Original Article

Prevalence and Risk Factors of Trichomoniasis, Bacterial Vaginosis, and Candidiasis for Married Women of Child-Bearing Age in Rural Shandong

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SUMMARY: The aim of this study was to examine the prevalence rates and risk factors for reproductive tract infections (RTIs) among married women of reproductive age in a rural area of Shandong Province in China. A population-based cohort of 4,039 married women of reproductive age was cluster-randomly selected from the local birth control registry. All subjects underwent clinical and microbiological tests and an interview in the form of a standardized questionnaire. The prevalences of trichomoniasis, bacterial vaginosis (BV), and candidiasis as diagnosed by clinical tests were 2.8, 5.9, and 3.1%, respectively. The infection rates of *Trichomonas*, BV, and *Candida* were 2.9, 6.6, and 3.9%, respectively. The infection rates of gonorrhea and syphilis were low and no cases of HIV infection were found. After adjustment for confounding factors the risk factors for trichomoniasis were income higher than $200, lack of knowledge about sexually transmitted diseases, and marriage to a businessmen. For candidiasis the risk factors were three or more abortions, income higher than $200, age of 30 - 39 years, and women with extramarital sex partner(s). For BV the risk factors were three or more abortions and age of 30 - 39 years. The prevalence of RTI/sexually transmitted infection (STI) and the risk behavior observed in this study indicate a need for primary programs to prevent the increase of RTI/STI and HIV infections in rural areas.

INTRODUCTION

In recent years there has been growing concern about reproductive tract infections (RTIs), especially those that are sexually transmitted. The serious threat posed by the AIDS epidemic has resulted in more attention to the prevention of RTI/sexually transmitted diseases (STDs), and particularly to the goal of lowering the increased morbidity of STDs in China. It is, therefore, worthwhile to screen all women of reproductive age for various RTIs so that appropriate interventions can be planned and initiated. However, no epidemiological data have been gathered and no functional surveillance system has been established for such infections, except human immunodeficiency virus (HIV) infection. In addition, there has been no population-based survey for RTI. We therefore conducted a population-based survey of RTI/ sexually transmitted infection (STI) prevalence in married women of reproductive age from September to October of 2004 in a rural area of Shandong Province to determine the prevalence rates and risk factors for RTIs. This paper reports the results related to the prevalence and risk factors of trichomoniasis, bacterial vaginosis (BV), and candidiasis.

MATERIALS AND METHODS

Study site and population: The study was undertaken in three counties (Zhucheng, Zhangqiu, and Daiyue) of a rural area of Shandong. The Shandong Medical Sciences Ethical Committee authorized the program after considering all conceivable ethical issues. A random cluster of married women aged 20 - 49 years was drawn from the local birth control registry, which was set up in 1995 in both the city and rural area of Shandong. The registry includes data on each woman of child-bearing age such as the woman's name, birth date, age, date of marriage, target date in the case of planned pregnancy, number of children, date of delivering children and children's health status, birth control methods used and the dates they were started, changes in the birth control methods used, and husband's age, education level, and occupation. The participants were informed that they would be tested for RTIs and STIs and that they would be offered free treatment if found to be infected. Informed consent was obtained in all cases. An HIV test was carried out using unlinked anonymous screening test.

The purpose of the study was explained to all eligible women. Each woman who agreed to participate attended a clinical examination and was privately interviewed about her sociodemographic data and reproductive history, history of any odorous vaginal discharge and sexual behavior. For purposes of the questionnaire, a sex partner was defined as someone who had sexual relations with the interviewee in the preceding year, questions about condom use were limited to the 2 preceding years, the abortions consisted of both artificial abortions and natural abortions since marriage, and the number of STDs known by the participants at present was based on the knowledge or ignorance of five STDs (gonorrhea, syphilis, HIV, trichomoniasis, and viral hepatitis type B). The years of education were calculated as follows: completion of primary school was scored as six, completion of junior high school as nine, and completion of senior high school as 12 school years. The income per person-year comes from the total income of the family divided by the number of persons in the family. The husband's occupation was classified as factory work, farm work, or business.

