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Sex. Transm. Inf. 2006;82;243-249
doi:10.1136/sti.2005.016451

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PUBLIC HEALTH

The burden and determinants of reproductive tract infections in India: a population based study of women in Goa, India

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Sex Transm Infect 2006;**82**:243–249. doi: 10.1136/sti.2005.016451

See end of article for authors' affiliations

Correspondence to:
Dr Vikram Patel, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK; vikram.patel@lshtm.ac.uk

Accepted for publication 28 September 2005

Background/objective: Reproductive tract infections (RTI) present major health, social, and economic problems in developing countries. Our objective was to describe the prevalence and risk factors of RTIs in a population based sample of women aged 18–45 years.

Method: 2494 women of 3000 randomly selected from the population defined by a primary health centre catchment area consented to participate. Participants were interviewed regarding complaints and risk factors. Laboratory specimens were collected for the diagnosis of RTIs. Analyses of risk factors were carried out separately for the outcomes of sexually transmitted infections: chlamydia, gonorrhoea, trichomoniasis; and endogenous infections: bacterial vaginosis (BV) and candida.

Results: Endogenous infections were relatively common (BV 17.8%; candida 8.5%), and sexually transmitted infections (STI) were infrequent (4.2%). Factors indicative of poverty and marginalisation were associated with STIs and BV. Gender disadvantage, particularly spousal violence, was associated with BV, while concern about a husband's extramarital relationships, an indicator of sexual risk, was associated with STI. Husband's discharge was strongly associated with STI, and a non-white vaginal discharge was associated with both STI and BV. Condom use and oral contraceptive use were associated with a reduced risk of BV.

Conclusions: Most of the population burden of RTIs is attributed to endogenous infections. Socioeconomic deprivation and gender disadvantage are associated with raised risk for BV, while the risk factors for STIs indicated that disadvantaged women were likely to be infected by their husbands.

Reproductive tract infections (RTIs) are associated with adverse health outcomes such as infertility, intrauterine growth retardation, premature labour, and increased vulnerability to HIV/AIDS.¹ There are few population based studies using gold standard diagnostic tests for RTIs in south Asia.² Prevalences of STIs are significantly higher among women than among men in developing countries.³ Apart from biological factors, the limited ability of women in developing countries to negotiate sexual relationships is considered a major factor; thus, the rising rates of STIs and the "feminisation" of the HIV/AIDS epidemic is linked with gender disadvantage.^{4–6} Gender influences the control men and women have over the determinants of their health, including their economic position and social status, access to resources, and treatment in society.⁷ There are no studies describing the association of gender disadvantage with RTIs from India.

The aim of the analyses presented in this paper is to describe the burden and risk factors for RTI, in particular the association of factors indicative of gender disadvantage, in Goa, India. These data were collected in the course of a population based cohort study of the risk factors for gynaecological complaints.⁸

METHOD

Sample

The study population was women aged 18–45 years living in the catchment area of the Aldona primary health centre of north Goa district (n = 8595). A computer program (SPSS) was used to randomly select 3000 women from the sampling frame (the population registers maintained by the health department). The population registers are updated through door to door surveys and represent the most complete record of the population in the catchment area. Subjects were approached in two stages; firstly, community level awareness programmes were held in each village and community level

consent obtained from village leaders. Next, women who had been randomly selected were sent letters informing them of their selection; a visit to their homes was scheduled a week later, at which time consent to participate was requested. The eligibility criteria for recruitment at the time of the visit were an age between 18 years and 50 years (since the enumeration date of the registers could be as old as 4 years in some areas); residence in the area for the following 12 months; speaking one of the study languages; not having cognitive impairment; and not being currently pregnant. If the selected woman did not meet any of these criteria, or was no longer living in the area, she would be replaced with another woman from the household who met the eligibility criteria. If there were no eligible women in the house, women from the first house to the right, and then to the left, would be approached. Eligible women who refused were not replaced. Recruitment took place from November 2001 to May 2003.

Data collection

The two mandatory requirements for participation were a face to face interview with a trained researcher, and the collection of biological samples for the diagnosis of RTI. The study employed a semi-structured interview, which was a composite of questions eliciting data on different aspects of the participant's personal and health history, derived from a number of sources.^{9–11} The composite interview was piloted with 100 women attending gynaecological outpatient clinics in two hospitals. For participants who consented to a gynaecological examination, two high vaginal (for polymerase chain reaction) and two vaginal swabs (for smears and

Abbreviations: BV, bacterial vaginosis; CT, *Chlamydia trachomatis*; NG, *Neisseria gonorrhoeae*; PCR, polymerase chain reaction; RTI, reproductive tract infections; STI, sexually transmitted infections; TV, *Trichomonas vaginalis*

Table 1 Prevalence of reproductive tract infections in a community sample of women in Goa, India

