HIV infection and sexually transmitted infections among men who have sex with men in Senegal

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Background: No epidemiological study has been conducted on HIV and vulnerability to sexually transmitted diseases (STI) among men who have sex with men (MSM) in sub-Saharan Africa

Method: A survey including questionnaire, physical examination and detection of HIV and STI was carried out among 463 MSM, aged 18–52 years, recruited through the snowball technique in five urban sites throughout Senegal.

Results: A total of 21.5% of men were found to be infected with HIV [95% confidence interval (CI), 17.8–25.6]. Active syphilis, positive serology for herpes simplex virus (HSV)-2, and polymerase chain reaction detection in urine of *Chlamydia* and gonorrhea infections were recorded in 4.8, 22.3, 4.1 and 5.4% of participants, respectively. Most respondents reported sex with women (94.1%). In the month preceding the interview, 24% reported at least one unprotected insertive anal intercourse with a male partner, 20% at least one unprotected receptive anal intercourse, and 18% at least one unprotected intercourse with a female partner. Genital examination showed that 5% of participants had at least one clinical sign of STI. Factors associated with HIV infection were age group, the reporting of more than nine lifetime male partners [odds ratio (OR), 3.76; 95% CI, 1.61–8.79], being a waiter or bartender (OR, 3.33; 95% CI, 1.41–7.84), and living in Dakar (OR, 3.33; 95% CI, 1.07–3.43).

Conclusion: Men who have sex with men in Senegal are highly infected with HIV and other STI. Intervention programs targeting this population are urgently needed, given their particular vulnerability and because infections are likely to disseminate into the general population given the high proportion of bisexual activity in this community.

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Introduction

Heterosexual contacts represent the main mode of HIV transmission in sub-Saharan Africa [1]. However, a growing body of literature shows that MSM exist in all parts of Africa [2] and suggests that they could be a population that is significantly vulnerable to HIV and sexually transmitted infections (STIs) [3–5]. Research in this area has been neglected because of criminalization of MSM (male-to-male sex is illegal in more than half of

African countries [6]), difficulty of access, lack of funding or simply because of widespread denial of male-to-male sex in African societies [7]. A study conducted in South Africa, the sole country in Africa where MSM rights are protected by the constitution, showed reluctance by ethics committees and political leaders to address the issue of MSM vulnerability [8]. Consequently, studies in this field have been delayed and to date there are no published studies providing epidemiological data on STI rates and risk behaviors among MSM in sub-Saharan Africa.

In Senegal, ethnographic studies conducted in Dakar have described a great variety of sexual behaviors that are kept secret from public scrutiny. Qualitative interviews with a limited number of MSM showed how social and sexual relationships were shaped by local cultural and economic forces [9,10]. Homosexuality is illegal in Senegal and male-to-male sex is generally condemned by political and religious authorities and by the general population. Consequently, most MSM must keep their sexual life secret, including from their own family. In 2000, quantitative anthropological data about needs, behaviors, knowledge and attitudes were collected from a convenience sample of 250 MSM in Dakar [11]. This study investigated the identities and social roles of respondents in detail and confirmed that their lives were often characterized by stigma, violence and rejection. Reluctance to use health services because of fear of stigmatization by health staff and poor preventative behaviors had led to high vulnerability to HIV and STIs.

We present here the first epidemiological study of MSM vulnerability conducted in Africa. We collected data on HIV, STIs, sexual behaviors and access to health care in a sample of MSM in Dakar and in four other urban sites in Senegal.

Methods

The particular context of stigmatization and criminalization of MSM in Senegal led us to take several measures in order to ensure the safety of the participants and the feasibility of the study. It was made clear to the political and administrative authorities that we intended to carry out a public health study and that sexual behaviors were investigated only because of their connection with STI transmission. The survey was conducted from April 2004 to September 2004, predominantly in Dakar but also in four other urban locations of the country. The period of recruitment was purposely extended in order to make the survey as discreet as possible, avoiding the gathering of several participants at the same place.

