Impact of decentralization of Antiretroviral Therapy services on HIV testing and care at population level in Agago District in rural Northern Uganda: Results from the Lablite population surveys

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Abstract:

Background: We conducted unlinked cross-sectional population-based surveys in Northern Uganda before and after ART provision (including Option B+ (lifelong ART for pregnant/breast-feeding women)) at a local primary care facility (Lira Kato Health Centre (HC)).Prior to decentralization, people travelled 56-76km round-trip for ART; we aimed to evaluate changes in uptake of HIV-testing, ART coverage and access to ART following decentralization.

Methods: 2124 adults in 1351 households in 2 parishes closest to Lira Kato HC were interviewed using questionnaires between March-April/2013; 2123 adults in 1229 households between January-March/2015.

Results: Adults reporting HIV-testing in the last year increased from 1077/2124 (51%) to 1298/2123 (61%) between surveys ($p<0.001$). ART coverage increased from 74/136(54%) self-reported HIV-positive adults in 2013 to 108/133 (81%) in 2015 ($p<0.001$). Post-decentralization, 47/108(44%) of those on ART were in care at Lira Kato HC (including 37 new initiations). Most of the remainder (47/61) started ART prior to any ART provision at Lira Kato HC; the most common reason given for not accessing ART locally was concern about drug-stock-outs (30 (51%)).

Conclusions: HIV-testing and ART coverage increased after decentralization combined with Option B+ roll-out. However, patients on ART before decentralisation were reluctant to transfer to their local facility.

Key words: Antiretroviral therapy decentralization, Uganda, Sub-Saharan Africa, Population survey, HIV services

Introduction:

Decentralization of HIV care to get treatment close to where people live is essential to achieve the UNAIDS target of ensuring 90% of HIV positive individuals know their status, 90% of diagnosed HIV positive individuals receive sustained antiretroviral therapy (ART) and 90% of people on ART have suppressed viral load (90-90-90) by 2020[1]. The recent WHO guidelines recommend all individuals diagnosed with HIV

should be initiated on ART at any CD4 cell count, further emphasizing that lack of access to CD4 cell count testing should not be a barrier to starting treatment and thus simplifying the ART initiation process in remote rural areas[2].

Uganda has an estimated adult HIV prevalence of 7.3%[3]. According to the Uganda Ministry of Health (MOH) Semi-Annual ART report (January-June 2014), 1,211,768 adults and 193,500 children are currently living with HIV, of whom, 629,212(52%) adults and 51,302 (27%) children are on ART[4]. If Ugandan guidelines follow the WHO recommendation of treatment for all, the number of people in need of ART will further increase, reinforcing the need to decentralize care to all health facilities. Although the estimated adult HIV prevalence in rural areas is slightly lower than in urban areas (6.9% versus 8.4%),82% of the population live in rural areas[3,5], highlighting the importance scaling up decentralized HIV treatment and care services.

Studies evaluating decentralization of HIV care and ART services to primary level facilities generally show this is a successful strategy for expanding HIV care, highlighting lower loss to follow up (LTFU), better adherence and improved retention in care in comparison to secondary health facilities[6-11].Most information on ART scale-up focuses on adults, although lower mortality and LTFU have also been reported with successful ART rollout to children[12,13]. Decentralization has been shown to be beneficial especially to poorer individuals and those living in rural areas who are less likely to access HIV testing and treatment services due to the distance to facilities and transport costs[14-16].

The Lablite project investigated strategies for cost-effective and safe roll out of HIV treatment to primary health facilities in Uganda, Malawi and Zimbabwe in collaboration with respective ministries of health[17]. In Uganda, we conducted a population survey immediately prior to decentralization of ART to Lira Kato Health Centre (local primary health care facility)in Lapono sub-county in the Agago district of Northern Uganda, a remote poor rural area, with low levels of education where most individuals rely on farming for their livelihoods (Supplementary tables 1 and 2)[18]. HIV services available at Lira Kato HC before decentralization of ART were HIV-testing and drugs for Elimination of Mother to Child Transmission of HIV (EMTCT).HIV-positive individuals in Lapono

sub-county were only able to access ART by travelling long distances to the district hospital (Kalongo hospital) or to Patongo Health Centre (56 or 76 km round-trip respectively), the majority on foot; despite this, 54% of adults who self-reported being HIV-positive were receiving ART, although few children were accessing testing and treatment[18].

ART for Option B+ (lifelong ART for all pregnant/breastfeeding women) was provided at Lira Kato HC from April 2013 and general ART for all HIV-positive individuals eligible for treatment from September 2013. In this paper, we report results of a repeat population survey in the same area approximately 20 months after Option B+ roll out and 15 months after general ART provision at Lira Kato HC. Objectives were to describe the knowledge of local ART provision and to compare results with the survey pre-decentralisation with respect to: (1) uptake of HIV testing in the last year; (2) coverage of ART; and (3) access to ART, including choice of health care facility.

Methods:

Study setting

We conducted two unlinked cross-sectional population-based surveys in Lapono sub-county in Agago district, before and after decentralization of ART services to Lira Kato HC. The first survey was conducted between February- April 2013 (Population Based Survey 1 (PBS1)). The repeat survey was conducted between January-March 2015 (Population Based Survey 2 (PBS2)).

According to the health facility structure in Uganda, Lira Kato HC is categorized as a Health Centre III (HC III); it is headed by a clinical officer, serves a sub-county and provides inpatient care, outpatient, antenatal, immunization and outreach services and environmental health. Patongo HC is categorized as a Health Centre IV (HC IV) and is headed by a medical officer, serves a sub-district and additionally provides surgery, supervision of the lower HCs, data collection and health service planning. Kalongo hospital is the district hospital and is headed by senior medical officer, serves the district and additionally provides training and supervision of staff at the lower HCs and is the main referral facility for the district. All facilities are open seven days a week. Both

