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Meredith Wesley   April 21, 2017

Predictors of HIV/STI Incidence Among Female Sex Workers in Rwanda and Zambia

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By

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An abstract of

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Abstract

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By Meredith Wesley

Background
Female sex workers (FSW) are at a disproportionately high risk of HIV acquisition[2] – a disparity affected by a multitude of risk factors that extends into other areas of sexual and reproductive health. The aim of this study was to determine the rate and contributing factors for incident sexually transmitted infection (STI) including HIV, syphilis and trichomonas in FSW in Rwanda and Zambia.

Methods
From 2012-2015, RZHRG recruited FSW in Zambia and Rwanda. Participants received demographic and risk behavior questionnaires and a gynecologic examination (when indicated) at baseline and follow-up visits. Crude hazard ratios were calculated for all indicators and multivariate Cox proportional hazard models were specified using indicators significantly associated ($p<0.05$) with the outcome, stratified by country.

Results
Among 458 participants in Rwanda, 101 incident infections occurred at a rate of 16 cases per 100 person-years (95% CI: 12.85, 19.07) and in Zambia, 138 incident infections occurred among 555 participants at a rate of about 24 cases per 100 PY (95% CI: 18.99, 26.76). About 80% of covariates varied significantly between countries. The model for Rwanda includes younger age at first sex, treatment of vaginal discharge in the prior year and report of a chronic ulcer. For Zambia, the model includes younger age at first sex, widowed marital status, increased number of repeat and non-repeat clients in the prior month and report of vaginal itching.

Conclusions
Based on significant associations shown in this analysis, age of sexual debut, marital status, gynecologic symptoms and number of repeat and non-repeat clients are all important factors in determining the occurrence of incident infections in FSW. Recognizing that FSW are a heterogeneous population across regions will better inform prevention strategies and interventions.

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Table of Contents

Chapter I – Background

Sex workers, defined as persons who receive money or goods in exchange for sexual services, are among five key populations identified by the World Health Organization as at disproportionately high risk for HIV acquisition in most contexts. In 2016, they concluded that prevention, care and treatment efforts targeted toward these key populations will be the only way to achieve a sustainable response to the global HIV epidemic(1). Understanding the sexual and reproductive health context of sex workers is an important step in best providing these services.

A systematic review on HIV in female sex workers (FSW) across low and middle-income countries reported a pooled odds ratio of 13.5 (95% CI: 10.0, 18.1) in FSW compared to the general population (2). Despite the elevated risk these women face, it is estimated that less than 4% of all global HIV funds have been spent on prevention among sex workers (3). In several studies, male clients of FSW have shown higher-than-average HIV prevalence, showing the impact high prevalence in FSW can have on the prevalence of the general population (4-6).

Risk Factors

A variety of factors contribute to this disparity including structural disadvantages, sociodemographic characteristics and sexual risk behaviors that have been demonstrably associated with increased risk of HIV infection and are common among FSW. A systematic review published in 2012 concluded that increased risk of HIV acquisition among FSW could be attributed to the context in which their work is conducted, where poverty, violence and criminalization are common (7). These disadvantages extend

beyond the bounds of the HIV epidemic into other areas of sexual and reproductive health with many risk factors for HIV also increasing risk for other sexually transmitted infections (STI).

Gender Disparity

FSW incur the compounding effects of social, cultural and economic disadvantages that being female indicates in many parts of the world with the additional disadvantages brought on by the nature of the work they engage in. Globally, HIV prevalence among young women is estimated to be at least double that of men of the same age. Sub-Saharan Africa, specifically, claims 3 out of 4 HIV infections in women over the age of 15 (8).

Structural Disadvantage

In many parts of the world, sex work remains illegal which only increases the amount of barriers to access of healthcare and other services. Inability to ensure confidentiality in the healthcare setting further discourages sex workers from benefiting from health services and even in places where it is legalized, sex workers face intense stigmas that may affect the decision to engage with the healthcare system (2, 9-11).

In a review of human rights and sex workers published in 2015, Decker et al. cited discrimination in access to health or welfare as one of the main violations of human rights against sex workers worldwide (12). There is known discrimination in providing healthcare to people practicing sex work, with specific regards to HIV testing and treatment. FSW report many agents of discrimination including government clinic

providers as well as non-governmental organizations providing counseling or other healthcare services (12).

Criminalization of sex work and lack of assured confidentiality compounded with stigma commonly shown to accompany sex work prevent sex workers from accessing preventative services and from seeking care. Those who do enter the care continuum are unlikely to honestly disclose their status as a sex worker and may be missing out on important services targeted at populations at high risk of HIV or other infections. Aside from healthcare, sex workers face discrimination from social services such as housing (12) or microfinance support (7) which may exacerbate existing social and financial strains and further increasing risk of negative health outcomes.

As important as these factors may be in improving the quality of life for FSW, a 2012 study of the influence of structural determinants on the global epidemiology of HIV among FSW found that only 87 (43%) of 204 studies reviewed explicitly examined structural factors related to HIV infection (13).

Sociodemographic Factors

Poverty is commonly reported as a reason women pursue sex work(14, 15) which is impacted by many sociodemographic features such as marital status and education level. For many, sex work is an avenue to independent income without falling into traditional gender roles such as domestic work.

After loss or separation from a husband or partner, many women find themselves in compromising financial situations and this reason is cited in several studies as the

driver for initiating sex work (14, 15) in addition to being orphaned, for younger women who have not been married.

Low educational attainment is also a risk factor for STIs including HIV and many FSW achieve a low level of education with studies reporting over 30% of FSW participating having received no formal education (7). In a formative study conducted in FSW in Zambia, over 60% of FSW interviewed had reached a primary school education level, at most (14).

Although young women in sub-Saharan Africa are at heightened risk for HIV, older age is often associated with STI and HIV risk in FSW. This could be explained by the increasing number of sexual encounters that a woman has, affected by factors such as age at first sex, age beginning sex work and duration of sex work (16).

Sexual Risk Behavior

FSW often engage in risky sexual behaviors including multiple and concurrent sex partners and more frequent unprotected sex.

Multiple and concurrent sex partners have been shown to be associated with prevalence of HIV. A study of HIV prevalence among FSW on the US-Mexico border showed significant, positive associations between total number of clients in the past month and total number of non-regular clients with prevalent HIV infection ($p = 0.008$; $p = 0.005$) (5). As the number of sexual encounters and new sexual partners increases, the risk of STI acquisition also increases. This relationship can be influenced by factors such as prevalence of infections in the population, condom usage and the prevalence of other risky sexual behaviors.

Unprotected sexual encounters are reported commonly among sex workers and are contributing to heightened risk in this population. A study by Adu-Oppong et al., women reported client refusal (73%) and client brutality (43%) as primary reasons for engaging in unprotected sex (17). Often times, clients are willing to pay more to coerce women into having sex without a condom. Women may be intimidated, physically forced or otherwise powerless to negotiate condom use with clients (18).

Early sexual debut has been linked to poor health outcomes later in life, specifically related to increased risk of STI and HIV acquisition (19-21). It is hypothesized that younger age at sexual debut leads to riskier sexual activity as they have received less sexual education. Additionally, the younger age first sex occurs at, the more sexual encounters a person is able to have, increasing the risk of STI or HIV acquisition.

Gynecologic Symptom Reporting

STIs are an important outcome to track when considering HIV transmission. Co-infection with an STI increases risk of HIV transmission by attracting immune cells that are vulnerable to infection with HIV to the infection site (22). Additionally, the behaviors that increase risk for contracting an STI are essentially the same behaviors responsible for increased risk of HIV infection, strengthening epidemiologic evidence for this association (23).

Report of an STI symptom such as vaginal discharge or ulcer has been associated with increased risk for HIV. The association between occurrence of ulcers and ulcerative infections with other STIs and HIV is well-established (24). Proposed mechanisms for

the role of these symptoms in increased risk for other infections include mucosal disruption, recruitment of HIV target cells to the genital tract and increased HIV load in secretions when a person has an existing STI (25).

Rwanda

Rwanda ranks among the 25 countries with the highest HIV prevalence among adults, estimated at 2.9% (26). In 2014, there were an estimated 12,000 sex workers in Rwanda (26) and sex work remains illegal in Rwanda.

