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Chuma na Uchizi: A Livelihood Intervention to Increase Food Security of People Living with HIV in Rural Zambia

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Abstract

The objective of this study was to evaluate the impact of Chuma na Uchizi, a livelihood intervention for people living with HIV (PLHIV) in rural Eastern Province, Zambia, on food security. The intervention included cash transfers to purchase income-generating assets, access to a savings account, and life-skills training. The study employed a non-equivalent groups design to compare intervention (n = 50) and control participants (n = 51) who were receiving outpatient care from two comparable health facilities in distinct constituencies in the same geographic area. We collected data before and after implementation of the intervention. Chuma na Uchizi improved access to food. At follow-up, the intervention group reported lower food insecurity scores compared with the control group (β = − 5.65; 95% CI − 10.85 –− 0.45). Livelihood programs for PLHIV are practical and may be a promising approach to address food insecurity and its adverse effects.

Keywords

Evaluation studies; quasi-experiment; food security; livelihood; HIV; Zambia; cash transfer; productive assets

The number of Zambian adults living with HIV who have access to antiretroviral therapy (ART) increased by more than 25 percentage points between 2010 and 2015.[1] This expanded access signifies that more than 50% of adults living with HIV are receiving ART in the country, which has an estimated national HIV prevalence of 13.3%.[2,3] This expansion of ART coverage has provided lifesaving drugs to hundreds of thousands of people living with HIV (PLHIV) and contributed to a marked decline in the number of AIDS-related mortality in the country.[2] However, timely HIV testing, early diagnosis, and patient

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adherence and retention remain key barriers to treatment success.[4,5] In particular, scaling-up access to ART has presented additional challenges for economically poor PLHIV who now have access to HIV treatment but remain without adequate access to food. Studies in Zambia and elsewhere in Eastern and Southern Africa have shown a high proportion of treatment-experienced PLHIV who are food-insecure.[6–9]

The substantial fraction of food-insecure PLHIV may undermine current and future efforts to increase survival of PLHIV and to eventually end HIV/AIDS. Food is vital to optimize treatment outcomes through increased absorption and bioavailability of drugs.[10–12] Adequate food may alleviate medication side effects, satisfy increased appetite, compensate for nutrient losses, and prevent hunger and weight loss.[13,14] Alternatively, food insecurity, or lack of access to adequate, safe, and nutritious food at all times, consistently predicts adverse health outcomes, including elevated risks of morbidity and mortality.[15–18] Food insecurity is also associated with poor treatment outcomes, including lower CD4 count and incomplete viral suppression.[19–22] In addition, inadequate access to food has increasingly become a critical barrier to treatment adherence. Research in Zambia and other countries in the region has shown that food-insecure ART patients are less likely to take their medications as prescribed, more likely to delay treatment initiation, and less likely to remain in care than food-secure ART patients.[6,8,23–25] Non-adherence to ART, in turn, predicts adverse outcomes, including lower CD4 count,[26–28] virologic failure,[29–31] and rapid progression to AIDS and death.[5,27,32]

The high prevalence of food insecurity and its adverse effects on treatment success and survival have led to development and testing of different strategies to tackle inadequate access to food. In resource-limited countries, such as Zambia, interventions for food security of PLHIV include food assistance (such as nutrition supplementation and in-kind transfers through food baskets) and livelihood support.[33–36] Although receipt of food assistance is associated with positive outcomes, including increased access to food[37–39] and improved ART adherence,[7,37,40] food assistance programs are not designed to tackle the underlying predictors of food insecurity in PLHIV, such as unemployment, lack of income, and limited productive assets.[9,41–43] Food assistance typically offers temporary access to food.

A complementary strategy to food assistance is livelihood support. Livelihood programs focus on identifying and promoting sustainable ways of achieving food security, generally through income generation and asset accumulation. Livelihood programs that are integrated with HIV treatment are designed to create more sustainable and stable access to food and to maintain positive benefits associated with having adequate food at all times by addressing underlying predictors of food insecurity. A number of livelihood programs for treatment-experienced PLHIV have been implemented in sub-Saharan Africa (SSA), including in Cote d'Ivoire,[44] Kenya,[36,45,46] and Uganda.[47] These programs, albeit a few, have demonstrated a positive effect on food security, adherence, and other health outcomes.[36,47] However, to date, we are not aware of livelihood programs for PLHIV in Zambia, particularly in rural areas where more adults with HIV live[3] and where food insecurity is more prevalent than in urban settings, that have been evaluated to demonstrate potential effects on food security. Although rural residents are at a higher risk of food insecurity due to their dependence on subsistence

farming and crops that are vulnerable to flood and drought,[48] current evidence from Zambia has come primarily from evaluation of food assistance programs in urban settings.[7,40,49]

