SHORT REPORT

Low incidence of syphilis among factory workers in Ethiopia: effect of an intervention based on education and counselling

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Background: The prevalence and incidence of syphilis infection were examined in a cohort study of factory workers in Ethiopia.
Method: Between February 1997 and March 1999, 409 men and 348 women were enrolled and followed in the cohort study.
Results: The prevalence (95% CI) of past/current syphilis (positive TPPA serology) was 28.9% (25.7% to 32.3%), and factors associated with past/current syphilis were markers of risky sexual behaviours including HIV infection. In this cohort of factory workers subject to public information/education meetings, testing for HIV antibodies, and individual counselling, the incidence (97.5% one sided CI) of new syphilis infections was 0/691 = 0 (0 to 0.5) per 100 person years.
Conclusion: This study has documented a reduction in risky sexual behaviours and a low syphilis incidence among factory workers participating in a cohort study on HIV infection progression in Addis Ababa

The study of the epidemiology of syphilis infection has regained importance in the past two decades with the advent of the human immunodeficiency virus (HIV) epidemic. Indeed, genital ulcer diseases, of which many are related to primary syphilis, have been identified as important co-factors for HIV transmission.[1] Ethiopia is the country with the third largest population of HIV infected people in the world.[2] This study was therefore initiated to examine the prevalence, risk factors, and incidence of syphilis among factory workers in Addis Ababa, the capital city of Ethiopia.

MATERIALS AND METHODS

This study was conducted as part of a cohort study on HIV-1 infection incidence and progression which was established in a factory in the suburbs of Addis Ababa in February 1997.[3] All factory workers aged 18–44 years were invited during public information/education meetings to participate in the cohort study, and those willing to join underwent the following procedures: pretest counselling and obtaining of informed consent for HIV testing and study participation; sex matched structured interview on sociodemographic characteristics, medical history, and sexual behaviour; clinical examination; and blood drawing in EDTA vacutainer tubes (Becton and Dickinson, USA) for laboratory analyses. During the pretest counselling session, the participant's knowledge of HIV transmission, prevention, and course of infection was evaluated; his/her perception of risk of being infected was discussed; and his/her understanding of the potential consequences of a positive or negative HIV antibody test result was assessed. The results of this evaluation have already been published elsewhere.[4] Condoms were provided free of charge to workers willing to use them.

Screening for plasma antibodies against HIV-1 was performed by an enzyme linked immunosorbent assay (ELISA) using Organon Vironostika Kits (Organon Teknica BV, Netherlands) plus western blot (Genelabs Diagnostics Inc, Redwood City, CA, USA) confirmation. HSV-2 antibody testing was performed using gG1 and gG2 coated antigens in a commercially available ELISA test kit (Gull Laboratory, Germany). Anti-HSV-2 screening could not be done in all participants owing to lack of serum available. The serological test used to diagnose treponemal antibodies was the TPHA (Serodia-TP, Fujirebio Inc, Tokyo, Japan) until 1 November 1997, which was then replaced by the *Treponema pallidum* particle agglutination (TPPA) test after the Furijebio company changed the assay. When follow up TPPA serological results differed from the initial TPHA result, enrolment samples were tested again by TPPA. The result of the confirmatory TPPA assay was used in subsequent analysis, and for the remainder of the report, TPPA will be used instead of TPHA/TPPA. Antibodies to cardiolipins were detected using the rapid plasmin reagin test (RPR Slide-Test, Biomérieux, Marcy l'Étoile, France). All the laboratory analyses were done at the Ethio-Netherlands AIDS Research Project (ENARP) laboratory at the Ethiopian Health and Nutrition Research Institute (EHNRI) in Addis Ababa, Ethiopia.

Study participants were seen every 6 months by the study team. HIV and TPPA serological tests were repeated at each visit, and results up to 22 March 1999 are included in this analysis. Results of HIV and syphilis serological tests were made available 3 weeks after enrolment to participants who were willing to have them. The same counsellor involved in the pretest counselling session gave the HIV test results. The counsellor was available 5 days a week at the study clinic for follow up visits when needed. All participants with positive TPPA were treated as late latent syphilis, since reliable history of past treatment was difficult to obtain. Treatment consisted of intramuscular penicillin G benzathine, 2.4 million U weekly, for three consecutive weeks. Free treatment was also offered to sexual contacts.

