Risk factors for gonorrhoea, syphilis, and trichomonas infections among women attending family planning clinics in Nairobi, Kenya

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Abstract

Objective—To identify the risk factors for gonorrhoea, syphilis, and trichomonas infections among low risk women in Nairobi, Kenya.

Method—In a cross-sectional study, 4,404 women attending two peri-urban family planning clinics between 1989 and 1991 were interviewed using a structured questionnaire and examined for signs of sexually transmitted disease (STD) infection. Cervical cultures for gonorrhoea, PAP smear (including microscopy for trichomonas), RPR and HIV testing were done.

Results—Positive cervical cultures for gonorrhoea were found in 3.2% of women, positive syphilis serology in 1.9%, and positive trichomonas microscopy in 5.2%. Genital ulcers were found in 1.9% of women. Although unmarried status and reporting more than one sex partner in the previous year were both significantly associated with each disease in the crude analysis, these associations were attenuated after controlling for each other and for other risk factors. The population attributable risks (PARs) for these factors were low (7–16%) owing to the high proportion of cases who were married and monogamous. The majority of women with microbiological evidence of infection had normal pelvic examinations. Clinical diagnostic algorithms for STDs in this population had a low sensitivity and positive predictive value. Nevertheless, a strong association between HIV seropositivity and STDs was observed.

Conclusion—The low population attributable risks found in this study suggest that behaviour change messages directed to women, particularly if they are married, have a low potential for preventing STDs. The poor performance of clinical diagnostic algorithms illustrates the desirability of testing these algorithms in a variety of populations and reinforces the need for low-cost methods of microbiologic diagnosis if populations with relatively low prevalences of these infections are to be included in programmes to diagnose and treat STDs.

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Introduction

The need for the control of sexually transmitted diseases (STDs) has become more urgent since they have been recognised as independent risk factors for HIV acquisition.¹ Recent prospective studies have demonstrated the role of genital ulcer disease,^{2,3} gonorrhoea,⁴ chlamydia,^{3,4} and trichomonas vaginitis⁴ as co-factors in the heterosexual transmission of HIV in Africa. Estimations of the attributable risk of STDs on HIV infections in Africa range from 8% to 33%,⁵ indicating that a substantial proportion of HIV infections might be prevented by control of other STDs.^{6–8}

In addition, STDs and their complications result in substantial morbidity and mortality independent of their role in HIV transmission. This burden, borne mainly by women and children, includes such life-threatening conditions as ectopic pregnancy, perinatal infections, ophthalmia neonatorum, stillbirth, spontaneous abortion, cervical cancer, low birth weight and congenital infections, in addition to both male and female infertility.^{9–11}

In Africa, a high prevalence of STDs is often observed even among women usually considered to be at a low risk for STDs. Village surveys and studies among antenatal and family planning clinic attenders and post-partum women report infection rates ranging from 2%–22% for gonorrhoea, 0.3%–22% for syphilis, 6%–29% for chlamydia, and 5%–49% for trichomonas vaginitis.^{5,9–11} Current facilities for STD diagnosis and treatment in developing countries are inadequate and it has been recommended that STD care be integrated into maternal and child health care and family planning services.⁸

Numerous prevalence studies have been done in Africa, but fewer attempts have been made to identify the behavioural and biological risk factors for sexually transmitted diseases other than HIV in “low-risk” women.^{12–18} To further investigate risk factors for STDs among women of reproductive age not considered to be members of high risk groups, we conducted interviews and examinations at two family planning clinics in Nairobi, Kenya.

Methods

Study population As previously described, we enrolled women attending two peri-urban family planning clinics serving mainly lower

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Table 1 Relationships between socio-demographic, sexual behaviour, and physical examination variables and positive cervical cultures for *Neisseria gonorrhoeae* among 4165 women attending two family planning clinics in Nairobi, Kenya

