Factors associated with HIV-1 infection among sex workers of Addis Ababa, Ethiopia

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Objective: To study the prevalence and risk factors for HIV infection among sex workers of Addis Ababa, Ethiopia.

Design and methods: Cross-sectional survey on socio-demographic characteristics, behaviours, and HIV serological status of sex workers attending two health centres of Addis Ababa.

Results: HIV prevalence among sex workers was 274 of 372 (73.7%). Several factors were significantly associated with an increased risk of being HIV-infected [among others, working in 'shared rooms', high number of clients, use of injectable hormones, and positive *Treponema pallidum* particle agglutination (TPPA) serology], and others with a decreased risk (being born in Addis Ababa, high level of education, peer education on sex work, condom use, use of oral pill, and use of condoms for contraception). Of interest, sex workers who were using condoms for contraception were, compared with others, more likely to use condoms consistently (65 versus 24%, respectively; $P < 0.001$), and less likely to be HIV-infected (55 versus 86%, respectively; $P < 0.001$). In multivariate analysis [log-binomial model, giving estimates of the prevalence ratio (PR)], being born in Addis Ababa (PR = 0.74; 95% confidence interval (CI), 0.61–0.91), using condoms for contraception (PR = 0.73; 95% CI, 0.64–0.85), and a positive TPPA serology (PR = 1.21; 95% CI, 1.09–1.36), remained significantly associated with HIV infection.

Conclusions: HIV prevalence was remarkably high among sex workers of Addis Ababa. Condom use was higher, and HIV prevalence lower, in sex workers using condoms not only for prevention of HIV and sexually transmitted diseases, but also for contraceptive purpose. This finding is of particular interest for its implications for prevention strategies among sex workers in the developing world.

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Introduction

Since the beginning of the HIV pandemic, sex workers have been highly exposed to the virus, particularly in Africa and in Asia [1]. In some countries, such as Kenya and the Ivory Coast, HIV prevalence among sex workers may reach 70%, higher than in any other group in society [2,3]. Such high prevalence can be attained

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because of the multiple partners of sex workers, the inconsistent use of condoms, and the co-infection with other sexually transmitted diseases (STDs), which are co-factors of HIV transmission [4,5]. Due to their high HIV prevalence, to their increased ability to transmit HIV when co-infected with other STDs, and to the broad population groups they reach through their clients, sex workers have often been described as a 'core group', namely, a small group in which the infection is endemic and from whom it spreads to the population at large [6]. Therefore, HIV prevention programmes targeted at sex workers and their clients are essential to HIV control in countries where sex work is an important contributor to the spread of the virus, and some programmes have shown remarkable successes, as in Zaire, Thailand or Senegal [7–9]. However, such programmes need to be locally adjusted to the prevalent distribution of behavioural and societal factors associated with HIV transmission in sex workers [10], and should not permit the stigmatization of and discrimination against sex workers [1].

For the past 15 years, Ethiopia has been experiencing a severe HIV epidemic, and in 1996, HIV prevalence was 17.8% among pregnant women in Addis Ababa, the capital city [11]. The first sera found to be positive for HIV antibodies date back to 1984 [12], and the first AIDS cases were diagnosed in Addis Ababa hospitals in 1986 [13]. In 1987–1988, a large survey carried out among 6234 sex workers and 468 truck drivers operating along the main trading roads of Ethiopia documented HIV prevalence of 17.0 and 13.0%, respectively, confirming the important role played by sex workers and truck drivers in the dissemination of the virus in the country [14,15]. Not surprisingly, HIV prevalence was already 24.7% in sex workers of Addis Ababa in 1989 [16], whereas it was only 3.6% in antenatal care attenders in the same year [17]. Few studies have examined factors associated with HIV infection in sex workers of Ethiopia [16], and their findings, already 10 years old, need to be updated in view of the changes of behaviours and practices expected in a society dramatically hit by HIV/AIDS. We have therefore initiated this study to describe the socio-demographic characteristics, the sex work history, the attitude and knowledge regarding HIV/STDs, and the sexual behaviours of Addis Ababa sex workers, in relation with their HIV serological status.