The sizable overlap of food-insecure and treatment-experienced PLHIV in Zambia, the undermining effect of food insecurity on the country's progress to reduce HIV incidence and efforts to eliminate HIV/AIDS, and a national policy environment that encourages integration of economic self-sufficiency and improved health for PLHIV underscore the importance and timeliness of implementing and evaluating promising livelihood strategies to increase food security and to enable long-term adherence to ART in the country. Accordingly, the objective of this study was to examine how Chuma na Uchizi (a Tumbuka phrase which means Health and Wealth), a livelihood-focused intervention for treatment-experienced PLHIV in rural Zambia, affects food security. Chuma na Uchizi was a multifaceted economic strengthening program that combined cash transfers, skills training, access to a savings account, and health education. First, Chuma na Uchizi provided cash transfers as capital to purchase income-generating assets. Second, the intervention offered skills training related to small business management and financial literacy. Third, a low-cost savings account was made available to facilitate use of financial services. Last, Chuma na Uchizi included a health education component tailored to the needs of treatment-experienced PLHIV.

Although food security is a multidimensional construct,[50,51] we narrowed our focus to access (or the ability to obtain food either through one's own production or in the marketplace) because access is closely associated with economic and social resources such as income and assets.[52,53] In turn, increasing economic and social resources is a core objective of livelihood assistance and other economic-strengthening programs. To our knowledge, Chuma na Uchizi was one of the first livelihood programs in rural Zambia to be evaluated and to provide evidence on the potential benefits to food security for PLHIV. Our study aims to expand what we know about the effectiveness of livelihood assistance in improving access to food and to provide initial evidence on the feasibility and efficacy of this type of intervention in Zambia, one of the countries most affected by HIV/AIDS.

Methods

Study design

We used a non-equivalent groups design, comparing access to food before and after the implementation of Chuma na Uchizi. Two comparable health facilities in Lundazi District were selected. Lumezi Mission Hospital (LMH) was assigned as the intervention site, and Lundazi District Hospital (LDH) was assigned as the control site. Instead of assigning individuals within the same health facility into intervention or control group, we chose health facilities as the unit of assignment to control for intervention diffusion and resentful demoralization. The study protocol was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill and the University of Zambia.

Study sites and sample

Chuma na Uchizi was implemented in Lundazi District, Eastern Province. Eastern Province, one of Zambia's 10 provinces has a population of approximately 1.6 million people.[54] It is the third most populous province behind Lusaka and Copperbelt. Eastern Province is predominantly rural, with 87% of the population living in rural areas.[3] Most households are engaged in crop-growing or livestock and poultry-raising due to the province's predominantly rural landscape. Poverty is pervasive in the province. An estimated 78% of the population is living at or below the national poverty threshold, the third highest in the country. HIV prevalence in Eastern Province was estimated at 9.3% in 2014.[3]

Lundazi District is the northernmost district in Eastern Province. The district has a population of 314,281 people.[55] Consistent with the general pattern in the Eastern Province, agriculture is the most common livelihood. Lundazi District was selected as the study site because it is a rural and poor district with high prevalence of HIV. Lundazi District has an estimated HIV prevalence rate of 15%, which is higher than the prevalence rates for Eastern Province (9.3%) and Zambia (13.3%).[3] Within Lundazi District, two health facilities were selected as project sites: LDH in Lundazi and LMH in Lumezi. In consultation with local stakeholders, LMH in Lumezi was selected as the intervention site based on the area's higher rates of poverty, absence of livelihood assistance from other organizations, and a local economy that could support and sustain micro and small enterprises.

At each health facility, we used the ART enrollment records to identify and create a list of eligible patients based on the study's inclusion criteria. The criteria included that participants were at least 18 years old; HIV positive and receiving outpatient ART and medical care at either LDH or LMH; and income-poor, which was defined as living at or below the Zambian national poverty threshold of approximately 90 USD per month.[54] Participants were randomly selected from the list of eligible patients. Fifty ART patients were recruited at LMH, and 51 ART patients were recruited at LDH for a total study sample size of 101. Informed consent was obtained from all individual participants included in the study.

Description of Chuma na Uchizi

Chuma na Uchizi was a multifaceted livelihood program that was designed to provide tangible and intangible tools necessary to tackle underlying predictors of food insecurity, including limited income and assets and to improve health outcomes of PLHIV. Participants in the intervention site received: 1) cash transfers valued at 1,200 Zambian kwacha (Zk), or approximately 200 USD (details below); 2) skills training; 3) access to a savings account; and 4) health education. In addition, participants in the intervention and control sites received medication adherence counseling as part of their outpatient care.

