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Factors associated with prevalent HIV infection among female sex workers in Zambia and Rwanda

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Abstract

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By Emeli J. Anderson

Female sex workers (FSW) generally have an increased risk of acquiring HIV infection. In Rwanda and Zambia, FSW have an HIV prevalence that is about 17 times and 4 times greater than the HIV prevalence among the adult population (ages 15 to 49) in those countries, respectively. In this paper, we analyze cross-sectional data collected on 1,204 HIV-negative (N=191) and HIV-positive (N=1,013) women recruited from a sample of FSW seeking HIV, STI, and family planning services between September 2012 and March 2015 in Kigali, Rwanda and Lusaka and Ndola, Zambia, to assess factors associated with prevalent HIV infection. Eligible women were between the age of 18 and 45, completed a face-to-face interview, underwent a gynecological exam and HIV and STI testing. We assessed all variables for potential associations with prevalent HIV in the overall sample and stratified by city, and estimated prevalence odds ratios (pORs) using logistic regression. All variables that were statistically significant in the bivariate analysis were considered for the multivariate logistic regression model. A final model was determined based on backwards elimination and adjusted ORs (aORs) calculated. The final model of correlates of HIV infection included condom use by city (condomless sex in the past month was reported more frequently by HIV-positive women in Kigali, but less frequently in Lusaka and Ndola), no previous HIV test, older age, being widowed, treatment for ulcers in the past year, lower abdominal pain, treatment for urinary tract infection, treatment for syphilis, and treatment for pelvic inflammatory disease. HIV-positive women were less likely to report a previous HIV test (aOR=2.3, 95% confidence interval (CI): 1.4, 3.6) and more likely to report a reproductive health disturbance (e.g. treatment for ulcers in the past year (aOR=5.4, 95% CI: 2.4, 12.1)). Nonetheless, there was a high burden of STIs among all women in the study. STI screening and treatment may be a useful intervention for FSW in Rwanda and Zambia regardless of serostatus. Similarly, creating programs that target HIV-positive women for HIV testing would be beneficial to identify unknown positive infections and link women to care.

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Chapter I

Background

HIV/AIDS Globally

In 2015, there were 2.1 million new HIV infections and over 36 million people living with HIV (PLWH) globally (1). Between 2000 and 2015 the number of new HIV infections decreased by 35%. Antiretroviral treatment (ART) coverage increased from 2010 to 2015, with 46% of all PLWH on treatment. The increase in ART coverage has resulted in fewer AIDS-related deaths.

Nonetheless, significant challenges remain in combating the HIV/AIDS epidemic. For example, approximately 40% of persons with HIV are unaware of their serostatus, which represents around 14 million people worldwide. There are disparities across and within countries; two-thirds of all new infections occur in sub-Saharan Africa (2). Key populations, such as female sex workers (FSW), are often not reached through prevention and treatment programs. Stigmatization of HIV/AIDS, discrimination, and criminalization, are barriers to fighting the epidemic. Data collected by various countries between 2009 and 2014 and analyzed by UNAIDS, indicate that about 50% of adults aged 15-49 would not buy food from an HIV positive sales person (1).

On June 7, 2016, the UN published a declaration to end the AIDS epidemic by 2030 (3). The goals include reducing the number of new HIV infections to 500,000, reducing AIDS-related deaths to fewer than 500,000, and eliminating HIV-related stigma and discrimination by 2020. While these goals are lofty, they highlight the global concern and awareness surrounding the HIV/AIDS epidemic. The declaration indicates the importance of developing programs that reach key populations, such as sex workers.

Sex Work and HIV/AIDS

HIV research in recent years has begun to focus more rigorously on key populations, who are often at an increased risk of HIV compared with the general population (4). The World Health Organization (WHO) estimates that HIV prevalence among sex workers globally is approximately 12%, although there is much regional variation. As defined by the WHO, sex workers are persons who exchange sex (oral, anal, or vaginal) for money or goods, and can include males, females, and transgender adults (aged 18 and above). Sex work may occur regularly or occasionally, and may or may not be a primary source of income for an individual. In this paper, we focus on FSW.

Regardless of epidemic type (concentrated or generalized), sex workers often have a greater HIV prevalence than the general population and may serve as a driver of the epidemic (5). In a recent study, Ustun-Pruss et al estimated that approximately 15% of HIV prevalence in the general adult female population could be attributed to sex work across the globe, but was highest in sub-Saharan Africa at approximately 18% (6). Baral et al reviewed over 100 studies in a systematic review and meta-analysis of HIV among FSW in low- and middle- income countries (7). Overall HIV prevalence among FSW was 11.8%, but among countries with medium to high background prevalence, HIV prevalence among FSW was 30.7%. This highlights the fact that although in most places, sex workers bear a significant burden of HIV, certain regions are more affected than others. In particular, FSW in sub-Saharan Africa generally have a high prevalence and risk of HIV, compared with other regions of the world.

Factors that put FSW at an increased risk for HIV include multiple sex partners, inconsistent condom use, limited access to healthcare services, legal issues, stigma,

discrimination, and violence (4, 7). Understanding regional differences in risk factors will help governments, organizations, and practitioners design preventive and treatment programs that better target sex workers. Herein, we discuss HIV/AIDS and sex work in two countries: Rwanda and Zambia.

HIV/AIDS in Rwanda

Rwanda is in Central-Eastern Africa, with a population of just under 13 million (8). The country is comprised of four provinces: North, South, East and, West (9). The capital city, Kigali, has a population of approximately 1.25 million people and is comprised of 30 districts (8, 9). HIV prevalence among adults ages 15-49 is estimated at 2.9%, but higher among women than men, with a prevalence of 3.7% and 2.2%, respectively (9, 10). Women between the ages of 35 and 39 have a prevalence of almost 8%. Kigali has the highest HIV prevalence in the country of 7.3%.

The Rwandan government has several ongoing initiatives to combat the HIV/AIDS epidemic in Rwanda (9). These include Vision 2020, Economic Development and Poverty Reduction Strategy 2013-2018, Health Sector Strategic Plan III, and the National Strategic Plan on HIV and AIDS. The National Accelerated Plan for Women, Girls, Gender Equality and HIV ended in 2014. Their objectives include making Rwanda a middle-lower-income country by 2020, developing a framework for a multi-sector response to HIV/AIDS, to lower HIV incidence by two-thirds, decrease the number of HIV-related deaths by 50%, guarantee equal opportunities and access to HIV services for PLWH, and to empower women and girls in the context of HIV.

In 2011, the Rwandan government signed the UN General Assembly declaration on HIV/AIDS and has reported progress towards meeting the goals outlined in the declaration. For example, ART is currently provided at no charge to those who are eligible and implementation of treatment programs has been shifter to nurses. Additionally, HIV testing and counseling is currently offered for free at accredited facilities and between July 2012 and June 2013, 493 facilities conducted over 3 million HIV tests. Non-governmental organizations and funding from international governments also play a role in addressing the HIV epidemic in Rwanda. The Global Fund has invested over 8 million dollars for HIV/AIDS programs (11). UNICEF supports government programs aimed at reducing HIV infection among women and children (12). The U.S. President's Plan for Emergency AIDS Relief (PEPFAR) has been providing funding to Rwanda since 2004 (13).

Sex Workers in Rwanda

The Rwandan government's ongoing initiatives to address HIV/AIDS include preventive programs targeted for sex workers (9). Programs include outreach through peer education to address HIV and sexually transmitted infection (STI) prevention, condom use promotion, referrals for HIV and STI testing, violence prevention, and socioeconomic self-reliance. Forty-two group savings and loan associations (GSLA) were created through a USAID project to support sex workers. As of 2014, 2,310 FSW had been reached through outreach programs, 70.6% of whom were provided with STI screening, HIV testing and family planning services. Additionally, over 200 women were trained as peer educators.

In 2010, the Rwandan Ministry of Health published the Behavioral and Biological Surveillance Survey Among Female Sex Workers (14). Site mapping and time-location sampling was used to identify participants for the survey. Of the 1,338 women sampled, 1,112 (83%) agreed to HIV testing, of which 51% were HIV-positive. The highest prevalence was seen in Kigali (56%) and the lowest in the East Province (33%). Prevalence also increased with age with a prevalence of 63% among women who were 40 or older. STI prevalence was also highest in Kigali (44%) and lowest in East Province (22%). Overall, 36% of women reported having had at least one STI symptoms in the previous 12 months.

There is considerable uncertainty as to the total population size of FSW in Rwanda. The Rwanda Biomedical Center (RBC) estimated there to be between 25,000 and 45,000 FSW in Rwanda in 2012 (9). A study conducted in 2015 by Mutagoma et al estimated the number to be between 3,205 and 3,345, much smaller than the estimates from the RBC (15). In the same study, they also estimated the number of FSW in Kigali to be 2,253.

In January, 2017, an article by Mutagoma et al was published on data from the 2010 Behavioral and Biological Surveillance Survey Among Female Sex Workers (16). They analyzed factors associated with prevalent HIV. Variables that were statistically significantly associated with HIV included marital status (in particular, being separated), older age, province, years of experience as a FSW, comprehensive HIV knowledge, and STI symptoms.