Material and methods

From August to November 1998, in two health centres of Addis Ababa, all women attending the outpatient department and known to the health staff as being sex workers were approached for participation in this study. Most women were attending the health centres for STD-related symptoms. This sampling approach was chosen over a random sampling strategy of the sex worker population for convenience. Indeed, lists of sex workers, or totals for number of sex workers by sex work type (e.g. street, bar, hotel, etc.), which would be required for most random sampling methods, were not available in Addis Ababa, where sex work is not legalized. After informed consent was obtained in writing, sex workers were interviewed by a trained female nurse using a structured questionnaire. Data were collected on socio-demographic characteristics, sex work history, knowledge and attitude regarding STDs including HIV, and sexual behaviours. Two tubes, each of 10 ml EDTA-anti-coagulated blood were collected from each study participant, using vacutainer tubes and transported to the Ethio-Netherlands AIDS Research Project (ENARP) laboratory at the Ethiopian Health and Nutrition Research Institute (EHNRI) in Addis Ababa. Plasma samples were tested for HIV-1 antibodies by HIVSPOT (Genelabs, Singapore) and Organon Vironostika enzyme-linked immunosorbent assay (ELISA) Uniform II (Organon, Boxtel, The Netherlands). Samples with discordant results were confirmed with Western blot test (HIV Blot 2.2; Genelabs Diagnostics Inc., Redwood City, California, USA). For the first 125 participants enrolled in the study, total lymphocyte counts were determined by Coulter counter (T 540; Coulter Electronics Ltd, Miami, Florida, USA), and lymphocyte subsets were determined by flow cytometry using a FACSCAN (Becton Dickinson, San Jose, California, USA). Screening for syphilis antibodies was performed using the *Treponema pallidum* particle agglutination test (TPPA; Fujirebio Inc., Tokyo, Japan), and the rapid plasma reagin test (RPR; Bio Merieux, Marcy l'Etoile, France). Women with positive TPPA serology were said to have past/current syphilis. Women with positive TPPA and RPR serologies were said to have active syphilis.

All participants wishing to know their HIV test results were referred to the local HIV counselling centre. Syphilis results were returned within 2 weeks to the health centres, and patients with positive TPPA and RPR tests were offered free treatment with two injections of benzathine penicillin, according to the national guidelines of care. The study protocol was approved by institutional and national ethical clearance committees.

Statistical methods

Proportions and means were compared using χ^2 and Mann–Whitney U- test where appropriate ($P < 0.05$ was considered statistically significant). Trends were assessed using a non-parametric test (Culicz test). Correlation between two continuous variables was assessed using a Spearman rank correlation coefficient. These analyses were carried out using the Stata statis-

tical package (Stata Statistical Software, Stata Corporation, College Station, Texas, United States).

In cross-sectional surveys in which the study outcome is common, such as HIV infection in this study, odds ratios are very different from prevalence ratios [18]. Odds ratios give one valid measure of the magnitude of the association, but are difficult to interpret, and can be very different from the estimate of the relative risk. Prevalence ratios would be a more meaningful measure of the magnitude of the association, but their use has been limited by the absence of statistical models able to provide estimates of the prevalence ratios in multivariate analysis. Since 1993, a macro called GENMOD has been available in SAS statistical software (SAS Institute, Cary, North Carolina, USA). This macro is capable, by restricting the parameter space, of modelling the logarithm of a prevalence, while keeping the sum of the products of parameter estimates and covariates less than zero [19–21]. We have applied this model to identify factors associated with HIV infection, and describe their association with HIV infection in the form of prevalence ratios: all variables with P values < 0.25 in univariate analysis were tested in a single model including all of them, and those with P values less than 0.05 in the presence of any other variable were kept in the final model. The final model was used to assess confounding in other variables, by studying the changes in the prevalence ratio estimate of a given variable after its introduction in the final model. No test for trends was carried out in the multivariate analysis. An alternative model was built using logistic regression, and variables included in the final model were compared between log-binomial and logistic models.

Results

Between August and November 1998, a total of 372 sex workers were enrolled in the study. Most of them [291 of 372 (78.2 %)] were attending the health centres for STD treatment. The sex workers were divided into two groups, depending on whether they were born in or outside Addis Ababa. The majority [290 of 372 (78.0%)] of the sex workers were born outside Addis Ababa, and of these, most [213 of 290 (73.4%)] came from the northern part of the country. Their median age at arrival in Addis Ababa was 15 years. Only eight women (2.8%) had already worked as a sex worker before coming to Addis Ababa, and the median number of years before starting sex work after arrival in the capital city was 4 years. For women born in Addis Ababa [82 of 372 (22%)], the median age at which they began sex work was 17 years, which was 2 years earlier than for women born outside Addis Ababa ($P < 0.001$).

The majority [303 of 371 (81.7%)] of sex workers had 7 years or less of sex work. The number of years of sex work and age were, as expected, strongly correlated (Spearman correlation coefficient = 0.56; $P < 0.0001$), and 88 of 110 (80.0%) of the women with 2 years or less of sex work were aged 24 years or younger. More than two-thirds (70.7%) of the sex workers had received some instruction about safer sex (i.e. condom use, importance of STD treatment, negotiation with clients, etc.) before or while working as sex workers. For these women, instructions were given mostly by friends (46.9%), or by peer educators (37.7%). The most common site of work was individually owned rooms (36.4%), followed by rooms shared with others ('shared rooms') (30.7%), bars (21.1%), streets (16.7%), and others (local beer houses called 'tella bets', 'red light' houses, and hotels). The mean (median) number of clients during the last working day was 2.19 (1), with 10% of sex workers having had four clients or more. For the 338 (90.9%) sex workers who worked during the daytime, the median charge per client was five Ethiopian Birr (ETB) (range, 1–30; US$ 1 = ETB 8.25). During the night-time (n = 365), the median charge per client was ETB 15 (range, 1–60).