First, the cash transfers were provided as capital to assist intervention participants in starting a small business or in building productive assets that generate income or produce food. Unlike previous livelihood programs for PLHIV that offered microloans,[45,47] the cash transfers were given as a grant and no payment was expected. Cash grants were given in two installments of 700 Zk and 500 Zk. Second, intervention participants received two types of

economy-focused, life-skills training: small business management and financial literacy. The training component was designed to enhance intervention participants' knowledge and skills in managing and improving profitability of their income-generating activities, while recognizing critical needs such as food and health care expenses. The small business management module included topics such as record keeping, separating business and personal money, sales and profits, losses, and using profits to meet business and personal needs. Financial literacy covered subjects related to learning about money, planning for the future, saving and various saving methods, and transacting with financial service providers, which covered key banking activities (e.g., deposits and withdrawals) and financial products and services. We developed the training materials by reviewing existing training manuals, adapting appropriate topics into the local context, and consulting with local experts. The third author provided the training in a classroom setting.

Third, a low-cost savings account for small-scale entrepreneurs and lower-income individuals was opened for intervention participants. The savings account, which was offered by Zanaco (Zambia National Commercial Bank), one of Zambia's largest commercial banks, was meant: a) to extend access to financial products and services to poor PLHIV, many of whom were out of reach of formal financial institutions; b) to provide unbanked PLHIV with a secure way to set aside money for future use; and c) to promote positive saving behaviors and shape worldviews about the future. To facilitate use of financial services, the cash transfers were directly deposited into the participants' accounts.

Fourth, a health education component tailored to the needs of treatment-experienced PLHIV was included in the intervention. The health training module covered topics such as adequate food and proper nutrition, diet improvement to enhance drug efficacy, management of ARV side effects, and proper sanitation (e.g., handwashing, water safety, and personal hygiene). We used an existing health manual developed by the Ministry of Health.[56] The third author also provided the training in a classroom setting.

Data collection, variables, and measures

This study used pre-and post-test survey data. Baseline data were collected between December 2014 and January 2015, or at least six months before implementation of intervention activities. Follow-up data were collected in September 2015, or three months after completion of key intervention activities. All 101 participants had baseline survey data; 80 participants were surveyed at follow-up. The baseline survey gathered data on participants' demographics and their households' social and economic characteristics, including food security. Baseline survey also included questions on psychosocial functioning, accessibility of health facilities (e.g., distance and travel time), and barriers to HIV treatment adherence. The follow-up survey collected data on food security. Clinical records were also collected to obtain ART-related information (e.g., ART start date and duration) and patient health data (e.g., weight and CD4 count).

Food insecurity—The outcome variable was measured using an adapted version of the Household Food Insecurity Access Scale (HFIAS).[57] The HFIAS consists of nine items that ask respondents the frequency of experiencing different conditions and degrees of food

insecurity within the past four weeks (or 30 days). Response options for the nine items range from 0 (*never*) to 3 (*often*). Sample HFIAS items include: how often did you or any household members have to eat a limited variety of foods due to a lack of resources and how often was there ever no food to eat of any kind in your household because of lack of resources to get food? The HFIAS is a commonly-used measure of food insecurity in the literature and has been validated with low-income populations in resource-limited countries.[58,59] We obtained a continuous measure of food insecurity by summing the scores for all HFIAS items.[57] The higher the score, the more food insecurity the household experienced. Scores ranged from a minimum of 0 to a maximum of 27. For descriptive purposes, we also calculated the household food insecurity access prevalence, or a categorical measure of the different levels of household food insecurity, including food secure, and mild, moderately and severely food insecure.[58]

Intervention variable—A binary variable for intervention receipt was coded as 1 for intervention site participants (or LMH patients) and 0 for control site participants (or LDH patients).

Covariates—Covariates included gender (female or male), education level (primary or secondary education/higher), household size (total number of household members regardless of age), financial situation (worse or stayed the same/better), household monthly income (measured in four categories: 0–20 Zambian kwacha [Zk], 21–50 Zk, 51–500 Zk, or ≥ 501 Zk), debt (owed money or did not owe money), asset ownership, perceived stress, ART treatment duration (measured in months), medication adherence (non-adherent or adherent), and CD4 count. Asset ownership included four different types of assets: land, mode of transport, livestock, and household possessions. With the exception of landownership (owned or did not own), all asset variables were measured using asset indices.[60] Finally, perceived stress was measured using the 10-item perceived stress scale (PSS).[61] Consistent with prior research,[62,63] we used the two-factor PSS in our analysis. The first factor is a four-item measure of perceived coping strategies. The second factor is a six-item measure of perceived mental distress.

Analysis

To evaluate the effect on food security, we performed bivariable and multivariable analyses to compare the outcomes for the intervention group with the control group. Treatment effects were examined using intention-to-treat analysis. First, we conducted bivariable tests to examine whether key baseline characteristics (including food security) were comparable between intervention and control groups. Second, we examined bivariable differences in HFIAS scores between intervention and control groups. Third, we estimated multivariable linear regression models that controlled for potential confounders to examine the effect of Chuma na Uchizi on food insecurity. For all multivariable models, the final set of covariates was selected using purposeful variable selection methods.[64–66] These model-building strategies were used in addition to clear and careful review of the scientific literature and to avoid over parameterization (given the study's sample size). Based on variable selection results, the final covariates included household size, financial situation, household income,

asset ownership (transportation and household possessions), debt, and perceived stress (coping and distress).

