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Human Recognition among HIV-Infected Adults:
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Abstract: This paper introduces the concept of human recognition, defined as the extent to which an individual is acknowledged by other individuals, groups, or organizations to be of inherent value with intrinsic qualities in common with the recognizer, i.e., recognition as a fellow human being. The paper examines the role human recognition plays in development, and uses data from a randomized controlled trial to evaluate the impacts of food supplementation and medical treatment on human recognition among malnourished, HIV-infected adults in Kenya. Questions specially designed to measure human recognition were included in the trial, demonstrating how data on human recognition can be collected and analyzed as part of research or programs. The data are used to test hypotheses generated by a theoretical model about the impacts health interventions have on human recognition, the determinants of human recognition, and the role human recognition plays in nutritional status and subjective well-being. Six months of food supplementation is found to have a significant, independent, positive impact on recognition levels, though this effect does not persist six months after completion of the supplementation. Location of the HIV clinics is a determinant of human recognition improvements, with smaller improvements among subjects in urban slums of Nairobi than among subjects in district and provincial hospitals, controlling for demographic, socio-economic, and health characteristics. Women receive lower levels of human recognition than men and also have worse mental health status; the relationship among gender, mental health, and human recognition merits further investigation. There is some evidence of an association between human recognition and nutritional status, but findings about the role human recognition plays in nutritional status and subjective well-being are limited, and further study is needed in this area.

JEL Codes: I12, I15, I31, O15

Keywords: human recognition, respect, dehumanization, HIV, AIDS, malnutrition, nutrition, food supplementation, well-being, randomized trial, stigma, Kenya

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Before…I was treated like an animal – by my employer, by my husband, by my village. Now I am treated like a human…I am not afraid anymore.

- a tobacco worker, Gujarat, India
(*Voices of the Poor*, World Bank 2000, quoted in Narayan 2005)

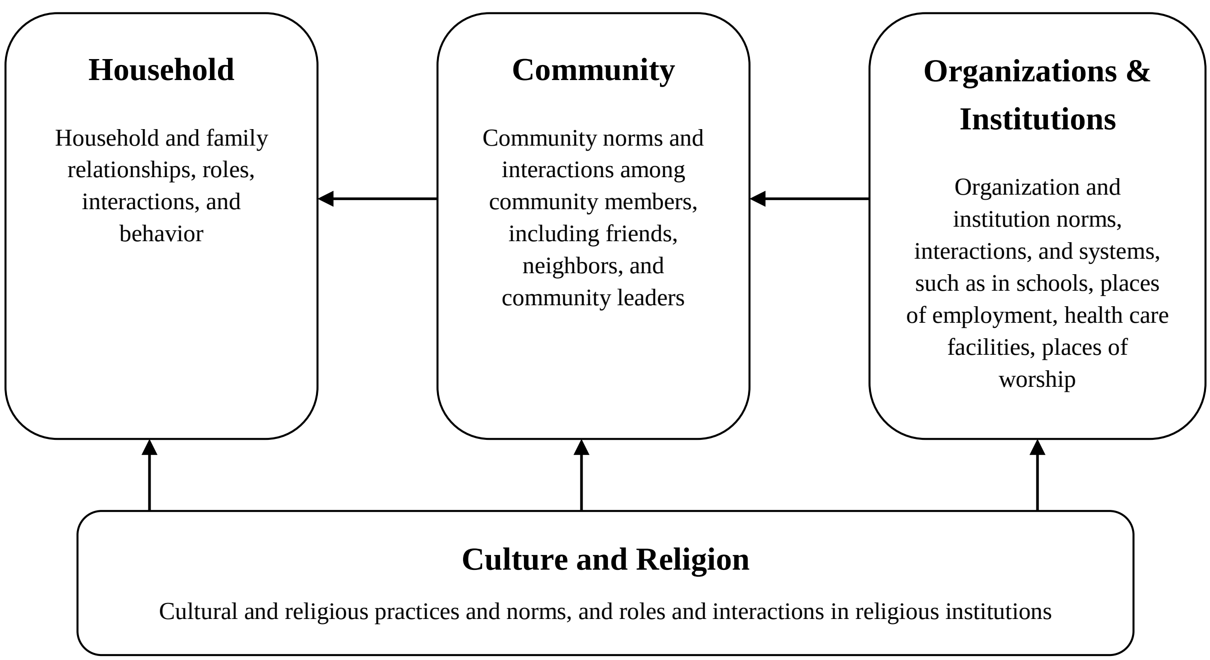
I. Introduction

The quotation above from the World Bank's Voices of the Poor publication attests to something that many development practitioners and researchers have observed: how individuals are viewed, valued, and treated by others can influence and be influenced by development programs and their outcomes. This paper explores that observation by empirically measuring the extent to which individuals are viewed, valued, and treated as fellow human beings – defined here as "human recognition" – and evaluating the impact of specific health and nutrition program interventions on human recognition.

In recent years, the study and practice of economic development have expanded to focus on less tangible components, such as freedom (Sen 1999), empowerment (World Bank 2005), and social capital (Isham, Kelly and Ramaswamy 2002), that have been identified as underlying factors of successful economic development. This paper builds on this work but focuses on human recognition, which is distinct from the concepts cited above. Human recognition is defined as the extent to which an individual is acknowledged by other individuals, groups, or organizations to be of inherent value with intrinsic qualities in common with the recognizer, i.e., recognition as a fellow human being. Human recognition can be positive or negative. Positive human recognition refers to acknowledging an individual to be of value by virtue of being a human being who possesses basic qualities in common with oneself and other human beings. Negative recognition refers to viewing an individual as lacking inherent value as a human being or not acknowledging this value. The concepts closest to negative recognition are objectification and dehumanization. More detailed description of the concept of human recognition is in Castleman (2011a).

Human recognition transactions occur in multiple domains of individuals' lives. Figure 1 below organizes these domains into a simple framework. The household, community, and organizations and institutions are the three primary domains in which individuals receive human recognition. Culture and religion are also sources of human recognition and they operate primarily through the three primary domains. The horizontal arrows in Figure 1 indicated that the "larger" domains can influence human recognition transactions in the "smaller" domains, such as when community attitudes about HIV affect the human recognition people living with HIV receive in their households. The approach for measuring human recognition levels uses this framework.

Figure 1: Framework of Human Recognition Domains



Human recognition plays multiple roles in development. As modeled in this paper and more extensively in Castleman (2011b), human recognition is hypothesized to affect development outcomes such as health and consumption through impacts on individuals' behaviors, choices, and access to opportunities and services. Development programs themselves can influence human recognition transactions. The above quotation is from a woman in India who attributes the improved human recognition she receives to joining the Self-Employed Women's Association (SEWA). In other cases development programs can reduce human recognition levels among participants, for example through dehumanizing behavior by service providers.

As depicted in Table 1, development programs can affect human recognition through *how* interventions are implemented (systems, processes, interpersonal approaches, and organizational norms) and through the *content* of the interventions. The content of interventions can affect human recognition in two distinct ways: by directly addressing human recognition, or by improving material outcomes that in turn improve human recognition transactions. This paper studies two specific interventions that fall in the latter category: supplementary food and antiretroviral therapy for HIV. Data from a randomized controlled trial are used to examine the impact that food supplementation and medical treatment have on the human recognition levels of malnourished, HIV-infected adults in Kenya. Different pathways by which these interventions affect recognition are tested by controlling for changes in nutritional status and mental and physical health. Determinants of human recognition are also studied, as well as the extent to which human recognition is a determinant of nutritional status and well-being.

Table 1: Pathways by which Development Interventions Affect Human Recognition

Program Element	Channel	Example
Implementation approach	Systems	Seating and waiting arrangements for services
	Processes	Client privacy and consent processes
	Interpersonal approaches	Teacher treatment of students
	Organizational norms	Employee conditions and rules
Content of interventions	Directly improve human recognition	Education and law enforcement to prevent domestic violence
	Improve material development outcome, which leads to improvement in human recognition transactions	Women's income generation that increases human recognition received in the household

Sub-Saharan Africa is home to approximately 22.9 million people living with HIV/AIDS (UNAIDS 2011). HIV-infected individuals are often subject to stigma from their families, communities, and institutions (Brown et al. 2001). HIV-related stigma refers to "all unfavorable attitudes, beliefs, and policies directed toward people perceived to have HIV/AIDS" (U.S. Department of Health and Human Services 2003). Many documented manifestations of stigma are also manifestations of negative human recognition, such as domestic violence, barring infected individuals from participating in household or community activities, and turning infected individuals out of the house. This overlapping incidence of stigma and negative recognition occurs because provision of negative human recognition underlies stigma and stigmatizing behaviors. Failure to recognize an HIV-infected individual to be of inherent value and to have characteristics in common with oneself facilitates stigma's "unfavorable attitudes, beliefs, and policies" and makes one more likely to engage in behaviors such as refusing to allow the individual to participate in common household or community activities. Conversely, acknowledging that an HIV-infected individual is of value and shares intrinsic qualities with oneself may make one less likely to stigmatize her. Based on this relationship between human recognition and stigma and given the prevalence of HIV-related stigma in Kenya (see Hamra et al. 2006 for quantification of stigma in Kenya), it is expected that some HIV-infected individuals in Kenya receive low levels of human recognition.

The primary objective of this randomized trial was to evaluate the impact of supplementary food. HIV infection increases the risk of malnutrition (WHO 2003); in fact, during the early years of the HIV epidemic the disease was referred to as "Slim Disease" in some African countries because rapid weight loss and wasting were the disease's most visible manifestations (Mhiri et al. 1992). Even with the expansion of HIV treatment services, HIV-infected populations continue to experience high rates of malnutrition in sub-Saharan Africa (Koethe and Heimburger 2010). Increasingly, HIV care and treatment programs integrate nutrition interventions, including nutrition assessment and counseling, food supplementation, and micronutrient supplementation to improve clients' nutritional status, promote adherence and response to treatment, help manage symptoms, and enhance quality of life (WHO 2009; WHO 2005). Evidence about the impacts that food supplementation has on HIV-infected adults remains limited. Strong evidence exists that nutritional status is a significant independent predictor of survival among clients taking antiretroviral therapy (ART)[1] (Paton et al., 2006; Koethe et al. 2010) as well as among clients who are not taking ART (van der Sande et al. 2004). There is also evidence that weight loss during ART treatment is strongly associated with increased risk of mortality (Koethe et al. 2010).

[1] ART, also known as highly active antiretroviral therapy (HAART), consists of a combination of antiretroviral drugs that dramatically reduce HIV viral loads and extend survival.

Given the complex, bidirectional relationship between HIV and malnutrition, knowledge that malnutrition is a significant predictor of mortality does not necessarily imply that food supplementation will reduce mortality or confer other benefits to HIV-infected clients. There may be other factors affecting both nutritional status and mortality, or malnutrition may be an effect, rather than a cause, of disease progression. To better understand this relationship and to inform decisions about investment in food supplementation, there is a need for randomized controlled trials to assess the impacts of food supplementation on HIV-infected adults in resource poor settings.

Studies of various types of nutrition supplementation for HIV-infected adults in developed countries have had mixed results, with some studies demonstrating beneficial impacts on anthropometric measures, body composition, immune function, and quality of life (Kotler et al. 1990, Melchior et al. 1996, Shabert et al. 1999), and other studies finding no differences in outcomes between clients who receive supplementation and those who do not (Keithley et al. 2002, Rabeneck et al. 1998, Gilbert et al. 1999). A 2007 Cochrane review of macronutrient interventions for HIV-infected individuals identified eight small randomized controlled trials, all of which took place in Europe or U.S.A. Results from the trials were mixed, and none reported on mortality, morbidity or disease progression, and the review states that no firm conclusions can be reached based on these trials (Mahlungulu et al. 2007).

These studies were carried out with specialized supplements in developed countries, and there is a need for randomized trials among HIV-infected adults in resource-limited settings where food insecurity is prevalent and individuals often have pre-existing nutrient deficiencies. A published review found only two published studies of supplementary feeding of HIV-infected adults in Africa (Koethe and Heimburger 2010). A randomized trial in Malawi compared two types of foods among clients beginning ART, and found that a ready-to-use fortified spread (RUFS) led to faster weight gain than corn-soy blend (CSB), though in the follow-up period after supplementation, weight gain among clients receiving CSB caught up to clients receiving RUFS (Ndekha et al. 2009a; Ndekha et al. 2009b). In a study in Zambia, food supplementation provided to food insecure ART clients as part of an ART adherence program significantly increased adherence, and impacts on weight gain and other outcomes were not statistically significant (Cantrell et al. 2008).