	Culture Results* +VE (% + ve) - VE	Crude odds ratio (95% CI)	Multivariate odds ratio (95% CI)†
Age in years			
15-19	10 (3.7) 260	1.0	1.0
20-24	61 (3.7) 1585	1.0 (0.5, 2.0)	1.1 (0.5, 2.1)
25-29	37 (2.5) 1424	0.7 (0.3, 1.4)	0.8 (0.4, 1.9)
30-49	21 (2.8) 723	0.8 (0.4, 1.6)	0.8 (0.3, 2.0)
Test for trend		p = 0.12	p = 0.35
Marital status			
Married/cohabiting	105 (2.9) 3545	1.0	1.0
Unmarried	27 (5.2) 488	1.9 (1.2, 2.9)	1.3 (0.8, 2.3)
Education level			
≥5 years	110 (3.0) 3549	1.0	1.0
<5 years	22 (4.3) 484	1.5 (0.9, 2.3)	1.5 (0.9, 2.5)
Lifetime pregnancies			
<3	78 (3.7) 2058	1.0	1.0
≥3	54 (2.7) 1975	0.7 (0.5, 1.0)	0.6 (0.4, 1.0)
Age at first pregnancy			
13-16 years	33 (5.8) 532	1.0	1.0
17, 18 years	27 (2.1) 1234	0.4 (0.2, 0.6)	0.4 (0.2, 0.6)
19-21 years	59 (3.6) 1558	0.6 (0.4, 0.9)	0.6 (0.4, 1.1)
22+ years	12 (1.8) 640	0.3 (0.2, 0.6)	0.3 (0.2, 0.8)
Test for trend		p = 0.01	p = 0.10
Age at first sexual activity			
10-15 years	41 (3.7) 1070	1.0	1.0
16-18 years	65 (3.1) 2042	0.8 (0.6, 1.2)	1.2 (0.7, 1.8)
19+ years	26 (2.9) 884	0.8 (0.5, 1.3)	1.2 (0.6, 2.2)
Test for trend		p = 0.28	p = 0.54
No. of sexual partners in the past year			
1	112 (2.9) 3721	1.0	1.0
2+	18 (6.6) 256	2.3 (1.4, 3.9)	1.7 (0.9, 3.1)
No. of sexual partners in the past six years‡			
1	59 (2.7) 2163	1.0	1.0
2	27 (3.6) 721	1.4 (0.9, 2.2)	1.1 (0.7, 1.8)
3	17 (3.3) 491	1.3 (0.7, 2.2)	1.0 (0.6, 1.8)
4, 5	17 (4.1) 396	1.6 (0.9, 2.7)	1.2 (0.7, 2.1)
6+	11 (4.2) 248	1.6 (0.9, 3.1)	1.1 (0.6, 2.3)
Test for trend		p = 0.05	p = 0.65
No. of lifetime sexual partners§			
1	28 (2.6) 1051	1.0	1.0
2	34 (3.5) 932	1.4 (0.8, 2.3)	1.3 (0.8, 2.2)
3	20 (2.4) 814	0.9 (0.5, 1.6)	0.9 (0.5, 1.6)
4, 5	28 (3.7) 727	1.5 (0.9, 2.5)	1.3 (0.7, 2.3)
6+	22 (4.1) 509	1.6 (0.9, 2.9)	1.3 (0.7, 2.4)
Test for trend		p = 0.13	p = 0.51
Circumcision of usual male partner			
Uncircumcised	14 (4.0) 337	1.0	1.0
Circumcised	113 (3.0) 3602	0.8 (0.4, 1.3)	0.8 (0.4, 1.4)
Past history of syphilis			
No	116 (3.1) 3666	1.0	1.0
Yes	2 (5.0) 38	1.7 (0.2, 6.6)	1.4 (0.3, 6.2)
Past history of gonorrhoea			
No	106 (3.0) 3476	1.0	1.0
Yes	12 (4.6) 247	1.6 (0.9, 2.9)	1.5 (0.8, 2.9)
HIV serology			
Negative	118 (3.0) 3841	1.0	1.0
Positive	14 (6.8) 192	2.4 (1.4, 4.2)	1.9 (1.1, 3.5)
Current use of oral contraceptives			
No	90 (3.0) 2878	1.0	1.0
Yes	42 (3.5) 1155	1.2 (0.8, 1.7)	1.3 (0.9, 2.0)
Current use of injectable hormones			
No	116 (3.0) 3809	1.0	1.0
Yes	16 (6.7) 224	2.4 (1.4, 4.0)	3.0 (1.6, 5.7)
Current use of IUD			
No	116 (3.1) 3612	1.0	1.0
Yes	16 (3.7) 421	1.2 (0.7, 2.0)	1.4 (0.8, 2.4)
Current use of condoms			
No	129 (3.2) 3960	1.0	1.0
Yes	3 (3.9) 73	1.3 (0.4, 3.8)	1.4 (0.4, 4.7)
Vaginal discharge/cervicitis			
Absent	105 (2.8) 3634	1.0	—
Present	26 (6.5) 371	2.4 (1.6, 3.8)	—
Vaginal/vulvar/cervical ulcers			
Absent	129 (3.2) 3926	1.0	—
Present	2 (2.6) 76	0.8 (0, 3.0)	—

*Numbers do not always add to 132 gonorrhoea culture positives and 4033 culture negatives due to missing values.

†From a multivariate logistic regression model including indicator variables for: age, marital status, education level, number of lifetime pregnancies, age at first pregnancy, age at first intercourse, number of sex partners in the past year, circumcision status of usual male partner, history of syphilis infection, history of gonorrhoea infection, HIV serologic status, current use of oral contraceptives, current use of injectable hormones, current use of IUD, current use of condoms.

‡From the above multivariate logistic regression model with number of sexual partners in the past six years replacing number of sexual partners in the past year.