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A physician conducted a comprehensive physical examination including a speculum-based examination of the cervix and vagina. Samples were taken for laboratory diagnosis of vaginal and cervical infections: a high vaginal swab for BV and *Candida* spp., a posterior fornix swab for *Trichomonas vaginalis*, and an endocervical swab from a cleaned cervix for *Neisseria gonorrhoeae*, *Chlamydia* and *Ureaplasma urealyticum*. A blood sample was obtained for the diagnosis of syphilis and HIV. All women with symptoms and signs of RTI were treated immediately according to management flow charts.

Laboratory methods: Vaginal wet mounts were immediately examined for evidence of candidiasis. BV was diagnosed on the basis of the criteria by Amsel et al. (1). At least three of the following four criteria needed to be present for the diagnosis to be confirmed. (i) Thin, white, homogeneous discharge. (ii) Clue cells on microscopy. (iii) pH of vaginal fluid >4.5. (iv) Release of a fishy odor on adding alkali (10% KOH). Trichomoniasis was considered to be present if microscopic examination revealed *Trichomonas*. The diagnosis of *Chlamydia* infection was determined by golden colloid immunity diffuse test. *U. urealyticum* was diagnosed by the broth culture method. Gonorrhea was identified using a gram stain done on material taken from the cervical canals site; the bacteria appeared as small Gram-negative diplococci (pairs of round bacteria) inside white blood cells, and a plate with special culture medium called Thayer-Martin (TM) medium was used. The diagnosis of syphilis was made at first by the rapid plasma reagin (RPR) test, and if the results were positive, then treporema pallidum particle agglutination (TPPA) was used to specifically detect the patient's immune response to syphilis. The presence of HIV antibody was tested with a commercial sandwich enzyme-linked immunosorbent assay (ELISA) and confirmed with a Western blot assay (2-5).

Teams of gynecological doctors, laboratory technicians, and health workers in the country family planning stations were trained together for half a month and then separately conducted the screening survey.

Case-control study: In order to analyze the risk factors of infectious trichomoniasis, BV, and candidiasis, a multinomial case-control study was designed. The women infected with trichomoniasis, BV, and candidiasis were treated as three respective groups and women without any RTI as a control group.

Statistical methods: Data was entered twice using FoxPro software and analyzed using SPSS 10.0 software. The infection prevalence was calculated, and risk factors for all infections were examined individually using cross-tabulations and chi-square test. Sociodemographic risk factors were examined in relation to STIs. Bivariate analysis was undertaken to seek associations with the presence of these infections. Sociodemographic and hygiene-related factors were examined as risk factors for trichomoniasis, BV, and candidiasis. The odds ratio (OR) and 95% confidence interval (95% CI) were listed after adjustment for possible confounding factors using a multinomial logistic regression model.

RESULTS

A total of 4,494 married women of reproductive age were selected systematically from the local birth control registry for interview. The participation rate was 92.3% (4,147/4,494). Among the participants, 68 women were pregnant, and the data for 40 women were not complete, so only the data of 4,039 women were analyzed.

The sociodemographic characteristics of the participants showed that the mean age was 36.3 ± 6.84 years, the education period was 6.3 ± 3.89 years, and the total number of pregnancy times were 1.82 ± 0.91. The mean income per person-year was $300 ± 260, and the contraceptive use was as follows (number and percent): no use, 286 (7.1%); intrauterine contraceptive device (IUD), 2,833 (70.1%); tubectomy, 737 (18.2%); sperm duct ligation, 77 (1.9%); oral contraception, 14 (0.3%); condom, 86 (2.1%), and other method, 6 (0.1%). The rates of current odorous vaginal discharge in the four groups of subjects with trichomoniasis, subjects with candidiasis, subjects with BV, and controls were 51.8, 37.3, 67.9, and 0.6%, respectively. The rates of past odorous vaginal discharge in the four groups were 48.7, 46.8, 51.1, and 16.9%, respectively.

Prevalence of RTIs: The prevalences of RTIs as diagnosed by clinical examination are shown in Table 1. The prevalences of trichomoniasis, BV, and candidiasis were 2.8, 5.9, and 3.1%, respectively.

The prevalences of pathogenic agents of RTIs as detected by laboratory tests are shown in Table 2. The positive rates of *Trichomonas* and *Candida* were 2.9 and 3.9%, respectively. The prevalence of patients whose epithelial cell samples consisted of more than 20% clue cells (BV-positive patients) was 6.6%.