Stigmatization also made it difficult to reach MSM and ask them to participate. Required discretion made it impossible to establish a sampling frame of venues in the cities. We recruited 24 recognized peer leaders (15 in Dakar, and nine in the four other urban sites) who were in charge of recruiting participants through informal social networks, in settings where MSM meet, and through snowball referrals. Leaders were selected in order to represent the different subgroups of MSM (several age groups and members from all community organizations). Eligibility criteria for participation were age 18 years or older, same-gender sex (ever had sex with another man) and residence in the study site. In Dakar, the long duration of the survey also allowed the information to circulate and reach MSM less involved in the community.

A special procedure was designed to ensure participants' safety and anonymity. No individual identification was written on questionnaires, clinical and laboratory result forms. Questionnaire, clinical and laboratory data were linked using stickers with numbers. Participants' identities were recorded on the consultation registry of the study center in which a sticker number was also placed. In order to make it impossible to identify the participants, we started to put stickers corresponding to other regular patients on the consultation registry several weeks before and continued several weeks after the survey. As a consequence, individuals in the registry with stickers were not necessarily MSM and included other individuals including women.

The study team consisted of two male medical doctors, a female social worker and a pharmacist–medical laboratory technologist. On arrival in the consultation room, potential participants were received in private by one of the two medical doctors or by the social worker who presented the procedures and the objectives of the study. After written consent, the participants were interviewed by the same member of the study team who received him using a standardized questionnaire on sociodemographic characteristics and sexual behavior. The two medical doctors proceeded with a physical examination to search for any sign of STIs while the social worker sent them to one of the two medical doctors for this part of the study. If a clinical sign of STIs was found, participants received syndromic STI treatment following a syndromic management protocol recommended by the Senegalese health authorities. Finally, participants were sent to the pharmacist–medical laboratory technologist who asked for another written consent for biological samples. A blood sample was taken and sent to the laboratory to be tested for HIV, syphilis, *Chlamydia*, hepatitis B virus, hepatitis C virus and herpes simplex virus (HSV)-2 antibodies; and a urine sample was collected and sent to the laboratory to be tested for current gonorrheal and chlamydial infections. Finally, participants were offered a genital examination to check for the presence of STI signs.

Participants were asked to come back to the center 2 weeks later to be informed of their laboratory test

results. If a current STI was detected the participant was treated free of charge.

For those participants who were found to be HIV positive, a new physical examination was performed and the patient was referred to the local reference center for AIDS treatment where a decision was made regarding inclusion in an antiretroviral protocol after a complete check-up. The social worker in the research team was in charge of psychosocial support.

The questionnaire was designed in the light of the experience of previous sexual behavior surveys conducted in Senegal and the results of the anthropological survey on MSM conducted in Dakar in 2000 [11]. Information was obtained on demographic characteristics, history of STI symptoms and access to care in the past 12 months, alcohol and drug consumption, social life and sexual behavior. We also asked for information on first intercourse with a man and with a woman, number of lifetime male and female partners, history of forced sex, commercial sex and condom and lubricant use. A range of sexual practices with men and women were also investigated using a month recall period, including a question on condom use frequency. Sexual practices with men included insertive anal, receptive anal, insertive oral and receptive oral sex.

Laboratory procedures

Serum samples were first tested for HIV by enzyme-linked immunosorbent assay (Murex HIV Ag/Ab combination; Abbott, Abbott Park, Illinois, USA). Confirmation was obtained with immunoblot (HIV Blot 2.2; GENELABS Diagnostics, Redwood City, California, USA). Samples that produced discrepant results were further tested with Determine HIV (Abbott).

