



# Predictors of mobility among women engaged in commercial sex work in Uganda using generalized estimating equations model

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Joshua Kiyingi<sup>1</sup> , Susan S Witte<sup>2</sup>, Proscovia Nabunya<sup>1</sup> , Edward Nsubuga<sup>1</sup>, Ozge Sensoy Bahar<sup>1</sup>, Larissa Jennings Mayo-Wilson<sup>3</sup>, Samuel Kizito<sup>1</sup>, Jennifer Nattabi<sup>1</sup>, Josephine Nabayinda<sup>1</sup> and Fred M Ssewamala<sup>1</sup>

## Abstract

**Background:** Women engaged in commercial sex work (WESW) are at a higher risk of acquiring and transmitting HIV. WESW are highly mobile, and their mobility may increase their economic status, and increased access to healthcare and other social services. However, it may also facilitate the spread of HIV infection from higher to lower prevalence regions. This study examined the predictors of mobility among WESW in Uganda using a generalized estimating equations model.

**Methods:** We defined and measured mobility as the change in residence by WESW between baseline, 6 months, and 12 months follow-up. Participants who changed places were considered mobile, and those who never changed were non-mobile. We used data from a longitudinal study, which recruited 542 WESW from Southern Uganda aged 18–55 years and constructed a Generalized Estimating Equations Model.

**Results:** Findings show that 19.6% of WESW changed residence between baseline and 6 months of follow-up and 26.2% (cumulative) between baseline and 12 months of follow-up. Older women (OR = 0.966, 95% CI = 0.935, 0.997) were associated with decreased odds of mobility, whereas WESW who were HIV positive (OR = 1.475, 95% CI = 1.078, 2.018) and those from large households (OR = 1.066, 95% CI = 1.001, 1.134) were associated with increased odds of mobility. WESW residing in rural areas (OR = 0.535, 95% CI = 0.351, 0.817) were associated with decreased odds of mobility compared to those from fishing sites.

**Conclusion:** The results indicate risk factors for mobility, further research is needed to determine the directionality of these factors in order to design interventions addressing mobility among WESW.

## Keywords

Female sex workers, mobility, Sub-saharan Africa, Uganda

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## Introduction

In Uganda, the population of women engaged in sex work (WESW) is estimated at 130,000.<sup>1</sup> WESW are at a higher risk of acquiring and transmitting HIV.<sup>2</sup> Worldwide, WESW have an estimated HIV prevalence of 12% or higher, with 13.5 times increased odds of infection than the general population.<sup>3</sup> In sub-Saharan Africa (SSA), the HIV prevalence among WESW is three times higher than the general population.<sup>4</sup> Globally, key populations including WESW account for 65% of all new HIV infections.<sup>5</sup> In Uganda, while the HIV prevalence is estimated at 6.8%,<sup>1</sup> HIV prevalence among WESW is estimated at 41%, and

accounts for 18% of all new infections.<sup>1,6,7</sup> WESW move for shorter (temporarily - no change of semi-permanent

<sup>1</sup> Washington University in St Louis Brown School, International Center for Child Health and Development (ICHAD), St Louis, MO, USA

<sup>2</sup> Columbia University, School of Social Work, New York, NY, USA

<sup>3</sup> University of North Carolina Gillings School of Global Public Health, Chapel Hill, NC, USA

### Corresponding author:

Fred M Ssewamala, Washington University in St Louis International Center for Child Health and Development (ICHAD) Goldfarb, Room 346 Campus Box 1196, One Brookings Drive, St Louis, MO 63130 USA.  
Email: [fms1@wustl.edu](mailto:fms1@wustl.edu)

residence) and longer periods (permanently-change of semi-permanent residence) for diverse reasons, which include but are not limited to better economic opportunities, persistent family responsibilities, health care and other mobility aspirations.<sup>8-10</sup> Mobility is defined as the movement from one place to another, and it is determined by the duration of journeys or movement, the distance of the journey, frequency of movement, mode of transit, reason for movement and seasonality.<sup>11,12</sup> Mobility in a given population is compelled by the ambition to advance their lives through better employment and social opportunities, which can transform their health and safety.<sup>13</sup> Similarly, among WESW, mobility increases their social and economic wellbeing; however, it weakens their sexual negotiation power hence boosting their risky behaviors.<sup>6</sup> Therefore, WESW's mobility may facilitate the spread of HIV infection from higher to lower prevalence regions.<sup>14</sup>