Most of the studies identified among FSW in Rwanda reported on a single cohort followed between 2006 and 2009 (17). The cohort was recruited by a medical research

non-profit, Project Ubuzima, located in Kigali (18-20). Women unaware of their HIV status or those whose most recent test was negative were eligible. Women were recruited at community meetings with assistance from community members, including sex workers. Eight-hundred women were recruited at baseline, 403 enrolled in the follow-up study, and 338 attended all follow-up visits.

HIV prevalence was 24% among the initial 800 women screened at baseline (19). Prevalence varied significantly by age (older age was associated with higher prevalence) and district of residence. Over half of the women had CD4 counts less than 500. Only 21% of women reported always using a condom and 63% reported never using a condom with their regular partner. About one-third of participants had never had an HIV test, and another third had only been tested once. The authors explored factors associated with prevalent HIV infection at baseline. After adjusting for age and district of residence, only STI treatment in the past month and herpes simplex virus type 2 (HSV-2) seropositive were statistically significantly associated with HIV serostatus at baseline. Other factors explored include marital status, breastfeeding status, condom use at last sex, cleansed vagina prior to last sex, years working as a sex worker, history of forced sex, number of vaginal acts in the past month, number of clients in the past month, having an HIV positive sexual partner, number of lifetime HIV tests, HIV testing in past 6 months, one or more genital symptom in last month, regular alcohol consumption, history of imprisonment, and pregnancy status. In the baseline study, the authors also included data on women attending a voluntary counseling and testing center (VCT) in Kigali. HIV prevalence was twice as high among FSW as it was among the women attending the VCT (24% vs. 12.8%).

The 403 women recruited through Project Ubuzima were followed to determine HIV incidence (18). The 2-year HIV incidence rate was 2.9 cases per 100 person years (PY). Incident STIs were more common with incident rates of 8.7 per 100 PY for HSV-2, 16.9 per 100 PY for trichomonas, 12.1 per 100 PY for gonorrhea, 8.1 per 100 PY for chlamydia, and 6.2 per 100 PY for syphilis. Pregnancy was also common with a pregnancy rate of 26.3 pregnancies per 100 PY. Unadjusted and adjusted hazard ratios were calculated for various factors. After adjustment, the following factors had statistically significant hazard ratios: years in sex work, change in reproductive intentions, and incident syphilis. Women who had worked as a FSW a year or less had a hazard of HIV that was 6.3 times the hazard of women who had been in sex work for two to three years. Women who had a change in reproductive intentions had a rate of HIV 5.5 times the rate among women who had not had a change in reproductive status. Lastly, women with an incident syphilis infection had an HIV rate that was 5.7 times the rate among women without an incident syphilis infection. The follow-up period was relatively short and so there were few HIV infections. This can be seen in the relatively large confidence intervals calculated for the hazard ratios.

Braunstein et al evaluated linkage to care and risk behaviors of the HIV-positive women in the Ubuzima cohort one-year post-screening (20). All women who tested positive at baseline were referred to a health facility for treatment. Eighty-five percent of the women who were reached at follow-up had linked to care and of those 48% had initiated ART. Of those on ART, 33% reported being non-adherent at some point since treatment initiation.

Veldhuijzen et al determined the prevalence of various STIs among the HIV-negative FSW in the Ubuzima cohort (17). Thirty percent of women had a laboratory confirmed non-ulcerative STI at baseline and 55% had laboratory confirmed syphilis and/or HSV-2 antibodies. Trichomonas was the most common non-ulcerative STI, present in 17% of women, followed by gonorrhea (12%) and chlamydia (5%).

None of the studies of the Ubuzima cohort described above included multivariate modeling, which we seek to do in this paper to better understand the factors that are associated with serostatus among FSW in Rwanda (and Zambia, described below). Additionally, following the Braunstein et al study, Rwanda signed the UN Political Declaration on HIV and AIDS, and implemented new programs designed to better reach key populations, such as FSW. New data is warranted to understand this population.

A 2014 analysis of preliminary screening data from Kigali on the study reported on in this paper was done by RZHRG for a conference presentation. Over half of the respondents tested HIV-positive (21). Of those who had never been tested before, 61.5% were positive, and among those who had previously tested negative, 26.1% were positive. Almost half of the HIV negative respondents reported that they entered sex work due to poverty and another quarter because they had lost a partner or husband. One-third of uninfected women indicated that their first sexual encounter was physically forced. HIV positivity was higher among older women and those that had a history of STIs. Twenty-two percent of HIV-positive women were positive for trichomonas, compared with 15% positive for trichomonas among HIV-negative women (22). The majority of both HIV positive and negative women reported condom use as their only contraceptive method.

HIV/AIDS in Zambia

Zambia is located in Southern Africa with a population of over 15 million, slightly larger than Rwanda's population (23). The country is composed of 10 provinces, two of which (Lusaka and Copperbelt) are largely urban. The capital, Lusaka, is in the region of the same name (24). The adult (ages 15-49) HIV prevalence in the country is 12.9%, almost four times that of Rwanda's adult HIV prevalence, with the highest regional prevalence in the Copperbelt (18%) (24, 25). Similar to Rwanda, the prevalence in women is greater than in men (15% and 11%, respectively) (24). Heterosexual transmission is the most common form of HIV infection in Zambia.

According to the 2013-2014 Zambia Demographic and Health Survey (DHS) approximately half of the general population ages 15-24 both used condoms at last sex and had comprehensive correct knowledge of HIV/AIDS (24). As excepted, results from the DHS indicate that HIV prevalence increases with age and that those who reported an STI or STI symptoms in the past year were more likely to be HIV infected than those who did not report an STI or STI symptoms. Prevalence also appeared to increase with higher education and wealth. Widowed women were found to be disproportionately HIV infected, with a prevalence of 48%. Thirteen percent of men reported having paid for sex in the past 12 months, and among those only 60% reported condom use during last paid sex act.

The first diagnosed case of HIV in Zambia was in 1984 (24). By 1987 the government had developed its first plan to combat HIV and AIDS, the Emergency Short-Term Plan, followed by several other initiatives in the 1990s and early 2000s. HIV prevalence between 2001-2002 and 2013 decreased by 3%. In 2010, the Zambian

government initiated the 2011-2015 National HIV and AIDS Strategic Framework, which included 4 broad priorities. These included accelerating and intensifying prevention activities, provide universal access to treatment, care, and support for people living with HIV (PLWH), comprehensive treatment for opportunistic infections, such as TB and STIs, mitigate the socioeconomic impact of HIV/AIDS, and strengthen capacity for a multi-sectoral response. Similarly to Rwanda, NGOs and international governments provide support and funding to the HIV/AIDS response in Zambia. For example, The Global Fund has invested over 660 million U.S. dollars (USD) in HIV/AIDS programs and another 150 million USD in TB/HIV programs in Zambia to-date (26). Recipients of The Global Fund's investment funds include the United Nations Development Programme, Zambia, the Ministry of Health of the Government of the Republic of Zambia, and Churches Health Association of Zambia. As with Rwanda, Zambia is also supported by PEPFAR (27). In 2016, PEPFAR committed 343 million USD to Zambia.

Sex Workers in Zambia

In 2015, the Ministry of Health, the Ministry of Community Development Mother and Child Health, and the National HIV/AIDS Council, along with the assistance of USAID, FHI 360, and the Tropical Diseases Research Centre, Ndola, conducted the Integrated Biological and Behavioral Surveillance Survey (IBBS) Among Female Sex Workers in Zambia (28). Previous surveys among FSW (and long-distance truck drivers, who represent the majority of FSW's clients) were conducted in 2000, 2003, 2005, 2006, and 2009. The survey was conducted in 5 provinces across Zambia: Ndola, Solwezi, Chirundu, Kapiri Mposhi, and Livingstone/Kazungula. Behavioral data was collected via face-to-face interview and laboratory specimen collected to test for biologic outcomes. In

total, 1,189 women were sampled, 94% of whom were tested for HIV and syphilis (n = 1,113). Approximately 56% of respondents were HIV-positive, 21% were positive for syphilis, and 9% were positive for *Trichomonas vaginalis*. Women who tested HIV positive were statistically significantly older, positive for syphilis, and were more likely to drink alcohol regularly. Educational attainment and condom use were similar between HIV-positive and HIV–negative women. HIV prevalence was highest in Chirundu (73.3%) and lowest in Livingston (46%).

The earliest study identified during the literature search dates back to 2004 and is a qualitative study of 20 street and nightclub-based sex workers in Lusaka (29). Both groups of women found it difficult to avoid or take precautions to protect themselves against HIV or STIs. For example, participants expressed the desire to use condoms for protection against HIV and STIs but indicated that they were often unable to use them due to power imbalances or monetary reasons. Violence towards the women was also a common theme, and several participants reported that they had been gang raped. The article highlights the vulnerability that FSW face in Zambia and the factors that put them at a heightened risk for HIV and STIs.