Fourth, given the quasi-experimental design, we estimated the effect of the livelihood intervention on food security using the treatment effect model. The treatment effect model offers a more rigorous estimation of treatment effects using quasi-experimental data by modeling explicitly the sample selection process.[67–69] In our analysis, treatment effect models adjusted for heterogeneity of intervention participation by taking into consideration covariates hypothesized to affect selection bias. Based on our review of the literature, the following covariates have been shown to influence participation in livelihood activities: gender, education level, assets (landownership, ownership of transport-related assets, livestock and household possession), and treatment-related factors (such as treatment duration, medication adherence, and CD4 count).[70–77] All these covariates were measured at baseline, and were included in the selection equation of the treatment effect models. In addition to adjusting for heterogeneity of program participation, we controlled for potential confounders hypothesized to affect the outcome variable. These covariates of food insecurity were consistent with the covariates in the multivariable linear regression model.

We also performed multiple imputation (MI) to address potential issues (such as reduction in sample size and biased parameter estimates) related to missing data. Missing data included 21% of follow-up HFIAS scores and 12% of baseline medication adherence. We conducted MI based on best practices suggested in the literature.[78–81] First, results of diagnostic tests suggested that the missing at random (MAR) assumption may be reasonable. Missing data are considered MAR if other variables in the dataset can be used to predict missingness on a given variable. Second, all variables in the MI model were at least minimally associated with the variables containing the missing values.[78] Third, MI datasets were created by imputation using the chained equations approach.[81,82] This approach does not assume multivariable normal distribution and can be used to impute different types of variables such as categorical, ordinal, and count.[81] Fourth, we created our primary MI model with 20 imputed datasets.[79,83] We also tested the sensitivity of results to the number of imputations by generating additional models with 5, 50, and 100 multiply imputed datasets. Last, we compared the results based on complete-case analysis and MI. Results were consistent. However, complete-case results had biased parameter estimates (i.e., larger coefficient sizes) and smaller robust standard errors compared with MI results. All analyses were conducted using Stata 14.[84]

Results

Sample characteristics

Table 1 lists the characteristics of study participants. Ninety-three percent of the sample experienced food insecurity during the past 30 days prior to baseline data collection. Among those who were food insecure at baseline, a high percentage (74%) was considered severely food insecure. The average baseline food insecurity (HFIAS) score was 14.42. Overall, food insecurity decreased at follow-up, or eight months after baseline. The mean follow-up HFIAS score was three points lower than the mean baseline HFIAS score. Bivariable results showed that intervention and control groups did not significantly differ on their baseline

HFIAS scores, demographic characteristics, adherence, and livestock ownership. However, there was evidence that intervention and control groups significantly differed on economic and health factors, including income, asset ownership, and ART duration.

Effect on food security

Mean HFIAS score decreased from 14.43 at baseline to 11.34 at follow-up. Although both intervention and control groups reported lower HFIAS scores at follow-up, intervention participants reduced their food insecurity scores at a higher rate than control participants. Mean food insecurity score in the intervention group decreased from 15.32 at baseline to 10.21 at follow-up, or a change score of −5.10 points. On the contrary, mean food insecurity score in the control group declined from 13.55 at baseline to 13.44 at follow-up, or a change of −0.11.

Bivariable results indicated that Chuma na Uchizi significantly improved access to food. Table 2 presents the differences in HFIAS scores before and after adjustment for baseline HFIAS values. Unadjusted mean difference showed that intervention participants had significantly lower follow-up HFIAS scores than control participants. The intervention group scored 3.23 points lower on HFIAS contrasted with the control group. When results were adjusted for baseline HFIAS scores, the intervention group remained significantly less food insecure than the control group. The intervention group scored 3.77 points lower on HFIAS than the control group.

Table 2 also presents differences in HFIAS scores before and after multivariable adjustment, and Table 3 shows the full multivariable results after adjustment for potential confounders of food insecurity. Multivariable linear regression results were consistent with bivariable findings. Chuma na Uchizi had a significant, positive effect on food security. The intervention group scored 5.76 points lower on HFIAS compared with the control group.

Further, Table 2 presents the estimated differences in HFIAS scores between intervention and control groups before and after adjustments for sample selection. In addition, Table 3 lists the full results, including regression and selection equations, after adjustment of sample selection. First, selection bias appeared to be a problem because intervention and control groups were significantly different on some variables in the selection equation, including ownership of transportation assets and household possessions, and ART adherence and duration. Participants who reported owning more transport-related assets and household possessions at baseline were less likely than their counterparts with fewer assets to receive the intervention. Participants with optimal medication adherence level were less likely than participants with suboptimal adherence to receive the intervention. In addition, participants who had been on ART for longer than 19 months were more likely than their counterparts who had been on ART for 19 months or less to receive the intervention.