Reproductive tract infection	n/N	Prevalence (95% CI)
<i>Neisseria gonorrhoeae</i> (NG)	47/2425	1.9% (1.4% to 2.5%)
<i>Chlamydia trachomatis</i> (CT)	32/2423	1.3% (0.9% to 1.8%)
<i>Trichomonas vaginalis</i> (TV)	29/2488	1.2% (0.8% to 1.7%)
Bacterial vaginosis	432/2432	17.8% (16.2% to 19.3%)
Candida	206/2432	8.5% (7.4% to 9.6%)
Any cervical infection (NG, CT)	72/2416	3.0% (2.3% to 3.7%)
Any vaginal (BV, TV, candida)	619/2431	25.5% (23.7% to 27.2%)
Any STI (NG, CT, TV)	101/2414	4.2% (3.4% to 5.0%)
Any RTI (BV, candida, TV, CT, NG)	672/2379	28.3% (26.4% to 30.1%)

*Denominators differ because of missing data.

culture) were collected. For unmarried participants, and participants who refused a gynaecological examination, first void urine specimens were collected instead of the high vaginal swabs, and self administered vaginal swabs for smears and culture. The use of self administered swabs had been piloted in Goa, and was shown to be a reliable method of collection of vaginal specimens for the diagnosis of endogenous infections.¹⁰ The data were organised in the following manner for the analyses.

Socioeconomic factors

Information on age, education, religion, and marital status was collected from all subjects, including those who refused to participate. In addition, data were collected from participants on the type of housing, the access to safe drinking water and a toilet, household composition and income, employment status, indebtedness, and the experience of hunger in the previous 3 months.

Gender disadvantage factors

Questions covered five domains. The first set of risk factors related to marital history: being widowed or divorced (which poses unique disadvantages for women in India), and being married or had had a pregnancy during adolescence (<20 years) which indicate restricted reproductive choices. The second domain covered the lifetime experience of verbal, physical, and sexual violence by the spouse and concerns about her partner's substance use habits. The third domain covered the autonomy the woman had to make decisions regarding visiting her mother's or friend's home, seeing a doctor, keeping money aside for personal use, and having time to do things for herself. The responses to these four items were added to generate an autonomy score. The fourth domain inquired about the level of engagement, in the past 3 months, with four activities—namely, religious activities, participation in a community/voluntary group, social outings to meet friends/relatives, and having friends/relatives visit her. The responses to these four items were added to generate a social integration score. The fifth domain consisted of items regarding social support from family when faced with five different situations (good news, a personal problem, needing to borrow a small amount of money, feeling low, and becoming ill). The responses to these five items were added to generate a family support score.

Reproductive and sexual health risk factors

All participants were asked about current gynaecological complaints; pregnancies; numbers of pregnancies and their outcome were recorded. Pregnancies and abortions in the previous 12 months were recorded. Participants who were sexually active in the past year were asked about their experience of difficulty in conception (infertility) in the previous 12 months and use of contraceptives (sterilisation and intrauterine contraceptive device). Indicators of sexual risk

elicited from married participants were concerns about the partner's extramarital relationships; duration of time in the previous 3 months that the husband had been away from home; husband's genital discharge; and extramarital relationships that the woman had been engaged in in the past year.

Outcome variables

RTIs were diagnosed in a single laboratory, using the following tests: for chlamydial and gonococcal infection, polymerase chain reaction (PCR) using the Roche Amplicor system (Roche Molecular Systems, Alameda, CA, USA) with internal controls, according to the manufacturer's instructions; for *Trichomonas vaginalis* (TV) infection, culture using the InPouch TV Culture Kit (Biomed Diagnostic, San Jose, CA, USA) incubated at 37°C for up to 5 days and examined daily for motile trichomonads; for bacterial vaginosis, the reading of Gram stained slides based on Nugent's score¹²; and for candidiasis, the reading of Gram stained slides using a rating of the density of yeast cells seen per high power field.¹³ Slides were read by trained laboratory technologists. These tests are the most sensitive and specific available for the diagnosis of RTIs.¹⁴ All positive *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) results were confirmed by repeating the test, first with a duplicate of the original specimen and, if this was equivocal, with a back-up specimen. Quality control for the laboratory tests consists of independent verification of 10% of slides (for BV and candida) by an independent microbiologist or one of the authors (BW). The laboratory participated in the Quality Control for Molecular Diagnostics annual quality control tests, and achieved 100% correct results for the CT and NG panels in 2003–4.

Ethical considerations

The study proposal received ethical approval from the ethical committee of the London School of Hygiene and Tropical Medicine, and from the independent ethics commission, Mumbai (India). All participants were offered free care by the study gynaecologists.