Risk factors of infectious *Trichomonas*, BV, and *Candida*: Based on a laboratory test to identify the pathological agents, there were 115 women infected with *Trichomonas* (Group 1), 127 with *Candida* (Group 2), and 241 with BV

Table 1. Low reproductive tract infections (RTIs) in married
women of child-bearing age

Type of RTIs	Infection no. (n = 4,039) (%)
Trichomoniasis	115 (2.8)
Bacterial vaginosis	239 (5.9)
Candidiasis	126 (3.1)
Cervical hypertrophy	997 (24.7)
Gently cervical erosion	230 (5.7)
Midrange cervical erosion	156 (3.9)
Serious cervical erosion	57 (1.4)
Hysteromyoma	63 (1.6)
Gerontism vaginitis	7 (0.2)
Metra-resection	12 (0.3)
Ovario-resection	3 (0.1)
Ovario tumor	2 (0.05)
Prolapse of uterus	2 (0.05)
Other disorders	101 (2.5)

Table 2. Prevalence of RTIs pathogenic agents
detected by laboratory test

Agent type	Positive no. (%)[1]
Trichomonas	115 (2.9)
Bacterial vaginosis	264 (6.6)
Candida	154 (3.9)
Ureaplasma ureatytium	104 (2.6)
Chlamydia	36 (0.9)
Gonorrhea	4 (0.1)
Syphilis	2 (0.04)
HIV	0 (0.0)

[1]: The whole number of participants in laboratory
tests was 4,001.

Table 3. Odds ratios of trichomoniasis, candidiasis, and BV associated with potential risk factors

Factors	Control[1] (n = 537)	Group 1[1] (n = 115)	Group 2[1] (n = 127)	Group 3[1] (n = 241)	Group 1 OR[2]	Group 1 95%CI	Group 2 OR[2]	Group 2 95%CI	Group 3 OR[2]	Group 3 95%CI
Age (year)										
20-29	18.4	10.5	18.1	20.4	0.6	0.3-1.2	1.3	0.7-2.4	1.5	1.0-2.4
30-39	44.7	47.0	56.7	53.1	1.0	0.6-1.7	1.7	1.1-2.7	1.7	1.1-2.4
40-49	36.9	42.6	25.2	26.6	1.0					
Income ($)										
400+	23.1	32.2	32.3	27.8	2.14	1.18-3.88	1.90	1.08-3.34	1.15	0.75-1.78
200-400	35.9	43.5	41.7	34.0	1.90	1.11-3.27	1.68	1.00-2.80	0.95	0.65-1.40
<200	41.0	24.3	26.0	38.0	1.00		1.00		1.00	
School years										
none	26.8	21.7	17.3	23.7	0.86	0.31-2.39	0.42	0.18-1.00	0.76	0.36-1.59
≤6	25.9	18.3	24.4	23.7	0.73	0.26-2.00	0.47	0.21-1.04	0.66	0.32-1.37
9-12	42.6	54.8	48.0	46.5	1.15	0.45-2.95	0.46	0.22-1.00	0.76	0.38-1.50
12+	4.7	5.2	10.2	6.2	1.00		1.00	1.00	1.00	
Husband was a businessman										
yes	13.4	26.1	14.0	17.0	1.8	1.1-3.1	0.8	0.4-1.4	1.2	0.6-1.8
no	86.6	73.9	86.0	83.0		1.0				
Husband had extramarital sex partner										
yes	2.7	5.3	1.6	2.6	2.2	0.8-5.9	0.6	0.1-2.7	0.9	0.3-2.4
no	97.3	94.7	98.4	97.4	1.0					
Women had extramarital sex partner										
yes	0.2	–	2.4	1.3	–	–	10.5	1.1-103.4	6.6	0.7-64.8
no	99.8	100.0	97.6	98.7						
Months of condom use										
0	94.4	95.7	92.1	91.7	4.7	0.6-37.0	1.1	0.3-4.1	0.9	0.3-2.4
<6	3.4	3.5	5.5	5.8	4.1	0.4-42.3	1.6	0.3-7.5	1.5	0.4-5.0
6+	2.2	0.9	2.4	2.5	1.0					
Abortion number										
3 and over	0.6	0.9	3.9	2.9	1.3	0.1-12.5	7.5	1.7-32.9	7.1	1.8-28.3
2	4.8	7.8	5.5	5.0	1.4	0.6-3.1	1.2	0.5-2.8	1.3	0.6-2.7
1	17.1	20.9	18.1	25.3	1.1	0.7-1.9	1.0	0.6-1.7	1.7	1.2-2.5
0	73.5	70.4	72.4	66.8	1.0					
Knowledge of five STDs[3]										
1	12.5	15.6	8.7	19.9	10.4	1.3-82.9	1.2	0.4-3.5	1.2	0.6-2.4
2	10.1	16.7	11.5	12.0	13.2	1.6-105.5	1.7	0.6-5.0	0.9	0.4-1.8
3	20.3	19.8	23.1	15.7	8.1	1.0-63.2	1.7	0.6-4.5	0.6	0.3-1.1
4	47.6	46.9	51.0	39.8	6.7	0.9-50.9	1.4	0.5-3.5	0.6	0.3-1.0
5	9.4	1.0	5.8	12.6	1.0					

