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Prospective Study of the Incidence of HIV among Registered Female Sex Workers between 1992-2010 in Dakar, Senegal

By

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Master of Public Health

Epidemiology

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Abstract

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By Aminata Mboup

Background: HIV prevalence in Senegal is 1% nationwide but 30% among female sex workers (FSWs). In 1970, the government mandated FSW registration, which included periodic monitoring for sexually transmitted infections and HIV. While clinical data have been prospectively collected on all FSWs since 1985, limited analysis has been performed regarding HIV incidence. This study aims to provide updated estimates of HIV incidence among FSWs and identify potential predictors of seroconversion.

Methods: We analyzed 1992-2010 longitudinal data on 974 FSWs. Eligibility criteria included availability of data from a baseline and ≥1 follow-up visit, an enrollment questionnaire with demographics and sexual behaviors data, ≥2 serology results and a negative HIV baseline serum. Dividing the number of FSWs who seroconverted by time in the observational cohort provided an estimate of HIV incidence. The association between independent variables and HIV seroconversion was analyzed using univariate Cox Proportional hazards (CPH) regression models. Factors significantly associated ($P<0.05$) on univariate analysis were used in CPH multiple regression modeling.

Results: Out of 974 FSWs, 958 (98.4%) were eligible for inclusion. Of these, 66 (6.9%) seroconverted to HIV (HIV-1=61; HIV-2=4; both=1) during the 4921.5 person-years of observation (PYO) of follow-up through the end of 2010. The overall estimated HIV incidence was 1.3 per 100 PYO (95% CI, 1.0-1.7). In univariate analyses, seroconversion was significantly associated ($p<0.05$) with low prices for services, > 5 partners/week, and older age at registration. Length of time as registered FSWs and low prices for services were significant ($p<0.05$) in multivariate analysis. Length of time as registered FSW was protective.

Conclusion: HIV seroconversion rates are moderately high. FSWs with more partners and lower prices are at greater risk of seroconversion; prevention interventions should be prioritized for them. Length of time registered is protective, suggesting that registration of FSWs might be associated with lower HIV transmission.

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Background/ Literature Review

Country Overview

The Republic of Senegal is located on the western coast of Africa. It is bordered by Mauritania to the north, Mali to the east, and Guinea and Guinea Bissau to the south.

In 2012, the estimated population size is 13 million with nearly 3 million inhabitants in the capital city, Dakar. The Wolofs comprise 43% of the population, and are the largest ethnic group. Senegal's economy is largely dependent on agriculture, fish processing, and a mining industry. Natural resources include phosphates, iron, ore, and fish. The country is also highly reliant on foreign aid. It is one of the world's least developed countries with a GDP per capita as of 2011 of $1900 US dollars. In 2001, the Central Intelligence Agency estimated that 54% of the population lived below the poverty

line. The official language is French, but Wolof is the most spoken indigenous language. More than 90% of the population is Muslim (1).

Health Profile

Malaria, child mortality, maternal death and sexual diseases (including HIV/AIDS) are the major health concerns in Senegal. The estimated infant mortality rate is 55.16 per 1,000 live births while the maternal mortality rate is estimated at 410 per 100,000 live births. Life expectancy is about 60 years. The fertility rate is 4.69 children born/woman. Malnutrition remains a major public health issue. Almost 15% of the children are underweight (1). Seventy nine percent of 1-year-old children are vaccinated against measles. Senegal is classified as the 172th country when it comes to physician density (0.059 physicians/1,000 population) (1,2).

HIV/AIDS situation in Senegal

Despite the country's economy and insubstantial health profile, Senegal has maintained a low HIV prevalence while other sub-Saharan countries are facing the worst generalized epidemics in the world (3,4). At the end of 2009, 68% of the estimated 33 million people living with HIV/AIDS were from sub-Saharan Africa. The HIV prevalence in that region was estimated at about 5% in the adult population (5). HIV prevalence in Senegal was estimated between 0.7% - 1.4% within the adult general population aged 15 to 49, at the end of 2007 (6). Nonetheless, high rates are generally recorded within specific population groups, considered as "most at risk populations" (MARPs). In Senegal, female sex workers (FSW) and men who have sex with men

(MSM) constitute the two highest risk groups. The prevalence among FSW observed varies between 19% and 29%, depending on the region (6). In Dakar, this prevalence was estimated to be 19.4% in 2002 (7).