Screening for syphilis was done with the rapid plasma reagin (RPR) Card Antigen Suspension (Syphilis RPR, Human GmbH, Germany) and with the *Treponema pallidum* hemagglutination assay (TPHA) (Syphilis TPHA liquid, Human GmbH). A positive RPR test (at any titer) and TPHA was considered as evidence of recently acquired and/or untreated syphilis. We used enzyme immunoassays to screen blood specimens for antibodies for HSV-2 (Kalon Biological Limited, Hants, UK) and *Chlamydia* (Immuno Comb Chlamydia Ige; Monovalen, Immuno Comb Bivalent IgG Chlamydia, PBS Organics, Yavne, Israel). The urine samples were frozen and tested for gonorrheal and chlamydial infection using DNA amplification methods (Amplicor *Chlamydia trachomatis/ Neisseria gonorrhoeae* Test; Roche Diagnostics, Basel, Switzerland).

Data management and analysis

All data were double-entered and validated in a specially designed EPI-INFO database. Further data cleaning and data analysis were done using SPSS 11.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Sociodemographic characteristics, main parameters of sexual behavior, laboratory findings and physical examination results were tabulated. Risk factors associated with HIV infection were assessed. Bivariate analysis results were tabulated for those factors associated with a *P*-value less than 20%. We also constructed a multiple logistic-regression model with all factors identified in the bivariate analysis and modified the model through backwards elimination, which removed explanatory variables. In order to avoid chance selection, only variables with a *P*-value greater than 0.20 were removed [12]. We finally considered the variation of HIV prevalence with the study period in the Dakar site to assess the impact of a potential selection bias on our estimate.

Ethical approval

The national ethics committee of Senegal gave its ethical approval to the study, which was subject to an ethical audit by the Agence National de Recherche sur le SIDA.

Role of funding source

The study was funded by the Agence Nationale de Recherche contre le SIDA (ANRS–1282). The study sponsor had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

In the five study sites, 468 men attended the study center and all agreed to participate after being informed of the study procedures. Of these men, two were excluded because they were under 18 years of age. The questionnaire was stopped for another three participants who had had no sex with another man. All of the remaining 463 men answered the questionnaire and underwent the physical examination, and of these 442 consented to provide blood and urine samples.

There were 297 participants in Dakar, 66 in Thiés, 33 in Mbour, 22 in Kaolack and 45 in Saint-Louis. Table 1 shows the main sociodemographic characteristics of participants. Median age of participants was 24 years (range, 18–52 years) and the majority were single (90.1%) and reported being Senegalese (96.5%). A small proportion had been married (9.9%). Most of the participants (86.4%) reported living with their parents; only three said they were living with their male sexual partner.

Of the 297 participants in Dakar, 114 (38.4%) reported that they had participated in the previous study conducted among 250 MSM in Dakar [11]. This means that the overall population of MSM in Dakar is at least three times as high as 297 and probably higher as the recruitment methods of both surveys were not independent, as confirmed by the time trend in this indicator: in April,

Table 1. Sociodemographic characteristics and sexual behaviors among 463 men who have sex with men in Senegal.