Abbott et al published a second qualitative study of FSW in Zambia in 2013 (30). The results echo that of the 2004 study, suggesting that FSW are often either unable to negotiate condom use or willingly engage in condomless sex due to monetary pressures. Nonetheless, the women in both studies appeared knowledgeable about the benefits of condom use in protection against HIV and STIs. In contrast with the earlier study, the results in Abbott et al suggest that alcohol use is common place among both the sex workers and their clients.

To-date no quantitative evaluation has been undertaken to estimate factors that are associated with HIV-positivity among FSW in Zambia. Leclerc et al conducted a study among the clients of sex workers in Zambia to explore factors associated with FSW use (31). The authors analyzed data from the 2001 DHS. Over a quarter of respondents had ever paid for sex, about 13% of whom had done so in the past 12 months. This suggests a high prevalence of FSW use among men in Zambia.

As discussed in the Rwanda section above, a preliminary analysis of the current study was conducted by RZHRG for conference presentation in 2014 (32, 33). Similarly to Rwanda, over half (53%) of the women screened were HIV-positive. Among HIV positive women, 23% were positive for syphilis and 10% positive for trichomonas, compared with 7% positive for syphilis and 9% positive for trichomonas among HIV negative women (32). The most commonly used contraceptive method by both HIV positive and negative women was condoms (57% and 38%, respectively).

In a subset of HIV negative women, 66% reported receipt of money or presents at first sexual act and 36% (33). Almost all of the women were interested in being HIV tested with their partners and repeat client, but only half were interested in testing with non-repeat clients. Alcohol use was common among respondents and 95% stated they had sex while under the influence.

Rwanda Zambia HIV Research Group (RZHRG)

Background

The data analyzed in this paper are from an RZHRG study to estimate HIV incidence among FSW in Rwanda and Zambia. RZHRG has been working in Rwanda

since 1986 and Zambia since 1994 (34). The aims of the current study are to: (1) understand baseline differences between HIV positive and HIV negative FSW in Kigali, Rwanda, and Ndola and Lusaka, Zambia, and (2) build a multivariate model to estimate the association between various factors and HIV serostatus.

Chapter II

Manuscript

Introduction

Two-thirds of all new HIV cases occur in sub-Saharan Africa (2). In 2015, approximately 5% of all HIV-positive persons in sub-Saharan Africa were living in Rwanda and Zambia (2, 10, 25). In both countries, female sex work is considered a key driver of the HIV epidemic (9, 14, 28). Sex work generally increases an individuals' risk of acquiring HIV (35). Current estimates put HIV prevalence among female sex workers (FSW) at 51% in Rwanda and 56% in Zambia (9, 28). The HIV prevalence among adults aged 15 to 49 is estimated at 3% in Rwanda and 13% in Zambia, about 17 times and 4 times less than the estimated prevalence among FSW in Rwanda and Zambia, respectively. Understanding the factors that contribute to the high prevalence among sex workers is important for designing and implementing programs aimed at prevention and linkage to care for those already infected.

There are a handful of studies in Rwanda and Zambia among FSW (15, 17-20, 30, 36). The literature from Rwanda is relatively more robust, including mostly cross-sectional studies, a cohort study, and an effort to model the total number of FSW (15-20, 36). Two cross-sectional studies in Rwanda by Veldhuijzen et al examined prevalence of sexually transmitted infections (STIs) among HIV-negative FSW and associations between known HIV risks and anal intercourse, respectively (17, 36). Neither directly addressed risk factors for HIV due to the cross-sectional nature of the studies, although the latter study found that anal intercourse was not statistically significantly associated with HIV. Braunstein et al conducted a cohort study in Rwanda among HIV-negative

FSW to assess HIV, STI, and pregnancy incidence (18). Significant associations were identified between incident HIV and previous HIV testing, more lifetime pregnancies, recent initiation of sex work, gonorrhea, and syphilis. A cross-sectional study was conducted to investigate associations between various factors and prevalent HIV in Rwanda and found that older age and history of forced sex were both statistically significantly associated with prevalent HIV (19). In Zambia we identified two qualitative studies among FSW and an Integrated Biological and Behavioural Surveillance Survey (IBBS) among FSW (28-30). Both qualitative studies were among HIV-negative FSW and addressed topics such as condom use, violence, and male circumcision (29, 30). The IBBS described the current epidemiology of HIV, STIs and risk behaviors among FSW in Zambia (28). More research is needed to understand and identify factors that put FSW at risk for HIV in Rwanda and Zambia.

Many studies in sub-Saharan Africa have indicated that older age, as a proxy for more opportunity to become infected, may be associated with a higher prevalence of HIV infection among FSW (16, 37-41). Similarly, the presence of other STIs is generally associated with prevalent and incident HIV (16, 19, 36, 38, 39, 41-43). Other factors that have been explored with respect to prevalence with varying results include lower education, condom use, contraception method (implant and hormonal methods), longer duration of sex work, higher number and type (regular vs. non-regular) of sexual partners, experienced violence, sex work venue (brothel-based vs. non-brothel based), history of HIV testing, substance use, and non-marital status (16-19, 37, 38, 40-42, 44). As consistent condom use is key in the prevention of HIV and other STIs, it is additionally

useful to gain insight into factors associated with condom use among FSW (45). These factors often differ by country and region.

Herein we report the results of a cross-sectional analysis of associations between various factors and HIV-seropositivity among FSW in Rwanda and Zambia. We also report on significant differences between FSW in Rwanda and Zambia.

Methods

Study Population and Data Collection

A cohort of FSW was recruited for a follow-up study by the Rwanda Zambia HIV Research Group (RZHRG) headquartered at Emory University, between September 2012 and March 2015 from Kigali in Rwanda and Ndola and Lusaka in Zambia. Community workers and peer FSW were trained to recruit FSW at known "hotspots," such as bars, restaurants, boarding houses, lodges/hotels, and street areas. The peer recruiters were study participants who had completed at least three follow-up visits. Recruiters provided written invitations to potential participants to receive HIV and STI testing and counseling, STI treatment, and long-acting reversible contraceptive (LARC) methods at the in-country study sites

The objective of this study was to estimate HIV incidence and enroll high-risk HIV-negative women in preparation for HIV vaccine trials. Eligible and interested HIV-negative women and a subset of HIV-positive women for comparison completed a comprehensive baseline questionnaire including demographic, and behavioral data. . Eligibility included verification as a sex worker (done by a nurse during the screening visit described below), between 18 and 45 years of age on the day of enrollment, and

unmarried (either never married or divorced/separated). All participants were compensated for travel and time costs. In this paper, we report on an analysis of the cross-sectional data collected at baseline to assess differences between HIV-positive and -negative women.

Screening and Enrollment Visit

All women attended an initial screening visit which included, at no cost, HIV and STI testing and the provision of LARC. Age, marital status, prior HIV testing history, and contraceptive use were recorded. The enrollment visit followed the screening visit and included a gynecological exam and the baseline questionnaire on demographics, HIV risk factors and intravaginal practices, and family planning services. For some women, the screening and enrollment visits took place on the same day. For others, the enrollment visit took place one to two weeks after the screening visit. Initially, both HIV-positive and HIV–negative women were invited to participate in the enrollment visit. After 2013, only eligible HIV-negative women participated in enrollment visits. For those who tested positive for STIs, treatment was offered at no cost, and for those testing HIV-positive, HIV treatment referral was provided to follow-up at the government clinic. Staff nurses administered the approximately 45 minute face-to-face behavioral risk assessment questionnaire for each participant.

Laboratory Testing

Laboratory staff were trained in specimen handling, sample processing, and management of samples. The RZHRG laboratory has a system in place for quality assurance certification. The following specimen were collected at baseline: blood for HIV testing and syphilis serology, dried blood spots and plasma for storage, vaginal and

endocervical swab samples for wet preparation for diagnosis of trichomonas, sperm, and in the event of symptoms, bacterial vaginosis (BV) and candida. Rapid HIV testing was performed on blood obtained by finger prick. Women who tested positive for STIs received same-day treatment and HIV-positive women were referred to the government program for HIV care.

Demographic and Behavioral Survey

The baseline survey consisted of 16 topic areas including socio-demographics, lifetime and recent sexual history, client recruitment, safety and violence, intravaginal practices, reproductive practices and disturbances, STI history, gynecological exam and laboratory results, and treatment information. The survey was administered by a staff nurse in the appropriate language for each location: either Nyanja or Bemba in Zambia and Kinyarwanda in Rwanda. Initially, the questionnaire was divided into two parts: a general survey and a demographic survey. In 2013, the survey was combined into one document; several pilot questions were added and existing questions changed. For our analysis, we considered only questions that were asked on both survey versions including demographics, reproductive and contraceptive questions, current reproductive health disturbances, gynecological exam results, and STI treatment. Our outcome variable was baseline HIV test result (prevalent HIV-positive or prevalent HIV-negative).

IRB Approval

Written informed consent was provided by all participants at the initial screening visit. The research project was approved by Emory University's Institutional Review Board (IRB) and Office for Human Research Protections-registered IRBs in Rwanda and Zambia.

