



Published in final edited form as:

*AIDS Care*. 2022 July ; 34(7): 878–886. doi:10.1080/09540121.2021.1894316.

## Food insecurity predicts loss to follow-up among people living with HIV in Senegal, West Africa

Noelle A. Benzekri<sup>a</sup>, Jacques F. Sambou<sup>b</sup>, Sanou Ndong<sup>c</sup>, Mouhamadou Baïla Diallo<sup>c</sup>, Ibrahima Tito Tamba<sup>d</sup>, Dominique Faye<sup>b</sup>, Jean Philippe Diatta<sup>b</sup>, Khadim Faye<sup>c</sup>, Ibrahima Sall<sup>b</sup>, Fatima Sall<sup>c</sup>, Ousseynou Cisse<sup>b</sup>, Jean Jacques Malomar<sup>b</sup>, Cheikh T. Ndour<sup>e</sup>, Papa Salif Sow<sup>c</sup>, Stephen E. Hawes<sup>f,g</sup>, Moussa Seydi<sup>c</sup>, Geoffrey S. Gottlieb<sup>a,g</sup>

<sup>a</sup>Department of Medicine, University of Washington, Seattle, WA, USA

<sup>b</sup>Centre de Santé de Ziguinchor, Ziguinchor, Senegal

<sup>c</sup>Services des Maladies Infectieuses et Tropicales, Centre Hospitalier National Universitaire de Fann, Dakar, Senegal

<sup>d</sup>Centre de Santé de Bignona, Bignona, Senegal

<sup>e</sup>Division de Lutte contre le Sida et les IST, Ministère de la Santé et de l'Action Sociale, Dakar, Senegal

<sup>f</sup>Department of Epidemiology, University of Washington, Seattle, WA, USA

<sup>g</sup>Department of Global Health, University of Washington, Seattle, WA, USA

### Abstract

The goals of this study were to assess retention on antiretroviral therapy (ART) and to identify predictors of loss to follow-up (LTFU) among people living with HIV (PLHIV) in Senegal. HIV-positive individuals presenting for initiation of ART in Dakar and Ziguinchor were enrolled and followed for 12 months. Data were collected using interviews, clinical evaluations, laboratory analyses, chart review, and active patient tracing. Of the 207 individuals enrolled, 70% were female, 32% had no formal education, and 28% were severely food insecure. At the end of the follow-up period, 58% were retained on ART, 15% were deceased, 4% had transferred care, 5% had migrated, and 16% were lost to follow-up. Enrollment in Ziguinchor (OR 2.71 [1.01–7.22]) and severe food insecurity (OR 2.55 [1.09–5.96]) were predictive of LTFU. Sex, age, CD4 count, BMI <18.5, country of birth, marital status, number of children, household size, education, consultation with traditional healers, transportation time, and transportation cost were not associated with LTFU. The strongest predictor of severe food insecurity was lack of formal education (OR 2.75 [1.30–5.80]). Addressing the upstream drivers of food insecurity and

---

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

**CONTACT** Noelle A. Benzekri benzekri@uw.edu.

Disclosure statement

No potential conflict of interest was reported by the author(s).

implementing strategies to enhance food security for PLHIV may be effective approaches to reduce LTFU and strengthen the HIV care cascade in the region.

## Keywords

HIV; retention in care; loss to follow-up; antiretroviral therapy; care cascade; food insecurity; social determinants; West Africa

---

## Introduction

According to UNAIDS, progress towards the 90-90-90 targets in West and Central Africa has been slow compared to other regions (UNAIDS, 2020). Among the 4.9 million people living with HIV (PLHIV) in West and Central Africa in 2019, 68% knew their HIV status, 58% were receiving antiretroviral therapy (ART), and 45% had suppressed viral loads. Although 13% of PLHIV globally live in West and Central Africa, 20% of AIDS-related deaths in 2019 occurred in the region.

The second UNAIDS 90-90-90 target states that 90% of all people diagnosed with HIV infection will receive sustained ART, which is predicated on retention in care (UNAIDS, 2014). Previous studies of retention on ART among PLHIV have found that loss to follow-up (LTFU) rates are high in West Africa (Ekouevi et al., 2010; Fox & Rosen, 2015; Haas et al., 2018); however, prospective studies to identify risk factors for LTFU among PLHIV in West Africa are limited.

Addressing weaknesses along the entire continuum of care, including barriers to sustained ART, is critical to interrupting transmission, preventing mortality, and ending the HIV epidemic. The aims of this study were to assess retention on ART and to identify predictors of LTFU among a prospective cohort of PLHIV in Senegal, West Africa.

## Methods

This study was conducted at the Services des Maladies Infectieuses et Tropicales, CHNU-Fann in Dakar and the Centre de Santé de Ziguinchor, located in the Casamance Region. Participants were enrolled from April 2017 to April 2018 and were followed for a period of 12 months. All HIV-positive individuals initiating ART through the Senegalese Antiretroviral Drug Access Initiative who provided informed consent were eligible for enrollment. For participants <18 years of age, consent was obtained from their legal guardian. Study procedures were approved by the University of Washington Institutional Review Board and the Senegal Comité National d’Ethique pour la Recherche en Santé.

Data were collected using interviews, clinical evaluations, laboratory analyses, and chart review. Sociodemographic characteristics and health seeking behaviors were determined using enrollment interviews. Baseline nutritional status, WHO clinical stage, CD4 cell count, and HIV associated characteristics were determined at enrollment using clinical evaluations, lab analyses, and chart review. Food insecurity was determined at enrollment, month 6, and month 12 using the Household Food Insecurity Access Scale (HFIAS) (Coates

et al., 2007). “Not food insecure” was defined as a HFIAS score of 1 on a scale of 1–4, “food insecure” was defined as a HFIAS score of 2–4, and “severely food insecure” was defined as a HFIAS score of 4.

Outcomes were determined at the end of the 12 month follow-up period. “Retained on ART” was defined as alive, retained in care, and receiving ART as determined by patient report and the medical record. Medical records and family report were used to ascertain mortality. Patients who had no contact with the clinic for >6 months were traced by phone call or home visit, and were classified as deceased, transferred care to another clinic, migrated, or lost to follow-up. Patients were considered lost to follow-up if they had no contact with the clinic for >6 months (Chi et al., 2011; Grimsrud et al., 2013) and were alive but not retained in care or if they could not be traced. The primary outcome for this study was loss to follow-up; the comparison group included those retained in care at the study clinic, transferred to another clinic, and migrated.