The country has experienced long-term success with HIV control. Long before the emergence of the HIV/AIDS epidemic, Senegal had already launched a national sexually transmitted infection (STI) program as a response of increasing incidence of STIs (8). As a result, in 1970, the government legalized prostitution and mandated FSW registration (9). The registration program required periodic monitoring for STI in the highest risk group (10). This national program coupled with the country's active engagement by both the public and private sectors resulted at Senegal's success at controlling the HIV epidemic at an early stage (11). As of today, Senegal is the only west African Nation where prostitution is legalized and heavily regulated (12).

Moreover, Senegal began treating AIDS patients with antiretroviral (ARV) drugs in 1998, being amongst the first nation to do so. It was estimated that as of 2007 about 5,900 AIDS patients received ARV treatment, of whom 95% have received the treatment free of charge (13,14).

Since the first case of HIV in Senegal, diagnosed in 1985, both HIV-1 and HIV-2 subtypes are prevalent, but with HIV-1 being predominant (15).

Prostitution in Senegal

Registration system for commercial sex work (CSW)

Prostitution is defined as the exchange of sexual services for money or material goods. In Senegal, prostitution has been increasing, mainly in urban centers, due to economic hardship. Most of the commercial sex workers are females. Lack of education, divorce, forced marriage, death of a primary provider (e.g. husband, father) or simply the desire to have a high standard of living are the main reasons that motivate women to enter the prostitution business. CWS has been reported to be their sole source of income (16). These women are usually heads of households and need to provide food, and ensure education and medical care for several family members (8,13,17).

Following the law legalizing prostitution, all self-identified FSWs, at least 21 years old, must be registered in health clinics established in Dakar, Kaolack or Ziguinchor (10). The health clinics were initially managed by social workers and nurses who were subsequently assisted by local physicians. The enrollment requirements include that at registration, the women sign a consent form and agree to visit the designated clinic every 2 months to receive a complete follow-up, including a clinical examination and a vaginal swab. These bi-monthly visits are alternated with monthly visits where only one clinical examination is performed and a vaginal swab is done upon request. Serological screening is conducted every 6 months to assess for syphilis status and once a year to test for HIV status. Monthly exams cost 500 francs CFA (~1 US dollar) (13). To have an official file, all women attending the health clinics are interviewed by a social worker and complete a questionnaire in French and/or Wolof on their demographics and sexual behaviors (12,18). Upon completion, the women receive a “carnet sanitaire”, a green booklet with the FSW photograph on the back and front cover, which serves as a reminder for her next appointment to the clinic and allows the FSW to solicit clients. The

“carnet sanitaire” contains an identification number unique to each FSW. A copy of the FSWs health record is then sent to the police. At each follow-up visit, physicians and social workers provide counseling on the prevention of both STIs and HIV/AIDS. Also, free condoms are distributed and FSW are instructed and advised on their use (11). While the FSWs wait for their test results, the “carnet sanitaire” is revoked for safety reasons, and a green card with a red line drawn (indicating temporary annulment) is given to the FSWs. The “carnet sanitaire” is also suspended if the FSW misses an appointment or tests positive for any STIs unless the clinics confirm a complete recovery. The suspension of the green booklet prevents the FSW from soliciting clients and may result in imprisonment if arrested by the police.

Registration cards are not suspended for HIV-infected FSWs since they are not required to disclose their serologic status to family members or clients. It is assumed that even without a registration card, the FSWs may pursue their activities illegally whereas allowing them to attend the clinics for follow-up enable them to receive appropriate counseling, support, care and treatment and encourage them to make wise decisions. A FSW can resign at anytime from the commercial sex business and be removed officially from the records if she provides a certificate of resignation and final STIs and HIV test results to the police (13). As of 2004, it was estimated that 1,500 FSWs were registered and about 1,000 (67%) attended the health clinics regularly (4).

This government policy has some limitations. Indeed, many FSWs do not participate in the mandatory registration program either on purspose or due to lack of awareness. These FSWs are classified as “clandestine”. The “clandestine” FSWs constitute another high-risk group for HIV transmission (4). To date the number of

clandestine FSWs is unknown and difficult to assess since the unregistered FSWs manage not to be caught by the police or identified by other registered FSWs. Research has shown that younger age (under the legal age for prostitution), lack of awareness of the legal system and identity documentation, rejection of the official system and fear of stigmatization are several reasons for non-registration (11,13,19). Limited data are currently available on the prevalence of HIV in the clandestine population. In 2001, the Senegalese Ministry of Health reported that HIV prevalence was estimated at 14% among a group of 212 unregistered FSWs, and the age range was between 15 to 65 years old (13).