Sex work mobility acts as a coping mechanism for WESW to access health care services away from stigmatizing health service providers, friends, families and communities where they are known and live.<sup>12,15,16</sup> On the other hand mobility impacts women's access to and utilization of HIV-related health services, including HIV prevention and risk reduction services, as well as continued engagement in care, which in turn exacerbates their burden of HIV, risk of HIV transmission and poor treatment outcomes.<sup>12,17,18</sup> Therefore, there is a need to study and understand the mobility correlates among WESW to effectively intervene to reduce their risk of HIV infection or transmission, but also to ensure access to care among those WESW who are living with HIV facilitated by their movements. Yet, there are limited data on mobility and correlates of mobility among WESW in Uganda and SSA in general.<sup>10,19</sup> A few studies showed social and economic factors as the leading causes of mobility among women, including education, employment opportunities and family support.<sup>10,19</sup> Against this backdrop, this study examines the factors associated with mobility among WESW participating in a combination HIV risk reduction intervention in southern Uganda.

### *Theoretical framework*

This study applied the push-pull theory developed by Everett Spurgeon Lee in 1966. The theory posits that people can improve their living conditions through mobility.<sup>20,21</sup> The factors that cause them to move to their new locations for better living conditions are the pull factors, and those that cause them to move away from their current residences are the push factors.<sup>20</sup> Pull factors are the same as the push factors, which could be social, economic, environmental and political.<sup>20</sup> The theory has been used widely to study mobile populations.<sup>22-24</sup> In this study, social factors include age, marital status, level of education, alcohol and drug use, mental health, and household composition. Economic factors include asset ownership, financial self-efficacy and

financial distress. Political and environmental factors include arrest history and type of community they live in.

## **Methods**

### *Study design*

Data from a longitudinal cluster-randomized study involving 542 WESW (18–55 years) recruited from 19 HIV hotspots in Southern Uganda, were analyzed. The study aimed to evaluate the efficacy of adding economic empowerment to traditional HIV risk reduction to reduce new incidences of HIV and STIs among vulnerable women in Uganda.<sup>25</sup> Participants were randomized to either treatment or control condition. Participants in the treatment condition received four sessions of HIV risk reduction (HIVRR), six sessions of financial literacy and matched savings accounts at a rate of 1:1 with a matching cap of ~15 USD for 10 months. The participants' savings were matched every month for 10 months. Participants were not restricted from accessing their savings and matched savings to make investment decisions. Participants in the control condition received four sessions of HIVRR only. Trained Community Health Workers delivered the HIVRR sessions immediately after baseline data collection. These covered the following areas; supporting healthy behaviors, reducing risk from HIV and STIs, strengthening skills to keep safe and healthy, reducing violence and planning a safer future. Trained members of the research team facilitated financial literacy sessions following the completion of the HIVRR sessions. They were specific about using bank services, savings, budgeting and debt management.

### *Sample*

WESW, totaling 542, were recruited in the study from 19 HIV hotspots in fishing villages and small towns along the trans-Africa highway (Kenya, Uganda, Tanzania and Rwanda) in seven districts of Southern Uganda. The districts include Masaka, Mpigi, Kalungu, Lwengo, Rakai, Kyotera and Lyantonde. Since WESW is a hidden population, the study team engaged WESW leaders or peers in the hotspots during the recruitment exercise.<sup>26</sup> WESW were eligible if they were 18 years old and above, exchanged sex for money or other goods and services in the last 30 days and reported one episode of unprotected sex. Participants at each particular hotspot were recruited at the same time of the year and followed up within the same period.

### *Ethical considerations*

The study team received approval to conduct the study in Uganda and USA. All participants in the study provided written consent before participation, which was voluntary, and they could withdraw from the study at any time for any reason.

