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Decline in the prevalence of HIV and sexually transmitted infections among female sex workers in Benin over 15 years of targeted interventions

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Abstract

Background—An HIV preventive intervention targeting the sex work milieu and involving fully integrated components of structural interventions (SI), communication for behavioural change and care for sexually transmitted infections (STI), was implemented in Benin by a Canadian project from 1992 to 2006. It first covered Cotonou before being extended to other main cities from 2000. At the project end, the Beninese authorities took over the intervention, but SI were interrupted and

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Author contributions

LB was involved in the study design and participated in the data collection, managed the data and had the main responsibility for data analysis and drafted the manuscript. SD contributed significantly to data analysis and preparation of the manuscript. IM was in charge of data collection in 2008 and reviewed critically the content of the manuscript. CML, MCB and ACL were involved in the study design and contributed significantly to the preparation of the manuscript. CA, SA and DMZ were involved in the study design and reviewed critically the content of the manuscript. MA was responsible for the overall study design, guided the data analysis and contributed significantly to the preparation of the manuscript. All authors approved the final version of the manuscript.

Competing Interests

No competing interests exist.

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other intervention components were implemented separately. We estimated time trends in HIV/STI prevalence among female sex workers (FSW) from 1993 to 2008 and assessed the impact of the change in intervention model on trends.

Methods—Six integrated biological and behavioural surveys were carried out among FSW. Time trend analysis controlled for potential socio-demographic confounders using log-binomial regression.

Results—In Cotonou, from 1993 to 2008, there was a significant decrease in HIV (53.3 to 30.4%), gonorrhea (43.2 to 6.4%) and chlamydia (9.4 to 2.8%) prevalence (all adjusted- $p=0.0001$). The decrease in HIV and gonorrhea prevalence was also significant in the other cities between 2002 and 2008. In 2002, gonorrhea prevalence was lower in Cotonou than elsewhere (prevalence ratio [PR]=0.53; 95% confidence interval [95%CI]: 0.32–0.88). From 2005 to 2008, there was an increase in gonorrhea prevalence (PR=1.76; 95%CI: 1.17–2.65) in all cities combined.

Conclusion—Our results suggest a significant impact of this targeted preventive intervention on HIV/STI prevalence among FSW. The recent increase in gonorrhea prevalence could be related to the lack of integration of the intervention components.

Introduction

In countries of sub-Saharan Africa with relatively concentrated HIV epidemics, like Benin, female sex workers (FSW) and their clients continue to play a major role in the spread of sexually transmitted infections (STI) and HIV at the population level.^{1–4} Indeed, a recent systematic review and meta-analysis showed that FSW in this region are approximately 12 times more likely to be infected with HIV than women of reproductive age in the general population, and that they are central in the HIV transmission dynamics.⁵ There is some evidence that prioritising these high-risk groups with specific preventive interventions reduces both the incidence and prevalence of HIV/STI not only in the groups prioritised by the interventions, but also in the general population at low-risk.^{3,6–11}

In 1992, “Projet SIDA-1/2/3”, a three-phase prevention project, was implemented among FSW of Cotonou, the largest city of Benin. The project was supported by the Canadian International Development Agency (CIDA) and had community, clinical and structural components.³ The community activities were provided by field workers and peer-educators and composed of communication for behavioural change (BCC), improved condom accessibility, promotion of correct condom use and empowerment activities (improving STI/HIV knowledge, strengthening negotiation skills for condom use, accompanying FSW into collective actions addressing issues related to stigma and in the development of micro-projects). The clinical component consisted in monthly check-ups and free STI treatment (based on syndromic approaches^{12,13}) at a FSW-dedicated clinic integrated into a primary health care centre. Because FSW suffered from different forms of violence and exploitation by the police, clients and other persons involved in the sex trade, a structural component consisting in a collaboration with the police and sex work sites’ owners/managers to reduce harassment and to secure the working environment and conditions of FSW was developed by the project. From 1992 to 2006 (end of “Projet SIDA-1/2/3”), the three components of the intervention were fully integrated. From year 2000, the project was extended to the clients of

