
Reproductive tract infections, gynaecological morbidity and HIV seroprevalence among women in Mumbai, India

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Reported are the prevalence of reproductive tract infections and their contribution to pelvic inflammatory disease (PID), as well as the seroprevalence of human immunodeficiency virus (HIV), among women living in three inner city wards of Mumbai, India. Women aged ≤ 35 years were recruited and screened as cases if they had been admitted to hospital for gynaecological investigation for suspected PID (n = 151) or infertility (n = 295); controls were healthy fertile women attending for laparoscopic tubal ligation (n = 2433). The women were mainly of low socioeconomic status. A total of 59.4% were migrants and 14.9% of these came to Mumbai to seek treatment. Cases reported a history of adverse pregnancy outcomes significantly more often than controls, and 30.5% of suspected PID cases had previously undergone laparoscopic tubal ligation. At examination 24.2% of cases and 8.4% of controls had a vaginal discharge. Pelvic infection was confirmed in 42.0% of suspected PID cases and 14.6% of infertile cases for whom diagnostic laparoscopy was performed. The prevalence of sexually transmitted diseases was low: Chlamydia trachomatis was found in 0.2%; and Neisseria gonorrhoeae was cultured from the cervix in only four cases. Neither of these infections was detected in laparoscopic aspirates. The prevalence of HIV1/2 infections in unlinked samples was 1.9%. Sexually transmitted diseases were not major factors leading to gynaecological morbidity. Heterosexual spread of HIV infection to this population of married women is still relatively low but needs to be carefully monitored. The gynaecological morbidity detected may be a consequence of widespread use of invasive methods of fertility regulation.

Introduction

Gynaecological morbidity associated with sexually transmitted diseases (STDs) is thought to be high among women in developing countries. Pelvic inflammatory disease (PID) is one consequence of STD infection and itself may lead to infertility (1). Previous studies have indicated that in India PID was more likely to be obstetric in origin rather than to result from STDs (2). A study of reproductive tract infections among rural Maharashtra women by Bang et al. in 1989 reported a high prevalence of signs and symptoms indicative of reproductive tract infections in older women (3). Those

observations were made at a time when India was experiencing a rapid rise in reported human immunodeficiency virus (HIV) infections and acquired immunodeficiency syndrome (AIDS) cases among commercial sex workers, and there was growing international concern that HIV infection would spread heterosexually to lower-risk populations of women in India (4, 5). Under such circumstances a rise in STDs and PID among these women might also be expected. In order to determine the prevalence of reproductive tract infections and their contribution to pelvic infection, we carried out a cross-sectional study of Indian women suffering

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Reprint No. 5860

from infertility and pelvic inflammatory disease and of controls who were representative of fertile, healthy women. The control group selected consisted of women attending for tubal ligation; not only are such women demonstrably fertile, but tubal ligation in India is routinely performed by laparoscopy (6). This provided a unique opportunity to screen apparently healthy women for lower and upper genital tract infection as well as for tubal pathology. The first epidemiological results from this study are reported in this article: a detailed analysis of risk factors for pelvic infection has been reported elsewhere (7).

Methods

Study area and subjects

The study was undertaken in Mumbai (formerly Bombay), capital of Maharashtra State, between October 1993 and December 1995, in association with Brihan Mumbai Municipal Corporation (BMC). Mumbai is the industrial, commercial, and financial capital of India and over the last 20 years urbanization and industrialization have led to its rapid growth. The current population is over 10 million and inner city areas are densely populated. Almost half of the population lives in slums (huts and one-room tenements (*chawls*) (8). Since 1988 BMC has sought to extend family health services to all slum areas by creating health posts and postpartum centres offering health education, preventive services, simple curative care, family planning and legal abortion (medical termination of pregnancy), and laparoscopic sterilization (tubal ligation). Clinical care, including medical termination of pregnancy and tubal ligation, is available free at municipal establishments, although nonscheduled medicines must be paid for.

The study women were recruited at three centres located in three neighbouring administrative areas (wards). Most cases were recruited at Lokmanya Tilak Municipal General Hospital (LTMGH) (ward F/N) and most controls from Mahim Maternity Home (ward G/N) and F/S Postpartum Centre (ward F/S). Wards F and G are characterized by the presence of textile mills and tenements. All three wards have large slum areas, although vacant plots have attracted private builders and settlement of middle-class families. LTMGH is a 1304 bed tertiary hospital with a medical school and has six consultant units providing obstetric and gynaecological out- and inpatient care. Mahim Maternity Home is a 60-bed unit, performing 1200 deliveries a year and postpartum services, including tubal ligation. The

Postpartum Centre in ward F/S is the city's busiest municipal clinic offering family planning, medical termination of pregnancy, and tubal ligation services. It is favoured by women because they are not retained for overnight observation after sterilization. Medical termination of pregnancy may be performed at the same time as tubal ligation, and at LTMGH and Mahim tubal ligation is often performed immediately after delivery.