	Number of participants (%)
Age groups	
18–20 years	139 (30.0)
21–24 years	110 (23.8)
25–28 years	116 (25.1)
29–52 years	98 (21.2)
Matrimonial status	
Currently married	36 (7.8)
Single	417 (90.1)
Divorced	9 (1.9)
Widowed	1 (0.2)
Children	
Had at least one child	72 (15.6)
Education	
Never been to school	83 (17.9)
Primary	183 (39.5)
Secondary	177 (38.2)
Higher	20 (4.3)
Occupation	
None	46 (9.9)
Student	66 (14.3)
Trade	82 (17.7)
Hairdresser or beautician	39 (8.4)
Waiter or bartender	29 (6.3)
Tailor	52 (11.2)
Manual worker	132 (28.5)
Other	17 (3.6)
First sex	
Median age with a woman (interquartile range)	16 (14–20)
Median age with a man (interquartile range)	17 (13–20)
Age of first sex with man lower than with woman	165 (35.6)
A man forced him to have sex	46 (9.9)
Sexual life	
Ever physically forced to have sex with a man	139 (30.0)
Median number of male lifetime partners (interquartile range)	6 (3–20)
Median number of female lifetime partners (interquartile range)	4 (2–9)
Male partners in the last 12 months	
0	22 (4.8%)
1–2	170 (36.7%)
3–5	113 (24.4%)
More than 5	158 (34.1%)
Female partners in the last 12 months	
0	120 (25.9%)
1	142 (30.7%)
2–3	118 (25.5%)
More than 3	83 (17.9%)
Last month sexual practices/proportion with inconsistent condom use	
Insertive anal sex with men	199 (43.0%)/(55.3%)
Receptive anal sex with men	159 (34.3%)/(57.9%)
Insertive oral sex with men	118 (25.5%)/(94.1%)
Receptive oral sex with men	111 (24.0%)/(84.7%)
Vaginal sex with women	152 (32.8%)/(53.9%)
Commercial sex with men (received money for sex)	104 (22.5%)/(65.4%)
Anal sex (insertive or receptive) with men AND vaginal sex	110 (23.8%)/(43.6%*)
Lubricating gel use in the last 12 months	
Always	35 (7.6%)
Often	66 (14.3%)
Sometimes	89 (19.2%)
Never	268 (57.9%)
Had no anal sexual intercourse in the period	5 (1.0%)

*unprotected sex with both men and women.

May–June and July–September, respectively, those who reported having participated in the previous study were 71 of 130 (54.6%), 19 of 70 (27.1%) and 24 of 97 (24.7%).

Most of the respondents (94.1%) reported having had sex with women. Median age at first sex was 16 years with a woman and 17 years with a man. At least one-third of those who also had sex with women had sex with a man first (8.2% reported same age at first sex with a man and with a woman) and one in ten reported that their first sexual intercourse with a man was forced. The median reported number of lifetime partners was six male partners

[interquartile range (IQR), 3–20] and four female partners (IQR, 2–9). A substantial proportion (30.0%) reported ever having been physically forced to have sex and 21 said this was by a policeman. In the 12 months preceding the interview, 22 and 120 men reported no sex with a male and a female partner, respectively. The median (mean) numbers of sexual partners in this period were 3 (5.7) and 1 (2.2) for male and female partners, respectively.

As far as sexual practices in the past 12 months are concerned (Table 1), insertive anal sex with men was the practice most frequently reported, by 43.0% of respondents, followed by receptive anal sex with men (34.3%) and vaginal sex (32.8%). Oral sex was also reported by one-quarter of the sample, either insertive or receptive. Finally, 22.5% of the participants said they had received money for sex with a man. For each sexual practice in the past month participants were asked if they used a condom always, often, sometimes or never. Inconsistent condom use (i.e. often, sometimes or never) ranged from 53.9 to 94.1% and was maximal for oral sex. We can deduce from these figures that, in the month preceding the interview, about 24% of respondents had at least one unprotected insertive anal intercourse with a male partner, 20% had at least one unprotected receptive anal intercourse with a male partner, and 18% had at least one unprotected intercourse with a female partner. In addition, almost one man out of four reported sex with both men and women in the same 1 month period, and among this group 44% did not use condoms consistently either with men or with women. Use of lubricating gel during anal intercourse was rarely reported: only 21.9% said they used gel always or often.

Table 2 shows the prevalence of HIV infection and STIs. Overall HIV prevalence was 21.5% with a predominance of HIV-1 infections. Serological evidence of past HSV-2 infection was also frequent (22.3%) and was strongly correlated with HIV infections [crude odds ratio (OR), 4.76; 95% confidence interval (CI), 2.89–7.83; OR adjusted on age, survey site, occupation, travel in another African country and alcohol consumption was 3.83; 95% CI, 2.26–6.43]. Of the 463 participants who underwent genital examination, 4.8% had at least one sign of STIs and were treated accordingly. Of the 442 participants who provided a urine sample, 4.1 and 5.4% were found to have signs of current chlamydial and gonorrheal infections, respectively. Finally, of the participants who answered questions on the history of STIs and reported symptoms

Table 2. Prevalence of HIV infection and sexually transmitted infections (STIs) among 442 men who have sex with men in Senegal.