## Data collection and measures

**Data collection.** The data was collected by well-trained Research Assistants using a 90-min interviewer-administered questionnaire in Luganda. The questionnaire was translated from English to Luganda since it is the most used language in the study region. For accuracy, the questionnaire was translated and back-translated to English by language experts from Makerere University School of Languages, Literature and Communication. Data were collected at baseline, 6, 12, 18 and 24 months from April 2019 to December 2022. Blood samples were collected from all study participants to test for HIV and viral load for those who were HIV positive by medical personnel from Rakai Health Sciences Program (RHSP), a study collaborator. HIV was tested using two HIV-1 enzyme immunoassays (EIA). All participants were tested for HIV at baseline, therefore, they knew their HIV status before we started tracking their mobility. Vaginal swabs were used to collect samples of vaginal discharge to test for *Neisseria gonorrhoeae*, *Chlamydia trachomatis* and *Trichomonas vaginalis*. Participants were followed up for data collection at six, 12 months post baseline. Participants were called at their respective hotspots for interviews and those who had moved out of the study region were tracked and interviewed at their respective new locations. A total of 483 participants completed 6 month follow-up interviews and 481 at twelve month-follow-up. Participants who were not interviewed at their respective hotspots at 6 months follow-up but returned at 12 months follow-up were captured as well.

## Measures

**Outcome measure.** Mobility was measured by the change in residence by WESW between baseline, 6 months, and 12 months follow-up. These included participants who permanently changed their residence, temporary or seasonal relocations. Participants who changed places were considered mobile, and those who never changed places non-mobile.

## Independent variables

Independent variables were categorized as social, economic, environmental and political; these are broken down below.

**Socio-demographical variables.** These included age, education level (primary or secondary school education), marital status (married/in a relationship, single and others), household size (number of people in the household), drug use (whether a woman had ever used drugs or not), and alcohol use (woman used alcohol in the last 30 days), depressive symptoms, post-traumatic stress disorder (PTSD), having a pimp/manager, HIV status (tested positive or negative), STI status (tested positive or negative for at

least one of the three STIs: *Neisseria gonorrhoea*, *Chlamydia trachomatis* and *Trichomonas vaginalis*. Depressive symptoms were assessed using the brief symptom inventory subscale.<sup>27</sup> The 5-items examined respondents experiences of any depressive symptoms in the past 7 days, with *Not at all* = 1, *A little bit* = 2, *Moderately* = 3, *Quite a bit* = 4, and *Extremely* = 5 as possible responses. Post-traumatic stress disorder was assessed using six items adapted from the abbreviated PTSD checklist.<sup>28</sup> Participants responded how often they experienced problems and complaints in response to stressful life experiences applied to them in the past 30 days using a 5-point Likert scale. Possible responses included 1 = *not at all*, 2 = *a little bit*, 3 = *moderately*, 4 = *quite a bit*, and 5 = *extremely*.

**Economic variables.** These included financial distress, asset ownership and financial self-efficacy. Financial distress was assessed with a five-item Likert scale adapted from the DHS Model A Questionnaire and the Uganda Household Survey.<sup>29</sup> The questionnaire examined the respondents' access to basic life needs, and these included money to buy food, clothing, transportation, housing fees, and health or medical expenses. The possible responses ranged from 1 = *Never* and 4 = *Many times* with a high score indicating a high financial distress. The study assessed household assets ownership with a 21-item index, examining the availability of assets in the respondents' households (*e.g. house, agricultural plantations, transportation and communication means*). Summation of the total scores were weighted and categorized it into a binary variable with low possession (6 or fewer reported assets, code = 0) or high possession (7 or more reported assets, code = 1).<sup>30</sup> Financial self-efficacy was assessed using five items from the Domestic Violence-related Financial Issues (DV-FI) scale.<sup>31</sup> Women were asked questions regarding their abilities to achieve specific financial goals using a 5-point Likert scale. Possible responses included 1 = *not confident at all*, 2 = *not very confident*, 3 = *somewhat confident*, 4 = *very confident*, and 5 = *extremely confident* with higher scores indicated higher financial self-efficacy.

**Political and environmental variables.** We included arrest history (ever been arrested or not) and locality (fishing village, small town or rural area). We also included an intervention variable to test whether the intervention impacted women's mobility.

## Data Analysis

We used STATA17.0 (StataCorp, Texas 77845, USA) to analyze the data. We ran univariates to determine the characters of the total sample ( $N = 542$ ) at baseline, reporting means and standard deviations for continuous variables and percentages for categorical variables. Data were then transformed from wide to long. Follow-up data at

six and 12 month was used to was only used to measure mobility. We controlled for clustering using hotspots ( $n = 19$ ). We used *xtgee* command to construct generalized estimating equations (GEE) to predict the correlates of mobility among WESW. We reported odds ratio with a significance level set at 0.05.

