Prospective Cohort Study of the Impact of Antiretroviral Therapy on Employment Outcomes Among HIV Clients in Uganda

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Abstract

This study evaluates the impact of antiretroviral treatment (ART) on employment-related outcomes using prospective, longitudinal analysis. Starting in January 2008, 602 treatment-naïve clients in one rural clinic and in one clinic in the capital Kampala were interviewed about their medical history, and psychosocial and socioeconomic adjustment at baseline and at months 6 and 12. Half of the sample was eligible to receive ART, while the other half was also in HIV care, but not yet eligible for ART, therefore providing a comparison group that is similar to the treatment group in that its members are HIV-positive and have made the decision to enroll in HIV care. We found improvements in general health, reduction in the incidence of pain and health interfering with work, as well as improvements in work-related self-efficacy for both groups over time, but significantly more so for the group receiving ART treatment. At baseline, less than half of the people in the ART group worked, but after 6 months more than three quarters of them were working, surpassing the fraction of people working in the control group after 1 year. Another key finding of the study was the importance of mental health as a key mediator for employment-related outcomes. These data indicate that ART clients experience greater improvements compared to pre-ART clients, and not only with regard to general health, but also in restoring confidence in their ability to work, as well as actual work status.

Introduction

THE HIV EPIDEMIC HAS DEVASTATED sub-Saharan Africa (SSA). In Uganda alone, over one million people are HIV-infected.¹ HIV antiretroviral therapy (ART) has dramatically decreased mortality and morbidity rates in SSA,² and ART scale-up has resulted in over 200,000 Ugandans receiving ART.¹ What is much less clear is the impact of ART on dimensions of health that go beyond physical and virologic outcomes, in particular, the ability to restore the economic capacity and well-being of patients. Furthermore, depression has been found to be present in 18–31.2% of ART clients,³ yet we are not aware of any research investigating whether mental health influences the impact of ART on employment outcomes, which is therefore a novel contribution of our study.

The last few years have seen an increase in research on the impact of HIV and ART on economic outcomes (for a literature review, see Beard, Feeley, and Rosen³). Early work by Fox et al.⁵ using a retrospective cohort approach revealed that the output productivity of Kenyan tea estate workers decreased

due to AIDS-related causes, leading to 16–17.7% lower earnings; a study by Larson et al.⁶ reported that ART led to a significant increase in the work capacity of workers in the same setting; workers after 1 year of receiving ART worked at least twice as many days in a month as they would have in the absence of treatment. In a recent article that uses data from the completed study, the authors found workers' income to be 6% (men) and 9% (women) lower than that of the reference group about 2 years after ART initiation.⁷ Habyarimana et al. found worker absenteeism to increase before and drop after ART initiation in a large mining company in South Africa.⁸ Gender differences in work output pre- and post-ART initiation were observed in Larson et al. for a sample of Kenyan agricultural workers.⁹ As these studies focused only on those who had employment, the findings related to changes in the hours worked or other output measure rather than changes in work force participation. In contrast, Rosen et al. followed a sample of treatment-initiators for 3 years and observed increases in the fraction of respondents having a job following ART that were sustained over that time period.¹⁰ Thirumurthy, Zivin, and Goldstein present novel evidence that ART led to a 20%

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increase in ART clients' labor force participation, and a 35% increase in the number of hours worked per week.¹¹ A recent article by Bor et al. provides first estimates of the effects of ART on employment outcomes in a large cohort study of 30,000 adults in South Africa and found that ART largely restored labor force participation.¹²

One potential drawback of these reports is that they either do not have a control group but observe changes over time only, or compare the change in employment-related outcomes of ART patients with a random sample of individuals whose HIV status is generally unknown but will be largely HIV-negative, which may not be the most appropriate control group. For example, HIV-positive workers may differ along unobservable factors, such as their propensity to take on risk that may affect both their health as well as their economic outcomes. For this reason, a control group consisting of HIV-positive clients is preferable, yet few articles in the literature provide such evidence. An exception is a recent study by Thirumurthy et al. who followed a cohort of clients initiating ART and a cohort of pre-ART clients in India, and found that the ART group experienced a significant increase in employment levels and hours worked, in particular for men.¹³ A control group composed of HIV-positive clients reduces the possibility of selection bias in the outcome evaluation as both groups are HIV-positive; furthermore, having a control group receiving medical care from the same clinic also avoids a potential bias that could arise when HIV-positive individuals are more likely to seek HIV care when they are unemployed as they have more time then (i.e., their opportunity cost of time is lower in times where less income is generated).

