Increase in condom use and decline in HIV and sexually transmitted diseases among female sex workers in Abidjan, Côte d'Ivoire, 1991–1998

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Objective: To assess clinic- and community-based trends in demographic and behavioral characteristics and clinic-based trends in HIV infection and other sexually transmitted diseases (STD) in female sex workers in Abidjan, Côte d'Ivoire.

Design: Multiyear cross-sectional study of first-time attenders in Clinique de Confiance, a confidential STD clinic; biannual community-based behavioral surveys.

Methods: From 1992 to 1998, female sex workers were invited to attend Clinique de Confiance, where they were counseled, interviewed, clinically examined during their first visit and tested for STD and HIV infection. Community-based surveys, conducted in 1991, 1993, 1995, and 1997, interviewed women regarding socio-demographic characteristics and HIV/STD-related knowledge, attitudes and behavior.

Results: Among female sex workers in Abidjan, there was a trend toward shorter duration of sex work, higher prices, and more condom use. Among sex workers attending Clinique de Confiance for the first time, significant declines were found in the prevalence of HIV infection (from 89 to 32%), gonorrhoea (from 33 to 11%), genital ulcers (from 21 to 4%), and syphilis (from 21 to 2%). In a logistic regression model that controlled for socio-demographic and behavioral changes, the year of screening remained significantly associated with HIV infection.

Conclusion: The increase in condom use and the decline in prevalence of HIV infection and other STD may well have resulted from the prevention campaign for female sex workers, and such campaigns should therefore be continued, strengthened, and expanded.

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Keywords: sexually transmitted diseases, female sex workers, Africa, prevention, condom use, behavioral surveillance

Introduction

Côte d'Ivoire, along with several other African countries, experienced an explosive AIDS epidemic in the late 1980s [1–3], and by 1989 AIDS had become the leading cause of death in adult males [4]. Female sex workers and their clients appear to have played a central role in this epidemic, as sexual contact with

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female sex workers was common among men in Abidjan and was an important risk factor for HIV infection in male blood donors [5], sexually transmitted diseases (STD) clinic patients [6], and tuberculosis patients [7].

To educate the general public concerning AIDS and its prevention, the Côte d'Ivoire Ministry of Health initiated a general information campaign in 1987, using media such as television, radio, newspapers, and billboards. In 1991 a condom social marketing program was started [8]. As of 1991 a prevention campaign directed to female sex workers was conducted by the 'Programme de Prévention et de Prise en charge des MST/SIDA chez les femmes libres et leurs Partenaires' (PPP). The PPP was initiated in 1991 in three districts of Abidjan by social scientists of the Institut National de Santé Publique, within the Programme National de Lutte contre le SIDA, les MST, et la Tuberculose. The PPP project's activities gradually expanded and by 1994 covered all ten districts of Abidjan. Since October 1992 a confidential STD/HIV clinic for female sex workers and their stable partners (Clinique de Confiance) has offered group health education, diagnosis and treatment for STD, HIV counseling and testing, and condom distribution without charge. Since July 1997, the female condom and a lubricating gel for use with male condoms were also made available. Clinique de Confiance is operated by Projet RETRO-CI, a collaborative HIV/AIDS research project of the Centers for Disease Control and Prevention and the Côte d'Ivoire Ministry of Health, and the Institute of Tropical Medicine, Antwerp, Belgium.

To describe changes in the population of female sex workers in Abidjan and to evaluate the impact of the HIV prevention campaign, we examined community- and clinic-based trends in the socio-demographic and behavioral characteristics of female sex workers in Abidjan, and clinic-based trends in the prevalence of HIV infection and other STD among first-time attenders to Clinique de Confiance.