## Results

### Sample characteristics

Table 1 shows the descriptive characteristics of the sample used in the study ( $N = 542$ ). The average age of participants recruited in the study was 31.6 years (SD 7.18), and of the total sample, 25.6% reported to be married or in a relationship, 13.3% were single, and 61.1% were either divorced, separated or widowed. Most participants attained primary education (87.7%), 53.7% of the participants were residing in small towns along the trans-Africa highway, and 24.2% and 22.1% were living in fishing sites and rural areas, respectively.

Participants lived in households with an average size of 3.6 (SD 2.18) persons. About 19.2% of the participants reported having used drugs (cocaine, mira, tobacco, marijuana, kuba, shisha, petrol), 75.3% had used alcohol in the last 30 days, and 24.9% had ever been arrested. All participants were tested for HIV and STIs at baseline (time zero), 41% tested HIV positive, and 10.5% tested positive for at least one STI (*Neisseria gonorrhoeae*, *Chlamydia trachomatis* and *Trichomonas vaginalis*).

**Mobility.** 19.6% of participants changed residence between baseline and 6 months follow-up and the 26.2% changed residence between baseline and 12 months follow-up. Five point nine per cent of participants who had moved out of the study area at 6-month follow-up moved back at 12-month follow-up.

### Generalized estimating equations model results

Results from the model estimating the correlates of mobility are presented in Table 2 Of all the social factors considered

**Table 1.** Description and characteristics of the population studied at Baseline.

Variable	Total sample (N = 542) Mean (SD)
Age (Min/Max: 18–55)	31.6 (7.18)
Marital status (% , n)	—
Married/In a relationship	25.6 (139)
Single	13.3 (72)
Other (divorced, separated, widowed)	61.1 (331)
Level of education (% , n)	—
Primary school education	87.7 (473)
High school education	12.7 (69)
Number of people in the household (Min/Max: 1–18)	3.6 (2.18)
PTSD (Min/Max: 6–30)	13.7 (5.85)
Depression (Min/Max: 6–30)	10.9 (4.98)
Alcohol use in lass 30 days (% , n)	75.3 (408)
Drug use (% , n)	19.2 (104)
Pimp/Manager (% , n)	16.24 (88)
HIV Positive (% , n)	41 (220)
STIs detected (% , n)	10.5 (57)
Financial distress (Min/Max: 4–20)	14.4 (4.5)
Asset ownership (% , n)	30.1 (163)
Financial self-efficacy (Min/Max: 4–20)	8.5 (4.09)
Community (% , n)	—
Fishing sites	24.2 (131)
Rural	22.1 (120)
Small towns	53.7 (291)
Arrest history (% , n)	24.9 (135)
Intervention (% , n)	—
Control	34.3 (186)
Treatment	65.7 (356)
Mobility at 6 months follow-up (% , n)	19.6 (106)
Mobility at 12 months follow-up (cumulative) (% , n)	26.2 (142)
WESW moved back to hotspot at 12-months follow-up (% , n)	5.9 (32)

**Table 2.** Generalized estimating equations model.

Variable	Odds ratio	Robust std. err	Z	P > z	95% CI
Age	0.966	0.016	-2.1	0.036	0.935, 0.997
Education level (Ref: Primary education)	—	—	—	—	—
Secondary education	0.948	0.223	-0.23	0.821	0.598, 1.502
Marital status (others)	—	—	—	—	—
Married/In a relationship	0.856	0.133	-1	0.317	0.631, 1.161
Single	1.249	0.305	0.91	0.364	0.773, 2.016
<b>Number of people in household</b>	<b>1.066</b>	<b>0.034</b>	<b>2.02</b>	<b>0.044</b>	<b>1.001, 1.134</b>
PTSD	0.972	0.020	-1.37	0.171	0.933, 1.012
Depression	1.040	0.023	1.74	0.082	0.995, 1.086
Alcohol use	1.236	0.243	1.08	0.281	0.841, 1.818
Drug use	1.235	0.232	1.12	0.262	0.854, 1.785
Pimp/Manager	0.698	0.170	-1.48	0.14	0.433, 1.124
<b>HIV</b>	<b>1.475</b>	<b>0.236</b>	<b>2.43</b>	<b>0.015</b>	<b>1.078, 2.018</b>
STI	0.500	0.189	-1.84	0.066	0.238, 1.048
Financial distress	0.963	0.023	-1.59	0.113	0.919, 1.008
Assets	1.164	0.303	0.58	0.559	0.699, 1.938
Financial self-efficacy	0.989	0.025	-0.43	0.665	0.942, 1.038
Community (Ref: Fishing site)	—	—	—	—	—
Small towns	0.679	0.145	-1.81	0.071	0.445, 1.032
<b>Rural areas</b>	<b>0.535</b>	<b>0.116</b>	<b>-2.89</b>	<b>0.004</b>	<b>0.351, 0.817</b>
Arrest history	1.046	0.203	0.23	0.818	0.714, 1.531
Intervention (Ref: Control)	—	—	—	—	—
Treatment	1.362	0.252	1.67	0.094	0.948, 1.957