In this article, we investigate the impact of ART on employment outcomes in Uganda compared to a sample of pre-ART clients in the same clinics, and analyze the role of mental and physical health in regaining work-related health and employment. This is one of the first papers to stress the role of mental health as a factor mediating the effect of ART on employment outcomes.

Methods

Program description

The study collected data from a longitudinal, prospective cohort of HIV-positive clients who had newly entered care and were followed up for 12 months. Clients from two HIV clinics operated by the Joint Clinical Research Center (JCRC) in Uganda were enrolled, one in Kampala and the other in Kakira. Kampala is the capital of Uganda and its only large urban center, while Kakira is a small rural town located next to a sugar plantation approximately 100 kilometers outside Kampala. JCRC is the largest provider of ART in Uganda, with operations in more than 75 health care facilities and HIV care provided to more than 75,000 clients, including 40,000 on ART (20% of the Ugandans now on ART). Given the large reach of JCRC, our findings have the potential to apply to a large part of the HIV-positive population of Uganda and to hold wide relevance for policies addressing HIV-positive individuals in Uganda.

Study population

A sample of 602 HIV-positive JCRC clients was enrolled, of whom half (300) were eligible for and prescribed ART, while

the other half (302) was not yet eligible for ART but had signs of immunosuppression ($CD4 < 400$ cells/mm³). ART eligibility was primarily based on a CD4 count of less than 250 cells/mm³ or WHO disease stage III or IV (representing an AIDS diagnosis), and having a "treatment supporter" (a patient-identified relative or friend who helps to support the patient's treatment adherence). Study participants had to fulfill the following requirements: (1) age 18 or older; (2) new to the clinic and just evaluated for ART eligibility; and (3) having a CD4 count of less than 400 cells/mm³ if not otherwise eligible for ART. Eligible clients were approached and informed of the study by a clinic staff member at the visit in which their eligibility for ART was determined (usually the second or third clinic visit).

The study coordinator obtained informed consent and then administered the baseline interview. Willingness to participate in the study was close to universal as reported by clinic staff. Follow-up interviews were administered at months 6 and 12. Participants who were not eligible for ART at baseline may have initiated ART during the course of the 12-month study if their medical status changed and treatment became warranted. Participants received 5000 Uganda Shillings (~\$2.50 USD) for completing each interview. The RAND and JCRC Institutional Review Boards, as well as the Uganda National Council for Science and Technology approved the study protocol.

Data sources

Clients in both the ART and pre-ART group received structured interviews that included sections on background characteristics such as age, gender, education, and household composition, as well as physical and mental health. Chart-abstracted data included CD4 count and HIV disease stage (the 4-level WHO disease staging). Data on economic outcomes included questions on the four main outcomes of interest: work status in the week preceding the interview; health interference with work (a binary indicator of whether health was perceived to keep the respondent from working); pain interference with work (whether in the month preceding the interview pain interfered with normal work on a five-point scale from "not at all" to "extremely" that subsequently was collapsed into a binary indicator with value unity if pain was reported to interfere "extremely" or "quite a bit"); and work-related self-efficacy (measured by a single visual analog scale from 0–10). Physical health functioning is measured by its 6-item subscale of the Medical Outcomes Study-HIV (MOS-HIV) scale; the items assess ability to engage in activities of daily life and scores are standardized on a 0–100 scale.¹⁴ Depression was evaluated using the Patient Health Questionnaire (PHQ-9), which uses 9 items to assess symptoms that directly correspond to the DSM-IV criteria for major depression. Each item is scored on a 0–3 response scale and sum scores of 10 or more represent clinical depression.¹⁵ This scale has been used successfully in SSA,¹⁶ including our own research in Uganda with HIV clients.¹⁷

Statistical analysis

The main approach to estimate the impact of ART on the outcomes of interest is an intent-to-treat approach (i.e., those in the pre-ART group who start receiving ART over the observation period are categorized as being in the control group

throughout the study). This approach avoids selection bias such as when people in the control group end up in the treatment group, and thereby estimates a lower bound of the actual treatment effect. We compare the effect over time for the ART group relative to the pre-ART group. Bivariate statistics (two-tailed *t*-test, chi square test) were used to compare baseline characteristics among the ART and non-ART groups. Multivariate longitudinal models were used to examine the effects of ART on outcomes measured across the three assessments. We fit a generalized linear model using the generalized estimating equation method for analysis of correlated data to the repeated measurements. We assumed a binomial distribution for the dichotomous outcomes (work status; pain interference; health interference with work) and used linear regression analysis of the continuous outcome variable of work-related self-efficacy. In each of the models, the dependent variable was the measure of change in the outcome variable across the three study assessments, and the independent variables included ART status, time (ordinal variable representing the three time periods), and the interaction of ART status by time. In addition, the models included patient characteristics controlling for age, location, gender, and education level that are not presented for space reasons.

