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Effects of short-term cash and food incentives on food insecurity and nutrition among HIV-infected adults in Tanzania: a randomized trial

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Abstract

Objective: Food insecurity (FI) impedes antiretroviral therapy (ART) adherence. We previously demonstrated that short-term cash and food incentives increased ART possession and retention in HIV services in Tanzania. To elucidate potential pathways that led to these achievements, we examined whether incentives also improved FI.

Design: Three-arm randomized controlled trial.

Methods: From 2013 to 2015, 805 food-insecure adult ART initiates (≤90 days) at three clinics were randomized to receive cash or food transfers (~$11/month for ≤6 months, conditional on visit attendance) or standard-of-care (SOC) services. We assessed changes from baseline to 6 and 12 months in: FI (severe; access; dietary diversity), nutritional status (body weight; body-mass

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The evaluation was designed by SM, PN, and WD. SM, PN, and CF implemented the study and collected data with input from NK. CF and SM conducted the statistical analysis with input from WD. CF drafted the initial manuscript and all authors participated in reviewing the draft for intellectual content and assisting with revisions. All authors approved the final version of the protocol and manuscript.

index), and work status. Difference-in-differences average treatment effects were estimated using inverse-probability-of-censoring weighted longitudinal regression models.

Results: The modified intention-to-treat analysis included 777 non-pregnant participants with 41.6% severely FI. All three study groups experienced improvements from baseline in FI, nutritional status, and work status. After 6 months, severe FI declined within the cash [−31.4 percentage points (pp) to 11.5%] and food (−30.3 to 10.4%) groups, but not within the SOC. Relative to the SOC, severe FI decreased by an additional 24.3 pp for cash (95% CI: −45.0, −3.5) and 23.3 pp for food (95% CI: −43.8, −2.7). The interventions did not augment improvements in severe FI at 12 months, nor food access, dietary diversity, nutritional status, or work status at 6 or 12 months.

Conclusions: Small cash and food transfers provided at treatment initiation may mitigate severe FI. These effects may have facilitated previously observed improvements in ART adherence.

Keywords

HIV; food security; nutrition; cash transfer; food assistance; adherence

Introduction

Despite expansion of access to antiretroviral therapy (ART) around the world, persistent food insecurity and undernutrition impede efforts to stem the HIV/AIDS epidemic.[1] Food insecurity manifests when "the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain."[2] It is critical to address food insecurity in the context of HIV/AIDS due to bidirectional links between food insecurity and HIV in which one condition exacerbates the other.[1]

For example, food insecurity undermines treatment adherence through multiple mechanisms, including greater side effects experienced in the absence of food and competing resource demands between food and medical care.[3,4] Food insecurity adversely impacts overall nutritional and health status among HIV-infected adults due to their 10%−30% increase in energy requirements.[5] Combined with HIV-related malabsorption, lack of access to appropriate foods can further cascade into nutrient deficiency, weight loss, accelerated disease progression, and mortality.[6,7] At the same time, HIV intensifies food insecurity by reducing the ability to engage in livelihood-generating activities,[8] increasing medical cost burdens,[9] and weakening social support due to stigma.[10]

To achieve UNAIDS' 90–90-90 goal to improve HIV treatment access and adherence as part of a global epidemic control strategy,[11] there exists an urgent need for integrated responses to HIV and food insecurity. This approach is especially important in sub-Saharan Africa, where an estimated 69.5% of 36.7 million people living with HIV globally reside[12] and nearly a third of the population experiences severe food insecurity.[13] However, few studies have rigorously evaluated the effects of food security interventions for people living with HIV, with a particular dearth of evidence in low- and middle-income countries. To address this gap, we compared short-term cash and food assistance to the standard of care among food-insecure adults initiating ART in Tanzania. We previously found that 85.0% of the cash group and 79.2% of the food group achieved high levels of ART adherence during the 6-month intervention period using a pharmacy-based measure of adherence, both of which were higher than the standard of care (64.3%).[14] To elucidate potential pathways that led to these achievements, this analysis examines whether cash and food incentives also improved food security, nutritional status, or participation in livelihood-generating activities.

Methods

Study Design

To evaluate the effects of short-term cash and food assistance among people living with HIV, we conducted a three-arm randomized trial in Shinyanga, Tanzania. Study procedures have been previously described[14,15] and the trial was preregistered (clinicaltrials.org, NCT01957917). Briefly, patients initiating treatment at three HIV primary care clinics were individually randomized to receive standard-of-care ART services (comparison condition) or to additionally receive one of two interventions: cash transfers or food baskets.