However, no randomized trial comparing food supplementation to no food supplementation among malnourished, HIV-infected adults had been carried out in resource-poor settings. To address this gap in the evidence base and to inform program design, from 2006 to 2008 the Kenya Medical Research Institute (KEMRI) and the Food and Nutrition Technical Assistance (FANTA) Project at the Academy for Educational Development (AED) carried out a randomized controlled trial of the impacts of supplementary food with funding from the U.S. Agency for International Development (USAID). Questions were included to measure human recognition levels among study subjects.

The next section presents a model of human recognition in development programs. Section III describes the study design and variables used. Section IV describes the approach used to measure human recognition, and Section V presents the estimation methods. Section VI reports results, and the final section discusses key findings and limitations.

II. Model of Human Recognition

A simplification of the full model of human recognition in Castleman (2011b) is presented here to focus on the hypotheses being tested in this study.

The recognition an individual receives is given by the expression

$$R_i = \frac{1}{\sqrt{n}} \sum_{h=1}^{n} \rho_{hi} r_{hi} .$$

Individual *i* interacts with *n* individuals who provide varying levels of human recognition to her. The term r_{hi} is the recognition that each individual *h* provides to *i*. The ρ_{hi} parameter is a provider-specific weight that captures differences in the impact a given level of provided recognition has on individual *i*'s received recognition, depending on the provider[2]. The *r* terms may be positive or negative, signifying positive or negative human recognition. See Castleman 2011b for discussion of the properties this expression satisfies.

Individual i's utility function is given by $U_i = U(h_i, c_i, R_i,)$ where h and c are health and consumption. Utility received from provision of human recognition to others is not included in this model because it is not part of the empirical study. The subscripts are dropped for simplicity, and the utility function is expanded to include sub-utility functions for health and consumption:

$$U = U(h, c, R) = u_h[h(H, R)] + u_c[c(C, R] + \phi R = \eta\, h(H, R) + \kappa\, c(C, R) + \phi R$$

$$= \eta(H + \frac{HR}{\lambda} + \sigma R) + \kappa(C + \frac{CR}{\gamma} + \delta R) + \phi R$$

where H, C, and R $\geq$ 0; σ, δ > 0; ϕ > 0; and λ, γ > max(R).

[2] For example, recognition provided by a spouse or parent may have a greater impact than recognition provided by a stranger.

ϕ is a parameter reflecting the psychic utility that one's human recognition level confers (or more broadly, the utility conferred by human recognition through all pathways other than health and consumption). η and κ are parameters reflecting the utility conferred by health and consumption. σ and δ are parameters reflecting recognition's direct effect on health and consumption respectively. H and C are factors and inputs other than human recognition that determine health status and consumption respectively, e.g. availability of health services, income, age, proximity to health facilities, etc. For the purposes of this model, H, C, and R are non-negative with the lowest value being zero signifying the worst conditions

The $\frac{HR}{\lambda}$ and $\frac{CR}{\gamma}$ terms represent the effects that one's human recognition level has on the "productivity" of other factors in producing health and consumption respectively. For example, if one component of H is physical proximity to health care facilities, an individual with a higher level of human recognition may obtain greater health benefits from living a given distance from health facilities than an individual with a lower level of recognition. Greater recognition from family members may enable an individual to visit the facility more freely, and greater recognition from health care providers at the facility may encourage more frequent attendance and better adherence to treatment and recommended practices. The restriction on the parameters λ and γ that they are greater than the maximum level of R means that the effect these interactions between recognition and other factors have on health and consumption will always be smaller in magnitude than the direct effect that non-recognition factors, H and C, have on health and consumption. These interactive terms enhance or diminish the impacts that H and C have on health and consumption, rather than supersede them.

A number of predictions emerge from the model that can be empirically tested using the study data.

1) $\frac{\partial U}{\partial R} = \eta(\frac{H}{\lambda} + \sigma) + \kappa(\frac{C}{\gamma} + \delta) + \phi > 0$. This expression is the partial derivative of utility with respect to human recognition. The hypothesis is that an individual's recognition level has a net positive effect on her total utility. This hypothesis is tested with regression models in which subjective well-being is the dependent variable and human recognition is one of the explanatory variables, and health, income and other variables are not included as control variables.

2) $\phi > 0$. In the model ϕ is a parameter that signifies the direct, psychic effect an individual's human recognition level has on his/her utility level. The hypothesis is that an individual's recognition level has a positive psychic effect on his/her utility level in addition to recognition's effect through changes in material outcomes. This hypothesis is tested with regression models in which subjective well-being is the dependent variable and human recognition is an explanatory variable, controlling for health, economic status, and other material characteristics.

3) $\frac{\partial h}{\partial R} = \frac{H}{\lambda} + \sigma \geq 0$. This expression is the partial derivative of health with respect to human recognition. The hypothesis is that an individual's recognition level is an independent determinant of health and that the relationship between the two is positive. This hypothesis is tested using regression models in which nutritional status or change in nutritional status is the dependent variable and recognition levels or change in recognition levels is among the explanatory variables.

4) $\frac{\partial R}{\partial H} \geq 0$. This partial derivative captures the effect that other factors affecting health have on human recognition levels; the study examines the impact that program health interventions of food supplementation and medical treatment have on human recognition levels. The hypothesis is that these interventions have positive impacts on recognition levels of individuals receiving the interventions. This hypothesis is tested with regression models in which change in recognition levels is the dependent variable and food supplementation and medical treatment are among the explanatory variables. Note that because the theoretical model presented here does not include determinants of recognition provision and receipt, this hypothesis – unlike the first three – is not an explicit prediction of the model.

5) $\frac{\partial R}{\partial h} \geq 0$. Because the relationship between health and human recognition is hypothesized to be simultaneous, this partial derivative captures the reverse effect of 3) above, i.e., that health status is an independent determinant of recognition levels and that the relationship is positive. This hypothesis is tested with regression models in which human recognition is the dependent variable and health status variables are among the explanatory variables. Because of the presumed simultaneity between health status and recognition, instrumental variables are used.

III. Study Design and Variables

Study Design

The study was designed to investigate the impacts that food supplementation has on clinical and nutritional outcomes of malnourished, HIV-infected adults. At six HIV treatment sites[3] in Kenya eligible subjects were randomized to receive, along with their other treatment services, either a) nutrition counseling or b) nutrition counseling and food supplementation consisting of 300 grams/day of pre-cooked micronutrient-fortified blended flour composed of corn, soy, vegetable oil, sugar, whey protein, and micronutrient premix. This quantity provides approximately 50% of estimated daily energy needs for malnourished, HIV-infected adults.

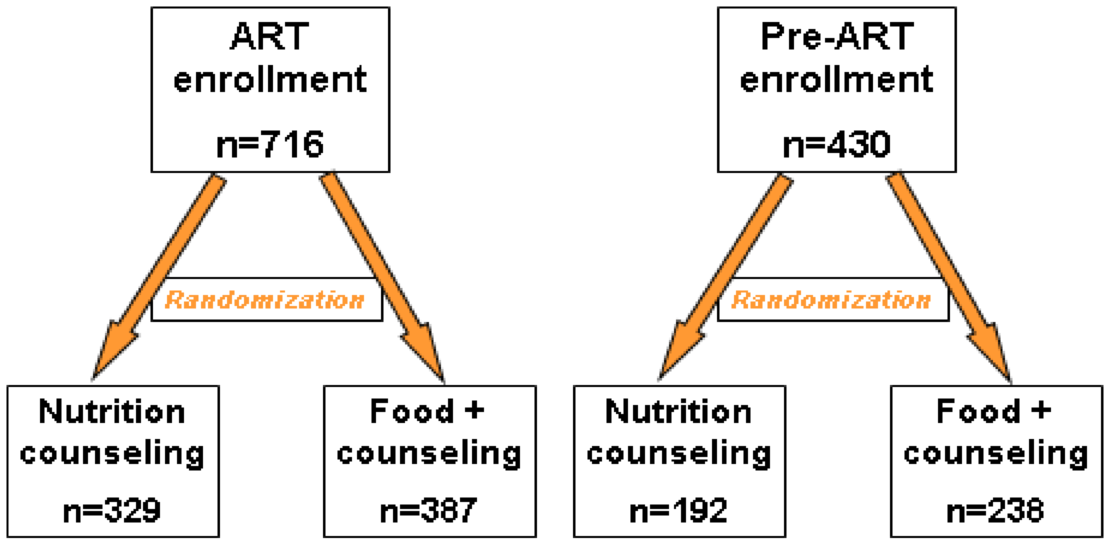
The food supplementation was provided for a period of 6 months to the group receiving food, and nutrition counseling was provided to all subjects for the entire 12 months of study participation. Each month during their clinic visits, subjects in the group receiving food were provided a package of 30 daily doses of 300 grams of the food. Data on a range of outcomes were collected from each subject at the time of enrollment and monthly, quarterly, or semi-annually (depending on the variable) for 12 months.

There were two arms of subjects. One arm consisted of malnourished, HIV-infected adults who were beginning ART within a month of recruitment into the study. The other arm consisted of malnourished or nutritionally vulnerable HIV-infected adults who were not yet eligible for ART at the time of enrollment because their disease was at an earlier stage but who were prescribed antibiotics (cotrimoxazole) as per the current standard of care to prevent opportunistic infections since their immune systems were weakened. Subjects in both arms were randomized between food and non-food groups[4]. Figure 1 diagrams the study design.

[3] The six sites were: Maragwa District Hospital, Mathere North Hospital, Mbagathi District Hospital, Naivasha District Hospital, Nyeri Provincial Hospital, and Riruta City Council Hospital.

[4] The main reason the number of clients receiving food is somewhat higher than the number not receiving food is that some clients chose to drop out of the study after learning which group they had been randomized to, and more of those randomized not to receive food dropped out than those randomized to receive food.

Figure 1: Design of Randomized Controlled Trial



Body mass index (BMI), calculated by weight in kilograms divided by the square of height in meters, was used to classify nutritional status using the cutoffs recommended by WHO (WHO 1999). To be eligible for the ART arm, subjects had BMIs between 14-18.5 kg/m^2 at the time of enrollment. To be eligible for the pre-ART arm, subjects either had BMIs between 14-18.5 kg/m^2 or had BMIs between 18.5-20 kg/m^2 and had lost weight during the past month. The broader inclusion criteria for the pre-ART group were in part because pre-ART clients may be more vulnerable than ART clients since their HIV is not being treated yet. There may be benefits of supporting such clients who have declining nutritional status before they cross the threshold into malnutrition. The broader inclusion criteria were also in part a concession to sample size because there were fewer malnourished pre-ART clients at the clinics. Because the BMI cutoffs for malnutrition do not apply to pregnant women and because weight changes follow different patterns among pregnant and lactating women than among other women, all women who reported they were pregnant or lactating were excluded.

For ethical reasons, all patients with BMI < 14 kg/m^2 were provided food because their severe vulnerability made it ethically untenable not to provide them with food supplementation. Data for these patients were excluded from the analysis because there were no members of the non-food group with comparable baseline nutritional status. Randomization of the food supplementation was determined to be ethical because at the time of the study the standard of care for malnourished HIV-infected individuals in Kenya did not include food supplementation. Programs were providing food supplementation at some facilities, but the study was conducted only at sites where food was not already being provided. Therefore, introduction of the study did not prevent any clients from receiving food supplementation who would otherwise have received it. The study protocol was approved by institutional review boards in the U.S. and in Kenya.

A total of 1,146 subjects were enrolled. Due to high attrition rates and missing data, complete data are available for substantially fewer subjects. Attrition among ART clients was a significant problem in Kenya, and post-election violence that occurred in Kenya during January and February 2008 was a further source of missing data, causing some subjects to miss their appointments and some clinics to be short of staff.

Because unreported mortality was one cause of attrition and studies indicate that clients with low baseline nutritional status (Paton et al. 2006; van der Sande et al. 2004) or with low baseline immune response (Hogg et al. 2001) experience higher rates of mortality, the subjects with complete data through the end of the study period were likely to be those who entered the study healthier. Inability to return to the clinic due to illness or poverty may also be more likely to occur among those who enter the study with poorer health. The data support this conclusion: mean CD4 count, a measure of immune response and disease progression, was significantly higher at baseline among subjects for whom there are data at 9 and/or 12 months than it is for all subjects (mean = 211 vs. 186, $p < .05$). Therefore, results at later periods (e.g. 9 and 12 months) reflect a sample that was somewhat healthier at baseline than the full set of subjects.