Methods

Community-based health education

Education activities included peer education and group health education sessions. Peer education was conducted by current and former sex workers trained in communication techniques and in STD and HIV transmission and prevention. The peer educators used a picture album as a tool for the education on HIV/AIDS/STD. In addition, they demonstrated condom use on a wooden penis model, and distributed condoms. The group health education sessions were conducted in bars, hotels, and other sex-work sites. These group sessions were conducted by the staff of the PPP including health educators and social workers using slides, video films and drawings. During both the peer education activities and the group health education sessions, attendees were informed about the STD/HIV services that Clinique de Confiance offers to female sex workers.

Procedures at Clinique de Confiance

Sex workers were contacted at their places of work through the network of peer educators and invited to come to Clinique de Confiance for a physical examination including a STD assessment as well as HIV counseling and testing. After receiving counseling and giving informed consent, sex workers who attended Clinique de Confiance for the first time completed a standard questionnaire on socio-demographics and sexual behavior, administered by a female nurse. The duration of sex work included time in sex work at other locations than their present location, although most women had only done sex work in Abidjan. The number of sexual contacts was recorded for the most recent working day, since most women were unable to recall this information accurately for longer periods. The price charged for intercourse with the most recent client was recorded in francs CFA (500 FCFA = US $1 for most of the study period). The clinic doubled in size between 1992 and 1998 to accommodate the growing numbers of clinic attenders.

A general physical as well as a gynecological examination of women attending the clinic for the first time was then performed by a physician. A clinical diagnosis of genital ulcers was made if interruption of the genital epithelium was present. Secretions from the posterior vaginal fornix and the endocervix were collected by swab. Venous blood samples for HIV and syphilis serology were obtained from consenting participants. All women were invited to return after 1 week for post-test counseling and additional treatment, if indicated. They could return on a regular basis if they were subsequently enrolled in an intervention study or whenever they experienced STD-related symptoms.

Laboratory methods

A wet mount preparation of vaginal secretions was examined for the presence of *Trichomonas vaginalis*. Endocervical secretions were tested for *Chlamydia trachomatis* using enzyme immunoassay (EIA Microtrak; Syva Co, Palo Alto, California, USA) and for *Neisseria gonorrhoeae* using culture. The sensitivity of the EIA used for *Chlamydia trachomatis* is lower than that of more recent DNA amplification techniques that were introduced at the clinic after 1998. HIV serologic testing was carried out according to previously published diagnostic algorithms that included screening by enzyme-linked immunosorbent assay (ELISA) and confirmatory testing by either synthetic-peptide based tests,

Western blot, or a combination of monospecific ELISAs [9,10]. Specific antitreponemal antibodies were detected by *Treponema pallidum* haemagglutination assay (TPHA; Fujirebio, Tokyo, Japan), and a rapid plasma reagin (RPR) test was also performed (Macro-Vue, Becton-Dickinson, Cokeysville, Maryland, USA). A woman was considered to have syphilis when both RPR and TPHA tests were positive.

Treatment for all diagnosed STD was dispensed free of charge together with a supply of condoms on the day of the examination. Results of laboratory tests, post-test counseling for HIV/AIDS, and additional treatment, if indicated, were given during a second visit 1 week later.

Community-based surveys

Community-based surveys were conducted in 1991 (three districts), 1993 (six districts), 1995 (nine districts), and 1997 (all 10 districts). Sex work sites were selected by random cluster sampling proportional to the estimated number of female sex workers working at the site. At the sites a systematic sample of sex workers was selected. The sampling fraction ranged between 10 and 20% in the different surveys. Peer educators were involved in all surveys to facilitate the interactions with the gate keepers of the sex work sites, and with the sex workers. Refusal rates were below 10%, for example, in the 1997 survey, out of a total of 540 women who were invited to participate, 30 refused to participate, and another 10 did not complete the interview. Anonymous interviews were conducted with consenting female sex workers at the sex work sites. Questions were asked about socio-demographics, STD/HIV-related knowledge and attitudes, sexual behavior, condom use, and previous visits to Clinique de Confiance.