We recruited participants using the following inclusion criteria: ≥18 years old; ART initiates (≤90 days); and food insecure, according to the Household Hunger Scale (score ≥2).[16] We excluded severely malnourished patients (BMI <16 kg/m^2) due to their need to receive special nutritional and clinical support for recovery. During the recruitment time period (2013–2015), national guidelines restricted ART eligibility among non-pregnant adults to individuals with CD4 cell count <350 cells/μL.[17]

Cash or food assistance was provided monthly for up to six consecutive months, conditional on attending scheduled clinic visits which were typically monthly. The cash transfer was 22 500 Tanzanian Shillings per month (approximately $11 USD). The food basket was equivalently valued and designed to supplement the household food supply, including whole maize meal (12 kg), groundnuts (3 kg), and beans (3 kg). Each clinic also provided nutrition assessment and counseling to all patients through the President’s Emergency Plan for AIDS Relief Nutrition Assessment, Counseling, and Support program.[18]

Study staff conducted clinic-based interviews and medical record abstraction at baseline and approximately 6 (range: 5–10) and 12 (10–20) months among participants who continued attending HIV care at the same clinic. Interviews were conducted in Kiswahili and assessed food security, labor force participation, and other socio-demographic characteristics. Medical record abstraction included body weight, height, CD4 count, and WHO Clinical Stage.

The Tanzania National Institute for Medical Research and the Committee for Protection of Human Subjects at the University of California, Berkeley approved this study.

Measures

Primary outcomes include changes in food security and nutritional status from baseline to 6 months. Secondary outcomes include changes in food security and nutritional status from baseline to 12 months, and changes in livelihood-generating activities from baseline to 6 and 12 months.

Food Security—Food security was assessed via interview using three validated and widely used scales, each constructed following official guidelines: food deprivation using the Household Hunger Scale (HHS);[16] food access using the Household Food Insecurity Access Scale (HFIAS);[19,20] and diet quality using the Individual Dietary Diversity Score (IDDS).[21]

The HHS and HFIAS are household-level indicators consisting of occurrence and frequency-of-occurrence questions (rarely, sometimes, or often) about experiences affecting household members in the past four weeks. The HHS includes three items about insufficient food intake (e.g., someone went to sleep at night hungry), scored from 0 to 6 and categorized as little to no hunger (0–1), moderate hunger (2–3), or severe hunger (4–6); we collapsed the first two categories to focus on changes in the proportion with severe HHS. The HFIAS includes the HHS and six additional items capturing anxiety about the household food supply and insufficient food quality, scored from 0 to 27 (with a higher score indicating greater food insecurity). The IDDS is an individual-level measure about nutritional quality of the diet which asks participants to recall the foods eaten yesterday or the last typical day, with responses categorized into nine food groups and summed to create a score with maximum of nine.

Nutritional Status—Nutritional status was evaluated as body weight (kg) and body-mass index (BMI, kg/m^2), using patient height and weight measurements abstracted from clinic-based records. Clinic staff measured height at treatment initiation and weight at each clinic visit.

Livelihood—The proportion engaged in livelihood-generating activities was assessed via interview with measures including labor force participation (currently working) and functional limitation (inability to do work or housework due to illness in the past year).

Statistical Analysis

We first evaluated the baseline balance of participant characteristics by group using chi-square and one-way analysis of variance tests. We then constructed multivariable longitudinal regression models for each outcome using inverse-probability-of-censoring weighted generalized estimating equations (IPCW-GEE) to account for repeated measures and attrition.[22] IPCW is a well-established method to reduce bias from attrition by up-weighting observed participants who have similar characteristics as missing participants. Weights were constructed using *a priori* specified predictors of attrition including study group, clinic, month and year enrolled, socio-demographics, baseline outcome values, and medication possession ratio (MPR) ≥95% from 0–6 months or 0–12 months as a measure of adherence (Supplementary Table 1).[23]

To evaluate mean differences in outcomes, all models used the Gaussian distribution and identity link and included terms for assigned intervention group, follow-up period, and intervention-period interaction. Covariates including clinic and factors imbalanced at baseline were included in each model, along with baseline characteristics known to be associated with food security and nutritional status to increase precision.[24, 25]

Using these models, we first assessed within-group changes from baseline to 6 and baseline to 12 months as the linear combination of terms for period and period-by-group interaction. We then evaluated the difference-in-differences average treatment effect (ATE) between groups as the period-by-group interaction term for each follow-up period.[26] Pairwise comparisons of the three groups were assessed using a Wald test with alpha = 0.05 and Bonferroni's correction for multiple comparisons. All participants were included in primary analyses as contributors to baseline estimates, regardless of censoring status. As a sensitivity analysis, we calculated unweighted outcomes among the sub-population of participants observed at both baseline and 6 months. We also repeated the primary analyses without excluding pregnant women, without adjustment for covariates, and using stabilized weights.[27] Analyses were performed with Stata version 14.2 (College Station, Texas, USA).