§From the above multivariate logistic regression model with number of lifetime sexual partners replacing number of sexual partners in the past year.

socio-economic status areas of Nairobi between October 1989 and May 1991.¹⁹ Signed informed consent for HIV and STD screening was obtained after HIV pre-test counselling. Over 90% of women approached agreed to participate and there were no signif-

icant differences between women who agreed and those who refused with relation to age, marital status, and parity.²⁰

Information on social, demographic, medical, and sexual behaviour characteristics was obtained by a pre-tested structured questionnaire administered by trained interviewers. Each participant underwent a general medical examination and pelvic examination, at which time endocervical swabs for gonorrhoea cultures and scrapings (using an Ayre's wooden spatula) for PAP smears were taken. Blood was drawn for HIV testing and syphilis serology. A follow-up appointment was made for post-test counselling and treatment of and referral for any identified STDs or abnormal PAP smears.

Laboratory methods Specimens for gonorrhoea were inoculated directly onto Thayer-Martin culture medium plates at the clinics. The plates were transported to the laboratory on the same day and incubated at 36-37°C. The oxidase test and Gram stain were used to identify positive *Neisseria gonorrhoeae* cultures. Syphilis serology was assayed using the rapid plasma reagin (RPR) test (Becton Dickinson Microbiology Systems). Infection with *Trichomonas vaginalis* was identified by the presence of trichomonads on the PAP smear. HIV serology was initially tested by ELISA (using commercially available kits) and positive sera were confirmed by Western Blot (Dupont de Nemours, Wilmington, DE). All laboratory tests were performed by technicians who were unaware of the questionnaire or examination findings. Gonorrhoea results (239), 37 syphilis results, and 496 trichomonas results were unavailable owing to laboratory error or unsatisfactory PAP smears.

Statistical methods Odds ratios (hereafter referred to as relative risks²¹) and their 95% confidence intervals were calculated using STATA Statistical Software²²; exact confidence intervals were calculated when appropriate using Epi Info.²³ The Mantel test for trend in ordered categorical variables in the univariate analysis was also calculated using Epi Info.²⁴ Multivariate logistic regression was used to control for confounding factors using STATA. The choice of variables in the model was based on both the results of the univariate analyses and past studies of risk factors for STDs. To maximise comparability of risk factors for the three STDs, we present multivariate analyses for each STD controlling for the same set of observed and potential risk factors. Calculation of population attributable risks (PARs) was based on odds ratios generated by the crude analysis.⁵

Results

Among the 4,404 women enrolled in the study, the prevalence of sexually transmitted diseases was as follows: positive cervical gonorrhoea cultures, 3.2% (132 out of 4165 with an available result, 95% CI 2.6-3.7); syphilis seropositivity, 1.9% (83 out of 4367 with an available result, 95% CI 1.5-2.4); and posi-

Table 2 Relationship between socio-demographic, sexual behaviour, and physical examination variables and positive cervical cultures for positive syphilis serology among 4367 women attending two family planning clinics in Nairobi, Kenya