Data were analyzed using SPSS Statistics 26. Descriptive analysis was performed for all variables. Chi-square and Fisher’s Exact tests were used to identify differences in patient characteristics between individuals in Dakar versus Ziguinchor. The Mann–Whitney U test was used to identify differences in medians between groups. Logistic regression was used to identify predictors of LTFU and severe food insecurity. Variables that were significantly associated with LTFU or severe food insecurity using simple regression were included in the multiple logistic regression models. Individuals known to be deceased and the individual who withdrew from care were excluded from the LTFU regression model. Missing data were excluded from analysis. *P*-values <0.05 were considered significant.

## Results

We enrolled 207 HIV-positive individuals, of which 84 (41%) were enrolled in Dakar and 123 (59%) were enrolled in Ziguinchor (Table 1). More than two-thirds of participants (70%) were female and the median age was 37 years (IQR 31–46). The median baseline CD4 count was 181 cells/mm<sup>3</sup> (IQR 63–382). Among non-pregnant participants 18 years of age, 41% had a BMI <18.5.

The majority of participants (80%) were born in Senegal. Nearly one third of participants had no formal education and fewer than 30% had received any education beyond primary school. Only 61% of women had received any formal education versus 86% of men (*p* < 0.01), and only 27% of women had received any education beyond primary school versus 36% of men (*p* = 0.01). The majority of participants (86%) were unemployed. Approximately two thirds of participants had some form of food insecurity at their most recent study encounter and 28% were severely food insecure; a greater percentage of participants in Ziguinchor were severely food insecure compared to Dakar (35% vs. 17%, *p* = 0.01). Seeking care from traditional healers was reported by 36% of all participants and was more common in Ziguinchor (43% vs. 26%, *p* = 0.02). Individuals in Dakar spent more time traveling to and from clinic (median 240 min vs. 40 min, *p* < 0.01), while individuals in Ziguinchor spent more on the cost of transportation (\$1.74 vs. \$1.39, *p* < 0.01).

At the end of the 12 month follow-up period, 120 individuals (58%) were alive and retained on ART at the study clinic, 30 individuals (15%) were deceased, 8 (4%) had transferred care, 11 (5%) had migrated, and 33 (16%) were lost to follow-up. Four individuals (2%) were retained in care but were not receiving ART. One participant withdrew from care <24 h after enrollment in order to seek care from a traditional healer, and was not traced. In Ziguinchor, 22% of participants were lost to follow-up compared to 7% of participants in Dakar ( $p < 0.01$ ). Of the 11 individuals who had migrated, 1 moved to France, 2 went to the Gambia, and 8 returned to Guinea-Bissau. Excluding individuals who were deceased and those who had migrated or transferred, 75.9% of participants were retained on ART at 12 months (91.5% in Dakar and 63.2% in Ziguinchor).

Enrollment at the Ziguinchor site (OR 2.71, 95% CI 1.01–7.22;  $p = 0.047$ ) and severe food insecurity (OR 2.55, 95% CI 1.09–5.96;  $p = 0.03$ ) were predictive of LTFU (Table 2). Sex, age, baseline CD4 cell count, BMI <18.5, country of birth, marital status, number of children, household size, education, seeking care from traditional healers, transportation time to clinic, and transportation cost were not associated with LTFU. Individuals enrolled at the Ziguinchor site (OR 2.66, 1.34–5.29;  $p = 0.01$ ), women (OR 2.37, 1.10–5.10;  $p = 0.03$ ), and those without any formal education (OR 3.51, 1.75–7.04;  $p < 0.01$ ) had greater odds of severe food insecurity using simple logistic regressions (Table 3). In the multiple regression model, the only significant predictor of severe food insecurity was lack of any formal education (OR 2.75, 95% CI 1.30–5.80;  $p = 0.01$ ).

## Discussion

In this prospective longitudinal study, we evaluated factors that we hypothesized could contribute to LTFU, and traced patients who were not retained in care in order to refine our understanding of patient outcomes. We found that retention on ART is substantially lower than the UNAIDS target, particularly among individuals enrolled in Ziguinchor, and severe food insecurity is a strong predictor of LTFU.

Food security exists when people have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Food and Agricultural Organization of the United Nations, 2009; Food and Agricultural Organization of the United Nations, 2019). The four dimensions of food security are food availability, access, utilization, and stability over time (Food and Agricultural Organization of the United Nations, 2019; Benzekri et al., 2017). The right to adequate food and freedom from hunger are recognized as basic human rights in the Universal Declaration of Human Rights (Food and Agricultural Organization of the United Nations, 1998; Universal Declaration of Human Rights, General Assembly of the United Nations, 1948), and ending hunger and achieving food security are targets of goal 2 of the United Nations Sustainable Development Goals (United Nations, 2015).

Our previous work has shown that the majority of PLHIV in Senegal are food insecure (Benzekri et al., 2015). The mechanisms through which food insecurity can contribute to poor HIV outcomes are mediated through vulnerabilities along the entire HIV continuum of care. Food insecurity can contribute to increased risk of HIV acquisition through high-

risk behaviors and coping strategies (Chop et al., 2017; Weiser et al., 2007; Willie et al., 2018). Food insecurity contributes to poor adherence to ART when individuals choose not to take ART due to hunger and lack of food to take with their medications (Au et al., 2006; Benzekri et al., 2015; Hardon et al., 2007; Merten et al., 2010; Musumari et al., 2013; Nagata et al., 2012; Weiser et al., 2010), when they are confronted with the competing demands of paying for transportation costs and medical expenses or purchasing food (Merten et al., 2010; Tuller et al., 2010; Weiser et al., 2010), or when time spent earning wages or performing agricultural work is prioritized over time spent traveling to clinic and waiting for care. As a barrier to ART adherence (Singer et al., 2015; Young et al., 2014), food insecurity can contribute to virologic failure (Aibibula et al., 2017), which increases risk of HIV transmission. Food insecurity also has the potential to contribute to vertical transmission when it acts as a barrier to uptake of prevention of maternal to child transmission services (McCoy et al., 2015). The high prevalence of food insecurity among PLHIV in Senegal and its role as a driver of poor outcomes across the HIV care cascade, suggest that strategies to address food insecurity will be critical to achieving the 90–90–90 targets and ending the HIV epidemic.