FSW and to six other cities (Porto Novo, Abomey, Bohicon and Parakou in 2000–2001; Kandi and Malanville in 2004). Outreach activities prioritising clients (at sex work venues) were coupled with referral to STI clinics dedicated to men and offering confidential clinical services with free STI treatment.³ From 2005, at the FSW-dedicated clinic in Cotonou, anti-retroviral therapy (ART) was progressively introduced using the WHO recommendations in use at the time (CD4 < 200/mm³ or WHO clinical stage 3 with CD4 < 350/mm³ or WHO stage 4 regardless of CD4 cell count).¹⁴ In 2006, after the closing year of the project when multiple knowledge transfer activities were carried out, the responsibility of the program was transferred from CIDA to the national authorities of Benin. The clinical component of the intervention was then scaled up to the whole country, but there was a reduction in the intensity of the BCC activities that were also managed separately from the clinical component. Structural interventions and strategies prioritising clients of FSW were abandoned. The objectives of the present study were to estimate the time trends in HIV/STI prevalence and associated sexual behaviour among FSW in Benin from 1993 to 2008, and to assess whether or not the modification of the intervention that occurred after the Canadian project had any impact on the trends.

Methodology

Study sites, sampling, recruitment and data collection

Our study is based on data obtained from six integrated biological and behavioural surveys (IBBS). The first three rounds (1993, 1996 and 1999) took place only in Cotonou. The fourth round in 2002 included all the cities covered by the project at this time. The 2005 and 2008 surveys included all the covered cities under the responsibility of the national authorities of Benin after the end of the Canadian project.

A cluster sampling procedure based on the most recent mapping and enumeration of FSW was used during each round of IBBS. Sex work sites were sampled with a probability proportional to size. The sampled clusters were systematically visited and all the FSW aged 15 years or older were asked to participate in the study. Overall, the number of clusters selected and FSW recruited was 47 and 374 (1993), 47 and 350 (1996), 74 and 593 (1999), 97 and 474 (2002), 185 and 1482 (2005), and 135 and 1082 (2008).

After being pre-tested and adapted, structured questionnaires, elaborated by Family Health International (FHI) and validated by UNAIDS, were used to collect information on socio-demographic characteristics and sexual behaviour.¹⁵ In 1993, 1996 and 1999 cervical swabs were collected for *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) detection. The biological specimens were frozen at −20°C and transported to Quebec (Canada) where they were tested. The FSW were also asked to provide 10 ml of venous blood for HIV testing at the reference laboratory of the Benin National AIDS Control Programme (NACP-STI). For the last rounds (2002, 2005 and 2008), self-administered vaginal swabs for NG and CT testing and dried blood spot (DBS) samples for HIV testing were collected directly on-site and tested in Benin, except in 2002 where the vaginal swabs were tested in Quebec.

Laboratory procedures

During all surveys, NG and CT were tested using nucleic acid amplification tests (NAAT). The multiplex Amplicor CT/NG polymerase chain reactions (PCR, Roche Diagnostic Systems Inc., Branchburg, NJ, USA) was used from 1993 to 2005, whereas the ProbeTec strand displacement amplification assay (Becton Dickinson, Sparks, MD, USA) was used in 2008. The NAAT were carried out at the microbiology department of the CHA universitaire de Québec (Canada) from 1993 to 2002, and at the STI laboratory in Cotonou in 2005 and 2008. Quality control was carried out by Quebec specialists in both the 2005 and 2008 surveys. At each round, an enzyme immunoassay for the detection of HIV-1/HIV-2 antibodies (Vironostika HIV mixt; Organon Teknika, Boxtel, the Netherlands) followed by a confirmation test were used. The confirmation tests used were the Recombigen HIV-1/2 (Cambridge Biotech, Galway, Ireland) in 1993 and 1996, and the ICE HIV-1.0.2 (Murex Diagnostics SA, France) in 1999, whereas during the last three surveys (2002, 2005 and 2008), positive DBS samples were confirmed by Genie II HIV-1/HIV-2 (Sanofi Diagnostics Pasteur, Marne La Coquette, France). The quality control for HIV testing was carried out on all the positive samples and 2% of the negative ones.¹⁶ HIV testing was anonymous, but the result was linked to other laboratory results and interview data. Participants who wished to know their HIV serostatus were referred for pre- and post-test counselling and retesting (free of charge) at the nearest national testing centre.

