2007. "Food insufficiency is associated with high-risk sexual behavior among women in Botswana and Swaziland." *PLOS Medicine* 4(10): 1-10.
- World Health Organization (WHO). 2007. "BMI Classification," [www.who.int/bmi/](http://www.who.int/bmi/) (accessed 16 April, 2008).
- Wiig, Kristen and Chery Smith. 2007. "An exploratory investigation of dietary intake and weight in human immunodeficiency virus-seropositive individuals in Accra, Ghana." *Journal of the American Dietetic Association* 107(6): 1008-1013.
- World Food Programme. 2005. "Reducing the burden of HIV/AIDS: Experience of food aid intervention in western Kenya." Nairobi, Kenya: World Food Programme Kenya Country Office.