We also performed two sensitivity analyses to test the robustness of our results. In the first one, we excluded clients in the control group who during the observation period received ART that in the intent-to-treat analysis are classified as being in the control group ($n=50$). The second sensitivity analysis restricted the control group to clients ($n=122$) similar in its health status to the ART group (showing WHO disease stage III or IV or CD4 count < 250 at baseline), but for whom ART had been deferred for medical or psychosocial reasons (e.g., poor clinic attendance, active TB that was being treated first). However, neither of these sensitivity analyses results in significant departures from the results of our intent-to-treat analysis, hence we do not report them here.

Interpretation of the coefficient estimates

A control group consisting of HIV-positive clients in HIV care rather than of individuals from the general population as is common in the literature offers several advantages: first, it controls for unobservable characteristics that may be associated with a person contracting the virus and enrolling in HIV care (such clients may for example be more outgoing or proactive compared to those who are infected but do not take this step). It also addresses the possibility mentioned in Bor et al.¹² that the decision to enroll in care may be related to employment status such as when unemployed people decide to enroll in care earlier due to their generally lower opportunity cost of time.

The approach deviates from the unobservable counterfactual of the changes happening to the person receiving ART in the absence of this treatment that may compromise the standard (yet untestable) assumption underlying our difference-in-difference analysis of a parallel time trend between the treatment and control group. On the one hand, the control group receives HIV care (and is put on ART when their CD4 level or clinical status justifies it), thereby leading to an underestimation of our results. In the absence of any HIV care, the control group likely would experience a sharp decline in health and subsequent work capacity over time.

TABLE 1. BASELINE SAMPLE CHARACTERISTICS BY ART STATUS ($N=602$)

Variable	Total Sample	Pre-ART	ART
N	602	302	300
<i>Demographics</i>			
Mean age (years)	35.7	35.7	35.7
Male	32%	30%	33%
More than primary education	41%	45%	37%
<i>Work-related outcomes</i>			
Working (past 7 days)	61%	71%**	50%
Report "pain interfered with work"	27%	19%**	35%
Report "health keeps me from working"	31%	20%**	43%
Work self-efficacy (range 0–10)	6.90	7.30**	6.50
<i>Physical health</i>			
CD4 count	216	301**	130
AIDS diagnosis (WHO stage 3/4)	45%	31%**	60%
Physical health functioning	71.8	78.5**	65
<i>Mental health</i>			
Depression	5.22	4.36**	6.09

** $p < 0.01$; * $p < 0.05$

On the other hand, if clients in the control group not yet on ART experience a worsening of health and associated work capacity before they become eligible for ART, then we would potentially find a positive effect of ART on economic outcomes, even if the labor outcomes of the ART group remained largely unchanged.

We therefore interpret the coefficient estimates we find as the effect of receiving ART relative to an HIV-positive person in HIV care not yet eligible for ART based on CD4 count or WHO disease stage. As we observe individuals who have decided to enroll in HIV care, we control for the potential bias associated with the decision to enroll in HIV care (and of contracting HIV, which studies using controls from the general population cannot control for). The decision to initiate ART is taken by the physician based on CD4 count and WHO disease status and is therefore to a large extent exogenous to the individual.

Results

Baseline descriptive statistics of key variables for the ART and pre-ART groups are presented in Table 1. The demographic variables of age, gender, and education status do not differ significantly between the 300 clients in the ART group and the 302 pre-ART clients, providing support that the two groups are comparable along these observable characteristics. Due to the study design, there are clear differences in the health status between the two groups as, for example, expressed in the fraction of clients experiencing symptoms leading to their classification as being in WHO disease stage 3 or 4. This shows that ART initiation is (as expected) conditional on CD4 count or WHO disease stage (i.e., is not driven by behavioral characteristics of the client or provider, but on objectively measured health status). Depression is similarly