Statistical analyses

Data were analysed with SAS 9.2 (SAS Institute, Inc., Cary, North Carolina, USA). The chi-square (proportions) and F (means) tests were used to assess temporal variations in socio-demographic and sexual behaviour characteristics. For univariate and multivariate analyses of trends in HIV/STI prevalence, the extension of the Mantel-Haenszel chi-square for linear trend analysis and log-binomial regression were used, respectively. Data from Cotonou and outside Cotonou (Porto Novo, Abomey, Bohicon and Parakou) were analysed separately. Using data from the 2002 IBBS, we compared HIV/STI prevalence and sexual behaviour in Cotonou to those outside Cotonou. Finally, we put together all the cities where the intervention was implemented and we compared sexual behaviour and HIV/STI prevalence between years 2005 and 2008.

Ethical Considerations

In each survey round, verbal informed consent was obtained separately for the interview and for the collection of biological specimens. Verbal consent was preferred to written consent to ensure full anonymity of the participants on all documents related to the study in the context of the stigma related to HIV and to the practice of sex work. The consent was documented on the consent forms by the signature of the interviewer. For all six surveys, an ethical approval was obtained from ad hoc ethics committees convened by the Ministry of Health of Benin.

Results

Temporal variations in demographic characteristics and sexual behaviour

The response rates for the interview and for HIV, NG and CT testing were high (85%) and similar in all rounds. In Cotonou, there was a significant variation in age and country of origin over time (Table 1.A). The proportion of FSW aged 15–24 years increased two-fold between 1993 and 2008. In 1993, most women were from Ghana (66.3%) or Togo (20.1%). In 2008, Nigeria (43.0%) and Benin (22.2%) were the main countries of origin. Outside Cotonou, we also observed an increase in the proportion of young FSW and a decrease in the proportion of women from Ghana. Ghanaian women were replaced over time by women from Togo and Benin (Table 1.B).

In time trend univariate analyses, the proportion of women who reported consistent condom use (CCU, condom use at all sex acts) with clients during the previous month increased in Cotonou from 29.7% in 1993 to 87.7% in 2008 ($p < 0.0001$), while outside Cotonou it remained stable (59.1% in 2002 and 59.7% in 2008, $p = 0.903$; figure 1.A).

Time trends in HIV, gonorrhea and chlamydia prevalence

In univariate time trend analyses (figure 1.B), there was a significant decline in HIV, gonorrhea and chlamydia prevalence in Cotonou from 1993 to 2008 (all $p < 0.0001$, Table 2.A). In the other cities, there was also a significant decline in HIV and gonorrhea prevalence between 2002 and 2008 (Table 2.B).

After controlling for age and country of origin using multivariate log-binomial regression, we still observed a significant decline in HIV and gonorrhea prevalence in both Cotonou and outside Cotonou (Table 2).

In 2002, HIV prevalence was lower in Cotonou than outside Cotonou. After adjusting for country of origin and age, this difference was no more significant while after adjustment, gonorrhea prevalence remained significantly lower in Cotonou (Table 3.A). The proportion of FSW who reported CCU with clients in the previous month and the mean number of clients were significantly higher in Cotonou (Table 3).

Between 2005 and 2008, in all the cities covered by the intervention, there was a significant increase in gonorrhea prevalence (from 3.4 to 6.2%, $p = 0.007$), and stability in chlamydia prevalence and in reported CCU with clients (Table 4). When excluding Cotonou from these analyses, reported CCU declined significantly (60.5% in 2005 versus 52.0% in 2008, $p = 0.0006$).