A cohort study of 329 non-pregnant, FSW in Rwanda reported an estimated HIV incidence rate of 3.5/100 (95% CI: 1.6, 5.4) (27). Incidence rates of 16.9/100 person years for trichomonas and 6.2/100 person years for syphilis were also reported.

A study of cross-sectional factors associated with HIV prevalence in FSW in Rwanda found an HIV prevalence of about 51% (28) as compared to an estimated prevalence of 3% among the general population of Rwanda (29). This study found a significant positive association between HIV prevalence and several previously mentioned risk factors including older age (≥ 25 years) (OR = 0.9, 95% CI: 0.5, 2.4), duration of experience as a sex worker greater than or equal to 5 years (OR = 1.4, 95% CI: 1.1, 1.8), and report of vaginal discharge or ulcer in the last 12 months (OR = 1.8, 95% CI: 1.4, 2.3) (28).

Zambia

Zambia continues to face one of the most severe HIV epidemics in the world, with the 7th highest estimated prevalence of 12.9 (12.3 - 13.4) among (30). In 2015, there were an estimated 18,107 sex workers in Zambia and sex work remains illegal.

Importance

Given the hard-to-reach nature of this population, much about the factors associated with incident STIs, including HIV, in FSW remains unknown. Further, regional and sub-regional differences have not yet been explored. This study aims to fill the gap in studies of STI incidence among FSW in Rwanda and Zambia and to shed light on predictors of STI incidence in these populations.

Chapter II – Manuscript

Predictors of HIV/STI Incidence Among Female Sex Workers in Rwanda and Zambia

By Meredith Wesley

Background
Female sex workers (FSW) are at a disproportionately high risk of HIV acquisition[2] – a disparity affected by a multitude of risk factors that extends into other areas of sexual and reproductive health. The aim of this study was to determine the rate and contributing factors for incident sexually transmitted infection (STI) including HIV, syphilis and trichomonas in FSW in Rwanda and Zambia.

Methods
From 2012-2015, RZHRG recruited FSW in Zambia and Rwanda. Participants received demographic and risk behavior questionnaires and a gynecologic examination (when indicated) at baseline and follow-up visits. Crude hazard ratios were calculated for all indicators and multivariate Cox proportional hazard models were specified using indicators significantly associated ($p<0.05$) with the outcome, stratified by country.

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Conclusions
Based on significant associations shown in this analysis, age of sexual debut, marital status, gynecologic symptoms and number of repeat and non-repeat clients are all important factors in determining the occurrence of incident infections in FSW. Recognizing that FSW are a heterogeneous population across regions will better inform prevention strategies and interventions.

Introduction

Sex workers, defined as persons who receive money or goods in exchange for sexual services, are among five key populations identified by the World Health Organization (WHO) as at disproportionately high risk for HIV acquisition in most contexts. In 2016, WHO concluded that prevention, care and treatment services targeted toward these key populations will critical to achieve a sustainable response to the global HIV epidemic (1). Understanding the sexual and reproductive health context of sex workers is an important step in best providing these services.

A systematic review of HIV risk in female sex workers (FSW) across low and middle-income countries reported a pooled odds ratio of 13.5 (95% CI: 10.0, 18.1) in FSW compared to the general population (2). The disparity this population faces is compounded with gender inequality and impacted by structural, sociodemographic, sexual, and biological risk factors. In Sub-Saharan Africa, 3 out of 4 prevalent HIV infections are estimated to occur in women over the age of 15 (8).

In many parts of the world, sex work remains illegal which increases barriers to access of healthcare and other services (11, 12). This legal status, in addition to implicit stigma leads to high levels of discrimination, particularly in the healthcare setting. FSW report many agents of discrimination including from government clinic providers as well as non-governmental organizations providing counseling or other healthcare services (12).

Several sociodemographic factors including high levels of poverty, low education, and dissolution of a partnership may increase women's likelihood of engaging in sex work (14, 31). After loss of or separation from a husband or partner, women may find

themselves in compromising financial situations which has been cited as a driver for initiating sex work (14, 15) in addition to being orphaned for younger women who have not been married (14).

Frequency of risky sexual behaviors is often higher among FSW as is the nature of the work they engage in. These factors may include infrequent condom-usage, use of alcohol during sex, limited ability to negotiate condoms, financial incentive to engage in condom-less sex, high number of sexual encounters, multiple and concurrent sexual partners, and younger age of sexual debut (17-21, 28, 32, 33). A study of HIV prevalence among FSW on the US-Mexico border showed significant, positive associations between total number of clients in the past month (p = 0.008) and total number of non-regular clients (p = 0.005) with prevalent HIV infection (5). HIV/STI risk in FSW is influenced by factors such as prevalence of infections in the population, condom usage, and the prevalence of other risky sexual behaviors. Presence of gynecologic symptoms have also been associated with risk of other STIs or HIV (5, 16, 27, 28, 34).

Rwanda ranks among the 25 countries with the highest HIV prevalence among adults, estimated at 2.9% (26). In 2014, there were an estimated 12,000 sex workers in Rwanda (26) where sex work remains illegal. A cohort study of 329 non-pregnant FSW in Rwanda reported an HIV incidence rate of 3.5/100 (95% CI: 1.6, 5.4) (27). Incidence rates of 16.9/100 person years for trichomonas and 6.2/100 person years for syphilis were also reported.

Zambia continues to face one of the most severe HIV epidemics in the world, with the 7th highest estimated prevalence of 12.37% among adults and HIV prevalence

among FSW estimated at 51% (30). In 2015, there were an estimated 18,107 sex workers in Zambia and sex work remains illegal (30).

Given the hard to reach nature of this population, few studies have reliably estimated incidence of STIs and HIV in FSW or evaluated factors associated with incident infections. This study aims to fill that gap by describing associations between various sociodemographic and reproductive factors and incident STI (HIV, syphilis or trichomonas vaginalis) in a cohort of HIV-negative FSW in Zambia and Rwanda.

Methods

Study Design

From 2012-2015, the Rwanda Zambia HIV Research Group (RZHRG) conducted a prospective cohort study of FSW in Lusaka and Ndola, Zambia and Kigali, Rwanda to study family planning, reproductive health, HIV and other sexually transmitted infections (STI), and associated risk factors in this population. Eligible women were unmarried, HIV-negative FSW between the ages of 18-45 on the day of enrollment.

All study protocols were approved by the Emory University Institutional Review Board and either the Rwanda National Ethics Committee or the Zambia Institutional Review Board. Study activities were carried out at RZHRG sites - Project San Francisco (PSF) in Rwanda and the Zambia Emory HIV Research Group (ZEHRP) in Zambia.

Recruitment

Venue-based recruitment was conducted by trained community workers who targeted local commercial sex work hotspots in Kigali, Rwanda; Lusaka, Zambia; and

Ndola, Zambia. During recruitment, women were offered written invitations to PSF or

ZEHRP for various reproductive health services available at the screening visit.

Screening Visit

Women who attended a screening visit were offered HIV testing and counseling,

STI screening and treatment (syphilis, trichomonas vaginalis, bacterial vaginosis, herpes,

warts, gonorrhea, chlamydia and X), and long acting reversible contraceptive (LARC)

methods at the RZHRG sites. The visit consisted of a gynecologic exam performed by

RZHRG clinical staff when deemed necessary, or a self-administered vaginal swab when

the exam was not indicated. Women who tested positive for HIV were connected to care

and services. Treatment for STIs was provided at no charge during screening and when

required at subsequent visits.

The screening visit included a short questionnaire to address inclusion and

exclusion criteria. Status as a FSW was established through a series of questions on this

questionnaire that probed women's experiences exchanging sex for money, goods or

services; marital status; and place of recruitment. Women who met all eligibility criteria

were invited back for enrollment 1-2 weeks after screening.

Enrollment Visit

At enrollment, informed consent was obtained before a series of baseline self-

reported demographic and risk behavior questionnaires were completed. A gynecologic

exam was completed for women who did not receive one at screening, and treatment for

STIs was provided when indicated.

Follow-up Visit

Follow-up visits occurred quarterly and included a risk behavior questionnaire for the preceding follow-up period in addition to HIV testing, screening and treatment for STIs, a gynecologic exam when indicated, and provision of LARC methods to women who were interested.