Statistical analysis

Multiple logistic regression was used to assess factors associated with three RTI outcomes: BV, candida, and any STI (CT, NG, TV). For brevity, only results for BV and any STI are shown in detail in the tables. Potential risk factors were considered in three groups: socioeconomic factors, gender disadvantage, and reproductive and sexual health. Continuous risk factors, such as autonomy scores, were categorised using tertiles, based on the distribution of scores. Statistical significance was assessed with the likelihood ratio test. To assess factors associated with each outcome, we first determined the univariate association with each socioeconomic factor; all factors whose association reached significance at $p \leq 0.1$ using the likelihood ratio test were included in a multivariate model. All variables were initially fitted as

Table 2 Association of socioeconomic factors with STI and BV in a community sample of women in Goa, India

Factor	No of STI cases (n = 2414)	Univariate OR (95% CI)	No of BV cases (n = 2432)	Univariate OR (95% CI)
Age (years)		p=0.007		p<0.001
18-24	8 (1.7%)	1	52 (11%)	1
25-29	23 (5.2%)	3.28 (1.5 to 7.4)	73 (16%)	1.60 (1.1 to 2.3)
30-34	18 (3.7%)	2.31 (1.0 to 5.4)	109 (23%)	2.42 (1.7 to 3.5)
35-39	22 (4.8%)	3.01 (1.3 to 6.8)	72 (16%)	1.57 (1.1 to 2.3)
40-50	30 (5.5%)	3.49 (1.6 to 7.7)	126 (23%)	2.59 (1.8 to 3.7)
Subject type		p=0.40		p=0.40
Random	58 (3.9%)	1	258 (17.3%)	1
Replacement	43 (4.6%)	1.19 (0.8 to 1.8)	174 (18.6%)	1.10 (0.9 to 1.4)
Marital status		p=0.002		p<0.001
Married	83 (4.9%)	1	343 (20.1%)	1
Single	13 (2.0%)	0.40 (0.2 to 0.7)	69 (10.6%)	0.47 (0.4 to 0.6)
Div/Wid/Sep	5 (6.5%)	1.34 (0.5 to 3.4)	20 (26.7%)	1.44 (0.9 to 2.4)
Language		p=0.17		p=0.15
Konkani	90 (4.5%)	1	358 (17.7%)	1
English	8 (2.4%)	0.52 (0.3 to 1.1)	55 (16.2%)	0.90 (0.7 to 1.2)
Other	3 (4.1%)	0.91 (0.3 to 3.0)	19 (26.4%)	1.67 (1.0 to 2.8)
Education (years)		ptrend<0.001		p=0.04
None	17 (7.3%)	1	52 (22.8%)	1
1-9	53 (5.6%)	0.74 (0.4 to 1.3)	183 (18.8%)	0.79 (0.6 to 1.1)
10-14	26 (2.7%)	0.35 (0.2 to 0.7)	149 (15.4%)	0.62 (0.4 to 0.9)
15-23	5 (1.9%)	0.25 (0.1 to 0.7)	48 (18.0%)	0.74 (0.5 to 1.2)
Literate		p=0.003		p=0.01
Yes	73 (3.5%)	1	355 (17.0%)	1
No	28 (8.1%)	2.42 (1.5 to 3.8)	77 (22.7%)	1.44 (1.1 to 1.9)
Ethnicity		p=0.33		p=0.005
Goan	88 (4.1%)	1	373 (17.0%)	1
Other	13 (5.4%)	1.36 (0.7 to 2.5)	59 (24.7%)	1.60 (1.2 to 2.2)
Religion		p=0.71		p=0.75
Hindu	79 (4.4%)	1	326 (18.0%)	1
Christian	19 (3.6%)	0.81 (0.5 to 1.3)	91 (16.8%)	0.92 (0.7 to 1.2)
Muslim	3 (3.9%)	0.89 (0.3 to 2.9)	15 (19.7%)	1.12 (0.6 to 2.0)
Occupation		p=0.20		p=0.89
Homemaker	59 (3.7%)	1	292 (18.0%)	1
Employed	25 (4.9%)	1.35 (0.8 to 2.2)	87 (17.1%)	0.94 (0.7 to 1.2)
other	17 (5.7%)	1.57 (0.9 to 2.7)	53 (17.6%)	0.97 (0.7 to 1.3)
Household size		p=0.68		p=0.09
1-3	20 (4.9%)	1	82 (20.2%)	1
4-5	50 (3.8%)	0.77 (0.5 to 1.3)	230 (17.6%)	0.84 (0.6 to 1.1)
6-9	26 (4.2%)	0.85 (0.5 to 1.5)	112 (17.7%)	0.85 (0.6 to 1.2)
10-17	5 (5.9%)	1.20 (0.4 to 3.3)	8 (9.3%)	0.41 (0.2 to 0.9)
No of children at home		p=0.10		p=0.15
None	33 (5.1%)	1	97 (15.2%)	1
1	17 (2.8%)	0.54 (0.3 to 1.0)	105 (17.2%)	1.16 (0.9 to 1.6)
2	27 (3.7%)	0.72 (0.4 to 1.2)	140 (19.2%)	1.32 (1.0 to 1.8)
≥3	24 (5.4%)	1.06 (0.6 to 1.8)	90 (19.9%)	1.38 (1.0 to 1.9)
Housing		p=0.07		p=0.06
Own home	84 (3.9%)	1	374 (17.2%)	1
Other	17 (6.5%)	1.70 (1.0 to 2.9)	58 (22.1%)	1.36 (1.0 to 1.9)
No of bedrooms		p=0.36		p=0.002
1	50 (4.8%)	1	220 (20.9%)	1
2	33 (3.5%)	0.72 (0.5 to 1.1)	149 (15.8%)	0.71 (0.6 to 0.9)
≥3	18 (4.2%)	0.87 (0.5 to 1.5)	63 (14.6%)	0.65 (0.5 to 0.9)
Toilet access		p=0.07		p=0.06
In house	31 (3.1%)	1	174 (17.6%)	1
Outside toilet	24 (4.3%)	1.38 (0.8 to 2.4)	85 (14.9%)	0.82 (0.6 to 1.1)
No toilet	46 (5.3%)	1.72 (1.1 to 2.7)	173 (19.8%)	1.16 (0.9 to 1.5)
Tap water inside		p=0.04		p=0.14
Yes	35 (3.3%)	1	205 (19.1%)	1
No	66 (4.9%)	1.53 (1.0 to 2.3)	227 (16.7%)	0.85 (0.7 to 1.1)
Monthly income		p=0.04		p=0.88
<2000	48 (5.8%)	1	152 (18.2%)	1
2000-2999	16 (3.8%)	0.65 (0.4 to 1.2)	79 (18.8%)	1.04 (0.8 to 1.4)
3000-4999	21 (3.5%)	0.60 (0.4 to 1.0)	102 (17.1%)	0.93 (0.7 to 1.2)
5000-9999	9 (2.3%)	0.38 (0.2 to 0.8)	63 (16.4%)	0.88 (0.6 to 1.2)
>10000	7 (3.8%)	0.63 (0.3 to 1.4)	35 (18.5%)	1.02 (0.7 to 1.5)
Family in debt		p=0.04		p=0.10
No	56 (3.6%)	1	262 (16.6%)	1
Yes	43 (5.4%)	1.53 (1.0 to 2.3)	162 (20.1%)	1.26 (1.0 to 1.6)
Hunger in past 3 months		p=0.24		p=0.04
No	93 (4.1%)	1	401 (17.4%)	1
Yes	8 (6.4%)	1.61 (0.8 to 3.4)	31 (24.8%)	1.57 (1.0 to 2.4)