TABLE 2. TREND IN PHYSICAL AND MENTAL HEALTH OVER THE THREE SURVEY WAVES

	<i>Pre-Art group</i>	<i>ART group</i>
CD4 cell count		
Baseline	301.16**	126.17
6 month follow-up	322.74**	277.32
12 month follow-up	369.26*	336.11
Physical functioning		
Baseline	78.45**	65.03
6 month follow-up	87.71	85.72
12 month follow-up	86.87**	92.88
Depression scale		
Baseline	4.36**	6.09
6 month follow-up	2.45	2.42
12 month follow-up	2.36**	1.48

* $p < 0.05$; ** $p < 0.01$.

higher in the ART group at baseline, indicating that this group experiences not only worse physical but also mental health, as has been previously found in the literature.³

People receiving ART display significantly worse work-related outcomes as indicated by the four main indicators. Twice as many clients in the treatment than the control group indicate that their health status prevents them from working or that pain interfered with working. At the beginning of the study, there is a clear need for ART to restore physical and mental health, and assist patients in recovering their economic capacity. At baseline, about one-quarter of the sample each report having an office job and working in farming; the other significant occupation groups include security guards, restaurant attendants, and vendors. Attrition was not a serious problem in our sample, as we retained close to 95% of our original sample.

In Table 2 we report the evolution of physical and mental health as the two main pathways through which we expect ART to restore economic capacity. We present results for baseline, 6 and 12 months later for CD4 count, physical health functioning, and depression. CD4 count improves for the ART group but remains statistically lower than that of the pre-ART group. Physical health functioning improves to the point where the ART group reports significantly better physical

functioning at month 12 compared to the pre-ART group. Mental health improves also for both groups, but significantly more so for the ART clients who report significantly fewer depression symptoms at month 12 than the pre-ART clients. These three indicators suggest that ART successfully restores physical and mental health to levels comparable to (or better than) those in the pre-ART group. It is noteworthy that most of the improvement appears to occur by month 6 of treatment. Next we investigate whether these improvements in physical and mental health also translate into improved employment-related outcomes.

Table 3 presents the multivariate regressions for four self-reported work-related outcomes: whether pain interfered with working (column 1), whether health interfered with working (column 2), work self-efficacy (column 3), and whether the respondent worked in the 7 days prior to the interview (column 4). We report coefficients as odds ratios for being in the ART group, the overall time-trend, the change in the outcome for the ART group over and above that for the pre-ART group (i.e., the interaction of time by ART), as well as baseline measures of physical health functioning and depression.

At baseline, the ART group is clearly displaying negative effects for all four employment-related outcomes, as was already evident in the summary statistics. While there is an improvement for work-related outcomes for both groups (as reflected in the time trend), clients on ART experience improvements (from a lower base level) that are significantly larger; they are more likely to report improved work self-efficacy, and are more likely to report having worked in the last 7 days. For example, the odds of having worked in the last 7 days for ART clients are 1.88 times that of those of the control group over time. Similarly, the ART group is less likely to report that health problems or pain reduce their capacity to work over time. These findings are also reflected in the raw associations in Figure 1 that show a similar catching-up of individuals in the treatment group to the levels observed in the pre-ART group.

There is some evidence that baseline physical health functioning is a statistically significant predictor for subsequent work-related outcomes. However, the magnitude of this effect is small, with less than a 1% increase in the relative chance of having worked in the previous week. There is little evidence

TABLE 3. IMPACT OF ART ON WORK-RELATED OUTCOMES

	(1) <i>Pain interfered with work</i>	(2) <i>Health interferes with work</i>	(3) <i>Work self-efficacy</i>	(4) <i>Currently working</i>
ART group	15.542 (6.12)**	13.402 (6.02)**	0.367 (4.06)**	0.259 (5.02)**
Time	0.612 (3.43)**	0.468 (4.74)**	1.564 (5.89)**	1.392 (3.73)**
ART impact	0.116 (6.87)**	0.219 (6.01)**	1.688 (4.87)**	1.880 (5.02)**
Physical health baseline	0.968 (8.11)**	0.964 (9.33)**	1.018 (5.83)**	1.016 (4.58)**
Depression scale baseline	1.086 (3.41)**	1.029 (1.19)	0.992 (0.44)	0.965 (1.67)
Observations	1739	1739	1739	1739
Number of ID	602	602	602	602

Odds-ratios reported; t -statistics in parentheses; ** $p < 0.01$; * $p < 0.05$.

FIG. 1. Raw trends in key outcomes for treatment and control groups.

that baseline depression displays a similar effect. To address the question of whether changes in physical and mental health are associated with improvements in work-related outcomes, we include the change in these variables as explanatory variables in the regressions in Table 4. Due to multicollinearity between baseline health status and subsequent changes, we omit the baseline health levels from these regressions.