Data Analysis

Data were entered and maintained in an Access database. All analyses were performed using SAS 9.4. Initial univariate analyses were conducted on all variables for which there were responses for both HIV-negative and HIV–positive women at baseline. Characteristics of the study participants at baseline according to HIV status were compared using Chi-square or Fisher's Exact tests for categorical variables and t-tests for continuous variables. Further, we stratified the bivariate analysis by city to determine if there were any meaningful differences in the bivariate associations across the three cities. Unadjusted prevalence odds ratios (pOR) were calculated for each of the variables using unconditional logistic regression.

To assess the associations of various risk factors with HIV status at baseline multivariate unconditional logistic regression models were used to calculate adjusted prevalence odds ratios (aOR) and 95% confidence intervals (CI). Variables that were significant at $p < 0.05$ in the bivariate analysis were considered for the model. These included: city (Kigali, Lusaka, or Ndola), receipt of a previous HIV test, age, marital status (single, divorced/separated, or widowed), number of live births, years living in current city, treatment of ulcers in the past year, treatment for discharge in the past year, current contraceptive method, interest in receiving LARC, cystitis/dysuria, vaginal discharge, painful intercourse, trichomonas diagnosis, lower abdominal pain, acute genital ulcers, chronic genital ulcers, treatment for urinary tract infection (UTI), treatment for trichomonas, treatment for syphilis, and pelvic inflammatory disease. As some women declined gynecologic exams, more than 10% of the gynecological exam variables were missing, so these variables were not considered for the multivariate model.

Additionally, we considered two interaction terms: a city by condom use interaction and a city by literacy status interaction. Collinearity between the variables in the model was evaluated following interaction assessment and after model selection. A final model was determined using backwards selection. aORs and 95% confidence intervals were calculated from the final model.

Results

Demographics

Data were available on 191 (15.9%) HIV-positive and 1013 (84.1%) HIV-negative women at baseline (n=1204). Almost half of the women (46.1%) were from Kigali, about one-third from Ndola (32.6%), and the remaining women from Lusaka (21.4%) (Table 1). The odds of HIV-seropositivity was greater in Lusaka (pOR = 1.3; 95% confidence interval (CI): 0.9, 1.9) and lower in Ndola (pOR = 0.5; 95% CI: 0.4, 0.8), compared with Kigali (Table 2).

HIV-positive women were less likely to have had a previous HIV-test than were HIV-negative women (pOR = 2.1; 95% CI: 1.4, 3.0). Women who were HIV-positive were statistically significantly more likely to be older (average age of 30 vs. 26 for HIV-negative women) and divorced/separated or widowed. The proportion of women who reported having sex without a condom in the past month was roughly the same between HIV-positive and HIV-negative women. However, this proportion varied by city. In Kigali, HIV-positive women were statistically significantly less likely to report condom use in the prior month compared to HIV-negative women (73.2% vs. 49.3%, respectively). In Ndola, HIV-positive were *more* likely to report condom use in the prior

month compared to HIV-negative women (64.1% and 86.4%, respectively). In Lusaka, the proportions were again approximately the same (75.6% vs. 73.3% respectively).

Literacy levels, measured as not literate, can read a little, can read well, or can read multiple languages, were similar between HIV-positive and HIV-negative women. In the stratified by-city analysis, literacy level and HIV serostatus were statistically significantly associated with one another in Lusaka ($p = 0.01$), with HIV-positive women more likely to be illiterate or able to read a little than HIV-negative women.

Reproductive Health Disturbances and Contraception

HIV-positive women were more likely to report treatment for both ulcers (pOR = 7.5; 95% CI: 3.7, 15.0) and/or discharge (pOR = 2.2; 95% CI: 1.4, 3.6) in the previous year. A statistically significant greater proportion of HIV-negative women were on some form of contraception other than condoms, compared with HIV-positive women (60.7% vs. 45.0%). About one-third of HIV-positive reported a current reproductive health disturbance compared with only about 15% of HIV-negative women (pOR = 2.4; 95% CI: 1.7, 3.4). Commonly reported health disturbances included cystitis/dysuria (15.0% of HIV-positive women vs. 5.8% of HIV-negative women), vaginal discharge (15.2% of HIV-positive women vs. 6.5% of HIV-negative women), painful intercourse (9.4% of HIV-positive women vs. 2.4% of HIV-negative women), and lower abdominal pain (20.4% of HIV-positive women vs. 6.4% of HIV-negative women). Participants were also tested for trichomonas and the presence of sperm. Trichomonas was present among 16.2% of HIV-positive whereas only 9.4% of HIV-negative women tested positive. Sperm was present in similar amounts in both HIV-positive and HIV-negative participants.

Gynecological Exam

Several gynecological exam variables were statistically significantly associated with prevalent HIV infection. However, in general there were few instances of gynecological abnormalities. Abnormal vaginal discharge was present in 18.7% of HIV-positive women but only 5.3% of HIV-negative women. Adnexal tenderness was also about 10 times more common among HIV-positive women than HIV-negative women (9.4% vs. 1.1%, respectively). Other gynecological abnormalities present in greater proportions among HIV-positive women include bilateral inguinal adenopathy greater than 1 cm, inflammation, ulceration, and genital warts.

Treatment for Reproduction Health Disturbances

Almost half of all the HIV-positive respondents were treated for a reproductive health disturbance, compared with only about one-fifth of HIV-negative respondents (48.1% vs. 19.6%, respectively). Trichomonas was common among all women: 14.3% of HIV-positive and 9.1% of HIV-negative women. Syphilis was treated in 28.0% of HIV-positive women and 8.9% of HIV-negative women (pOR = 4.0; 95% CI: 2.7, 5.8). Pelvic inflammatory disease was also more prevalent among HIV-positive women than HIV-negative women (pOR = 9.2; 95% CI: 4.1, 20.7).

Multivariate Model

The final multivariate model included the following variables: city, sex without a condom in the past month, previous HIV testing status, age (continuous), marital status, treatment for ulcers in the past year, lower abdominal pain, treatment for urinary tract infection (UTI), treatment for syphilis, treatment for pelvic inflammatory disease, and a city by condom use interaction term.

Self-reported sex without a condom in the past month was only statistically significant among women from Ndola. HIV-negative women were more likely to have had sex without a condom in the past month than were HIV-negative women in Ndola (aOR = 0.2; 95% CI: 0.1, 0.6) (Table 3). Similarly, although not statistically significant, HIV-negative women in Lusaka were also more likely to have sex without a condom in the past month than were HIV-positive women (aOR = 0.7; 95% CI: 0.2, 2.0). In Kigali, HIV-positive women were more likely to report sex without a condom in the past month (aOR = 1.6; 95% CI: 0.9, 2.9). Receipt of a previous HIV test was more common among HIV-negative women than HIV-positive women (aOR = 2.3; 95% CI: 1.4, 3.6). HIV-positive, similarly to the unadjusted models, were statistically significantly more likely to have been treated for ulcers in the past year, report lower abdominal pain, and receive treatment for UTIs, syphilis and pelvic inflammatory disease. The odds of HIV infection was greater among older women than younger women.

Discussion

Overall about 16% of our sample were prevalent HIV-positive, representing a substantial proportion of the total cohort. However, because data on HIV-positive women represent only two years of data collection, whereas data on HIV-negative women represent four years, we do not have an estimate of the true prevalence in our cohort.

There were some significant differences between HIV-positive and HIV-negative participants at baseline. HIV-positive women, overall, were less likely to use a form of contraception other than condoms or no contraception. This suggests that HIV-positive women may be at an increased risk of pregnancy compared with HIV-negative women.

Without effective interventions, mother-to-child HIV transmission rates can be between 15 and 45 percent (46). Many women begin sex work due to monetary constraints of taking care of dependents. This places FSW in a vulnerable position because they may need to make a certain minimum income to take care of their family. HIV-positive women were also less likely to be interested in receipt of LARC at their visit compared with HIV-negative women. However, while HIV-positive women reported a greater number of live births, the number of living children women reported did not differ by HIV status.

Overall, HIV-positive and HIV-negative women were similarly likely to report sex without a condom in the past month and the proportion was high at around 70%. Research suggests that while sex workers may prefer to use condoms, they can make more money with condomless sex (14, 28-30). In many instances, FSW have little ability to negotiate condom use with their clients. Interestingly, the proportion of women reporting condomless sex varied by city. In Kigali, 73% of HIV-positive women reported condomless sex in the past month compared with only 49% of HIV-negative women, although this result was not statistically significant. In Lusaka, the proportion of condomless sex in the past month was about equal between HIV-positive and HIV-negative women (75% and 73%, respectively). In Ndola, HIV-positive women were *less* likely to report condomless sex in the past month compared with HIV-negative women (64% and 76%, respectively). There may be several reasons for this difference across cities. It may be due to true differences between FSW in each city. However, it could also be an artifact of the sample. Regardless of association between condom use and serostatus, sex without a condom was common among all women.