Statistical methods

Data were analysed by Statistical Analysis Software (SAS Institute, Cary, North Carolina, USA). Frequencies and median were calculated for categorical and continuous variables respectively by year. In the 1991 community-based survey, the proportion of women who used a condom with their most recent client was estimated from the number of clients who used a condom among a woman's most recent five clients. To test for trends over time of categorical variables, the chi-square test for linear trend was used, considering the year of screening as an ordered categorical variable. To test for trends over time of continuous variables, linear regression was used considering the year of screening as the explanatory continuous variable. To test for an independent linear trend of overall HIV seroprevalence with year of screening, logistic regression was performed using a model including the year of screening and all other factors that were associated with the year of screening in the univariate analysis. Significance ($P < 0.05$) was based on Wald's test. Interaction between year of screening and the other variables was examined by comparing the model that included the interaction term with the model without the interaction term. The final model included the year of screening, all other factors that were associated with the year of screening in the univariate analysis, and terms for the interaction of the year of screening with these other variables for which there was significant interaction.

The study was approved by the Ethical Committee of the Côte d'Ivoire Ministry of Health; the Ethical Committee of the Institute for Tropical Medicine, Antwerp, Belgium; and the Institutional Review Board of the Centers for Disease Control and Prevention, Atlanta, Georgia, USA.

Results

Trends in socio-economic and behavioral characteristics

Between October 1992 and December 1998, 5218 female sex workers attended Clinique de Confiance for the first time. In 1992, 356 women were seen, and between 1993 and 1998 the number of women who attended the clinic for the first time ranged from 607 in 1994 to 916 in 1996. There were major shifts in the country of origin of the sex workers, with the proportion of Ivorian women increasing from 9% in 1992 to 45% in 1997 and of Nigerian women from 2% in 1992 to 56% in 1998 (Table 1). The proportion of Ghanaian women decreased from 82% in 1992 to 9% in 1998, and the proportion of Liberian women increased from 0% in 1992 to a peak of 15% in 1995 before declining to 2% in 1998. There were also significant changes in socio-demographic characteristics of first time attenders. In later years, they tended to be younger (median age 30 in 1992 compared with 23 in 1998), to have received formal schooling (51% with any schooling in 1992 compared with 83% in 1998), to be in sex work for a shorter period (3 years in 1992 compared with 7 months in 1998), to charge more for sexual intercourse (500 FCFA in 1992 compared with 1000 FCFA in 1998), and to have slightly more clients during their most recent working day. In 1992, 20% of female sex workers reported consistent use of condoms during their most recent working day; by 1998 this proportion had increased to 78%.

In the community-based surveys 329, 602, 850, and 500 female sex workers participated in 1991, 1993, 1995, and 1997 respectively. A major shift occurred in the women's country of origin. The proportion of Ghanaian women decreased from 64% in 1991 to 39% in 1997 ($P < 0.001$), whereas the proportion of Ivorian women increased from 25 to 38% ($P < 0.001$), and the

Table 1. Socio-demographic and behavioral characteristics in female sex workers in Abidjan, 1991–1998.