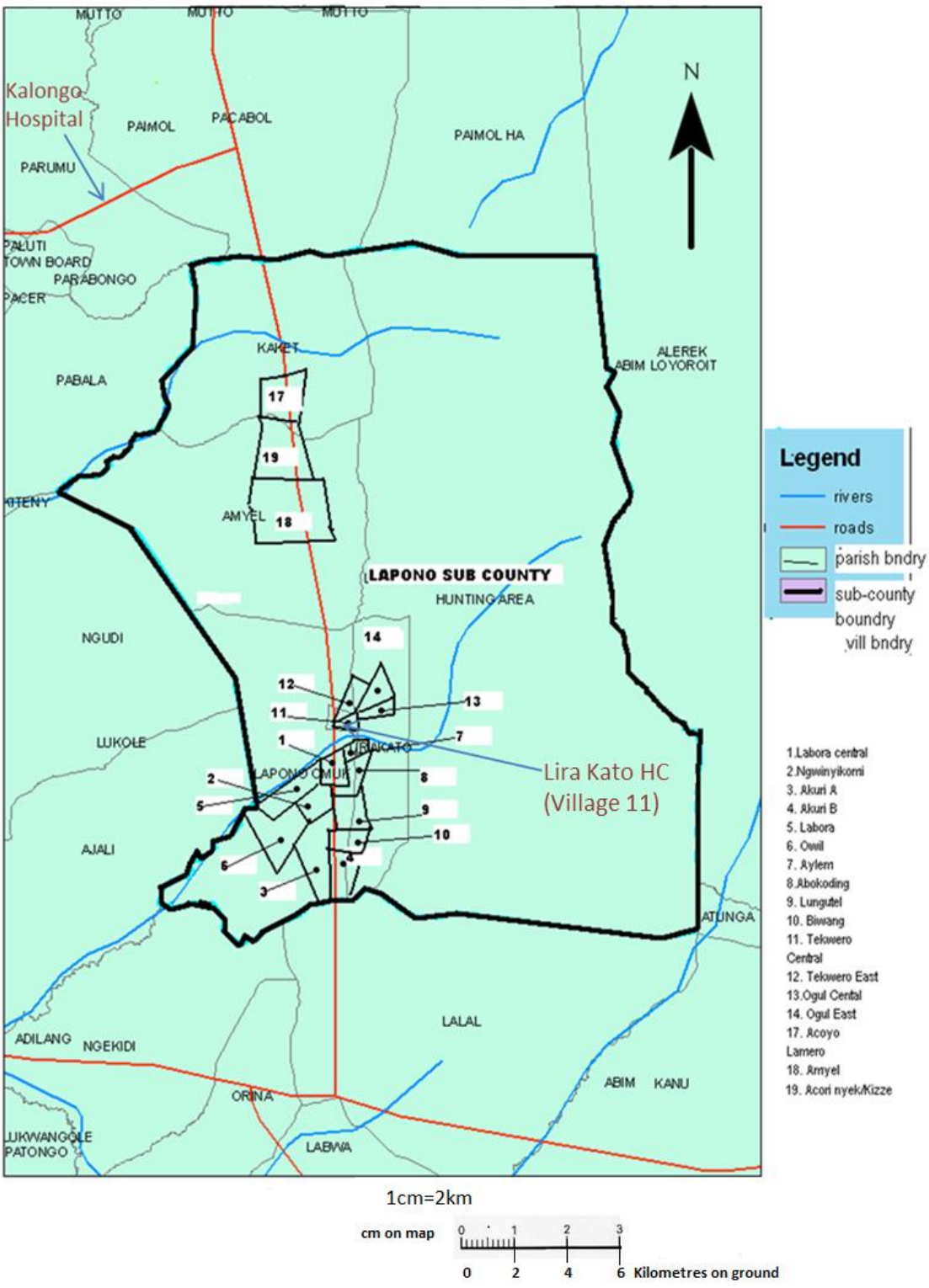
Kalongo hospital and Patongo HC have provided ART since 2006; Lira Kato HC referred patients to Kalongo hospital for ART pre-decentralization. Individuals within the catchment for Lira Kato HC are at most nine km and mostly less than 5km from the HC, whereas average distances from the sub-county to Kalongo hospital and Patongo HC are 28km and 38km respectively (56km, 76km round-trip).

Both surveys were carried out in 2 of the 6 parishes including ~20% of villages in Lapono sub-county (figure 1). All villages in the two parishes closest to Lira Kato HC were included. One village was used for the pilot (excluded from both main surveys) and seventeen villages were included in the main surveys. Every household in each village was mapped and approached during the surveys. Community meetings were held in collaboration with local leaders to encourage participation of the villagers in the survey. Prior to PBS1, village mapping was done using Geographical Positioning System (GPS) technology for fourteen villages and manual mapping for three villages, with additional guidance from a village member to locate dwellings and demarcate village boundaries within the study area. Manual mapping to update the previous maps from PBS1 was done prior to PBS2.

Data Collection

Both surveys were carried out in the same way. Two field supervisors led a survey team of four members trained in data collection and fluent in Luo (local language in Agago District). A local village member guided an interviewer to each household but did not remain for the interviews. The interviewer returned later if household members were not at home; up to two visits were made to each household. Questionnaires were used to collect socioeconomic data and information on children from the household head (PBS1 and PBS2 Household questionnaires, Supplementary Information) and individual demographic and health-related information from up to three adults aged 15-59 years in each household (PBS1 and PBS2 Individual questionnaires, Supplementary information) (in a small number of households >3 adults were interviewed (Table 1); all data were included in the analysis). Individual health-related information included information on HIV-testing, HIV-status and, for HIV-positive individuals, information on HIV care and treatment. Minor amendments were made to the questionnaires prior to

Figure 1: Map of Lapono sub-county.



PBS2, to capture knowledge of availability of ART at Lira Kato HC and reasons for not accessing ART at Lira Kato HC, where applicable. Interviews were held with 2124 adults from 1351 households in PBS1 and 2123 adults from 1229 households in PBS2 (Table 1). Respondents were not linked between surveys but household identifier numbers were maintained; 747/1401 (53%) of households with a completed household questionnaire in PBS1 completed the household questionnaire in PBS2.

Table 1: Summary of households approached during the surveys

Number of Households	**PBS 1**	**PBS 2**
Total households mapped	1895	1964
Household questionnaire completed	1401(74%)	1316 (67%)
≥1 adult individual questionnaire completed	1351 (71%)	1229 (63%)
1 adult interviewed	753	558
2 adults interviewed	454	494
3 adults interviewed	116	138
>3 adults interviewed[a]	28	39

[a]The protocol allowed to interview up to three adults per household, although all interviews were included in analysis.