Table 3 Association of gender disadvantage factors with STI and BV/candida in a community sample of women in Goa, India

Factor	Prevalence of STI (n=2414)	Adjusted OR* (95% CI)	Prevalence of BV (n=2432)	Adjusted OR† (CI)
Age at marriage‡		p trend = 0.37		p trend = 0.01
<18 years	11 (7.7%)	1	42 (29.4%)	1
19–20 years	28 (6.7%)	1.12 (0.5 to 2.4)	92 (21.9%)	0.73 (0.5 to 1.2)
21–24 years	21 (3.5%)	0.63 (0.3 to 1.4)	117 (19.3%)	0.64 (0.4 to 1.0)
>25 years	23 (4.4%)	0.87 (0.4 to 2.0)	92 (17.3%)	0.55 (0.3 to 0.9)
Husband verbal abuse‡		p=0.22		p=0.05
No	65 (4.5%)	1	279 (19.3%)	1
Yes	18 (7.2%)	1.44 (0.8 to 2.5)	64 (25.0%)	1.38 (1.0 to 1.9)
Husband physical abuse‡		p=0.36		p=0.01
No	71 (4.6%)	1	296 (19.2%)	1
Yes	12 (7.5%)	1.37 (0.7 to 2.6)	47 (29.2%)	1.65 (1.1 to 2.4)
Husband sexual abuse‡		p=0.73		p=0.03
No	79 (4.9%)	1	322 (19.7%)	1
Yes	4 (6.6%)	1.21 (0.4 to 3.5)	21 (32.8%)	1.89 (1.1 to 3.3)
Concern about husband's habits‡		p=0.09		p=0.02
No	68 (5.1%)	1	252 (18.8%)	1
Yes	15 (4.1%)	0.61 (0.3 to 1.1)	91 (25.3%)	1.42 (1.1 to 1.9)
Social integration		p=0.006		p=0.74
High	27 (3.6%)	10	127 (16.6%)	1
Medium	21 (2.6%)	0.68 (0.4 to 1.2)	142 (17.8%)	1.08 (0.8 to 1.4)
Low	53 (6.2%)	1.54 (0.9 to 2.5)	163 (18.8%)	1.10 (0.8 to 1.4)
Family support		p=0.46		p=0.07
High	47 (3.7%)	1	199 (15.7%)	1
Medium	33 (4.8%)	1.38 (0.9 to 2.2)	132 (19.1%)	1.25 (1.0 to 1.6)
Low	21 (4.5%)	1.10 (0.6 to 1.8)	101 (21.4%)	1.32 (1.0 to 1.7)
Autonomy		p=0.10		p=0.48
High	39 (4.8%)	1	143 (17.6%)	1
Medium	32 (3.1%)	0.66 (0.4 to 1.1)	183 (17.6%)	1.13 (0.9 to 1.5)
Low	30 (5.2%)	1.09 (0.7 to 1.8)	106 (18.2%)	1.17 (0.9 to 1.6)

*Adjusted for age, literacy, number of children in household, tap water in house, debt, and marital status.