Limitations of the program are also seen with the registered FSWs. Some FSWs may continue their activities when their "carnet sanitaire" is revoked, or may provide inaccurate information about safe sex practices to the clinic staff in order to avoid reprimands. According to Homaifar et al., even though Senegal's policy toward commercial sex must be commended, "there is a need for improvements" (13).

The prostitution market

The literature shows that most of the registered FSWs work in the streets in certain middle class residential areas. Bars, nightclubs, and hotels are also common meeting places. Prices vary from 5,000 to 10,000 francs CFA (~10 to 20 US dollars), but are negotiable and change depending on the FSWs. FSWs often based their on the physical appearance of their clients usually charging higher fees to men who seem to spend a lot of money on drinks and are willing to pay for the hotel room (13,17).

Foreigners are also believed to be wealthy and would be charged more if they requested services from the FSWs (17).

For FSWs in the suburbs, brothels, usually in dilapidated conditions, are the most frequent meeting places. They are illegal but “tolerated”, given that little legal action has been taken towards their elimination. Many women working in these places are registered and legal in their practice. The clients visiting the brothels usually pay between 500 to 1,000 francs CFA (~1 to US 2 dollars). In a survey of 738 FSWs, 94 % reported using a condom during their last encounter with a regular client and 98% with a new client (11). Interviews of brothel FSWs and their clients however revealed that some clients reported not using condoms with the FSWs, whereas FSWs claimed consistent condom use, despite the refusal of their clients (13). Similar results were corroborated by an HIV incidence study conducted the in brothel FSW population in northern Thailand. This study reported that brothel-based sex work was significantly associated with HIV infection when compared to non-brothel-based sex work. The FSWs in the brothels were more likely to have a higher number of partners and used condoms inconsistently (20). Another cross sectional study on condom use in registered FSWs in Senegal revealed that FSWs were less likely to use condoms with regular partners, especially after a negative HIV serology result (4). These findings suggested that some registered FSWs may have not truthfully reported their condom use and have practiced unsafe sex (13).

FSWs as reservoir for HIV infection

In many African countries, FSWs are an important reservoir for HIV infection (4). Their clients as well as regular sex partners act as potential “bridge populations” for HIV

transmission to the general population (4,7). The HIV prevalence in male clients of FSWs in Senegal is still undetermined; however the prevalence is estimated at 5% in males attending STD clinics (4). Limited data exists on the characteristics of male clients of FSWs (21). In a study of male clients of brothel FSWs, the authors found many clients had unprotected sexual contact with brothel FSWs, and then unprotected sexual contacts with their casual and steady partners, which increased HIV transmission risk for both married and unmarried women. Married women were described to be more exposed to HIV infection than other women in the population (7).

Some studies also reported that FSWs used condoms less frequently during sexual intercourse with their regular partners than with clients (22). In Benin, research showed that condom use in FSWs in the last week was, on average, 80% with their clients, compared to only 20% with their regular partners (23). In China, clients of FSWs were found to be 10 times more likely to have an STI than non-client Chinese men and also inconstantly used condoms with their wives (24). There is a need for increasing prevention and intervention efforts for this bridge population of clients of FSWs in Senegal. In countries with a concentrated HIV epidemic in high-risk groups, interventions among FSWs and their clients may significantly reduce the spread of the epidemic in the general population (21,25).

Previous studies on prevalence, risk determinants, and incidence trends of HIV infection

In Senegal, several studies have been conducted to document the prevalence of infectious disease biomarkers among FSWs in the country. A cross-sectional prevalence

and risk determinants study for HIV-1 and HIV-2 in FSWs in Dakar found that increased years of sexual activity and history of scarifications were associated with higher HIV-2 sero-prevalence; whereas, HIV-1 sero-prevalence was associated with a shorter duration of prostitution and a history of hospitalization (9). There are limited data on incidence of HIV-1/HIV-2 dual infection and related factors among FSWs. The first published study on the incidence of HIV1-/HIV-2 infections among FSWs in Senegal covered the period from 1985 to 1992. The overall incidence of both HIV-1 and HIV-2 infection was 1.11 per 100 person year of observation (PYO). The incidence was stratified by age, years registered in prostitution, and nationality. Age and years of prostitution were not significantly associated with seroconversion to HIV-1 or HIV-2. Registered Senegalese and Ghanaian FSWs in Senegal had a lower risk of seroconversion compared to FSWs originating from other countries (18). Another study on HIV subtype diversity in this cohort has reported that incidence rates have been varying between 0.9 to 2.8 per 100 PYO from 1990 to 2004 (15). No recent information on the HIV incidence is available; thus, new updates are necessary and further investigation of factors related to HIV seroconversion in this cohort of FSWs is needed.