Our findings suggest that there is a substantial gap in progress towards achieving the second 90–90–90 target in Senegal and reveal important regional differences in retention in care. We found that loss to follow-up was higher among individuals in Ziguinchor, located in the Casamance Region. The Casamance Region, which recently emerged from a decades long war for independence (TNH, 2015), has been the most severely affected by the HIV epidemic and has the highest prevalence of food insecurity in the country (World Food Program, 2014). The longstanding civil conflict, which included the extensive use of landmines, disrupted social structures and agricultural and economic development (Analyses et Cartographie de la Vulnérabilité au VIH - Rapport de la région de Ziguinchor, 2013; TNH, 2015). Although the Casamance has the highest prevalence of HIV in the country, this is the first study to evaluate retention in care among PLHIV in the region.

Male sex, younger age, and indicators of advanced HIV disease have been associated with LTFU in a number of studies conducted in sub-Saharan Africa, including the few studies conducted in West Africa (Agbaji et al., 2015; Alhaj et al., 2019; Aliyu et al., 2019; Arnesen et al., 2017; Asiimwe et al., 2015; Bekolo et al., 2013; Bilinski et al., 2017; Dalhatu et al., 2016; Ekouevi et al., 2010; Geng et al., 2016; Jespersen et al., 2016; Nordentoft et al., 2017; Nsanzimana et al., 2015; Ochieng-Ooko et al., 2010; Saka et al., 2013; Sifa et al., 2019; Tsague et al., 2008; Tweya et al., 2018; Wringe et al., 2018). In our study, these factors were not predictors of LTFU. The absence of an association between advanced disease and LTFU in this study may be attributable to the inclusion of patient tracing, which minimized the number of deceased patients that might otherwise have been misclassified as lost to follow-up.

Social and structural barriers to retention in care that have been identified previously include lower educational level (Agbaji et al., 2015; Dalhatu et al., 2016), unemployment (Mekonnen et al., 2019), being unmarried (Agbaji et al., 2015; Asiimwe et al., 2015; Nsanzimana et al., 2015), transportation time or distance to clinic (Bekolo et al., 2013; Bilinski et al., 2017; Geng et al., 2016; Ochieng-Ooko et al., 2010) and transportation

costs (Hardon et al., 2007; Tuller et al., 2010). Our findings indicate that despite the immense potential barriers confronted by HIV-infected individuals in Senegal, including lack of access to education, unemployment, and lengthy travel times, these factors do not directly contribute to LTFU. Rather, our study highlights a potential pathway by which lack of formal education is a major risk factor for severe food insecurity, which subsequently contributes to poor retention in care. Poor retention in care and interruptions in ART increase the risk of virologic failure, ongoing HIV transmission, and death (Bangsberg et al., 2001; Cohen et al., 2016; Donnell et al., 2010; Fox & Rosen, 2015; Hogg et al., 2002; Nachega et al., 2007; Thompson et al., 2012; Turner, 2002).

Previous studies have suggested that seeking care from traditional healers and the use of traditional medicine may contribute to poor retention in care and interruption of ART (Dahab et al., 2010; Merten et al., 2010; Tong et al., 2018; Unge et al., 2011). We previously reported an association between seeking care from traditional healers and presentation with advanced HIV disease in Senegal (Benzekri et al., 2019). In this study, we explored whether individuals who sought care from traditional healers would be less likely to remain in care. Although traditional healer use was reported by more than a third of individuals, we did not find an association between traditional healer use and loss to follow-up. Given the high prevalence of traditional healer use in this population, the implications of concurrent use of ART and traditional medicine warrant further investigation.

Our study demonstrates the importance of enhanced monitoring and evaluation of programmatic data, including active patient tracing, in order to obtain an accurate understanding of the state of the HIV care cascade in Senegal. The primary limitations of our study were evaluation of only two HIV clinics in Senegal, small sample size, missing data, and incomplete data regarding rates of viral suppression. Future studies which include viral load monitoring would contribute to our understanding of the impact of food insecurity on HIV outcomes in this region.

## Conclusion

LTFU is common in our study population and is associated with severe food insecurity. Addressing the upstream drivers of food insecurity and implementing strategies to enhance food security for PLHIV may be effective approaches to reduce LTFU and strengthen the HIV care cascade.

## Acknowledgements

The authors would like to thank the study participants and the staff of the Services des Maladies Infectieuses et Tropicales and the Centre Régional de Recherche et de Formation à la Prise en Charge Clinique, Centre Hospitalier Universitaire de Fann and the Centre de Santé de Ziguinchor.

### Funding

This study was supported by the National Institutes of Health (National Institute of Allergy and Infectious Diseases, K23 AI120761 to N.A.B). The funding body had no role in the design of the study, collection, analysis, or interpretation of data, or in writing the manuscript.