Women were defined as cases if they presented for gynaecological investigations, either with symptoms of acute pelvic infection (suspected PID) or a history of infertility that might indicate prior salpingitis. Such women were suspected to have a reproductive tract infection — although their precise PID status was not confirmed until after clinical examination and laparoscopy. Excluded were infertility cases where an infertile male partner was identified. Women with infertility problems were always requested to bring their partners for tests. Controls were fertile women seeking tubal ligation who had no symptoms of gynaecological disease. Since acute salpingitis patients were likely to be younger than tubal ligation controls, women older than 35 years were excluded from the study.

Permission to conduct the study was granted by BMC and ethical approval was obtained from the Ethical Committee of LTMGH and Medical School.

Study procedures

Questionnaires. *Social questionnaire.* A total of 30 auxiliary nurse midwives (ANMs) were seconded by BMC to the research project, and trained to enhance their skills in questioning women on their sexual behaviour. The questionnaire was developed with ANMs through a process of careful piloting, asking open-ended questions on predetermined issues, until closed questions with meaningful response categories could be specified. Interviews were conducted in the local languages (Marathi and Hindi) in a separate, quiet room where confidentiality could be maintained. Interviews were always conducted by two ANMs — one who asked questions, while the other recorded the responses. This procedure allowed one ANM to give full and sympathetic attention to the women, while ensuring careful recording of answers. At Mahim and F/S social interviews preceded clinical procedures, and the ANMs explained these procedures and reassured women, who were often fearful. At LTMGH, social interviews were given after the clinical procedures because the hospital was very busy and women waiting to go into the operating theatre could not be interviewed confidentially. A disadvantage of this approach was that

the women, particularly tubal ligation patients, might be discharged before the ANMs interviewed them.

The social questionnaire covered the sociodemography (marital status, religion, migrant history, education, income), contraceptive use, and sexual history of the woman and her partner.

Clinical questionnaire. A clinical questionnaire was administered at all centres. This involved six consultant units at LTMGH and one consultant unit at Mahim Maternity Centre. The questionnaire covered the reasons for referral, gynaecological history — including menstruation and symptoms of genital and urinary tract infection — and obstetric, medical, and surgical histories.

Gynaecological examination. Consultants were brought together to agree on study procedures, and overall supervision was provided by the consultant at Mahim Maternity Centre (S.G.). The vulva was examined for lesions and any vaginal discharge was noted. The cervix was inspected for ulcers, warts, ectopy, and cervicitis — defined as erythema or inflammation with or without a mucopurulent discharge. Three high vaginal swabs were taken: one was placed in TV medium for *Trichomonas vaginalis* and candida; a second was placed in Amies transport medium for aerobes, anaerobes, and *Gardnerella vaginalis*; and a third was placed in sterile saline solution for wet mounting and Gram staining. After the ectocervix had been cleaned of secretions, two Dacron-coated swabs were placed in the cervical os and rotated to collect endocervical secretions and cells. These were placed separately in Amies transport medium for Gram staining and culture of *Neisseria gonorrhoeae*, *Mycoplasma hominis*, and *Ureaplasma urealyticum*. A third wire swab for antigen detection of *Chlamydia trachomatis* by enzyme-linked immunosorbent assay (ELISA) was collected in Mastazyme transport medium (Mast Laboratories, Bootle, England). After removal of the speculum, a bimanual examination was carried out to test for rebound tenderness and masses, which were recorded diagrammatically, as well as tenderness of the fornices and excitation of the cervix. A clinical diagnosis of PID was made when lower abdominal pain and/or tenderness of the fornices, adnexal tenderness, and/or fever were present. After physical examination and before any operative procedure, a 5-ml blood sample was taken for serological tests. At F/S Postpartum Centre, where only control cases were enrolled, transvaginal sonography was performed before all laparoscopic tubal ligations were carried out to rule out any pelvic pathology and to confirm pregnancy in cases

of medical termination of pregnancy with tubal ligation.

Laparoscopy. Before laparoscopy, routine haematological tests (erythrocyte sedimentation rate, white blood cell count, haemoglobin level) were performed. Laparoscopy was carried out under general anaesthesia in the usual manner. Acute salpingitis was classified as follows: mild (tubes inflamed but mobile, with no pus observed); moderate (tubes immobile and pus present); or severe (pyosalpinx or an abscess present). Chronic pelvic infection was recorded if there were adhesions around the uterus and adnexa, and/or in the cul-de-sac, with formation of tubal ovarian masses. Prior to any further endoscopic procedures, 20ml sterile saline was inoculated into the cul-de-sac, sprayed over the uterus, and adnexal areas and aspirated back from the cul-de-sac. If any fluid was already in the cul-de-sac it was aspirated directly and returned to the laboratory for microbiological tests. Although obstetricians were requested to perform laparoscopy for all cases where acute salpingitis was suspected, most were extremely reluctant to do so for the most severe cases since it was standard practice to treat such cases immediately without performing laparoscopy. For such cases, culdocentesis was performed, although it was recognized that cul-de-sac specimens obtained by this procedure would be open to interpretation (9), and they are not discussed here. Women with acute salpingitis were immediately started on antibiotic therapy.

Microbiological assessments. Samples were transported to the laboratory at LTMGH within 4 hours of collection.