†Adjusted for age, ethnicity, number of bedrooms in household, and marital status where applicable.

‡Among married women only.

categorical variables, and tests for non-linearity were carried out as appropriate. If there was no evidence of non-linearity, a p value for trend is shown; otherwise the p value shows significance of the categorical variable. All factors that remained significantly associated with the outcome ($p \leq 0.1$) in this model were retained. Next, the association between each outcome and gender and reproductive health risk factors were assessed, adjusting for socioeconomic factors. Stata 8.2 was used for all analyses.

RESULTS

Of the 3000 randomly selected women, 2494 (83.1%) consented to participate in the study. The most common reasons for refusal were that the woman did not have time to participate (52.4%) or that a family member had not given permission (18.8%). Women who consented differed significantly from those who refused. Refusers were more likely to be ethnic Goans (9.9% v 1.6%, $p < 0.001$), Christian (39.7% v 22.2%, $p < 0.001$), unmarried (41.4% v 26.7%, $p < 0.001$), younger in age (mean 31.3 years versus 32.3 years, $p = 0.01$), and to have completed more years of education (10.2 years versus 8.4 years, $p < 0.001$). About half the interviews were conducted in the woman's home, the remainder being conducted in the field research centre.

Burden of RTIs

The number of missing values for specific RTI diagnoses ranged from 6/2494 (0.2%) for TV to 71/2494 (2.8%) for CT infection. The primary reasons for missing values for BV and candida were inadequate smears (57/62 for both) and for CT and NG was inhibition of the PCR sample (48/71 and 48/69 respectively). Women with missing STI data were significantly ($p < 0.05$) more likely to have a larger household size, and those with missing BV/candida were significantly more likely to be older and less educated. There were no significant differences for missing values of STIs whether specimens were

collected by self administered swabs at home or by the gynaecologist at the clinic, but missing BV/candida data were more common among women who had the specimen collected at home (3.8%) rather than the clinic (2.3%) $p = 0.08$.

Table 1 presents the prevalence of RTIs. While the overall burden of RTIs was high (28.3%), the prevalence of STI was relatively low (4.2%). BV was the most prevalent RTI (17.8%), and a quarter of participants (24.9%) had either BV or candida.

Socioeconomic determinants

The majority of participants were Hindu (74.6%); most of the remainder were Christian (22.2%); 356 (14.3%) participants were unable to read or write. The majority of participants were homemakers (66.7%). Over a third of participants (36.1%) had no toilet facility of any kind. A third of households (33.3%) were currently in debt but the experience of hunger in the recent 3 months was uncommon (5.2%). Table 2 shows the univariate associations of socioeconomic factors with any STI and BV, respectively. Older age, being married (an indicator of being sexually active in this population), having lower education, smaller household size, lack of access to a toilet in the home, and economic difficulties were associated with the risk of both any STI and BV. Risk factors for candida (results not shown) indicated that candida was associated with younger age, being non-Muslim, fewer children in the household, and not having tap water in the house.

On multivariate analyses, the risk of STI was significantly higher among women who were married (OR = 2.78, CI 1.25 to 5), illiterate (OR = 1.78, CI 1.1 to 2.9), had fewer than three children in the household (OR = 2.15, CI 1.3 to 3.5), and who had no tap water in the household (OR = 1.51, CI 1.0 to 2.3) or the family were in debt (OR = 1.42, CI 0.9 to 2.2). The risk of BV increased significantly with older age (p value for trend = 0.07), being married (OR = 1.54, CI 1.0 to 2.3), being a migrant (OR = 1.44, CI 1.0 to 2.0), and living in

Table 4 Association of reproductive health factors with STI and BV/candida in a community sample of women in Goa, India