In both the bivariate and multivariate analyses, HIV-positive women were less likely to report a previous HIV test. This relationship held across cities. This suggests that HIV-positive FSW are not accessing testing programs, and improved strategies are needed to reach FSW to identify infection and initiate therapy. Several studies have elucidated potential barriers to HIV testing uptake (47, 48). In a study among HIV-negative FSW in Ethiopia, FSW identified factors such as location of the nearest clinic, transportation fees, privacy concerns, low risk perception, and stigma as barriers to HIV testing and counseling services uptake (47). Nakanwagi et al conducted a similar study, but among HIV-positive FSW in Uganda (48). The participants expressed similar reasons for failure to link to care as the HIV-negative women in Ethiopia expressed for failure to utilize HIV testing and counseling services. In particular, the women in Uganda expressed negative feelings towards the healthcare workers at clinics, stating that they faced discrimination and feared being seen at the clinic. They also indicated that economic factors such as transportation costs or work-related factors such as a busy schedule were reasons for failure to link to care.

Another concern regarding HIV testing uptake is that if HIV-positive women are less likely to know their status, then they are at risk of transmitting infection to their clients. Sex work is considered a key driver of the HIV epidemic in both Rwanda and Zambia and so treating infection and promoting condom use among sex workers is vital to prevent spread to the general population (9, 14, 24, 28).

In the multivariate model, treatment for ulcers in the past year was statically significantly more common among HIV-positive women, but current ulcers (chronic and/or acute) were not. Because the data do not indicate when women seroconverted we

do not know whether the ulcers occurred before or after infection. If they occurred prior to serconversion, it is possible that the ulcers were a mediating factor in acquisition (49-51). Thus, screening and treatment for ulcers among FSW may be an effective intervention for preventing HIV infection. The other variables that remained significant in the multivariate model were lower abdominal pain, treatment for UTI, treatment for syphilis, and treatment for PID. Treatment occurred at the time of the study visit, but again we cannot establish whether such reproductive disturbances occurred before or after infection. Older age was also associated with prevalent HIV-infection. These results are in accord with previous research (18, 19, 39, 41-43). Finally, widowed women were more likely to be HIV-positive than single women, but divorced/separated women were not. This result may be because about 73% of widowed women were 30 years of age or older. Research among FSW has indicated that HIV prevalence generally increases with age (16, 37-41).

Many of the reproductive health disturbances, including STIs, were common among both HIV-positive and HIV-negative women. Trichomonas was significant in the unadjusted analysis, but did not remain so in the multivariate model. The proportion of HIV-positive women that tested positive for trichomonas was about twice the proportion of HIV-negative women that tested positive. However, a trichomonas diagnosis among HIV-negative women was around 10%-not negligible. Similarly, syphilis prevalence among HIV-negative was about 9%. However, the odds of syphilis among HIV-positive women was 3.4 times the odds of syphilis among HIV-negative women. Although few women were treated for gonorrhea or chlamydia diagnosis was limited to presence of endocervical pus with no laboratory confirmation. In general, the proportion of HIV-

positive treated for a reproductive health disturbance was about twice the proportion of HIV-negative women treated for a reproductive health disturbance. Therefore, while reproductive health disturbances were typical among both groups of women, they were more common among HIV-positive women. Nonetheless, the burden of STIs among HIV-negative is concerning. Many of the STIs that participants were tested for can result in serious sequelae if untreated. STI screening and treatment may provide a useful intervention among FSW, regardless of HIV serostatus.

Our study has several limitations. Data were cross-sectional so we were not able to confirm temporality of the associations between covariates and HIV status. Nonetheless, our goal was to understand important differences between HIV-positive and HIV-negative women in our cohort at baseline. Many of the variables were based on self-report, which can result in recall bias or social desirability bias (i.e. misclassification bias). For example, participants may have been reluctant to discuss previous STI treatment or condom use with the interviewers. However, many of the variables considered for our analysis were based on examination, diagnostic testing, and/or treatment at the time of the interview, in which recall bias or social desirability bias would not be an issue. Finally, there was a significant amount of missing data for the gynecological exam variables. We were not able to use these variables in our multivariate analysis or make any strong conclusions from the bivariate analysis. There were also several strengths to our study. We had a large sample size and so could make precise estimates for some of the variables. There were few missing values for most variables. As mentioned above, over half of our variables were based on diagnoses and/or treatment at the time of the study visit, and so were not subject to recall or social desirability bias. The

cross-sectional nature of the data meant that selection bias due to loss to follow-up was not an issue.

Few studies have addressed HIV, STIs, and sex work in Rwanda and Zambia (15, 17-20, 29, 30). Those that have generally support our results. In Veldhuijzen et al, results suggest a high prevalence of both ulcerative and non-ulcerative STIs among HIV-negative FSW in Kigali (17). While we observed a high prevalence of non-ulcerative STIs among both HIV-positive and HIV-negative women, ulcerative STIs were less common. Similar results to ours were obtained in the Braunstein et al articles, which found associations between HIV and older age, marital status (being widowed), condom use (HIV-positive women were less likely to report condom use at last sex), number of lifetime HIV tests (fewer tests among HIV-positive women), and treatment for STIs in past 3 months (18-20). Because the only studies we identified among FSW in Zambia were qualitative it is difficult to compare to our results to these studies. Abbott et al, interviewed HIV-negative FSW with the primary objective of assessing their experiences with male circumcision, but also to better understand the context that puts FSW at risk for HIV (30). The primary objective in Sohail et al was to describe HIV risk among HIV-negative street-based and nightclub-based sex workers in Lusaka (29). In both articles participants expressed their willingness to have condomless sex and vulnerability to violence, suggesting that they are at risk of both HIV and STIs (29, 30).

In conclusion, our study corroborates and extends the evidence identified in earlier studies of FSW in Zambia and Rwanda. We have also identified an interesting difference in condom use between sex workers across Kigali, Lusaka, and Ndola. In particular, report of condomless sex differed by location, but sex without a condom was

prevalent regardless of serostatus or location. Overall, we found a high burden of STIs among both HIV-positive and HIV-negative women. Finally, our results indicate that HIV-positive sex workers are less likely to have had a previous HIV test.

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Tables

Table 1. Differences at baseline between HIV-positive and HIV-negative FSW study in Rwanda and Zambia

Characteristic	HIV-Positive[a] N=191	HIV-Negative N=1,013	P-value[b]
Demographics			
Literacy level[d]			
Not literate in any language	55 (28.8)	289 (28.6)	
Can read a little	37 (19.4)	186 (18.4)	
Can read well	79 (41.4)	401 (39.6)	
Can read multiple languages	20 (10.5)	136 (13.4)	0.729
Age, years*	30.9 (6.4)	26.4 (6.3)	**<0.0001**
Marital status			
Single, never married	89 (46.6)	624 (62.6)	
Divorced, separated	79 (41.4)	345 (34.6)	
Widowed	23 (12.0)	28 (2.8)	**<0.0001**
Number of live births*	2.3 (1.7)	1.9 (1.5)	**0.002**
Have children	159 (83.3)	849 (83.8)	0.846
Years in current city*	19.0 (11.3)	16.0 (9.4)	**0.0009**
Previously tested for HIV	135 (74.6)	859 (85.7)	**0.0002**
Reproductive Health and Contraception			
Contraceptive method[e]			
LARC or permanent methods	37 (19.5)	242 (24.1)	
Hormonal methods	49 (25.8)	373 (37.1)	
None or condoms only	104 (54.7)	391 (38.9)	**0.0002**
Interest in receiving LARC			
Yes	14 (7.4)	137 (14.0)	
No	141 (74.6)	610 (62.2)	
Already has IUD/Implant	34 (18.0)	234 (23.9)	**0.003**
Sex without a condom in the last month	137 (76.1)	746 (77.3)	0.726
Treated for ulcers in the past year	19 (10.2)	15 (1.5)	**<0.0001**
Treated for discharge in the past year	25 (13.4)	66 (6.5)	**0.001**
Current Reproductive Health Disturbances			
Cystitis/dysuria	30 (15.8)	59 (5.9)	**<0.0001**
Vaginal itching	20 (10.6)	85 (8.4)	0.342
Vaginal discharge	29 (15.3)	66 (6.6)	**<0.0001**