Second, based on the regression equation that controlled for covariates of food insecurity, Chuma na Uchizi had a significant and positive impact on food security. Intervention participants were less likely to be food insecure eight months after baseline compared with control participants. The intervention group scored 5.65 points lower on HFIAS than the control group. The comparison of treatment effect model results based on two different

procedures (maximum likelihood and two-step) also showed consistent results. Treatment effect results using either ML or two-step showed that Chuma na Uchizi significantly improved food security. In addition, the observed relationships between baseline covariates and follow-up HFIAS scores were consistent with results from the multivariable linear regression model.

Comparison of different MI models—Table 4 compares treatment effect outcomes before and after adjustment of sample selection based on number of multiply imputed datasets. Overall, results were consistent across different number of multiply imputed datasets. In other words, the positive effect of the intervention on food security was not sensitive to the number of imputations. Across all models, Chuma na Uchizi had a statistically significant positive effect on food security.

Discussion

The importance of adequate food on survival and health of PLHIV has led to testing and evaluation of various strategies that promote better access to food. Although prior interventions have addressed inadequate access to food among treatment-experienced PLHIV in Zambia and elsewhere in SSA,[7,33,34,39,85] most interventions reflect a biomedical approach to addressing the downstream consequences of food insecurity, particularly undernutrition and weight loss. Few published intervention studies, particularly those conducted in rural Zambia, have addressed the upstream causes of food insecurity, including lack of income, assets, and other means of livelihood. To our knowledge, Chuma na Uchizi was one of the first programs of its kind to tackle underlying predictors of food security among PLHIV who are receiving ART in rural Zambia. Chuma na Uchizi provided tangible resources to generate income, skill-building opportunities to facilitate development and maintenance of income-generating sources, and access to financial services to provide safe and secure ways to save money and plan for the future. Chuma na Uchizi was also one of the first intervention studies implemented in rural Zambia that demonstrated feasibility and positive impact of a livelihood intervention on food security for PLHIV on ART. At follow-up, intervention participants were more food secure than control participants. These positive results were consistent across various analytical models, including unadjusted, adjusted, bivariable, multivariable, and treatment effect models. In addition, our findings are consistent with prior research, including a study in Kenya by Weiser and colleagues that showed significant and positive impact of a livelihood intervention that combined agriculture and financial services on food security and frequency of food consumption.[36] However, unlike prior livelihood interventions for PLHIV, Chuma na Uchizi, to our knowledge, was one of the first interventions to combine social protection with asset development (cash transfers for productive assets) through access to financial services and small business management training for PLHIV.

The positive impact of Chuma na Uchizi on food security may be attributed to a single or multiple aspects of the program. For instance, the cash transfer component might have given intervention participants a new source of cash flow that they used to purchase food. It is possible that participants set aside a portion of the cash they received to buy food and improve their consumption patterns. Because of high vulnerability of intervention

participants to food insecurity as illustrated by their low incomes, it is probable that the cash transfer would improve their ability to obtain food. In addition, it is possible that improvements in food security resulted from higher income from livelihood or income-generating activities that were financed by the cash grants. Interventions participants could have used the money, as intended, to start or continue income-generating activities. It is likely that intervention participants began (or recapitalized) their income-generating activities, which were mostly retail-oriented, and produced monetary returns. Retail-oriented businesses that buy and sell goods, such as micro and small businesses—which 80% of the intervention participants reported owning—might generate income more quickly than other types of livelihood activities (e.g., farming and livestock-raising). In turn, income from these livelihood sources might have been used to obtain or purchase food.

In addition to the cash transfer component, it is possible that the life-skills training component contributed to improvements in food security for intervention participants. From the financial education and business management training, the intervention group might have learned how to set aside money and prepare a financial plan that meets household needs, as well as how to use income from livelihood activities to meet (business and) household basic needs such as food. The food and nutrition component might have also reminded participants about the importance of adequate food and proper nutrition to maintain good health and improve ART efficacy. However, our study was not able to isolate effects of individual components from other aspects of the livelihood intervention due to the study design.