Factor	Prevalence of STI	Adjusted OR* (95% CI)	Prevalence of BV	Adjusted OR† (CI)
Ever pregnant		p=0.02		p=0.74
Yes	75 (4.5%)	1	345 (20.5%)	1
No	26 (3.5%)	2.71 (1.2 to 6.0)	87 (11.6%)	0.91 (0.5 to 1.5)
Age at first pregnancy‡		p=0.10		p=0.50
<20 years	19 (7.6%)	1	60 (24.2%)	1
20–29 years	53 (4.2%)	0.60 (0.3 to 1.1)	258 (20.1%)	0.84 (0.6 to 1.2)
30–39 years	3 (2.0%)	0.31 (0.1 to 1.1)	27 (18.1%)	0.74 (0.4 to 1.3)
Pregnancy past year‡		p=0.41		p=0.30
No	67 (4.7%)	1	378 (17.4%)	1
Yes	8 (3.3%)	0.72 (0.3 to 1.6)	54 (21.3%)	1.21 (0.8 to 1.7)
No of pregnancies‡		p=0.40		p=0.08
1	26 (3.5%)	1	134 (17.9%)	1
2	36 (4.8%)	1.19 (0.7 to 2.1)	177 (23.3%)	1.35 (1.0 to 1.8)
3+	13 (7.6%)	1.75 (0.8 to 3.9)	34 (19.8%)	1.11 (0.7 to 1.7)
Lifetime induced abortions‡		p=0.03		p=0.47
No	66 (5.1%)	1	274 (20.9%)	1
Yes	9 (2.5%)	0.48 (0.2 to 1.0)	71 (19.3%)	0.90 (0.7 to 1.2)
Infertility in past year‡		p=0.60		p=0.63
No	72 (4.7%)	1	316 (20.4%)	1
Yes	11 (7.4%)	1.24 (0.6 to 2.7)	27 (17.9%)	0.90 (0.6 to 1.4)
Use of intrauterine contraceptive device§		p=0.15		p=0.55
No	82 (5.1%)	1	327 (20.1%)	1
Yes	1 (1.4%)	0.30 (0.04 to 2.2)	16 (21.9%)	1.20 (0.7 to 2.1)
Sterilised§		p=0.04		p=0.12
No	51 (4.1%)	1	240 (18.9%)	1
Yes	32 (7.3%)	1.71 (1.0 to 2.8)	103 (23.6%)	1.25 (0.9 to 1.6)
Condom use§		p=0.53		p=0.02
No	94 (4.2%)	1	325 (20.9%)	1
Yes	7 (4.6%)	1.31 (0.6 to 3.0)	18 (12.4%)	0.56 (0.3 to 0.9)
Oral contraceptive use§		p=0.16		p=0.003
No	101 (4.3%)	1	341 (20.6%)	1
Yes	0 (0%)	0	2 (4.6%)	0.19 (0.1 to 0.8)
Concerns about husband's affairs		p=0.04		p=0.98
No	79 (4.7%)	1	338 (20.1%)	1
Yes	4 (17.4%)	3.97 (1.3 to 12.3)	5 (20.8%)	0.99 (0.4 to 2.7)
Husband away from home§		p=0.56		p=0.93
Never	70 (4.8%)	1	296 (20.2%)	1
Sometimes	7 (5.9%)	1.41 (0.6 to 3.2)	25 (20.3%)	1.09 (0.7 to 1.7)
All the time	6 (5.2%)	1.44 (0.6 to 3.5)	22 (18.8%)	1.01 (0.6 to 1.7)
Sex outside marriage§		–		p=0.95
No	83 (4.9%)	–	341 (20.2%)	1
Yes	0/9 (0%)	–	2 (18.2%)	0.95 (0.2 to 4.5)

*Adjusted for age, literacy, number of children in the household, tapwater in the house, debt, and marital status where applicable.

†Adjusted for age, ethnicity, number of bedrooms in household marital status where applicable.

‡Among ever pregnant women only.

§Among married women only.

a house with fewer rooms (p value for trend = 0.004). The risk of candida was significantly higher among women who were older (p value for trend = 0.003), were Christian or Hindu rather than Muslim (OR = 5.26, CI 0.7 to 38.3), were not married (OR = 2.91, CI 1.7 to 5.0), did not have tap water in the household (OR = 1.30, CI 1.0 to 1.7), and had fewer than three children in the household (OR = 1.74, CI 1.1 to 2.8).

Gender determinants

Table 3 shows the association of gender disadvantage factors with STI and BV. After adjusting for socioeconomic factors, STI was associated with a low social integration score. BV was associated with younger at marriage (p trend = 0.01), reported husband's verbal abuse, physical abuse, and sexual abuse, concern about husband's habits, most commonly alcohol consumption, and a low level of family support. Candida was not associated with any of the gender determinants.

Reproductive health determinants

Analyses of reproductive health factors, after adjustment for socioeconomic factors (table 4) showed that STI was more common among participants who had never been pregnant, had a younger age at first pregnancy or were sterilised, and

concern about a husband's extramarital affairs. STIs were less common among participants who reported having had an induced abortion. Among married women, BV was significantly less common among women reporting that their main contraceptive method was condom use or the oral contraceptive pill than among women reporting no contraceptive use, or other methods. Candida was not associated with any of the reproductive health variables.

Table 5 shows associations of STI and BV with gynaecological complaints reported to the field worker. There was little association of STI with any reported complaints from the woman, although the report that a participant's husband also had a discharge was strongly associated with cervical infections (OR 6.91, 1.4 to 33.2). None of the individual symptoms were statistically significantly associated with BV, but women who reported any symptom were at higher risk (OR = 1.23, CI 1.0 to 1.5). The strength of the associations was not affected by whether the symptom was current, associated with fever, or of long duration. However, among the 355 women reporting a vaginal discharge, those with STI and BV were more likely to have a coloured discharge than a white/clear discharge (STI: OR = 3.58, CI 1.1 to 11.7; BV: OR = 1.67, CI 0.9 to 3.1). There was little association of reported symptoms with candida (results not shown).