The knowledge of sex workers on HIV/AIDS, as measured by the study questionnaire, was high, and most (96.2%) said that they were afraid of AIDS. Although the vast majority (90.4%) said that one can protect oneself against HIV infection, and that condoms were an effective means of prevention (95.0% of the sex workers), more than two-thirds (71.5%) of the sex workers thought that they were already infected with HIV. One widespread misconception (47.4% of the sex workers) was that people looking healthy could not be infected with HIV. Other than that, most of other questions concerning knowledge of facts about HIV transmission and outcome were correctly answered. Surprisingly, despite a good knowledge on HIV/AIDS, and the severity of the HIV epidemic among sex workers, only 40.5% of the study participants reported knowing someone with AIDS.

Almost all (99.2%) sex workers had used condoms at least once in their life, and almost all of them (98.1%) said that condoms were easy to find. However, only 40% reported using condoms in more than 95% of sexual acts with clients. Reasons for occasionally not using condoms were: refusal by the client (reported by 72.8% of sex workers); brutality from a client (42.7%); higher payment from a client (33.2%);, and instructions given by the owner of the working place (7.0%).

The most common mode of contraception used in the past 5 years by the sex workers was the oral pill (57.0% of women), followed by condoms (39.3%), and injectable hormones (16.3%). Twenty-four per cent of the sex workers had not used any systematic contraception

in the past 5 years. Interestingly, women who had used condoms for contraception had a much more regular use of condoms compared with others (65.3% were using condoms with more than 95% of clients versus 24.1% for others; $P < 0.001$; see Fig. 1). These women also differed from other sex workers in many characteristics, such as, among others: being born in Addis Ababa (32.4 versus 15.2%; $P < 0.001$), being 30 years or older (31.7 versus 17.0%; $P = 0.001$), having received instruction by peer educators (49.7 versus 11.3%; $P < 0.001$), having no more than one client per day on average (91.0 versus 32.2%; $P < 0.001$), and refusing clients who do not want to use condoms (53.8 versus 10.3%; $P < 0.001$).

Genital symptoms were common among sex workers: 77.0% complained about at least one episode of genital discharge requiring treatment in the past year (mean: 3.2 episodes), and 41.4% complained of a genital ulcer (mean: 2.2 ulcers). Bleeding after sex was quite common, being reported by 16.0% of women.

HIV prevalence and related risk factors

HIV prevalence was 73.7% (274 of 372) [95% confidence interval (CI), 69.2–78.2%] among the sex workers of Addis Ababa, and the prevalence of past/current syphilis was 52.4% (195 of 372) (95% CI, 47.3–57.5%). The associations between socio-demographic characteristics, history of sex work, knowledge and attitude towards HIV/AIDS, sexual behaviours and HIV infection are shown in Tables 1–4. The fourth column of each table displays the prevalence ratio (PR) of the association between the exposure variable and HIV infection in univariate analysis. The fifth column displays the corresponding PR in a model including all variables with significant association with HIV infection in a multivariate analysis, so that changes in the PR between columns four and five indicate the amount of confounding present in the univariate association. The variables included in the final model for the multivariate analysis were: being born in Addis Ababa (PR = 0.74; 95% CI, 0.61–0.91); using condoms for contraception (PR = 0.73; 95% CI, 0.64–0.85); and positive TPPA serology (PR = 1.21; 95% CI, 1.09–1.36). These variables remained significantly associated with HIV infection whenever other variables were added to the model. Other variables, such as instruction by peer educators, working in a shared room, or knowing someone with AIDS, were significantly ($P < 0.05$) associated with HIV infection when added to the final model, but lost their significant association when additional variables were introduced in the model. These variables were therefore not included in the final model (see Material and methods). The variables included in the final model remained identical when logistic models were used instead of log-binomial models, except for working in a shared room which became integrally part of the final model when using logistic regression.

HIV prevalence was lowest (63.8%) in the youngest age group (15–19 years), rising to 85.3% in the age group 25–29 years, and declining thereafter to 65.2% in the 35 years and over age group (Table 1). Among all socio-demographic characteristics recorded, two were associated with a decreased risk of being HIV-