## References

- Agbaji OO, Abah IO, Falang KD, Ebonyi AO, Musa J, Ugoagwu P, Agaba PA, Sagay AS, Jolayemi T, Okonkwo P, Idoko JA, & Kanki PJ (2015). Treatment discontinuation in Adult HIV-infected patients on first-line antiretroviral therapy in Nigeria. *Current HIV Research*, 13(3), 184–192. 10.2174/1570162X1303150506181945 [PubMed: 25986369]
- Aibibula W, Cox J, Hamelin AM, McLinden T, Klein MB, & Brassard P (2017). Association between food insecurity and HIV viral suppression: A Systematic Review and meta-analysis. *AIDS and Behavior*, 21(3), 754–765. 10.1007/s10461-016-1605-5 [PubMed: 27837425]
- Alhaj M, Amberbir A, Singogo E, Banda V, van Lettow M, Matengeni A, Kawalazira G, Theu J, Jagriti MR, Chan AK, & van Oosterhout JJ (2019). Retention on antiretroviral therapy during Universal test and treat implementation in zomba district, Malawi: A retrospective cohort study. *Journal of the International AIDS Society*, 22 (2), e25239. 10.1002/jia2.25239
- Aliyu A, Adelekan B, Andrew N, Ekong E, Dapiap S, Murtala-Ibrahim F, Nta I, Ndemi N, Mensah C, & Dakum P (2019). Predictors of loss to follow-up in art experienced patients in Nigeria: A 13 year review (2004–2017). *AIDS Research and Therapy*, 16(1), 30. 10.1186/s12981-019-0241-3 [PubMed: 31594539]
- Analyses et Cartographie de la Vulnérabilité au VIH - Rapport de la région de Ziguinchor. (2013). Programme Sante de l'USAID. Composante VIH-SIDA et TB. USAID.
- Arnesen R, Moll AP, & Sheno SV (2017). Predictors of loss to follow-up among patients on ART at a rural hospital in KwaZulu-natal, South Africa. *PLoS One*, 12(5), e0177168. 10.1371/journal.pone.0177168
- Asimwe SB, Kanyesigye M, Bwana B, Okello S, & Muyindike W (2015). Predictors of dropout from care among HIV-infected patients initiating antiretroviral therapy at a public sector HIV treatment clinic in sub-Saharan Africa. *BMC Infectious Diseases*, 16(1), 43. 10.1186/s12879-016-1392-7
- Au JT, Kayitenkore K, Shutes E, Karita E, Peters PJ, Tichacek A, & Allen SA (2006). Access to adequate nutrition is a major potential obstacle to antiretroviral adherence among HIV-infected individuals in Rwanda. *Aids (london, England)*, 20(16), 2116–2118. 10.1097/01.aids.0000247580.16073.1b
- Bangsberg DR, Perry S, Charlebois ED, Clark RA, Roberston M, Zolopa AR, & Moss A (2001). Non-adherence to highly active antiretroviral therapy predicts progression to AIDS. *Aids (london, England)*, 15(15), 1181–1183. 10.1097/00002030-200106150-00015
- Bekolo CE, Webster J, Batenganya M, Sume GE, & Kollo B (2013). Trends in mortality and loss to follow-up in HIV care at the nkongsamba Regional hospital, Cameroon. *BMC Research Notes*, 6(1), 512. 10.1186/1756-0500-6-512 [PubMed: 24308609]
- Benzekri NA, Sambou JF, Diaw B, Sall EHI, Sall F, Niang A, Ba S, Guèye NFN, Diallo MB, Hawes SE, Seydi M, & Gottlieb GS (2017). The dimensions of food insecurity and malnutrition among people living with HIV in Senegal, West Africa. *AIDS Care*, 29(12), 1510–1516. 10.1080/09540121.2017.1338652 [PubMed: 28612658]
- Benzekri NA, Sambou J, Diaw B, Sall el HI, Sall F, Niang A, Ba S, Ngom Guèye NF, Diallo MB, Hawes SE, Seydi M, & Gottlieb GS (2015). High prevalence of severe food insecurity and malnutrition among HIV-infected adults in Senegal, West Africa. *PLoS One*, 10(11), e0141819. 10.1371/journal.pone.0141819
- Benzekri NA, Sambou JF, Ndong S, Tamba IT, Faye D, Diallo MB, Diatta JP, Faye K, Sall I, Sall F, Manga NM, Malomar JJ, Ndour CT, Hawes SE, Seydi M, & Gottlieb GS (2019). Prevalence, predictors, and management of advanced HIV disease among individuals initiating ART in Senegal, West Africa. *BMC Infectious Diseases*, 19(1), 261. 10.1186/s12879-019-3826-5 [PubMed: 30876400]
- Bilinski A, Birru E, Peckarsky M, Herce M, Kalanga N, Neumann C, Bronson G, Po-Chedley S, Kachimanga C, McBain R, Keck J, & Anglewicz P (2017). Distance to care, enrollment and loss to follow-up of HIV patients during decentralization of antiretroviral therapy in neno district, Malawi: A retrospective cohort study. *PLoS One*, 12(10), e0185699. 10.1371/journal.pone.0185699
- Chi BH, Yiannoutsos CT, Westfall AO, Newman JE, Zhou J, Cesar C, Brinkhof MWG, Mwangi A, Balestre E, Carriquiry G, Sirisanthana T, Mukumbi H, Martin JN, Grimsrud A, Bacon M, Thiebaut