Results

Sample Characteristics

As previously described,[14] we recruited and randomized 805 participants from December 2013 to July 2015 (Figure 1). We subsequently excluded five patients with no follow-up time (transferred, died, or opted out before their next scheduled visit or had no medical records). For this analysis, we additionally excluded 23 women who were pregnant at baseline (Supplementary Table 2) due to their unique biopsychosocial circumstances, resulting in a modified intention-to-treat (mITT) population of 777 participants.[28]

At enrollment, 62.6% of participants were female and the mean age was 37 years (Table 1). All participants were food insecure as per eligibility criteria and 41.6% had experienced severe food insecurity in the past 30 days. The mean BMI was 21.4 kg/m^2 with 16.2% underweight (<18.5 kg/m^2). Just over half (58.4%) were working, 55.9% had experienced functional limitation due to illness in the past year, and 58.2% were classified as WHO Clinical Stage 3–4 (advanced disease progression). Baseline characteristics were balanced between groups except for age, occupation, WHO stage, and weight.

Clinical records were abstracted for 664 (85%) participants who attended their original clinic at 6 months and 580 (75%) at 12 months. Due to variable appointment attendance, study staff conducted 461 (59%) 6-month questionnaires and 453 (58%) 12-month questionnaires. Median (IQR) follow-up times were 7.1 (6.8–7.8) and 13.0 (12.3–13.8) months for 6- and 12-month clinical abstraction, respectively, and 7.4 (7.0–8.2) and 13.6 (12.9–15.0) months for 6- and 12-month questionnaires, respectively; timing did not differ by study arm.

Participants in the comparison group were more commonly missing all follow-up measures (20.7%) compared to cash (8.4%) and food participants (16.0%), reflecting the previously demonstrated effectiveness of incentives at increasing retention in care. Additional predictors of censoring are shown in Supplementary Table 1. Higher baseline food insecurity (HFIAS) and lower asset index predicted censoring in the comparison group only, suggesting that the interventions were more effective than the standard of care at retaining disadvantaged participants in clinic-based care. For these reasons, our statistical analysis included inverse probability of censoring weights to address differential missing data.

Within-Group Temporal Changes

All three study arms experienced within-group improvements in food security, nutritional status, and labor force participation from baseline to 6 and 12 months (Table 2).

Baseline to 6 Months—In the primary weighted analysis, severe food insecurity (from HHS) declined from 38.2% at baseline to 13.0% at 6 months. Within the cash and food groups, severe HHS declined by 31.4 (95% CI: −38.9, −23.9) and 30.3 (−37.7, −22.9) percentage points (pp) respectively from baseline to 6 months. Within the comparison group, the proportion with severe HHS was similar from baseline to 6 months [−7.1 pp (−22.3, 8.2)].

Food access (HFIAS) improved within all groups from baseline to 6 months [Comparison: −4.1 (95% CI: −6.5, −1.7); Cash: −6.0 (−7.2, −4.9); Food: −5.6 (−6.7, −4.5)], along with increases in BMI [Comparison: 0.91 (0.57, 1.25); Cash: 0.93 (0.73, 1.14); Food: 1.11 (0.89, 1.32)], weight [Comparison: 2.3 kg (1.4, 3.2); Cash: 2.4 kg (1.9, 2.9); Food: 2.8 kg (2.3, 3.4)], and the proportion working [Comparison: 19.7 pp (5.4, 33.9); Cash: 14.9 pp (7.2, 22.6); Food: 19.1 pp (10.5, 27.6)]. There was no change in dietary diversity (IDDS) within any group from baseline to 6 months.

Baseline to 12 Months—Within-group improvements from baseline in severe HHS, HFIAS, BMI, weight, and the proportion working were evident for all three study groups at 12 months. Functional limitation also decreased within the intervention groups only from baseline to 12 months [Cash: −27.6 pp (−37.6, −17.7); Food: −24.8 pp (−34.0, −15.6)]. A slight improvement in IDDS was observed within the food group from baseline to 12 months [0.33 (0.16, 0.50)].