	RPR results* + VE (% + ve) - VE	Crude odds ratio (95% CI)	Multivariate odds ratio (95% CI)†
Age in years			
15-19	7 (2.5) 277	1.0	1.0
20-24	30 (1.7) 1706	0.7 (0.3, 1.6)	0.7 (0.3, 1.8)
25-29	36 (2.4) 1484	1.0 (0.4, 2.1)	1.2 (0.5, 3.1)
30-49	9 (1.2) 773	0.5 (0.2, 1.2)	0.6 (0.2, 1.9)
Test for trend		p = 0.42	p = 0.75
Marital status			
Married/cohabiting	66 (1.7) 3756	1.0	1.0
Unmarried	17 (3.1) 528	1.8 (1.1, 3.1)	1.5 (0.8, 2.9)
Education level			
≥5 years	71 (1.8) 3769	1.0	1.0
<5 years	12 (2.3) 515	1.2 (0.7, 2.3)	1.3 (0.7, 2.4)
Lifetime pregnancies			
<3	46 (2.1) 2192	1.0	1.0
≥3	37 (1.7) 2092	0.8 (0.6, 1.3)	0.8 (0.5, 1.5)
Age at first pregnancy			
13-16 years	12 (2.0) 578	1.0	1.0
17, 18 years	27 (2.0) 1299	1.0 (0.5, 2.0)	1.1 (0.5, 2.4)
19-21 years	31 (1.8) 1669	0.9 (0.5, 1.7)	1.2 (0.6, 2.7)
22+ years	11 (1.6) 668	0.8 (0.4, 1.8)	1.2 (0.5, 3.2)
Test for trend		p = 0.50	p = 0.73
Age at first sexual activity			
10-15 years	29 (2.5) 1142	1.0	1.0
16-18 years	42 (1.9) 2160	0.8 (0.5, 1.2)	0.8 (0.5, 1.3)
19+ years	12 (1.3) 946	0.5 (0.3, 1.0)	0.5 (0.2, 1.0)
Test for trend		p = 0.04	p = 0.06
No. of sexual partners in the past year			
1	71 (1.8) 3949	1.0	1.0
2+	11 (3.8) 278	2.2 (1.2, 4.2)	1.5 (0.7, 3.2)
No. of sexual partners in the past six years‡			
1	37 (1.6) 2297	1.0	1.0
2	12 (1.5) 781	1.0 (0.5, 1.8)	0.8 (0.4, 1.5)
3	11 (2.1) 521	1.3 (0.7, 2.6)	1.1 (0.5, 2.2)
4, 5	14 (3.3) 412	2.1 (1.1, 3.9)	1.5 (0.8, 3.0)
6+	8 (3.0) 259	1.9 (0.9, 4.1)	1.4 (0.6, 3.2)
Test for trend		p = 0.01	p = 0.16
No. of lifetime sexual partners§			
1	23 (2.0) 1110	1.0	1.0
2	12 (1.2) 1004	0.6 (0.3, 1.2)	0.5 (0.2, 0.9)
3	12 (1.4) 862	0.7 (0.3, 1.3)	0.5 (0.2, 1.1)
4, 5	18 (2.3) 772	1.1 (0.6, 2.1)	0.8 (0.4, 1.5)
6+	18 (3.2) 536	1.6 (0.9, 3.0)	1.0 (0.5, 2.1)
Test for trend		p = 0.07	p = 0.61
Circumcision of usual male partner			
Uncircumcised	6 (1.6) 363	1.0	1.0
Circumcised	75 (1.9) 3822	1.2 (0.5, 2.7)	1.4 (0.6, 3.4)
Past history of syphilis			
No	73 (1.8) 3887	1.0	1.0
Yes	3 (7.3) 38	4.2 (1.4, 13.1)	3.6 (1.0, 12.7)
Past history of gonorrhoea			
No	70 (1.9) 3686	1.0	1.0
Yes	6 (2.2) 262	1.2 (0.5, 2.7)	1.0 (0.4, 2.4)
HIV serology			
Negative	71 (1.7) 4082	1.0	1.0
Positive	12 (5.6) 202	3.4 (1.8, 6.3)	3.2 (1.7, 6.1)
Current use of oral contraceptives			
No	55 (1.8) 3066	1.0	1.0
Yes	28 (2.2) 1218	1.3 (0.8, 2.0)	1.2 (0.8, 2.0)
Current use of injectable hormones			
No	80 (1.9) 4026	1.0	1.0
Yes	3 (1.1) 258	0.6 (0.2, 1.8)	0.7 (0.2, 2.2)
Current use of IUD			
No	74 (1.9) 3842	1.0	1.0
Yes	9 (2.0) 442	1.1 (0.5, 2.1)	1.1 (0.5, 2.2)
Current use of condoms			
No	81 (1.9) 4203	1.0	1.0
Yes	2 (2.4) 81	1.3 (0, 4.8)	1.4 (0.3, 6.1)
Vaginal discharge/cervicitis			
Absent	74 (1.9) 3854	1.0	—
Present	9 (2.2) 400	1.2 (0.6, 2.3)	—
Vaginal/vulvar/cervical ulcers			
Absent	79 (1.9) 4174	1.0	—
Present	4 (4.9) 77	2.7 (1.0, 7.4)	—

*Numbers do not always add to 83 RPR positives and 4284 RPR negatives due to missing values.

†From a multivariate logistic regression model including indicator variables for: age, marital status, education level, number of lifetime pregnancies, age at first pregnancy, age at first intercourse, number of sex partners in the past year, circumcision status of usual male partner, history of syphilis infection, history of gonorrhoea infection, HIV serologic status, current use of oral contraceptives, current use of injectable hormones, current use of IUD, current use of condoms.

‡From the above multivariate logistic regression model with number of sexual partners in the past six years replacing number of sexual partners in the past year.

§From the above multivariate logistic regression model with number of lifetime sexual partners replacing number of sexual partners in the past year.

tive trichomonas microscopy, 5.2% (205 out of 3908 with an available result, 95% CI 4.6-6.0). 4.9% (216 out of 4404, 95% CI 4.3-5.5) of women were HIV seropositive.

Syphilis seropositivity was positively associated with both gonorrhoea infection (RR 2.5, 95% CI 1.1-5.8) and trichomonas vaginitis

(RR 1.6, 95% CI 0.7-3.6). Gonorrhoea and trichomonas infections were not positively associated (RR 0.8, 95% CI 0.3-2.0). Few women were found to have evidence of more than one disease at the time of the study. Of women who were gonorrhoea positive, only 2% (3/132) also had a positive RPR. Of women with positive trichomonas microscopy, 3% (6/205) had a positive RPR, and 2% (5/205) had positive gonorrhoea cultures. Only one study participant had all three outcomes simultaneously.