Discussion

Overall, we found a significant decline in HIV, gonorrhea and chlamydia prevalence among FSW in Cotonou from 1993 to 2008 and outside Cotonou from 2002 to 2008, but this decrease was strictly monotonic only between 1993 and 2005. From 2005 to 2008, we observed a significant increase in gonorrhea prevalence whereas the other prevalences remained stable. The observed declines were coincident with the implementation of an

integrated HIV preventive intervention targeting the sex work milieu that was implemented first in Cotonou (1992–2006) and thereafter progressively in other main cities from 2000 to 2006. Consistent with the declines in STI/HIV prevalence, a significant increase over time in the proportion of FSW who reported CCU with their clients was observed.

Several lines of evidence suggest that the observed reductions in sexual risk behaviour and STI/HIV prevalence may be mainly due to “Projet SIDA-1/2/3”. One of the main components of this project was BCC activities provided at sex work venues by field workers and peer-educators. Previous studies have shown that specific preventive interventions of this type, including interactive educational activities to promote behavioural change among FSW, can be effective in reducing both sexual risk taking and HIV/STI acquisition and transmission.^{6,11,17–20} The increase in reported CCU is supported by the rapid and significant decrease in the prevalence of curable STIs including gonorrhoea and chlamydia known to be related to recent sexual behaviour.²¹ Increase in condom use and decrease in gonorrhea prevalence are also in accordance with a decrease in HIV transmission and acquisition.

Several natural experiments imbedded in the present analysis also strengthen the evidence of a positive impact of “Projet SIDA-1/2/3” on safer sexual behaviour and HIV/STI prevalence. Indeed, we previously reported that from 1993 to 1999, HIV prevalence among FSW was decreasing in Cotonou while increasing (34% in 1993 to 51% in 1999) outside Cotonou (where the intervention project was not yet implemented).⁸ In 2002, at the beginning of the intervention outside Cotonou, the prevalence reached 59.5%. In the present study, the 2002 round of IBBS showed that HIV/STI prevalence was higher outside Cotonou (where the intervention had just been introduced) than in Cotonou where the intervention had been ongoing since 1993. Furthermore, coincident with the timing of the intervention, a subsequent decline in HIV/STI prevalence was observed outside Cotonou between 2002 and 2005. These observations are in accordance with a natural experiment in and outside Cotonou, with a mix of geographical and temporal control groups.^{22,23}

Finally, when we considered all the cities covered by the intervention together, we observed an upward trend in gonorrhoea prevalence after the end of “Projet SIDA-1/2/3”. This is consistent with a small but significant decline in the proportion of FSW who reported CCU with their clients outside Cotonou. Relapse in safer sexual behaviour at the end of the Canadian project could have been due to the decrease in the intensity of outreach activities, their separation from the clinical component of the intervention, and to the withdrawal of both the structural interventions and the strategies prioritizing clients of FSW. Maintaining and reinforcing interventions’ intensity is important to maintain positive behavioural changes.²⁴ The prevalence of gonorrhea declined during the Canadian project and returned to a higher level after its end. As seen in case-crossover natural experiments,²⁵ this is in favour of the plausibility of a causal relationship between the project and the decline in gonorrhea prevalence.

The complex multi-component interventions implemented by the Canadian project could be characterized as employing the principles of combination prevention,²⁶ which are considered nowadays as offering the best promise for success in the HIV prevention field.²⁷

Indeed, this project included three major components organised around central services tailored to the needs of the prioritised population, represented by the FSW-dedicated clinics. In addition, even though our study is not a randomized controlled trial, the context of natural experiments, referred to above, confers a level of plausibility for attributing the strong declines in HIV/STI prevalence to the Canadian project.²⁸ The use of plausibility designs for the evaluation of combination prevention is increasingly advocated, because of the recent recognition of the limitations of community-based randomized designs to evaluate complex large-scale combination public health programs.²⁹