Data Collection and Management

Trichomonas vaginalis was diagnosed using self-administered vaginal swab samples or during the gynecologic exam if an exam was completed. Syphilis was diagnosed through blood serologic testing. To differentiate between incident and serofast syphilis, incident syphilis was defined as a low RPR titer (1:1) subsequently followed by a high RPR titer result (1:2 or higher). Testing for HIV was conducted through an antibody test and upon receipt of a positive result, seroconversion was verified using different, confirmatory antibody test. Test results were returned on the day of the study visit and treatment or linkage to care was provided upon positive test results.

Data was input into Microsoft Access by trained data managers after a quality assurance check in the field and sent to the main RZHRG site at Emory University in Atlanta, Georgia where further quality assurance was conducted.

Data Analysis

First occurrence of incident STI (either incident syphilis, trichomonas vaginalis, or HIV) was the composite outcome of interest for this analysis. Bivariate analyses for all fixed and time-dependent indicators were conducted to establish associations with the outcome of interest, stratified by country. Chi-square tests were used for categorical indicators and two-sample t-tests were used for continuous predictors unless otherwise indicated in Table 1 and Table 2 (Mann-Whitney test for non-parametric indicators; Fisher's Exact test for indicators with sparse data including an expected cell count <5). Fixed (baseline) indicators are described by unique participants in the study and time-varying indicators are described by study intervals.

Cross country comparisons were made for all fixed and time-varying indicators using the chi-square test. All fixed (baseline) variables satisfied the proportional hazards assumption, as verified using Schoenfeld residuals and graphical methods.

Crude hazard ratios were calculated for each indicator of interest using bivariate Cox proportional hazard models, stratified by country. Indicators significantly associated ($p<0.05$) with the outcome at the 95% confidence level were evaluated for multi-collinearity before being selected for inclusion in the final models, stratified by country. Multicollinearity was assessed using condition indices greater than 30 and variance decomposition proportions greater than 0.50 as cutoffs. Ease of interpretation and potential for intervention development were considered when selecting between continuous and categorical variables when both were significant.

All data analysis was conducted using SAS 9.4 and all tests were conducted at a 95% confidence level.

Results

Participant Characteristics

Demographic and risk behavior characteristics of participants, stratified by

country, are shown in Table 1. In Rwanda, 458 unique women were described over

3,035 study intervals with an average age at baseline of about 28 years. In Zambia, 555

unique women were described over 2,768 intervals with a significantly lower average age

at baseline of about 25 years (p < 0.001). The average amount of person-time contributed

by each participant was about 1.34 years in Rwanda and about 1.05 in Zambia.

Participants in Zambia were more highly educated with about 9% having received no

formal education compared to 64% in Rwanda (p < 0.001). Use of a modern

contraceptive other than condoms was slightly higher in Zambia at about 66% of

participants reporting use, while about 62% reported use in Rwanda.

The cohorts in each country were significantly different for all covariates except

vaginal sex requested by clients, oral sex requested by clients, number of non-repeat

clients in the last month (continuous), report of sex without a condom in the last month,

pill or emergency contraception use, permanent contraceptive method use, and report of a

chronic ulcer. The results of these comparisons are shown in Table 3.

Infection Incidence

There were 101 total incident infections in Rwanda with an overall risk of STI at

22.10% (95% CI: 18.49, 26.08). Figure 1 displays the proportion of the outcome due to

the different STIs, by country. In Rwanda the risk of HIV was 1.09% (95% CI: 0.39,

2.61), 4.15% (95% CI: 2.63, 6.43) for syphilis and 16.81% (95% CI: 13.66, 20.52) for

trichomonas. The incidence rate for any STI of interest was 16.00 cases per 100 person-

years (PY) (95% CI: 12.85, 19.07) and was 0.79 (0.11, 1.48), 3.01 (95% CI: 1.65, 4.35),

and 12.22 (95% CI: 9.45, 14.88) for HIV, syphilis and trichomonas, respectively.

In Zambia, 138 incident infections occurred and the overall risk of infection was

24.89% (95% CI: 21.5, 28.6). A higher risk was found at 2.34% (95% CI: 1.33, 4.01) for

HIV, 3.96% (95%CI: 2.60, 5.96) for syphilis and 18.85% (95% CI: 15.85, 22.34) for

trichomonas. The incidence rate for any STI of interest was also higher at 23.8 cases per

100 PY (95% CI: 20.06, 28.02). Broken down into components of the composite

outcome, the incidence rate for HIV was 2.24 cases per 100 PY (95%CI: 1.02, 3.45),

syphilis was 3.79 cases per 100 PY (95% CI: 2.20, 5.36), and trichomonas was 17.75

cases per 100 PY (95% CI: 14.60, 21.52).

Predictors of Incident STI

In Rwanda (Table 4), continuous age at first sex younger than 12 years (per year

increase) had a statistically significant, negative association with incident STI (cHR:

0.93, p = 0.038) while report of treatment for vaginal discharge in the last year and report

of a chronic ulcer had statistically significant, positive associations with the outcome

(cHR: 1.759, p = 0.0239; cHR: 8.329, p = 0.036, respectively)

In Zambia (Table 5), incident STI infection had statistically significant, negative

association with continuous age at first sex (per year increase) (cHR: 0.92, p = 0.011).

The outcome had a statistically significant, positive association with marital status

reported as widowed compared to single, report of more than 20 non-repeat clients in the

last month, report of more than 10 repeat clients in the last month, and report of vaginal

itching (cHR: 3.71, p = 0.011; cHR:1.92, p = 0.016; cHR: 1.59, p = 0.042; HR: 6.30, p <0.001, respectively). While number of lifetime sex partners was significantly associated in Lusaka, it could not be included in the final model because methods for calculating this variable were not consistent between sites.

Multivariate Models

No collinearity was detected. The final, multivariate model for Rwanda (Table 6) includes age at first sex, report of treatment for vaginal discharge in the last year, and report of a chronic ulcer (aHR = 0.93, p = 0.071; aHR = 1.48, p = 0.190; aHR = 8.78, p = 0.032).

For Zambia, the final, multivariate model (Table 6) includes age at first sex, marital status, number of repeat and non-repeat clients in the last month, and report of vaginal itching (aHR = 0.92, p = 0.089; widowed: aHR = 6.24, p = 0.013; aHR = 1.49, p = 0.110; more than 20 clients: aHR = 1.74, p = 0.060; aHR = 12.14, p < 0.001).

Discussion

In this cohort study of HIV-negative FSW in Rwanda and Zambia, we identified STI incidence rates, across country differences in factors associated with STIs, and predictors of an incident STI composite. In both Rwanda and Zambia, younger age of sexual debut was statistically significantly associated with incident STI. Younger age at first sex is putting women at higher risk due to increased sexual risk taking behavior among young and adolescents including lower condom use.

These results highlight the importance of focusing on delaying onset of sexual debut in adolescents. Prevention strategies may include increasing sexual and

reproductive health education among adolescents, messaging to encourage the delay of onset in healthcare, religious, family, and other settings, or increased attention on sexual and reproductive health of adolescent populations to ensure early diagnosis and treatment of STIs as they begin to occur.

Report of being widowed was significantly associated with incident STI compared to being single. Some studies of FSW have found significant associations between separation of some sort from a partner with prevalent HIV (14, 15). This may be due to the vulnerable emotional and financial state women find themselves in after loss of a partner that results in them entering sex work (14). This vulnerability may also result in women taking riskier sexual behaviors for financial incentive or prevent women from successfully negotiating condom use (17, 28, 32).

These findings are supportive of programs to support women experiencing loss of a partner. Potential prevention strategies include creation of communities among women experiencing loss of a partner, focus on empowerment and education, promotion of avenues to financial independence, or targeted health services to educate and promote positive sexual and reproductive health behaviors among women who have lost their partner.

There was a statistically significant association between incident STI and several prior gynecologic symptoms including report of treatment for vaginal discharge in the last year and report of a chronic ulcer in Rwanda and report of vaginal itching in Zambia. Vaginal itching is a common symptom women present with when infected with trichomonas and therefore this result is to be expected.