None of the STDs studied were significantly related to age or educational level in this population. Eighty eight percent of the women were married. Owing to the low number of unmarried women, we were not able to examine the component categories single, widowed, and divorced separately. Ninety three percent of all women and 97% of married women reported only a single sexual partner in the past year. Only 2.7% reported having accepted money for sex at any time. Having more than one sex partner in the past year and being unmarried were both significantly associated with each STD in the crude analyses (Tables 1, 2, 3). However, these associations were not significant in the multivariate analysis (except for the association between being unmarried and trichomonas), largely because of mutual confounding of number of sex partners and marital status. The crude PAR for unmarried women vs. married women was 9.7% for gonorrhoea, 9.1% for syphilis, and 15.9% for trichomonas.

The crude PARs for more than one sex partner in the past year are of similarly low magnitude: 7.7% for gonorrhoea, 7.2% for syphilis, and 7.4% for trichomonas. The number of sex partners in the past year was more strongly associated with current STDs than the number of sex partners in the past six years or number of lifetime sex partners.

Later age at first sexual intercourse was weakly inversely associated with gonorrhoea and trichomonas infections and significantly inversely associated with syphilis seropositivity ($p = 0.04$ in the crude analysis, $p = 0.06$ in the multivariate analysis). Older age at first pregnancy was inversely associated with a positive gonorrhoea culture. The test for trend was not significant in multivariate analysis, but the relative risks for 17-18 years of age and for 22+ years of age (both compared to 13-16 years) remained significantly inverse. Age at first pregnancy was not significantly associated with either syphilis or trichomonas.

A past history of gonorrhoea infection was reported by 6% of women and a past history of syphilis was reported by 1%. In the multivariate analysis, a history of gonorrhoea was positively associated with current evidence of gonorrhoea infection, but not with positive syphilis serology or trichomonas microscopy. Similarly, a reported past history of syphilis was significantly associated with positive syphilis serology. Only 8% (11/132) of women with positive gonorrhoea cultures reported a history of gonorrhoea in their usual male partner, 12% reported no past history in

Table 3 Relationship between socio-demographic, sexual behaviour, and physical examination variables and positive cervical cultures for positive trichomonas microscopy among 3908 women attending two family planning clinics in Nairobi, Kenya