Average Treatment Effects

While all groups experienced temporal improvements from baseline to 6 months, compared to the standard of care the decline in severe food insecurity was 24.3 pp greater in the cash group (95% CI: −45.0, −3.5; p=0.015) and 23.3 pp greater in the food group (95% CI: −43.8, −2.7; p=0.020; Table 2; Figure 2). When directly compared, cash and food assistance had similar reductions in severe food insecurity. There were no between-group differences in the changes from baseline for food access, dietary diversity, weight, BMI, or work status over six months.

From baseline to twelve months, although *within*-group temporal improvements from baseline persisted, differences in severe food insecurity *between* study groups were no longer observed. No between-group effects were evident for food access, dietary diversity, weight, work status, or functional limitation over 12 months.

In sensitivity analyses, results did not substantially differ when including women pregnant at baseline (Supplementary Table 3) or additionally excluding incident pregnancies (n=12), without adjustment for covariates (Supplementary Table 4), or using stabilized weights. There were no between-group differences for any outcomes in unweighted complete case analyses (Supplementary Table 5). However, this latter approach does not account for potential bias arising from differential attrition by study group.

Discussion

A decade of research has documented the bi-directional links between food insecurity and HIV, [1,3,4,7] leading to the hypothesis that interventions to mitigate food insecurity may improve treatment adherence.[29,30] The parent analysis of the current study supported this hypothesis, demonstrating that short-term conditional cash and food assistance improves ART possession and retention in HIV services among food-insecure adults initiating treatment in Shinyanga, Tanzania.[14] In the present analysis, we sought to understand potential pathways of impact. We assessed whether incentives also improved food security and nutritional status, which were hypothesized *a priori* and shown in qualitative findings to be mediators of improved adherence.[15,31] We found that although all groups' food security, nutritional status, and work status improved from baseline to 6 months, the decrease in severe food insecurity was greater among participants assigned to cash or food assistance compared to the standard of care. Neither cash nor food enhanced the temporal improvements in food access, nutritional status, or work status which all groups experienced after six months on ART. At twelve months—six months after the intervention ceased—temporal improvements from baseline persisted within each group, with no between-group differences in food security, nutritional status, or labor force participation. These results may suggest that alleviating severe short-term food insecurity is a plausible explanation for some of the positive effects on retention and adherence.

Several observational or quasi-experimental studies of food assistance have also demonstrated improvements in adherence and retention, however these studies yielded mixed results on food security and nutritional status.[32–37] The lack of randomization in previous studies precludes inference about whether the intervention caused the observed outcomes. Inconsistencies may also derive from differences in sample size and characteristics, attrition, intervention timing in relation to starting ART, follow-up time, and transfer sizes. For example, a study in Haiti with larger food basket sizes observed improvements in food security and BMI,[33] whereas our finding that cash and food transfers did not have an added effect on nutritional status is consistent with the three previous food assistance studies conducted in sub-Saharan Africa (none of which examined food security).[32,34,35] While the transfers in the present study appear effective for alleviating severe short-term household food insecurity, the lack of corresponding effects on individual nutritional status is understandable given that the basket was designed to supplement household consumption of local foods (as opposed to therapeutic treatment of undernutrition); both the basket and food purchased with cash were likely shared among household members, with little resultant increase in individual caloric intake.

It is important to emphasize that food security, nutritional status, and engagement in livelihood-generating activities improved *within* all groups over time, including the standard of care. Such improvements have been observed in other studies and attributed to the benefits of ART on physical health, in turn enabling participants to return to work and attain greater food security.[38,39] Indeed, in the present study the overall prevalence of functional limitation declined from 53.9% at baseline to 29.3% at 12 months after adjusting for attrition. The improvements oppose seasonal explanations, as a greater proportion of 6-month outcomes were measured during the "lean season" of widespread food insecurity among the general population (21% baseline vs. 67% 6-month interviews and 64% 6-month record abstraction, with no differences by arm) and improvements were maintained at 12 months. Furthermore, our models adjusted for enrollment during the lean season.