Reporting treatment for vaginal discharge in the last year was found to be associated with incident STI in Rwanda. Vaginal discharge is a symptom associated with trichomonas, one of the components of the composite outcome, and therefore this result is unsurprising. In addition, reporting vaginal discharge has been associated with prevalent STI, specifically in FSW.

Self-report of a chronic ulcer was significantly associated with incident STI in Rwanda. Ulcerative infection is a well-established risk factor for other STIs and is highly associated with HIV transmission (24).

While stigmatization and discrimination play a role in dissuading FSW from engaging with the healthcare system, these gynecologic symptoms as indicators for incident STI indicates the importance of improving healthcare services available to FSW through promotion of safe, targeted programs. Associations between these gynecologic symptoms and incident STI among FSW support the need to scale up programs for STI screening and treatment services along with sexual and reproductive health promotion and education.

In Zambia, number of reported repeat and non-repeat sex partners in the last month were both positively associated with incident STI. On average, FSW in Zambia reported about 4 repeat and 15 non-repeat clients per month. This finding may be due to the high prevalence of HIV in the population of Zambia. High number of repeat clients may be explained by the tendency of women to stop using condoms with clients they see more regularly (33).

Though FSW in Rwanda reported higher numbers of repeat and non-repeat clients on average per month (about 5 and 16, respectively), the population prevalence in Rwanda is

about 3% compared to more than 12% in Zambia (30). The likelihood of sex with an HIV-positive person in Zambia is higher than in Rwanda which may explain the significance of these predictors in Zambia only.

These findings have significant implications for developing prevention strategies and interventions in FSW between countries. Intervening on number of clients may be difficult as this would have financial implications on the woman, though condom use with all partners is an important message to continue promoting. Encouraging uptake of testing and counseling services with all willing partners is also a key prevention message for FSW.

The cross-country comparisons made between Rwanda and Zambia showed statistically significant differences between countries in 84% of the predictors analyzed. These vast differences observed between the cohorts in Rwanda and Zambia support the conclusion that populations of FSW are heterogeneous between countries, and potentially on more granular, regional levels. For example, the age at which a woman reported starting sex work was 17 or less for about 62% of participants in Rwanda and about 86% in Zambia (p <0.001). Those reporting a previous HIV test in Rwanda was about 94% compared to 78% in Zambia (p<0.001). These differences create opportunities for intervention, specific to the populations in each country.

Older age was not found to be significant in this analysis, which is inconsistent with some literature that reports older age as a risk factor for STIs among FSW because of the increase in sexual partners and encounters over time (35).

Inconsistent with some literature, report of sex without a condom in the last month was not significant in either country. As sex without a condom is a known risk

factor for incident STI, this highlights the fact that unprotected sex is extremely underreported.

Strengths and Limitations

A limitation of this study is the inability to generalize the results to FSW in other countries. Sexual and reproductive health challenges vary across countries as they are impacted by cultural, political and social climates as demonstrated by the HIV epidemic. Generalizability is also limited by women's self-selection into the cohort.

The study is subject to several sources of bias relatively common to cohort studies. Much of the data was collected through self-report which is subject to information bias due to misclassification. Number of lifetime sex partners was collected using different methods by site which may have resulted in non-differential misclassification. In Lusaka, a recalled estimate was asked of participants whereas in Ndola and Kigali, counselors calculated the value based on a formula including average number of monthly partners and number of years practicing sex work. Loss to follow-up also may also introduce selection bias.

Since the outcome of interest was time to first event, not all longitudinal outcomes were considered. However, this characteristic reduces bias due to time-varying confounders that may act as mediators in a repeated outcomes analysis.

Other strengths of this study include the size of the cohort and length of follow-up in an otherwise challenging to reach population. Ability to calculate STI incidence in FSW puts this study in an important position.

Conclusions

FSW in Rwanda and Zambia showed high rates of incident HIV, syphilis and trichomonas. Based on significant associations shown in this analysis, age of sexual debut, marital status, gynecologic symptoms and number of repeat and non-repeat clients are all important factors in determining the occurrence of incident infections in FSW. Prevention strategies and interventions should be designed with these factors in mind to better serve the needs of the population, while acknowledging the regional heterogeneity of FSW populations as demonstrated here.

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Tables

Table 1. Participant demographics by incident STI (HIV, syphilis, trichomonas) in Rwanda.

	Total (N = 458)	No incident STI (N = 357)	Incident STI (N = 101)	
	Mean or n (SD or %)			p-value (2-tailed)
Age (years)	27.89 (5.7)	28.04 (5.7)	27.34 (5.8)	0.273
Education				
None	250 (64.3%)	198 (66.0%)	52 (58.4%)	0.331[a]
Primary level	133 (34.2%)	98 (32.7%)	35 (39.3%)	
Secondary level or higher	6 (1.5%)	4 (1.3%)	2 (2.3%)	
Marital status				
Single	197 (43.2%)	156 (43.7%)	42 (41.6%)	0.750[a]
Divorced/Separated	240 (52.6%)	184 (51.8%)	56 (55.5%)	
Widowed	19 (4.2%)	16 (4.5%)	3 (3.0%)	
Number of live births	2.08 (1.4)	2.07 (1.3)	2.12 (1.5)	0.765
Number of living children	1.93 (1.2)	1.92 (1.2)	1.96 (1.4)	0.772
Number of years in city	14.01 (9.1)	14.11 (9.3)	13.63 (8.4)	0.641
Able to understand French or English				
Cannot understand French/English	420 (91.7%)	328 (91.9%)	92 (91.1%)	0.569[a]
Can understand some French/English	34 (7.4%)	25 (7.0%)	9 (8.9%)	
Can understand French/English well	4 (0.9%)	4 (1.1%)	0 (0.0%)	
Able to read in local language				
Cannot read Kinyarwanda	130 (28.4%)	101 (28.3%)	29 (28.7%)	0.680
Can read some Kinyarwanda	57 (12.5%)	42 (11.8%)	15 (14.9%)	
Can read Kinyarwanda well	271 (59.2%)	214 (59.9%)	57 (56.4%)	
Lifetime sexual partners				
Less than or equal to 365	115 (25.1%)	90 (25.2%)	25 (24.8%)	0.582
366-1000	117 (25.6%)	95 (26.6%)	22 (21.8%)	
1001-2309	112 (24.5%)	88 (24.7%)	24 (23.8%)	
2310 or more	114 (24.9%)	84 (23.5%)	30 (29.7%)	
Age at first sex (years)				
Less than 12	18 (4.6%)	10 (3.3%)	8 (7.9%)	0.012
13 to 15	91 (23.4%)	71 (23.7%)	20 (22.5%)	
16 to 17	134 (34.5%)	95 (31.7%)	39 (43.8%)	
18 to 19	96 (24.7%)	82 (27.3%)	14 (15.7%)	
20 or older	50 (12.9%)	42 (14.0%)	8 (9.0%)	
Continuous age at first sex (years)	16.88 (2.9)	17.08 (2.7)	16.40(3.2)	0.030
Consent at first sex				
Willingly	235 (60.4%)	184 (61.3%)	51 (57.3%)	0.711
Verbally pressured	45 (11.6%)	35 (11.7%)	10 (11.2%)	
Physically forced	109 (28.0%)	81 (27.0%)	28 (31.5%)	
Receive money/ goods at first sex				
Yes	53 (13.6%)	43 (14.3%)	10 (11.2%)	0.454
No / Don't Remember	336 (86.4%)	257 (85.7%)	79 (88.8%)	