For some clients recruited late in the study period, data were collected for less than 12 months. Recruitment took longer than expected due to decentralization of HIV treatment services in Kenya and other factors. Funding for the study required that data collection end in June 2008, and data from clients who had not reached 12 months by then are used in analyses at earlier months but not in the 12-month analysis. Because the only factor determining this exclusion was the date of recruitment, it is not expected to bias the 12-month data, though it does reduce the sample size for the 12-month analysis.

Variables

Data were collected by nurses and nutritionists working at the clinics and by study coordinators stationed at each site. Data were collected on nutritional status and dietary consumption, clinical status, biochemical measures of immune response, quality of life and daily functioning, subjective well-being, socio-economic status, basic demographic indicators, and human recognition. Table 2 presents subjects' baseline statistics, and details about key variables are described below.

Table 2: Baseline Statistics

Variable	**Baseline Status**
Age	35.3 years (mean)
Sex	57% female 43% male
Body mass index	17.6 kg/m^2 (mean)
CD4 counts	186 cells/µl (mean) 126 cells/µl (ART clients' mean) 285 cells/µl (pre-ART clients' mean)
Income (monthly)	24% < 1,000 Ksh 22% 1,000 – 2,999 Ksh 19% 3,000 – 4,999 Ksh 23% 5,000 – 9,999 Ksh 9% 10,000 – 19,999 Ksh 2% 20,000 – 49,999 Ksh 0.1% $\geq$ 50,000 Ksh
Distance to health facilities	43% < 5 km 14% 5-10 km 9% 10-15 km 6% 15 – 20 km 28% > 20 km
Education	5% no education 8% 1-4 years 52% 5-8 years 7% 9-12 years 26% 13-14 years 3% > 14 years
Physical health (days of poor health last month + days of pain last month)	19 days (mean)
Mental health	2.09e-9 (mean) (from factor analysis)
Human recognition	-.001 (mean) (from factor analysis)
Subjective well-being	5% very satisfied 57% satisfied 33% unsatisfied 5% very unsatisfied

Human Recognition Variables

A number of questions in the trial were specially designed to measure the level of human recognition received by subjects. These variables, listed in Table 3, include self-reported levels of recognition subjects receive in different domains, self-reported levels of respect received from others, how subjects' problems and needs are viewed by others, and an objective indicator of human recognition received in the household. Self-reported responses use a 4-point scale. Although self-reported receipt of recognition is being measured directly, the variables on respect and how one's problems are viewed by others are included as well because the concept of human recognition was new to both subjects and data collectors in this study. Questions about related concepts that respondents are familiar with, such as respect, aim to illuminate aspects of human recognition experience that subjects may not consider in responding to the human recognition question. Whether subjects eat meals with other household members serves as an objective measure of the human recognition that family members provide to subjects. In Kenya and elsewhere, cases have been reported of family members refusing to allow HIV-infected individuals to eat meals with them, denying them participation in a basic and communal part of household life.

As detailed in Section IV, these indicators are combined into a single score using factor analysis, so human recognition levels have a mean of approximately 0. The variable is coded such that lower values indicate lower levels of human recognition.

Other Variables

The high female-to-male ratio among clients is consistent with the HIV treatment situation in Kenya at the time; more women undergo treatment than men, primarily due to the higher prevalence of HIV among women than men, 8.7 % among women and 4.6%

(Central Bureau of Statistics Kenya 2004). Treatment seeking behaviors also differed between men and women, with women more likely to seek treatment or to seek treatment earlier in the course of the disease (see Voeten et al. 2004).

Table 3: Variables Measuring Human Recognition Receipt

Domains	Variables
Household	Self-reported assessment of how much one is recognized and valued as a human being by one's family members
	Self-reported level of respect received from family members
	Self-reported assessment of how family members view the individual's problems and needs
	Whether eat together with other family members at least once per day
Community and Organizations & Institutions	Self-reported assessment of how much one is recognized and valued as a human being by employer, neighbors, and other non-family members
	Self-reported level of respect received from employer, neighbors, and other non-family members
	Self-reported assessment of how employer, neighbors, and other non-family members view the individual's problems and needs

The measure of nutritional status is BMI, which is a common indicator of nutritional status among adults and was the nutritional eligibility criterion for participation in the study. Medical treatment is measured with a value of 2 assigned to those taking ART and 1 to those taking cotrimoxazole but not ART. CD4 count measures the number of CD4 proteins are in one cubic millimeter of blood and is commonly used to monitor HIV disease progression and indicate when treatment interventions are needed. At the time of the study, WHO recommended beginning ART when CD4 counts drop below 200 cells/μl. (In 2009, WHO revised its guidelines, recommending initiation of ART when CD4 counts drop below 350 cells/μl.) Cotrimoxazole or other prophylaxis to prevent opportunistic infections are often begun when CD4 counts are below 500 cells/μl.

The physical health and mental health variables use self-reported responses to standard questions developed by the U.S. Centers for Disease Control and Prevention (CDC) to measure quality of life. Because the physical health variable is generated by adding the number of poor physical health days per month and the number of days with pain per month, the minimum value for physical health is 0 and the maximum value is 60. The mean value at baseline is 19. The mental health variable combines responses to three questions: how many days in the past 30 days the subject's mental health was not good, including stress, depression, and emotional problems; how many days in the past 30 days the subject felt sad, blue or depressed; and how many days in the past 30 days the subject felt worried, tense or anxious. Because there are three variables and the correlations among all three are quite high (ranging from 0.66 to 0.8), factor analysis is used to generate the final value instead of summation of responses. The final variable is a factor score, so the mean value is very close to zero (2.09e-9) and the standard deviation is 1. Both the physical health and mental health variables measure number of days with a particular malady, so higher values indicate worse health.

Subjective well-being is used as a dependent variable in the models testing the role human recognition plays in utility. Subjective well-being is measured by responses to the question, "Overall, how satisfied are you with your life these days?" The subjective well-being variables are coded such that lower values signify higher levels of well-being, and the changes in well-being variables are calculated by subtracting later values from baseline values so higher values signify improved well-being and lower values signify worsened well-being. Substantial experience exists with using subjective well-being in empirical research in economics and other fields (e.g. Frey and Stutzer

2005; Kingdon and Knight 2007), and the language used to measure subjective well-being in this study is a common way of framing and measuring subjective well-being. Examining the relationship between subjective well-being and psychological empowerment, Diener and Biswas-Diener raise the possibility of each being determinants of the other (Diener and Biswas-Diener 2005). Similar simultaneity may exist between subjective well-being and human recognition, so endogeneity is tested for and addressed in the empirical models.

IV. Measurement of Human Recognition

Measurement of human recognition follows the approach developed in Castleman (2011c). Human recognition is measured in the three primary domains depicted in Figure 1 above, and the indicators from these domains (listed in Table 2 above) are combined into an index. Using the expression for received human recognition above, the index is:

$$\mathrm{R_i} = \omega_{\mathrm{ho}} \frac{1}{\sqrt{n_{ho}}} \sum_{h=1}^{n_{ho}} \rho_{hi} r_{hi} + \omega_{\mathrm{c}} \frac{1}{\sqrt{n_c}} \sum_{h=1}^{n_c} \rho_{hi} r_{hi} + \omega_{\mathrm{in}} \frac{1}{\sqrt{n_{in}}} \sum_{h=1}^{n_{in}} \rho_{hi} r_{hi}$$

The subscripts represent the three domains of household, community, and institutions. The ωs are domain weights that reflect the relative impact a given domain has on one's overall level of recognition. Indicators used in this study are self-reported recognition levels and occurrence of specific interactions, and recognition levels provided by each individual are not measured and summed. Reflecting this measurement approach, a more general expression of the index that does not restrict the type of indicators used is:

$$\mathrm{R_i} = \omega_{\mathrm{ho}} r_i^{ho} + \omega_{\mathrm{c}} r_i^{c} + \omega_{\mathrm{in}} r_i^{in}$$

In this study the questionnaire combined the community domain and the organizations and institutions domain in order to avoid biases from respondents or data collectors. Health care providers collected the data from sick individuals at a health facility, and for many subjects the health care system is likely to be a primary institutional contact and a primary source of human recognition in the organizations and institutions domain. So the index used in this study is:

$$R_i = \omega_{ho} r_i^{ho} + \omega_{c/in} r_i^{c/in}$$

Indicators within each domain are correlated, and factor analysis is used to measure the common factor of human recognition in each domain. The domain measures are then weighted and combined into an index score that measures overall recognition received by the individual.

Factor analyses are run with data at each month (baseline through month 12) for household recognition and for community/institution recognition. All factor analyses generate one strong factor with low uniquenesses (except for the *eat_together* variable discussed below) and factor loadings that are consistent with interpreting the factor to be receipt of recognition in the specified domain(s). Since this process involved 26 separate factor analyses and since the results are quite similar at each month – though the number of observations varies considerably – all results are not reported here. Baseline results are shown below illustratively.

The factor analysis for human recognition received in the household at baseline is based on the following model:

$$\begin{aligned}
&\textit{self-reported_recognition_hh}_i = \lambda_{1srh}\textit{hhrecognition}_i + \lambda_{2srh}\textit{eat_together}_i + \delta_{isrh} \\
&\textit{respect_hh}_i = \lambda_{1rh}\textit{hhrecognition}_i + \lambda_{2rh}\textit{eat_together}_i + \delta_{irh} \\
&\textit{view_problems_hh}_i = \lambda_{1vph}\textit{hhrecognition}_i + \lambda_{2vph}\textit{eat_together}_i + \delta_{ivph} \\
&\textit{eat_together}_i = \lambda_{1et}\textit{hhrecognition}_i + \lambda_{2et}\textit{eat_together}_i + \delta_{iet}
\end{aligned}$$

$$i = 1, 2\ldots..763$$

Hhrecognition$_i$ is the latent variable (factor) of human recognition that individual i receives in the household; *eat_together*$_i$ characterizes whether subject i eats with other household members; the λs are the factor loadings; and δ_{ix} are unique factors (i.e. error terms) that affect the individual measures. The letter subscripts (srh…et) refer to the four measured variables. Two factors are included in the model because two factors achieve an Eiegenvalues $\geq$ 1. Initial factor analysis results are given in Table 4.

Table 4: Factor Analysis Results for Human Recognition Received in the Household at Baseline by Study Subjects (including eating together)

Measure	Factor 1 Loadings	Factor 2 Loadings	Uniqueness
Self-reported level of respect received from household members	0.909	-0.012	0.174
How household members view subject's problems and needs	0.868	0.007	0.247
Self-reported recognition and value received from household members	0.922	-0.027	0.150
Whether eat together with other household members at least once per day	0.029	0.9995	0.0002
Eigenvalue	*2.43*	*1.0*	

The factor analysis results indicate that variations in the three self-reported responses are closely correlated, but the variation in *eat_together* is not correlated with the others. In fact, when only Factor 1 is retained, the uniqueness for the *eat_together* measure leaps to 0.9995 (results not shown). Because the *eat_together* measure's variation differs so much from the other three variables' variation and has a 0.9995 factor loading, it appears that Factor 2 is whether or not subjects eat with other members of the family. (This is why *eat_together* is its own factor in the model.) Clearly, there is not a common factor underlying this variable and the others. Consistent with the spirit of exploratory factor analysis, this variable is dropped from the factor analysis.

Table 5 reports results when the factor analysis is run with only the three self-reported responses. Not including the variable on eating together also allows more data points to be used; as part of the quality of life questionnaire, the self-reported questions were collected from subjects on a monthly basis, but the question about eating together is part of the socio-economic questionnaire that was collected only at baseline, 6 months, and 12 months. The model for the factor analysis becomes:

$$\begin{aligned}
&\textit{self-reported_recognition_hh}_i = \lambda_{1srh}\textit{hhrecognition}_i + \delta_{isrh} \\
&\textit{respect_hh}_i = \lambda_{1rh}\textit{hhrecognition}_i + \delta_{irh} \\
&\textit{view_problems_hh}_i = \lambda_{1vph}\textit{hhrecognition}_i + \delta_{ivph}
\end{aligned}$$

$$i = 1, 2\ldots..857$$

Now all the factor loadings are quite high and the uniquenesses are low. The factor score has a mean of 1.05e-8 and a standard deviation of 1.