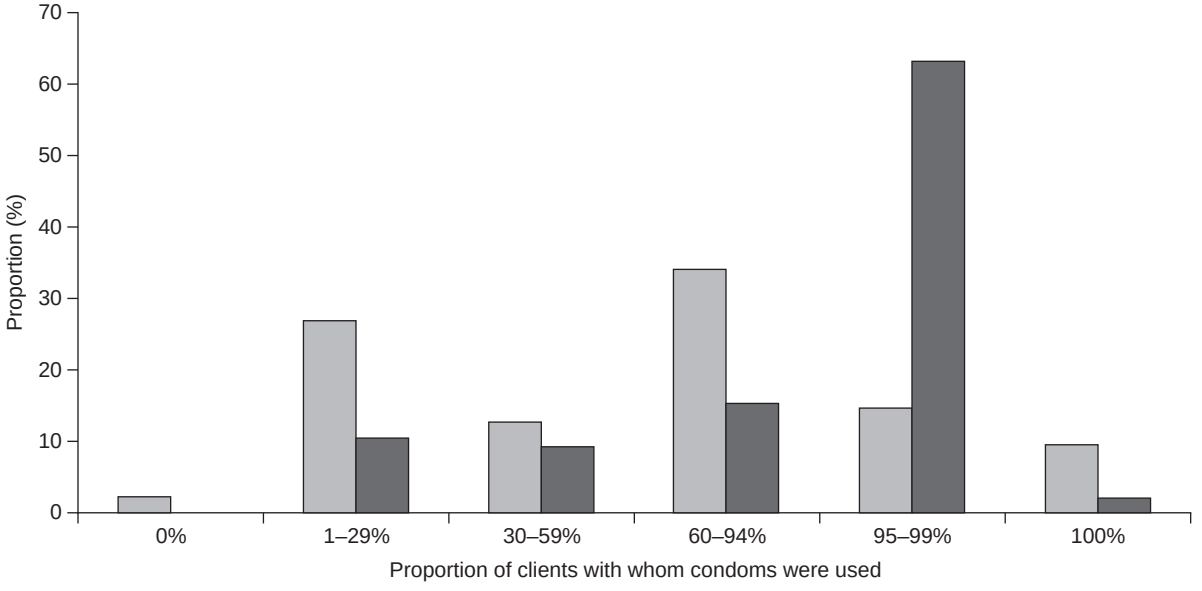

Fig. 1. Proportion (%) of clients with whom male condoms were used, as reported by the sex workers, by category of condom use for contraception ($P < 0.001$). In light grey: women not using condoms for contraception; in dark grey: women using condoms for contraception.

Table 1. Socio-demographic characteristics and HIV serological status among sex workers of Addis Ababa, 1998.

Variable	n (%)	% HIV+	PR (95% CI) Univariate	PR (95% CI) Multivariate[a]
Age (years) (n = 372)				
15–19	69 (18.5)	63.8	1.0	1.0
20–24	144 (38.7)	76.2	1.19 (0.97–1.45)	1.04 (0.90–1.21)
25–29	75 (20.2)	85.3	1.34 (1.09–1.64)	1.07 (0.92–1.24)
30–34	38 (10.2)	71.1	1.11 (0.85–1.46)	1.00 (0.81–1.23)
⩾ 35	46 (12.4)	65.2	1.02 (0.78–1.35)	0.90 (0.71–1.15)
Born in Addis Ababa (n = 372)				
Yes	82 (22.0)	48.8	0.60 (0.48–0.76)	0.74 (0.61–0.91)
No	290 (78.0)	80.7	1.0	1.0
Education (n = 371)				
No schooling	121 (32.6)	89.2	1.0	1.0
Literacy campaign	25 (6.7)	76.0	0.86 (0.68–1.08)	1.05 (0.74–1.49)
Grade 1–6	124 (33.4)	69.1	0.78 (0.68–0.90)	0.97 (0.87–1.09)
Grade 7–8	65 (17.5)	61.5	0.70 (0.57–0.85)	1.06 (0.80–1.40)
Grade 9+	36 (9.7)	58.2*	0.66 (0.50–0.88)	0.95 (0.77–1.16)

[a]The multivariate model includes, as independent variables, the exposure variable of interest and all variables independently associated with HIV infection (place of birth, use of condom for contraception, positive *Treponema pallidum* particle agglutination serology).
* $P < 0.01$ (test for trend of the association between HIV infection and level of education). PR, prevalence ratio, CI, confidence interval.

Table 2. History of sex work and HIV serological status among sex workers of Addis Ababa, 1998.