Statistical analysis

Individuals with positive TPPA serology were considered to have past or current syphilis. For the study of prevalence and assessment of risk factors for past/current syphilis, all participants of the cohort study were included. For the estimation of syphilis incidence, all factory workers with negative TPPA serology at enrolment were included, and new syphilis infection was defined as TPPA and RPR seroconversions occurring before 22 March 1999, the cut-off date used for this analysis. To rule out false seroconversions as a result of a mix up of

Table 1 Relation of sociodemographic characteristics, sexual behaviours, and past medical history by syphilis serological findings in male factory workers (n=409), Akaki, 1997–9

Variable	No (%)	TPPA positive (%)	PR* (95%CI†) univariate	PR (95% CI) multivariate
Number of years of sexual activity				
0–14	93 (23.0)	21.5	1.00	1.00
15–20	121 (29.9)	31.2	1.45 (0.91 to 2.32)	1.42 (0.90 to 2.22)
21–24	100 (24.7)	35.6	1.66 (1.04 to 2.65)§	1.63 (1.04 to 2.56)§
25–32	91 (22.5)	44.6‡	2.07 (1.32 to 3.30)§	1.98 (1.29 to 3.05)§
Missing	4			
Lifetime sexual partner:				
<5 partners	146 (35.7)	25.3	1.00	1.00
≥5 partners	263 (64.3)	37.3	1.47 (1.07 to 2.02)§	1.35 (0.99 to 1.85)
Ever had sexual intercourse with a sex worker:				
No	176 (44.2)	26.1	1.00	
Yes	222 (55.8)	37.8	1.45 (1.07 to 1.95)§	
Missing	11			
Genital ulcer in the past 5 years:				
No	394 (97.0)	32.2	1.00	
Yes	12 (3.0)	25.0	0.75 (0.28 to 2.02)	
Missing	3			
HIV infection:				
No	365 (89.2)	30.1	1.00	1.00
Yes	44 (10.8)	56.8	1.89 (1.39 to 2.55)§	2.05 (1.45 to 2.53)§
HSV-2 infection¶:				
No	205 (55.7)	22.9	1.00	
Yes	163 (44.3)	42.9	1.87 (1.38 to 2.55)§	
Missing	41			

*PR = prevalence ratio; †CI = confidence interval; ‡p<0.01, test for trend; §p<0.05; ¶not included in the multivariate model because of the large number of missing observations.

samples, the TPPA seroconversion had to be confirmed at the subsequent follow up visits. Indicators used to assess changes in sexual behaviours were reports of casual sex, sex with sex worker, condom use, history of genital discharge, and history of genital ulcer. Casual sex was defined as having sex with someone who is not your spouse or your steady sexual partner. Sex with a sex worker was defined as having sex with a sex worker when going to bars, the usual place to meet sex workers for these factory workers. Condom use was queried in relation to the last sexual act with a casual partner. History of genital discharge and genital ulcer was based on the participant's recollection. At intake, the question on casual sex referred to the past year, and the questions on genital discharge and ulcer to the past 5 years. There was no specific time frame for the questions regarding sex with a sex worker at intake, so that it was not possible to assume that people reporting sex with sex workers had casual sex in the past year. During follow up visits, these questions referred to the time period since the last visit. Any person reporting sex with sex workers during follow up visits was assumed to have had casual partners since their last visit. Changes in reported sexual behaviours during follow up were assessed only from the second visit onwards, so that the time period to which the questions refer would be identical from one visit to another.

Proportions and medians were compared using the χ^2 and Mann-Whitney U tests where appropriate, and tests for trends across ordered categorical exposure variables was done using the Cuzick test for trend ($p<0.05$ was considered statistically significant). Predictors of past/current syphilis at enrolment were identified using log binomial models, providing estimates of prevalence ratios and 95% confidence intervals.[5] Multivariate analysis was performed through stepwise modelling including all variables with a univariate p value <0.25. The incidence of syphilis infection was calculated per 100 person years of follow up, and confidence intervals were derived assuming a Poisson distribution of events. Data were analysed using the STATA statistical package version 6.0 (Stata statistical software, Stata Corporation, College Station, TX, USA).