During the intervention, we observed changes in some socio-demographic characteristics of the FSW. In both Cotonou and outside Cotonou, Ghanaian women were progressively replaced by women from Benin and from other countries (Nigeria, Togo). These results are comparable to those of a study carried out in Abidjan.³⁰ In most West African countries, HIV prevalence in FSW is over eight times higher than that of the general population.³ Although the fact that the changes in nationality over time could have led to a variation in HIV prevalence at entry in sex work, this is unlikely to have affected the trends, because HIV prevalence in the general population of all the FSW countries of origin was <4% (mostly 2%) during the study period,³¹ thus not contributing significantly to the overall prevalence among FSW, which is about 12-fold that of the general population in Benin.^{3,5} Consequently, since the HIV decline remained statistically significant after adjustment for age and country of origin, it is unlikely to have been due to changes in socio-demographic characteristics over time.

In Benin, HIV prevalence from sentinel surveillance among pregnant women attending antenatal clinics (ANC) increased from 0.4% in 1990 to 2% in 2001 and then remained stable till 2009, followed by a small decline to 1.7% in 2010.^{2,32} Data from comparable general population surveys are available for Cotonou in 1998 and 2008. During this period, the prevalence remained stable at about 3%, but there was a significant decline among men, especially in those aged <30 years. This decline could be related to the intervention prioritising FSW and their clients and to a very large increase in education level, whereas the relative increase observed in older age groups was related to ART scaling-up.³³ The mechanism for the intervention impact among young men appears to be related to the impact among clients of FSWs that was shown in a previous study.³⁴ There are potential limitations to our results, including sampling and representativeness issues; use of different specimen types and test kits in different survey rounds; and potential confounding. Since response rates were high and comparable, non responses probably could not have biased the observed trends. Non brothel-based FSW constitute a fluid population. So, to minimize the probability of selecting convenience instead of random samples, a mapping with enumeration of all FSW, including non-brothel based ones, was done very carefully before each round of IBBS.⁸ The information for weights estimation and clusters (not integrated in the data base) was not available for the first three rounds of IBBS. Furthermore, for the last three rounds, the observations were not correctly classified by cluster. Consequently, we could not carry out weighted regression taking into account the cluster effect, which could have induced a sampling bias and increased the probability of type I error. However, since the clusters were of small size and relatively numerous, and considering the diversity of the FSW and also the specificity of the questionnaires, we can assume that there was intra-cluster heterogeneity

and that the intra-cluster correlation coefficient would be low; the resulting design effect will then be close to one with limited effect on estimated variances.³⁵

The type of specimen used for HIV testing changed from serum up to 1999 to DBS afterwards. This is however unlikely to have affected the results since HIV testing on DBS is a simple procedure using similar testing kits than those used on serum and that its sensitivity and specificity have been shown to be equivalent to that on serum.^{36–39} In addition, the different kits used for HIV testing have similar reported performances and could thus not affect the observed trends in HIV prevalence.^{40,41} The NAAT for NG and CT diagnosis were performed on cervical swab specimens before 2002 and on vaginal swab specimens in 2002, 2005 and 2008. However, NAAT using both specimen types yield equivalent diagnostic performance.^{42,43} Various confirmatory assays for the Roche PCR tests have been used in most rounds, but none in 1996. For the trend analysis, we exclusively used the results of Amplicor tests to be sure that the variation over time would not be affected by the variation in the confirmatory assays. For example, NG prevalence according to Amplicor was 43.2% as used in our earlier analysis of time trends,⁸ compared to 37.0% when we used confirmatory assays in a clinical study on NG using the same data.¹³ The use of the BD ProbeTec in the 2008 study could possibly have biased the observed differences between 2005 and 2008. However, since Amplicor is generally less specific and more sensitive for both NG and CT than ProbeTec,^{44–47} although some studies found them as quite equivalent,^{42,48} the upward trend in NG from 2005 to 2008 could be more pronounced than observed, which would not affect our conclusions.