Condom at first sex				
Yes	63 (16.2%)	46 (15.3%)	17 (19.1%)	0.397
No / Don't Remember	326 (83.8%)	254 (84.7%)	72 (80.9%)	
Age starting sex work (years)				
Less than 15	9 (2.3%)	7 (2.3%)	2 (2.3%)	0.041
16 to 17	234 (60.2%)	169 (56.3%)	65 (73.0%)	
18 to 19	96 (24.7%)	82 (27.3%)	14 (15.7%)	
20 or older	50 (12.9%)	42 (14.0%)	8 (9.0%)	
Continuous age starting sex work (years)	23.03 (5.2)	23.10 (5.2)	22.60 (4.9)	0.394
Previous HIV test	430 (93.9%)	333 (93.3%)	97 (96.0%)	0.479 [a]
Services Requested (select all that apply)				
Vaginal sex	206 (100.0%)	162 (100.0%)	44 (100.0%)	
Oral sex	26 (12.6%)	17 (10.5%)	9 (20.5%)	0.078
Anal sex	14 (6.8%)	11 (6.8%)	3 (6.8%)	1.00 [a]
Treated for STI in the last year (select all that apply)				
Ulcer	11 (2.4%)	7 (2.0%)	4 (4.0%)	0.270
Discharge	58 (12.7%)	38 (10.6%)	20 (20.0%)	0.013
Syphilis	20 (8.1%)	15 (7.8%)	5 (9.3%)	0.731
Gonorrhea	13 (5.3%)	10 (5.2%)	3 (5.6%)	0.920
Time-varying				
Repeat clients in the last month				
Less than or equal to 10	1335 (68.0%)	1291 (68.0%)	44 (68.8%)	0.892
More than 10	629 (32.0%)	609 (32.1%)	20 (31.3%)	
Continuous[c]	4.89 (7.7)	4.59 (7.7)	4.71 (9.1)	0.894 [b]
Non-repeat clients in the last month				
Less than or equal to 10	674 (34.8%)	661 (35.0%)	13 (25.0%)	0.044 [b]
11 to 20	624 (32.2%)	599 (31.7%)	25 (48.1%)	
More than 20	641 (33.1%)	627 (33.2%)	14 (26.9%)	
Continuous[c]	15.46 (29.1)	15.71 (29.5)	8.11 (12.8)	0.029
Sex without a condom in the last month	2188 (72.1%)	2112 (72.0%)	76 (75.3%)	0.472
Contraception				
Injection	567 (18.%)	557 (19.1%)	10 (10.2%)	0.026
Pill or Emergency	258 (8.5%)	247 (8.4%)	11 (11.9%)	0.381
LARC (Implant or IUD)	1013 (33.4%)	978 (33.3%)	35 (34.7%)	0.782
Permanent Methods (tubal ligation/ hysterectomy)	22 (0.7%)	20 (0.7%)	2 (2.0%)	0.165 [a]
None/condoms only/pregnancy termination	1147 (37.8%)	1107 (37.7%)	40 (39.6%)	0.703
Any modern contraceptive other than condoms	1861 (61.8%)	1803 (61.9%)	58 (59.2%)	0.598 [a]
Reproductive Disturbances Reported (select all that apply)				
Cystitis	122 (4.1%)	121 (4.2%)	1 (1.0%)	0.186
Dyspareunia	44 (1.5%)	44 (1.5%)	0 (0.0%)	0.402 [a]
Vaginal itching	179 (5.9%)	176 (6.0%)	3 (3.1%)	0.280 [a]

Vaginal discharge	124 (4.1%)	122 (4.2%)	2 (2.0%)	0.437 [a]
Abdominal Pain	126 (4.2%)	124 (4.3%)	2 (2.0%)	0.438 [a]
Acute Ulcer	27 (0.9%)	26 (0.9%)	1 (1.0%)	0.593 [a]
Chronic Ulcer	10 (0.3%)	9 (0.3%)	1 (1.0%)	0.282 [a]

Categorical analyses using chi-square test and continuous analyses using t-test unless otherwise specified

[a]Fisher's Exact Test

[b]Mann-Whitney Test

[c]Median and IQR reported

STI: sexually transmitted infection; SD: standard deviation; IQR: interquartile range; LARC: long-acting reversible contraception; IUD: intrauterine device.

Table 2. Participant demographics by incident STI (HIV, syphilis, trichomonas) in Zambia.

	Total (N = 555)	No incident STI (N = 417)	Incident STI (N = 138)	p-value (2-tailed)
	Mean or n (SD or %)			
Age (years)	25.1 1 (6.5)	25.29 (6.5)	24.54 (6.6)	0.248
Education				
None	35 (8.2%)	25 (8.3%%)	10 (8.0%)	0.409
Primary level	204 (47.9%)	138 (45.9%)	66 (52.8%)	
Secondary level or higher	187 (43.9%)	138 (45.9%)	49 (39.2%)	
Marital status				
Single	427 (78.9%)	316 (76.9%)	111 (85.4%)	0.015[a]
Divorced/Separated	105 (19.4%)	90 (21.9%)	15 (11.5%)	
Widowed	9 (1.7%)	5 (1.2%)	4 (3.1%)	
Number of live births	1.71 (1.6)	1.71 (1.5)	1.71 (1.1)	0.991
Number of living children	1.64 (1.4)	1.65 (1.5)	1.59 (1.3)	0.294
Number of years in city	17.7 (9.4)	17.9 (9.5)	17.24 (9.1)	0.515
Able to understand English				
Cannot understand English	137 (24.8%)	108 (25.6%)	29 (21.8%)	0.456
Can understand some English	209 (38.0%)	153 (36.4%)	56 (42.1%)	
Can understand English well	207 (37.4%)	159 (37.9%)	48 (36.1%)	
Able to read in local language				
Cannot read Bemba/Nyanja	420 (75.8%)	322 (76.5%)	98 (73.7%)	0.792
Can read some Bemba/Nyanja	98 (17.7%)	72 (17.1%)	26 (19.6%)	
Can read Bemba/Nyanja well	36 (6.5%)	27 (6.4%)	9 (6.8%)	
Lifetime sexual partners				
Lusaka				
Less than or equal to 15	55 (27.2%)	50 (29.4%)	5 (15.6%)	0.293
16-30	60 (29.7%)	51 (30.0%)	9 (28.1%)	
31-50	43 (21.3%)	35 (20.6%)	8 (25.0%)	
51 or more	44 (27.8%)	34 (20.0%)	10 (31.3%)	
Ndola				
Less than or equal to 130	91 (25.8%)	65 (25.8%)	26 (25.7%)	0.181
131-500	92 (26.1%)	59 (23.4%)	33 (23.7%)	
501-1300	92 (26.1%)	66 (26.2%)	26 (25.7%)	
1301 or more	78 (22.1%)	62 (24.6%)	16 (15.8%)	
Age at first sex (years)				
Less than 12	46 (8.3)	28 (6.7%)	18 (13.5%)	0.044
13 to 15	232 (41.9%)	173 (41.1%)	59 (44.4%)	
16 to 17	140 (25.3%)	109 (25.9%)	31 (23.3%)	
18 to 19	100 (18.1%)	84 (20.0%)	16 (12.0%)	
20 or older	36 (6.5%)	27 (6.4%)	9 (6.8%)	
Continuous age at first sex (years)	15.79 (2.7)	15.96 (2.6)	15.31 (2.4)	0.012
Consent at first sex				
Willing	298 (70.1%)	215 (71.67%)	83 (66.4%)	0.436