	Year								
	1991	1992	1993	1994	1995	1996	1997	1998	P^a
Clinique de Confiance									
Number of participants	NA	356	778	607	832	916	876	853	
Age (median)		30	29	28	26	26	25	23	< 0.001
Country of origin (%)									
Ivorian		9	13	42	45	42	45	29	< 0.001
Ghanaian		82	66	42	29	31	20	9	< 0.001
Liberian		0	2	1	15	10	4	2	< 0.001
Nigerian		2	6	3	6	10	24	56	< 0.001
Formal schooling (%)		51	54	56	60	60	67	83	< 0.001
Reported consistent condom use[b] (%)		20	23	35	40	44	59	78	< 0.001
Duration of sex work in years (median)		3	3	3	2	2	1.5	0.6	< 0.001
Price for intercourse paid by most recent client (median; in FCFA)		500	1000	1000	1500	1500	1500	1000	< 0.001
Number of clients (median) during most recent working day		3	4	2	2	3	3	3	0.001
Community-based surveys									
Number of participants	329	NA	602	NA	850	NA	500	NA	
Age (median)	26		28		25		26		0.2
Country of origin (%)									
Ivorian	25		28		45		38		< 0.001
Ghanaian	64		59		42		39		< 0.001
Liberian	NC		6		2		3		0.004
Nigerian	NC		NC		NC		14		–
Formal schooling (%)	53		49		48		56		0.2
Reported condom use with last client (%)	63		78		76		91		< 0.001
Sex work duration in years									
Median	2		3		3		2		0.03
Interquartile range	1–4		2–5		1–5		0.7–4		
Price for intercourse paid by most recent client (median)	500		500		1000		NC		0.002
Attended Clinique de Confiance (%)	NA		9		21		37		< 0.001

[a]Chi-square test for linear trend for categorical variables; linear regression for continuous variables. NA, not applicable, as Clinique de Confiance opened only in 1992, or as no survey was conducted in that year. [b]Reported condom use with all clients during the most recent working day. NC, not collected.

proportion of Nigerian women was 14% in 1997 (Table 1). Female sex workers charged more for intercourse in 1995 than in earlier years, and women in recent surveys had been in sex work for a shorter period than women in earlier surveys ($P < 0.05$). There were no significant trends over time in age or in the proportion of women who had received formal schooling. Reported condom use with the most recent client increased from 63% in 1991 to 91% in 1997 ($P < 0.001$). The proportion of women who had visited Clinique de Confiance increased from 9% in 1993 to 37% in 1997 ($P < 0.001$). More women who had attended Clinique de Confiance reported having used a condom with their most recent client than did women who had not attended the clinic (91 versus 77% in 1993, 87 versus 72% in 1995, and 95 versus 89% in 1997; all $P < 0.05$).

Trends in the prevalence rates of STD

Between 1992 and 1998 there were significant declines in the prevalence rates of gonorrhoea (from 33 to 11%), genital ulcers (from 21 to 4%), syphilis (from 21 to 2%), trichomoniasis (from 26 to 11%) (all $P \leqslant 0.001$) (Fig. 1). The prevalence of chlamydial infection increased from 5 to 7% ($P = 0.01$).

Trends in the prevalence rate of HIV infection

The overall prevalence of HIV infection declined from 89% in 1992 to 32% in 1998 (Fig. 2) ($P < 0.001$). Between 1992 and 1998 there was a decline in the prevalence of HIV-1 infection (from 49 to 29%), of dual seroreactivity (from 38 to 3%), and of HIV-2 infection (from 3 to 1%) (all $P < 0.001$)

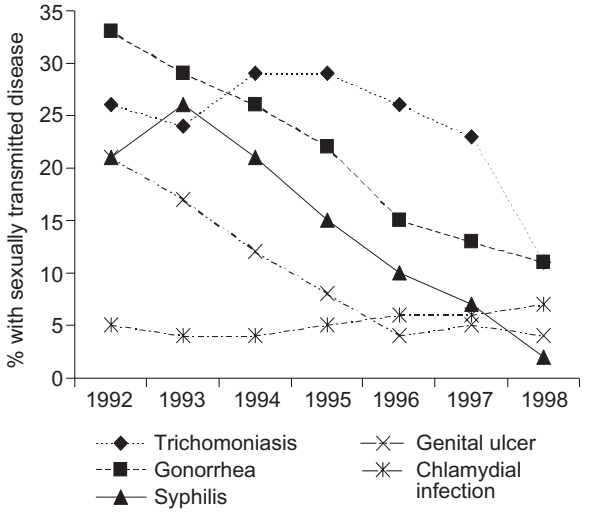

Fig. 1. Annual prevalence rates of trichomoniasis, gonorrhea, syphilis, genital ulcers, and chlamydial infection among female sex workers first time attenders at Clinique de Confiance, Abidjan, 1992–1998.