Implications for research and practice

Our findings have important implications for future research and programming. Livelihood interventions, such as Chuma na Uchizi, offer a feasible and promising approach that targets malleable predictors of food security. Although a growing body of empirical evidence has shown positive effects of integrated HIV and livelihood programs on household economic viability, including improved food security, little is known about optimal combinations of intervention activities. Because there is no single, effective combination of intervention components, livelihood activities will vary from one program to another. Custom-tailoring of intervention activities may be a desirable practice as selection of program components depends on localized factors such as economic conditions, feasibility and viability of entrepreneurial ventures, and availability and access to financial services, among others. In other words, engaging local stakeholders, similar to our process of developing Chuma na Uchizi, is necessary to identify an optimal and relevant combination of livelihood activities for a particular locality. Nonetheless, livelihood interventions should be appropriate to the needs and characteristics of PLHIV, in addition to their local contexts. For instance, livelihood activities may not be appropriate for PLHIV who are severely undernourished or experiencing rapid weight loss. Similarly, labor-intensive activities may not be appropriate for PLHIV with limited strength and stamina. In addition, livelihood interventions for PLHIV should be part of a bigger framework that tackles barriers to food security at different levels. Interventions that promote improved access to food at the household or community-level may not be effective when macro-level challenges such as physical

unavailability of food (for example, due to insufficient agricultural output or environmental change) and rising food prices are not addressed.

Furthermore, in Zambia, a potential policy and program "entry point" for integrated HIV and livelihood interventions is illustrated in the revised National AIDS Strategic Framework. This revised framework recognizes the importance of increasing and strengthening access to programs that incorporate food security into HIV treatment and care.[86] The strategic framework calls for scaling up of comprehensive interventions that address underlying determinants of food insecurity. Programs such as Chuma na Uchizi closely align with the framework's priority strategies in the areas of social protection, poverty alleviation, and livelihoods. Consistent with the motivation behind Chuma na Uchizi, the framework recognizes the value of interventions that empower individuals to develop skills and acquire resources that foster self-reliance and resilience through sustainable livelihood activities. Study results may provide timely empirical evidence to support inclusion of livelihood programs into the country's national strategy to improve HIV treatment and care.

Limitations

Our study is not without limitations, and results should be interpreted in the context of these limitations. First, the timing of follow-up data collection (eight months after baseline and three months after intervention training) might not be enough time to reveal the full range and sustainability of effects on food security. Similarly, studies with at least three data collection time points may be a more rigorous alternative than a pre-and post-intervention design. This design may help examine whether the effect on food access extends beyond the project duration, which in turn, might indicate how the cash transfers were used (e.g., to smooth consumption patterns temporarily, to invest in livelihood activities, or a combination of both). Second, we only evaluated the intervention's effect on access to food. We do not know the impact of the intervention on actual food intake or frequency of consumption. Actual food intake is equally important because of its role in improving nutrition and efficacy of HIV therapy. Similarly, HFIAS, like other food insecurity measures, primarily quantifies previous histories of food insecurity (in this case, the past 30 days) and fails to capture information pertaining to food acquisition. Forward-looking measures of access to food are needed to identify and assist individuals and households before they experience or re-experience food insecurity. Additionally, context-specific indicators to assess inadequate access to food in diverse HIV-positive populations, as well as measurement scales that recognize subcomponents of access to food such as quality, variety, safety, and socially acceptable procurement are needed to improve construct validity and to provide a more comprehensive picture of food insecurity. Third, a larger study with experimental design is needed to definitively establish causal relationships. A larger experiment should also take into account the cluster-level effects due to the clustering of ART patients within health facilities. The inclusion of only two health facilities (with little variation) limited our ability to examine intervention effects while controlling for community or health facility level variables. A larger study should also consider how best to isolate impacts of individual components from other aspects of the program. Fourth, our statistical tests are based on assumptions that might or might not have been present in the current study. For instance, the treatment effect model is useful in producing better estimates of average treatment effects if

we know the predictors of selection process (in this case, participation in Chuma na Uchizi) and if we correctly specify these predictors in the selection equation. When models are misspecified (i.e., when predictors are incorrect or omitted), results may be biased. To address this limitation, we reviewed the livelihood literature to identify evidence-based factors that influence livelihood participation. Lastly, the lack of qualitative data precluded our ability to better understand potential causal mechanisms in which individual components of the intervention helped participants to obtain access to food. For example, it is possible that from the financial education and business management training, the intervention group might have learned how to set aside money and prepare a financial plan that meets household needs, as well as how to use income from livelihood activities to meet basic needs such as food.

Conclusions

The increasing overlap between food-insecure and HIV-positive individuals who are receiving ART threatens future progress in increasing survival of PLHIV and ending the HIV/AIDS epidemic. This alarming trend requires timely interventions and indicates relevance of such interventions for a large segment of the population. Consistent with prior intervention research, our study findings suggest promising and encouraging effects of a livelihood intervention on food security. Chuma na Uchizi combined various economic strengthening components to address compounded factors associated with food insecurity, including low income, limited productive assets, inadequate training on business management, and lack of access to financial services. In addition, livelihood interventions such as Chuma na Uchizi may offer a more sustainable, holistic, and socially appropriate way to obtain food compared with other types of food security programs for PLHIV in resource-limited settings.