- R, Bartlett J & International Epidemiologic Databases to Evaluate, A. C. (2011). Universal definition of loss to follow-up in HIV treatment programs: A statistical analysis of 111 facilities in Africa, Asia, and latin america. *PLoS Medicine*, 8(10), e1001111. 10.1371/journal.pmed.1001111
- Chop E, Duggaraju A, Malley A, Burke V, Caldas S, Yeh PT, Manjulaa Narasimhan, Avni Amin, Kennedy CE (2017). Food insecurity, sexual risk behavior, and adherence to antiretroviral therapy among women living with HIV: A systematic review. *Health Care for Women International*, 38(9), 927–944. 10.1080/07399332.2017.1337774 [PubMed: 28586273]
- Coates J, Swindale A, & Bilinsky P (2007). Household Food Insecurity Access Scale (HFIAS) for measurement of Household Food Access: Indicator Guide (v. 3). Food and Nutrition Technical Assistance Project, Academy for Educational Development.
- Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, Hakim JG, Kumwenda J, Grinsztejn B, Pilotto JHS, Godbole SV, Chariyalertsak S, Santos BR, Mayer KH, Hoffman IF, Eshleman SH, Piwowar-Manning E, Cottle L, Zhang XC, & HPTN 052 Study Team. (2016). Antiretroviral therapy for the prevention of HIV-1 transmission. *New England Journal of Medicine*, 375(9), 830–839. 10.1056/NEJMoa1600693 [PubMed: 27424812]
- Dahab M, Charalambous S, Karstaedt AS, Fielding KL, Hamilton R, La Grange L, Churchyard Gavin J, Grant, A. D. (2010). Contrasting predictors of poor antiretroviral therapy outcomes in two South African HIV programmes: A cohort study. *BMC Public Health*, 10(1), 430. 10.1186/1471-2458-10-430 [PubMed: 20649946]
- Dalhatu I, Onotu D, Odafe S, Abiri O, Debem H, Agolory S, Shiraishi RW, Auld AF, Swaminathan M, Dokubo K, Ngige E, Asadu C, Ellerbrock TV, & Anglewicz P (2016). Outcomes of Nigeria's HIV/AIDS treatment program for patients initiated on antiretroviral treatment between 2004–2012. *PLoS One*, 11(11), e0165528. 10.1371/journal.pone.0165528
- Donnell D, Baeten JM, Kiarie J, Thomas KK, Stevens W, Cohen CR, McIntyre J, Lingappa JR, Celum C; Partners in Prevention HSV/HIV Transmission Study Team. (2010). Heterosexual HIV-1 transmission after initiation of antiretroviral therapy: A prospective cohort analysis. *The Lancet*. 375(9731):2092–2098. Epub 2010 May 26 10.1016/S0140-6736(10)60705-2.
- Ekouevi DK, Balestre E, Ba-Gomis FO, Eholie SP, Maiga M, Amani-Bosse C, Minga A, Messou E, Sow PS, Lewden C, Traoré HA, Bissagnene E, Dabis F, & IeDEA West Africa Collaboration. (2010). Low retention of HIV-infected patients on antiretroviral therapy in 11 clinical centres in West Africa. *Tropical Medicine & International Health*, 15(Suppl 1), 34–42. doi:10.1111/j.1365-3156.2010.02505.x <https://doi.org/10.1111/j.1365-3156.2010.02505.x> [PubMed: 20586958]
- Food and Agricultural Organization of the United Nations. (2009). Declaration of the World Summit on Food Security. <http://www.fao.org/wsfs/wsfs-list-documents/en/>
- Food and Agricultural Organization of the United Nations. (2019). The State of Food Security and Nutrition in the World, Rome. <http://www.fao.org/state-of-food-security-nutrition/en/>
- Food and Agriculture Organization of the United Nations. (1998). The human right to adequate food and freedom from hunger. <http://www.fao.org/3/w9990e/w9990e03.htm>
- Fox MP, & Rosen S (2015). Retention of Adult patients on antiretroviral therapy in Low- and middle-income countries: Systematic Review and meta-analysis 2008–2013. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 69(1), 98–108. 10.1097/QAI.0000000000000553 [PubMed: 25942461]
- Geng EH, Odeny TA, Lyamuya R, Nakiwogga-Muwanga A, Diero L, Bwana M, Braitstein P, Somi G, Kambugu A, Bukusi E, Wenger M, Neilands TB, Glidden DV, Wools-Kaloustian K, Yiannoutsos C, & Martin J (2016). Retention in care and patient-reported reasons for undocumented transfer or stopping care Among HIV-infected patients on antiretroviral therapy in Eastern Africa: Application of a sampling-based approach. *Clinical Infectious Diseases*, 62(7), 935–944. 10.1093/cid/civ1004 [PubMed: 26679625]
- Grimrud AT, Cornell M, Egger M, Boulle A, & Myer L (2013). Impact of definitions of loss to follow-up (LTFU) in antiretroviral therapy program evaluation: Variation in the definition can have an appreciable impact on estimated proportions of LTFU. *Journal of Clinical Epidemiology*, 66(9), 1006–1013. 10.1016/j.jclinepi.2013.03.013 [PubMed: 23774112]
- Haas AD, Zaniewski E, Anderegg N, Ford N, Fox MP, Vinikoor M, Dabis F, Nash D, Sinayobye J. d., Niyongabo T, Tanon A, Poda A, Adedimeji AA, Edmonds A, Davies M-A, Egger M, &



- African regions of the International epidemiologic Databases to Evaluate, A. (2018). Retention and mortality on antiretroviral therapy in sub-Saharan Africa: Collaborative analyses of HIV treatment programmes. *Journal of the International AIDS Society*, 21(2), e25084. 10.1002/jia2.25084
- Hardon AP, Akurut D, Comoro C, Ekezie C, Irunde HF, Gerrits T, Kglatwane J, Kinsman J, Kwasa R, Maridadi J, Moroka TM, Moyo S, Nakiyemba A, Nsimba S, Ogenyi R, Oyabba T, Temu F, Laing R (2007). Hunger, waiting time and transport costs: Time to confront challenges to ART adherence in Africa. *AIDS Care*, 19(5), 658–665. 10.1080/09540120701244943 [PubMed: 17505927]
- Hogg RS, Heath K, Bangsberg D, Yip B, Press N, O’Shaughnessy MV, & Montaner JS (2002). Intermittent use of triple-combination therapy is predictive of mortality at base-line and after 1 year of follow-up. *Aids (London, England)*, 16(7), 1051–1058. 10.1097/00002030-200205030-00012
- Jespersen S, Hønge BL, Esbjornsson J, Medina C, da Silva Te D, Correia FG, Laursen AL, Østergaard L, Andersen A, Aaby P, Erikstrup C, Wejse C, & Bissau H. I. V. C. s. g. (2016). Differential effects of sex in a West African cohort of HIV-1, HIV-2 and HIV-1/2 dually infected patients: Men are worse off. *Tropical Medicine & International Health*, 21(2), 253–262. 10.1111/tmi.12646 [PubMed: 26616349]
- McCoy SI, Buzdugan R, Mushavi A, Mahomva A, Cowan FM, & Padian NS (2015). Food insecurity is a barrier to prevention of mother-to-child HIV transmission services in Zimbabwe: A cross-sectional study. *BMC Public Health*, 15(1), 420. 10.1186/s12889-015-1764-8 [PubMed: 25909583]
- Mekonnen N, Abdulkadir M, Shumetie E, Baraki AG, & Yenit MK (2019). Incidence and predictors of loss to follow-up among HIV infected adults after initiation of first line anti-retroviral therapy at University of Gondar comprehensive specialized Hospital northwest Ethiopia, 2018: Retrospective follow up study. *BMC Research Notes*, 12 (1), 111. 10.1186/s13104-019-4154-y [PubMed: 30819236]
- Merten S, Kenter E, McKenzie O, Musheke M, Ntalasha H, & Martin-Hilber A (2010). Patient-reported barriers and drivers of adherence to antiretrovirals in sub-Saharan Africa: A meta-ethnography. *Tropical Medicine & International Health*, 15(Suppl 1), 16–33. 10.1111/j.1365-3156.2010.02510.x [PubMed: 20586957]
- Musumari PM, Feldman MD, Techasrivichien T, Wouters E, Ono-Kihara M, & Kihara M (2013). If I have nothing to eat, I get angry and push the pills bottle away from me”: A qualitative study of patient determinants of adherence to antiretroviral therapy in the democratic Republic of Congo. *AIDS Care*, 25(10), 1271–1277. 10.1080/09540121.2013.764391 [PubMed: 23383757]
- Nachege JB, Hislop M, Dowdy DW, Chaisson RE, Regensberg L, & Maartens G (2007). Adherence to non-nucleoside reverse transcriptase inhibitor-based HIV therapy and virologic outcomes. *Annals of Internal Medicine*, 146(146), 564–573. 10.7326/0003-4819-146-8-200704170-00007 [PubMed: 17438315]
- Nagata JM, Magerenge RO, Young SL, Oguta JO, Weiser SD, & Cohen CR (2012). Social determinants, lived experiences, and consequences of household food insecurity among persons living with HIV/AIDS on the shore of lake Victoria, Kenya. *AIDS Care*, 24(6), 728–736. 10.1080/09540121.2011.630358 [PubMed: 22150119]
- The New Humanitarian (TNH). (2015). Forgotten conflicts. The conflict in Casamance. <http://www.thenewhumanitarian.org/feature/2015/08/03/casamance>
- Nordentoft PB, Engell-Sorensen T, Jespersen S, Correia FG, Medina C, da Silva Te D, Østergaard L, Laursen AL, Wejse C, & Hønge BL (2017). Assessing factors for loss to follow-up of HIV infected patients in Guinea-Bissau. *Infection*, 45(2), 187–197. 10.1007/s15010-016-0949-0 [PubMed: 27743308]
- Nsanzimana S, Kanters S, Remera E, Forrest JI, Binagwaho A, Condo J, & Mills EJ (2015). HIV care continuum in Rwanda: A cross-sectional analysis of the national programme. *The Lancet HIV*, 2(5), e208–e215. 10.1016/S2352-3018(15)00024-7 [PubMed: 26423003]
- Ochieng-Ooko V, Ochieng D, Sidle JE, Holdsworth M, Wools-Kaloustian K, Siika AM, Yiannoutsos CT, Owiti M, Kimaiyo S, & Braitstein P (2010). Influence of gender on loss to follow-up in a large HIV treatment programme in western Kenya. *Bulletin of the World Health Organization*, 88(9), 681–688. 10.2471/BLT.09.064329 [PubMed: 20865073]