Microscopy. Wet mount microscopy of high vaginal swabs for *T. vaginalis* was performed immediately on arrival at the laboratory. Gram-stained vaginal smears were examined microscopically for clue cells and white blood cells. Bacterial vaginosis was diagnosed if >5 clue cells per high power field ($\times 40$) were counted and white vaginal discharge had been observed clinically. Gram-stained cervical smears were also used for observation of diplococci, candida and any other microorganisms.

Cultures. Aerobes were inoculated into glucose phosphate broth and anaerobes into sodium thioglycollate broth. Gonococcal culture specimens were incubated at 35–37°C in an atmosphere containing carbon dioxide (10%) for up to 48 hours on Thayer-Martin medium. Sugar utilization tests were carried out on all oxidase-positive Gram-negative diplococci. *G. vaginalis* was grown on GV medium under an atmosphere of 95% hydrogen and 5% carbon dioxide. *T. vaginalis* specimens were cultured in

AC medium. Sabouraud's agar was used to culture candida. PPLO broth was used for ureaplasma and mycoplasma, followed by PPLO agar for colonies of *M. hominis*. All the media were prepared, inoculated, and incubated as routine microbiological procedures.

Antigen detection and serology. Cervical swabs from all cases and controls for chlamydia antigen were frozen at -40°C until examined by ELISA (Mastzyme; Mast Laboratories, Bootle, England). Antigen detection of *C. trachomatis* by ELISA was performed on all the cases (suspected PID and infertility) and on every fifth specimen of the aspirates collected. All ELISA-positive samples and a subsample of negatives were frozen and returned to Liverpool for polymerase chain reaction (PCR) testing. PCR amplification was carried out by using both primers for *C. trachomatis* major outer membrane protein (MOMP in-house assay) and for the *C. trachomatis* cryptic plasmid (Roche, Diagnostics Ltd., Welwyn Garden City, Herts, England). Occasionally false-negatives arise in PCR detection because of the presence of inhibitory factors (either destroying target DNA or inhibiting *taq* polymerase). In order to assess this possibility, 10% of PCR-negative samples were retested after *C. trachomatis* had been added to them. In each case, *C. trachomatis* was detected (i.e. no inhibitory factors were detected). Those samples that were positive by ELISA and confirmed by PCR were classified as positive for *C. trachomatis*. Samples that were positive by ELISA and negative by PCR were classified as negative for *C. trachomatis*, and similarly all ELISA negatives. The prevalence shown in the Results section was obtained using this classification. Blood samples were tested for syphilis using the Venereal Disease Research Laboratory (VDRL) test in which positive and negative controls were included with each batch. A *Treponema pallidum* haemagglutination assay (TPHA) was carried out on all positive VDRL samples for confirmation. Unlinked blood samples were tested for HIV 1/2 by ELISA (Wellcozyme 1/2, Dartford, Kent, England). All positive samples were confirmed using a second ELISA (RECOMBIGN; Cambridge Biotech Corporation, MA, USA) and when positive by both were reported as positive.

Patient follow-up. All patients undergoing laparoscopy received doxycycline or ampicillin orally for 5 days during the post-operative period. Those with PID received either cefuroxime or ciprofloxacin along with metronidazole. All the patients were called for follow-up 7–10 days after laparoscopy, at which time laboratory reports were reviewed and those cases with lower genital tract infections as well

as control cases found to have PID were given full appropriate treatment. Patients who did not come for follow-up were visited at home by trained ANMs wherever possible. Husbands were requested to come for follow-up advice and treatment, though the response was rather poor.

Data analysis. Questionnaire data were entered in dBase III and analysed using STATA software. Differences in proportions between cases and controls were tested for significance using χ^2 tests. Fisher's exact test was used for small sample sizes.

Results

A total of 3588 women were screened, 1746 of whom were recruited at LTMGH Hospital, 886 at Mahim Maternity Home and 954 at F/S Postpartum Centre; for two cases the centre was unrecorded. Women for whom the data were incomplete (576) were excluded from the analysis. A further 133 were excluded because either they were aged >35 years or it was unclear if laparoscopy had been performed. This left a total of 2879 women, 295 of whom were infertile and 151 were suspected PID patients, giving a total of 446 cases. A total of 2433 women attended for tubal ligation and were designated as controls. Altogether, 37.9% of tubal ligations were performed with concurrent medical termination of pregnancy, 37.1% followed delivery, and 24.9% were interval sterilizations (i.e. not associated with pregnancy). A total of 86 (3%) women reported taking antibiotics 15 days prior to the clinic visit but as the precise nature and duration of their medication were uncertain, they were not excluded from the analysis.