[1]: The women infected with trichomoniasis (Group 1), candidiasis (Group 2), bacterial vaginosis (Group 3), and women without any reproductive tract infectios (Control).
[2]: The ORs adjusted for age, income and education.
[3]: STDs: gonorrhea, syphilis, HIV, trichomoniasis, and viral hepatitis type B.

(Group 3), and 537 women without infections were selected from the survey sample as a control group. After all factors had been analyzed by univariate analysis, the age, education and income were found to be associated with STIs, and thus were treated as confounding factors. As shown in Table 3, after adjustment, the factors that remained significantly associated with trichomoniasis were lack of knowledge about STDs, income higher than $200, and marriage to a businessman. Two potential risk-increasing factors were absence of condom use and marriage to a man with extramarital sex partners, although the 95% CIs included 1.0. For candidiasis the risk factors were income higher than $200, women experienced three or more abortions, age of 30-39 years and extramarital sex partners. For BV the highest risk factor was age of 30-39 years, and there was a strong association between BV and three or more abortions (OR = 7.1, 95% CI:

1.8-28.3). No correlation was found between the three RTIs and IUD use or other factors.

The relative risk and distribution of frequency of women's age combined with number of abortions are shown in Table 4 and Table 5. As shown in Table 5, an age of 40-49 years and no abortions was treated as a reference category. Adjustments were made for education and income as confounding factors. For subjects who had experienced no abortions, younger age tended to protect against trichomoniasis, and to be a risk factor for candidiasis and BV, but none of these trends reached the level of statistically significance. For women with one abortion, younger age significantly increased the risk of candidiasis and BV. For women with two or more abortions, younger age showed a nonsignificant tendency to increase the risk for trichomoniasis, and young age was associated with a highly significant increase in the risk of candidiasis

Table 4. Distribution of frequency of age combined with times of abortion in the four groups

Age	No. of abortion	Group 1[1] No. (%)	Group 2[1] No. (%)	Group 3[1] No. (%)	Control[1] No. (%)	Total No. (%)
20 -	2 +	–	1 (0.8)	3 (1.2)	1 (0.2)	5 (0.5)
30 -	2 +	5 (4.3)	6 (4.7)	9 (3.7)	13 (2.4)	33 (3.2)
40 -	2 +	5 (4.3)	5 (3.9)	7 (2.9)	15 (2.8)	32 (3.1)
20 -	1	1 (0.9)	5 (3.9)	7 (2.9)	8 (1.5)	21 (2.1)
30 -	1	13 (11.3)	10 (7.9)	41 (17.0)	49 (9.1)	113 (11.1)
40 -	1	10 (8.7)	8 (6.3)	13 (5.4)	35 (6.5)	66 (6.5)
20 -	0	11 (9.6)	17 (13.4)	39 (16.2)	90 (16.8)	157 (15.4)
30 -	0	36 (31.3)	56 (44.1)	78 (32.4)	178 (33.1)	348 (34.1)
40 -	0	34 (29.6)	19 (15.0)	44 (18.3)	148 (27.6)	245 (24.0)
Total		115 (100.0)	127 (100.0)	241 (100.0)	537 (100.0)	1,020 (100.0)

[1]: See Table 3, footnote [1].