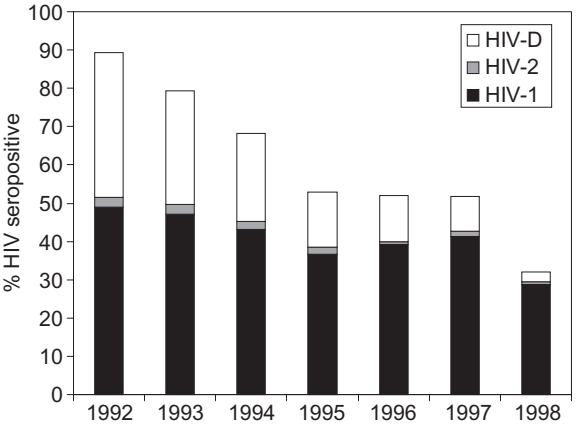

Fig. 2. Overall and type-specific annual prevalence rate of HIV infection among female sex workers first time attenders at Clinique de Confiance, Abidjan, 1992–1998. HIV-D, seroreactive to both HIV-1 and HIV-2.

When stratifying by duration of sex work, the decline in overall prevalence of HIV infection persisted ($P < 0.001$). Among women who had been in sex work for less than 1 year, prevalence of HIV infection was 86% in 1992 and 19% in 1998 (Fig. 3). The decline in overall prevalence of HIV infection also persisted when stratifying for country of origin, schooling, consistent condom use on the most recent working day, age, price paid by the most recent client, and number of clients on the most recent working day (all $P < 0.001$). In logistic regression modelling, there was significant interaction between the year of screening and duration of sex work, age, schooling, Nigerian and Ivorian nationality, and the number of clients on the last working day. In the final logistic regression model that included terms for these interactions, the year of screening remained significantly associated with HIV infection ($P = 0.0001$) (Table 2).

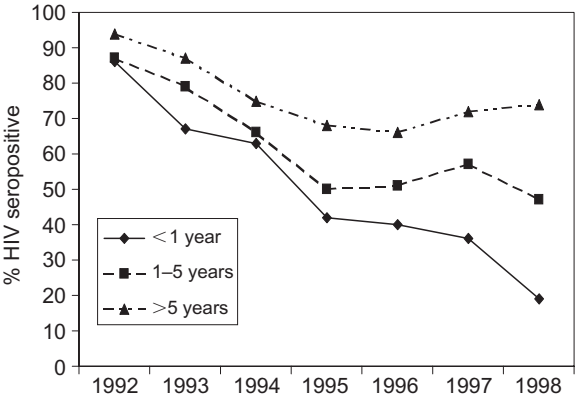

Fig. 3. Annual prevalence rate of HIV infection among female sex workers first time attenders at Clinique de Confiance, Abidjan, 1992–1998, by duration of sex work.

Table 2. Logistic regression analysis of factors associated with HIV infection among female sex worker first-time attenders at Clinique de Confiance, Abidjan, 1992–1998.

	Adjusted OR	95% CI	P^a
Year of screening	0.44	0.33–0.59	0.0001
Country of origin[b]			
Nigerian	1.03	0.47–2.23	0.9
Liberian	0.39	0.22–0.69	0.001
Ghanaian	3.69	2.28–5.97	0.0001
Other	2.53	1.49–4.28	0.0005
Schooling	1.04	0.69–1.56	0.8
Reported consistent condom use[c]	1.16	1.00–1.36	0.06
Age	1.07	1.00–1.14	0.04
Duration of sex work	1.16	1.08–1.25	0.0001
Price for intercourse	0.94	0.91–0.96	0.0001
Number of clients[d]	1.20	1.09–1.32	0.0003