	Microscopy results* + VE (% + ve) - VE	Crude odds ratio (95% CI)	Multivariate odds ratio (95% CI)†
Age in years			
15-19	16 (6.3) 240	1.0	1.0
20-24	81 (5.2) 1462	0.8 (0.5, 1.4)	0.9 (0.5, 1.6)
25-29	69 (5.0) 1307	0.8 (0.5, 1.4)	0.9 (0.5, 1.7)
30-49	33 (4.8) 660	0.8 (0.4, 1.4)	0.9 (0.4, 1.9)
Test for trend		p = 0.40	p = 0.92
Marital status			
Married/cohabiting	152 (4.5) 3262	1.0	1.0
Unmarried	53 (10.7) 441	2.6 (1.9, 3.6)	2.3 (1.5, 3.4)
Education level			
≥5 years	184 (5.4) 3252	1.0	1.0
<5 years	21 (4.4) 451	0.8 (0.5, 1.3)	0.7 (0.4, 1.2)
Lifetime pregnancies			
<3	114 (5.7) 1894	1.0	1.0
≥3	91 (4.8) 1809	0.8 (0.6, 1.1)	0.9 (0.6, 1.3)
Age at first pregnancy			
13-16 years	27 (5.1) 499	1.0	1.0
17, 18 years	67 (5.6) 1124	1.1 (0.7, 1.7)	1.1 (0.7, 1.9)
19-21 years	77 (5.1) 1442	1.0 (0.6, 1.5)	1.2 (0.7, 2.0)
22+ years	32 (5.3) 577	1.0 (0.6, 1.7)	1.3 (0.7, 2.4)
Test for trend		p = 0.83	p = 0.38
Age at first sexual activity			
10-15 years	58 (5.6) 987	1.0	1.0
16-18 years	104 (5.3) 1875	0.9 (0.7, 1.3)	0.9 (0.7, 1.4)
19+ years	38 (4.5) 811	0.8 (0.5, 1.2)	0.8 (0.5, 1.3)
Test for trend		p = 0.30	p = 0.31
No. of sexual partners in the past year			
1	176 (4.9) 3420	1.0	1.0
2+	27 (10.5) 231	2.3 (1.5, 3.5)	1.4 (0.8, 2.3)
No. of sexual partners in the past six years‡			
1	93 (4.5) 1963	1.0	1.0
2	44 (6.0) 686	1.4 (0.9, 2.0)	1.1 (0.7, 1.6)
3	25 (5.2) 457	1.2 (0.7, 1.8)	0.9 (0.6, 1.5)
4, 5	26 (6.7) 362	1.5 (1.0, 2.4)	1.1 (0.7, 1.8)
6+	16 (6.7) 224	1.5 (0.9, 2.6)	1.0 (0.5, 1.7)
Test for trend		p = 0.04	p = 0.99
No. of lifetime sexual partners§			
1	40 (4.0) 952	1.0	1.0
2	49 (5.4) 863	1.4 (0.9, 2.1)	1.2 (0.8, 1.9)
3	42 (5.3) 744	1.3 (0.9, 2.1)	1.2 (0.7, 1.9)
4, 5	38 (5.3) 681	1.3 (0.9, 2.1)	1.1 (0.7, 1.8)
6+	36 (7.2) 463	1.9 (1.2, 2.9)	1.3 (0.8, 2.2)
Test for trend		p = 0.02	p = 0.40
Circumcision of usual male partner			
Uncircumcised	17 (5.2) 311	1.0	1.0
Circumcised	181 (5.2) 3312	1.0 (0.6, 1.7)	1.1 (0.6, 1.8)
Past history of syphilis			
No	188 (5.3) 3376	1.0	1.0
Yes	1 (2.6) 38	0.5 (0, 2.8)	0.4 (0.1, 3.1)
Past history of gonorrhoea			
No	177 (5.2) 3206	1.0	1.0
Yes	14 (5.8) 226	1.1 (0.6, 2.0)	0.9 (0.5, 1.6)
HIV serology			
Negative	180 (4.9) 3526	1.0	1.0
Positive	25 (12.4) 177	2.8 (1.8, 4.3)	2.4 (1.5, 3.8)
Current use of oral contraceptives			
No	155 (5.5) 2644	1.0	1.0
Yes	50 (4.5) 1059	0.8 (0.6, 1.1)	0.8 (0.6, 1.2)
Current use of injectable hormones			
No	196 (5.3) 3478	1.0	1.0
Yes	9 (3.8) 225	0.7 (0.4, 1.4)	0.7 (0.3, 1.4)
Current use of IUD			
No	174 (5.0) 3331	1.0	1.0
Yes	31 (7.7) 372	1.6 (1.1, 2.4)	1.5 (1.0, 2.3)
Current use of condoms			
No	204 (5.3) 3632	1.0	1.0
Yes	1 (1.4) 71	0.3 (0, 1.5)	0.3 (0, 2.0)
Vaginal discharge/cervicitis			
Absent	188 (5.3) 3338	1.0	—
Present	17 (4.6) 351	0.9 (0.5, 1.4)	—
Vaginal/vulvar/cervical ulcers			
Absent	202 (5.3) 3613	1.0	—
Present	3 (3.9) 74	0.7 (0.2, 2.2)	—

*Numbers do not always add to 205 microscopy positives and 3703 microscopy negatives due to missing values.

†From a multivariate logistic regression model including indicator variables for: age, marital status, education level, number of lifetime pregnancies, age at first pregnancy, age at first intercourse, number of sex partners in the past year, circumcision status of usual male partner, history of syphilis infection, history of gonorrhoea infection, HIV serologic status, current use of oral contraceptives, current use of injectable hormones, current use of IUD, current use of condoms.

‡From the above multivariate logistic regression model with number of sexual partners in the past six years replacing number of sexual partners in the past year.

§From the above multivariate logistic regression model with number of lifetime sexual partners replacing number of sexual partners in the past year.

their partner, and 80% felt unable to assess their partner's history. These percentages were not materially different in analyses restricted to married women only.

No strong associations were observed between the type of contraceptive method

used and the three STDs studied, with the exception of a significant positive association between the current use of injectable hormones and gonorrhoea infection (multivariate RR = 3.0, 95% CI 1.6-5.7) and the current use of an IUD and trichomonas infection (multivariate RR = 1.5, 95% CI 1.0-2.3). Duration of past injectable hormone use was positively but not significantly related to the gonorrhoea risk (crude RRs 1.9 for 1-12 months and 1.5 for 13-65 months, *p* value for trend = 0.07). Similarly, the duration of past IUD use was not significantly related to the risk of trichomonas infection (crude RRs 1.1 for 1-12 months and 1.6 for 13-66 months, *p* value for trend = 0.14).

The most significant predictor of gonorrhoea, syphilis, and trichomonas infections in both the crude and multivariate analyses was HIV seropositivity. This association is reported in detail elsewhere.²⁵ Interestingly, a strong positive association between a woman's usual male partner being circumcised and HIV seropositivity was observed, but we did not observe any strong associations between partner's circumcision and these three STDs in the same population.

Genital ulcers were present in 1.9% of women in the study and were positively associated with syphilis seropositivity. Clinical evidence of vaginal or cervical inflammation (vaginal discharge or cervicitis) on examination was present in 9.4% of study participants and was significantly positively associated with positive gonorrhoea cultures (RR 2.4, 95% CI 1.6-3.8), but not syphilis or trichomonas.