Variable	n (%)	% HIV+	PR (95% CI) Univariate	PR (95% CI) Multivariate[a]
Number of years of sex work (n = 371)				
0–2	110 (29.7)	76.4	1.0	1.0
3–7	193 (52.0)	72.5	0.95 (0.83–1.09)	1.01 (0.94–1.09)
> 7	68 (18.3)	72.0	0.94 (0.79–1.13)	0.91 (0.79–1.05)
Instruction on sex work (n = 368)				
No	108 (29.3)	75.0	1.0	1.0
Yes	260 (70.7)	73.1	0.97 (0.85–1.11)	0.91 (0.76–1.09)
Main instructor (n = 368)				
No instruction	108 (29.3)	75.0	1.0	1.0
Peer educators	98 (26.3)	56.1	0.75 (0.61–0.92)	0.81 (0.65–1.00)
Bar owners	13 (3.5)	69.2	0.92 (0.63–1.34)	0.97 (0.68–1.39)
Relatives	6 (1.6)	83.3	1.11 (0.76–1.61)	0.99 (0.55–1.77)
Friends	122 (32.8)	84.4	1.12 (0.98–1.28)	0.94 (0.78–1.13)
Others	21 (5.6)	85.7	1.14 (0.93–1.40)	0.87 (0.68–1.12)
Working in 'shared room' (n = 371)				
No	257 (69.3)	65.4	1.0	1.0
Yes	114 (30.7)	92.1	1.41 (1.27–1.56)	1.11 (1.02–1.21)
Charge per client during daytime (in ETB[b]) (n = 370)				
< 4	132 (39.1)	84.1	1.0	1.0
5	98 (29.0)	78.6	0.93 (0.82–1.06)	0.98 (0.91–1.07)
> 5	108 (32.0)	52.8*	0.63 (0.52–0.76)	0.83 (0.69–0.99)[c]
No work at daytime	32			
Charge per client during night time (in ETB) (n = 372)				
< 10	126 (34.5)	82.5	1.0	1.0
11–15	95 (26.0)	80.0	0.97 (0.85–1.10)	0.95 (0.87–1.04)
16–20	62 (17.0)	67.7	0.82 (0.68–0.99)	0.94 (0.83–1.07)
> 20	82 (22.5)	57.3*	0.69 (0.57–0.85)	0.97 (0.78–1.21)
No work at night	7			
Number of clients on an average day (n = 369)				
1	192 (55.7)	63.6	1.0	1.0
2	54 (15.7)	79.6	1.25 (1.05–1.49)	1.07 (0.94–1.21)
> 2	99 (28.7)	88.9*	1.40 (1.23–1.59)	1.08 (0.97–1.21)
Did not know	24			

[a]The multivariate model includes, as independent variables, the exposure variable of interest, and all variables independently associated with HIV infection (place of birth, use of condom for contraception, positive *Treponema pallidum* particle agglutination serology).
[b]US$ 1 = 8.25 Ethiopian Birr (ETB).
[c]despite a significant association with HIV infection, this variable was not kept in the final model because of too many missing observations (32 women did not work in the daytime).
* $P < 0.05$ (test for trends). PR, prevalence ratio, CI, confidence interval.

Table 3. Knowledge on HIV/AIDS and HIV serological status among sex workers of Addis Ababa, 1998.

Variable	n (%)	% HIV+	PR (95% CI) Univariate	PR (95% CI) Multivariate[a]
Do you think that someone who looks healthy can be HIV-infected ? (n = 372)				
No	176 (47.4)	79.6	1.0	1.0
Yes	196 (52.6)	68.7	0.86 (0.77–0.97)	0.99 (0.91–1.07)
Do you think that people can be resistant to HIV infection ? (n = 372)				
No	339 (91.1)	72.3	1.0	1.0
Yes	33 (8.9)	90.0	1.25 (1.09–1.43)	0.97 (0.86–1.10)
Do you think that it is possible to protect oneself from HIV/AIDS? (n = 363)				
No	35 (9.6)	80.0	1.0	1.0
Yes	328 (90.4)	73.2	0.91 (0.77–1.09)	1.00 (0.90–1.12)
Do you think that condoms can protect against HIV/AIDS? (n = 342)				
No	17 (5.0)	82.4	1.0	1.0
Yes	325 (95.0)	73.8	0.89 (0.71 –1.12)	0.94 (0.67–1.31)
Do you think there is a cure for AIDS? (n = 361)				
No	326 (90.3)	73.3	1.0	1.0
Yes	35 (9.7)	71.4	0.97 (0.78–1.21)	1.06 (0.81–1.39)
Do you know someone with AIDS? (n = 370)				
No	220 (59.5)	82.7	1.0	1.0
Yes	150 (40.5)	60.7	0.73 (0.64–0.85)	0.84 (0.73–0.96)
Do you think that you are at risk for HIV? (n = 341)				
No	45 (13.2)	82.2	1.0	1.0
Yes	296 (86.8)	70.5	0.85 (0.73–1.00)	0.97 (0.88–1.06)
Are you afraid of AIDS? (n = 369)				
No	14 (3.8)	78.6	1.0	1.0
Yes	355 (96.2)	73.5	0.94 (0.71–1.24)	1.04 (0.86–1.27)

[a]The multivariate model includes, as independent variables, the exposure variable of interest, and all variables independently associated with HIV infection (place of birth, use of condom for contraception, positive *Treponema pallidum* particle agglutination serology).
PR, prevalence ratio, CI, confidence interval.

infected: one was being born in Addis Ababa (PR = 0.60; 95% CI, 0.48–0.76); the other was higher education (PR for the highest versus lowest education level = 0.66; 95% CI, 0.50–0.88) (Table 1).

HIV prevalence was not associated with the number of years of sex work (Table 2). It was highest, although not significantly different, in women with 2 years or less of sex work compared with others (76.4 versus 72.4%; $P > 0.05$). Instructions regarding sex work were beneficial against HIV infection to sex workers, but only when given by peer educators (PR for peer education compared to no sex work instruction = 0.75; 95% CI, 0.61–0.92). Sex workers operating in a 'shared room' were, compared with others, less likely to have received peer education (6.2 versus 35.1%; $P < 0.001$), more likely to have more than two clients per day (59.8 versus 14.7%; $P < 0.001$), and less likely to use quasi-consistently (95% of sexual acts) condoms with their clients (16.5 versus 50.4%; $P < 0.001$). As a result, women working in 'shared rooms' were more likely to be HIV-infected compared with others (PR = 1.41; 95% CI, 1.27–1.56) (Table 2).