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Table 1

BASELINE CHARACTERISTICS OF CHUMA NA UCHIZI PARTICIPANTS AND BY STUDY SITE

	All N = 101	Lumezi (Intervention) N = 50	Lundazi (Control) N = 51	p-value
Variables		% or M (SD)		
Food insecurity (continuous)	14.43 (7.86)	15.32 (1.06)	13.55 (1.15)	.26
Food insecurity (categorical)				.72
Food secure	7%	6%	8%	
Food insecure	93%	94%	92%	
Demographics				
Age (in years)	37.54 (7.39)	37.62 (7.19)	37.47 (7.65)	.92
Gender				.37
Female	56%	52%	61%	
Male	44%	48%	39%	
Education level				.89
Primary education	65%	66%	65%	
Secondary education or higher	35%	34%	35%	
Household size (continuous)	5.99 (3.60)	6.04 (2.63)	5.94 (4.38)	.89
Economic Characteristics				
Financial situation				.04
Worse than two years ago	82%	90%	75%	
Stayed the same or better	18%	10%	25%	
Household income				.00
0–20 Zk (< $0.15 per day)	45%	62%	29%	
21–50 Zk ($0.15–$0.30 per day)	25%	32%	18%	
51–500 Zk ($0.30–$2.75 per day)	15%	6%	24%	
≥ 501 Zk (> $2.75 per day)	15%	0%	29%	
Land ownership				.03
Yes	89%	96%	82%	
No	11%	4%	18%	
Transportation asset index	0.19 (0.38)	0.09 (0.24)	0.29 (0.46)	.01
Livestock ownership index	1.40 (2.99)	0.89 (1.68)	1.84 (3.83)	.11
Household possessions index	0.64 (0.81)	0.34 (0.34)	0.94 (1.01)	.00
Respondent owes money …				.02
Yes	24%	14%	33%	
No	76%	86%	67%	
Health and Treatment Characteristics				
Perceived stress, coping	9.44 (4.24)	11.55 (4.36)	7.41 (2.95)	.00
Perceived stress, distress	7.45 (4.64)	5.36 (4.32)	9.49 (4.01)	.01
ART treatment duration	26.40 (20.66)	35.50 (23.43)	17.49 (12.33)	.00
ART adherence				.50
Adherent	74%	72%	78%	
Non-adherent	26%	28%	22%	

	All N = 101	Lumezi (Intervention) N = 50	Lundazi (Control) N = 51	p-value
CD4 count	471.27 (293.56)	523.13 (347.33)	419.42 (219.22)	.08

Notes:

% = percentage distribution for categorical variables.

M = mean for continuous variables.

SD = Standard Deviation.

p-values were based on two-tailed tests.

Table 2

DIFFERENCES IN HOUSEHOLD FOOD INSECURITY ACCESS SCALE (HFIAS) SCORES BEFORE AND AFTER SAMPLE SELECTION[a]

	HFIAS scores	
Group and Comparison	**β (robust SE)**	**95% CI**
Unadjusted mean difference	−3.23 (1.61)*	−6.46, −0.01
Adjusted mean difference[b]	−3.77 (1.59)*	−6.95, −0.59
Regression-adjusted mean difference[c]	−5.76 (2.00)**	−9.78, −1.75
Adjusted mean difference controlling for sample selection using ML procedure[d]	−5.65 (2.63)*	−10.65, −0.45
Adjusted mean difference controlling for sample selection using two-step procedure[d]	−5.49 (2.52)*	−10.49, −0.50

Note:

* p < .05

** p < .01

*** p < .001, two-tailed test

[a] Results were based on multiply imputed data (m = 20).

[b] Results were adjusted for baseline HFIAS scores.

[c] Results were adjusted for covariates of food insecurity.

[d] Results were adjusted for the sample selection process and covariates of the outcome variable.

SE = Standard Error

CI = Confidence Interval

Reference group = Control group

Table 3

EFFECT OF CHUMA NA UCHIZI ON FOOD INSECURITY AFTER MULTIVARIABLE ADJUSTMENT[a]