Table 5 Association of STI and BV with gynaecological complaints reported to field worker

Factor	Prevalence of STI (n=2414)	Crude OR (95% CI)	Prevalence of BV (n=2432)	Crude OR (95% CI)
Vaginal discharge		p=0.44		p=0.24
No	89 (4.3%)	1	361 (17.4%)	1
Yes	12 (3.4%)	0.80 (0.4 to 1.5)	71 (20.0%)	1.19 (0.9 to 1.6)
Itching in genitals		p=0.39		p=0.42
No	83 (4.0%)	1	362 (17.5%)	1
Yes	18 (5.0%)	1.27 (0.7 to 2.1)	70 (19.3%)	1.13 (0.8 to 1.5)
Sores in genitals		p=0.30		p=0.25
No	99 (4.3%)	1	412 (17.6%)	1
Yes	2 (2.2%)	0.51 (0.1 to 2.1)	20 (22.5%)	1.36 (0.8 to 2.3)
Pain in abdomen		p=0.17		P=0.20
No	82 (4.0%)	1	369 (17.6%)	1
Yes	19 (5.6%)	1.45 (0.9 to 2.4)	63 (18.6%)	1.07 (0.8 to 1.4)
Dysuria		p=0.86		p=0.23
No	92 (4.2%)	1	385 (17.5%)	1
Yes	9 (4.0%)	0.94 (0.5 to 1.8)	47 (20.7%)	1.23 (0.9 to 1.7)
Dyspareunia*		p=0.72		p=0.28
No	79 (5.0%)	1	319 (19.9%)	1
Yes	4 (4.2%)	0.83 (0.3 to 2.3)	24 (24.5%)	1.31 (0.8 to 2.1)
Husband white discharge*		p=0.03		p=0.26
No	4 (2.2%)	1	39 (21.0%)	1
Yes	3 (13.6%)	6.91 (1.4 to 33.2)	7 (31.9%)	1.76 (0.7 to 4.6)
Any of the above symptoms		p=0.16		p=0.06
None	59 (3.8%)	1	264 (16.7%)	1
Any	42 (5.0%)	1.34 (0.9 to 2.0)	168 (19.8%)	1.23 (1.0 to 1.5)

*Among married women only.

DISCUSSION

We report a high prevalence of RTIs in a relatively stable population of women in India, living in a state with a moderate prevalence (0.5–1%) of HIV/AIDS (www.nacoonline.org/index.htm accessed 14 April 2005). Endogenous infections were the most prevalent (24.9%) and BV was the most common infection; the three sexually transmitted infections (CT, NG, TV) were relatively infrequent (4.2%). Older and married women, and those who were socioeconomically disadvantaged—for example, being a migrant, being illiterate, not having access to tap water, living in a small home, and being in debt, had a greater risk for RTI. The main limitation of our study is the possibility of a selection bias because of the refusal to participate (particularly of younger women, also reported in other studies¹⁵). We did not include all STIs, such as viral STIs and syphilis. We did not have independent data on spousal sexual behaviour or symptoms. However, to the best of our knowledge, this is the largest population based study of RTI in women in India, and one of the largest from any developing country. We used gold standard diagnostic tests and ensured high levels of quality assurance. We used standardised and locally validated measures of risk factors and symptoms. Despite the invasive nature of the study, we enjoyed good participation rates.

The main similarity of our findings with those reported from the few Asian population based studies of RTI is the confirmation that, although rates of RTIs are high, the majority of RTIs are endogenous and BV is the commonest RTI. Cervical STIs are uncommon. In a review of studies of RTIs in south Asia,² rates of cervical infections were reported to range from 0–5.2% while those of TV rates were higher (0.8–14.0%). A recent population based study from rural south India reported higher rates of gonorrhoea (3.6%) and trichomoniasis (5.2%).¹⁶ Our rates fall within the lower end of these ranges, perhaps reflecting the relatively lower levels of social disadvantage in this community compared to other communities in India.⁹ A similar study from the Gambia reported very low rates of NG (as low as 0%) and comparable rates of CT.¹⁵ On the other hand, a study from Peru showed much higher rates of all RTIs (70.4%), and CT (6.8%).¹⁷ Rates of RTIs/STI are not consistently higher in studies of women attending health centres with the complaint of vaginal discharge; for example, while in a New Delhi study,¹⁸ rates were high (12.2% CT; 10% TV), a similar study in primary

care in Bangladesh reported rates comparable to our study.¹⁹ The higher New Delhi study rates possibly reflect the low income urban demographic characteristics of the sample.