Socioeconomic status of the study women

The three main religions of the cases and controls were Hinduism (73.8%), Islam (12.3%), and Buddhism (10.9%). The mean age of infertility cases was 25.1 ± 4.1 years, that of suspected fertility cases, 25.4 ± 4.6 years and that of tubal ligation patients, 27.0 ± 3.6 years. A total of 4.7% of cases and 0.27% of controls were aged <20 years. Altogether, 59.4% of the women were migrants to Mumbai, mostly from other areas of Maharashtra State (34.8%) and Uttar Pradesh (13.7%). Nonmigrants were younger than migrants with the exception of infertility cases, for whom the age distribution was similar: 45.5% versus 43.0% infertile cases were aged <25 years; 42.3% versus 23.2% for suspected PID cases ($P = 0.02$); and 24.4% versus 12.1% for tubal ligation controls ($P < 0.01$). In general, migrant cases and controls had fewer years of schooling: 50.8% of migrants

Reproductive tract infections among women in Mumbai, India

compared with 26.0% of nonmigrants had <3 years of schooling ($P < 0.01$). The reasons most often cited by migrants for moving to Mumbai were marriage (47.1%) or family displacement (21.9%), while 14.9% had come to seek treatment. Migrant cases were more likely than migrant controls to have arrived in Mumbai over the previous 5 years (60.5% of cases versus 27.5% of controls); 33.3% of such women had household incomes <1000 rupees per month.

Fertility status

A total of 98.8% of the study women were married and only 33 reported a previous divorce or widowhood. The mean age (\pm SD) at marriage was 18.3 ± 3.9 years for infertile women, 18.0 ± 3.3 years for tubal ligation groups, and 17.5 ± 3.9 years for suspected PID cases. Altogether, 75.3% of infertility cases and 13.9% of suspected PID cases had never been pregnant. These groups also had significantly

fewer live-born children and reported more preterm pregnancies, stillbirths, and spontaneous abortions than controls (Table 1). The proportion of cases who had undergone at least one medical termination of pregnancy prior to the clinic visit (13.3%) was similar to that among fertile controls (13.0%). In contrast, 9.1% of infertile women reported having ever used a contraceptive method (oral contraceptive pill, condoms or intrauterine device) compared with 31.8% of suspected PID cases and 53.1% of tubal ligation patients (Table 2). The most widely used method was the copper intrauterine device. Very few women reported use of the safe period or pre-ejaculatory withdrawal, although later in-depth interviews of the women (not reported here) found that they did use a number of natural spacing methods — although they were not perceived as such. Of the suspected PID patients, 30.5% reported that they had previously undergone tubal ligation although no information was collected on when this had been performed.

Table 1: Outcome of pregnancy among cases and controls who had ever been pregnant

Pregnancy outcome	Cases			Controls	P-value
	No. infertile	No. suspected PID	Total	Tubal ligation	
<i>Live-born children (n)</i>					
0	30 (41.1) ^a	11 (8.5)	41 (20.2)	0 (0)	<0.01
1	31 (42.5)	33 (25.4)	64 (31.5)	22 (0.9)	
2	8 (11.0)	45 (34.6)	53 (26.1)	1 040 (42.8)	
3	3 (4.1)	24 (18.5)	27 (13.3)	1 036 (42.5)	
4	1 (1.4)	16 (12.3)	17 (8.4)	259 (10.6)	
≥4	0 (0)	1 (0.8)	1 (0.5)	76 (3.1)	
Total	73 (100)	130 (100)	203 (100)	2 433 (100)	
<i>Pre-term deliveries (n)^b</i>					
0	70 (95.9)	120 (92.3)	190 (93.6)	2 382 (97.9)	<0.01
1	3 (4.1)	10 (7.7)	13 (6.4)	38 (1.6)	
>1	0 (0)	0 (0)	0 (0)	5 (0.2)	
Not known	0 (0)	0 (0)	0 (0)	8 (0.3)	
Total	73 (100)	130 (100)	203 (100)	2 433 (100)	
<i>Still births (n)</i>					
0	67 (91.8)	123 (94.6)	190 (93.6)	2 376 (97.6)	<0.01
1	6 (8.2)	7 (5.4)	13 (6.4)	47 (1.9)	
1	0 (0)	0 (0)	0 (0)	10 (0.4)	
Total	73 (100)	130 (100)	203 (100)	2 433 (100)	
<i>Spontaneous abortions (n)</i>					
0	38 (52.1)	116 (89.2)	154 (75.9)	2 279 (93.7)	<0.01
1	25 (34.2)	8 (6.2)	33 (16.3)	128 (5.3)	
>1	10 (13.7)	6 (4.6)	16 (7.9)	26 (1.1)	
Total	73 (100)	130 (100)	203 (100)	2 433 (100)	
<i>MTP (n)^c</i>					
0	67 (91.8)	109 (83.8)	176 (86.7)	2 117 (87.0)	0.96
1	5 (6.8)	18 (13.8)	23 (11.3)	263 (10.8)	
>1	1 (1.4)	3 (2.3)	4 (2)	53 (2.2)	
Total	73 (100)	130 (100)	203 (100)	2 433 (100)	

^a Figures in parentheses are percentages.

^b <37 weeks.

^c Medical termination of pregnancy.