Prospective Study of the Incidence of HIV among Registered Female Sex Workers between 1992-2010 in Dakar, Senegal

Background: HIV prevalence in Senegal is 1% nationwide but 30% among female sex workers (FSWs). In 1970, the government mandated FSW registration, which included periodic monitoring for sexually transmitted infections and HIV. While clinical data have been prospectively collected on all FSWs since 1985, limited analysis has been performed regarding HIV incidence. This study aims to provide updated estimates of HIV incidence among FSWs and identify potential predictors of seroconversion.

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Introduction

The HIV epidemic continues to affect Sub-Saharan Africa with high rates in high-risk groups such as female sex workers (FSWs) (7,11,26). In 2009, UNAIDS estimated 1.8 million new HIV infections in Sub-Sahara, emphasizing that a majority of the world's new infections continue to occur in that region. Many of the new HIV infections in Sub-Saharan Africa occur during unprotected heterosexual intercourse, including paid sex (5,7,16). Research has shown that socio-economic development has contributed to the spread of HIV infections (3,16).

Previous studies have reported that FSWs are susceptible to becoming infected with HIV and sexually transmitted infections (STIs) (26,27). FSWs are a principal "core group" for HIV transmission in Africa and high rates of STIs, and sero-prevalence imply that they contribute to the spread of HIV (26,27). They are an important reservoir in HIV transmission in many countries in Africa (4,28).

Senegal is known for its successful program to control the HIV/AIDS epidemic. The adult HIV prevalence has been kept under 2% since the beginning of the HIV/AIDS epidemic (4). This overall low and stable HIV prevalence masks the HIV epidemic among FSWs (4,11). HIV prevalence estimates as high as 30% have been recorded in this high-risk group, depending on the region (5,11). Even though many studies have been conducted to document the prevalence of infectious disease biomarkers among FSWs in Senegal, there are limited data on HIV-1/HIV-2 incidence and related factors among FSWs (9,19,29-31). The first published study on the incidence of HIV1-/HIV-2 infections among FSWs in Senegal covered the period from 1985 to 1992. The study reported an overall incidence of HIV-1 of 1.11 per 100-person year of observation (PYO) and an

incidence of 1.11 per 100-PYO for HIV-2. The incidence was stratified by age, years registered in prostitution and nationality. Age and years of prostitution were not significantly associated with seroconversion to HIV-1 or HIV-2. Registered Senegalese and Ghanaian FSWs had a lower risk of sero-conversion compared to FSWs originating from other countries (18). Another study on the changes of HIV diversity in Senegal reported an increase in the annual incidence rate of HIV-1 in FSWs from 0 in 1986 to 2.5 per 100 PYO in 1992, and rates in the range of 0.9-2.8 per 100 PYO until 2004 (15). Current information on HIV incidence in FSWs in Senegal and further investigation of related factors are needed.

In this study, we describe HIV incidence and risk factors associated with new HIV infections in registered FWSs in Dakar over a period of 18 years.

Methods

Study Population and Setting

In 1970, the Senegalese government legalized prostitution and mandated FSW registration at clinics implemented at major urban centers for this purpose of the registration program. This registration program consists of compulsory periodic evaluation and treatment, if required, for sexually transmitted infections (STI). At each visit, FSWs are counseled on STI and HIV prevention and offered condoms and medical care if necessary at no cost. An annual blood screening for HIV-1 and/or HIV-2 antibodies is performed on all registered FSWs (9,10,18). Since 1985, registered FSWs visiting the clinic in Dakar (Institut d'Hygiene Sociale) have been prospectively followed for studies on the clinical and immunologic outcome of HIV-1 and HIV-2 and the

evaluation of a candidate HIV vaccine, when available. Protocols for study enrolment and cohort design have been previously described (9-11,31).