The sensitivity, specificity, and positive predictive value of being unmarried, having more than one sex partner in the past year, and having signs on physical examination (either genital ulcer or inflammation) for each of the STDs are presented in table 4. Risk factors are considered singly and then combined into risk profiles. In general, the sensitivity and positive predictive value of individual and combined variables was low and the specificity was high.

Discussion

Even in this relatively low-risk population attending family planning clinics, we observed a substantial burden of sexually transmitted diseases. However, few historical, demographic, or clinical factors were predictive of STDs. Due to the low prevalence of high-risk behaviours and positive examination findings, only a minority of women with STDs would be identified if screened according to the presence of such factors.

The prevalences of STDs and HIV observed in this study are similar, although slightly lower than those seen in studies of STDs in obstetric populations in Nairobi.^{16 17 26-28} Not all of those studies measured risk factors, but those that did included a higher proportion of women with risk factors than we observed, such as being unmarried, reporting a past STD infection,^{16 26} or reporting more

Table 4 Sensitivity, specificity, and positive predictive value of selected history and physical examination variables associated with sexually transmitted diseases

Predictor variables for positive gonorrhoea culture	Sensitivity	Specificity	Positive predictive value
Unmarried	20%	88%	5%
>1 sex partner in past year	14%	94%	7%
Vaginal discharge/cervicitis	20%	91%	7%
Unmarried and/or >1 sex partner in the past year and/or vaginal discharge/cervicitis	38%	76%	5%
Unmarried and >1 sex partner in the past year and vaginal discharge/cervicitis	2%	>99%	18%
Predictor variables for positive syphilis serology			
Unmarried	20%	88%	3%
>1 sex partner in past year	13%	93%	4%
Genital ulcers	5%	98%	5%
Unmarried and/or >1 sex partner in the past year and/or genital ulcers	29%	82%	3%
Unmarried and >1 sex partner in the past year and genital ulcers	1%	>99%	20%
Predictor variables for positive trichomonas microscopy			
Unmarried	26%	88%	11%
>1 sex partner in past year	13%	94%	10%
Vaginal discharge/cervicitis			
Unmarried and/or >1 sex partner in the past year and/or vaginal discharge/cervicitis	35%	76%	8%
Unmarried and >1 sex partner in the past year and vaginal discharge/cervicitis	<1%	>99%	6%

than one recent sex partner.²⁶ In addition, area of residence within Nairobi has previously been demonstrated to be an independent predictor of upper genital tract infection.¹⁷ The slightly lower prevalences of STDs in our study may be due to geographic variation in STD risk factor prevalence, or the fact that family planning clinics and obstetric clinics sample different source populations.

Both having more than one sex partner in the past year and being unmarried were significant predictors of all three STD outcomes, although these were not independent in the multivariate analysis. Since the majority of women with STDs were married and monogamous, the crude population attributable risks for unmarried status and more than one sex partner in the past year ranged from 7% to 16%. Only 7% of all women in the study reported more than one sex partner in the past year, consistent with other studies of the self-reported sexual behaviour of women in the general population in Africa.²⁹

The scarcity of facilities and personnel available for the microbiologic diagnosis of STDs in developing countries means that although screening women in the general population for STDs is highly desirable, it is not currently feasible or affordable. Although the World Health Organization has recommended diagnostic algorithms based on clinical symptoms for the treatment of STDs,³⁰ case-finding for asymptomatic STDs presents a more difficult challenge. Few tests of this approach have been conducted in general populations. Braddick *et al*¹⁶ developed a diagnostic algorithm to identify pregnant women at risk of cervical infection in a Nairobi hospital and were able to predict a combined endpoint of either gonorrhoea and/or chlamydial infection (combined prevalence 16%) using history and speculum examination findings with a sensitivity of 68%, a positive predictive value of 35%, and specificity of 93%. Vuylsteke *et al*¹⁸ developed a scoring system based on five epidemiologic

and historical risk factors and a urine leukocyte-esterase dipstick (for polymorphonuclear leukocytes) which gave a sensitivity of 72%, a positive predictive value of 16%, and a specificity of 74% in the diagnosis of gonorrhoea and/or chlamydial infection in pregnant women (combined prevalence 6.5%) in Kinshasa.

In our study, the construction of diagnostic algorithms using the most readily accessible and significant risk factors and physical examination findings gave lower sensitivities and positive predictive values, although specificities remained high. The highest sensitivity of 38% was found for any combination of unmarried status, more than one sex partner in the previous year, and evidence of vaginal or cervical infection on physical examination in the diagnosis of cervical gonorrhoea infection, but the positive predictive value was low (5%). The prevalence of historical risk factors was lower in our study than in other studies; this would be expected to reduce the observed sensitivity and increase the specificity of these factors in the diagnosis of each STD. Furthermore, we used single STDs as the outcome, in contrast to a combination of gonorrhoea and/or chlamydia as in the previous studies, which would be expected to lower the performance of the algorithms in this study. Some of the women who fit the risk profiles but did not have one of the three STDs in this study may have had cervical chlamydial infection: if we had also screened for chlamydia, we would expect that the positive predictive value of each algorithm would be higher for a combined outcome. The effect of the addition of chlamydia diagnosis on sensitivity and specificity however, would depend on the performance of the particular algorithm for chlamydia.