[a]Logistic regression was performed using a model including the year of screening, all other factors that were associated in the univariate analysis, and interaction terms for year of screening by schooling, by Nigerian and Ivorian origin, by number of clients, by age, and by duration of sex work. The adjusted odds ratios for the numerical variables are expressed per calendar year, per year of age, per year duration of sex work, per 1000 FCFA price for intercourse, and per client on the most recent working day. [b]Women of other countries of origin are compared to Ivorian women. [c]Reported condom use with all clients during the most recent working day. [d]During the most recent working day. OR, odds ratio; CI, confidence interval

Among all HIV-seropositive women, the proportion who were dually seroreactive decreased significantly from 42% in 1992 to 8% in 1998 ($P < 0.001$). This decrease persisted when stratifying for country of origin, schooling, consistent condom use on the most recent working day, age, duration of sex work, price paid by the most recent client, and number of clients on the most recent working day (all $P < 0.001$).

Discussion

We observed a dramatic decline in the clinic-based prevalence of HIV infection and STD among female sex workers in Abidjan from 1992 to 1998. Although during the same period there were also dramatic shifts in the socio-demographic characteristics of the sex worker population, we believe that changes in sex workers' behavior have contributed to the observed decline in prevalence. Because the changes in country of origin, price charged for intercourse, duration of sex work, and, most importantly, condom use observed in the clinic are paralleled by similar changes observed in the community surveys, we believe that the changes observed in first-time clinic attenders largely represent a real shift in the Abidjan sex workers' community. Similar changes have been observed recently in Cotonou, Benin [11].

The lower prevalence of HIV infection and of other STD among Abidjan female sex workers and their higher level of condom use indicate that female sex workers are better able to protect themselves from sexually transmitted pathogens and that their clients are at lower risk of acquiring STD and HIV. In view of the large proportion of men having sex with female sex workers in Abidjan [5–7], these results may have considerable impact on the HIV epidemic in Abidjan.

For maximum effect, AIDS prevention activities need to be tailored to the recipient population. Our results indicate that the population of female sex workers is constantly changing. It is important to monitor these changes, because they call for an adaptation of the strategies and the content of prevention activities. For example, in the Abidjan sex worker population the distribution of country of origin changed from primarily Ghanaian women to a mix of Ivorian and Nigerian women. Whereas in 1991 most peer educators working with PPP and the Clinique de Confiance were Ghanaian women, in recent years Ivorian and Nigerian women have been recruited and trained.

The factors that determine which women enter into sex work in Abidjan are poorly understood and represent a complex mix of economic, psychological, and political factors [12]. Part of the shifts in country of origin may be due to HIV-related disease and death, which have mainly affected Ghanaian women, who constituted the majority of sex workers in Abidjan in the early 1990s. Younger women from the same communities may be less likely to replace these sex workers because of a heightened awareness of the health risks of sex work. The decrease in proportion of Ghanaian sex workers in Abidjan may in part be due to acts of violence towards the Ghanaian community in Abidjan following an international soccer game be-

tween a Ghanaian and an Ivorian team in 1993. For Ivorian women the decreased purchasing power due to the devaluation of the CFA currency in 1994 may have limited other employment opportunities. Liberian and Nigerian women may have entered sex work in Abidjan because of the serious civil strife and poor economical and political conditions in their countries respectively.