Statistical Analysis

We used descriptive statistics for most analyses. In line with study objectives we evaluated differences between pre- and post-decentralization surveys in self-reported HIV testing in the last year, EMTCT coverage and uptake of ART. We also investigated any changes in the proportions attending Lira Kato HC for HIV testing and for ANC. Villages 17, 18 and 19 were grouped as the villages furthest from Lira Kato HC and closest to Kalongo hospital (figure 1); we describe ART uptake in these villages versus the remainder. Differences were tested using random effects logit models including a random effect for village. All data were analysed using Stata12.1.

Ethics

Approval for the study protocol was obtained from the Joint Clinical Research Centre/Research Ethical Committee (JCRC/REC) and from the Uganda National Council for Science and Technology (UNCST) and Office of the President of the Republic of Uganda. All study participants provided written informed consent. The interviews were conducted within the household of the participants with one participant being interviewed at a time. Interviewers sought a private space for each interview in the home or surrounding compound.

Results:

Participants

In PBS2, 2123 individuals were interviewed including 821 (39%) males and 1302 (61%) females; numbers were similar in PBS1 (755 (36%) males and 1369 (64%) females). Household socio-economic indicators and participants' individual characteristics were similar in both surveys (Supplementary tables 1 and 2).

Knowledge of ART provision at nearest health facility in PBS2

After introduction of ART provision at Lira Kato HC, 1454 (69%) participants reported Lira Kato HC as the nearest ART facility with ART provision; 618 (29%) still thought Kalongo hospital was the nearest ART facility. Knowledge of ART provision at Lira Kato HC depended on village location; 324/771 (42%) participants in the three villages furthest from Lira Kato HC reported ART was available there (with most reporting Kalongo hospital as the nearest facility with ART) compared with 1130/1336(85%) in the 13villages closer to the health centre. Knowledge of ART provision at Lira Kato HC did not vary by age, sex or education (data not shown), and was mostly acquired from friends/relatives (640 (44%)) or through attendance at Lira Kato HC for other services (432 (30%)), while 148 (10%) heard about it through community talks.

HIV testing in last 12 months and HIV prevalence

The proportion of people who reported testing for HIV at least once in the last year had increased from 1077/2124 (51%) in 2013 to 1298/2123 (61%) in 2015 (p<0.001), with increases seen in men and women (Table 2, Figure 2). Among those who tested in the last year, most recent HIV tests were more likely to be at Lira Kato HC in PBS2 than in PBS1; recent HIV tests at Lira Kato HC in the past year increased nearly 2-fold between surveys from 357/2124 (17%) in PBS1 to 696/2123 (33%) participants in PBS2 (Table 2, Figure 2). Self-reported HIV prevalence in individuals ever-tested was similar in both surveys (136/1730 (8%) in PBS1; 133/1907 (7%) in PBS2); prevalence was lower in individuals who had tested in the last year in PBS2 (21 (1.6%)) than in PBS1 (36 (3.3%)) (p=0.007).

ANC and Elimination of Mother to Child Transmission of HIV (EMTCT)

At the time of PBS1, rates of attendance at ANC during pregnancy and HIV-testing during pregnancy were both high[18].Similarly, in PBS2, 576/579 (99%) women who had given birth in the two years preceding the survey attended ANC; 15/576 (3%) were already diagnosed with HIV (including 8 on ART). Of the remainder, 558/661 reported testing for HIV and 13 (2%) tested positive. 14/15 (93%) women diagnosed pre-pregnancy and 12/13 (92%) women newly diagnosed in ANC reported receiving ART for themselves to prevent transmission to their baby. Although not statistically significant, ART coverage in newly diagnosed women was higher than in PBS1 (12/13 (92%) versus 15/23 (65%); p=0.12). HIV-positive women who gave birth in the two years prior to survey were marginally more likely to attend Lira Kato HC for ANC in PBS2 (19/28 (68%)) than in PBS1 (12/27 (44%)) (p=0.10).

HIV care and treatment in adults

Most HIV-positive adults with self-reported HIV diagnosis (including those diagnosed through ANC) were in HIV-care in both surveys (124/136 (91%) in PBS1; 125/133 (94%) in PBS2). At the time of PBS1, 74/136 (54%) individuals were on ART compared with 108/133 (81%) in PBS 2 (p<0.001). The proportion of men on ART increased from 20/34 (59%) to 27/39 (69%) (p=0.17) and women on ART increased from 54/102 (53%) to 81/94 (86%) (p<0.001). Very few individuals had taken ART in the past but were not currently on ART (7 in PBS1, 1 in PBS2).16/81 (20%) of women on ART at the time of

PBS2 initiated ART post Option B+ roll-out either during pregnancy or within one year of giving birth; without Option B+ (assuming none of these women would have otherwise started ART), ART coverage would have reached 92/133 (69%) (compared to 54% in PBS1, p=0.003).

During PBS1, 69/74 (93%) adults on ART received care either at Kalongo hospital or Patongo HC (average 56 km and 76 km round trip from Lapono sub-county respectively); the remainder were being seen elsewhere (3) or the information was missing [16]. HIV-positive individuals living in the three villages closest to Kalongo hospital (villages 17, 18, 19 (figure 1)) were more likely to be on ART than those living further away (44/63 (70%) versus 30/73 (41%); p=0.001). Post-decentralization, 47/108 (44%) of those on ART were in care at Lira Kato HC, 58/108 (54%) were in care either at Kalongo Hospital (n=55) or Patongo HC (3) and the remaining 3/108 were at other facilities (Table 3, Figure 3). In PBS2, proportions of HIV-positive individuals on ART were similar in the three villages closest to Kalongo hospital and the remainder (33/41 (80%) versus 75/92 (82%); p=0.89). All individuals receiving ART at Lira Kato HC went there on foot. Median self-reported time taken for an individual to travel to Lira Kato HC, receive ART and return home was 5 hours (3-6 hours); this was substantially less than time taken to access ART across all facilities in PBS1 (12 hours (10-24 hours)).

When interviewed for PBS2, only 5/52 (10%) individuals who started ART prior to April 2013 were receiving ART at Lira Kato HC, having transferred there post ART initiation, whereas 6/9 (67%) individuals who started ART between April-August 2013 (including 4 initiations at Lira Kato (all for Option B+) and 2 transfers) and 36/47 (77%) individuals who started ART from September 2013 onwards (33 initiations, 3 transfers) were receiving ART at Lira Kato HC (Table 3, Figure 3).