Table 2: Distribution of contraceptive use among cases and controls

Ever used/had:	Cases			Controls	P-value
	Infertile (n = 295)	Suspected PID (n = 151)	Total (n = 446)	Tubal ligation (n = 2 433)	
Oral contraceptive pill	8 (2.7) ^a	5 (3.3)	13 (2.9)	283 (11.6)	<0.01
Condoms	11 (3.7)	18 (11.9)	29 (6.5)	429 (17.6)	<0.01
Copper (IUD)	8 (2.7)	25 (16.6)	33 (7.4)	581 (23.9)	<0.01
Tubal ligation	5 (1.7)	46 (30.5)	51 (11.4)	0 (0)	<0.01

^a Figures in parentheses are percentages.

Clinical status

History and symptoms. History and symptoms consistent with a genitourinary infection were reported significantly more often by cases, particularly by women with suspected PID (Table 3). Vaginal discharge and pain during intercourse were the symptoms registered most often by all cases (21.7% and 26.4%, resp.), with suspected PID patients exhibiting lower abdominal pain, either between or during menstrual episodes. A history of tuberculosis was reported by 7.2% of infertile and 5.3% of suspected PID cases, compared with 1.4% of controls.

Gynaecological examination. No warts or ulcers were observed on inspection of the vulva and cervix. The proportion of woman with vaginal discharges reported by clinicians was similar to that reported by the women themselves (24.2% for cases and 8.4% for controls; $P < 0.01$). Cervicitis was described for 6.0% of cases (11.3% of those with suspected PID) and 1.8% of controls ($P < 0.01$). Of the suspected PID cases, 74.8% were considered to

have clinical pelvic infection after bimanual examination. All women were referred for diagnostic laparoscopy or, if the symptoms were very acute, for culdocentesis (143 cases).

Laparoscopy results. The results of laparoscopy are shown in Table 4. A total of 26 women had acute salpingitis and 48 chronic pelvic infection. A diagnosis of PID was confirmed in 42.0% of women with suspected PID but in only 14.6% of infertile patients.

Microbiological results

Vaginal infections. The number of women with symptomatic candidosis and trichomoniasis was very low (Table 5). Bacterial vaginosis was detected in 6% of women with suspected PID. For women in whom bacterial vaginosis was detected, *G. vaginalis* was present in 13.6% compared with 7.9% of those without bacterial vaginosis ($P = 0.32$). Presence or absence of bacterial vaginosis was examined in relation to "ever" having used contraceptive methods, but no association was found.

Table 3: Clinical history and symptoms reported by cases and controls

	Cases			Controls	P-value
	No. infertile	No. suspected PID	Total	No. with tubal ligation	
History of STD	0/291 (0) ^a	11/149 (7.4)	11/440 (2.5)	1/2 418 (0.1)	<0.01
Had PID symptoms before ^b	2/295 (0.7)	13/151 (8.6)	15/446 (3.4)	0/0 (0)	—
History of tuberculosis	21/293 (7.2)	8/150 (5.3)	29/443 (6.5)	33/2 425 (1.4)	<0.01
Partner infection	19/289 (6.6)	17/140 (12.1)	36/429 (8.4)	111/2 393 (4.6)	<0.01
≥1 infections reported					
Any pains related to menstruation	23/295 (7.8)	36/151 (23.8)	59/446 (13.2)	57/2 433 (2.3)	<0.01
Lower abdominal pain outside menstruation	5/295 (1.7)	81/151 (53.6)	86/446 (19.3)	8/2 433 (0.3)	<0.01
Frequent urination with lower abdominal pain	0/295 (0)	22/146 (15.1)	22/441 (5.0)	1/2 431 (0)	<0.01
Vaginal discharge	27/295 (9.2)	70/151 (46.4)	97/446 (21.7)	126/2 433 (5.2)	<0.01
Irritation/itching	3/295 (1.0)	20/151 (13.3)	23/446 (5.2)	22/2 433 (0.9)	<0.01
Pain during intercourse	64/294 (21.8)	53/150 (35.3)	117/444 (26.4)	159/2 428 (6.5)	<0.01

^a Figures in parentheses are percentages.

^b Only suspected cases asked.

Reproductive tract infections among women in Mumbai, India

Table 4: Distribution of diagnostic laparoscopy findings

Finding	Cases			Controls
	No. infertile	No. with suspected PID	Total	No. with tubal ligation
<i>Acute salpingitis</i>				
Mild	4 (1.5) ^a	4 (8.0)	8 (2.6)	1 (0)
Moderate	6 (2.3)	6 (12.0)	12 (3.9)	2 (0.1)
Severe	0 (0)	2 (4.0)	2 (0.6)	1 (0)
Chronic PID	28 (10.7)	9 (18.0)	37 (11.9)	11 (0.5)
No PID	223 (85.4)	29 (58.0)	252 (81)	2 410 (99.4)
Total	261 (100)	50 (100)	311 (100)	2 425 (100)

^a Figures in parentheses are percentages.