Verbally pressured	57 (13.4%)	41 (13.7%)	16 (12.8%)	
Physically forced	70 (16.5%)	44 (14.7%)	26 (20.8%)	
Receive money/ goods at first sex				
Yes	307 (72.1%)	216 (71.8%)	91 (72.8%)	0.828
No / Don't Remember	119 (27.2%)	85 (28.2%)	34 (27.2%)	
Condom at first sex				
Yes	108 (25.4%)	79 (26.3%)	29 (23.2%)	0.499
No / Don't Remember	317 (74.6%)	221 (73.7%)	96 (76.8%)	
Age starting sex work (years)				
Less than 15	103 (24.4%)	63 (21.1%)	40 (32.3%)	0.050
16 to 17	217 (51.3%)	156 (52.2%)	61 (49.2%)	
18 to 19	71 (16.8%)	57 (19.1%)	14 (11.3%)	
20 or older	32 (7.8%)	23 (7.7%)	9 (7.3%)	
Continuous age starting sex work (years)	18.69 (5.2)	18.64 (4.9)	17.85 (4.6)	0.103
Previous HIV test	418 (78.4%)	319 (76.2%)	99 (76.2%)	0.469
Services Requested (select all that apply)				
Vaginal sex	259 (99.6%)	197 (99.5%)	62 (100.0%)	0.575[a]
Oral sex	18 (7.1%)	13 (6.7%)	5 (8.3%)	0.773
Anal sex	31 (12.2%)	21 (10.8%)	10 (16.7%)	0.222
Treated for STI in the last year (select all that apply)				
Ulcer	4 (0.7%)	3 (0.7%)	1 (0.8%)	1.000[a]
Discharge	8 (1.5%)	4 (1.0%)	4 (3.0%)	0.076[a]
Syphilis	29 (7.9%)	19 (7.1%)	10 (10.2%)	0.324
Gonorrhea	2 (0.5%)	2 (0.7%)	0 (0.00%)	1.000[a]
Time-varying				
Repeat clients in the last month				
Less than or equal to 10	1790 (77.1%)	1738 (77.8%)	497 (22.2%)	<0.001
More than 10	531 (22.9%)	52 (60.5%)	34 (39.5%)	
Continuous[c]	3.78 (15.2)	3.79 (15.5)	3.50 (2.8)	0.852[b]
Non-repeat clients in the last month				
Less than or equal to 10	1192 (52.2%)	1155 (52.6%)	37 (42.5%)	0.033
11 to 20	608 (26.6%)	586 (26.7%)	22 (25.3%)	
More than 20	484 (21.2%)	456 (20.8%)	28 (32.2%)	
Continuous[c]	14.56 (37.7)	14.51 (38.0)	15.62 (28.5)	0.771
Sex without a condom in the last month	2584 (77.8%)	2473 (77.7%)	111 (80.4%)	0.448[b]
Contraception				
Injection	900 (30.2%)	868 (30.4%)	32 (25.2%)	0.210
Pill or Emergency	307 (9.2%)	299 (9.4%)	8 (5.8%)	0.154
LARC (Implant or IUD)	749 (22.5%)	708 (22.2%)	41 (29.7%)	0.040
Permanent Methods (tubal ligation/ hysterectomy)	23 (0.7%)	22 (0.7%)	1 (0.7%)	1.000[a]
None/condoms only/pregnancy termination	969 (29.2%)	927 (29.1%)	42 (30.4%)	0.737

Any modern contraceptive other than condoms	1981 (66.3%)	1899 (66.4%)	82 (64.6%)	0.673
Reproductive Disturbances Reported (select all that apply)				
Cystitis	13 (0.4%)	13 (0.5%)	0 (0.0%)	1.000[a]
Dyspareunia	13 (0.4%)	13 (0.5%)	0 (0.0%)	1.000[a]
Vaginal itching	32 (1.1%)	26 (0.9%)	6 (4.7%)	<0.001
Vaginal discharge	9 (0.3%)	8 (0.3%)	1 (0.8%)	0.324[a]
Abdominal Pain	13 (0.4%)	13 (0.5%)	0 (0.0%)	1.000[a]
Acute Ulcer	10 (0.3%)	10 (0.4%)	0 (0.0%)	1.000[a]
Chronic Ulcer	8 (0.3%)	8 (0.3%)	0 (0.0%)	1.000[a]

Categorical analyses using chi-square test and continuous analyses using t-test unless otherwise specified

[a]Fisher's Exact Test

[b]Mann-Whitney

[c]Median and IQR reported

STI: sexually transmitted infection; SD: standard deviation; IQR: interquartile range; LARC: long-acting reversible contraception; IUD: intrauterine device.

Table 3. Comparison of covariates between Rwanda and Zambia.

	Rwanda (n=458)	Zambia (n=555)	p-value (2-tailed)
Age (years)	27.89 (5.7)	25.1 1 (6.5)	<0.001
Education			<0.001
None	250 (64.3%)	35 (8.2%)	
Primary level	133 (34.2%)	204 (47.9%)	
Secondary level or higher	6 (1.5%)	187 (43.9%)	
Marital status			<0.001
Single	197 (43.2%)	427 (78.9%)	
Divorced/Separated	240 (52.6%)	105 (19.4%)	
Widowed	19 (4.2%)	9 (1.7%)	
Number of live births	2.08 (1.4)	1.71 (1.6)	<0.001
Number of living children	1.93 (1.2)	1.64 (1.4)	<0.001
Number of years in city	14.01 (9.1)	17.7 (9.4)	<0.001
Able to understand French/English[a]			<0.001
Cannot understand French/English	420 (91.7%)	137 (24.8%)	
Can understand some French/English	34 (7.4%)	209 (38.0%)	
Can understand French/English well	4 (0.9%)	207 (37.4%)	
Able to read in local language[b]			<0.001
Cannot read local language	130 (28.4%)	420 (75.8%)	
Can read some local language	57 (12.5%)	98 (17.7%)	
Can read local language well	271 (59.2%)	36 (6.5%)	
Lifetime sexual partners			
Rwanda to Lusaka		-	-
Rwanda to Ndola		-	-
Lusaka to Ndola		-	-
Age at first sex (years)			<0.001
Less than 12	18 (4.6%)	46 (8.3%)	
13 to 15	91 (23.4%)	232 (41.9%)	
16 to 17	134 (34.5%)	140 (25.3%)	
18 to 19	96 (24.7%)	100 (18.1%)	
20 or older	50 (12.9%)	36 (6.5%)	
Continuous age at first sex (years)	16.88 (2.9)	15.79 (2.7)	<0.001
Consent at first sex			<0.001
Willingly	235 (60.4%)	298 (70.1%)	
Verbally pressured	45 (11.6%)	57 (13.4%)	
Physically forced	109 (28.0%)	70 (16.5%)	
Receive money/ goods at first sex			<0.001
Yes	53 (13.6%)	307 (72.1%)	
No / Don't Remember	336 (86.4%)	119 (27.2%)	
Condom at first sex			<0.001
Yes	63 (16.2%)	108 (25.4%)	
No / Don't Remember	326 (83.8%)	317 (74.6%)	
Age starting sex work (years)			<0.001

Less than 15	9 (2.3%)	103 (24.4%)	
16 to 17	234 (60.2%)	217 (51.3%)	
18 to 19	96 (24.7%)	71 (16.8%)	
20 or older	50 (12.9%)	32 (7.8%)	
Continuous age starting sex work (years)	23.03 (5.2)	18.69 (5.2)	<0.001
Previous HIV test	430 (93.9%)	418 (78.4%)	<0.001
Services Requested (select all that apply)			
Vaginal sex	206 (100.0%)	259 (99.6%)	0.363
Oral sex	26 (12.6%)	18 (7.1%)	0.261
Anal sex	14 (6.8%)	31 (12.2%)	0.014
Treated for STI in the last year (select all that apply)			
Ulcer	11 (2.4%)	4 (0.7%)	0.028
Discharge	58 (12.7%)	8 (1.5%)	<0.001
Syphilis	20 (8.1%)	29 (7.9%)	0.016
Gonorrhea	13 (5.3%)	2 (0.5%)	<0.001
Time-varying			
Repeat clients in the last month			<0.001
Less than or equal to 10	1335 (68.0%)	1790 (77.1%)	
More than 10	629 (32.0%)	531 (22.9%)	
Continuous	4.89 (7.7)	3.78 (15.2)	0.021
Non-repeat clients in the last month			<0.001
Less than or equal to 10	674 (34.8%)	1192 (52.2%)	
11 to 20	624 (32.2%)	608 (26.6%)	
More than 20	641 (33.1%)	484 (21.2%)	
Continuous	15.46 (29.1)	14.56 (37.7)	0.347
Sex without a condom in the last month	2188 (72.1%)	2584 (77.8%)	0.441
Contraception			
Injection	567 (18.%)	900 (30.2%)	<0.001
Pill or Emergency	258 (8.5%)	307 (9.2%)	0.302
LARC (Implant or IUD)	1013 (33.4%)	749 (22.5%)	<0.001
Permanent Methods (tubal ligation/ hysterectomy)	22 (0.7%)	23 (0.7%)	0.876
None/condoms only/pregnancy termination	1147 (37.8%)	969 (29.2%)	<0.001
Any modern contraceptive other than condoms	1861 (61.8%)	1981 (66.3%)	0.003
Reproductive Disturbances Reported (select all that apply)			
Cystitis	122 (4.1%)	13 (0.4%)	<0.001
Dyspareunia	44 (1.5%)	13 (0.4%)	<0.001
Vaginal itching	179 (5.9%)	32 (1.1%)	<0.001
Vaginal discharge	124 (4.1%)	9 (0.3%)	<0.001
Abdominal Pain	126 (4.2%)	13 (0.4%)	<0.001
Acute Ulcer	27 (0.9%)	10 (0.3%)	0.005

Chronic Ulcer	10 (0.3%)	8 (0.3%)	0.648

[a]Non-local language: French or English in Rwanda and English in Zambia.
[b]Local language: Kinyarwanda in Rwanda and Bemba or Nyanja in Zambia.