Dyspareunia (painful intercourse)	18 (9.5)	24 (2.4)	**<0.0001**
Lower abdominal pain	39 (20.5)	65 (6.5)	**<0.0001**
Acute genital ulcer	8 (4.2)	15 (1.5)	**0.020**
Chronic genital ulcer	8 (4.2)	7 (0.7)	**0.0008**
Positive for trichomonas	31 (16.7)	95 (9.4)	**0.003**
Positive for sperm	9 (4.8)	33 (3.3)	0.279
Gynecological Exam - External Genitalia[f]			
Inguinal adenopathy >1cm, unilateral	1 (0.7)	9 (1.0)	1.0
Inguinal adenopathy >1cm, bilateral	10 (6.8)	16 (1.7)	**0.001**
Inflammation	3 (2.1)	3 (0.3)	**0.037**
Ulceration	6 (4.1)	7 (0.8)	**0.005**
Condyloma/warts	5 (3.4)	2 (0.2)	**0.0008**
Gynecological Exam - Internal Genitalia			
Inflammation – cervix	4 (2.8)	13 (1.4)	0.267
Inflammation – vagina	3 (2.1)	5 (0.5)	0.078
Ulcer – cervix	1 (0.7)	4 (0.4)	0.512
Ulcer – vagina	3 (2.1)	0 (0)	NA
Discharge/pus – cervix	0 (0)	8 (0.9)	NA
Discharge/pus – vagina	26 (18.7)	49 (5.3)	**<0.0001**
Erosion/friability – cervix	2 (1.4)	6 (0.7)	0.285
Erosion/friability – vagina	1 (0.7)	1 (0.1)	0.246
Non-menstrual bleeding – cervix	2 (1.4)	3 (0.3)	0.132
Non-menstrual bleeding – vagina	0 (0)	1 (0.1)	NA
Condyloma/warts – cervix	1 (0.7)	1 (0.1)	0.246
Condyloma/warts – vagina	1 (0.7)	2 (0.2)	0.346
Adnexal tenderness	13 (9.4)	10 (1.1)	**<0.0001**
Adnexal mass	0 (0)	2 (0.2)	NA
Treatment for Reproductive Health Disturbances			
Urinary tract infection	7 (3.7)	6 (0.6)	**0.002**
Trichomonas	27 (14.3)	92 (9.1)	**0.034**

Candida	4 (2.1)	11 (1.1)	0.276
Herpes	1 (0.5)	3 (0.3)	0.498
Syphilis	53 (28.0)	90 (8.9)	**<0.0001**
Chancroid	2 (1.1)	1 (0.1)	0.067
Genital warts	1 (0.5)	0 (0)	NA
Pelvic inflammatory disease	16 (8.5)	10 (1.0)	**<0.0001**

Abbreviations: LARC: Long-acting reversible contraceptives, including IUD (intrauterine device and implant); OCP: oral contraceptive pills
[a] Values in HIV-positive and HIV-negative columns are reported as sample size (%) for categorical variables and mean (SD) for continuous variables
[b]P-values calculated using chi-square tests for categorical variables and t-tests for continuous variable; for variables with <10 observations in a category, Fisher's exact test was used for chi-square values
[c]Kigali, Rwanda and Ndola and Lusaka, Zambia
[d]Literacy determine by a composite variable consisting of Kinyarwanda, French, and English for Rwanda, and Nyanja, Bemba, and English for Zambia
[e]LARC or permanent methods include IUD, implant, tubal ligation, and hysterectomy; hormonal methods include oral contraceptives and injection
[f]Gynecological exam variables are missing between n=136 and n=153 observations
[*]Continuous variable

Table 2. Unadjusted prevalence odds ratios of various risk factors for HIV infection determined at baseline

Variable	pOR[a]	95% Confidence Interval[b]
Literacy level		
Not literate	1.0 (ref)	
Can read a little	1.05	0.66, 1.65
Can read well	1.04	0.71, 1.51
Can read multiple languages	0.77	0.45, 1.34
Marital status		
Single, never married	1.0 (ref)	
Divorced/separated	1.61	**1.15, 2.23**
Widowed	5.76	**3.18, 19.44**
Previous HIV test		
No	2.05	1.40, 2.99
Yes	1.0 (ref)	
Age		
≤23	1.0 (ref)	
24-29	3.81	**2.30, 6.31**
30+	6.63	**4.09, 10.77**
Have children		
No	1.0 (ref)	
Yes	1.0	0.63, 1.45
Years in current city		
0-7	1.0 (ref)	
8-20	1.25	0.81, 1.91
21+	1.66	**1.08, 2.56**

Contraceptive method[d]		
LARC or permanent methods	1.0 (ref)	
Hormonal methods	0.86	0.54, 1.36
Condoms only/none	1.74	**1.16, 2.62**
Interest in receiving LARC		
Yes	1.0 (ref)	
No	2.26	**1.27, 4.04**
Already uses LARC	1.42	0.74, 2.43
Sex without a condom in the past month		
No	1.0 (ref)	
Yes	0.94	0.64, 1.36
Treated for ulcers in past year		
No	1.0 (ref)	
Yes	7.48	**3.73, 15.02**
Treated for discharge in past year		
No	1.0 (ref)	
Yes	2.20	**1.35, 3.59**
Self-reported reproductive health disturbances		
Cystitis/dysuria		
No	1.0 (ref)	
Yes	3.01	**1.88, 4.82**
Vaginal itching		
No	1.0 (ref)	
Yes	1.28	0.77, 2.14
Vaginal discharge		
No	1.0 (ref)	
Yes	2.58	**1.62, 4.12**
Dyspareunia (painful intercourse)		
No	1.0 (ref)	
Yes	4.27	**2.27, 8.04**
Lower abdominal pain		
No	1.0 (ref)	
Yes	3.74	**2.43, 5.76**
Acute genital ulcer		
No	1.0 (ref)	
Yes	2.90	**1.21, 6.95**
Chronic genital ulcer		
No	1.0 (ref)	
Yes	6.27	**2.25, 17.51**
Trichomonas (by swab)		
No	1.0 (ref)	
Yes	1.93	**1.24, 3.00**
Sperm (by swab)		
No	1.0 (ref)	
Yes	1.51	0.71, 3.21
Gynecological exam, external genitalia		
Inguinal adenopathy >1 cm unilateral		
No	1.0 (ref)	
Yes	0.70	0.09, 5.55
Inguinal adenopathy >1 cm bilateral		

No	1.0 (ref)	
Yes	4.16	**1.85, 9.36**
Inflammation		
No	1.0 (ref)	
Yes	6.42	**1.28, 32.12**
Ulceration		
No	1.0 (ref)	
Yes	5.60	**1.85, 16.89**
Condyloma/warts		
No	1.0 (ref)	
Yes	16.29	**3.13, 84.78**
Gynecological exam, internal genitalia		
Inflammation, cervix		
No	1.0 (ref)	
Yes	2.03	0.65, 6.32
Inflammation, vagina		
No	1.0 (ref)	
Yes	3.97	0.94, 16,78
Ulcer, cervix		
No	1.0 (ref)	
Yes	1.63	0.18, 14.69
Discharge, vagina		
No	1.0 (ref)	
Yes	4.08	**2.44, 6.82**
Erosion or friability, cervix		
No	1.0 (ref)	
Yes	2.22	0.44, 11.09
Erosion or friability, vagina		
No	1.0 (ref)	
Yes	6.64	0.41, 106.73
Non-menstrual bleeding, cervix		
No	1.0 (ref)	
Yes	4.45	0.74, 26.86
Condyloma/warts, cervix		
No	1.0 (ref)	
Yes	6.64	0.41, 106.73
Condyloma/warts, vagina		
No	1.0 (ref)	
Yes	3.32	0.30, 36.81
Adnexal tenderness		
No	1.0 (ref)	
Yes	9.33	**4.01, 21.72**
Treatment for current reproductive health disturbances		
Urinary tract infection		
No	1.0 (ref)	
Yes	6.41	**2.13, 19.29**
Trichomonas		
No	1.0 (ref)	
Yes	1.66	**1.05, 2.63**
Candida		
No	1.0 (ref)	

Yes	1.96	0.62, 6.21
Herpes		
No	1.0 (ref)	
Yes	1.78	0.18, 17.21
Syphilis		
No	1.0 (ref)	
Yes	3.97	**2.70, 5.83**
Chancroid		
No	1.0 (ref)	
Yes	10.75	0.97, 119.14
Pelvic inflammatory disease		
No	1.0 (ref)	
Yes	9.22	**4.12, 20.65**

Abbreviations: LARC: Long-acting reversible contraceptives, including IUD (intrauterine device and implant); OCP: oral contraceptive pills
[a]pOR: prevalence odds ratio calculated using unconditional logistic regression
[b]95% confidence intervals calculated using Wald method
[c]Kigali, Rwanda and Ndola and Lusaka, Zambia
[d]LARC or permanent methods include IUD, implant, tubal ligation, and hysterectomy; hormonal methods include oral contraceptives and injection

Table 3. Adjusted prevalence odds ratios of various risk factors for HIV infection determined at baseline

Variable	pOR[a]	95% Confidence Interval
Condomless sex in the past month[c]		
Kigali	1.63	0.92, 2.90
Lusaka	0.68	0.23, 2.04
Ndola	0.25	0.10, 0.64
Previous HIV Test		
No	2.25	1.39, 3.63
Yes	1.0 (ref)	
Age[d]		
18	0.70	0.62, 0.79
22	1.0 (ref)	
26	1.43	1.27, 1.62
31	2.25	1.72, 2.95
45	7.96	3.98, 15.93
Marital status		
Single, never married	1.0 (ref)	
Divorced/separated	1.08	0.70, 1.67
Widowed	3.11	1.51, 6.42
Treated for ulcers in the past year		
No	1.0 (ref)	
Yes	5.37	2.38, 12.10
Lower abdominal pain		
No	1.0 (ref)	
Yes	2.03	1.13, 3.63
Urinary tract infection		

No	1.0 (ref)	
Yes	8.92	2.16, 36.74
Syphilis		
No	1.0 (ref)	
Yes	3.44	2.15, 5.51
Pelvic inflammatory disease		
No	1.0 (ref)	
Yes	3.66	1.29, 10.39

[a]pOR: prevalence odds ratio calculated using multivariate unconditional logistic regression
[b]95% confidence intervals calculated using Wald method
[c]Kigali, Rwanda and Ndola and Lusaka, Zambia
[d] Age values represent: minimum age, 1st quartile, 2nd quartile, 3rd quartile, and maximum age

Chapter III

Public Health Implications

FSW are considered a key driver of the HIV/AIDS epidemic in both Rwanda and Zambia. Not only do they bear a disproportionate burden of HIV and STIs in their respective countries, but they also have regular sexual contact with the general population. Identifying HIV-positive FSW and linking them to care will not only result in health improvements for HIV-positive women, but help prevent transmission to clients and partners. Similarly, it is vital to implement preventive programs among HIV-negative sex workers to combat the HIV/AIDS epidemic. To design effective programs, we must understand what factors put FSW at risk for HIV and STIs and if there are significant differences in women who are HIV-positive compared with women who are HIV-negative. Additionally, understanding the local context for FSW in different countries, and cities within countries, can assist in program development. For example, in some countries FSW may be more likely to wear to condoms with their clients than in other countries.