These findings add to a broader literature on the effects of cash and food transfers on food security and nutrition not only among HIV-infected populations.[40–45] Cash and food transfers are provision incentives intended to meet basic needs and help to stabilize vulnerable households,[46] such as those starting ART who may be experiencing stress and economic shock due to stigma, illness, and loss of productivity.[47] Conditional transfers, such as those provided in this study, can operate via an *income effect* of increased economic wellbeing or via a *price incentive* whereby it is more "expensive" not to attend the clinic.[48] Our finding that cash and food assistance appeared to alleviate severe short-term food insecurity to a greater extent than the standard of care may potentially represent an income effect, serving to increase adherence by overcoming the barrier of food insecurity at the critical time of treatment initiation. However—given the lack of effects on overall food security, nutritional status, or labor force participation—we might hypothesize that the transfers operated primarily via the price incentive, improving ART adherence by increasing motivation and mitigating costs such as transportation, clinic fees, and time spent at the clinic. Via either mechanism, the improvement in ART adherence holds potential for future advances in patient wellbeing given a positive feedback cycle between adherence and food security.[38]

This study has important limitations. First, recruitment occurred during an era when ART availability was limited to the sickest, before recent policy changes extended universal access to ART. However, these findings remain relevant given the high prevalence of food insecurity in the general population and the likelihood that many patients will continue initiating treatment at later disease stages. Next, the study was powered to detect effects on adherence, not marginal changes in food security and nutrition supplementary to the benefits of ART. Multiple comparisons increase the risk of over-interpreting a spurious result, a concern we reduced by using the Bonferroni correction at the expense of precision. Substantial attrition from clinic-based care and study follow-up further limited power. Loss to follow-up—a pervasive problem in clinic-based studies—can also bias results if not properly addressed,[49] which we endeavored to do using inverse probability of censoring weights.[22] This approach assumes that data are missing at random conditional on characteristics observed before censoring. However, observed patients may differ from censored patients with respect to missing outcome data, resulting in missing-not-at-random in which case results may still be biased. Under this scenario, whereby we observe a relatively better-off comparison group compared to those who were lost, the reported findings may underestimate the average treatment effects.

Despite the randomized design, imbalance in some baseline characteristics occurred by chance due to a relatively small sample size, especially in the control arm. This raises the possibility that the intervention groups had an increased probability of improvement due to worse baseline conditions. However, considering that all participants were highly disadvantaged at baseline, it is likely that any participant could have potentially benefited from the intervention had they been randomized to it. It is also possible that more disadvantaged participants would be *less* likely to benefit from treatment if they were unable to return to the clinic for subsequent appointments. Therefore, the magnitude and direction of any bias resulting from baseline imbalances is uncertain.

Lastly, outcomes were based on either self-report or record abstraction, each with limitations. Self-reported outcomes may be subject to influences such as social desirability. The use of record abstraction for anthropometry may have reduced the validity of weight and BMI measurements. We anticipate that any misclassification would be non-differential by study arm and bias effects toward the null.

Despite these limitations, this study has several strengths. The randomized design, including a referent standard-of-care group, provides an important contribution for evaluating the casual effects of cash and food assistance. The efforts to mitigate bias from attrition reinforce internal validity. Additionally, the inclusion of multiple measures of food insecurity and nutrition allows for a nuanced understanding of the effects on these outcomes. Finally, the follow-up to 12 months, six months after the incentives ended, provides some insight into the durability of effects.