Several explanations could account for our most dramatic finding, the decline in HIV prevalence. It partly reflects the shorter duration of sex work among women tested more recently. However, when stratifying for duration of sex work the decline in HIV prevalence persisted in all strata, but most strongly among women who had been in sex work for less than 1 year. We believe that this decline in prevalence is also the result of a decline in the incidence of HIV infection due to an increase in condom use. Reported condom use increased significantly over the study period, as measured both at the clinic and in the community. Secondly, the multivariate analysis, even after taking into account the demographic and behavioral factors associated with HIV infection, including sex work duration, and interaction of these factors with the year of screening, showed the year of screening to remain significantly associated with HIV infection. This association indicates that the decline in HIV prevalence is independent of the changes in these other factors. Although logistic regression analysis of prevalence data is not as powerful as analysis of incidence data, logistic regression has been used elsewhere to analyse time trends of drug-resistant tuberculosis [13] and of HIV infection in STD patients [14] and injecting drug users [15,16]. Thirdly, there was a concurrent decline in the prevalence of most other STD. Since these are treat able, they represent more recent exposure, thereby supporting the hypothesis that the decline in the STD and in HIV infection is through increased condom use.

Although we did not ask sex workers about exposure to PPP's activities, we believe that the observed increase in condom use among sex workers attending the clinic is at least partly the result of PPP's education campaign for sex workers. The large-scale HIV counseling and testing for female sex workers and the condom promotion and distribution in Clinique de Confiance may also have contributed to an increased awareness and behavior change at the community level. This is also supported by the higher rates of condom use among women who have attended the clinic. The Ministry of Health's information campaign for the general public may also have influenced the behaviour of sex workers and their clients.

As in other countries in West Africa, both HIV-1 and HIV-2 are present in Côte d'Ivoire, and individuals can be seropositive to either virus or be dually seroreactive to both HIV-1 and HIV-2. Although the overall HIV prevalence decreased from 1992 to 1998, the most dramatic decline was observed in dual seroreactivity. It is unlikely that this decline is a laboratory artifact, since the diagnostic algorithm that was used remained unchanged between 1992 and 1997. Most dually sero reactive individuals are infected with both HIV-1 and HIV-2 [17]. The strong decline in the prevalence of dual seroreactivity to HIV-1 and HIV-2 over the study period is probably related to lower levels of sexual exposure to HIV-2 among sex workers who attended the clinic in recent years. The prevalence of HIV-2 may be lower in clients of female sex workers since there has been a decline in the prevalence of HIV-2 in several populations in Abidjan [18]. It may be a reflection of the shorter duration of sex work of women tested in recent years. Finally, the decline may be a result of lower levels of sexual exposure through increased condom use, since the decline in dual seroreactivity persisted even after controlling for duration of sex work and other risk factors [19].

The dramatic decline in prevalence of HIV infection and other STD, combined with important changes in socio-demographic characteristics and an increase in reported condom use among female sex workers in Abidjan in recent years, stress the need for continued intervention in this high risk population, and may influence the course of the HIV epidemic in Abidjan. The observed increase in condom use and the decline in prevalence of HIV infection and other STD supports the expansion of large-scale community-based and clinic-based HIV prevention activities for female sex workers.