Annex.

in the model, older women (OR = 0.966, 95% CI = 0.935, 0.997,  $p = 0.036$ ), were associated with decreased odds of mobility whereas WESW who were HIV positive (OR = 1.475, 95% CI = 1.078, 2.018,  $p = 0.015$ ) and those from large household sizes (OR = 1.066, 95% CI = 1.001, 1.134,  $p = 0.044$ ) were associated with increased odds of mobility. Other social factors were not significant.

We included economic factors in the model, which included financial distress (OR = 0.963, 95% CI = 0.919, 1.008,  $p = 0.113$ ), assets ownership (OR = 1.164, 95% CI = 0.699, 1.938,  $p = 0.559$ ), and financial self-efficacy (OR = 0.989, 95% CI = 0.942, 1.038,  $p = 0.665$ ), all these were not statistically significant.

Under environmental factors, WESW residing in rural areas (OR = 0.535, 95% CI = 0.351, 0.817,  $p = 0.004$ ) were associated with decreased odds of mobility compared to those in fishing communities. The study intervention had no significant effect on the mobility of WESW, treatment (OR = 1.362, 95% CI = 0.948, 1.957,  $p = 0.094$ ) and treatment 2: (OR = 1.344, 95% CI = 0.846, 2.133,  $p = 0.021$ ).

## Discussion

The study examined the predictors of mobility among WESW in Uganda by applying the Generalized Estimating

Equations Model. Our study found evidence that social factors, which included age and HIV status, were associated with mobility among WESW.<sup>32,33</sup> Older WESW had decreased odds of mobility compared to young ones. This could be explained by the more responsibilities older WESW have compared to younger ones. Older WESW are more likely to have more children, reflecting more responsibilities and movement restrictions.<sup>33</sup> It could also be that older WESW are more established in their communities and financially stable, therefore reducing their urge to move.<sup>34</sup>

Mobility among WESW is assumed to be associated with the high prevalence of HIV among this key population.<sup>14</sup> Previous studies have shown that WESW who are mobile are more likely to be living with HIV, though it is not clear whether they move after knowing their HIV status.<sup>14,35,36</sup> This is not different from our study findings, where WESW living with HIV had increased odds of mobility compared to their counterparts who were HIV-negative. WESW who are mobile may be more likely to take on risky behaviors, which include unprotected sex, multiple sexual partners and workplace violence.<sup>8,37</sup> Mobility may weaken their sexual negotiating power, which may be caused by forced sexual encounters by violent clients, less access to condoms, the urge for more money and less access to health care services.<sup>37</sup> However, it is possible that mobility can

improve their access to care as well.<sup>6</sup> Our study findings showed that WESW from large households had increased odds of mobility. This could be explained by the substantial family responsibilities which come with a large household size, which forces WESW to move to other places in search for better economic opportunities.<sup>8–10</sup> On the other hand, it can be an escape from family stigma in order to access health care services in different locations.<sup>12,15</sup>

Contrary to other studies that examined predictors of sex work mobility, WESW's level of education was not associated with mobility in our research.<sup>19,33,38</sup> Indeed, increased education level is critical for mobility since it comes with more rewards or higher pay.<sup>33</sup> However, in our study sample, only 12.7% had attained secondary education, and the rest had primary education and lower; this may explain why education was not significant. Contrary to this narrative, King and colleagues found that lower education levels facilitated mobility among WESW. This could be caused by the high unemployment rate in Uganda vis-à-vis their employability skills, which force them to move for better economic opportunities.<sup>19</sup>

In their study, King and colleagues found that WESW working under managers or pimps were associated with mobility, contrary to our study findings.<sup>19</sup> pimps/managers control the movement of WESW, and determine where they have to go, when and the duration of their stay.<sup>19</sup> In our study, only 16.2% of the participants reported working under pimps/managers, which could explain the insignificance of the study results.