- Saka B, Landoh DE, Patassi A, d'Almeida S, Singo A, Gessner BD, & Pitche PV (2013). Loss of HIV-infected patients on potent antiretroviral therapy programs in Togo: Risk factors and the fate of these patients. *Pan African Medical Journal*, 15, 35. 10.11604/pamj.2013.15.35.2198 [PubMed: 24009811]
- Sifa JS, Manortey S, Talboys S, Ansa GA, & Houphouet EE (2019). Risk factors for loss to follow-up in human immunodeficiency virus care in the greater Accra Regional Hospital in Ghana: A retrospective cohort study. *International Health* 11(6), 605–612. 10.1093/inthealth/ihz043 [PubMed: 31185084]
- Singer AW, Weiser SD, & McCoy SI (2015). Does food insecurity undermine adherence to antiretroviral therapy? A Systematic review. *AIDS and Behavior* 19(8), 1510–1526. 10.1007/s10461-014-0873-1 [PubMed: 25096896]
- Thompson MA, Mugavero MJ, Amico KR, Cargill VA, Chang LW, Gross R, Orrell C, Altice FL, Bangsberg DR, Bartlett JG, Beckwith CG, Dowshen N, Gordon CM, Horn T, Kumar P, Scott JD, Sturatt MJ, Remien RH, Simoni JM, & Nachega JB (2012). Guidelines for improving entry into and retention in care and antiretroviral adherence for persons with HIV: Evidence-based recommendations from an International association of physicians in AIDS Care panel. *Annals of Internal Medicine*, 156(11), 817–833. W-284, W-285, W-286, W-287, W-288, W-289, W-290, W-291, W-292, W-293, W-294. doi: 10.7326/0003-4819-156-11-201206050-00419. Epub 2012 Mar 5 10.7326/0003-4819-156-11-201206050-00419 [PubMed: 22393036]
- Tong C, Suzan-Monti M, Sagaon-Teyssier L, Mimi M, Laurent C, Maradan G, Mengue M-T, Spire B, Kuaban C, Vidal L, & Balick MJ (2018). Treatment interruption in HIV-positive patients followed up in Cameroon's antiretroviral treatment programme: Individual and health care supply-related factors (ANRS-12288 EVOLCam survey). *Tropical Medicine & International Health*, 23(3), 315–326. 10.1111/tmi.13030 [PubMed: 29327419]
- Tsague L, Koulla SS, Kenfak A, Kouanfack C, Tejiokem M, Abong T, ... Zekeng L (2008). Determinants of retention in care in an antiretroviral therapy (ART) program in urban Cameroon, 2003–2005. *The Pan African Medical Journal*, 1, 2. [PubMed: 21532891]
- Tuller DM, Bangsberg DR, Senkungu J, Ware NC, Emenyonu N, & Weiser SD (2010). Transportation costs impede sustained adherence and access to HAART in a clinic population in southwestern Uganda: A qualitative study. *AIDS and Behavior*, 14(4), 778–784. 10.1007/s10461-009-9533-2 [PubMed: 19283464]
- Turner BJ (2002). Adherence to antiretroviral therapy by human immunodeficiency virus-infected patients. *The Journal of Infectious Diseases*, 185(Suppl 2), S143–S151. 10.1086/340197 [PubMed: 12001036]
- Tweya H, Oboho IK, Gugsu ST, Phiri S, Rambiki E, Banda R, Mwafilaso J, Munthali C, Gupta S, Bateganya M, Maida A, & Beck EJ (2018). Loss to follow-up before and after initiation of antiretroviral therapy in HIV facilities in Lilongwe, Malawi. *PLoS One*, 13(1), e0188488. 10.1371/journal.pone.0188488
- UNAIDS Data. 2020. Retrieved February, 2021, from <https://www.unaids.org/en/resources/documents/2020/2020-UNAIDS-data>
- Unge C, Ragnarsson A, Ekstrom AM, Indalo D, Belita A, Carter J, Ilako F, & Sodergard B (2011). The influence of traditional medicine and religion on discontinuation of ART in an urban informal settlement in Nairobi, Kenya. *AIDS Care*, 23(7), 851–858. 10.1080/09540121.2010.534432 [PubMed: 21400317]
- United Nations Programme on HIV/AIDS (UNAIDS). (2014). “90–90–90 An ambitious treatment target to help end the AIDS epidemic”. [http://www.unaids.org/sites/default/files/media\\_asset/90-90-90\\_en\\_0.pdf](http://www.unaids.org/sites/default/files/media_asset/90-90-90_en_0.pdf)
- United Nations Sustainable Development Goals. (2015). <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
- Universal Declaration of Human Rights, General Assembly of the United Nations. (1948). United Nations. <https://www.un.org/en/universal-declaration-human-rights/>
- Weiser SD, Leiter K, Bangsberg DR, Butler LM, Percyde Korte F, Hlanze Z, Phaladze N, Iacopino V, Heisler M, & Gillespie S (2007). Food insufficiency is associated with high-risk sexual behavior among women in Botswana and Swaziland. *PLoS Medicine*, 4(10), 1589–1597, discussion 1598. 10.1371/journal.pmed.0040260 [PubMed: 17958460]