	Proportion in % (*n/N*)	Exact 95% CI
HIV infection serology		
HIV-1	18.1 (80/442)	14.6–22.0
HIV-2	0.5 (2/442)	0.055–1.6
Dual infection	2.9 (13/442)	1.4–4.5
All	21.5 (95/442)	17.8–25.6
HSV-2 infection serology	22.3 (98/440)	18.5–26.4
Active syphilis (TPHA and RPR positive)	4.8 (21/442)	3.0–7.2
Chlamydia infection		
Detection in urine by PCR	4.1 (18/442)	2.4–6.4
Gonorrhea infection		
Detection in urine by PCR	5.4 (24/442)	3.5–8.0
Clinical signs found on genital examination		
Penile ulceration	0.9 (4/463)	0.2–2.2
Penile discharge	2.6 (12/463)	1.3–4.5
Anal ulceration	0.4 (2/463)	0.05–1.6
Anal discharge	0.2 (1/463)	0.005–1.2
Anal condyloma	2.8 (13/463)	1.5–4.8
Hemorrhoids	8.2 (38/463)	5.9–11.1
Candidiasis	0.9 (4/463)	0.2–2.2
At least one sign of STI[a]	4.8 (22/463)	3.0–7.1
Self-reported history of STI symptoms in the last 12 months		
Genital discharge	24.6 (113/459)	20.7–28.8
Proportion not treated	15.8 (18/113)	9.7–22.7
Pain urinating	20.5 (94/459)	16.9–24.517
Proportion not treated	18.1 (17/94)	10.9–27.4
Itching	8.9 (41/459)	6.5–11.9
Proportion not treated	26.8 (11/ 41)	14.2–42.9
Genital and/or anal ulcerations	3.7 (17/459)	2.2–5.9
Proportion not treated	29.4 (5/17)	10.3–56.0
Testicular pain	5.7 (26/459)	3.7–8.2
Proportion not treated	38.5 (10/26)	20.2–59.4
At least one symptom	34.9 (160/459)	30.5–39.4
Already had an HIV test performed	10.8 (50/463)	8.1–14.0

[a]Hemorrhoids were not considered to be due to an STI. CI, confidence interval; HSV, herpes simplex virus; RPR, rapid plasma regain; TPHA, *Treponema pallidum* hemagglutination assay; PCR, polymerase chain reaction.

in the past 12 months, 35.1% reported at least one STI symptom, the most common being genital discharge (24.6%) and pain while urinating (20.5%). There was an association between history of symptoms during the past

12 months and HIV infection (crude OR, 1.63; 95% CI, 1.03–2.60), which was not significant when adjusted on age, survey site, occupation, travel in another African country and alcohol consumption (adjusted OR, 1.47;

Table 3. Risk factors for HIV infection among 442 men who have sex with men (MSM) in Senegal.