In total, only 10/71(7 from Kalongo Hospital, 2 from Patongo HC and 1 from another facility) patients who started ART elsewhere had transferred to Lira Kato HC for ART (Table 3). The primary reasons given by 59/61individuals for not accessing ART at Lira Kato HC included concerns about drug-stock-outs (30 (51%)), starting ART before ART availability at Lira Kato HC (13 (22%)), lack of trust in clinical staff at Lira Kato HC (5

(8%)), stigma (4 (7%) and others reasons 7 (11%); all 61 knew Lira Kato HC provided ART.

Of the 37 individuals who initiated ART at Lira Kato HC, 10 (27%) were men, 14 (38%) were women initiating for Option B+ and 13 (35%) were non-B+ women. Excluding Option B+ women, 11/23 (48%) initiations were in individuals who tested HIV-positive prior to any ART provision at Lira Kato HC.

During PBS2,3/47 individuals on ART at Lira Kato HC reported not being able to collect both ART and cotrimoxazole in the past year (one individual reported 2 occasions); reasons given were drugs out of stock (n=2) and no healthcare worker available (n=1). 1/55 individuals on ART at Kalongo Hospital had not been able to collect either drug because the clinic was closed; there were no other difficulties reported with drug collection at the clinic at Kalongo Hospital or the other secondary health facilities (test for difference (Lira Kato HC vs other facilities), p=0.20). In contrast, only 1/47ART patients at Lira Kato HC had missed a clinic visit due to distance/cost versus 9/61 of those still attending more distant secondary facilities (test for difference (Lira Kato HC vs other facilities),p=0.05).

HIV care and treatment in children

In each survey, information for only eight HIV-positive children was provided; based on household numbers, we estimate two children were reported in both surveys. All HIV-positive children in PBS2 were in care and receiving both cotrimoxazole and ART in contrast to PBS1 in which 6/8 children were on cotrimoxazole, and only 3/8 were on ART and 1/8 child had dropped out of care due to transport costs to Kalongo hospital (Table 6). The majority of children attended Kalongo hospital (5/7 in PBS1 and 5/8 in PBS2). Post-decentralization, 3/8 children on ART were in care locally at Lira Kato HC; one was a new initiation and two transferred to Lira Kato HC from another facility after starting ART. Reasons for not accessing ART locally included fear of drug stock outs (2/5), not knowing ART was available at Lira Kato HC (1/5), awaiting transfer to Lira Kato HC (1/5) and reason unknown (1/5).

Discussion:

Population-based surveys pre- and post-decentralization of ART alongside Option B+ roll-out at the local primary health care facility in Agago, Northern Uganda demonstrated benefits of decentralization including an increase in the proportion of adults who reported testing for HIV in the last year, increased ART coverage and 44% of adults on ART accessing HIV care locally. The increase in recent HIV testing was driven by additional testing at the primary health care facility, particularly in men, which suggests that the availability of ART locally may have been a catalyst for the population seeking HIV testing; the safe male circumcision programme has run in the district for four years, covered both survey periods, and is likely to have contributed to the high levels of testing in men noted in both surveys. We did not collect information on reasons for recent HIV-testing which would have aided the understanding of these results. Encouragingly, although overall HIV prevalence was similar, among those tested in the last year, the proportion of self-reported positive tests declined between surveys. There was a significant increase in overall ART coverage, with a likely increase in EMTCT coverage; although undoubtedly, these increases were partly due to a change in HIV treatment guidelines which raised the CD4 threshold for ART initiation from 350 to 500 cell count, as well as country-wide roll-out of the Option B+ programme.[19,20]Post-decentralization new ART initiations were predominantly at the primary care facility, suggesting over time a higher proportion of ART patients will be treated locally. Around half of non-option B+ initiations at the primary care facility were in patients who had tested positive before any ART provision was available there hence some individuals may have been eligible for treatment previously but unable to receive it.

The majority of patients who had started ART in secondary care prior to decentralization of ART locally were reluctant to transfer to the primary care facility, despite the long distances they were travelling for treatment. A study conducted in Tanzania found that some patients preferred to attend more established health facilities rather than seeking care at the closest HIV care facilities[21]. A study on patient attitudes towards decentralization at an urban clinic in South Africa, showed some patients had reservations about receiving ART close to where they live due to concerns about stigma, lack of confidentiality, untrained staff and poor relations with nurses[22]. However, in this study, fear of drug stock outs was given by around half of the HIV-positive

individuals as the reason for not transferring to the primary care facility for follow up. Most of the remainder cited already starting ART elsewhere; it was unclear whether these individuals were unwilling to move, had not considered transferring, or were encouraged to remain at their current centre; all were aware of local availability of ART. Notably few individuals cited stigma and this did not appear to be a major concern among individuals on ART in this particular rural location. However, this study cannot address whether or not stigma remains a problem for individuals who had not been tested for HIV or did not reveal their HIV diagnosis during interview. Engaging staff at the secondary care facility (Kalongo hospital) to encourage and promote transfer of individuals on ART from Lapono sub-county is one of the strategies being used to improve transfer of clients on ART to their local primary care facility. In addition community linkage facilitators and village health teams continue to emphasize the availability of comprehensive HIV care and treatment services locally during home visits; in the light of our results these activities may require strengthening.

A small number of patients reported problems collecting drugs due to stock-outs at the primary care facility but no issues were reported in secondary care facilities, reinforcing the need for stock management training for staff especially at primary level facilities to ensure timely ordering and correct projection of HIV commodities. However, patients were more likely to miss attending clinic at secondary facilities than at the primary care facility due to distance and cost.

The numbers of children in care still appeared low, even after decentralization of ART to the local primary care facility. Given high EMTCT coverage, it may be that few new infant infections now occur. It is unclear to what extent older HIV-infected children are still outside HIV care; although guidelines include provider-initiated counselling and testing, in practice this is often missed[23]. Although numbers were small, the majority of the children in care attended Kalongo Hospital for ART, and some carers cited fear of drug stock outs as the reason for not accessing ART locally; previous work has suggested that stock-outs of paediatric ART may be more frequent than of adult ART[24].

Post-decentralization, over two thirds of the population reported the local primary care facility as the nearest facility where one could receive ART, although fewer participants

were aware of local ART availability in the villages furthest from the health facility, suggesting community engagement could still be improved.