Cervical and upper genital tract infections. *M. hominis* and *U. urealyticum* were the cervical organisms most frequently cultured, with the prevalence of *M. hominis* being higher in cases (8.3% versus 5.6%) and that of *U. urealyticum*, higher in controls (22.0% versus 15.8%). From controls, four isolates of *N. gonorrhoeae* were made from the cervix but none from laparoscopic aspirate. Among controls the prevalence of *C. trachomatis* infection (positive by both ELISA and PCR) was 0.2% from cervical specimens and zero in laparoscopic aspirates. A number of aerobic and anaerobic bacteria were detected in cul-de-sac samples, but their prevalence was similar for cases and controls.

Serological findings. A total of 4.1% of infertile women were positive for syphilis compared with 2.8% of controls (Table 5). Altogether 3372 samples were tested anonymously for HIV 1/2 and 63 (1.9%) were positive.

Discussion

This study demonstrates that STDs did not make a major contribution to reproductive morbidity or PID in the study population of Indian women. The sensitive culture and PCR techniques that were used detected only a low prevalence of genital tract infec-

Table 5: Distribution of reproductive tract infections among cases and controls

	Cases			Controls	P-value
	No. infertile	No. with suspected PID	Total	No. with tubal ligation	
Vaginal infections					
Symptomatic candidosis	1/295 (0.3) ^a	3/151 (2.0)	4/446 (0.9)	1/2 432 (0)	<0.01 ^b
<i>Trichomonas vaginalis</i>	1/295 (0.3)	1/151 (0.7)	2/446 (0.5)	22/2 433 (0.9)	0.57 ^b
<i>Gardnerella vaginalis</i>	29/294 (9.8)	19/151 (12.6)	48/445 (10.8)	180/2 431 (7.4)	0.02
Bacterial vaginosis	1/295 (0.3)	9/151 (6.0)	10/446 (2.2)	12/2 433 (0.5)	<0.01
Cervical infections					
<i>Neisseria gonorrhoeae</i>	0/295 (0)	0/151 (0)	0/446 (0)	4/2 430 (0.1)	1.00 ^b
<i>Mycoplasma hominis</i>	25/295 (8.5)	12/151 (7.9)	37/446 (8.3)	137/2 426 (5.6)	0.03
<i>Ureaplasma urealyticum</i>	43/292 (15.0)	27/150 (18.0)	70/442 (15.8)	533/2 424 (22.0)	<0.01 ^b
<i>Chlamydia trachomatis</i>	1/286 (0.3)	1/145 (0.7)	2/431 (0.5)	4/2 377 (0.2)	0.23 ^b
Aspirates					
<i>N. gonorrhoeae</i>	0/234 (0)	0/42 (0)	0/276 (0)	0/2 295 (0)	—
<i>M. hominis</i>	0/232 (0)	0/42 (0)	0/274 (0)	2/2 264 (0.1)	1.00 ^b
<i>U. urealyticum</i>	2/230 (0.9)	0/41 (0)	2/271 (0.7)	29/2 260 (1.3)	0.78 ^b
<i>C. trachomatis</i>	0/197 (0)	0/34 (0)	0/231 (0)	0/1 028 (0)	—
Aerobes:					
<i>Staphylococcus aureus</i>	1/234 (0.4)	0/42 (0)	1/276 (0.4)	25/2 280 (1.1)	0.35 ^b
Streptococcus	0/234 (0)	0/42 (0)	0/276 (0)	0/2 280 (0)	—
Other	45/234 (19.2)	10/42 (23.8)	55/276 (19.9)	494/2 280 (21.7)	0.59
Anaerobes	0/191 (0)	1/28 (3.6)	1/219 (0.5)	0/1 882 (0)	0.11 ^b
Blood					
Syphilis	12/295 (4.1)	1/151 (0.7)	13/446 (0.5)	67/2 433 (2.8)	0.85

^a Figures in parentheses are percentages.

^b Fisher's exact test.

tions. Reproductive tract infections (RTIs) such as candidiasis were expected to be more common in view of the poor socioeconomic background of the women and the unsatisfactory housing conditions under which many of them lived. The study design required recruitment of women who were eligible for laparoscopy and who were attending a health facility. Like antenatal attendees — a population routinely used as a reference point for STD prevalence in the general population of women — the study women presented at the health facility for reasons other than STD infection. Although there may be subgroups of women among whom the prevalence of STDs is higher, cultural norms in India are conservative and women are not expected to have sexual relations before marriage or extramaritally. The results of this study suggest that many women adhere to these values; women who do not risk rejection by society and may be obliged to adopt a lifestyle that makes them more vulnerable to STDs and various degrees of involvement in commercial sex work.