Few knowledge and attitude factors were associated with HIV infection (Table 3). Knowing that someone who looks healthy can be HIV-infected and knowing someone with HIV/AIDS were both associated with lower HIV prevalence (PR = 0.86; 95% CI, 0.77–0.97 and PR = 0.73; 95% CI, 0.64–0.85, respectively), whereas believing that some people can be resistant to HIV infection was associated with a higher HIV prevalence (PR = 1.25; 95% CI, 1.09–1.43) (Table 3).

Several indicators of condom use were associated with protection against HIV infection (Table 4): HIV prevalence was 15% lower in women using condoms with ⩾ 95% of clients ($P = 0.01$); 25% higher in those who would have sex with clients refusing to use condoms ($P = 0.003$), and 36% lower in those using condoms for contraception ($P < 0.001$).

As shown in Table 4, the use of injectable hormones was strongly associated with HIV infection in univariate analysis (PR = 1.25; $P < 0.001$), whereas the use of oral contraceptives was associated with a protective effect against HIV infection (PR = 0.84; $P = 0.002$). However, both associations disappeared after introducing other independent predictors into the model. The use of injectable hormones was linked with several factors positively associated with HIV infection, such as being born outside of Addis Ababa (91.7% for hormone users versus 75.3% for non-users; $P = 0.005$), low education (45.0 versus 30.0%; $P = 0.02$), absence of

Table 4. Sexual behaviours / practices and HIV serological status among sex workers of Addis Ababa, 1998.

Variable	n (%)	%HIV+	PR (95% CI) Univariate	PR (95% CI) Multivariate[a]
Proportion (%) of clients with whom condoms were used (n = 367)				
0	5 (1.4)	80.0	1.0	1.0
1–29	74 (20.2)	77.0	0.96 (0.61–1.52)	0.96 (0.58–1.62)
30–59	44 (12.0)	93.2	1.16 (0.75–1.82)	1.05 (0.53–2.10)
60–94	97 (26.4)	74.2	0.93 (0.59–1.46)	0.97 (0.58–1.62)
95–99	123 (33.5)	65.8	0.82 (0.52–1.30)	0.97 (0.58–1.64)
100	24 (6.5)	75.0*	0.94 (0.57–1.54)	0.94 (0.55–1.62)
Reasons for occasionally not using condom:				
Client refusal (n = 371)				
No	101 (27.2)	62.4	1.0	1.0
Yes	270 (72.8)	78.1	1.25 (1.06–1.47)	1.10 (0.94–1.28)
Higher payment (n = 371)				
No	248 (66.8)	74.9	1.0	1.0
Yes	123 (33.2)	71.5	0.96 (0.84–1.10)	0.97 (0.89–1.06)
Client brutality (n = 372)				
No	213 (57.3)	69.8	1.0	1.0
Yes	159 (42.7)	79.3	1.14 (1.01–1.29)	1.02 (0.94–1.11)
Forced by establishment owners (n = 372)				
No	346 (93.0)	72.8	1.0	1.0
Yes	26 (7.0)	88.5	1.22 (1.05–1.42)	1.00 (0.89–1.13)
Sex during menses (n = 367)				
< 95% of menses	226 (61.6)	65.0	1.0	1.0
⩾ 95% of menses	141 (38.4)	87.2	1.34 (1.20–1.50)	1.07 (0.98–1.17)
Past/current syphilis (TPPA-positive) (n = 372)				
No	177 (47.6)	61.0	1.0	1.0
Yes	195 (52.4)	85.1	1.40 (1.22–1.59)	1.21 (1.09–1.36)
Active syphilis (TPPA and RPR positive) (n =369)				
No	240 (65.0)	67.1	1.0	1.0
Yes	129 (35.0)	85.3	1.27 (1.13–1.42)	1.08 (0.98–1.19)[b]
Contraceptive use during the past 5 years				
Oral pill (n = 372)				
No	160 (43.0)	81.3	1.0	1.0
Yes	212 (57.0)	67.9	0.84 (0.74–0.94)	1.03 (0.96–1.11)
Injectable hormones (n = 368)				
No	308 (83.7)	70.8	1.0	1.0
Yes	60 (16.3)	88.3	1.25 (1.11–1.40)	1.07 (0.89–1.29)
Condoms (n = 369)				
No	224 (60.7)	85.7	1.0	1.0
Yes	145 (39.3)	55.2	0.64 (0.55–0.75)	0.73 (0.64–0.85)