Because of changes in the socio-demographic characteristics of the FSW due to migration from neighbouring countries and to AIDS-related deaths, a possible effect of the natural transmission dynamics of HIV infection on the trends cannot be completely ruled out. However, even though there was no randomized control group in this study, the natural experiments reported here are suitable to demonstrate a plausible efficacy of a complex multi-component project like that implemented among FSW in Benin.²⁸

Finally, in the multivariate regression models, we adjusted only for age and country of origin because the other potential confounders were not comparable across all IBBS. Nonetheless, residual confounding is unlikely because in a previous study based on the first three rounds of IBBS, similar results were obtained when controlling for all potential confounders or only for age and country of origin.⁸ In addition, it would be inappropriate to control for variables that could be intermediate in the causal pathway⁴⁹ (for example: if preventive interventions, represented by time in our case, lead to increased condom use that then leads to reduction in gonorrhoea, it would not be appropriate to control for condom use when assessing the time trends in gonorrhoea prevalence).

Conclusion

Our results suggest a plausible significant impact on safer sexual behaviour and on HIV/STI prevalence of a preventive intervention prioritising FSW and their clients over 15 years in Benin. The increase in gonorrhea prevalence after the Canadian project could be related to the lack of integration of the intervention components, the absence of structural interventions

and the reduction in the intensity of the community component. To be effective on HIV and STI risk reduction, all components of preventive interventions prioritizing the most vulnerable populations, such as FSW, should be integrated. Such interventions should be scaled up in all countries where specific vulnerable populations contribute disproportionately to the spread of HIV.

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Figure 1. Time trends in reported consistent condom use (A) and in HIV/gonorrhea/chlamydia prevalence (B) among female sex workers in Benin, 1993–2008

A. After the beginning of the Canadian International Development Agency (CIDA) preventive project in Cotonou (vertical full arrow) and in Porto-novo, Abomey, Bohicon and Parakou (O/Cotonou, vertical dotted arrow), the proportion of FSW who reported consistent condom use with their clients in the previous month increased significantly in Cotonou (p -trend <0.0001 , univariate analysis) and remained stable O/Cotonou (p -trend $=0.903$, univariate analysis). **B.** In Cotonou, HIV, gonorrhea and chlamydia prevalence decreased significantly after the beginning of the project (p -trend <0.0001 , univariate analysis). O/Cotonou, there was also a significant decline in HIV and gonorrhea prevalence (p -trend <0.0001).

Table 1

Temporal variations in demographic characteristics and sexual behaviour among female sex workers, Benin, 1993–2008

A: Cotonou							
Year ¹ (size)	1993 (N= 374)	1996 (N=350)	1999 (N= 593)	2002 (N=474)	2005 (N=512)	2008 (N= 352)	p-value ²
Age [mean $\pm$ SD]	30.5 ($\pm$ 6.6)	29.8 ($\pm$ 6.7)	28.4 ($\pm$ 6.8)	28.9 ($\pm$ 8.3)	28.3 ($\pm$ 7.4)	29.4 ($\pm$ 8.4)	<0.0001
Age in years(%)							<0.0001
15–24	16.6	21.3	33.6	35.4	36.6	32.7	
25–34	57.2	54.5	45.6	39.7	42.7	41.5	
35	26.2	24.2	20.9	24.9	20.7	25.9	
Country of origin (%)							<0.0001
Ghana	66.3	38.7	21.5	21.3	14.3	11.1	
Nigeria	11.0	37.1	37.9	54.2	43.0	43.0	
Togo	20.1	12.3	15.1	14.1	22.4	21.9	
Benin	1.9	10.3	22.2	8.0	18.8	22.2	
Other	0.8	1.6	3.4	2.3	1.4	1.7	
Condom use ² (%)	29.7	34.5	49.2	81.9	77.5	87.7	<0.0001
Number of clients ³ [mean $\pm$ SD]	19.4 ($\pm$ 12.9)	25.6 ($\pm$ 15.1)	12.9 ($\pm$ 14.7)	26.3 ($\pm$ 28.9)	13.4 ($\pm$ 17.4)	20.4 ($\pm$ 22.3)	<0.0001