One of the limitations of the study was that we were unable to link individuals between surveys so our conclusions are limited to cross-sectional comparisons. Given there was substantial overlap between participating households, and must have been considerable overlap between individuals, we may have underestimated changes between surveys. Another limitation was that all information collected relied on self-report and we had no linked data from health facilities to verify participants' responses; in particular, we had no HIV-testing data thus we may have underestimated HIV prevalence. However, prior to the survey, the team of interviewers had residential training focusing on conducting community HIV surveys, including role play sessions on how to encourage accurate self-reporting of HIV status among respondents. There is evidence that response bias can be minimized by training interviewers to act ethically, build rapport and probe responses for more valid answers[25]. Lastly, we included all households in the two parishes closest to the local health centre; whilst this means that we interviewed individuals most likely to benefit from decentralisation of ART services this could be a limitation of our findings if use of health services differs in populations living further away.

Conclusion:

HIV-testing and ART coverage, increased after decentralization combined with Option B+ roll-out. Individuals starting ART mostly started locally. Patients who started ART prior to decentralization were however reluctant to transfer to their local facility; the majority feared drug stock-outs. Although we identified only a low level of experience of stock-outs, the emphasis on stock management training for staff especially at primary level facilities to ensure timely ordering and correct projection for HIV commodities is critical. Patients attending secondary facilities were more likely to miss collecting ART due to distance/cost therefore reinforcing the need for decentralizing ART services close to home.

Authors' contributions

GA contributed to the proposal writing; participated in interviews; conducted literature review and contributed towards interpretation and analysis of the results; writing manuscript. SK contributed towards the supervision of data entry; analysis and interpretation of the data; writing manuscript. DF contributed substantially towards the proposal writing; supervision of data entry; analysis and interpretation of the data; writing and editing the manuscript. JS and DMG contributed towards the study design; proposal writing; interpretation of the results; writing the manuscript. VM, AKC, LC and TM provided technical advice in proposal writing and editing the manuscript. PR, ANP, CK, EK, JH, RC and CG contributed towards study design; interpretation of results and reviewing of the manuscript. All authors read and approved the final manuscript. GA, DMG and DF are guarantors of the paper.

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Competing interests

None declared.

Ethical Approval

Approval for the study protocol was obtained from the Joint Clinical Research Centre/Research Ethical Committee (JCRC/REC) and from the Uganda National Council for Science and Technology (UNCST) and Office of the President of the Republic of Uganda. All study participants signed a written informed consent form.

References:

1. UNAIDS. 90-90-90 An ambitious treatment target to help end the AIDS epidemic. Geneva: UNAIDS; 2014.

2. WHO. Guideline on when to start antiretroviral therapy and on pre-exposure prophylaxis for HIV.Geneva: WHO; 2015.
3. Ministry of Health Uganda. Uganda AIDS Indicator Survey 2011. Kampala:Ministry of Health Uganda; 2012.
4. Ministry of Health Uganda. Status of antiretroviral therapy services in Uganda. Semi-Annual ART Report for January – June 2014. Kampala: Ministry of Health Uganda; 2014.
5. Uganda Bureau of Statistics. 2015 Statistical Abstract. Kampala:Uganda Bureau of Statistics; 2015.
6. Fatti G, Grimwood A, Bock P. Better antiretroviral therapy outcomes at primary healthcare facilities: an evaluation of three tiers of ART services in four South African provinces. PLoS One 2010; 5: e12888.
7. Chan AK, Mateyu G, JahnA, Schouten E, Arora P, Mlotha W,et al. Outcome assessment of decentralization of antiretroviral therapy provision in a rural district of Malawi using an integrated primary care model. Trop Med Int Health 2010; 15Suppl 1: 90–97.
8. Reidy WJ, Sheriff M, Wang C, Hawken M, Koech E, Elul B,et al. Decentralization of HIV Care and Treatment Services in Central Province, Kenya.JAcquir Immune DeficSyndr 2014; 67:e34–e40.
9. Boyer S, Ebokob F, Camara M, Abe C, Nguini MEO,Koulla-shiro S, et al.Scaling up access to antiretroviral treatment for HIV infection: the impact of decentralization of healthcare delivery in Cameroon. AIDS 2010; 24Suppl 1:S5–S15
10. Massaquoi M, Zachariah R, Manzi M, Pasulani O, Misindi D, Mwagomba B, et al. Patient retention and attrition on antiretroviral treatment at district level in rural Malawi. Trans R Soc Trop Med Hyg 2009; 103: 594–600.
11. McGuire M, Pinoges L, Kanapathipillai, R Munyenyembe T, Huckabee M, Makombe S, et al. Treatment initiation, program attrition and patient treatment outcomes associated with scale-up and decentralization of HIV care in rural Malawi. PLoS One 2012; 7: e38044.
12. Fayorsey RN, Saito S, Carter RJ, Gusmao E, Frederix K,Koech-Keter E,et al. Decentralization of pediatric HIV care and treatment in five sub-Saharan African countries. J Acquir Immune DeficSyndr 2013; 62: e124–130.
13. vanDijk JH, Moss WJ, Hamangaba F, Munsanje B, Sutcliffe CG. Scaling-Up Access to Antiretroviral Therapy for Children: A Cohort Study Evaluating Care and Treatment at Mobile and Hospital-Affiliated HIV Clinics in Rural Zambia. PLoS ONE 2014; 9(8): e104884.
14. Pinto AD, van Lettow M, Rachlis B, Chan AK, Sodhi SK. Patient costs associated with accessing HIV/AIDS care in Malawi. J Int AIDS Soc. 2013; 16:18055
15. MuulaAS. Who accesses antiretroviral drugs within public sector in Malawi? Croat Med J. 2006;47:356-9