[a]The multivariate model includes, as independent variables, the exposure variable of interest and all variables independently associated with HIV infection [place of birth, use of condom for contraception, positive *Treponema pallidum* particle agglutination (TPPA) serology].
[b]positive TPPA serology was removed from the multivariate model because of its strong correlation with active serology.
* $P = 0.03$ (test for trends). PR, prevalence ratio, CI, confidence interval; RPR, rapid plasma reagin test.

peer education (93.3 versus 69.5%; $P < 0.001$), working in 'shared rooms' (55.9 versus 25.6%; $P < 0.001$), inconsistent (< 95% of sexual acts) use of condoms (76.7 versus 56.4%; $P = 0.004$), and positive TPPA serology (68.3 versus 49.0%; $P = 0.006$). After introduction of these variables in the model, the univariate estimate of the prevalence ratio, which was 1.25, was reduced to 1.02, suggesting that the original association was confounded.

Similarly, the 'protective' effect of the pill was confounded, in this case by the use of condoms for contraception: 57.9% of pill users also used condoms for contraception, compared with 15% of non-users of the pill, suggesting either the simultaneous use of the two (the 'double-Dutch' method [22]), or the erratic use of the pill thereby requiring the use of condoms in pill-free intervals (the question asked for use of any method in the past 5 years). After controlling for condom use in multivariate analysis, the protective effect of the pill disappeared (the PR changed from 0.84 to 1.00).

Bleeding after sex was associated with an increase in the prevalence of HIV infection (PR for an increase of one category of frequency of bleeding after sex = 1.10; 95% CI, 1.04–1.16). However, in HIV-positive women, the median CD4+ T-cell count was lower in those bleeding after sex compared to those not bleeding (229 versus 361* 10^6 cells/l, respectively; $P = 0.02$), suggesting that bleeding might be a consequence of advanced HIV infection rather than a cause of it.

Along the same lines, women with recent (less than 1 year) genital ulcer were more likely to be HIV-positive compared to others (PR = 1.34; 95% CI, 1.19–1.51). However, the median CD4+ T-cell counts in HIV-positive women with recent genital ulcers was lower compared to others (270 versus 376×10^6 cells/l, respectively; $P = 0.04$), suggesting that clinical ulcers could be more a consequence of advanced HIV infection rather than a cause of it.

Discussion

This study has demonstrated a remarkably high HIV prevalence, 74%, among sex workers of Addis Ababa. A selection bias may however be partly responsible for this finding. Sex workers were recruited to our study from health centres where the majority of them came for STD treatment. Having an STD is a marker of unprotected sex, and thus of a higher risk of being HIV-infected. Moreover, in women with HIV infection, STDs are more likely to be symptomatic [4], and therefore to require medical management, thus increasing the proportion of women with HIV infection among those consulting for STDs. Finally, sex workers were recruited on the basis of their identification by the clinic staff, increasing the chances that sex workers with a long history of sex work would be selected. However, despite these limitations, it is likely that HIV prevalence in sex workers of Addis Ababa is extremely high. Already in 1989, HIV prevalence was 24.7% in a random sample of 2627 sex workers of the capital city [16]. Such findings are not surprising when one considers the central role played by sex workers and their clients in the spread of HIV in urban areas of Ethiopia [14,15]. In a study carried out in Addis Ababa and its suburbs in 1996, 306 of 763 (40%) of adult men acknowledged occasionally having sex with sex workers when going to bars (ENARP, unpublished data). Sex workers, estimated to represent around 7.1% of the sexually active female population of Addis Ababa in 1990 [23], are therefore highly solicited to respond to this demand.

We have used prevalence ratios instead of odd ratios to describe the association between HIV infection and exposure variables. Indeed, in cross-sectional surveys, when the prevalence of the outcome is high (i.e. > 20%), odds ratios can be misleading if they are interpreted as equivalents of relative risks [18–20]. For instance, in our study, HIV prevalence was 85.1% in sex workers with positive TPPA serology, and 61.0% in others. The odds of having HIV infection in TPPA-positive was 3.66 compared with TPPA-negative, wrongly suggesting, for an audience not familiar with the concept and meaning of odds ratios, a 3.66 higher risk of being HIV-positive if the TPPA is positive. Instead, the prevalence ratio was 1.40 (1.21 after adjustment for potential confounders using the log-binomial model), therefore giving a more convenient indication of the magnitude of the association between HIV and syphilis infection. It was comforting to realize that the variables included in the best multivariate models identified using logistic or log-binomial models were almost identical. The availability of macros such as GENMOD in SAS statistical software, allowing multivariate analysis with log-binomial models, should permit the generalization of the use of prevalence ratios instead of odds ratios in cross-sectional studies with common outcomes.