Contrary to findings from Suryawashi and colleagues, our study found that marital status was not a significant predictor of mobility. Their findings showed that unmarried WESW were more likely to be mobile. WESW who are married tends to have more responsibilities, which include children and spouses, which may restrict them from moving compared to those not married and more independent.<sup>33</sup> This is also supported by Banerjee and colleagues, who showed that women with childcare and more household responsibilities are less likely to be mobile.<sup>39</sup> More research is needed to find out why it was not significant in our study.

Previous studies have shown that poverty is one of the push factors of mobility among WESW. Women move to new locations for better-paying clients to improve their economic status.<sup>19,33,40,41</sup> However, in our study, the economic variables, which included asset ownership, financial self-efficacy and financial distress, were not statistically significant. This could be a methodological issue.

WESW's communities play a critical role in determining their mobility. From our results, women from rural areas were less likely to move compared to those from fishing sites. Women's mobility at fishing sites may be explained by the seasonal business at the sites, brought by the fishing cycles on Lake Victoria, which include the lunar cycle, the

rainfall patterns and fish species.<sup>42</sup> During lunar and rainfall seasons, the catches are low, meaning low business<sup>42</sup> therefore, women are forced to move to other places for more money. However, populations at fishing communities are known for their mobility, there is high mobility in rural communities along Lake Victoria in Uganda.<sup>43</sup> Women in these communities travel for antenatal care and other health services.<sup>44</sup>

## Conclusions

The results show that individual factors, including age, HIV status, and environmental factors (locality), are associated with a high likelihood of mobility among WESW in Uganda. These are risk factors, which can possibly hinder the prevention and access to HIV health-related services among WESW who are mobile. Further research is needed to confirm whether these a pull or push factors. The directionality of these factors will help in the designing of interventions and programs to address mobility among WESW.

## Limitations

The variables used are self-reported, which may have recall bias and social desirability. The study employed quantitative methods only; however, mixed methods, both qualitative and quantitative, would be important to understand the correlates of mobility among WESW. Specifically, this will expand and strengthen the study findings and conclusions.

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## Author contributions

Fred M. Ssewamala: Funding acquisition, Supervision, Conceptualization, Writing - Review and Editing. Joshua Kiyangi: Conceptualization, Methodology, Data curation, Formal analysis, Writing- Original draft preparation. Susan S. Witte: Funding acquisition, Conceptualization, Writing - Review and Editing. Proscovia Nabunya: Conceptualization, Writing - Review and Editing. Edward Nsubuga: Project administration. Ozge Sensoy

Bahar: Writing - Review and Editing. Larissa Jennings Mayo-Wilson: Writing - Review and Editing. Samuel Kizito: Writing - Review and Editing. Jennifer Nattabi: Writing - Review and Editing. Josephine Nabayinda: Writing - Review and Editing.

### Declaration of conflicting interests

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### Ethical approval

The Institutional Review Boards of Washington University in St Louis (#201811106), Columbia University Institutional Review Board (AAAR9804), Uganda Virus Research Institute Ethics Committee (GC/127/18/10/690) and Uganda National Council for Science and Technology (UNCST –SS4828) approved this study.

### Consent to participate

Written informed consent was obtained from study participants before participating in the study.

### Consent for publication

Written informed consent was obtained from study participants for their information to be used as an aggregate and de-identified for the purposes to publish or disseminate information on the results to describe the research study.

### Data availability

Due to the sensitivity around the data, the data will not be deposited in a data repository. However, data used in this analysis is available upon reasonable request. The team is open to data sharing provided the points outlined below, which were part of the study protocol, data sharing plan, and consenting process, are met; 1) A formal research question is specified a priori; 2) Names, affiliations, and roles of any other individuals who will access the shared data; 3) The deliverable(s) e.g., manuscript, conference presentation are specified a priori; 4) Proper credit and attribution e.g., authorship, co-authorship, and order for each deliverable are specified a priori; 5) A statement indicating an understanding that the data cannot be further shared with any additional individual(s) or parties without the PI's permission; 6) IRB approval for use of the data (or documentation that IRB has determined the research is exempt).

### Code availability

Statistical analysis code is available at the request of the first author.

### ORCID iDs

Joshua Kiyingi  <https://orcid.org/0000-0001-7264-6976>

Proscovia Nabunya  <https://orcid.org/0000-0002-9088-5839>

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