16. Makwiza I, Nyirenda L, Bongololo G, Banda T, Chimzizi R, Theobald S. Who has access to counseling and testing and anti-retroviral therapy in Malawi - an equity analysis.Int J Equity Health. 2009;8:13.
17. Lablite enabling ART roll out; 2012.Available at http://lablite.org/ (Accessed December 2015)
18. Abongomera G, Kiwuwa-Muyingo S, Revill P, Chiwaula L, Mabugu T, Phillips A, et al.Population level usage of health services, and HIV testing and care, prior to decentralization of Antiretroviral Therapy in Agago District in rural Northern Uganda BMC Health Services Research 2015; 15:527.
19. Ministry of Health Uganda. Addendum to the National Antiretroviral Treatment Guidelines. Kampala: Ministry of Health Uganda; 2013.
20. Ministry of Health Uganda: EMTCT Communication Plan to Support the Roll Out of Option B+ for EMTCT in Uganda. Kampala: Ministry of Health Uganda; 2012.
21. Ostermann J, Whetten K, Reddy E, Pence B, Weinhold A, Itemba D, et al. Treatment retention and care transitions during and after the scale-up of HIV care and treatment in Northern Tanzania. AIDS Care 2014; 26 (11): 1352–1358.
22. Mukora R, Charalambous S, Dahab M, Hamilton R, Karstaedt A. A study of patient attitudes towards decentralisation of HIV care in an urban clinic in South Africa. BMC Health Services Research 2011; 11:205.
23. PenazzatoM, Revill P, Prendergast AJ, Collins IJ, Walker S, Elyanu PJ, et al. Early infant diagnosis of HIV infection in low-income and middle-income countries: does one size fit all?Lancet Infectious Diseases 2014; 14 (7): 650–655
24. Chan AK, Ford D, Namata H, Muzambi M, Nkhata MJ, Abongomera G, et al.TheLablite project: A cross-sectional mapping survey of decentralized HIV service provision in Malawi, Uganda and Zimbabwe. BMC Health Services Research 2014;14:352.
25. Johnston LG, Sabin LM, Prybylski D, Sabin K, McFarland W, Baral S, et al. The importance of assessing self-reported HIV status in bio-behavioural surveys. Bull World Health Organ 2016;94:605–612

Table 2: Self-reported HIV testing and self-reported HIV prevalence

	Men		Women		Total		
	PBS1 N=755	PBS2 N=821	PBS1 N=1369	PBS2 N=1302	PBS1 N=2124	PBS2 N=2123	Test for difference (p)*
HIV testing in the last year							
Tested ≥ once in the last year	406 (54%)	584 (71%)	671 (49%)	714 (55%)	1077 (51%)	1298 (61%)	<0.001
Most recent HIV test facility[a]							
Lira Kato HC Kalongo Hosp Other facilities	150 (37%) 119 (29%) 137 (34%)	351 (60%) 124 (21%) 109 (19%)	207 (31%) 83 (12%) 381 (57%)	345 (48%) 80 (11%) 289 (40%)	357 (33%) 202 (19%) 518 (48%)	696 (54%) 204 (16%) 398 (31%)	<0.001
HIV prevalence[a]	5 (1.2%)	9 (1.5%)	31 (4.6%)	12 (1.7%)	36 (3.3%)	21 (1.6%)	0.007
HIV testing ever							
Ever tested	574 (76%)	734 (89%)	1156 (84%)	1173 (90%)	1730 (81%)	1907 (90%)	<0.001
HIV prevalence[b]	34 (6%)	39 (5%)	102 (9%)	94 (8%)	136 (8%)	133 (7%)	0.30

[a]Restricted to those who tested in the last 12 months

[b]Self-reported prevalence in those ever tested for HIV

*PBS1 versus PBS2 across total
**Lira Kato HC versus Kalongo & other health facilities

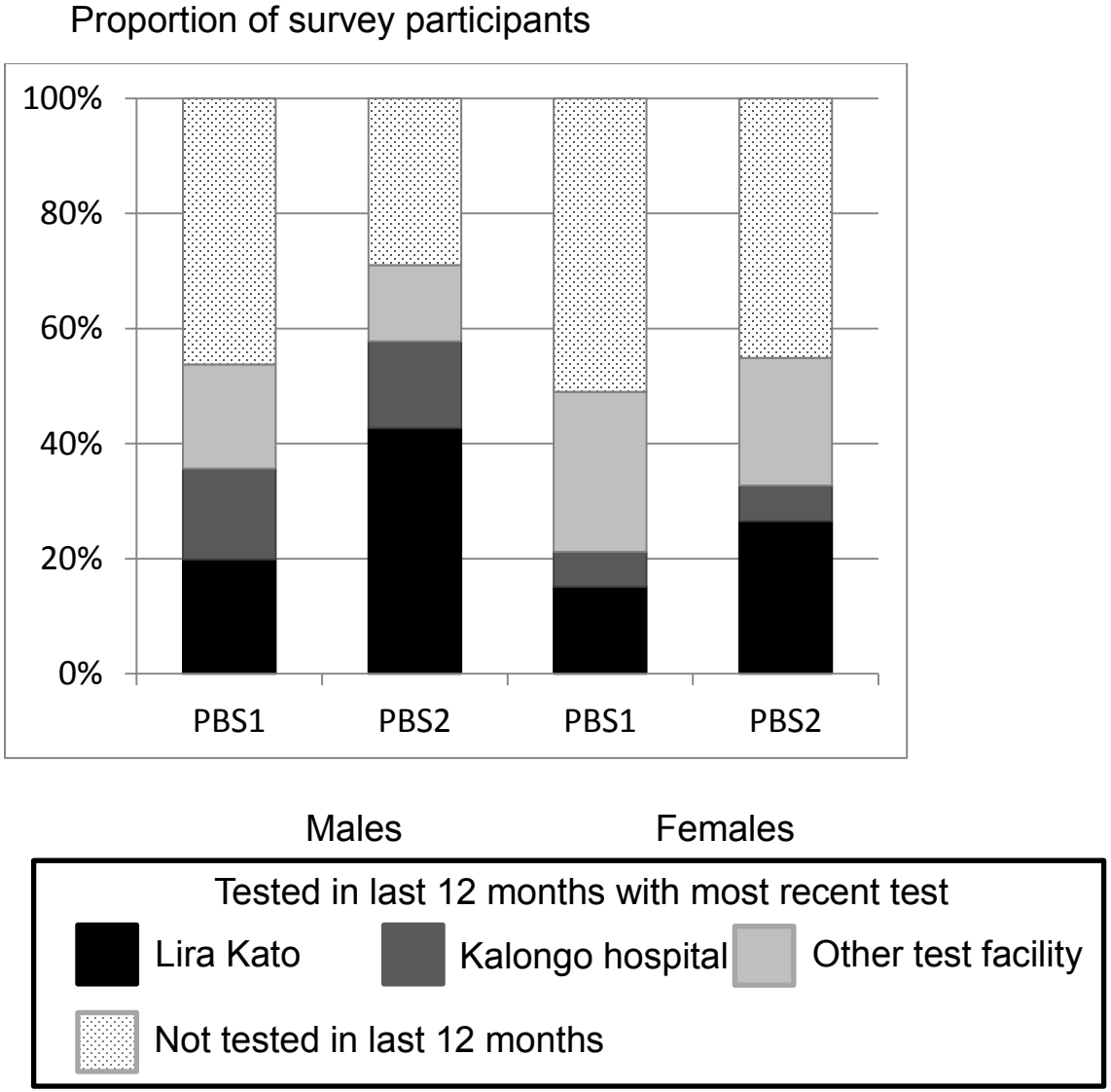

Figure 2: Self-reported HIV testing in the last 12 months and most recent test facility before and after ART provision at the local primary care facility (Lira Kato HC). PBS1: Population-based Survey 1 (before decentralization); PBS2: Population-based Survey 2 (after decentralization).