Table 5: Factor Analysis Results for Human Recognition Received in the Household at Baseline by Study Subjects (not including eating together)

Measure	Factor 1 Loadings	Uniqueness
Self-reported level of respect received from household members	0.908	0.175
How household members view subject's problems and needs	0.870	0.244
Self-reported recognition and value received from household members	0.920	0.153
Eigenvalue	*2.43*	

The factor analysis for human recognition received in the community and institutions at baseline is based on the following model:

$$\begin{aligned}
&\textit{self-reported_recognition_oth}_i = \lambda_{1sro}\textit{othrecognition}_i + \delta_{isro} \\
&\textit{respect_oth}_i = \lambda_{1ro}\textit{othrecognition}_i + \delta_{iro} \\
&\textit{view_problems_oth}_i = \lambda_{1vph}\textit{othrecognition}_i + \delta_{ivpho}
\end{aligned}$$

$$i = 1, 2\ldots..714$$

One common factor is included in the model because only one significant factor emerges from the factor analysis. Results from the factor analysis are given in Table 6. Again, the factor loadings are consistent with the factor being recognition received from non-household members, and the uniquenesses are low. The mean factor score is -2.9e-10 and the standard deviation is 1. Factor analysis results from months 1 to 12 yield similar results to the baseline levels.

Table 6: Factor Analysis Results for Human Recognition Received from the Community and Institutions at Baseline by Study Subjects

Measure	Factor 1 Loadings	Uniqueness
Self-reported level of respect received from employers, neighbors, and other non-family members	0.916	0.161
How employers, neighbors, and other non-family members view subject's problems and needs	0.812	0.341
Self-reported recognition and value received from employers, neighbors, and other non-family members	0.932	0.131
Eigenvalue	*2.37*	

To generate an overall measure of an individual's human recognition level, the scores from the factor analysis for each domain are weighted and summed. It is not possible to empirically determine the most accurate weights so there is likely to be some measurement error with any set of weights applied. Based on the balanced number and type of indicators and based on the aim of balancing household-level and external human recognition, equal weights of 0.5 are assigned to the household domain and to the combined community and institutions domain. When other weights are used, such as 0.6 and 0.4, regression results do not differ significantly.

The index is calculated at each of the 13 months for which human recognition data are available (baseline plus 12 months of follow-up), generating panel data on human recognition. Self-reported levels of recognition received in the household and from outside the household are two of the variables collected, and empirical models are also estimated using a composite variable of these two measures alone – also weighted 50-50 between the household and non-household domains – in place of the full factor score. Regression results using this measure, called the "direct measure" of human recognition, are similar to results using the factor scores, though there are some minor differences in statistical significance levels for a few specifications. Models were also estimated using a measure of "minimum recognition", the lowest level of recognition reported from the six self-reported questions. Again, other than some minor differences in statistical significance levels, the results do not differ substantially using this measure. The results reported use factor scores or the direct measures of recognition.

V. Empirical Models and Estimation Methods

To test the predictions generated from the theoretical model in Section II, three sets of empirical models are estimated. The first set of models uses human recognition as the dependent variable to test whether provision of supplementary food and whether medical treatment for HIV improve the levels of recognition received by subjects of the study ($\frac{\partial R}{\partial H} \geq 0$). These models also examine the determinants of human recognition, including the extent to which health status is an independent predictor of human recognition ($\frac{\partial R}{\partial h} \geq 0$). The second set of empirical models use nutritional status as the dependent variable to test the extent to which receipt of human recognition is a determinant of nutritional status ($\frac{\partial h}{\partial R} \geq 0$). The third set of models use subjective well-being as the dependent variable to test human recognition's association with utility (measured by subjective well-being) ($\frac{\partial U}{\partial R} > 0$) and whether recognition's contribution to utility occurs through changes in physical and mental health and/or through other pathways such as psychic utility ($\phi > 0$).

For each set of models, three different types of empirical specifications are estimated: baseline models, semi-differenced models, and panel models. *Baseline models* are estimated as cross-sectional data, using baseline status of the study subjects. The sample size is relatively large for these models because attrition has not occurred yet, though some clients are missing data for some variables. Variation in the variables in these models reflects differences among clients' baseline status. Some of the explanatory variables are endogenous due to omitted variables bias or simultaneity, and leading variables are used as instruments.

Semi-differenced models estimate the differences between the status at a given point of time (3, 6, 9, or 12 months post-baseline) and the status at baseline. "Semi-differenced" refers to the fact that not all variables in the model are differenced. Since not all variables are differenced and only two points of time are used in any given model, rather than estimating the model as a full panel, time invariant variables can be included such as food supplementation, age, sex, and education. Because differencing is used for the dependent variables, the effects of individual-specific, omitted variables that influence the dependent and independent variable *levels* are subtracted out by the differencing. However, if there are omitted variables that affect *changes* in the levels of both dependent and independent variables over the period of measurement, then this could still cause endogeneity and bias the OLS estimators. Simultaneity between the change in the independent variables and the change in the dependent variable can also cause endogeneity. Leading or lagging values are used as instruments to address endogeneity.

Panel models exploit all the data points and are estimated as full panels. Random effects are tested and rejected in the human recognition and the subjective well-being models, and fixed effects estimation methods are used. Random effects are not rejected in the nutritional status model, which is estimated using both fixed effects and random effects. The fixed effects approach is a "within" estimation that regresses on the differences between the value of each variable for a subject at a given month and the subject's mean value for that variable. Because of this differencing, with fixed effects it is not possible to include any time invariant variables, such as food supplementation, age, sex, or education. Individual-specific omitted variables that may cause endogeneity are subtracted out in the fixed effects, and the primary possible source of endogeneity is simultaneity between deviations from the mean of dependent variables and deviations from the mean of independent variables.

Prior to estimating the multivariate models, t tests for comparisons of means are used to demonstrate baseline equivalence in human recognition and the other dependent variables between the food and non-food groups. Comparison of means tests are also used for an initial examination of differences in human recognition between those receiving food and not receiving food, between ART and pre-ART clients, and between men and women.

Instrumental Variables

Since the food intervention is randomized, that variable is exogenous in all models. However, in some models there is evidence that other explanatory variables are endogenous, including *recognition*, *physical health*, *mental health*, *nutritional status*, and differenced values of these variables. For models with endogenous explanatory variables, instrumental variables are used. Leading values of variables and in a few cases lagged values are used as instruments. Lagged values are not used, except in the 12-month specification, in order to include baseline values in the models to ensure that changes during the initial months of interventions are captured. Future values of these variables are correlated with the endogenous variables, e.g. $mental\_health_{i6}$ is correlated with $mental\_health_{i0}$. The future values are not expected to be correlated with the error term in the original model because 1) there would not be simultaneity between, say, recognition levels at baseline (for the model in which recognition is the dependent variable) and mental health status in month 6; and 2) to the extent that mental health status in month 6 is a determinant of recognition at baseline, it is through the correlation between mental health status at baseline and month 6, which is the correlation the instrument is designed to use. Evidence supporting validity of the instruments is found in the Hansen J test statistics that indicate exogeneity of the instruments and the Anderson canonical correlation likelihood ratio statistics that indicate the instruments are correlated with the endogenous variables.

If serial correlation were to exist among the error terms, then future values may not be valid instruments because, for example, if $mental\_health_{i0}$ is correlated with the error term, e_{i0} in a given model, then it is likely that $mental\_health_{i6}$ is correlated with the error term, e_{i6} for the same model at month 6. And if e_{i0} and e_{i6} are correlated, then $mental\_health_{i6}$ may be correlated with e_{i0}. Serial correlation is tested using regression residuals. Furthermore, since the problem this could create is one of endogeneity of the instruments, Hansen J statistics are calculated and reported for instruments as a means of testing the exogeneity of the instruments.

Human Recognition Models

The model for determinants of human recognition at baseline is:

$$recognition_{i0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 site_i + \beta_6 income_{i0} + \beta_7 CD4_{i0} + \beta_8 physical\_health_{i0} + \beta_9 mental\_health_{i0} + \beta_{10} nutritional\_status_{i0} + e_i$$

The model is initially estimated with ordinary least squares (OLS) when the factor score for human recognition is used, and with ordered probit when the direct measure of recognition is used. A Breusch-Pagan test indicates heteroskedastic errors so heteroskedasticity robust standard errors are used. Hausman specification tests reject exogeneity of at least one of the following variables, *physical health*, *mental health*, and *nutritional status*, for the ordered probit model[5], though Hausman tests do not reject exogeneity for the OLS model. Instrumental variables are used to estimate this model, with leading values of the potentially endogenous variables used as instruments[6].

The model used to test the full effects of food and medical treatment on human recognition is:

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[5] The Hausman specification tests the equivalence of coefficient estimates from the two-stage least squares estimation (which will be consistent with or without exogeneity of explanatory variables) and from the OLS estimation (which will be inconsistent if explanatory variables are endogenous). In the ordered probit, the test compares the coefficients from the ordered probit models with and without instruments.

[6] Stata does not have commands for using instrumental variables with ordered probits. Therefore, here and for the other ordered probit specifications where endogeneity of independent variables is indicated, two stage least squares is performed manually, regressing each endogenous variable on the instruments (including the exogenous variables in the model), generating predicted values for the endogenous variables, and substituting the predicted values for the endogenous variables into the original model. This method follows Bartilow (2008).

$$\Delta recognition_{i\,6,0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 \Delta income_{i\,6,0} + \beta_6 site_i + \gamma_1 food_i + \gamma_2 \Delta medical\_treatment_{i\,6,0} + e_i$$

This specification is estimated using OLS. Hausman tests do not reject exogeneity of the independent variables. This is not surprising. Simultaneity is unlikely because the dependent variable is the difference in recognition between baseline and the period measured, and the independent variables are fixed characteristics (with the exception of treatment, which in most cases remains the same throughout the study period). There could still be omitted variables such as social capital or family characteristics that affect both change in recognition and one of the independent variables such as education or income. However, this is less likely than in the baseline model because it is the *change* in recognition that is relevant in this model. Based on results of the Hausman test, omitted variables do not appear to be causing endogeneity. The *food* variable is unquestionably exogenous because the food intervention is randomized among clients.

In order to isolate any direct effects food and medical treatment have on human recognition, independent of changes in health and nutritional status, the following model is estimated using two-staged least squares:

$$\Delta recognition_{i\,6,0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 \Delta income_{i\,6,0} + \beta_6 site_i + \beta_7 \Delta CD4_{i\,6,0} + \beta_8 \Delta physical\_health_{i\,6,0} + \beta_9 \Delta mental\_health_{i\,6,0} + \beta_{10} \Delta nutritional\_status_{i\,6,0} + \gamma_1 food_i + \gamma_2 \Delta medical\_treatment_{i\,6,0} + e_i$$

Hausman specification tests indicate that Δ*physical_health*, Δ*mental_health*, and/or Δ*nutritional_status* are endogenous[7]. To address endogeneity, the model is

[7] There are two possible sources of endogeneity. Although the differencing eliminates any problem from individual-specific omitted variables that affect the levels of both human recognition and these variables, there may still be omitted variables that affect both the change in human recognition and the change in these independent variables during the period of the study. For example, characteristics of the subject's family, social networks, or social capital may influence the extent to which improvements in human recognition occur as well as influencing changes in mental health and possibly physical health. The second

estimated with two stage least squares using leading values of these variables as instruments. The Hansen J test statistic is not significant, providing evidence that the leading values of these variables are exogenous to the model itself. One challenge posed by using leading values as instruments is it reduces the number of observations because data are not available for all variables in some of the months.

The human recognition model using full panel data to examine the determinants of changes in human recognition is:

$$recognition_{it} = \alpha + \beta_1 income_{it} + \beta_2 CD4_{it} + \beta_3 physical\_health_{it} + \beta_4 mental\_health_{it} + \beta_5 nut\_status_{it} + \beta_6 medical\_treatment_{it} + e_{it}$$

This model uses all data points. A Hausman specification test rejects the existence of random effects[8], and fixed effects are used. Because random effects are rejected, fixed effects estimation is used. To address endogeneity, two stage least squares estimation is used with leading values of endogenous variables as instruments.

Nutritional Status Models

Baseline data are used to test the hypothesis that individuals with higher human recognition levels have better nutritional status. The following model is estimated:

$$nutritional\_status_{i0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 income_{i0} + \beta_6 CD4_{i0} + \beta_6 physical\_health_{i0} + \beta_7 mental\_health_{i0} + \beta_8 recognition_{i0} + e_i$$

Hausman tests indicate that the human recognition and/or the physical health variables are endogenous. The model is estimated with two-stage least squares, using leading

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possible source of endogeneity is simultaneity between the dependent variable and one or more of these independent variables. That is, greater or rapider improvements in human recognition may lead to greater improvements in health and nutritional status during the study period, as well as vice versa. If such simultaneity exists, the independent variables will be endogenous, causing estimators to be biased.