The results in Table 4 show that improvements in physical and mental health contribute to improved work-related outcomes for people living with HIV/AIDS. The important role mental health plays in this process has been largely neglected in the literature and deserves further attention in future studies as suggested by Nakimuli-Mpungu et al.³ When we control for improvements in physical and mental health that are likely pathways through which HIV care improves work outcomes, we find that those in the ART group experience

additional benefits that are not explained in our analysis and deserve further research.

The above results clearly demonstrate that ART restores a person's work capacity; however, this may not suffice to restore employment and income for everyone, as employers may be reluctant to hire someone they suspect to be HIV-positive, or there may simply not be jobs available, or not enough funds left to re-start an informal business. In such a situation, additional support in the form of job-training or microfinance may be necessary to restore employment and income. To investigate this possibility, in Table 5 we first stratify the analysis by urban and rural site to account for the possibility that labor markets differ in the capital and the countryside. Second, the employment impact of ART may differ for men and women; hence, we also stratify the analysis by gender.

TABLE 4. IMPACT OF CHANGES IN MENTAL AND PHYSICAL HEALTH ON WORK-RELATED OUTCOMES

	(1) <i>Pain interfered with work</i>	(2) <i>Health interferes with work</i>	(3) <i>Work self-efficacy</i>	(4) <i>Currently working</i>
ART group	6.922 (3.82)**	9.276 (4.33)**	0.689 (1.56)	0.394 (3.44)**
Time	0.854 (0.99)	0.716 (1.83)	1.266 (3.21)**	1.155 (1.66)
ART impact	0.176 (4.86)**	0.277 (4.26)**	1.135 (1.20)	1.364 (2.47)*
Change in physical health functioning	0.942 (11.69)**	0.933 (13.06)**	1.029 (10.09)**	1.018 (5.66)**
Change in depression	1.211 (6.67)**	1.136 (4.51)**	0.913 (5.37)**	0.904 (5.33)**
Observations	1739	1739	1739	1739
Number of ID	602	602	602	602

Odds-ratios reported; *t*-statistics in parentheses; ** $p < 0.01$; * $p < 0.05$.

TABLE 5. WORK STATUS STRATIFIED BY URBAN/RURAL SITE AND GENDER

	(1) <i>Worked in the last 7 days Kampala</i>	(2) <i>Worked in the last 7 days Kakira</i>	(3) <i>Worked in the last 7 days Women</i>	(4) <i>Worked in the last 7 days Men</i>
ART group	0.367** (3.24)	0.097** (5.54)	0.212** (5.64)	0.311* (2.44)
Time	1.445** (3.97)	1.194 (1.19)	1.277** (2.91)	1.571* (2.47)
ART impact	1.402* (2.57)	2.912** (4.77)	1.865** (5.07)	1.427 (1.45)
Observations	886	853	1193	546

Odds-ratios reported; *t*-statistics in parentheses; ***p* < 0.01; **p* < 0.05.

While ART has an impact on work status in both locations, the effect seems to be stronger in the rural region, which is consistent with the idea previously discussed that it may be relatively easy for farmers to return to work, as they would need to spend relatively few resources on inputs to return to employment compared to those in the city (e.g., market vendors), or can simply rejoin an ongoing family farm (more than one-third of the rural sample is active in farming, compared to less than 10% in Kampala) rather than having to look for potentially scarce employment opportunities in the city. When performing the analysis separately for men and women, there is some indication that women may benefit more from receiving ART; however, given that only about one-third of the sample is male, the finding of an insignificant coefficient for ART impact for men may reflect that there is not enough power to detect a statistically significant effect.

Discussion

We find clear evidence that ART not only benefits health, but also greatly improves the probability of working already after 6 months of treatment, which is consistent with other findings in the literature.^{4,11} While the pre-ART group also experienced improvements due either to economic trends or standard HIV care (e.g., treatment of opportunistic infections), the effects for the ART group are larger statistically and the magnitudes of these differences are meaningful. Given the intent-to-treat nature of our analysis, some of the clients in the control group (*n* = 50) had started ART during the course of the study, rendering our results a conservative estimate of the effects of ART. This evidence for the economic benefits of ART further contributes to the growing literature on such effects^{4–13} that we extend by studying the potentially important role of depression in bringing these beneficial effects of ART about.