In conclusion, our findings suggest that small cash and food transfers may mitigate the most severe form of food insecurity when provided at treatment initiation, a critical time of habit formation amidst heightened household vulnerability to stress and economic shocks.[47] These effects may have facilitated the improvements in adherence and retention in care at 6 and 12 months as found in the primary analysis.[14] The implications of these findings for policy and practice suggest that even small cash or food transfers—when incorporated into HIV care—may serve as effective tools for addressing the HIV epidemic by improving ART adherence and the underlying barrier of food insecurity. Future studies are needed to better understand the optimal transfer amount to maximize both food security and adherence, and whether short-term cash and food assistance can sustain increased adherence and food security long after assistance ends.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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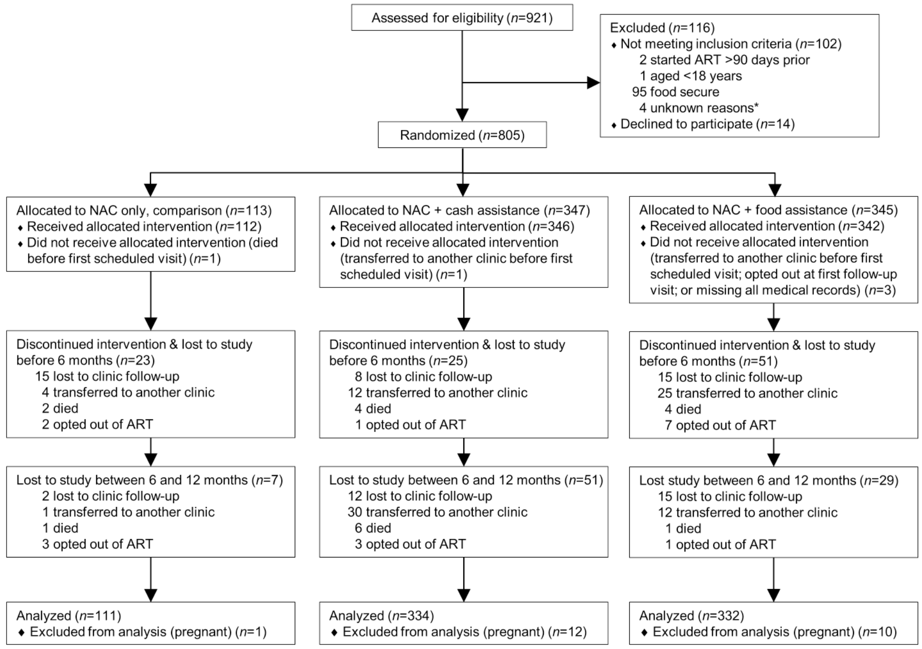

Fig. 1.

Trail profile.

ART, antiretroviral therapy; NAC, nutritional assessment and counseling. *Four screened patients were excluded for unknown reasons (e.g. missing screening data).

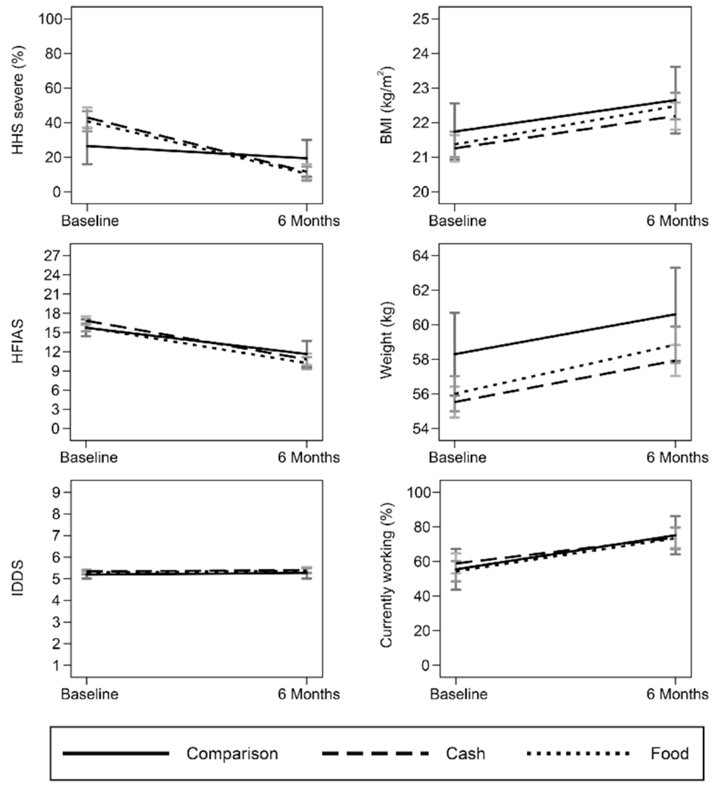

Fig. 2.

Changes in food insecurity, nutritional status, and work status among food-insecure antiretroviral therapy initiates after 6 months of standard HIV services alone or in combination with cash or food assistance.

Table 1.

Baseline characteristics and outcome values of the modified intention-to-treat population[a], Tanzania, 2013–2015.