Our study population consisted of an open cohort of FSWs registered and attending the clinic in Dakar from 1992 to 2010. Inclusion criteria included a completed enrollment questionnaire with demographics and sexual behaviors, availability of data from a baseline and one or more follow-up visits at the Dakar clinic, two or more HIV serology results and a negative HIV baseline serum. Our outcome variable was seroconversion to HIV. Demographic and behavioral characteristics such as age at registration, time in the prostitution business, time in the registration program, condom use, history of scarifications, excisions, nationality, number of partners, price for services, and education were used to determine potential factors for HIV seroconversion.

Statistical Analysis

All analyses were performed using SAS version 9.3 (SAS Institute, Cary, North Carolina). Routine medical records of study participants were used to provide estimates of HIV incidence among FSWs and identify potential predictors of seroconversion. Demographic and baseline characteristics of FSWs who seroconverted to HIV were compared to those of FSWs who did not seroconvert. Depending on whether distributional assumptions were met, continuous outcomes were examined using either t tests or Wilcoxon rank sum tests. Similarly, binary outcomes were examined using either Pearson Chi-square or Fisher's exact test.

Seroconversion date was arbitrarily calculated as the midpoint between the last negative HIV-1 and/or HIV-2 antibody test and the first positive HIV-1 and/or HIV-2 antibody test. Censoring was considered at the last negative HIV-1 and/or HIV-2 antibody test. HIV incidence was estimated by dividing the number of FSWs who seroconverted during the follow-up period by the amount of time in the observational cohort. Calendar-year specific incidence rates were computed to assess for HIV incidence trends over the study period. Univariate Cox proportional hazards regression models were used to measure the association between independent variables and HIV sero-conversion. The time-dependent interaction terms between each predictor and follow-up period were evaluated to confirm that all proportional hazard assumptions were met. For independent variables, the hazard ratio and their 95% confidence interval (CI) provided risk estimates. Factors that were significantly associated ($P<0.05$) on univariate analyses were included in a backward Cox proportional hazards multiple regression model and variables with $P>0.05$ were removed from the model. Collinearity was assessed for each potential model.

Results

Socio-demographic and behavioral characteristics

During the study period, 974 FSWs were considered. Of these, 8 FSWs (0.8%) were HIV seropositive at baseline and 8 (0.8%) did not return for a follow-up visit. The remaining 958 (98.4%) were then eligible for inclusion in the study. Characteristics of study participants are presented in Table 1. Mean age at registration was 31.0 (SD=6.8) years. Women practiced prostitution for an average time of 7.2 (SD=6.4) years. They waited on average a period of 2.0 (SD=4.1) years before enrolling in the mandatory

registration program. 471 (49.1%) reported always using condoms compared to 425 (44.4%) who reported seldom use of condoms and 62 (6.5%) who reported never using condoms. 236 (24.6%) had a scarification, 263 (27.5%) had an excision (female genital mutilation) and 579 (60.4%) had tattoos. 809 (84.4%) women in the cohort were Senegalese and 506 (52.8%) had more than 5 partners weekly. 750 (79.3%) reported charging higher fees for services at baseline (more than 5000 francs CFA or $10). 559 (55.2%) were not educated. When characteristics and sexual behaviors were stratified by seroconversion, the two groups did not differ significantly ($P<0.05$) by number of years of prostitution, condom usage, history of scarification, excision, number of partners per week, or education level.

HIV incidence

Women were followed for approximately 4921.5 person-years of observation (PYO) with a mean duration of 5.2 (SD=4.4) years. Sixty-six women seroconverted to HIV. Of the 66 seroconverters, 4 (6.1%) seroconverted to HIV-2 and 1 (1.5%) had dual-reactive status. Overall HIV incidence was estimated at 1.3 (95% CI, 1.0-1.7) per 100 PYO. The mean PYO for seroconverters was slightly lower (3.2, SD=3.1) than the mean of PYO for non-seroconverters (5.3, SD=4.4) ($p=0.0003$). The annual HIV incidence rate ranged from 0 to 3.7 per 100 PYO with the highest incidence rates observed between 1992 and 2001. In 1994 and 2004, no case of sero-conversion was reported (Table 2).

Risk factors for HIV incidence

In univariate analyses, seroconversion rates were significantly associated ($p<0.05$) with age at registration, length of time in the registration program, more than 5 partners per week, and low prices for services. In the final multivariate model, HIV incidence was independently associated with length of time as a registered FSW (adjusted hazard ratio 0.25, 95%CI, 0.18-0.34) and low prices for services (adjusted hazard ratio 2.07, 95% CI 3.41-1.25) (Table 3).