	Proportion with HIV (N)	P value bivariate[a]	aOR[b]	95% CI
Age groups		$< 10^{-3}$		
18–20 years	8.5 (130)		1	
21–24 years	23.8 (105)		3.38	**1.47–7.78**
25–28 years	25.0 (112)		3.60	**1.57–8.25**
29–52 years	32.6 (95)		5.24	**2.22–12.3**
Survey site		0.008		
Other sites	14.7 (163)		1	
Dakar	25.4 (279)		1.92	**1.07–3.43**
Occupation		0.004		
Other	20.0 (414)		1	
Waiter or bartender	42.9 (28)		3.33	**1.41–7.84**
Ever had sex with a woman		0.038		
Yes	20.2 (401)		1	
No	34.1 (41)		2.11	0.94–4.73
First sex		0.12		
With a man	26.3 (152)			
With a women	19.0 (290)			
Age of first male partner		0.026		
Same age or younger	16.1 (112)			
Older but difference < 12	21.3 (235)			
Older and difference > 11	29.0 (93)			
First sex with a man forced		0.001		
No	19.1 (398)		1	
Yes	43.2 (44)		2.09	0.95–4.60
First sex with a man paid		0.10		
No	19.9 (362)		1	
Yes	28.2 (78)		1.59	0.83–3.04
Lifetime male partners		$<10^{-3}$		
1–2	8.1 (99)		1	
3–9	16.7 (162)		1.65	0.68–4.03
10–150	35.1 (181)		3.76	**1.61–8.79**
Ever physically forced to have sex with a man		0.001		
No	17.3 (307)		1	
Yes	31.1 (135)		1.60	0.91–2.82
Number of partners of the last 12 months		$< 10^{-3}$		
0	9.5 (21)			
1–2	12.3 (162)			
3–5	22.0 (109)			
More than 5	32.7 (150)			
Age of partners		0.021		
Generally less than 25	13.9 (115)			
Generally 25 or over	24.2 (327)			
Receptive anal sex in the past month		0.03		
No	18.0 (295)			
Yes with consistent condom use	27.0 (63)			
Yes with inconsistent condom use	29.8 (84)			
Received money for sex in the last 12 months		0.07		
No	20.3 (345)			
Yes with consistent condom use	17.6 (34)			
Yes with inconsistent condom use	32.2 (59)			
Traveled in another African country (last 12 months)		0.11		
No	19.8 (339)			
Yes	27.2 (103)			
Member of an MSM NGO.		$< 10^{-3}$		
No	19.0 (394)		1	
Yes	42.6 (47)		2.01	0.97–4.14
Alcohol consumption during last week		0.13		
Never	20.1 (363)			
Once or more	27.8 (79)			

[a]Chi-square test when dichotomic or trend test when ordinal.
[b]Adjusted odds ratios (aOR). Multivariate logistic regression analysis was performed on 428 subjects as subjects with missing values were excluded. Bold indicates a statistically significant result. CI, confidence interval; NGO, non-governmental organization.

95% CI, 0.77−2.39). The proportions of participants who reported not having been diagnosed or treated depended on the symptoms, and ranged from 15.8% for genital discharge to 38.5% for testicular pain. A very small number of participants (10.8%) reported having already been tested for HIV infection before the survey. However, most of the participants (93.2%) came back to collect their results. Consequently, among the 95 HIV-infected participants, 75 could be referred for potential inclusion in a treatment protocol according to national guidelines and received preventive treatment for opportunist infections and counseling. Two participants had already been treated for AIDS before the survey and a further 10 were included in a treatment protocol after the survey.

We considered the variation in HIV prevalence within the study period at the Dakar site to assess the impact of a potential selection bias on our estimate. In April, May−June and July−September, 127, 69 and 83 men, respectively, were recruited in Dakar and agreed to provide blood samples. The prevalence in these three groups was 30.7, 31.9 and 12.0%, respectively, suggesting that we may have over-estimated the prevalence of HIV in the population of MSM in Dakar.

Risk factor multivariate analysis (Table 3) showed that HIV prevalence increased with age, in particular among those over 28 years of age; was higher in Dakar, among those working as waiters or bartenders; and among those with more than nine lifetime male partners. Although not statistically significant when adjusted, the prevalence of HIV infection was higher among those who had no sex with a woman, those who reported forced sex, and members of an MSM non governmental organization.

Discussion

We present results from the first study to provide epidemiological data on vulnerability to HIV and STIs in MSM in a sub-Saharan African country. The prevalence of HIV was high (21.5%) and risk behaviors were not uncommon: unprotected sex in the past month was reported by 24% (receptive anal), 20% (insertive anal) and 18% (vaginal) of respondents. The risk of HIV infection was higher in Dakar, among waiters and bartenders and increased with age and the number of lifetime male partners.