[8] This is likely because the time-invariant part of the residual includes some individual-specific omitted variables that affect both recognition levels and some of the explanatory variables. Examples of such omitted variables may be age, sex, family and household characteristics, available support systems, alcohol consumption, and the existence and strength of social networks.

values of these variables as instruments.

The initial semi-differenced model testing the extent to which changes in human recognition levels received by individuals during the study period are independent determinants of changes in nutritional status is:

$$\Delta nutritional\_status_{i\,6,0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 income_i + \beta_6 site_i + \beta_7 \Delta recognition_{i\,6,0} + \gamma_1 food_i + \gamma_2 \Delta medical\_treatment_{i\,6,0} + e_i$$

To better understand the pathways through which human recognition and other explanatory variables affect nutritional status, changes in physical and mental health are added to the model as explanatory variables:

$$\Delta nutritional\_status_{i\,6,0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 \Delta income_{i\,6,0} + \beta_6 site_i + \beta_7 \Delta phys\_health_{i\,6,0} + \beta_8 \Delta ment\_health_{i\,6,0} + \beta_9 \Delta recognition_{i\,6,0} + \gamma_1 food_i + \gamma_2 \Delta medical\_treatment_{i\,6,0} + e_i$$

A number of variations of these models are run to obtain more specific results and test robustness. Models at 3, 9, and 12 months are estimated, in addition to 6 months, and the direct measure of human recognition is used in place of the factor scores. Results are reported at 3 and 6 months for the factor scores. Hausman specification tests do not reject the null hypothesis of exogeneity (Prob > χ^2 = 0.297) so it is not necessary to use instruments[9].

The nutritional status model using full panel data is:

$$nutritional\_status_{it} = \alpha + \beta_1 income_i + \beta_2 CD4_{it} + \beta_3 physical\_health_{it} + \beta_4 mental\_health_{it} + \beta_5 recognition_{it} + \beta_6 medical\_treatment_{it} + e_{it}$$

Variations of the model are estimated using direct measurement of recognition in place of

[9] Note that Hausman specification tests did reject exogeneity in the recognition semi-differenced model but do not reject exogeneity in the nutrition semi-differenced model. This suggests that in the recognition models, differenced nutritional status is not one of the endogenous variables. If it were, it is likely that the differenced recognition variable would be endogenous in the semi-differenced nutrition models. In the semi-differenced recognition model, it is likely the differenced mental health and possibly the physical health variables that are endogenous.

factor scores and dropping some of the control variables. Unlike the recognition panel, Hausman specification tests do not reject random effects, which means the individual-specific variables not included in the model (time invariant components of the error term) are not correlated with the explanatory variables. Determinants of changes in nutritional status differ from determinants of human recognition, and apparently the omitted individual-specific variables in the human recognition model that were correlated with the explanatory variables are not significant determinants of changes in nutritional status so they are not part of the time invariant error term in this model. For example, based on the means tests and baseline specifications, a subject's sex is a significant determinant of human recognition but is not a significant determinant of nutritional status. Because random effects are not rejected, random effects estimation is used to estimate the model in addition to the fixed effect estimation. Hausman specification tests do not reject exogeneity for any of the nutrition panel models, so instrumental variables are not required.

<u>Subjective Well-Being Models</u>

The initial baseline model for subjective well-being is:

$$SWB_{i0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 income_{i0} + \beta_6 recognition_{i0} + e_i$$

The coefficient β_6 captures the full relationship between recognition and subjective well-being, controlling only for demographic and socio-economic characteristics. In order to further isolate human recognition's direct psychic effects on well-being, the following model controls for immune status, physical and mental health, and nutritional status:

$$SWB_{i0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 income_{i0} + \beta_6 CD4_{i0} + \beta_6 physical\_health_{i0} + \beta_7 mental\_health_{i0} + \beta_8 nutritional\_status_{i0} + \beta_9 recognition_{i0} + e_i$$

Initially, ordered probit is used to estimate these models, using both direct measures of recognition and the factor scores. The use of ordered probit to estimate models in which subjective well-being is the dependent variable follows Frey and Stutzer (2005) and Kingdon and Knight (2007). Hausman specification tests indicate that both models have endogenous explanatory variables. Therefore, future values of human recognition, physical health and mental health are used as instruments for these three potentially endogenous variables.

The semi-differenced subjective well-being model initially estimated is:

$$\Delta SWB_{i\,6,0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_\,facility_i + \beta_5 site_i + \beta_6 \Delta income_{i\,6,0} + \beta_7 \Delta recognition_{i\,6,0} + \gamma_1 food_i + \gamma_2 \Delta medical\_treatment_{i\,6,0} + e_i$$

As with the baseline model, the β_7 coefficient captures both effects that recognition has on well-being through changes in health, nutritional status and other outcomes, and through direct impact on psychic well-being. To better isolate recognition's direct effect on well-being, the following model controls for changes in immune response, physical and mental health, and nutritional status:

$$\Delta SWB_{i\,6,0} = \alpha + \beta_1 age_i + \beta_2 sex_i + \beta_3 education_i + \beta_4 distance\_health\_facility_i + \beta_5 site_i + \beta_6 \Delta income_{i\,6,0} + \beta_7 \Delta CD4_{i\,6,0} + \beta_8 \Delta physical\_health_{i6,0} + \beta_9 \Delta mental\_health_{i\,6,0} + \beta_{10} \Delta nutritional\_status_{i\,6,0} + \beta_{11} \Delta recognition_{i\,6,0} + \gamma_1 food_i + \gamma_2 \Delta medical\_treatment_{i6,0} + e_i$$

Ordered probit is used to estimate the parameters of these models. As with the other semi-differenced models, specifications are also estimated at 3, 9, and 12 months, in addition to 6 months (only 6 months is reported here). Hausman specification tests reject exogeneity for these models. Therefore, the models are re-estimated with instrumental variables using leading values as instruments.

The full panel data model is:

$$SWB_{it} = \alpha + \beta_1 income_{it} + \beta_2 CD4_{it} + \beta_3 physical\_health_{it} + \beta_4 mental\_health_{it} + \beta_5 nutritional\_status_{it} + \beta_5 recognition_{it} + \beta_6 medical\_treatment_{it} + e_{it}$$

A Hausman specification test rejects random effects and the model is estimated with fixed effects. Probit estimation cannot be used with fixed effect panel data[10], and Stata does not support ordered logit estimation with fixed effects for panel data. Therefore, the model is estimated as a linear model. A Hausman specification test rejects exogeneity for the model, and it is estimated using two stage least squares with leading values of endogenous variables as instruments. Due to missing data, there are not sufficient observations to estimate the full model with single leading values as instruments for *physical health*, *mental health*, and *recognition*. Therefore, one specification is estimated using 3-month leading values and another specification with single leading values but without *CD4* and *income* control variables, thereby enabling sufficient observations.

All estimates are generated using Stata 10.

VI. Results

Baseline Equivalence

Table 7 reports baseline levels for the three outcome variables of interest to demonstrate baseline equivalence between the group receiving food and the group not receiving food.

Table 7: Baseline Equivalence of Outcome Variables

Variable	***Mean among food group***	***Mean among no-food group***	***p-value***
Human recognition at baseline	-0.022	0.025	.43
BMI at baseline	17.67	17.64	.68
Subjective well-being at baseline	2.35	2.40	.256

[10] Fixed effects cannot be conditioned out of the likelihood function for a probit, and unconditional fixed effects probit models are biased (Stata 2007).

Impact of Food and Medical Treatment on Human Recognition and the Determinants of Human Recognition

Comparison of means

Table 8 reports the results of t-tests comparing the mean values of variables between intervention groups. The equivalence in human recognition levels at baseline between the food and no-food groups is expected because the food intervention was randomized. After 6 months of interventions, the increase in recognition is higher (p =.07) among those receiving food. With factor scores, it is difficult to quantify the magnitude in meaningful terms but the difference in the change in recognition is approximately one third of a standard deviation. At 12 months, after an additional 6 months of no food interventions to either group, the difference between the two groups is no longer significant. This suggests that food supplementation improves human recognition among this population group during the period of supplementation but that the effect does not persist following completion of supplementation. Multivariate is used to further investigate this conclusion.

A t-test finds that at baseline the group beginning ART had significantly lower mean human recognition levels than the group that was not yet eligible for ART (p = .03). Unlike food, ART was not randomized; per WHO guidelines, the subjects starting ART were those whose disease was more progressed. For example, CD4 counts, the measure of immune response, were significantly lower at baseline among those starting ART than those who were not (126 vs. 285, $p < .001$). Thus, this finding suggests that clients with more advanced disease receive lower levels of recognition, possibly because the effects of the disease are more visible, HIV status is more likely known by others, individuals are less productive in performing tasks, and they require greater care. Starting ART may also signal greater illness to others and may even entail disclosure of HIV status for the first time, leading to stigma and negative human recognition. During the period of the study, changes in recognition are not significantly different between those taking ART and those not taking ART.

Table 8: Results of Comparison of Means t-Tests by Interventions

Intervention	***Variable***	***Mean with intervention***	***Mean without intervention***	***p-value***
Food	CD4 count at baseline	184.9	187.7	.40
	Human recognition at baseline	-0.022	0.025	.43
	Change in human recognition at 6 months	***0.057***	***-0.186***	***.07***
	Change in human recognition at 12 months	-0.012	0.129	.35
ART	CD4 count at baseline	**126.4**	**284.8**	**< .001**
	Human recognition at baseline	**-0.053**	**0.072**	**.02**
	Change in human recognition at 6 months	0.020	-0.084	.22
	Change in human recognition at 12 months	0.021	0.073	.37

Bold values indicate significance at the .05 level. Bold italics values indicate significance at the .1 level.

An additional set of means tests is reported before proceeding to the multivariate analysis. At baseline there were significant differences in key variables between men and women (Table 9). Women were receiving significantly lower levels of recognition at baseline than men were. Women also experienced greater improvements in human recognition during and after the interventions; this difference was not statistically significant at completion of the food intervention (6 months) but was marginally significant at 12 months ($p = .056$). Men had lower CD4 counts than women at baseline, which is likely because men often seek treatment for HIV later in the progression of the disease than women do (Voeten et al. 2004).

Table 9: Results of Comparison of Means t-Tests by Sex

Variable	***Mean among Women***	***Mean among Men***	***p-value***
CD4 count at baseline	**196.2**	**173.0**	**.02**
Human recognition at baseline	**-0.118**	**0.151**	**<.001**
Change in human recognition at 6 months	0.012	-0.096	.21
Change in human recognition at 12 months	***0.145***	***-0.094***	***.056***

Bold values indicate significance at the .05 level. Bold italics values indicate significance at the .1 level.

Determinants of human recognition at baseline

Table 10 reports results of the human recognition models. The three baseline models examine determinants of human recognition prior to introduction of interventions. The first two models use OLS and ordered probit for human recognition factor scores and direct measures respectively, with very similar results. The signs of all the significant variables are as expected. Sex is a significant determinant of human recognition at baseline, with women more likely to receive low levels of recognition than men. This is consistent with the stark gender divide seen in the comparison of means test above. Physical and mental health are also both significant determinants of human recognition levels with less healthy subjects more likely to receive lower levels of recognition. Subjects with higher incomes are more likely to receive higher levels of recognition, though the coefficient is not statistically significant (p = .105 in the first specification).