	Overall (*n*=777)	Comparison (*n*=111)	Intervention	
			Cash (*n*=334)	Food (*n*=332)
Sociodemographic Characteristics				
Age, mean (SD)	36.9 (10.3)	34.9 (9.3)	36.8 (10.0)	37.8 (10.8)
Female, n (%)	486 (62.6)	72 (64.9)	206 (61.7)	208 (62.7)
Primary language is Swahili, n (%)	477 (61.4)	79 (71.2)	199 (59.6)	199 (59.9)
No formal education, n (%)	188 (24.6)	23 (20.7)	79 (24.2)	86 (26.3)
Farmer, n (%)	400 (51.5)	47 (42.3)	189 (56.6)	164 (49.4)
Married/partnership, n (%)	350 (45.1)	50 (45.1)	152 (45.5)	148 (44.6)
Head of household, n (%)	484 (62.3)	68 (61.3)	204 (61.1)	212 (63.9)
Household size, mean (SD)	3.7 (2.1)	3.4 (1.8)	3.7 (2.1)	3.8 (2.1)
Travel time to clinic (minutes), mean (SD)	46.6 (39.8)	40.4 (35.4)	46.5 (39.4)	48.8 (41.4)
Travel cost to clinic (TZS), mean (SD)	1465 (2260)	1381 (2064)	1376 (2261)	1583 (2323)
Asset index (1-4), mean (SD)	2.5 (1.1)	2.6 (1.1)	2.5 (1.1)	2.5 (1.1)
Enrolled during lean season[b], n (%)	166 (21.4)	27 (24.3)	67 (20.1)	72 (21.7)
Clinical Characteristics				
Days since ART started, mean (SD)	27.9 (25.5)	27.4 (25.8)	28.0 (25.6)	27.9 (25.4)
CD4 cell count (cells/μL), mean (SD)	203.7 (140.9)	214.5 (157.8)	199.1 (145.9)	204.8 (129.8)
WHO clinical stage 3-4, n (%)	451 (58.2)	56 (50.5)	214 (64.5)	181 (54.5)
Baseline Outcome Values				
Food Security				
HHS severe, n (%)	323 (41.6)	41 (36.9)	138 (41.3)	144 (43.4)
HFIAS (0-27), mean (SD)	15.9 (5.2)	15.7 (5.2)	16.1 (5.1)	15.8 (5.2)
IDDS (0-9), mean (SD)	5.3 (0.7)	5.2 (0.8)	5.3 (0.7)	5.3 (0.7)
Nutritional Status				
BMI (kg/m^2), mean (SD)	21.4 (3.5)	21.7 (3.3)	21.2 (3.5)	21.5 (3.5)
BMI <18.5, n (%)	122 (16.2)	12 (11.0)	56 (17.3)	54 (16.9)
Weight (kg), mean (SD)	56.3 (9.3)	58.2 (10.2)	55.5 (8.6)	56.5 (9.6)
Livelihood				

	Overall (n=777)	Comparison (n=111)	Intervention	
			Cash (n=334)	Food (n=332)
Currently working, n (%)	454 (58.4)	72 (64.9)	194 (58.1)	188 (55.6)
Functional limitation[c], n (%)	434 (55.9)	64 (57.7)	190 (56.9)	180 (54.2)

Data are mean (SD) or n (%). TZS, Tanzanian Shillings; WHO, World Health Organization; HHS, Household Hunger Scale; HFIAS, Household Food Insecurity Access Scale; IDDS, Individual Dietary Diversity Scale; BMI, body-mass index.

[a.]Of 805 food-insecure adults ART initiates randomized, 5 who did not receive the allocated intervention and 23 women who were pregnant at baseline were excluded from this analysis. Number of patients missing data for a particular variable: CD4 cell count: n=153. Body-mass index: n=24. All other variables: n<10.

[b.]September through January, during which time the "lean season" of widespread food insecurity typically occurs before the main harvest in this region.

[c.]Inability to do work or housework in the past year due to illness.

Table 2.

Summary of the effects[a] of cash or food transfers on food security, nutritional status, and livelihoods among HIV-infected adults, Tanzania, 2014–2016.