Discussion

Our study of updated estimates showed unchanging HIV incidence rates and identified low prices for services and length of time as a registered FSW as predictors for seroconversion. In this analysis, the overall HIV incidence rate was 1.3 (95% CI, 1.0-1.7) per 100 PYO. Length of time as a registered FSW and low fees for services were the two factors associated with increased risk of seroconversion. The overall HIV incidence rate found in our study is approximately comparable to rates described in 2 previous studies of this cohort of FSWs that included estimates through 2004 (15,18). Our study showed that from 1992 to 2010, annual incidence rates ranged from 0 to 3.7 per 100 PYO. One of the two studies previous to ours on incidence of HIV in this cohort of FSWs found an annual range of 0.9 to 2.8 per 100 PYO from 1990 to 2004 (15). In our study, HIV infection rates fluctuated over the 18 years of the study. Infection rates appear to be declining since 2007. The difference in rates between our study and the previous study may be due to the cohort size and inclusion criteria. Our study had a population size of 958, whereas the other study had a population size of 3910 registered FSWs.

A study of HIV incidence among FSWs in Rwanda reported an HIV incidence of 3.5 per 100 PYO, which is considerably higher than what we observed in our study (32). Possible reasons for the difference may be that our incidence estimates are based on a longer follow-up period and women in our study were routinely tested and counseled on HIV prevention, or a lower HIV prevalence in FSWs partners. The subjects in our study were women considered at high risk for HIV infection based on their self-identification as registered FSWs. HIV sero-prevalence has been higher in this high-risk group, compared to low risk groups such as blood donors or pregnant women (11,18,31). Therefore, incidence estimates reported are only illustrative of this specific high-risk group of women (18).

In our results, HIV-2 infection was less frequent than HIV-1. The findings concur with previous studies showing that the rate of HIV-2 infection is slower than the rate of HIV-1 infection (18,33,34). Researchers have even suggested that infectivity of HIV-1 in the Dakar cohort of FSWs is roughly three times that of HIV-2 per sexual act (10). Moreover, HIV-2 may be transmitted less efficiently than HIV-1 through an at-risk population (9). Due to the small number of new HIV-2 infections in our cohort, we calculated incidence estimates and identified potential factors of seroconversion to HIV overall instead of focusing on each type separately.

In this cohort of registered FWSs, a cross-sectional study on the prevalence and risk determinants for HIV-1 and HIV-2 found that increased years of sexual activity, and a history of scarifications were associated with HIV-2 sero-prevalence, whereas, HIV-1 sero-prevalence was associated with a shorter duration of prostitution and a history of hospitalization (9). In our study, only selected factors for sero-conversion were evaluated.

We did not find any significant association with a history of scarifications, but age was significantly associated with sero-conversion. Age has been found to be independently associated with HIV seroconversion in women (35,36). We assumed age may be representative of increased exposure to HIV via sexual transmission (9). Risk of sero-conversion has been reported to be associated with women of certain nationalities (18). We did not find any significant association between nationality and sero-conversion in our study.

Other findings of our data are noteworthy. We found a significant benefit of the registration program: length as registered sex worker was associated with reduced risk of HIV infection. This could indicate that FSWs who are engaged and frequently screen for HIV infection and participate in prevention programs are more likely to practice safer sex and get care and treatment of STIs that would increase their risk of HIV infection. Similar results were reported in a study of registered FSWs in Mexico (37).

In our cohort, self-reported condom use as advised by the registration program, may not always be accurate. Indeed, 40.9% of HIV seroconverters reported consistent use of condoms. In univariate analysis, lack of protection was found protective against HIV infection when compared to consistent protection, even though the result is not statistically significant. A cross sectional study on condom use in registered FSWs in Senegal found that FSWs were less likely to use condoms with regular partners, especially after a negative HIV serology result (4). Another study of brothel FSWs and their clients revealed that some clients declared not using condoms with the FSWs, whereas FSWs reported consistent condom use despite the refusal of their clients (13).

This discrepancy indicates that even though the registration provides condoms and encourages their use, there is room for more improvements.

Low service fees were found to be significantly associated with HIV seroconversion in our results. Research on FSWs working in brothels has revealed that most of them are registered. Brothels are common meeting places and are frequently visited by clients since women offer lower prices for sex (13). Similar results have been found in a study of FSWs in Thailand where brothel based FSWs offered lower prices for commercial work and had higher clients, which was significantly associated with HIV infection (20). This implies that a low customer fee may be a marker for high HIV prevalence in the pool of clients of brothel-based women (20).