Gender disadvantage, particularly spousal violence, was consistently associated with BV; this may reflect the lack of control women have over their hygiene and possible effects of stress on vaginal flora. Low social integration and concern about a husband's extramarital relationships, a potential indicator of sexual risk, were associated with STI; however, other indicators of gender disadvantage were not associated with STI. We are not aware of other studies that report on risk of gender disadvantage and there are inconsistent findings regarding other risk factors; in west African studies with health centre attenders, older age, marital status, or having a new sexual partner in the previous 3 months were associated with CT/NG.²⁰ Younger age, unemployment, and lack of financial support were associated with STIs in South Africa.²¹

After adjustment for socioeconomic factors, STI were less common among women who had been pregnant and who had had abortions, perhaps reflecting the role of chlamydia on fertility. The use of contraception, particularly oral contraceptives and condoms, was associated with a reduced risk for BV. These associations have been seen in previous studies.^{22–23} The reduced risk of BV among women using oral contraceptives may result from oestrogens stimulating vaginal epithelial cells to produce more glycogen.^{24–25} This creates a more favourable environment for lactobacilli and thus may prevent colonisation by anaerobes. The increased risk among women not using condoms may be another marker of gender disadvantage in our setting; condom use is rare among men and is attributed to the lack of control women have over their sexual health. Sterilisation was associated with higher risk for STI, perhaps owing to the fact that women who have been sterilised are less likely to engage in protected sexual intercourse because of the absence of risk of an unwanted pregnancy. With regard to clinical symptoms, only a non-white vaginal discharge showed a significant association with STI and BV. Presence of any genital symptom was significantly associated with BV.

Thus, rates and risk factors for RTI/STI are likely to be highly dependent on local contextual factors, such as poverty, gender disadvantage, and contraceptive use, and findings from one

Key messages

- The prevalence of RTI among women aged 18–50 years living in a relatively stable community in a relatively well developed region of India is high. An STI (gonorrhoea, chlamydia, or trichomoniasis) was detected in 4.2% of the sample
- Socioeconomic deprivation and gender disadvantage were associated with raised risk for BV while the use of oral contraceptives or condoms was associated with reduced risk
- The risk for STI was greatest in poorer, socially isolated, older, married women whose husbands were engaged in extramarital relationships and had a genital discharge
- Women's gynaecological complaints had little association with either infection

study cannot be generalised to any other population. We confirm the role of gender disadvantage for the risk of RTI, though this is most marked only for BV. The risk factors for STIs indicated that disadvantaged women were likely to be infected by their husbands; thus, women who were older, less educated, married and poorer, who had concerns regarding their husband's extramarital relationships, whose husbands also had a genital discharge, and who were socially isolated had higher risks. It is often clinically easier and more effective to diagnose and treat men with STIs than women in resource poor settings and this may prove to be an effective strategy in controlling the spread of STIs, and reducing the burden in women.²⁶ Women who have had a sterilisation operation should be informed that the risk for STI is not reduced through this intervention. Although the population prevalence of RTIs is high, the bulk of the burden comprises endogenous infections for which treatment is not always necessary for asymptomatic women.^{27–28} The feasibility of self administered swabs¹⁰ and relatively cheap and simple diagnostic tests for endogenous infections may make this a reasonable way of identifying infections in symptomatic women.

CONTRIBUTORS

VP, design of the study, analysis and interpretation of data, drafting of the manuscript; HAW, design of the study, analysis and interpretation of data, drafting of the manuscript; DM, design of the study, analysis and interpretation of data, approval and correction of the manuscript; BW, supervision and quality assurance of the microbiological aspects of the study, approval and correction of the manuscript; SD'S, acquisition of data (laboratory diagnostics), approval, and correction of the manuscript; VP, acquisition of data (laboratory diagnostics), approval, and correction of the manuscript; PN, design of the study, supervision and quality assurance of the clinical gynaecological aspects of the study, approval and correction of the manuscript; SG, design of the study, supervision and quality assurance of the clinical gynaecological aspects of the study, approval, and correction of the manuscript; BRK, design and analysis of the study, approval, and correction of the manuscript.

ACKNOWLEDGEMENTS

This study was funded by a Wellcome Trust Career Development Fellowship in Clinical Tropical Medicine to VP. We are grateful to the Directorate of Health Services, Government of Goa, which has collaborated with the project from its inception. We are grateful to Dr Suhas Lavanis and Dr Arvind Salelkar for their support of the study in the DHS; Tamara Hurst and Fiona Marquet in London, and Anil Pandey

in India for their administrative support to the project. Finally, we acknowledge the contribution of the research team of the Stree Arogya Shodh Project and the women who participated in this research.

Authors' affiliations

V Patel, H A Weiss, D Mabey, B R Kirkwood, London School of Hygiene and Tropical Medicine, Keppel Street, London, UK
V Patel, B West, S D'Souza, V Patil, S Gupta, Sangath, 831/1 Alto-Parvorim, Goa, India
P Nevrekar, Goa Medical College, Bambolim, Goa, India

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