Improvements in physical health functioning and mental health (i.e., depression) over the course of the 12-month study were significant predictors of improvement in each of the work-related outcomes. This is not surprising, as one might expect that the effects of HIV treatment on physical and mental health would be the key drivers of treatment effects on work, although there is little attention in the literature on the role of mental health on work outcomes, one of the key innovations in our study. Yet, even with these health measures controlled for, the ART group continued to have superior outcomes to that of the pre-ART group, indicating that there are other aspects associated with receipt of ART that influence these work outcomes. One possibility is that patients on ART

visit the clinic considerably more often than pre-ART patients because of the need for drug refills; this increases their opportunities for receiving support from peers and providers, which could translate to better overall functioning (including work) and even work-related propositions.

We find stronger results of ART on work status for the rural sample, which could come about for example if people in the countryside can enter or re-enter agricultural work with little need to pay for inputs. In contrast, self-employed informal sector workers in the city may have to purchase supplies to get their business (re-)started for which they may not have the means due to previous HIV-related expenses or loss of income. These individuals may need further support to return to their livelihoods, such as microfinance or business training.

The study design of comparing HIV-positive people receiving ART based on an observable factor (mainly CD4 count) to other HIV-positive people is an improvement over using non-infected individuals or people of unknown HIV-status for comparison. However, the approach is suboptimal if clients at our clinics differ in their (observable) CD4 count for reasons under their control, such as that those with a higher CD4 count are more risk-averse, which could influence their subsequent economic outcomes. To account for this possibility, we restrict the control group in one of our sensitivity analyses to those with a health status at baseline similar to that of the ART group and find that our results do not change significantly. The difference in health status between the two groups has implications for the interpretation of our results nevertheless: there are reasons to believe that our results represent an underestimate of the true ART effect: first, this would come about to the extent that in the absence of ART most people would see a sharp deterioration in health and early death. Similarly, the control group of pre-ART clients experience positive health impacts due to their HIV care, leading again to a potential underestimation of the beneficial economic effects of ART. This is suggested by the fact that the pre-ART group experiences positive employment-related outcomes over time, though to a lesser extent than the ART group. There are also reasons that reduce the impact of ART on work-related outcomes; for example, diarrhea is one of the leading side effects of ART (in particular during the first year of initiation), and has been found to be associated with loss of work productivity.¹⁸ Similarly, stigma has been found to mediate self-efficacy, which in our case could result in reduced work-related self-efficacy because of stigma associated with ART, for example.¹⁹

The data collected for this study come from only two clinics in Uganda, therefore more research is needed to test how

widely these findings are applicable. However, the provider in our study, JCRC is the largest in Uganda, and to the extent that the two clinics underlying our study are representative of other JCRC clinics, the findings will hold significance for a wider HIV-population in Uganda. Attrition was not a serious problem in our sample, as we retained close to 95% of our original sample.

This article is among the first to investigate the impact of ART on economic outcomes in an African country that uses a sample of similarly HIV-positive but pre-ART clients as the control group for those on ART. This is an important contribution as previous studies compared the outcomes of ART clients with those in a sample of the general population, which invites the criticism of selection bias (i.e., a lack of comparability of the two groups that could come about because the HIV-positive sample may differ in unobservable characteristics such as risk preference that could also influence economic outcomes). By comparing clients who decided to enroll in HIV care, we avoid a potential source of bias that could come about if people deciding to seek HIV care at a clinic differ from those who are HIV positive but do not seek such care. Therefore, an evaluation of ART effects for these two groups controlling for baseline differences comes as close as possible to the ethically impossible scenario of ART distribution via a randomized controlled trial.

Our results clearly speak to the beneficial economic impact of ART that needs to be taken into account when evaluating the sustainability and cost-effectiveness of ART programs. The results highlight the need to restore not only the physical (and mental) health of persons living with HIV/AIDS, but also their economic and social health. ART provision is a first and necessary step in this direction, but may not always suffice, as we have seen in the result that not all clients seem to benefit equally from ART, indicating the need for additional support (e.g., microfinance loans, job training). Future research should address this issue, and aim to provide longer-term evidence in different settings to test the robustness of our findings. Also, while we report results on perceived work self-efficacy and work status, subsequent research is needed to investigate the inframarginal work outcomes such as income (per hour) as well as derived economic decisions such as savings to arrive at a more detailed impact of ART on economic outcomes.

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its coordination and helped draft the manuscript. All authors read and approved the final manuscript.

Author Disclosure Statement

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