- Weiser SD, Tuller DM, Frongillo EA, Senkungu J, Mukiibi N, & Bangsberg DR (2010). Food insecurity as a barrier to sustained antiretroviral therapy adherence in Uganda. *PLoS One*, 5(4), e10340. 10.1371/journal.pone.0010340
- Willie TC, Kershaw TS, & Callands TA (2018). Examining relationships of intimate partner violence and food insecurity with HIV-related risk factors among young pregnant Liberian women. *AIDS Care*, 30(9), 1156–1160. 10.1080/09540121.2018.1466983 [PubMed: 29682990]
- World Food Program. (2014). Analyse globale de la vulnérabilité, de la sécurité alimentaire et de la nutrition (AGVSAN), Sénégal. Juillet 2014. <http://documents.wfp.org/stellent/groups/public/documents/ena/wfp266798.pdf>
- Wringe A, Cawley C, Szumilin E, Salumu L, Amoros Quiles I, Pasquier E, Masiku C, & Nicholas S (2018). Retention in care among clinically stable antiretroviral therapy patients following a six-monthly clinical consultation schedule: Findings from a cohort study in rural Malawi. *Journal of the International AIDS Society*, 21(11), e25207. 10.1002/jia2.25207
- Young S, Wheeler AC, McCoy SI, & Weiser SD (2014). A review of the role of food insecurity in adherence to care and treatment among adult and pediatric populations living with HIV and AIDS. *AIDS and Behavior*, 18 (Suppl 5), S505–S515. 10.1007/s10461-013-0547-4 [PubMed: 23842717]

**Table 1.** Characteristics of HIV-infected participants presenting for HIV care and ART initiation in Senegal, 2018–2019.

	All participants n (%)	Dakar n (%)	Ziguinchor n (%)	p-value
Total number of individuals, N	207	84 (40.6)	123 (59.4)	
Female	144 (69.6)	54 (64.3)	90 (73.2)	0.17
Age, median years (IQR)	37 (31–46)	37 (30–45)	38 (31–48)	0.80
Age, years				0.26
29 <sup>a</sup>	45 (22.4)	21 (25.0)	24 (20.5)	
30–49	122 (60.7)	53 (63.1)	69 (59.0)	
50+	34 (16.9)	10 (11.9)	24 (20.5)	
HIV type				<b>0.01</b>
HIV-1	183 (88.4)	79 (94.0)	104 (84.6)	
HIV-2	22 (10.6)	3 (3.6)	19 (15.4)	
HIV-1 and HIV-2	2 (1.0)	2 (2.4)	0 (0)	
Baseline CD4 cell count, median (IQR)	181 (63–382)	158 (63–308)	193 (63–452)	0.19
CD4 cell count				0.05
0–199	103 (53.4)	47 (56.6)	56 (50.9)	
200–499	57 (29.5)	28 (33.7)	29 (26.4)	
500	33 (17.1)	8 (9.6)	25 (22.7)	
Baseline BMI				0.17
<18.5	71 (40.6)	37 (48.1)	34 (34.7)	
18.5–24.9	81 (46.3)	30 (39.0)	51 (52.0)	
25.0	23 (13.1)	10 (13.0)	13 (13.3)	
Born in Senegal <sup>b</sup>	159 (79.9)	76 (90.5)	83 (72.2)	<b>&lt;0.01</b>
Marital status <sup>c</sup>				0.08
Monogamous	76 (39.2)	35 (42.7)	41 (36.6)	
Polygamous	31 (16.0)	10 (12.2)	21 (18.8)	
Single	26 (13.4)	12 (14.6)	14 (12.5)	
Divorced	32 (16.5)	18 (22.0)	14 (12.5)	
Widowed	29 (14.9)	7 (8.5)	22 (19.6)	

	All participants n (%)	Dakar n (%)	Ziguinchor n (%)	p-value
Number of children <sup>c</sup>				0.08
0	30 (15.9)	18 (22.5)	12 (11.0)	
1–2	70 (37.0)	30 (37.5)	40 (36.7)	
3–4	48 (25.4)	20 (25.0)	28 (25.7)	
5	41 (21.7)	12 (15.0)	29 (26.6)	
Household size				0.25
1–4	43 (23.0)	22 (27.5)	21 (19.6)	
5–11	89 (47.6)	39 (48.8)	50 (46.7)	
12	55 (29.4)	19 (23.8)	36 (33.6)	
Highest educational level obtained <sup>c</sup>				<0.01
No formal education	54 (31.8)	9 (15.0)	45 (40.9)	-
Any primary school	66 (38.8)	32 (53.3)	34 (30.9)	-
Any secondary school	42 (24.7)	14 (23.3)	28 (25.5)	-
Any university	8 (4.7)	5 (8.3)	3 (2.7)	-
Unemployed <sup>c</sup>	158 (86.3)	63 (80.8)	95 (90.5)	0.06
Food insecurity				
Food insecure <sup>d</sup>	131 (65.5)	54 (65.1)	77 (65.8)	0.91
Severely food insecure <sup>e</sup>	55 (27.5)	14 (16.9)	41 (35.0)	0.01
Traditional healer use	66 (35.5)	20 (25.6)	46 (42.6)	0.02
Transportation time <sup>f</sup> , median minutes (IQR)	90 (30–240)	240 (160–360)	40 (30–80)	<0.01
Transportation time <sup>f</sup> , minutes				<0.01
<60	73 (38.0)	2 (2.5)	71 (62.8)	
60–120	49 (25.5)	17 (21.5)	32 (28.3)	
>120	70 (36.5)	60 (75.9)	10 (8.8)	
Transportation cost <sup>f</sup> , median USD (IQR)	\$1.74 (\$0.69–\$1.78)	\$1.39 (\$0.69–\$4.52)	\$1.74 (\$0.35–\$1.74)	<0.01
Transportation cost <sup>f</sup> , USD				<0.01
<\$1.00	66 (35.5)	29 (39.2)	37 (33.0)	
\$1.00 – \$1.99	76 (40.9)	16 (21.6)	60 (53.6)	
\$2.00	44 (23.7)	29 (39.2)	15 (13.4)	