	HFIAS Scores			
	Linear Regression		Treatment Effect[b]	
Variables	**β (Robust SE)**	**95% CI**	**β (Robust SE)**	**95% CI**
Intervention (reference is control)	−5.76 (2.00)**	−9.78, −1.75	−5.65 (2.63)*	−10.65, −0.45
Covariates of Food Insecurity				
Household size	−0.25 (0.26)	−0.80, 0.29	−0.25 (0.26)	−0.77, 0.26
Financial situation (reference is worse than two years ago)	−5.11 (2.94)†	−11.13, 0.90	−5.10 (2.86)†	−10.81, 0.62
Household income (reference is 0–20 Zk per month)				
21–50 Zk per month	3.45 (1.93)†	−0.44, 7.34	3.48 (1.89)†	−0.25, 7.22
51–500 Zk per month	2.17 (2.31)	−2.51, 6.86	2.16 (2.22)	−2.26, 6.57
≥ 501 Zk per month	2.40 (5.11)	−8.04, 12.85	2.41 (4.98)	−7.54, 12.35
Transportation asset index	−1.71 (1.92)	−5.58, 2.16	−1.69 (1.76)	−5.15, 1.78
Household possessions index	−1.23 (1.80)	−4.95, 2.49	−1.21 (1.80)	−4.82, 2.40
Debt (reference is no debt)	−0.28 (1.95)	−4.22, 3.66	−0.25 (1.85)	−3.93, 3.43
Baseline food insecurity	0.08 (0.13)	−0.19, 0.34	0.07 (0.13)	−0.18, 0.33
Perceived stress, distress	0.37 (0.27)	−0.17, 0.92	0.38 (0.26)	−0.15, 0.90
Perceived stress, coping	0.64 (0.26)*	0.10, 1.18	0.64 (0.27)*	0.11, 1.18
Sample Selection Variables				
Gender (reference is male)			0.64 (0.40)	−0.15, 1.43
Education level (reference is primary education)			0.67 (0.42)	0.15, 1.48
Transportation index			−1.25 (0.60)*	−2.42, −0.86
Household possessions index			−2.58 (0.56)***	−3.68, −1.48
Livestock ownership index			0.12 (0.09)	−0.07, 0.30
Landownership (reference is do not own land)			−0.78 (0.64)	−2.03, 0.47
ART adherence (reference is non-adherent)			−0.89 (0.37)*	−1.62, −0.17
CD4 count			0.05 (0.55)	−1.03, 1.13
ART treatment duration			2.21 (0.42)***	1.39, 3.04

Notes:

† p < .10;

* p < .05;

** p < .01;

*** p < .001, two-tailed test.

[a] Results were based on multiply imputed data (m = 20).

[b] Treatment effect results were based on maximum likelihood estimates.

β = coefficient

robust SE = robust Standard Error

95% CI = 95% Confidence Interval

Table 4

COMPARISON OF HFIAS SCORES BEFORE AND AFTER ADJUSTMENT BASED ON NUMBER OF MULTIPLY IMPUTED DATASETS

	HFIAS Scores	
Group and Comparison	**β (robust SE)**	**95% CI**
m = 20		
Unadjusted mean difference	−3.23 (1.61)*	−6.46, −0.01
Adjusted mean difference[a]	−3.77 (1.59)*	−6.95, −0.59
Regression-adjusted mean difference[b]	−5.76 (2.00)**	−9.78, −1.75
Adjusted mean difference controlling for sample selection using ML procedure[c]	−5.65 (2.63)*	−10.65, −0.45
Adjusted mean difference controlling for sample selection using two-step procedure[c]	−5.49 (2.52)*	−10.49, −0.50
m = 5		
Unadjusted mean difference	−3.80 (1.37)**	−6.52, −1.08
Adjusted mean difference[a]	−4.41 (1.29)**	−6.98, −1.83
Regression-adjusted mean[b]	−6.59 (1.72)***	−10.01, −3.18
Adjusted mean difference controlling for sample selection using ML procedure[c]	−6.81 (2.04)**	−10.86, −2.76
Adjusted mean difference controlling for sample selection using two-step procedure[c]	−6.79 (2.01)**	−10.75, −2.83
m = 50		
Unadjusted mean difference	−3.33 (1.56)*	−6.44, −0.22
Adjusted mean difference[a]	−3.91 (1.53)*	−6.96, −0.85
Regression-adjusted mean difference[b]	−6.07 (2.15)**	−10.40, −1.74
Adjusted mean difference controlling for sample selection using ML procedure[c]	−5.86 (2.64)*	−11.07, −0.65
Adjusted mean difference controlling for sample selection using two-step procedure[c]	−5.88 (2.54)*	−10.90, −0.86
m = 100		
Unadjusted mean difference	−3.34 (1.61)*	−6.30, −0.37
Adjusted mean difference[a]	−3.90 (1.45)**	−6.79, −1.01
Regression-adjusted mean [b]	−5.76 (1.97)**	−9.69, −1.82
Adjusted mean difference controlling for sample selection using ML procedure[c]	−5.72 (2.45)*	−10.55, −0.89
Adjusted mean difference controlling for sample selection using two-step procedure[c]	−5.70 (2.33)*	−10.28, −1.12

Notes:

† p < .10

* p < .05

** p < .01

*** p < .001, two-tailed test.

[a] Results were adjusted for baseline HFIAS scores.

[b] Results were adjusted for covariates of food insecurity.

[c]Results were adjusted for the sample selection process and covariates of the outcome variable.

ML = Maximum Likelihood robust

SE = robust Standard Error.

Reference group was the control group.