This paper is a first step in understanding cross-sectional differences between FSW in Rwanda and Zambia based on their serostatus and to determine if there are any significant differences across countries. The HIV-negative women reported on this paper were enrolled in a prospective cohort study to estimate HIV incidence and determine factors that influence HIV acquisition. A further step will be to determine whether there are any differences between incident cases, occurring during the study, and the prevalent cases analyzed at baseline. Additionally, it might be beneficial to evaluate any behavior change occurring post-infection.

The few research studies that have been conducted among FSW in Rwanda and Zambia indicate economics as the primary driver for women entering sex work. Aside from public health programs, providing viable economic opportunities for women in Rwanda and Zambia has the potential to shift sex work labor to the mainstream sectors of the economy in these countries. Such programs are beyond the scope of this paper, but are nonetheless important for the success of public health programs. Regarding public health programs, this paper identified a high burden of STIs and other reproductive health disturbances such as PID, both among HIV-positive and HIV-negative women. STI screening and treatment programs that target FSW are needed to reduce this burden. Likewise, there is a need for HIV testing programs that reach HIV-positive FSW. Lastly, condomless sex was common among all FSW, so condom promotion would beneficial among FSW.

Appendix

Table 4. Differences at baseline between HIV-positive and HIV-negative FSW study in Kigali, Rwanda

Characteristic	HIV-Positive[a] N=97	HIV-Negative N=458	P-value[b]
Demographics			
Literacy level[d]			
Not literate in any language	24 (24.7)	130 (28.4)	
Can read a little	15 (15.5)	55 (12.0)	
Can read well	57 (58.8)	263 (57.4)	
Can read multiple languages	11 (1.98)	19 (2.2)	**0.049**
Age, years[*]	30.1 (6.4)	27.9 (5.7)	**0.0006**
Marital status			
Single, never married	30 (30.9)	197 (43.0)	
Divorced, separated	52 (53.6)	240 (52.4)	
Widowed	15 (15.5)	19 (4.2)	**<0.0001**
Number of live births[*]	2.0(1.6)	2.1(1.4)	0.714
Have children	79 (81.4)	413 (90.2)	**0.014**
Years living in Kigali[*]	14.9 (9.0)	14.0 (9.1)	0.380
Previously tested for HIV	82 (84.5)	430 (93.9)	**0.002**
Reproductive Health and Contraception			
Contraceptive method[e]			
LARC or permanent methods	19 (19.6)	120 (26.2)	
Hormonal methods	23 (23.7)	155 (33.8)	
None or condoms only	54 (55.7)	178 (38.9)	**0.009**
Interest in receiving LARC			
Yes	6 (6.2)	48 (10.5)	
No	71 (73.2)	269 (58.7)	
Already has IUD/Implant	18 (18.6)	115 (25.1)	0.066
Sex without a condom in the last month	71 (73.2)	226 (49.3)	**<0.0001**
Treated for ulcers in the past year	11 (11.3)	11 (2.4)	**0.0004**
Treated for discharge in the past year	20 (20.6)	58 (12.7)	**0.042**
Current Reproductive Health Disturbances			
Cystitis/dysuria	29 (29.9)	57 (12.5)	**<0.0001**
Vaginal itching	19 (19.6)	78 (17.0)	0.555
Vaginal discharge	28 (28.9)	64 (14.0)	**0.0004**
Dyspareunia (painful intercourse)	17 (17.5)	20 (4.4)	**<0.0001**

Lower abdominal pain	34 (35.1)	60 (13.1)	**<0.0001**
Acute genital ulcer	5 (5.2)	12 (2.6)	0.196
Chronic genital ulcer	6 (6.2)	4 (0.9)	**0.003**
Positive for trichomonas	22 (22.7)	41 (9.0)	<**0.0001**
Positive for sperm	6 (6.2)	20 (4.4)	0.428
Gynecological Exam - External Genitalia			
Inguinal adenopathy >1cm, unilateral	1 (1.0)	9 (2.0)	1.0
Inguinal adenopathy >1cm, bilateral	10 (10.3)	15 (3.3)	**0.002**
Inflammation	3 (3.1)	3 (0.7)	**0.046**
Ulceration	6 (6.2)	5 (1.1)	**0.002**
Condyloma/warts	5 (5.2)	2 (0.4)	**0.001**
Gynecological Exam - Internal Genitalia			
Inflammation – cervix	4 (4.1)	12 (2.6)	0.264
Inflammation – vagina	3 (3.1)	5 (1.1)	0.092
Ulcer – cervix	1 (1.0)	2 (0.4)	0.372
Ulcer – vagina	3 (3.1)	0 (0)	NA
Discharge/pus – cervix	0 (0)	6 (1.3)	NA
Discharge/pus – vagina	26 (26.8)	48 (10.5)	**<0.0001**
Erosion/friability – cervix	2 (2.1)	5 (1.1)	0.264
Erosion/friability – vagina	1 (1.0)	1 (0.2)	0.266
Non-menstrual bleeding – cervix	2 (2.1)	3 (0.7)	0.152
Non-menstrual bleeding – vagina	0 (0)	1 (0.2)	NA
Condyloma/warts – cervix	0 (0)	0 (0)	NA
Condyloma/warts – vagina	1 (1.0)	1 (0.2)	0.266
Adnexal tenderness	13 (13.4)	10 (2.2)	**<0.0001**
Adnexal mass	0 (0)	1 (0.22)	NA
Treatment for Reproductive Health Disturbances			
Urinary tract infection	7 (7.2)	6 (1.3)	**0.003**
Trichomonas	21 (21.7)	41 (9.0)	**0.003**
Candida	4 (4.1)	8 (1.8)	0.238

Herpes	1 (1.0)	2 (0.4)	0.439
Syphilis	31 (32.0)	35 (7.6)	**<0.0001**
Chancroid	2 (2.1)	0 (0)	NA
Genital warts	1 (1.0)	0 (0)	NA
Pelvic inflammatory disease	16 (16.5)	10 (2.2)	**<0.0001**

Abbreviations: LARC: Long-acting reversible contraceptives, including IUD (intrauterine device and implant); OCP: oral contraceptive pills
[a] Values in HIV-positive and HIV-negative columns are reported as sample size (%) for categorical variables and mean (SD) for continuous variables
[b]P-values calculated using chi-square tests for categorical variables and t-tests for continuous variable; for variables with <10 observations in a category, Fisher's exact test was used for chi-square values
[c]Literacy determine by a composite variable consisting of Kinyarwanda, French, and English for Rwanda, and Nyanja, Bemba, and English for Zambia
[d]LARC or permanent methods include IUD, implant, tubal ligation, and hysterectomy; hormonal methods include oral contraceptives and injection
[*]Continuous variable

Table 5. Differences at baseline between HIV-positive and HIV-negative FSW study in Lusaka, Zambia

Characteristic	HIV-Positive[a] N=55	HIV-Negative N=202	P-value[b]
Demographics			
Literacy level[d]			
Not literate in any language	23 (38.2)	53 (26.2)	
Can read a little	11 (20.0)	27 (13.4)	
Can read well	15 (27.3)	57 (28.2)	
Can read multiple languages	8 (14.6)	65 (32.2)	**0.025**
Age, years[*]	30.7 (6.2)	26.2 (6.4)	<**0.0001**
Marital status			
Single, never married	36 (65.5)	141 (69.8)	
Divorced, separated	17 (30.9)	57 (28.2)	
Widowed	2 (3.6)	3 (1.5)	0.535
Number of live births[*]	2.2 (1.6)	1.6 (1.5)	**0.015**
Have children	46 (83.6)	144 (71.3)	0.083
Years living in Lusaka[*]	22.7 (12.2)	18.4 (9.7)	**0.019**
Previously tested for HIV	32 (58.2)	150 (74.3)	0.143
Reproductive Health and Contraception			
Contraceptive method[e]			
LARC or permanent methods	13 (23.6)	53 (26.2)	
Hormonal methods	15 (27.3)	48 (23.8)	
None or condoms only	27 (49.1)	101 (50.0)	0.844
Interest in receiving LARC			