Status at 12 months	All participants n (%)	Dakar n (%)	Ziguinchor n (%)	p-value
Alive and retained in care at study clinic	124 (59.9)	65 (77.4)	59 (48.0)	<0.01
Retained on ART at study clinic <sup>*</sup>	120 (58.0)	65 (77.4)	55 (44.7)	
Deceased	30 (14.5)	12 (14.3)	18 (14.6)	
Transferred care	8 (3.9)	0 (0)	8 (6.5)	
Migrated <sup>g</sup>	11 (5.3)	1 (1.2)	10 (8.1)	
Lost to follow-up (LTFU)	33 (15.9)	6 (7.1)	27 (22.0)	
Alive but not retained in care	14 (6.8)	3 (3.6)	11 (8.9)	
Unable to trace	19 (9.2)	3 (3.6)	16 (13.0)	
Withdrew	1 (0.5)	0 (0)	1 (0.8)	

<sup>a</sup>Includes 6 participants <18 years of age

<sup>b</sup>Other countries of birth: Guinea-Bissau=29, Guinea=6, the Gambia=3, Mali=1, and Chad=1

<sup>c</sup>Among participants 15 years of age

<sup>d</sup>HFIAS score at most recent encounter = 2–4

<sup>e</sup>HFIAS score at most recent encounter = 4

<sup>f</sup>Round trip

<sup>g</sup>Migrated to: France=1, the Gambia=2, and Guinea-Bissau=8.

<sup>\*</sup>Excluding individuals who were deceased and those who had migrated or transferred, 75.9% of participants were retained on ART at 12 months (91.5% in Dakar and 63.2% in Ziguinchor).

**Table 2.** Logistic regressions showing predictors of loss to follow-up at one year among HIV-infected participants initiating ART in Senegal.

	Simple regressions			Multiple regression <sup>a</sup>		
	OR	95% CI	p-value	OR	95% CI	p-value
Ziguinchor site (ref. Dakar)	3.86	1.50 9.91	0.01	2.71	1.01 7.22	0.047
Female	1.30	0.54 3.11	0.56	-	-	-
Age (ref. 30–49)						
29	0.80	0.29 2.19	0.66	-	-	-
50+	1.63	0.60 4.44	0.34	-	-	-
Baseline CD4 count (ref. 200–499)						
0–199	1.14	0.46 2.84	0.77	-	-	-
500	1.49	0.49 4.50	0.48	-	-	-
Baseline BMI <18.5	0.68	0.28 1.68	0.41	-	-	-
Born in Senegal	1.13	0.40 3.23	0.82	-	-	-
Married	1.77	0.77 4.12	0.18	-	-	-
Number of children (ref. 1–2)						
0	0.23	0.03 1.93	0.18	-	-	-
3–4	1.63	0.58 4.52	0.35	-	-	-
5	1.71	0.59 4.94	0.32	-	-	-
Household size (ref. 5–11)						
1–4	0.79	0.26 2.40	0.68	-	-	-
12	0.80	0.30 2.15	0.66	-	-	-
No formal education	1.50	0.62 3.63	0.37	-	-	-
Severely food insecure	3.11	1.36 7.10	0.01	2.55	1.09 5.96	0.03
Traditional healer use	0.79	0.31 2.02	0.62	-	-	-
Transportation time (ref. <60)						
60–120	0.69	0.25 1.91	0.48	-	-	-
120	0.53	0.19 1.43	0.21	-	-	-
Transportation cost (ref. <\$1.00)						
\$1.00 – \$1.99	1.06	0.42 2.67	0.90	-	-	-
\$2.00	0.57	0.17 1.95	0.37	-	-	-

$N = 172$ , deceased and withdrawn participants excluded from analysis, data missing for 4 participants.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript



**Table 3.**

Logistic regressions showing predictors of severe food insecurity among HIV-infected participants initiating ART in Senegal.

	Simple regressions			Multiple regression <sup>a</sup>		
	OR	95% CI	p-value	OR	95% CI	p-value
Ziguinchor site (ref. Dakar)	2.66	1.34 5.29	0.01	1.85	0.83 4.13	0.13
Female	2.37	1.10 5.10	0.03	1.46	0.63 3.38	0.38
Age (ref. 30–49)						
29	0.98	0.45 2.13	0.96	-	-	-
50	0.71	0.28 1.79	0.47	-	-	-
Baseline BMI <18.5	0.60	0.30 1.21	0.15	-	-	-
Born in Senegal	1.43	0.63 3.23	0.39	-	-	-
Married	1.26	0.66 2.38	0.49	-	-	-
Number of children (ref. 1–2)						
0	0.61	0.20 1.85	0.38	-	-	-
3–4	2.19	0.99 4.83	0.05	-	-	-
5	1.16	0.48 2.81	0.74	-	-	-
Household size (ref. 5–11)						
1–4	1.17	0.53 2.56	0.70	-	-	-
12	0.69	0.32 1.52	0.36	-	-	-
No formal education	3.51	1.75 7.04	<0.01	2.75	1.30 5.80	0.01
Unemployed	2.10	0.46 9.61	0.34	-	-	-

<sup>a</sup>N=169, data missing for 39 participants.