B: Abomey, Bohicon, Porto-Novo and Parakou

Year ¹ (size)	2002 (N= 249)	2005 (N= 316)	2008 (N= 261)	p-value ²
Age [mean $\pm$ SD]	- - - 31.0 ($\pm$ 7.6)	28.8 ($\pm$ 7.7)	29.2 ($\pm$ 9.1)	0.007
Age in years(%)				0.002
15–24	- - - 21.5	33.9	36.5	
25–34	- - - 45.2	42.4	36.2	
35	- - - 33.3	23.7	27.3	
Country of origin (%)				<0.0001
Ghana	- - - 36.1	23.5	16.7	
Nigeria	- - - 22.6	16.5	10.9	
Togo	- - - 22.6	34.9	38.9	
Benin	- - - 18.3	21.3	29.6	
Other	- - - 0.4	3.8	3.9	

B: Abomey, Bohicon, Porto-Novo and Parakou

Year ¹ (size)	2002 (N= 249)	2005 (N= 316)	2008 (N= 261)	p-value ²
Condom use ² (%)	- - - 59.1	63.7	59.7	0.4855
Number of clients ³ [mean ± SD]	- - - 18.1 (±23.1)	10.5 (±10.6)	9.5 (±13.7)	<0.0001

¹ Chi-square for proportions or F-test for means; SD = standard deviation;

² year of survey;

³ reported consistent condom use with clients in the previous month;

⁴ number of clients in the previous week

Table 2

Multivariate log-binomial regression model for time trend analysis of HIV and sexually transmitted infections prevalence among female sex workers, Benin, 1993 – 2008

A: Cotonou									
HIV				<i>Neisseria gonorrhoeae</i>			<i>Chlamydia trachomatis</i>		
Year of Survey	Prevalence (%)	APR (95% CI)	p-value	Prevalence (%)	APR (95% CI)	p-value	Prevalence (%)	APR (95% CI)	p-value
1993 (N= 374)	53.3	1	-	43.2	1	-	9.4	1	-
1996 (N=350)	49.4	1.09 (0.95–1.25)	0.227	30.7	0.82 (0.66–1.01)	0.066	6.8	0.87 (0.51–1.48)	0.604
1999 (N= 593)	40.7	1.01 (0.88–1.15)	0.927	23.7	0.68 (0.55–0.83)	0.0002	5.4	0.58 (0.34–0.97)	0.040
2002 (N=474)	39.0	1.00	0.970	14.0	0.39 (0.26–0.57)	<0.0001	4.8	0.60 (0.29–1.26)	0.180
2005 (N=512)	33.3	0.84 (0.71–0.99)	0.047	2.8	0.09 (0.04–0.17)	<0.0001	3.4	0.39 (0.19–0.79)	0.009
2008 (N= 352)	30.4	0.74 (0.61–0.90)	0.002	6.4	0.19 (0.12–0.29)	<0.0001	2.8	0.31 (0.14–0.65)	0.002
p-value for trend [†]	0.0001			<0.0001			0.0003		-

B: Abomey, Bohicon, Porto-Novo and Parakou									
HIV				<i>Neisseria gonorrhoeae</i>			<i>Chlamydia trachomatis</i>		
Year of Survey	Prevalence (%)	APR (95% CI)	p-value	Prevalence (%)	APR (95% CI)	p-value	Prevalence (%)	APR (95% CI)	p-value
2002 (N=249)	59.5	1	-	31.0	1	-	8.0	1	-
2005 (N=316)	34.7	0.71 (0.54–0.92)	0.011	3.4	0.10 (0.05–0.23)	<0.0001	5.5	0.37 (0.14–0.92)	0.033
2008 (N= 261)	27.6	0.58 (0.44–0.78)	0.0003	5.3	0.15 (0.07–0.31)	<0.0001	5.3	0.29 (0.11–0.77)	0.012
p-value for trend [†]	0.0004			<0.0001			0.052		-

APR, adjusted proportion ratio; CI, confidence interval (year of survey as a categorical variable, adjustment for country of origin and age as a categorical variable).