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References

1. Denis F, Barin F, Gershy-Damet G, *et al*. **Prevalence of human T-lymphotropic retroviruses type III (HIV) and type IV in Ivory Coast.** *Lancet* 1987, **i**:408–411.
2. De Cock KM, Porter A, Odehouri K, *et al*. **Rapid emergence of AIDS in Abidjan, Ivory Coast.** *Lancet* 1989, **ii**:408–411.
3. Djomand G, Greenberg AE, Sassan-Morokro M, *et al*. **The epidemic of HIV/AIDS in Abidjan, Côte d'Ivoire: a review of data collected by Projet RETRO-CI from 1987 to 1993.** *J Acquir Immune Defic Syndr Hum Retrovirol* 1995, **10**:358–365.
4. De Cock KM, Barrere B, Diaby L, *et al*. **AIDS - The leading cause of adult death in the West-African City of Abidjan, Ivory Coast.** *Science* 1990, **249**:793–796.
5. Schutz R, Savarit D, Kadjo J-C, *et al*. **Excluding blood donors at high risk of HIV infection in a west African city.** *BMJ* 1993, **307**:1517–1519.
6. Diallo MO, Ackah A, Lafontaine M-F, *et al*. **HIV-1 and HIV-2 infections in men attending sexually transmitted disease clinics in Abidjan, Côte d'Ivoire.** *AIDS* 1992, **6**:581–585.
7. Sassan-Morokro M, Greenberg AE, Coulibaly I-M, *et al*. **High rates of sexual contact with female sex workers, sexually transmitted diseases, and condom neglect among HIV-infected and uninfected men with tuberculosis in Abidjan, Côte d'Ivoire.** *J Acquir Immune Defic Syndr Hum Retrovirol* 1995, **11**:183–187.
8. Drosin J. **Le marketing social des condoms comme stratégie de lutte contre le SIDA en Côte d'Ivoire.** *VII International Conference on AIDS in Africa*, Yaoundé, December 1993 [abstract WP166].
9. De Cock KM, Porter A, Kouadio J, *et al*. **Rapid and specific diagnosis of HIV-1 and HIV-2 infections: an evaluation of testing strategies.** *AIDS* 1990, **4**:875–878.
10. Nkengasong JN, Maurice C, Koblavi S, *et al*. **Field evaluation of a combination of monospecific enzyme-linked immunosorbent assays for the type-specific diagnosis of human immunodeficiency virus type 1 (HIV-1) and HIV-2 infections in HIV-seropositive persons in Abidjan, Ivory Coast.** *J Clin Microbiol* 1998, 36:123–127.
11. Alary M, Mukenge-Tshibaka L, Anagonou S, *et al*. **Impact of condom promotion and STD control on HIV and STD prevalence in female prostitutes in Cotonou, Benin: observations from the field in the context of a changing prostitution milieu.** *XIII International Conference on AIDS*, Durban, South Africa, July, 2000 [abstract WePpC1315].
12. Konan Y, Mah-bi G, Traoré M, *et al*. **Female sex workers in Abidjan, Côte d'Ivoire: determinants of entering sex work and perspectives for leaving.** *XII International Conference on AIDS*, Geneva, Switzerland, June–July 1998 [abstract 14198].
13. Moore M, Onorato IM, McCray E, Castro KG. **Trends in drug-resistant tuberculosis in the United States, 1993–1996.** *JAMA* 1997, **278**:833–837.
14. Weinstock HS, Sidhu J, Gwinn M, Karon J, Petersen LR. **Trends in HIV seroprevalence among persons attending sexually transmitted disease clinics in the United States, 1988–1992.** *J Acquir Immun Defic Syndr Hum Retrovirol* 1995, **9**:514–522.
15. Prevots DM, Allen DM, Lehman JS, Green TA, Petersen LR, Gwinn M. **Trends in human immunodeficiency virus seroprevalence among injection drug users entering drug treatment centers, United States, 1988–1993.** *Am J Epidemiol* 1996, **143**:733–742.
16. Des Jarlais DC, Perlis T, Friedman SR, *et al*. **Declining seroprevalence in a very large HIV epidemic: injecting drug users in New York City, 1991 to 1996.** *Am J Public Health* 1998, **88**: 1801–1806.
17. Ishikawa K, Fransen K, Ariyoshi K, *et al*. **Improved detection of HIV-2 proviral DNA in dually seroreactive individuals by PCR.** *AIDS* 1998, **12**:1419–1425.
18. Greenberg AE, Coulibaly I-M, Kadio A, *et al*. **Trends in the HIV-1 and HIV-2 epidemics in Abidjan, Côte d'Ivoire: 11 years of HIV serosurveillance at Projet RETRO-CI.** *X International Conference on AIDS & STD in Africa*, Abidjan, Côte d'Ivoire, December 1997 [abstract B041].
19. Ghys PD, Diallo MO, Ettiègne-Traoré V, *et al*. **Dual seroreactivity to HIV-1 and HIV-2 in female sex workers in Abidjan, Côte d'Ivoire.** *AIDS* 1995, **9**:955–958.