The coefficient on *site* is not significant. This indicates that at baseline site is not a significant determinant of human recognition level. A comparison of means test also finds no significant difference in baseline recognition values between the urban slum clinic sites and the district/provincial hospital sites (p = .32). This result is relevant

Table 10: Results from Human Recognition Models

	Baseline Models			Semi-Differenced Models			Panel Models	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Human recognition (HR)	HR (direct)	HR (direct)	ΔHR to 6 months	ΔHR to 6 months	ΔHR to 6 mo. (direct)	HR	HR
Constant	0.148	--	--	0.769	1.94	--	**-0.454**	**-2.29**
	(0.539)			(0.559)	(1.56)		**(0.216)**	**(1.07)**
Age	0.002	-0.002	-0.016	-0.001	-0.016	-0.031	--	--
	(0.003)	(0.007)	(0.013)	(0.008)	(0.018)	(0.033)		
Sex	**-0.233**	**-0.462**	0.034	0.152	0.283	-0.129	--	--
	(0.058)	**(0.137)**	(0.267)	(0.138)	(0.239)	(0.292)		
Education	-0.003	-0.016	0.005	-0.065	***-0.239***	**-0.473**	--	--
	(0.029)	(0.059)	(0.096)	(0.068)	***(0.135)***	**(0.213)**		
Distance to facility	-0.004	-0.005	-0.019	-3e-4	0.020	-0.196	--	--
	(0.022)	(0.041)	(0.065)	(0.045)	(0.098)	(0.135)		
Site	0.006	-0.053	0.144	**-0.243**	***-0.246***	**-0.475**	--	--
	(0.024)	(0.042)	(0.118)	**(0.055)**	***(0.148)***	**(0.134)**		
Income	0.045	0.084	0.066	-.012*	0.026*	-0.174*	--	--
	(0.028)	(0.056)	(0.104)	(0.045)	(0.123)	(0.171)		
CD4	-7e-5	3e-4	-3e-4	--	--	--	--	--
	(2e-4)	(4e-4)	(8e-4)					
Physical health	**-0.004**	**-0.007**	**0.073**	--	-0.011*	-0.062*	***-0.0024***	-0.001
	(0.002)	**(0.003)**	**(0.037)**		(0.033)	(0.506)	***(0.0012)***	(0.003)
Mental health	***-0.082***	***-0.117***	**-2.53**	--	0.235*	***0.520****	**-0.036**	-0.173
	(0.045)	***(0.067)***	**(0.929)**		(0.237)	***(0.305)***	**(0.018)**	(0.175)
BMI	0.009	0.061	***0.219***	--	-0.031*	-0.262*	**0.030**	**0.132**
	(0.027)	(0.050)	***(0.121)***		(0.115)	(0.212)	**(0.012)**	**(0.059)**
Medical Treatment	--	--	--	-0.002	-0.113	0.838	-0.0363	**-0.115**
				(0.140)	(0.291)	(0.564)	(0.026)	**(0.054)**
Food	--	--	--	**0.305**	**0.557**	***0.716***	--	--
				(0.137)	**(0.263)**	***(0.371)***		
n	485	485	212	141	54	55	2,689	983
Prob>F, χ^2	.004	.0001	.01	.0002	.02	.0004	.0004	.02
Estimation method	OLS	Ordered Probit	Ordered Probit with IV	OLS	2SLS	Ordered Probit with IV	Fixed Effects w/OLS	Fixed Effects w/2SLS
Instruments	--	--	Nutrition, physical, mental health (1)	--	Physical, mental health (12), nutrition (7)	Physical, mental health (12), nutrition (7)	--	Leading mental health, leading nutrition

Parameter estimates in bold indicate significance at the .05 level and those in bold italics are significant at the .1 level. Heteroskedasticity-robust standard errors are given in parentheses.
Physical and mental health variables measure the number of unhealthy days in the past month so higher values correspond to worse health.
Panel models use “within” differences between individual i’s value at year t and i’s average value for the variable.
* change in variable from baseline to 6 months

because *site* is a significant determinant of changes in recognition in the semi-differenced models, suggesting that there are systematic differences across sites either in the interventions or in factors that facilitate the interventions' impact on human recognition.

Because a Hausman specification test detects endogoneity in the ordered probit model, the third baseline model is estimated using leading values at month 1 of the suspected endogenous variables, *physical health*, *mental health* and *nutritional status*, as instruments. In the instrumental variables estimation results, the number of observations declines dramatically from 485 to 212 because of missing data at month 1. The coefficient on *mental health* has a large negative magnitude and is highly significant: those with better mental health receive higher levels of recognition. The *nutritional status* coefficient is positive and marginally significant, indicating that subjects with worse nutritional status also receive lower levels of recognition[11]. The coefficient on *physical health* remains significant but it is now positive, indicating those with worse physical health in the past 30 days receive higher levels of recognition. This is a surprising result but could be due to the additional care provided to ill subjects by household members or others.

Interestingly, the coefficient on *sex* is no longer significant. This suggests that when physical and mental health and nutritional status are fully controlled for and endogeneity addressed, being female does not significantly affect the level of human recognition received. In both the linear regressions and the ordered probits, when only *nutritional status* and *physical health* are treated as endogenous and instruments are used,

[11] At baseline all subjects have BMIs of 14-18.5kg/m^2, or BMIs of 18.5-20kg/m^2 with weight loss in the past month.

but not *mental health*, *sex* remains significant and positive (results not shown)[12]. But when *mental health* is treated as endogenous and instrumented, even when both *physical health* and *nutritional status* are treated as exogenous, the coefficient on *sex* is insignificant. (This is particularly dramatic in the linear regression where the t-statistic for the *sex* coefficient drops from over 2 to 0.07 by instrumenting for mental health.) This suggests that while women in the study receive significantly lower levels of human recognition, women and men with the same mental health status do not receive such different levels of recognition. A comparison of means test shows that women have worse mental health status than men (p=.09), and in a linear regression *sex* is a significant independent predictor of mental health status (p = .05, results not shown). The reverse is true for CD4 count with men having significantly lower CD4 counts, likely because they tend to begin treatment later in the disease progression than women.

Regression does not inform about the direction of causation, so while variation in mental health status partly explains the variation in human recognition by sex, it cannot necessarily be concluded that women have lower recognition levels *because* of worse mental health. In fact, causation may occur in both directions as receiving low levels of human recognition could negatively affect mental health, and poor mental health conditions may lead to lower real or perceived receipt of human recognition. Indeed, this bidirectional relationship between human recognition and mental health, as well as other variables that may influence both variables, is likely why *mental health* is endogenous in the specification. The relationship among gender, human recognition, and mental health bears further study.

[12] Here and throughout the paper, results that are not shown are available with the author.

Impacts of food and treatment on changes in human recognition

The first semi-differenced model (4) estimates the "full" impact of food and medical treatment on human recognition. The coefficient on *food* is positive and significant, indicating that subjects who received food supplementation had significantly greater improvements in human recognition than those who did not receive it, controlling for the demographic and socio-economic variables included. With factor scores being used for human recognition, interpretation of the magnitudes is a bit challenging, but addition of food supplementation increases the improvement in an individual's human recognition over 6 months by an average of 0.3 units, which is slightly less than one third of a standard deviation of the change in recognition ($sd(\Delta recognition_{i\ 6,0}) = 0.948$), and 40% of a standard deviation of baseline recognition ($sd(recognition_{i\ 0}) = 0.776$). The coefficient on *medical treatment* is not significant, suggesting that controlling for the demographic and socio-economic variables, treatment with ART for those requiring it does not confer significantly greater or lesser human recognition benefits than treatment with cotrimoxazole prophylaxis for those not yet requiring ART.

The significant coefficient on *food* captures all the effects that food supplementation has on changes in human recognition levels. These effects may occur through a number of possible pathways. One pathway is through improved health and nutritional status, which in turn leads to receipt of higher levels of human recognition. Another pathway may be that bringing home significant quantities of food increases the value and recognition other household members provide to subjects. The quantity of food that subjects received provided approximately 50% of their caloric needs during the six months of supplementation. Even though the food is intended to be consumed by the subject only, qualitative assessments indicated that it is sometimes shared with other household members. Even food consumed by the subject can still serve as an income transfer, reducing the quantity of food the household needs to provide and increasing the subject's value within the household[13].

The coefficient on *site* is negative and highly significant, indicating that subjects at the three district and provincial hospital sites outside of Nairobi accrued significantly greater human recognition gains than those in the three urban slum clinics in Nairobi. Given that there was baseline equivalence in human recognition levels between the two types of sites, one explanation of this result is that there are systematic differences in how interventions are being implemented that contribute to or undermine improvements in human recognition among clients. This could occur through counseling methods (all subjects receive nutrition counseling), health care staff's interpersonal approaches, or facility systems and processes such as those described in Table 1. Because data were collected in health facilities by health care staff, subjects were not asked about human recognition received at health facilities (or any specific service delivery points *per se*) to avoid biasing the results. Nevertheless, differences in implementation approach may be a contributing factor to the differences in recognition improvements across sites, and this could be explored further.

Another possible explanation is that subjects living in rural areas outside of Nairobi have greater potential to increase recognition levels than residents of urban slum areas do. In this case one might expect there to be differences at baseline as well between the two types of site, which there are not. A variation on this explanation is that there are

[13] Though valuing someone for the material goods she brings home is distinct from valuing her for her inherent worth as a human being, increases in the former may enhance or help actualize the latter.

differences across the sites that specifically facilitate or undermine the interventions' impacts on human recognition. For example, if subjects from the rural areas face greater household food insecurity, bringing home food may lead to greater changes in human recognition than subjects living in less food insecure households in urban areas. However, when a *siteXfood* interaction term is included in the model, its coefficient is not significant (results not shown).

A third possible explanation of this result is that the difference across sites is due to systematic differences in how data on human recognition was collected. However, because of the baseline equivalence and because the significance of the negative coefficient is robust to whether the *site* variable is coded as a binary variable measuring the two types of sites or is coded with different values for each site, it is unlikely that differences in data collection are the reason for this result.

The same model is run at 9 and 12 months to examine the extent to which the results persist after completion of the food interventions (results not shown). At 9 months the coefficient on *site* is still significant and negative, and the coefficient on food is still positive but no longer significant ($p = .16$). By 12 months *site* is still significant and negative, but *food* is no longer significant.

In the above model, the various pathways by which food supplementation and medical treatment affect human recognition are not controlled for, so the full effects are captured in the coefficients (barring any effects through monetary income, which is controlled for). These effects may include improvements in material outcomes such as health and nutrition, which in turn improve human recognition, and may include direct improvements in human recognition through improvements in how subjects are viewed and valued as a result of receipt of food. To separate out these two types of effects, the next two models control for changes in nutrition and physical and mental health. In models (5) and (6) the coefficient on *food* captures the effects that food has on recognition through enhanced status within the household or other factors unrelated to changes in health or nutritional status[14].

Because *Δphysical_health*, *Δmental_health*, and/or *Δnutritional_status* are endogenous, these models are estimated with instruments. One limitation of using future values as instruments here is that it reduces the number of observations considerably because there are fewer observations at month 12 than there are in months 6 and baseline – and even fewer with complete data at all three points of time.

In both the linear and the ordered probit estimations, the coefficient on *food* is still positive and significant ($p = .035$ and $p = .053$ respectively), though its significance has declined from the previous model. The diminished significance suggests that part of how food supplementation impacts human recognition is through improvements in health and nutritional status. The fact that the coefficient on *food* continues to be significant after controlling for these variables suggests that food supplementation also impacts human recognition through channels other than one's health and nutrition status. In model (5), receipt of food increases human recognition levels by 0.56 units, which is 59% of a standard deviation of the change in human recognition, and 72% of a standard deviation of the baseline level of human recognition. Although both of the specifications are significant, results should be interpreted with caution given the small number of observations.

[14] Since the variables used to measure changes in health and nutritional status may omit aspects of health or nutrition, or may contain measurement error, the coefficient on *food* could also reflect food's effect on recognition through changes in unmeasured aspects of health and nutrition.

The *sites* variable remains significant and negative in both models. The *mental health* variable is positive and significant in the ordered probit model, which given the units used for the changes in mental health and recognition, means that improved mental health since baseline is a positive, independent determinant of improved human recognition.

Determinants of changes in human recognition

The panel models estimate the determinants of changes in human recognition over the course of the study. When OLS is used to estimate the full panel with fixed effects in specification (7), coefficients on nutritional status, mental health, and physical health are all significant and have the expected signs. Increases in BMI, reductions in physically unhealthy days, and reductions in mentally unhealthy days are all significant predictors of increases in human recognition received.

Because Hausman specification tests reject exogeneity of *mental health* and/or *nutritional status*, the model is re-estimated in specification (8) with two-stage least squares. Interestingly, the coefficient on *nutritional status* remains significant and positive and the coefficient on *treatment* is negative and significant, but the coefficients on the two health variables are not significant. At baseline *treatment* is coded as 0 for all clients, and in subsequent months it is coded as 1 if the client is taking cotrimoxazole but not ART and 2 if the client is taking ART. While most clients starting ART began in month 1, some became eligible later in the trial. The significant negative coefficient on treatment suggests that when clients reached the stage of requiring ART, they were receiving lower levels of recognition relative to the average recognition they receive than when clients were at the stage of only requiring cotrimoxazole. This may be because they have reached more advanced stage of disease and therefore have more visible signs of disease and are less able to be productive. This is consistent with the earlier finding of lower mean values of human recognition among ART clients than pre-ART clients. The result may also reflect increased stigma as a result of starting ART, especially if subjects first disclose their HIV status to others when they begin ART.