The low prevalence of genital tract infections in our study contrasts with the findings of Bang et al. (3) in a population-based study in rural Maharashtra, where women did not have access to good health facilities. Apart from sample selection, the two studies used different criteria to measure STD prevalence and related morbidity. On clinical grounds, for example, Bang et al. classified 24.2% of women as having PID. If only 40% of suspected cases were confirmed by laparoscopy, as in our study, this proportion would be reduced to about 10%. The difficulties of comparing studies is exemplified by a recent rural, population-based survey of RTIs in Bangladesh, where only 1.1% of women were culture-positive for *N. gonorrhoeae* and no women had syphilis as defined by a positive TPHA (10). Less stringent criteria, however, were used to define other RTIs and the overall prevalence of RTIs was calculated to be 56.1%. For example, in Bangladesh but not in Mumbai, women were classified as having “nonspecific vaginosis”, as distinct from bacterial vaginosis based on the presence of 10 polymorphonuclear leukocytes and/or Gram-negative bacilli in a high vaginal swab or smear (11). In Bangladesh 9.0% of RTIs were defined on this basis, although trichomoniasis, an infection in which white blood cells may be detected, was found in only 0.3% of women by microscopy. In Mumbai, candidosis, defined as an acute candidal infection in symptomatic women, was found in < 1% of women; however, had its prevalence been based on the number of women with hyphae or spores on a Gram stain, 7.2% would have been classified as having candidosis, a level comparable to that found in Bangladesh

(9.0%). Virtually all the procedures used to measure RTI/STDs differed in the two studies. If the criteria applied in Bangladesh had been applied in Mumbai, it is likely that at least 50% of women in our study would have been registered as having an RTI. As more studies are conducted on RTIs in women, it will be important to standardize the definitions used and to recognize the limitations of interpretation of nonspecific laboratory tests if resources are to be allocated wisely for management of STDs.

Interpretation of the HIV seroprevalence data also presents difficulties. An HIV seroprevalence of 1.9% compares well with the results of the first round of sentinel surveillance in 1994 among antenatal clinic attendees in Mumbai, which found an HIV seroprevalence of 2.5% (12). It is of considerable importance to monitor the rate of increase in HIV positivity among low-risk populations of women, since among commercial sex workers in India this rose from 0.9% in 1987 to >40% by 1992 (5), and was more recently reported to be 47.7% (13). The expectation is that the HIV epidemic in India will rapidly spread to lower risk groups (14, 15). This was the conclusion of a study of 2800 people attending STD clinics in Pune, which found an HIV seroprevalence of 23.4% among women (16). The prevalence of HIV-1 among 222 women who were not sex workers, 13% of whom claimed to be monogamously married, was 14%. If HIV has truly begun to affect lower risk groups in India, it may reach the same epidemic proportions as are currently observed in some parts of sub-Saharan Africa, where the seroprevalence may be as high as 30% among antenatal clinic attendees (17). None the less, a variety of factors could influence the course of the epidemic.

The results of the present study are important because they imply that the number of women whose husbands visit commercial sex workers is relatively small, since otherwise a higher prevalence of HIV infection or cervical infections such as gonorrhoea would probably have been transmitted to their spouses. Alternatively, but less likely, is that the husbands visit sex workers but use condoms to protect themselves from infection. This is not to say that the men do not have extramarital affairs, but these relationships may not be with women at high risk of STDs/AIDS. Several Indian studies have demonstrated that the main risk factor for HIV infection is contact with commercial sex workers (18, 19). Although many men in Mumbai are migrants, a large proportion live with their families, unlike some categories of migrants such as truck drivers who may be at far higher risk of spreading HIV infection (20). Mehendale et al. observed that patients attending STD clinics and who lived with their families were

significantly less likely to seroconvert and become HIV positive (27). Of interest in this regard is an Indian study linking men's sexual behaviour to the risk of cervical cancer among their sexual partners. Agarwal et al. found that the husbands of monogamous women with persistent dysplasia were more likely than controls to have had premarital and extramarital sex, and to have resumed sexual activity with their wives before 40 days' postpartum (22). Conversely, no correlation was found between husbands' sexual activities with prostitutes and cervical cancer among their wives. This contrasts with the results of a study in Thailand that found no association between a woman's risk of cervical cancer and her husband's total number of sexual partners or with the number of his extramarital partners other than prostitutes (23). The association with cervical cancer was significantly higher only for women whose husbands had a first encounter with a prostitute in their teens or twenties. Hence, understanding the characteristics of men who visit commercial sex workers — as well as other types of premarital and extramarital relationships practised by men — is essential if targeted and relevant intervention and education strategies are to be promoted to prevent gynaecological morbidity and spread of HIV infection.

Finally, most women with suspected PID did not have evidence of RTIs. Women with the most acute symptoms of PID were not referred for laparoscopy but there was no evidence to suggest a higher prevalence of lower tract infection in this group (24). Of those women presenting with pelvic pain characteristic of salpingitis, 30.5% had undergone previous laparoscopic sterilization, and 13.9% medical termination of pregnancy. In India many women rely on invasive methods of fertility regulation such as tubal ligation, IUDs and medical termination of pregnancy, and a recent survey confirms that the reproductive span of many women has been artificially shortened to a mean of 10 years (25). In our study most women married at about 18 years of age and had been sterilized by 27 years of age, although 17.2% had elected for tubal ligation by the age of 24 years. Typically, the study women had had several pregnancies and medical terminations of pregnancy, had experimented with an IUD, and then sought tubal ligation. A total of 37.9% of all the tubal ligations were performed with concurrent medical termination of pregnancy — a striking demonstration of widespread acceptance of termination of pregnancy. There are several risks inherent in this strategy for limiting family size. If lower tract infections such as bacterial vaginosis are present, women undertaking medically invasive procedures may be at increased risk of reproductive morbidity (26).