STI: sexually transmitted infection; SD: standard deviation; IQR: interquartile range; LARC: long-acting reversible contraception; IUD: intrauterine device.

Table 4. Crude hazard ratios of fixed covariates with incident STI (HIV, syphilis, trichomonas) in Rwanda (n =3035).

Fixed Covariates	cHR	p-value (2-sided)
Age (per year increase)	0.97 (0.94, 1.01)	0.129
Education		
None	Reference	
Primary level	1.09 (0.72, 1.64)	0.688
Secondary level or higher	1.44 (0.35, 5.88)	0.615
Marital status		
Single	Reference	
Divorced/Separated	1.13 (0.76, 1.69)	0.554
Widowed	0.61 (0.19, 1.97)	0.407
Number of live births (per birth increase)	1.01 (0.87, 1.16)	0.928
Number of living children (per child increase)	1.01 (0.86. 1.17)	0.946
Number of years in city (per year increase)	0.99 (0.97, 1.01)	0.389
Able to understand French or English		
Cannot understand French/English	Reference	
Can understand some French/English	1.24 (0.63, 2.46)	0.538
Can understand French/English well	*can't estimate*	
Able to read in local language		
Cannot read Kinyarwanda	Reference	
Can read some Kinyarwanda	1.25 (0.67, 2.33)	0.488
Can read Kinyarwanda well	0.93 (0.60, 1.46)	0.759
Lifetime sexual partners		
Less than or equal to 365	Reference	
366-1000	0.72 (0.41, 1.28)	0.234
1001-2309	0.86 (0.49, 1.50)	0.256
2310 or more	1.03 (0.61, 1.75)	0.909
Age at first sex		
Less than 12	3.31 (1.30, 8.40)	0.012
13 to 15	1.14 (0.54, 2.42)	0.735
16 to 17	1.67 (0.84, 3.32)	0.143
18 to 19	0.90 (0.42, 1.95)	0.792
20 or older	Reference	
Continuous age at first sex (per year increase)	0.93 (0.859, 1.00)	0.038
Consent at first sex		
Willingly	Reference	
Verbally pressured	0.83 (0.42, 1.61)	0.573
Physically forced	1.07 (0.69, 1.66)	0.776
Receive money/goods at first sex	0.83 (0.45, 1.51)	0.537
Condom at first sex	1.17 (0.70, 1.94)	0.555
Age starting sex work		
Less than 15	0.86 (0.19, 3.91)	0.843
16 to 17	1.58 (0.82, 3.07)	0.174

18 to 19	0.90 (0.42, 1.95)	0.792
20 or older	Reference	
Continuous age at starting sex work (per year increase)	0.98 (0.95, 1.02)	0.414
Previous HIV test	1.35 (0.50, 3.66)	0.559
Services Requested		
Vaginal sex	*Can't estimate*	
Oral sex	0.86 (0.46, 1.61)	0.639
Anal sex	0.64 (0.26, 1.57)	0.327
Treated for STI in last year		
Ulcer	1.50 (0.55, 4.076)	0.429
Discharge	1.76 (1.08, 2.870)	0.024
Syphilis	1.00 (0.41, 2.46)	0.997
Gonorrhea	1.04 (0.59, 1.84)	0.883
Item – Time-Varying Indicators		
Repeat clients in the last month		
Less than or equal to 10	Reference	
More than 10	0.72 (0.43, 1.12)	0.226
Continuous (per partner increase)	0.78 (0.50, 1.21)	0.263
Non-repeat clients in the last month		
Less than or equal to 10	Reference	
11 to 20	1.88 (0.96, 3.67)	0.067
More than 20	1.26 (0.59, 2.69)	0.550
Continuous (per partner increase)	1.12 (0.79, 1.57)	0.531
Sex without a condom in the last month	1.53 (0.97, 2.42)	0.065
Contraception		
Injection	0.53 (0.27, 1.07)	0.076
Pill or Emergency	1.30 (0.67, 2.53)	0.445
LARC (Implant or IUD)	0.96 (0.61, 1.51)	0.857
Permanent Methods (tubal ligation/hysterectomy)	2.78 (0.67 11.56)	0.160
None/condoms only/pregnancy termination	Reference	
Any Contraceptive other than Condoms	0.90 (0.60, 1.35)	0.615
Reproductive Disturbances Reported		
Cystitis reported	0.403 (0.06, 2.89)	0.366
Dyspareunia reported	*can't estimate*	
Vaginal itching reported	0.829 (0.26, 2.62)	0.749
Vaginal discharge reported	0.976 (0.24, 3.97)	0.973
Abdominal Pain reported	0.830 (0.20, 3.37)	0.794
Acute Ulcer reported	1.450 (0.20, 10.44)	0.712
Chronic Ulcer reported	8.329 (1.15, 60.37)	0.036

Table 5. Hazard ratios of fixed covariates with incident STI (HIV, syphilis, trichomonas) in Zambia (n = 2768).

Item – Fixed Covariates	cHR	p-value (2-sided)
Age (years)	0.99 (0.96, 1.02)	0.488
Education		
None	Reference	
Primary level	1.19 (0.61, 2.31)	0.611
Secondary level or higher	1.02 (0.52, 2.01)	0.947
Marital status		
Single	Reference	
Divorced/Separated	0.66 (0.39, 1.09)	0.656
Widowed	3.71 (1.35, 10.16)	0.011
Number of live births	0.99 (0.888, 1.11)	0.915
Number of living children	0.97 (0.86, 1.10)	0.646
Number of years in city	0.99 (0.97, 1.01)	0.250
Able to understand English		
Cannot understand English	Reference	
Can understand some English	1.30 (0.29, 2.03)	0.255
Can understand English well	1.11 (0.702, 1.77)	0.649
Literacy in local language		
Cannot read Bemba/Nyanja	Reference	
Can read some Bemba/Nyanja	1.36 (0.89, 2.10)	0.159
Can read Bemba/Nyanja well	0.95 (0.48, 1.88)	0.887
Lifetime sexual partners		
Lusaka		
Less than or equal to 15	Reference	
16-30	1.79 (0.60, 5.35)	0.296
31-50	2.25 (0.73, 6.89)	0.156
51 or more	3.43 (1.16, 10.12)	0.026
Ndola		
Less than or equal to 130	Reference	
131-500	1.09 (0.66, 1.81)	0.735
501-1300	0.87 (0.51, 1.49)	0.611
1301 or more	0.65 (0.35, 1.21)	0.175
Age at first sex		
Less than 12	2.10 (0.94, 4.67)	0.070
13 to 15	1.49 (0.74, 3.00)	0.266
16 to 17	1.23 (0.59, 2.59)	0.578
18 to 19	0.99 (0.44, 2.26)	0.991
20 or older	Reference	
Continuous (per year increase)	0.916 (0.86, 0.98)	0.011
Consent at first sex		
Willingly	Reference	
Verbally pressured	1.06 (0.63, 1.77)	0.841