RESULTS

Out of 1060 eligible candidates, 757 (71.4%) factory workers were enrolled in the cohort of HIV infection progression between February 1997 and March 1999 (of which 95.6% were enrolled in 1997). The participation for males and females was pretty similar, 74.1% (409/552) and 68.5% (348/508), respectively, although statistically significantly different ($p=0.04$). Participation decreased with age, being 130/142 (91.5%) in males less than 35 years and 279/410 (68.0%) in males 35 years or more ($p<0.001$); 164/215 (76.3%) in females less than 35 years and 184/293 (62.8%) in females 35 years or more ($p=0.002$). The median age among participants was 38 years for males and 35 years for females. The overall prevalence of past/current syphilis (positive TPPA serology) was 219/757 = 28.9% (95% confidence interval (CI) = 25.7%-32.3%), being higher in males (33.0%) compared to females (24.1%) ($p=0.007$). TPPA prevalence increased with age in both sexes (test for trend, $p=0.01$ for males and $p<0.01$ for females). The associations between TPPA serological results and sociodemographic and behavioural characteristics are shown in table 1 for males and table 2 for females. As expected, positive syphilis serology was associated with past sexual behaviours in both sexes. In addition, there was a strong association between positive TPPA test results and being HIV positive, which remained after controlling for sexual behaviours in multivariate analysis. Of the 219 subjects with positive TPPA results, 71 (32.4%) had a positive rapid plasmin reagin serology.

Out of 538 individuals who had a negative TPPA serology at intake, none seroconverted for both syphilis specific and non-specific antibodies (TPPA and RPR, respectively) before 22 March 1999. The incidence (97.5% one sided CI) of syphilis infection among TPPA negative cohort participants was thus 0/691 = 0 (0 to 0.5) per 100 person years. Of these 538 subjects, 367 (68.2%) had attended HIV post-test counselling by 22 March 1999. Table 3 displays the proportion of TPPA negative cohort participants reporting "risky" sexual behaviours since last visit during follow up visits 2–4. Reported

Table 2 Relation of sociodemographic characteristics, sexual behaviours, and past medical history by syphilis serological findings in female factory workers (n=348), Akaki, 1997–9

Variable	No (%)	TPPA positive (%)	PR* (95%CI†) univariate	PR (95% CI) multivariate
Number of years of sexual activity				
0–14	101 (30.0)	10.9	1.00	1.00
15–20	102 (30.3)	25.5	2.34 (1.22 to 4.48)§	2.42 (1.29 to 4.56)§
21–24	70 (20.8)	25.7	2.36 (1.19 to 4.69)§	2.69 (1.38 to 5.26)§
25–32	64 (19.0)	40.6‡	3.73 (1.98 to 7.01)§	4.10 (2.25 to 7.49)§
Missing	11			
Lifetime sexual partner:				
<5 partners	324 (93.1)	23.2	1.00	1.00
⩾5 partners	24 (6.9)	37.5	1.62 (0.93 to 2.82)	1.80 (1.07 to 3.03)§
Genital ulcer in the past 5 years:				
No	330 (94.8)	23.0	1.00	
Yes	18 (5.2)	44.4	1.93 (1.11 to 3.35)§	
Use of contraceptive pill in the past 5 years:				
No	261 (75.0)	27.2	1.00	
Yes	87 (25.0)	14.9	0.55 (0.32 to 0.94)§	
HIV infection:				
No	306 (87.9)	21.6	1.00	1.00
Yes	42 (12.1)	42.9	1.99 (1.32 to 2.99)§	2.40 (1.67 to 3.45)§
HSV-2 infection¶:				
No	110 (38.6)	14.6	1.00	
Yes	175 (61.4)	29.1	2.00 (1.20 to 3.33)§	
Missing	63			

*PR = prevalence ratio; †CI = confidence interval; ‡p<0.01, test for trend; §p<0.05; ¶not included in the multivariate model because of the large number of missing observations.

Table 3 Proportion (%) of cohort participants with negative TPPA serology reporting markers of sexual behaviours during follow up visits in Akaki, 1997–9

	Visit 2	Visit 3	Visit 4	p Value
Males				
Casual sex	28/233 (12.0)	18/185 (8.9)	12/186 (6.1)	0.03
Sex with sex worker	8/230 (3.5)	3/208 (1.4)	2/195 (1.0)	0.07
Genital discharge	5/234 (2.1)	2/209 (1.0)	3/201 (1.5)	>0.05
Genital ulcer	1/234 (0.4)	0/209 (0.0)	2/201 (1.0)	>0.05
Females				
Casual sex	5/223 (2.2)	2/206 (1.0)	0/187 (0.0)	0.03
Genital discharge	29/225 (12.9)	23/207 (11.1)	17/192 (8.9)	>0.05
Genital ulcer	8/225 (3.6)	5/207 (2.4)	4/192 (2.1)	>0.05

casual sex decreased significantly among both males and females. Genital discharge remained as frequent throughout the follow up period, but was rare in males. Out of 18 episodes of genital ulcer reported during follow up in subjects with known HSV-2 serological status, 16 (88.9%) were in subjects with positive serology. There was no significant change in reported condom use during casual sex among males, which was 57.5% at the second visit and 50% at the fourth visit (numbers of episodes of casual sex in females were too small to allow similar analysis).