Yes	6 (10.9)	28 (13.9)	
No	38 (69.1)	125 (61.9)	
Already has IUD/Implant	11 (20.0)	46 (22.8)	0.680
Sex without a condom in the last month	41 (74.6)	148 (73.3)	1.0
Treated for ulcers in the past year	6 (10.9)	2 (1.0)	**0.001**
Treated for discharge in the past year	4 (7.3)	1 (0.5)	**0.006**
Current Reproductive Health Disturbances			
Cystitis/dysuria	0 (0)	1 (0.5)	NA
Vaginal itching	1 (1.8)	3 (1.5)	1.0
Vaginal discharge	1 (1.8)	0 (0)	NA
Dyspareunia (painful intercourse)	1 (1.8)	2 (1.0)	0.518
Lower abdominal pain	4 (7.3)	1 (0.5)	**0.008**
Acute genital ulcer	3 (5.6)	0 (0)	NA
Chronic genital ulcer	2 (3.6)	0 (0)	NA
Positive for trichomonas	5 (9.1)	7 (3.5)	0.070
Positive for sperm	1 (1.8)	4 (2.0)	1.0
Gynecological Exam - External Genitalia			
Inguinal adenopathy >1cm, unilateral	0 (0)	0 (0)	NA
Inguinal adenopathy >1cm, bilateral	0 (0)	0 (0)	NA
Inflammation	0 (0)	0 (0)	NA
Ulceration	0 (0)	1 (0.5)	NA
Condyloma/warts	0 (0)	0 (0)	NA
Gynecological Exam - Internal Genitalia			
Inflammation – cervix	0 (0)	1 (0.5)	NA
Inflammation – vagina	0 (0)	0 (0)	NA
Ulcer – cervix	0 (0)	1 (0.5)	NA
Ulcer – vagina	0 (0)	0 (0)	NA
Discharge/pus – cervix	0 (0)	1 (0.5)	NA
Discharge/pus – vagina	0 (0)	0 (0)	NA
Erosion/friability – cervix	0 (0)	0 (0)	NA

Erosion/friability – vagina	0 (0)	0 (0)	NA
Non-menstrual bleeding – cervix	0 (0)	0 (0)	NA
Non-menstrual bleeding – vagina	0 (0)	0 (0)	NA
Condyloma/warts – cervix	1 (1.8)	0 (0)	NA
Condyloma/warts – vagina	0 (0)	0 (0)	NA
Adnexal tenderness	0 (0)	0 (0)	NA
Adnexal mass	0 (0)	0 (0)	NA
Treatment for Reproductive Health Disturbances			
Urinary tract infection	0 (0)	0 (0)	NA
Trichomonas	3 (5.5)	6 (3.0)	0.403
Candida	0 (0)	2 (1.0)	NA
Herpes	0 (0)	0 (0)	NA
Syphilis	13 (23.6)	27 (13.4)	0.060
Chancroid	0 (0)	0 (0)	NA
Genital warts	0 (0)	0 (0)	NA
Pelvic inflammatory disease	0 (0)	0 (0)	NA

Abbreviations: LARC: Long-acting reversible contraceptives, including IUD (intrauterine device and implant); OCP: oral contraceptive pills

[a] Values in HIV-positive and HIV-negative columns are reported as sample size (%) for categorical variables and mean (SD) for continuous variables

[b]P-values calculated using chi-square tests for categorical variables and t-tests for continuous variable; for variables with <10 observations in a category, Fisher's exact test was used for chi-square values

[c]Literacy determine by a composite variable consisting of Kinyarwanda, French, and English for Rwanda, and Nyanja, Bemba, and English for Zambia

[d]LARC or permanent methods include IUD, implant, tubal ligation, and hysterectomy; hormonal methods include oral contraceptives and injection

[*]Continuous variable

Table 6. Differences at baseline between HIV-positive and HIV-negative FSW study in Ndola, Zambia

Characteristic	HIV-Positive[a] N=39	HIV-Negative N=353	P-value[b]
Demographics			
Literacy level[d]			
Not literate in any language	10 (25.6)	106 (30.0)	
Can read a little	11 (28.2)	104 (29.5)	
Can read well	7 (18.0)	81 (23.0)	
Can read multiple languages	11 (28.2)	61 (17.3)	0.405
Age, years[*]	32.8 (6.6)	24.5 (6.5)	<**0.0001**
Marital status			

Single, never married	23 (59.0)	286 (81.0)	
Divorced, separated	10 (25.6)	48 (13.6)	
Widowed	6 (15.4)	6 (1.7)	**<0.0001**
Number of live births*	3.1 (2.0)	1.8 (1.6)	**0.0003**
Have children	34 (87.2)	292 (82.7)	0.652
Years living in Ndola*	23.8 (11.6)	17.3 (9.2)	**0.002**
Previously tested for HIV	21 (53.9)	279 (79.0)	**0.009**
Reproductive Health and Contraception			
Contraceptive method[e]			
LARC or permanent methods	15(12.8)	74 (21.0)	
Hormonal methods	11 (28.2)	165 (46.7)	
None or condoms only	23 (59.0)	112 (31.7)	**0.005**
Interest in receiving LARC			
Yes	2 (5.1)	61 (17.3)	
No	32 (82.1)	216 (61.2)	
Already has IUD/Implant	5 (12.8)	73 (20.7)	**0.035**
Sex without a condom in the last month	25 (64.1)	305 (76.4)	**0.0004**
Treated for ulcers in the past year	2 (5.1)	2 (0.6)	0.051
Treated for discharge in the past year	1 (2.6)	7 (2.0)	0.572
Current Reproductive Health Disturbances			
Cystitis/dysuria	1 (2.6)	1 (0.3)	0.190
Vaginal itching	0 (0)	4 (1.1)	NA
Vaginal discharge	0 (0)	2 (0.6)	NA
Dyspareunia (painful intercourse)	0 (0)	2 (0.6)	NA
Lower abdominal pain	1 (2.6)	4 (1.1)	0.410
Acute genital ulcer	0 (0)	3 (0.85)	NA
Chronic genital ulcer	0 (0)	3 (0.9)	NA
Positive for trichomonas	4 (10.3)	47 (13.3)	0.802
Positive for sperm	2 (5.1)	9 (2.6)	0.300
Gynecological Exam - External Genitalia			
Inguinal adenopathy >1cm, unilateral	0 (0)	0 (0)	NA
Inguinal adenopathy >1cm, bilateral	0 (0)	1 (0.3)	NA
Inflammation	0 (0)	0 (0)	NA

Ulceration	0 (0)	1 (0.3)	NA
Condyloma/warts	0 (0)	0 (0)	NA
Gynecological Exam - Internal Genitalia			
Inflammation – cervix	0 (0)	0 (0)	NA
Inflammation – vagina	0 (0)	0 (0)	NA
Ulcer – cervix	0 (0)	1 (0.3)	NA
Ulcer – vagina	0 (0)	0 (0)	NA
Discharge/pus – cervix	0 (0)	1 (0.3)	NA
Discharge/pus – vagina	0 (0)	1 (0.3)	NA
Erosion/friability – cervix	0 (0)	1 (0.3)	NA
Erosion/friability – vagina	0 (0)	0 (0)	NA
Non-menstrual bleeding – cervix	0 (0)	0 (0)	NA
Non-menstrual bleeding – vagina	0 (0)	0 (0)	NA
Condyloma/warts – cervix	0 (0)	1 (0.3)	NA
Condyloma/warts – vagina	0 (0)	1 (0.3)	NA
Adnexal tenderness	0 (0)	0 (0)	NA
Adnexal mass	0 (0)	1 (0.3)	NA
Treatment for Reproductive Health Disturbances			
Urinary tract infection	0 (0)	0 (0)	NA
Trichomonas	3 (7.7)	45 (12.8)	0.450
Candida	0 (0)	1 (0.3)	NA
Gonorrhea	0 (0)	0 (0)	NA
Chlamydia	0 (0)	1 (0.3)	NA
Herpes	0 (0)	1 (0.3)	NA
Syphilis	9 (23.1)	28 (7.9)	**0.006**
Chancroid	0 (0)	1 (0.3)	NA
Genital warts	0 (0)	0 (0)	NA
Pelvic inflammatory disease	0 (0)	0 (0)	NA

Abbreviations: LARC: Long-acting reversible contraceptives, including IUD (intrauterine device and implant); OCP: oral contraceptive pills

[a] Values in HIV-positive and HIV-negative columns are reported as sample size (%) for categorical variables and mean (SD) for continuous variables
[b]P-values calculated using chi-square tests for categorical variables and t-tests for continuous variable; for variables with <10 observations in a category, Fisher's exact test was used for chi-square values
[c]Literacy determine by a composite variable consisting of Kinyarwanda, French, and English for Rwanda, and Nyanja, Bemba, and English for Zambia
[d]LARC or permanent methods include IUD, implant, tubal ligation, and hysterectomy; hormonal methods include oral contraceptives and injection
[*]Continuous variable