Physically forced	1.25 (0.81, 1.91)	0.319
Receive money/goods at first sex	1.021 (0.70, 1.49)	0.915
Condom at first sex	1.086 (0.73, 1.62)	0.685
Age starting sex work		
Less than 15	1.79 (0.87, 3.66)	0.113
16 to 17	1.30 (0.65, 2.60)	0.467
18 to 19	1.06 (0.47, 2.39)	0.892
20 or older	Reference	
Continuous (per year increase)	0.97 (0.93, 1.00)	0.072
Previous HIV test	0.90 (0.60, 1.34)	0.590
Services Requested		
Vaginal sex	*can't estimate*	
Oral sex	1.22 (0.70, 2.27)	0.483
Anal sex	1.00 (0.603, 1.668)	0.992
Treated for STI in last year		
Ulcer	1.13 (0.157, 8.085)	0.906
Discharge	1.61 (0.595, 4.361)	0.348
Syphilis	1.44 (0.841, 2.462)	0.185
Gonorrhea	*can't estimate*	
Item – Time-Varying Indicators		
Repeat clients in the last month		
Less than or equal to 10	Reference	
More than 10	1.59 (1.02, 2.48)	0.042
Continuous (per partner increase)	1.36 (0.93, 2.00)	0.116
Non-repeat clients in the last month		
Less than or equal to 10	Reference	
11 to 20	1.12 (0.65, 1.91)	0.688
More than 20	1.92 (1.13, 3.25)	0.016
Continuous (per partner increase)	1.37 (1.05, 1.79)	0.022
Sex without a condom in the last month	1.45 (0.94, 2.22)	0.092
Contraception		
Injection	0.81 (0.51, 1.30)	0.385
Pill or Emergency	0.59 (0.27, 1.25)	0.168
LARC (Implant or IUD)	1.25 (0.81, 1.92)	0.321
Permanent Methods (tubal ligation/hysterectomy)	0.88 (0.12, 6.62)	0.897
None/condoms only/pregnancy termination	Reference	
Any Contraceptive other than Condoms	0.91 (0.63, 1.31)	0.604
Reproductive Disturbances Reported		
Cystitis reported	*can't estimate*	
Dyspareunia reported	*can't estimate*	
Vaginal itching reported	6.30 (2.66, 14.91)	<0.001
Vaginal discharge reported	2.92 (0.41, 21.05)	0.288

|	
Abdominal Pain reported	*can't estimate*
Acute Ulcer reported	*can't estimate*
Chronic Ulcer reported	*can't estimate*

STI: sexually transmitted infection; SD: standard deviation; IQR: interquartile range; LARC: long-acting reversible contraception; IUD: intrauterine device.

Table 6. Multivariate Model for Rwanda.

	Adjusted Hazard Ratio (95% CI)	p-value (2-sided)
Age at first sex (per year increase)	0.93 (0.868, 1.01)	0.071
Treated for vaginal discharge in the last year	1.48 (0.88, 2.41)	0.190
Report of chronic ulcer	8.78 (1.21, 63.75)	0.032

Multivariate Model for Zambia.

	Adjusted Hazard Ratio (95% CI)	p-value (2-sided)
Age at first sex (per year increase)	0.92 (0.84, 1.01)	0.089
Marital status		
Single	Reference	
Separated/Divorced	1.12 (0.57, 2.21)	0.747
Widowed	6.24 (1.46, 26.63)	0.013
Repeat clients in the last month		
Less than or equal to 10	Reference	
More than 10	1.49 (0.92, 2.42)	0.110
Non-repeat clients in the last month		
Less than or equal to 10	Reference	
11 to 20	1.02 (0.57, 1.84)	0.945
More than 20	1.74 (0.98, 3.12)	0.060
Report of vaginal itching	12.14 (3.56, 41.37)	<0.001

CI: confidence interval

Figures

Figure 1. Outcome by type of incident infection – Rwanda; n = 101 cases.
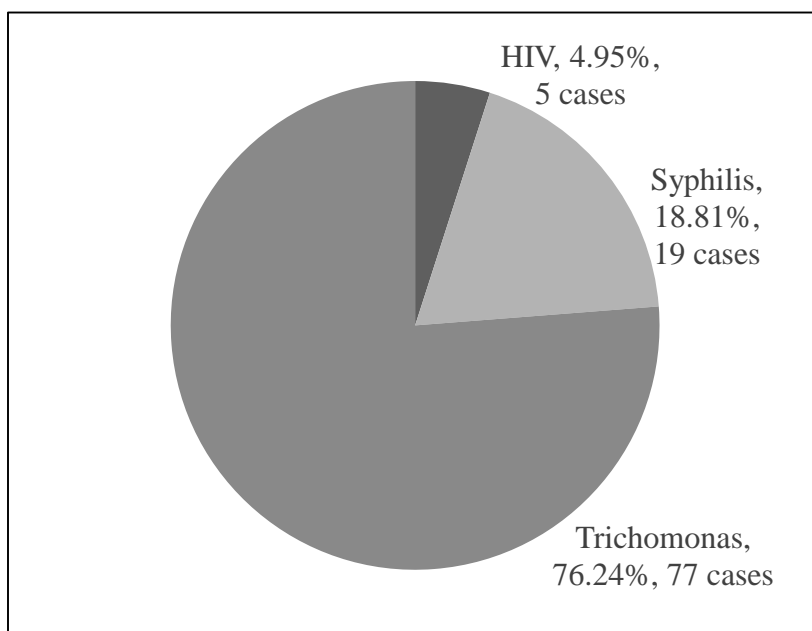
Figure 2. Outcome by type of incident infection – Zambia; n = 138 cases.
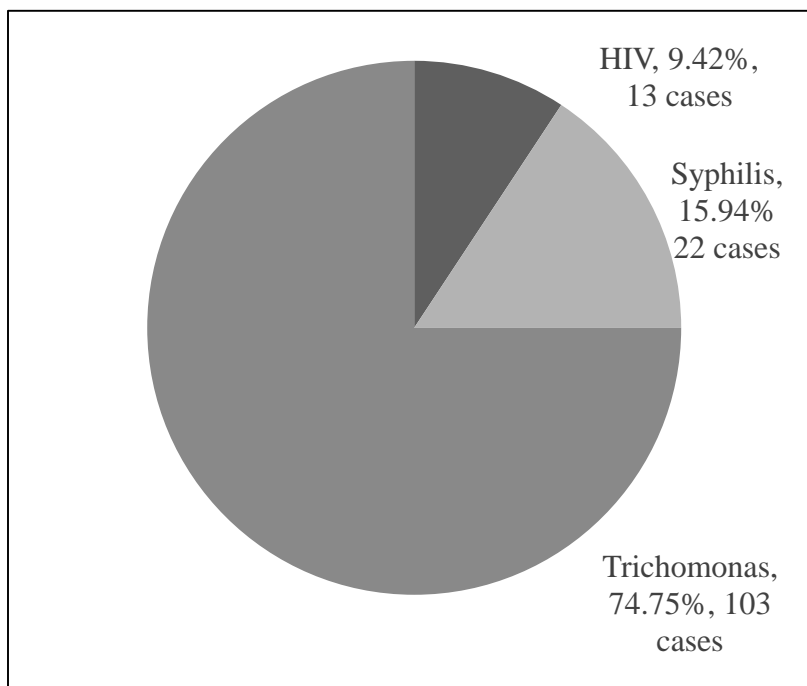
Chapter III – Public Health Implications and Future Directions

Public Health Implications

The findings of this study have implications across the fields of sexual and reproductive health and HIV prevention for FSW. Several actions can be taken before women enter the field of sex work in order to reduce the likelihood of STI acquisition. Focus should be put on delaying sexual debut of adolescents, especially young girls. Also, these findings support providing resources to women who have lost their partner as they are at increased risk of STI acquisition. Among populations of current FSW, emphasis should be put on new and recurring client reduction. Scale-up of STI screening and health service provision for FSW will be crucial in reducing the burden of STIs and HIV carried by this population.

A finding of particular importance in this analysis is the substantial difference between FSW in Rwanda and Zambia. A comparison of the cohorts reveals a different picture in each country. The needs of FSW in one context may be vastly different than the needs of those in another context and this is important to note when planning prevention strategies and interventions for FSW.

Future Directions

The aforementioned prevention strategies should be implemented to reduce the burden of STIs among FSW and formative research should be carried out to understand the challenges facing specific populations of FSW to target interventions appropriately.

Future directions of this research should include country-specific analyses of service provision to FSW. The literature stresses barriers to healthcare access for FSW

and the results of this study show that active STI symptom reporting is an important risk factor for incident STI and HIV(24).

Additionally, further analyses into behavior motivations could be conducted to get to the reason for engaging in riskier behaviors such as early sexual debut or high number of clients. Understanding the motivations for these behaviors will be useful in developing effective public health messages.

Ultimately, continuing research on FSW is a crucial factor in conquering the HIV epidemic and achieving equitable sexual and reproductive health for all women.