Several factors associated with HIV infection in this study have already been identified in previous studies in similar populations: among them are, for instance, high number of clients, low condom use, and past history of syphilis infection [16,24,25]. The strong association between past/current syphilis and HIV infection underlines the important role played by syphilis in the spread of HIV, most likely as a co-factor of HIV transmission [4]. Other factors, such as place of birth or working site, were more specific to this study population, and their association with HIV infection needs to be further examined (see below). We did not find any association between number of years of sex work and HIV infection. This finding, which may appear rather counter-intuitive, has already been observed by other researchers [2]). We do not think that misclassification of the number of years of sex work could explain it, since this variable was, as expected, strongly correlated with age. We rather believe that the selective loss from the sex worker population of the HIV-infected women after a few years of sex work, due to mortality or other factors, would, in a cross-sectional survey, contribute to the lack of observed increase in HIV prevalence as a function of time since start of sex work. That HIV prevalence would reach 76% in women with only 2 years or less of sex work is striking, but in line with results of other studies carried out among sex worker populations of the developing world [26,27]. This finding underlines the extremely high exposure of sex workers to HIV infection, and the need for urgent implementation of prevention activities from the time of initiation of sex work.

History of genital ulcer in the past year and post-coital bleeding were both associated with HIV infection. However, although biological mechanisms could easily explain their role as risk factors for HIV infection, their association with lower CD4+ T-cell counts (i.e. more advanced level of immuno-suppression) in HIV-positive women suggests that, in this context, genital ulcers and post-coital bleeding were more likely consequences of HIV infection, rather than causes. Similar conclusions were reached in previous studies by Ghys *et al.* for genital ulcers in sex workers of Abidjan, Ivory

Coast [3] and suspected by Padian *et al.* for post-coital bleeding in women living in the United States [28].

Other factors strongly associated with HIV infection in univariate analysis, such as the use of injectable hormones (PR = 1.25; $P < 0.001$), the use of contraceptive pills (PR = 0.84, $P = 0.002$), or sex during menses (PR = 1.34; $P < 0.001$), were no longer associated with HIV infection in multivariate analysis, suggesting that the original association was confounded by other exposure variables. Although the confounding factors which played a role in this study may not be relevant for other studies where factors such as the use of injectable hormones and oral pill were identified as risk factors for HIV infection [29–31], we would like to emphasize the potential for confounding in any association between HIV infection and sexual practices.

Sex workers not originally from Addis Ababa constitute the majority of the sex workers in our study. Most of them (94%) were not working as sex workers before arriving in the capital city, and their median time to beginning of sex work after arriving in Addis Ababa was 4 years. Although we did not collect data on the circumstances in which women arrived in the capital city (i.e. alone or with family), their age at arrival in the city (15 years), and their rapid transition to sex work, suggest that most of them came to Addis Ababa in search of better economical opportunities. More than a third (35.9%) of the sex workers not from Addis Ababa were working in 'shared rooms', which are known for a higher number of clients per day, a lower participation in peer education programs and a lower proportion of condom use, and, subsequently, a higher HIV prevalence. These results suggest that there are sub-populations of sex workers who are more vulnerable to HIV infection than others, and who should therefore be actively sought after and included in HIV education and prevention programmes.

One of the most interesting findings of this study was the protective effect associated with the use of condoms for contraceptive purposes. Women who used condoms for contraception had a higher rate of condom use compared to other women, 65.3% of them achieving quasi-consistent ($\geq$ 95% of sexual acts) condom use compared with only 24.1% of other women ($P < 0.001$). Also, a higher proportion of women using condoms for contraception would not have sex with clients who refuse to use condoms, compared with other women (53.8 versus 10.3%; $P < 0.001$). If the risk of becoming pregnant is a major concern for the sex workers, it is logical to speculate that sex workers who rely only on condoms for their contraception would achieve a higher rate of condom use, compared with other women who use other means of contraception, and thus the former are better protected against HIV/STDs. It is, however, not the only possible explanation for the lower HIV prevalence found in this study in women using condoms for contraception: these women differed in several aspects from the other women, some of these aspects being also protective against HIV infection, such as having fewer clients per day. The use of condoms for contraception was strongly linked with the participation in a peer education programme run by non-governmental organizations in Addis Ababa (74.2% of sex workers participating in the peer education programme used condoms for contraception, compared with 27.1% of other sex workers). This education programme, which specifically promoted the use of condoms for both contraception and protection against HIV and STDs, seems to have provided an effective intervention to the sex workers of the city.

Another finding from this survey was that some women who had been sex workers for several years were still HIV-free. We are currently investigating the immunological characteristics of these women (e.g. T-cell infectivity, HIV co-receptor expression, chemokines production), in order to identify individual biological markers of protection against HIV infection.

In conclusion, this study has been useful in documenting the remarkably high HIV prevalence rate among sex workers of Addis Ababa. Considering the central role played by sex workers in the spread of the epidemic in Ethiopia, it is essential that HIV prevention programmes targeted at sex workers and their clients are put in place. Such programmes should take example from positive experiences of other countries, such as Thailand or Senegal [8,9], where early diagnosis and treatment of STDs, improvement of negotiation skills with clients, and increase in condom use were important components. The findings that condom use was higher, and HIV prevalence lower, in sex workers using condoms not only for prevention against HIV and STDs, but also for contraceptive purpose should be considered for prevention strategies among sex workers of the developing world.

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