There are many strengths to our study. First, misclassification bias is considered irrelevant in our results. All blood samples were first tested by very sensitive and specific immunoblot assays and positive blood samples were retested thoroughly. HIV-1 and HIV-2 immunoblots used on each tested sample reduced the rate of false positive and false negative outcomes (18). Second, most of the studies documenting HIV incidence are cross-sectional, however our study allowed us to use clinical and behavioral data of FSWs prospectively collected and determine a precise interval when sero-conversion occurred. Third, this study has high rate of cohort retention and was directed to a hard-to-reach population.

We recognize some limitations to our study. Factors such as STIs or sexual practices were not available, and therefore were not included as possible predictors of HIV infection in our analysis. Genital ulcers, chlamydial infections, and gonorrhea were all found to be associated with HIV-1 seroconversion in other studies (38,39).

Additionally, a systematic review on socio-demographic and risk factors of FSWs in Sub-Saharan Africa revealed that chlamydia and gonorrhea may be present in one third or more of the sex workers (16). Another study showed that sex workers who performed anal intercourse had a 3-fold increase of acquiring HIV compared to other women (40). Our data does not allow us to make contributions to those findings. Data on STIs in this cohort would provide more information on the effectiveness of counseling, screening, and treatment offered by the Senegal's mandatory registration program for FSWs.

Despite those limitations, the use of routine medical records enabled us to provide updated estimates of the HIV seroconversion rate in a group considered at high-risk for HIV seroconversion as well as identify new areas for enhanced prevention. HIV is still a major health problem among FSWs. HIV prevalence has continued to rise among registered FSWs in Senegal during the past 20 years (4). Length of time as a registered FSW and a low price for services were important predictors for HIV seroconversion in this cohort. It is essential that data on this cohort be routinely used to implement and evaluate prevention programs (41).

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Table 1. Demographic and characteristics of registered FSWs (n=958) stratified seroconversion to HIV among registered female sex workers in Dakar, Senegal from 1992-2010.

	N(%) or Mean (SD)			
Characteristics	**Seroconverted (N=66)**	**Seronegative (N=892)**	**Whole Cohort (N=958)**	P-value*
Age at registration (years)	32.8(7.0)	30.9 (6.8)	31.0 (6.8)	0.0349
Number of years of practice	6.7 (6.7)	7.3 (6.4)	7.2 (6.4)	†NS
Time in the prostitution business before registration (years)	3.0 (5.6)	2.0 (4.0)	2.0 (4.1)	NS
Condom use				
Always	27 (40.9)	444 (49.8)	471 (49.1)	
Sometimes	37 (56.1)	388 (43.5)	425 (44.4)	NS
Never	2 (3.0)	60 (6.7)	62 (6.5)	
History of scarifications				NS
Yes	20 (30.3)	216 (24.2)	236 (24.6)	
No	46 (69.7)	676 (75.8)	722 (75.4)	
Excisions				NS
Yes	13 (19.7)	250 (28.0)	263 (27.5)	
No	53 (80.3)	642 (72.0)	695 (72.5)	
Tattoos				0.0175
Yes	49 (74.2)	530 (59.4)	579 (60.4)	
No	17 (25.8)	362 (40.6)	379 (39.6)	
Nationality				
Senegalese	62 (94.0)	747 (83.7)	809 (84.4)	0.0274
Other	4 (6.0)	145 (16.3)	149 (15.6)	
Number of partners per week				NS
≤5	24 (36.4)	428 (49.0)	452 (47.2)	
>5	42 (63.6)	464 (52.0)	506 (52.8)	
Price for services at baseline (CFA) §				0.0010
≤5000 CFA	25 (37.1)	183 (20.5)	205 (21.7)	
>5000CFA	41 (62.1)	709 (79.5)	750 (79.3)	
Education level				NS
No education	31 (47.0)	498 (55.8)	529 (55.2)	
Some education	35 (53.0)	394 (44.2)	429 (44.8)	

* Continuous outcomes were examined using either t tests or Wilcoxon rank sum tests. Binary outcomes were examined using either Pearson Chi-square or Fisher's exact test.

† Not significant

§1 US dollar ≈500 francs CFA

Table 2. Annual incidence of HIV-1/2 in a cohort of 958 registered female sex workers in Dakar, Senegal from 1992 to 2000.