Of the women with positive gonorrhoea cultures 62% (82 out of 132) did not fit any of the risk profiles, even those based on a single factor. This suggests that the identification of women for diagnostic testing or empirical treatment based on risk factors, although perhaps the best option in some settings, especially those in which the prevalence of risk factors and/or STDs is high, will miss most cases of disease in lower risk populations. Further studies to optimise risk profiles may increase their clinical usefulness in case-finding.

Despite the high level of awareness and knowledge of gonorrhoea in this population,³¹ only 8% of women with positive gonorrhoea cultures reported a history of gonorrhoea in their partner. A history of gonorrhoea in their partner was denied by 12% of infected women and 80% did not feel able to assess their partner's history. This highlights the difficulty of identifying women at risk through their knowledge of their male partner's history. Since men are more often symptomatic with STDs and are more likely to present to an STD clinic, referral of their asymptomatic female partners may provide an additional approach to identifying disease in this population of women. Further studies to identify

effective and culturally acceptable methods of partner referral in developing countries are needed.

Conducting this study in a family planning clinic offered an unusual opportunity to investigate the associations between contraceptive methods and STDs. In general, there was little association found. However, we observed a positive association between IUD use and trichomonas infection. A single published study³² reported a similar (but non-significant) association, suggesting that this deserves further study. In addition, a positive association between injectable contraceptive use and gonorrhoea was found, but this was not clearly related to the duration of use. This association has not been found in previous studies and it is not clear what biological mechanism could account for it. This association may be due to chance or to unknown confounding factor(s) in this population. It is also worth noting the very low rate of condom use in this population, even among women who do not desire pregnancy at the time of the study.

The associations found here between risk factors and these STDs are weaker than those observed between these risk factors and HIV seropositivity in this population.²⁵ Since self-reported behaviour information in this population is similar to that seen in other studies,²⁹ this is unlikely to be due to the effect of the interviewing methodology. It may be because of a different epidemiology of non-HIV STDs, but is likely to be at least partly due to the fact that these STDs are curable, whereas HIV is not. Treatment, by converting women from positive to negative for current STDs would attenuate associations with risk factors which would be seen if longer-term measures of STD occurrence were available. We did not have information about past STD treatment; however, the effect of recent treatment may not be substantial since STD screening and treatment are not routine in Nairobi at either family planning or antenatal clinics and relatively few other options for treatment exist. Also, women reported a low frequency of past history of STDs, suggesting that most had not received a recent specific diagnosis of STD. Informal treatment, or antibiotic use for other conditions, might still be responsible for lowering the prevalence of these STDs at the time of examination.

In addition, non-differential misclassification of the laboratory diagnosis of these STDs may have biased these associations towards the null, especially in the case of trichomonas and syphilis. The diagnosis of *Trichomonas vaginalis* either by wet mount or by Papanicolaou smears has a low sensitivity (50–60%) compared with culture, and cytologic smear diagnosis has a slightly lower specificity compared with wet mount (99% vs. 100%).^{33 34} Syphilis diagnosis in this study relied on the RPR card test with no confirmational treponemal tests. Although there is almost certainly some misclassification due to false positive RPRs, syphilis seropositivity can be thought of as a more long-term marker in

this study than gonorrhoea or trichomonas diagnosis. In addition, since the duration of a reactive RPR card test varies with many factors including treatment, a positive RPR could indicate either present or past infection. This may account for the stronger association for syphilis seen for past behaviour variables, such as age at first sexual intercourse, compared to the associations with gonorrhoea or trichomonas. Finally, the relative risks found in this study between STDs and HIV²⁵ are similar to those found in other studies in Africa,^{4 15 26 27 35 36} suggesting that our laboratory diagnosis of these STDs was reasonably accurate.

In summary, as the prevalence of STDs and HIV in women in the general population continues to rise, the importance of diagnosing and treating STDs increases. Since many STDs in women are asymptomatic, active case-finding is necessary. Unfortunately, although several risk factors studied here were associated with STDs, none were sufficiently predictive, even in combination, to be useful as screening tools for the diagnosis of STDs in this population. The low PARs found in this study suggest that the potential preventive effect of behavioural change messages directed at women is low, particularly if they are married, and such behaviour change messages could be more productive if directed toward their male partners. In the meantime, inexpensive diagnostic tests are urgently needed to take advantage of the opportunity to treat women with STDs in family planning and other clinics.

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