The high prevalence of HIV as measured in our study was striking when one considers the low prevalence in the general Senegalese population as measured by the sentinel surveillance system (1−2%) [13]. Published studies conducted among MSM in developing countries report rates of HIV infection from 3 to 15% [14−16].

Rates of inconsistent condom use differed according to the sexual practice (from more than half of respondents for anal sex to more than 80% for oral sex). Condoms are available in Senegal although there is no lubricating gel either on sale or delivered by any organization (expected during this study). Accordingly, the use of lubricating gel was very rarely reported. This is a matter of concern as anal sex is a not uncommon practice in this population.

Most survey participants (94.1%) also reported sexual activity with women showing that the MSM population could potentially serve as a sexual bridge between high-risk men and low-risk women, and that this sexual mixing pattern might contribute to the sexual transmission of HIV-1 to heterosexually active adults. The proportion of bisexual men among MSM varies greatly from one population to another but seemed in Senegal to be among the highest ever reported. One-third of MSM in the United Stated reported sex with women [17], 23% in the past year in Fortaleza, Brazil [18], 28% in the last 6 months in Beijing, China [19], 31% in Ho Chi Minh City, Vietnam [20], 61.2% in Phnom Penh, Cambodia [16], 47.1% in Lima, Peru [21] and 79% in St. Petersburg, Russia [22].

The validity of self-reports is always questionable and was a greater concern in the present study in view of the social context of homosexuality in Senegal. Only 57 participants (12.3%) said that at least one family member was aware of their sexual orientation. We suspect from qualitative discussion with participants that risky behavior was under-reported, in particular money issues in negotiating sex with men. However, only 50 participants (10.8%) reported having been tested for HIV at least once. This suggests that for most respondents, even if probably under-reported, sexual behaviors could not have been differentially reported according to the knowledge of their HIV serological status. The consecutive bias in risk factors analysis is therefore likely to be modest if any.

Our estimate of HIV prevalence might have been affected by the selection bias due to convenience sampling. In the Dakar site, this was confirmed by the variation in HIV prevalence over the study period, from 30.7% at the beginning of the study to 12.0% at the end. Therefore, 30.7% can be considered as a higher bound of the estimate of HIV prevalence among MSM in Dakar. It is likely that those who were more open about their sexual orientation, more active in networks of MSM and with high-risk behaviors participated first. As we estimate the size of the population of MSM in Dakar to be moderate (38.4% of the 297 participants from Dakar said they already participated in the study conducted 4 years earlier by Niang *et al.* that included 250 MSM in Dakar), 12.0% can be considered as a lower bound of the estimate of HIV prevalence.

Being more than 28 years old, reporting 10 or more lifetime partners, working as a waiter or a bartender and

living in Dakar were the demographic and behavioral characteristics most strongly associated with HIV infection. The effect of lifetime number of partners was independent of age and remained in the model even when adjusting for age as a continuous variable (not shown). The high infection rates of waiters and bartenders suggested that they were the core of a sexual network with high-risk partners. This finding argues for specific preventive actions targeting this occupational category.

A very high proportion of participants (93.2%) came back for their laboratory test results. This can be explained by the fact that the study setting was also known by many MSM to be the only place where they can be diagnosed and treated for STIs without the fear of stigmatization.

As in countries with relatively low HIV prevalence, such as Senegal, the epidemic is most likely fostered by small core groups, it is very cost-effective to implement interventions among those groups with high-risk behaviors and high HIV prevalence. So far, the only high-risk sub-group identified in Senegal was sex workers for whom an STI screening and treatment system has been running since 1969 [23,24]. Our results strongly argue in favor of adding MSM to the list of core groups that need special preventive efforts and care. Several programs have been designed and their implementations are currently on-going. They have two complementary operational objectives: to promote sexual health in the MSM community and to create the environment for a user-friendly access to psychosocial and heath services. The discrimination of this population and its high vulnerability to STIs make this challenge difficult as well as a priority.

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