[†] p-value from Chi-square trend obtained from a log-binomial regression model with the year of survey used as continuous variable (adjustment for age as a categorical variable and country of origin)

Comparison of HIV/STI prevalence and sexual behaviour among female sex workers from Cotonou and outside Cotonou (Porto-Novo, Abomey, Bohicon and Parakou), Benin, 2002

Table 3

A: HIV/STI prevalence and proportion of consistent condom use					
Crude prevalence (%)		Adjusted PR (95% CI)			
	Cotonou (N= 474)	Outside Cotonou (N= 249)	p-value [‡]	Cotonou (N= 474)	Outside Cotonou (N= 249)
HIV	39.0	59.5	0.0006	1.06 (0.85–1.34)	1
<i>Neisseria gonorrhoeae</i>	14.0	31.0	0.0004	0.53 (0.32–0.88)	1
<i>Chlamydia trachomatis</i>	4.8	8.0	0.271	0.75 (0.26–2.16)	1
Consistent condom use ¹	81.9	59.1	<0.0001	1.29 (1.14–1.45)	1

B: Number of sex worker clients					
Crude mean (95%CI [†])		Adjusted mean (95%CI [†])			
	Cotonou (N= 474)	Outside Cotonou (N= 249)	p-value	Cotonou (N= 474)	Outside Cotonou (N= 249)
Number of clients ²	26.3 (23.6–29.0)	18.1 (15.0–21.3)	0.0001	24.7 (21.7– 27.6)	16.9 (13.1–20.6)

¹ Proportion reporting consistent condom use with clients in the previous month;

² Mean number of clients in the previous week;

[‡] Chi-square of Mantel-Haenszel; PR, prevalence ratio (outside Cotonou as the reference); CI, confidence interval (multivariate log-binomial regression model adjusted for country of origin and age as a categorical variable);

[&] Wald chi-square from the multivariate log-binomial regression;

[†] Crude confidence interval from ANOVA or adjusted confidence interval from generalized linear model (adjusted for country of origin and age as categorical variable).

Comparison of HIV/STI prevalence and sexual behaviour between 2005 and 2008 among female sex workers, Benin

Table 4

A: HIV/STI prevalence and proportion of consistent condom use						
	Crude Prevalence (%)		Adjusted PR (95% CI)			
	2005 (N= 1482)	2008 (N= 1082)	p-value [†]	2005 (N= 1482)	2008 (N= 1082)	p-value [‡]
HIV	30.1	26.8	0.098	1	0.88 (0.77–1.01)	0.062
<i>N. Gonorrhoeae</i>	3.4	6.2	0.004	1	1.76 (1.17–2.65)	0.007
<i>C. trachomatis</i>	5.4	4.7	0.457	1	0.89 (0.61–1.30)	0.546
Consistent condom use ¹	66.3	64.0	0.237	1	1.02 (0.97–1.06)	0.500

B: Number of sex worker clients						
	Crude means (95% CI [‡])		Adjusted means (95% CI [‡])			
	2005 (N= 1482)	2008 (N= 1082)	p-value [†]	2005 (N= 1482)	2008 (N= 1082)	p-value
Number of clients ²	10.6 (9.9–11.4)	14.0 (12.7–15.3)	<0.0001	11.70 (10.78–12.62)	15.11 (14.04–16.17)	<0.0001

¹ Proportion reporting consistent condom use with clients in the previous month;

² Mean number of clients in the previous week;

[†] Chi square of Mantel-Haenszel (proportions) or t-test of ANOVA regression (means); Adjusted PR: adjusted prevalence ratio (2005 as the reference); CI, confidence interval (year of survey as a categorical variable, multivariate log-binomial regression model adjusted for country of origin and age as categorical variable);

[‡] Wald chi-square from the multivariate log-binomial regression;

[‡] Crude confidence interval from ANOVA or adjusted confidence interval from generalized linear model adjusted for country of origin and age as a categorical variable.