<u>Role of Human Recognition in Nutritional Status</u>

Determinants of nutritional status at baseline

Table 11 reports results from the nutritional status models. The model of determinants of nutritional status at baseline is estimated with two-stage least squares[15]. Recognition is not a significant independent predictor of baseline nutritional status. CD4 counts are a significant predictor of nutritional status, with subjects who entered the study with higher CD4 counts having higher BMI as well, controlling for the other variables. Greater income is also a predictor of higher BMI, as is younger age. As with the baseline human recognition model, when *site* is included as an explanatory variable, its coefficient is not significant (p = .45) (results not shown).

Changes in human recognition and nutritional status

Models of changes in nutritional status are estimated at 3 months in specification (2), 6 months in specifications (3) and (4), and 12 months (results not shown). Hausman specification tests do not reject exogeneity, so OLS is used. At 3 months[16], the coefficient on change in human recognition is positive and significant, meaning that subjects with greater increases in human recognition levels between baseline and 3

[15] The Hansen J statistic is insignificant (χ^2 p = .7413, adding an instrument to overidentify), providing evidence that the instruments are exogenous to the model. The Anderson canonical correlation likelihood ratio statistic is significant (χ^2 p = .0015), indicating that the instruments are correlated with the endogenous variables.

[16] Income is not included in the 3-month model because income data were not collected at 3 months.

months were more likely to have greater increases in nutritional status during the same period. The same result holds whether the factor scores or the direct measures of human recognition are used. The results reported use the direct measures, so results can be interpreted to mean that a one unit greater increase in human recognition over 3 months is associated with a 0.46 unit greater increase in BMI over the same period. Human recognition units refer to the four-unit scale of responses (e.g. a one unit increase could correspond to moving from “somewhat recognized and valued” response to “fully recognized and valued” response). BMI units are kg/m^2 and since average subject height is 1.646 m, a 0.46 kg/m^2 increase translates into an average weight gain of 1.25 kg. The coefficient on medical treatment is positive and highly significant, meaning that subjects taking ART had significantly greater improvements in nutritional status than subjects who were not yet eligible for ART (and were taking cotrimoxazole only).

At 6 months, change in human recognition was not a significant determinant of change in nutritional status. Medical treatment remains significant and positive. At 12 months, the coefficient on medical treatment remains highly significant, and the coefficient on change in human recognition, while positive, is no longer significant (results not shown).

Specification (4) controls for immune response, physical health and mental health to better understand the pathways through which nutritional status is affected. The coefficient on treatment is no longer significant. When CD4 count is not included in the specification, the coefficient on *treatment* remains significant, which makes sense since an increased CD4 count is a key marker of how ART functions. At 3 months and 12 months the coefficients on human recognition remains insignificant (results not shown).

Table 11: Results from Nutrition Models

	Baseline	Semi-Differenced Models			Panel Models			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	BMI	ΔBMI to 3 months	ΔBMI to 6 months	ΔBMI to 6 months	BMI	BMI	BMI	BMI
Constant	18.694 (0.948)	0.130 (0.824)	2.83 (1.89)	**6.06** **(2.74)**	**18.07** **(0.0758)**	**18.11** **(0.0788)**	**17.54** **(0.520)**	**17.36** **(0.252)**
Age	***-0.018*** ***(0.010)***	0.008 (0.011)	-0.007 (0.023)	-0.021 (0.037)	--	--	--	--
Sex	-0.110 (0.262)	0.028 (0.239)	-0.304 (0.422)	-0.363 (0.541)	--	--	--	--
Education	-0.128 (0.092)	-0.084 (0.099)	***-0.282*** ***(0.146)***	**-0.403** **(0.193)**	--	--	--	--
Distance to facility	0.076 (0.066)	-0.006 (0.081)	-0.088 (0.123)	**-0.336** **(0.165)**	--	--	--	--
Site	--	0.009 (0.084)	-0.139 (0.146)	**-0.430** **(0.204)**	--	--	--	--
Income	***0.142*** ***(0.083)***	--	0.177* (0.172)	0.176* (0.235)	--	--	**0.236** **(0.095)**	**0.164** **(0.0417)**
CD4	**0.0017** **(0.0007)**	--	--	--	--	--	***0.0015*** ***(0.0009)***	**0.0019** **(0.0003)**
Physical health	-0.038 (0.026)	--	**--**	0.0045* (0.0135)	**-0.0177** **(0.0028)**	**-0.0196** **(0.0021)**	**-0.0192** **(0.0073)**	**-0.0126** **(0.0035)**
Mental health	0.308 (0.274)	--	**--**	0.322* (0.214)	-0.0338 (0.0338)	-0.0330 (0.0330)	-0.070 (0.148)	0.0285 (0.0637)
Human recognition	0.235 (0.310)	**0.464*** **(0.210)**	0.0738* (0.319)	-0.179* (0.439)	**0.123** **(0.0452)**	**0.136** **(0.0428)**	0.380 (0.267)	0.225 (0.146)
Medical Treatment	--	**0.678** **(0.239)**	**0.838** **(0.391)**	0.555 (0.554)	**0.7946** **(0.0517)**	**0.7300** **(0.0427)**	**1.175** **(0.126)**	**1.177** **(0.078)**
Food	--	-0.205 (0.252)	-0.002 (0.399)	-0.221 (0.508)	**--**	--	**--**	**--**
n	201	195	123	81	2,689	2,689	831	831
Prob>F, χ^2	.0001	.08	.02	.02	<.0001	<.0001	<.0001	<.0001
Estimation method	2SLS	OLS	OLS	OLS	Fixed Effects w/OLS	Random effects w/GLS	Fixed Effects w/OLS	Random effects w/GLS
Instruments	Physical health, human recog. (1)	--	--	--	--	--	--	--

Parameter estimates in bold indicate significance at the .05 level and those in bold italics are significant at the .1 level. Heteroskedasticity-robust standard errors are given in parentheses.
Panel models use “within” differences between individual i’s value at year t and i’s average value for the variable.
* change in variable from baseline to 3 or 6 months

Determinants of changes in nutritional status

Because the Hausman specification tests do not reject random effects for the panel models, they are estimated with random effects models using generalized least squares, as well as fixed effects with OLS. Results of the fixed effects and random effects models are quite similar. When income and CD4 counts are included to the model, it dramatically reduces the number of observations because these data are collected less frequently and because data are missing for some observations. Therefore, a model is estimated without CD4 count and income. Coefficients on physical health, treatment, and human recognition are all significant with expected signs. Fewer days of poor physical health, improvements in human recognition, and taking ART are all significant independent predictors of improved nutritional status. These results hold both in the fixed effects ("within") model that estimates parameters using the difference between a subject's status in a given month and the subject's mean status over the course of the study, and in the random effects model that uses a weighted average of the "within" estimates and the "between" estimates that regress the mean values of variables for each subject.

In the fuller model that includes income and CD4 counts, the coefficients on human recognition remain positive but are no longer significant in either the fixed effects or random effects models. This may be because CD4 and income are controlled for or may be due to the significant reduction in sample size. Coefficients on physical health and treatment remain significant, and coefficients on income and CD4 counts are significant with positive signs as expected. Larger increases (decreases) in income or in CD4 counts are predictors of larger increases (decreases) in BMI.

Role of Human Recognition in Well-Being

Determinants of subjective well-being at baseline

Results from the subjective well-being models are presented in Table 12. In the first baseline model, estimated with ordered probit, the coefficient on *human recognition* is negative and significant, indicating that subjects with higher levels of human recognition at baseline are more likely to have higher levels of subjective well-being at baseline, controlling for the other variables. *Site* is positive and significant, meaning that subjects at the sites outside of Nairobi have higher subjective well-being at baseline than those in the Nairobi slum sites. Interestingly, *sex* is negative and significant, indicating that women report higher levels of well-being at baseline[17].

The coefficient on *recognition* in the first model captures associations between human recognition and subjective well-being through both direct psychic effects and health, nutrition and other material outcomes. The model estimated in (3) and (4) controls for health and nutrition status so the *recognition* coefficient now captures only the direct association between human recognition and well-being, as well as through any other material effects not measured by the other explanatory variables. When this model is estimated with ordered probit, the coefficient on human recognition remains negative and significant at the 0.1 level, though no longer significant at the .05 level. Coefficients on *mental health*, *nutritional status*, and *CD4* count are all significant with expected signs; fewer days of poor mental health, higher BMI, and higher CD4 counts are all independent predictors of higher subjective well-being. Inclusion of these variables reduces the significance of the human recognition variable. This can be interpreted to mean that one

[17] Subjective well-being *level* variables are coded such that lower values correspond to higher levels of well-being, and *differenced* variables are coded such that higher values correspond to larger improvements in well-being.

Table 12: Results from Subjective Well-Being Models

	Baseline Models				Semi-Differenced		Panel Models	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Subjective well-being (SWB)	SWB	SWB	SWB	ΔSWB to 6 months	ΔSWB to 6 months	SWB	SWB
Constant	--	--	--	--	--	--	5.078 (3.24)	2.772 (5.389)
Age	-0.0037 (0.267)	0.0085 (0.0090)	***-0.0108*** ***(0.0062)***	0.0142 (0.0109)	0.0168 (0.0225)	0.011 (0.026)	--	--
Sex	**-0.267** **(0.112)**	-0.0648 (0.1738)	***-0.232*** ***(0.121)***	-0.466 (0.382)	-0.3808 (0.4144)	-0.470 (0.390)	--	--
Education	0.0237 (0.0435)	-0.0194 (0.0599)	0.0059 (0.0454)	0.0021 (0.0883)	-0.0967 (0.1244)	-0.373 (0.429)	--	--
Distance to facility	0.046 (0.0304)	-0.0293 (0.0465)	0.027 (0.032)	0.0638 (0.1076)	-0.0744 (0.0739)	-0.202 (0.282)	--	--
Site	**0.210** **(0.0338)**	**0.1834** **(0.0493)**	**0.205** **(0.035)**	**0.189** **(0.060)**	-0.0668 (0.3686)	-0.303 (0.692)	--	--
Income	-0.044 (0.037)	0.0247 (0.490)	-0.008 (0.039)	0.0094 (0.0557)	**0.2341*** **(0.1154)**	-0.559* (0.567)	--	-0.273 (0.226)
CD4	--	--	***-0.0006*** ***(0.0003)***	0.0003 (0.0006)	**--**	-0.0001* (0.0008)	--	-0.00064 (0.00254)
Physical health	--	--	0.0021 (0.0031)	-0.0488 (0.0536)	--	-0.182* (0.164)	-0.018 (0.021)	-0.0217 (0.0474)
Mental health	--	--	**0.260** **(0.0604)**	1.972 (1.329)	--	2.254* (1.845)	0.251 (0.206)	0.555 (0.415)
BMI		--	**-0.120** **(0.042)**	-0.2287 (0.1813)	--	***0.487**** ***(0.256)***	-0.139 (0.163)	0.0487 (0.2560)
Human recognition	**-0.1977** **(0.0743)**	-0.0404 (0.1911)	***-0.118*** ***(0.071)***	0.692 (0.431)	-0.0768* (1.421)	-1.135* (1.923)	0.154 (0.503)	-0.719 (1.266)
Medical Treatment	--	--	--	-0.002 (0.140)	0.0110 (0.2188)	3.172 (2.859)	***-0.187*** ***(0.108)***	-0.285 (0.384)
Food	--	--	--	--	0.1401 (0.2676)	0.0458 (0.353)	--	--
n	500	261	480	209	99	81	819	207
Prob>F, χ^2	<.0001	.003	<.0001	.0007	.01	.26	<.0001	<.0001
Estimation method	Ordered Probit	Ordered Probit with IV	Ordered Probit	Ordered Probit with IV	Ordered Probit with IV	Ordered Probit with IV	Fixed Effects w/2SLS	Fixed Effects w/2SLS
Instruments	--	Human recogniti on (1)	--	Human recognition, physical, mental health, BMI (1)	Human recognition (12)	Human recognition, physical, mental health, BMI (12)	Leading physical, mental health, recog., BMI	Leading physical, mental health, recog., BMI

Parameter estimates in bold indicate significance at the .05 level and those in bold italics are significant at the .1 level. Heteroskedasticity-robust standard errors are given in parentheses.
Panel models use "within" differences between individual i's value at year t and i's average value.
Higher values of subjective well-being refer to lower levels of well-being, and vice versa for ΔSWB.
* change in variable from baseline to 6 months

way human recognition affects subjective well-being is through health and nutritional status, so when this pathway is no longer included in the *recognition* coefficient, the significance of the parameter decreases. However, the fact that the coefficient is still negative and significant suggests that human recognition makes other, direct contributions to well-being. Coefficients on *site* and *sex* remain significant, and the significant coefficient on *age* indicates higher reported well-being for older subjects.