There may also be surgical complications arising from such procedures (27). In a study by Keith et al. (28), despite the claimed safety of the procedure, hypotension occurred in 39 of 167 cases undergoing laparoscopic sterilization during puerperium. There are also likely to be psychosocial consequences resulting from such a dramatic shortening of the normal reproductive span. A total of 8.2% of the study women who were seeking treatment for secondary infertility had previously undergone a medical termination of pregnancy and 1.7% a previous tubal ligation. Their current treatment-seeking behaviour would seem to suggest that they had changed their minds about the desirability of pregnancy, as observed in other studies (29). Although women were not asked their reasons for choosing irreversible methods of fertility control, it is likely that increased education, intense pressure on living accommodation, convenience of the method, and regular exposure to messages encouraging sterilization were all factors that influenced them.

However, the long-term psychological, physical, or economic effects on individual women who terminate their reproductive lives at such an early stage have been little investigated. In recent years attention has focused on STD-related gynaecological morbidity amid concern to uncover the hidden problem of RTIs in women. Perhaps now is the time to widen this perspective and to focus more attention on women who do not necessarily have RTIs but who may suffer because of the growing acceptance that liberal use of invasive medical procedures promotes reproductive health.

Acknowledgements

The research reported in this article was carried out by the Brihan Mumbai Municipal Corporation and the Population and Reproductive Health Programme, Liverpool School of Tropical Medicine. The study on pelvic inflammatory disease was funded by the Overseas Development Administration of the United Kingdom. The Overseas Development Administration accepts no responsibility for any information provided or views expressed. A supplementary grant was received from the WHO Global Programme on AIDS for determination of the seroprevalence of syphilis and of HIV. Many people contributed to the success of this study and for all their help we are grateful. We wish specifically to thank Dr S. Desmukh, Dean, LTMGH, for facilitating work at the hospital, and all those who contributed to the clinical, laboratory and social and data management teams in India. In Liverpool we thank Dr W. Tong for PCR testing of chlamydia samples in his laboratory. We also wish to acknowledge the constant help of Mr B. Shackleton and finally, posthumously, Ms N. Dollimore, who helped set up the study, but who was tragically killed before seeing its conclusion.

Résumé

Infections génitales, morbidité gynécologique et séroprévalence du VIH chez des femmes de Mumbai, Inde

On estime que la morbidité gynécologique associée aux maladies sexuellement transmissibles (MST) est élevée dans les pays en développement. Les infections génitales hautes (*pelvic inflammatory disease* ou PID) sont l'une des conséquences des MST et peuvent conduire à la stérilité. Des études réalisées en Inde avaient déjà indiqué que les PID étaient plus probablement d'origine obstétricale que consécutives à une MST. La présente étude avait pour objectif de déterminer la prévalence des infections génitales et leur contribution aux PID, ainsi que la prévalence des infections à VIH, chez les femmes consultant des centres de santé dans trois secteurs administratifs de Mumbai (anciennement Bombay). Les femmes de ≤ 35 ans ont été recrutées comme cas lorsqu'elles étaient admises à l'hôpital pour une suspicion d'infection génitale haute ($n = 151$) ou de stérilité ($n = 295$), et le groupe témoin était constitué de femmes fécondes en bonne santé venues à l'hôpital pour une ligature des trompes par laparoscopie ($n = 2433$). Ces femmes étaient pour la plupart de faible niveau socio-économique; 59,4% étaient des immigrées et 14,9% étaient venues à Mumbai pour y recevoir un traitement. Les cas mentionnaient plus souvent des antécédents d'issue défavorable de la grossesse que les témoins. Parmi les cas de suspicion de PID, 30,5% avaient déjà eu une ligature des trompes par laparoscopie. A l'examen, 24,2% des cas et 8,4% des témoins avaient un écoulement vaginal. L'infection pelvienne a été confirmée chez 42,0% des cas suspects de PID et chez 14,6% des femmes stériles ayant fait l'objet d'une laparoscopie diagnostique. La prévalence des maladies sexuellement transmissibles était faible. *Chlamydia trachomatis* a été trouvé chez 0,2% des cas et *Neisseria gonorrhoeae* n'était présent dans les cultures de prélèvements cervicaux que dans 4 cas. Aucun de ces germes n'était présent dans les prélèvements effectués par laparoscopie. La prévalence des infections par le virus de l'immunodéficience humaine 1 ou 2 (VIH 1/2) dans les échantillons anonymes était de 1,9%. L'étude montre que les MST ne contribuent pas de façon importante à la morbidité due aux infections génitales hautes dans cette population. De nombreuses femmes subissent des interventions invasives comme la laparoscopie et l'interruption volontaire de grossesse, qui comportent par elles-mêmes un risque de complications et qui peuvent

être associées à un risque accru de morbidité en cas d'infection génitale basse. L'absence de détection d'autres MST chez ces femmes et la prévalence relativement faible de la séropositivité vis-à-vis du VIH semblent indiquer que le nombre de maris qui fréquentent des prostituées est faible dans cette population.

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