DISCUSSION

The prevalence of past/current syphilis (TPPA positive serology) was high (28.9%) in this factory workers population, in agreement with past and recent studies done among the general population of Addis Ababa and other Ethiopian cities.[6–9] Treponematoses other than syphilis infections are uncommon in this part of Ethiopia,[10] and thus unlikely to contribute to this high figure. As expected, past/current syphilis was associated with markers of risky sexual behaviours in both sexes, including HIV and HSV-2 infections.

No new syphilis infection was diagnosed among TPPA negative individuals, a surprising result when considering the high TPPA prevalence observed among participants at intake. Although one may speculate that the spread of syphilis had saturated among cohort participants at the start of the study, the examination of TPPA prevalence by age groups suggests that transmission was still ongoing in this community until recently, and that new infections were taking place in the younger age groups. The absence of new infections among cohort participants is therefore remarkable. We suggest that this positive result may be related to the interventions provided to the cohort participants, as well as to the ongoing HIV prevention efforts taking place in Ethiopia. Most cohort interventions evolved around the individual counselling sessions provided as part of the HIV testing. Of the 538 subjects with TPPA negative serological results, all had pretest counselling, and 68.2% attended post-test counselling and learned their HIV and syphilis test results. During the post-test counselling session, HIV/STD prevention messages were reinforced and put in the context of the serological test results of the participant. Voluntary HIV testing and counselling were recently shown to be effective in reducing risky sexual behaviours among subjects participating in a randomised trial in Kenya, Tanzania, and Trinidad.[11] The same effect was observed in our cohort, where reported casual sex decreased in both males and females, and sex with sex workers became very rare for males. Sex workers are an important core group for HIV/STD transmission in urban areas of

Key message

The developing world needs evaluation of prevention strategies against HIV and other STIs. Voluntary HIV testing and counselling in a cohort of factory workers in Addis Ababa were able to reduce the incidence of risky sexual behaviours and syphilis infection. Other ongoing HIV prevention efforts in Ethiopia may have contributed to this encouraging result

Ethiopia,[12 13] and such decrease in sexual contacts with sex workers is likely to have a strong impact in the spread of HIV/STD in the community. Genital discharges were rare in males, more common in females, but are known to be poor predictors of sexually transmitted infections in women. Genital ulcers remained constant over time, and occurred almost exclusively in subjects with positive HSV-2 serology, suggesting that most were related to local recurrences of herpes simplex virus infection. Besides the effects of HIV testing and counselling on participants' sexual behaviours, it is likely that HIV prevention messages provided through the media and at the community level also influenced behaviours among cohort participants. During the 2000 Demographic and Health Survey in Ethiopia, 97.8% and 99.0% of males and females interviewed in Addis Ababa had heard about HIV/AIDS, and 97.6% and 95.1% knew at least one correct method of HIV prevention.[14] The main sources of information on AIDS were, by decreasing order, radio (93.6% and 88.0% for males and females, respectively), television (79.1% and 57.3%), and community meetings (29.8% and 60.4%). It is expected that these HIV/STD educational messages will have an impact in the general population, and recent surveillance data from pregnant women in Addis Ababa showed a decline in HIV prevalence among those aged 15–24 years in the inner city (from 24.2% to 15.1% between 1995 and 2001, $p<0.05$).[15]

In conclusion, this study has documented a reduction in risky sexual behaviours and a low syphilis incidence among factory workers participating in a cohort study on HIV infection progression in Addis Ababa. This encouraging result may be related to the HIV testing and counselling provided to all study subjects, and to the ongoing HIV prevention efforts in Ethiopia.

CONTRIBUTORS

TS participated in the study design, execution, data analysis, and writing of the manuscript; TRdW and AT both supervised the laboratory work and participated in the interpretation of the findings; AB performed the laboratory analyses; BH did the clinical examination for all study participants; RC participated in the study design and interpretation of the findings; YM analysed the data on changes in sexual behaviours among cohort participants; AF participated in the study design, execution, data analysis, writing, and overall supervision of the paper. All authors reviewed and approved the final version of the manuscript.

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Longer versions of tables 1–3 can be found on the *STI* website