However, these results should be interpreted with caution because Hausman specification tests point to endogenous explanatory variables. The models are estimated again using instrumental variables (performed manually) with leading values of human recognition, physical health, mental health, and nutritional status as instruments[18]. After addressing endogeneity, the coefficients on *human recognition*, *mental health* and other variables are no longer significant, and *site* is the only significant independent predictor of subjective well-being status at baseline. Applying instruments reduces the sample size substantially, which may account for some of the loss in statistical significance.

Role of human recognition in changes in subjective well-being

Two subjective well-being semi-differenced models are estimated, one that does not control for changes in health and nutritional status and one that does. For both models, ordered probit estimates yield significant negative coefficients on Δ*recognition* when the model is estimated at 3 months, but not at 6 months (results not shown). However, in the first model Hausman specification tests indicate the Δ*recognition* variable may be endogenous in the 6-month specification, though the test does not reject

[18] While Hansen J test statistics cannot be generated using ordered probit, the instruments are tested by estimating the model as a linear model and checking the test statistics. The Hansen J test statistic is insignificant (χ^2 p = .6136), providing evidence that the instruments are exogenous. The Anderson canonical correlation likelihood ratio statistic is significant (χ^2 p = .0002) indicating that the instruments are correlated with the endogenous variables.

exogeneity in the 3-month specification. And in the second model Hausman specification tests indicate endogeneity of the recognition, mental health, physical health, and/or nutritional status variables. Therefore, instrumental variables are used for both models, with future values of the variables as instruments. Results are reported under (5) and (6) in Table 12. In both models, coefficients on Δ*human recognition* are not statistically significant. Coefficients on change in income and change in nutritional status are significant in the two models respectively[19].

Determinants of changes in subjective well-being

In the panel models Hausman specification tests indicate that *physical health*, *mental health*, *nutritional status*, and/or *recognition* are endogenous ($Pr>\chi^2 < .0001$), and leading values of these variables are used as instruments. Results for the two specifications using fixed effects estimation with two stage least squares are reported under (7) and (8) in Table 12. These specifications do not have significant explanatory power. The coefficient on *treatment* is marginally significant in the first specification.

VII. Discussion

Key Findings

A number of findings emerge from this study. The empirical findings provide initial evidence in support of some hypotheses predicted by the theoretical model, but not for others. In addition to the empirical findings, a number of lessons emerge from this study that can inform incorporation of human recognition measurement into research and programs in the future. One overarching result is demonstration of how human

[19] Note the second model is not statistically significant ($Pr>\chi^2 = .26$). The number of observations is quite small (n = 81) in order to obtain three data points for several variables (baseline and 6 months for the differencing and 12 months for the instrument). When the model is estimated without the change in CD4 counts it becomes marginally significant ($Pr>\chi^2 = .06$) because the number of observations increases somewhat (results not shown).

recognition can be feasibly measured in a research study; and since the study was implemented in the context of a health services program, it also demonstrates how measurement of human recognition can be incorporated into a program monitoring and evaluation system. Despite some limitations to the data, which are discussed below, the data enabled relatively robust empirical tests of hypotheses about the relationship between human recognition and health and nutrition interventions and outcomes. The study also opens the way for further empirical study of these hypotheses in different contexts and with different population groups.

The study finds that food supplementation improves receipt of human recognition among malnourished, HIV-infected adults in Kenya. This effect is statistically significant at completion of 6 months of food supplementation, but does not persist 6 months after completion of the food intervention. This finding emerges from the comparison of means tests and from multivariate analysis using various combinations of control variables. The smaller number of observations at 9 months and 12 months reduces the statistical power of results for the later data points.

The effect food supplementation has on human recognition may occur through changes in material outcomes, through changed perceptions and valuing of subjects by others, or through improved confidence and rapport-building by subjects. These latter, non-material effects are isolated to some extent by controlling for physical and mental health, income, and nutritional status in multivariate analysis. After controlling for these variables, the food intervention's positive effect on changes in human recognition diminishes somewhat but remains significant, even though the sample size becomes small for these models. This result suggests that food's effect on human recognition may occur through both pathways – changes in material outcomes that in turn affect human recognition levels, and direct effects on human recognition.

Because the food intervention is randomized, this result is among the most robust findings from the study. It is also an important result in terms of understanding how development interventions can influence human recognition transactions. Although it was not the primary aim of the intervention, food supplementation improves the human recognition received by malnourished HIV-infected subjects of the study. While further study is needed, the result suggests that this is an example of an intervention that confers positive impacts both on specific material outcomes that are the primary objectives of the program and on non-material outcomes such as human recognition.

Interestingly, while the food intervention had significant impacts on improvements in human recognition levels, the medical treatment intervention (introduction of ART) did not. In addition to the different content of the two interventions, another major difference may be that ART is provided based on stage of disease. Comparison of means tests found that clients eligible for ART began the study with significantly lower human recognition levels, and the panel data analysis found that treatment with ART (compared to those not yet eligible for ART) is a significant predictor of lower levels of recognition. Both of these results suggest that subjects with more advanced disease receive lower levels of recognition, perhaps due to more visible illness, lower productivity, disclosure of HIV status, and the need for greater care.

This finding is substantiated by the multivariate analyses of determinants of human recognition levels at baseline and over the course of the study. Better physical and mental health and better nutritional status are significant independent predictors of receiving higher levels of human recognition at baseline. The link between mental health and human recognition appears particularly strong. Endogeneity of the *mental health* variables in these models suggests that the same factors are at work influencing both mental health and recognition, and/or that human recognition and mental health form a self-reinforcing cycle in which each reinforces the other, both positively and negatively. Indeed, many of the factors that Patel and his colleagues find influence mental health in developing country settings (Patel and Kleinman 2003; Patel et al, 2002; Patel et al. 2001) are rooted in human recognition transactions.

There is evidence of a gender divide in human recognition as well. Comparison of means finds that women receive significantly lower levels of human recognition at baseline than men. The OLS estimation of determinants of baseline human recognition levels also finds that female subjects have lower levels of human recognition, though when mental health status is treated as endogenous, the effect of sex is no longer significant. As discussed in detail in the previous section, this combined with results showing lower mental health scores for women than men, suggests close relationships among being female, lower levels of mental health, and receipt of lower levels of human recognition. This merits further study.

In addition to the food intervention, the other variable that is a consistently significant independent predictor of changes in recognition is *site*. Improvements in human recognition are greater among subjects attending district and provincial hospitals outside of Nairobi than among those attending clinics serving urban slums of Nairobi. This result is robust to controlling for various demographic, socio-economic, and health variables. Further study is needed to understand the mechanism behind this result, but possible explanations include: differences in how interventions are implemented at the two types of sites, perhaps through some of the channels described in Table 1; higher food insecurity in the rural areas, which leads to greater changes in how subjects receiving food are valued; and systematically different family structures, social networks, or other sources of support in the two environments. *Site* is also a significant predictor of subjective well-being at baseline, with those attending the clinics outside Nairobi having greater baseline well-being, though *site* does not significantly predict changes in subjective well-being as it does for human recognition. Possibly, the same factors that generate greater well-being at baseline may enable greater improvements in recognition. In any event, it is intriguing that the same interventions lead to greater improvements in human recognition in rural and peri-urban areas than they do in urban slum areas of Nairobi, controlling for other characteristics.

Within individual subjects, deviation from the mean in nutritional status over time is a significant predictor of deviation in human recognition levels, with higher BMI associated with receipt of higher levels of recognition. The evidence that emerges from this study about the reverse relationship is mixed. When endogeneity is addressed using two stage least squares, at baseline CD4 count, income, and age are significant predictors of nutritional status, but human recognition is not. Change in human recognition is a significant predictor of change in BMI at 3 months but not at 6 months. The magnitude and sign of deviation from the mean in human recognition is a significant predictor of the magnitude and sign of deviation from the mean in nutritional status within subjects, though once CD4 count and income are controlled for and the sample size shrinks, recognition is no longer significant. Treatment regimen is a powerful predictor of changes in BMI.

While human recognition is a significant independent predictor of subjective well-being status at baseline in the initial models, once endogeneity is addressed, the human recognition variable is no longer significant. In the instrumental variables estimations, *site* is the only variable with a statistically significant coefficient. Similarly, in the models of changes in subjective well-being, change in human recognition is not significant once endogeneity is addressed, though these models do not seem to be well-specified as very few variables have significant coefficients and for some models the specification itself is not significant. The program interventions did not include components aimed at influencing human recognition, and the relationship between changes in recognition and changes in subjective well-being may differ in program settings where recognition is deliberately addressed in program design and implementation. Further study of human recognition and subjective well-being can help provide more information about this question.

<u>Limitations</u>

A number of limitations to this study existed, and some of these offer lessons for future research on human recognition. One such limitation was the challenge faced in accurately and reliably collecting data on human recognition, leading to possible measurement error. The concept of human recognition was new to those collecting data. While the study questionnaires were field tested, and training and supervision were provided to support data collection, more specialized preparation for collection of human recognition data would be beneficial. The need to translate the data collection questions into other languages adds a further complication as different enumerators may translate the question slightly differently. In this study, the questionnaires were not translated into Kiswahili, the primary spoken language in Kenya, because many people in Kenya can read English but do not read Kiswahili and because different dialects were used at different sites. Stronger efforts to ensure consistent measurement of human recognition across sites and across subjects in future research can help improve the validity of results.

There was limited variation across subjects and over time in human recognition levels based on the variables used in the study. To the extent that the questions used were not fine enough to pick up differences in recognition levels, refinement of the questions may help generate greater variation. To the extent that the lack of variation is due to lack of precision in data collection, improving data collection methods as mentioned above will also help. To some extent, the limited variation may truly reflect the situation among subjects of the study. For example, the12-month period of the study may be too short to observe significant changes in recognition levels for many subjects. While immediate changes in human recognition that have occurred as a result of the interventions were documented, longer term changes could not be captured. The results suggest that such short term changes do occur, but other changes in human recognition may accumulate and evolve over time. It would be valuable in future studies to monitor human recognition over a longer timeframe.

The significant amount of missing data posed a challenge to analysis. As discussed earlier, these missing data were due to a combination of attrition, missed appointments, and missed data collection. This reduced the power of results, especially when differenced models were used and when leading values were used as instruments. While a number of mechanisms to improve follow-up were established in the study to address the problem of attrition, this limitation was largely out of the researchers' control due to attrition that was common among HIV treatment clients in Kenya.

Human recognition was measured primarily through self-reporting. While this allowed human recognition to be more directly and specifically identified, it meant that what was being measured were subjects' perceptions of the recognition they received. This perception may differ from the recognition others were actually providing to them, and it was not possible to combine data on recognition received with data collected from other household members about recognition provided. However, for the purposes of assessing the impact of recognition on outcomes, an individual's perception of recognition received may be as or more relevant than the actual level of recognition others provide, even if the latter could be accurately measured.

Although the study collected data on human recognition issues, the interventions did not include components designed to address recognition directly. Program components designed to address recognition either directly through interventions or through *how* interventions are implemented, may be an important mechanism for improving human recognition transactions and strengthening program impacts. It may be valuable to plan future research in the context of programs that have components specifically designed to address human recognition. While this study provided information about the impacts that specific interventions (food supplementation and HIV treatment) have on human recognition, a study conducted with program interventions designed to address recognition would provide further evidence about how programs can improve human recognition transactions and whether doing so enhances program outcomes and beneficiary well-being.

Notwithstanding the limitations of the study and the need for further research, the apparent relevance of human recognition to outcomes of interest and the feasibility of measuring human recognition suggest that programs may consider explicitly incorporating human recognition components into program design and into monitoring and evaluation systems. The objectives of such integration would be threefold: to complement research efforts to enhance understanding of human recognition's role in development processes and outcomes; to identify interventions that improve human recognition transactions; and to strengthen program outcomes in terms of specific material program objectives and overall well-being of program participants.

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