Table 3: Current HIV care facility by time of ART initiation in adults in PBS 2

Time of ART initiation	HIV care facility at time of interview					
	Kalongo Hospital or Patongo HC		Lira Kato HC		Other	
	Initiating facility	Transfer-in	Initiating facility	Transfer-in	Initiating facility	Transfer-in
Before April 2013[a]	44	2	0	5	1	0
April 2013 – August 2013[b]	3	0	4	2	0	0
September 2013[c]- February 2014	3	0	12	0	1	0
March 2014 – August 2014	4	1	8	2	0	0
September 2014 - interview	1	0	13	1	1	0
Total	55	3	37	10	3	0

[a]No ART was available at Lira Kato HC prior to April 2013
[b]Option B+ was available at Lira Kato HC
[c]General ART was available at Lira Kao HC from September 2013

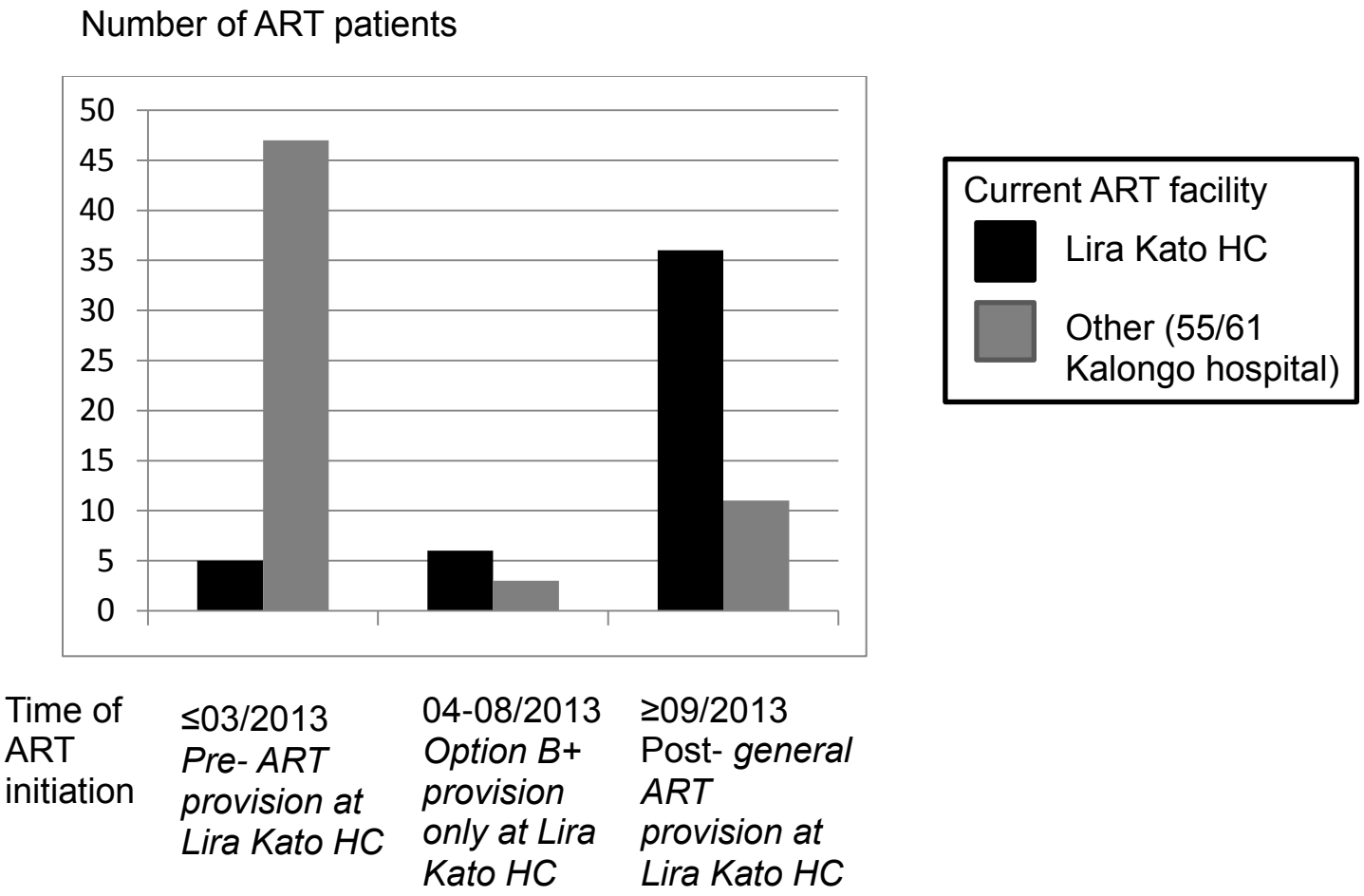

Figure 3: Current ART facility at time of interview (PBS2) by time of ART initiation

Table 4: Summary of the HIV-Infected children reportedin both surveys

Surveys	**PBS1 N=8**	**PBS2 N=8**
Current age		
<=2	0	0
2-5	4	3
>5	4	5
Current Health Facility		
Lira Kato HC	2	3
Kalongo Hospital	5	5
Not in care	1	0
Currently on cotrimoxazole	6	8
Currently on ART	3	8
TransporttoHealthFacility		
Own Bike	1	3
Borrowed Bike	1	2
Foot	5	3
Primary Carer		
Mother	5	6
Father	1	1
Grandmother	1	0
Siblings	1	0
Uncle	0	1

Supplementary Table 1: Percent distribution of household characteristics in the UDHS 2011, PBS 1 and PBS 2