	N^d	Mean Difference[b] from Baseline (95% CI)			Difference-in-Differences Average Treatment Effect[c] (95% CI)		
		Comparison (*n* =111)	Cash (*n* =334)	Food (*n* =332)	Cash vs. Comparison	Food vs. Comparison	Cash vs. Food
Baseline to 6 Months							
Food Security							
HHS severe (%)	430	−7.1 (−22.3, 8.2)	−31.4 (−38.9, −23.9)	−30.3 (−37.7, −22.9)	−24.3 (−45.0, −3.5)*	−23.3 (−43.8, −2.7)*	−1.0 (−14.0, 12.0)
HFIAS	429	−4.10 (−6.54, −1.66)	−6.03 (−7.18, −4.88)	−5.58 (−6.70, −4.45)	−1.93 (−5.22, 1.36)	−1.48 (−4.74, 1.79)	−0.45 (−2.42, 1.51)
IDDS	458	0.08 (−0.25, 0.40)	0.06 (−0.08, 0.20)	0.09 (−0.05, 0.22)	−0.02 (−0.45, 0.41)	0.01 (−0.42, 0.44)	−0.03 (−0.26, 0.21)
Nutritional Status							
BMI (kg/m^2)	640	0.91 (0.57, 1.25)	0.93 (0.73, 1.14)	1.11 (0.89, 1.32)	0.02 (−0.46, 0.51)	0.20 (−0.29, 0.69)	−0.18 (−0.54, 0.19)
Weight (kg)	657	2.31 (1.39, 3.23)	2.40 (1.90, 2.91)	2.84 (2.30, 3.37)	0.09 (−1.19, 1.37)	0.53 (−0.77, 1.83)	−0.44 (−1.34, 0.46)
Livelihood							
Currently working (%)	457	19.7 (5.4, 33.9)	14.9 (7.2, 22.6)	19.1 (10.5, 27.6)	−4.8 (−24.7, 15.1)	−0.6 (−21.0, 19.7)	−4.1 (−18.2, 10.0)
Baseline to 12 Months							
Food Security							
HHS severe (%)	451	−36.2 (−49.6, −22.8)	−33.2 (−40.8, −25.6)	−36.0 (−43.8, −28.3)	3.0 (−15.9, 22.0)	0.2 (−18.7, 19.1)	2.8 (−10.5, 16.2)
HFIAS	451	−7.26 (−9.29, −5.24)	−6.77 (−7.82, −5.71)	−5.96 (−6.98, −4.93)	0.50 (−2.31, 3.30)	1.31 (−1.47, 4.08)	−0.81 (−2.59, 0.97)
IDDS	451	0.21 (0.00, 0.42)	0.11 (−0.04, 0.25)	0.33 (0.16, 0.50)	−0.10 (−0.42, 0.21)	0.12 (−0.21, 0.45)	−0.22 (−0.49, 0.04)
Nutritional Status							
BMI (kg/m^2)	554	1.21 (0.79, 1.63)	1.50 (1.15, 1.85)	1.38 (1.08, 1.67)	0.28 (−0.38, 0.95)	0.16 (−0.47, 0.79)	0.12 (−0.44, 0.68)
Weight (kg)	567	3.05 (1.95, 4.15)	3.85 (3.01, 4.70)	3.66 (2.91, 4.42)	0.80 (−0.89, 2.50)	0.61 (−1.02, 2.24)	0.19 (−1.19, 1.57)
Livelihood							
Currently working (%)	447	25.7 (11.4, 40.0)	19.8 (11.6, 28.1)	25.2 (17.4, 33.0)	−5.9 (−26.0, 14.2)	−0.6 (−20.5, 19.4)	−5.4 (−19.2, 8.5)
Functional limitation (%)	345	−18.0 (−40.6, 4.6)	−27.6 (−37.6, −17.7)	−24.8 (−34.0, −15.6)	−9.6 (−39.9, 20.6)	−6.8 (−36.8, 23.2)	−2.8 (−19.6, 13.9)

Data are within-group mean differences from baseline and between-group mean difference-in-differences effect estimates (95% CI).

HHS, Household Hunger Scale; HFIAS, Household Food Insecurity Access Scale; IDDS, Individual Dietary Diversity Scale; BMI, body-mass index.

* $P < 0.05$ for average treatment effect

[a] Modified intention-to-treat estimates (excluding 23 pregnant women and 5 participants who did not receive allocated intervention) from generalized estimating equation (GEE) models: with Gaussian distribution and identity link; using Bonferroni's correction for multiple comparisons; adjusted for clinic, baseline imbalances [age, occupation, WHO stage, and weight (except for weight and BMI models)], and prognostic factors (sex, education, head of household, household size, asset index, and lean season); and weighted with inverse probability of censoring weights estimated by treatment group, baseline characteristics, baseline values for HHS severe, HFIAS, IDDS, weight, currently working, and functional limitation, and 0-6 month or 0-12 month MPR≥95%. Separate models were estimated for the change from baseline to 6 months and the change from baseline to 12 months due to non-monotone missingness, whereby some participants were observed at 12 months but not 6 months and vice versa.

[b] Within-group change from baseline in percentage point or continuous value at 6 and 12 months.

[c] Between-group difference in the change from baseline in percentage point or continuous value at 6 and 12 months.

[d] Number of subjects with fully observed baseline covariates (missing n=7) and the outcome observed at the specified follow-up time (6 or 12 months) out of 777 total subjects.