Calendar Year	PYO*	Number of seroconverters	Number of persons contributing PYO	Incidence rate per 100 PYO(95% CI)
1992	39.7	1	58	2.5 (0.1-12.4)
1993	74.0	1	78	1.4 (0.1-6.7)
1994	87.1	0	99	0
1995	135.8	5	183	3.7 (1.3-8.2)
1996	208.0	4	271	1.9 (0.6-4.6)
1997	242.8	3	298	1.2 (0.3-3.4)
1998	251.4	5	295	2.0 (0.7-4.4)
1999	278.8	7	339	2.5 (1.1-5.0)
2000	321.9	6	402	1.9 (0.8-3.9)
2001	362.3	9	433	2.5 (1.2-4.6)
2002	362.7	5	426	1.4 (0.5-3.1)
2003	371.0	5	380	1.3 (0.5-3.0)
2004	377.5	0	409	0
2005	361.2	5	409	1.4 (0.5-3.1)
2006	337.8	2	361	0.6 (0.1-2.0)
2007	334.8	4	368	1.2 (0.4-2.9)
2008	323.3	1	364	0.3 (0.0-1.5)
2009	307.8	2	356	0.6 (0.1-2.1)
2010	143.4	1	305	0.7 (0.0-3.4)
Overall incidence January 1992-December 2010	4921.5	66		1.3 (1.0-1.7)

*PYO= Person years of observation

Table 3. Univariate and multivariate analysis of socio-demographic and sexual behavior risk factors for HIV seroconversion among 958 registered female sex workers in Dakar, Senegal.

Covariate	Unadjusted HR (95%CI)	P-value	Adjusted HR	P-value
Age at registration (years)	1.04 (1.01-1.07)	0.0325*		
Time in the prostitution business before registration (years)	1.03 (0.98-1.08)	0.2404		
Length of time in the registration program	0.24 (0.18-0.34)	<0.0001*	0.25 (0.18-0.34)	0.0045*
Condom Use				
Never	0.53 (0.13-2.24)	0.1797		
Sometimes	1.41 (0.86-2.3)	0.3909		
Always	Referent			
History of Scarifications				
Yes	1.30 (0.77-2.20)	0.3260		
No	Referent			
Excisions				
Yes	0.70 (0.38-1.29)	0.2533		
No	Referent			
Tattoos				
Yes	1.66 (0.96-2.89)	0.0724		
No	Referent			
Nationality				
Senegalese	1.76 (0.64-4.88)	0.2741		
Other	Referent			
Number of partners per week				
>5	1.68 (1.01-2.78)	0.0421*		
≤5	Referent			
Price for services in at baseline[§] (CFA)				
≤5000 CFA	2.27 (1.38-2.27)	0.0013*	2.07 (3.41-1.25)	<0.0001*
>5000 CFA	Referent		Referent	
Education level				
No education	1.29(0.79-2.09)	0.3065		
Some education	Referent			

*Backward selection of variables with P<0.05 in univariate analysis. The following variable were removed from model (in order of removal): number of partners per week and age at registration

[§]1 US dollar ≈500 francs CFA

Summary, Public health implications and possible future directions

There are four major findings in this research. First, the overall HIV incidence rate was not significantly different from the rate estimated since the beginning of the HIV epidemic in Senegal. Second, we found that the length of time as a registered FSW decreased the risk of the HIV infection. Third, FSWs with low fees for services had a greater risk of HIV seroconversion. Lastly, self-reporting of condom use by the FSWs did not always reflect the reality.

This analysis suggests that, even though the registration program appears to be playing a critical role in restricting the overall spread of HIV in the general population, many new initiatives need to be taken. Increased levels of condom use should be further promoted and prevention programs should be prioritized for FSWs that are new to the registration program. Several steps can be taken toward accomplishing these goals. FSWs should receive more thorough education on STIs and HIV infections. Clients and regular partners of FSWs should also be targeted and benefit from prevention programs. Educating both the clients and the FSWs will probably increase their awareness and promote safer sex.

Unregistered sex workers may be at a higher risk of acquiring HIV and their management should be the next step for the control of the HIV epidemic.

APPENDIX I: IRB Letter of exemption

sented to the IRB for consideration prior to their implementation in the research.

Sincerely,
Steven J. Anzalone

IRB Analyst Assistant

This letter has been digitally signed

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