Characteristic	UDHS 2011		PBS 1	PBS 2
	Urban	Rural		
	n=2551	n=6482	n=1401*	n=1320*
Household Headship[a]				
Male	69.0	70.8	456 (61.5)	412 (51.4)
Female	31.0	29.2	286 (38.5)	389 (48.6)
Main water source[b]				
River	NA	NA	2 (0.1)	0 (0.0)
Well/Spring	12.5	28.4	10 (0.7)	5 (0.4)
Borehole	11.8	43.9	1370 (97.9)	1305 (98.9)
Rain catchment	0.5	1.4	1 (0.1)	0 (0.0)
Water tap in house/plot	27.9	1.5	0 (0.0)	0 (0.0)
Trench	NA	NA	8 (0.6)	7 (0.5)
Dam	NA	NA	9 (0.6)	3 (0.2)
Stand pipe/public tap	38.9	8.2	NA	NA
Bottle water	4.6	0.4	NA	NA
Tanker truck/vendor	2.2	0.9	NA	NA
Surface water	1.0	14.6	NA	NA
Other	0.6	0.8	NA	NA
Toilet				
Pit latrine	67.4	83.4	501 (35.8)	525 (40.0)
VIP latrine	18.6	4.2	12 (0.9)	0 (0.0)
Flush toilet	11.3	0.3	0 (0.0)	0 (0.0)
Other toilet	0.8	0.6	4 (0.3)	0 (0.0)
Toilet type not specified	0.0	0.0	20 (1.4)	0 (0.0)
No facility	1.8	11.5	864 (61.7)	792 (60.0)
				*** 3 missing**
Predominant Lighting[c]				
Electricity	55.9	3.9	11 (0.8)	28 (2.1)
Paraffin lantern/Candle	35.4	86.7	1339 (96.3)	900 (68.2)
Wax candle	5.8	2.0	5 (0.4)	3 (0.2)
Others[d]	3.0	7.5	36 (2.6)	389 (29.5)
Household Possessions				
Mosquito Net	80.9	72.4	844 (60.8)	1185 (89.8)
Radio	71.8	64.6	349 (25.0)	266 (20.2)
Television	45.0	4.9	4 (0.3)	7 (0.5)

Mobile phone	86.8	53.1	395 (28.3)	373 (28.3)
Means of transport				
Bicycle	19.5	41.1	497 (35.6)	477 (36.2)
Motorcycle	11.4	7.1	42 (3.0)	51 (3.9)
Car/truck	10.1	1.6	3 (0.2)	1 (0.1)

*For the PBS surveys numbers and percentages of households are provided. Where numbers do not sum to total, this is due to missing data. Percentages are of non-missing data.

[a]Not all participants interviewed for the PBS household questionnaires were heads of household and this information is only available if the head of household was interviewed

[b]The choices for water source did not completely overlap between the UDHS and PBS surveys. NA indicates the choice was not available and zero indicates it was available but not selected.

[c]Taken from Uganda AIDS Indicator Survey, 2011 [3] as not available in the UDHS Survey [18].

[d]InPBS2, 312 (23.6%) households were using torches for lighting and torches could not be separated out from other in PBS1

Supplementary Table 2: Socio-demographic characteristics of the study participants in PBS1 and PBS2

Surveys	PBS1			PBS2		
Characteristic	**Men** n=755	**Women** n=1369	**Total** n=2124	**Men** n=822	**Women** n=1300	**Total** n=2122
Age						
≤19	208 (27.6)	298 (21.8)	506 (23.9)	152 (18.5)	202 (15.5)	354 (16.7)
20-29	195 (25.9)	416 (30.4)	611 (28.8)	236 (28.7)	406 (31.2)	642 (30.2)
30-39	194 (25.8)	384 (28.1)	578 (27.3)	208 (25.3)	374 (28.8)	582 (27.4)
40-49	108 (14.3)	169 (12.4)	277 (13.0)	141 (17.2)	196 (15.1)	337 (15.9)
50+	48 (6.4)	100 (7.3)	148 (7.0)	84 (10.2)	119 (9.2)	203 (9.6)
Highest level of Education						
None	44 (5.8)	520 (38.2)	564 (26.6)	60 (7.3)	536 (41.2)	596 (28.1)
Pre-primary/Some primary	387 (51.3)	670 (49.2)	1057 (49.9)	304 (37.0)	520 (40.0)	824 (38.8)
Completed primary	104 (13.8)	93 (6.8)	197 (9.3)	184 (22.4)	143 (11.0)	327 (15.4)
Some secondary	142 (18.8)	63 (4.6)	205 (9.7)	168 (20.4)	61 (4.7)	229 (10.8)
Completed secondary	25 (3.3)	10 (0.7)	35 (1.7)	47 (5.7)	23 (1.7)	70 (3.3)
Higher Education/ Vocational	53 (7.0)	7 (0.5)	60 (2.8)	58 (7.0)	13 (1.0)	71 (3.3)
Source of Livelihood[a]						
Subsistence crop grower	710 (94.0)	1336 (97.6)	2046 (96.3)	794 (96.6)	1282 (98.6)	2076 (97.8)
Cash crop grower	322 (42.6)	573 (41.2)	895 (42.1)	282 (34.4)	419 (32.2)	701 (33.0)
Livestock farmer	309 (40.9)	476 (34.8)	785 (37.0)	216 (26.3)	222 (17.1)	438 (20.6)
Brick Maker	97 (12.8)	4 (0.3)	101 (4.8)	41 (5.0)	2 (0.2)	43 (3.3)
Alcohol brewing	0 (0.0)	724 (52.9)	724 (34.1)	43 (5.2)	411 (31.6)	454 (21.4)
Petty/retail business	68 (9.0)	192 (14.0)	260 (12.2)	60 (7.3)	132 (10.2)	192 (9.0)
Others	191 (25.3)	127 (9.3)	310 (14.6)	57 (6.3)	29 (2.2)	86 (4.1)
Current Partnership						
Married	493 (65.3)	1000 (73.0)	1493 (70.3)	560 (68.4)	846 (65.1)	1406 (66.4)
Living with partner as if married	10 (1.3)	18 (1.3)	28 (1.3)	64 (7.8)	136 (10.5)	200 (9.4)
Never married	232 (30.7)	179 (13.1)	411 (19.4)	172 (21.0)	139 (10.7)	311 (14.7)

Widow/widower	6 (0.8)	109 (8.0)	115 (5.4)	4 (0.5)	110 (8.5)	114 (5.4)
Separated/Divorced	14 (1.9)	63 (4.6)	77 (3.6)	19 (2.3)	68 (5.2)	87 (4.1)

Data are n (%). Where numbers do not sum to total this is due to missing data. Percentages are of non-missing data.

[a]Individuals were able to report >1 source of livelihood.