Table 5. Adjusted OR for age combined with times of abortion in three groups

Age (year)	No. of abortion	Group 1[1] OR[2]	95%CI	Group 2[1] OR[2]	95%CI	Group 3[1] OR[2]	95%CI
20 -	2 +			6.39	0.36 - 112.17	9.90	1.00 - 98.53
30 -	2 +	1.17	0.38 - 3.65	3.19	1.04 - 9.74	2.42	0.94 - 6.22
40 -	2 +	1.20	0.40 - 3.61	2.15	0.69 - 6.72	1.63	0.62 - 4.29
20 -	1	0.45	0.05 - 3.82	4.41	1.27 - 15.36	3.07	1.04 - 9.06
30 -	1	0.91	0.43 - 1.92	1.30	0.55 - 3.06	2.84	1.62 - 4.97
40 -	1	1.04	0.46 - 2.34	1.55	0.62 - 3.89	1.27	0.61 - 2.64
20 -	0	0.43	0.20 - 0.92	1.29	0.62 - 2.69	1.49	0.88 - 2.54
30 -	0	0.74	0.42 - 1.27	2.22	1.23 - 4.01	1.51	0.96 - 2.37
40 - 49	0	1.00		1.00		1.00	

[1]: See Table 3, footnote [1].
[2]: The ORs adjusted for income and education.

and BV. There was a positive interaction between age and abortion for women who suffered candidiasis and BV.

DISCUSSION

The present study, which employed a cross-sectional survey and laboratory tests to define the presence of RTIs, provided unique information on the burden of biomedically defined diseases in the community. The use of an established birth control registration system for married women provided a highly representative sample of people. We believe that the present study offers important guidelines for future work in this area.

China is in the midst of a major move toward urbanization. There are a large number of migrant workers who are now working in cities. Significant changes are taking place in the number of pregnancies among the migrant population. According to the State Council report, those aged between 16 and 30 account for 61% of the total migrant population; those between 31 and 40 account for 23%; and those older than 41 only account for 16%. The National Bureau of Statistics of China reported that average revenue per annum was $553 for a farmer, of which $322 (58.2%) came from payment for labor revenue in the year 2006 in Shandong Province. One report showed that 4.6% of rural women who relocated to work in cities engaged in extramarital sexual behaviors, compared with 2.8% of women who did not relocate from their villages. And 7.0% of women who worked in cities experienced an artificial abortion before marriage versus 3.0% of women who did not leave the country to work in the city (6). It is well established that the younger generations (those

aged < 30 years) in China have received more years of education. In the study the percentages of women who had received more than 9 years of school were 63.4, 57.5, and 36.1% for the age ranges of 20 - 29, 30 - 39, and 40 - 49 years, respectively. Twenty years ago Chinese women of child-bearing age were subjected to the enforcement of laws against prostitution and extramarital sexual relationships, which would have greatly reduced trans-mission of RTI diseases. In general, socioeconomic factors such as low level of education or economic income, and strong sexual desire are associated with a higher prevalence rate of trichomoniasis (7). However, in the present study we found that a lower level of education was negatively associated with candidiasis, and tended to confer protection against trichomoniasis and BV after adjustment by age and income. The reason may be related to the changes of sex conception in recent years. According to this result, in the analysis of influencing factors we treated the number of years of schooling as a confounder.

Trichomoniasis is not only a "nuisance" disease of women, but also an unpleasant, irritating, and potentially dangerous disease that can go undiagnosed for years and is often passed on by an asymptomatic carrier. "It is the world's most common nonviral STD, and it is strongly associated with an increase in the transmission of HIV" (8). The present study showed that relative ignorance of STDs was a risk factor for trichomoniasis. In China the STD incidence increased quickly after the "Reform and Open" campaign, and there are currently sex workers in many locations throughout China. This has led to transmission from husbands who engage in extramarital sexual activity with sex workers to their wives.

The etiology of candidiasis and BV are not clear. How-

ever, many reports have shown that several factors show some degree of association with candidiasis and BV, including pregnancy, disorders affecting the immune system, uncontrolled diabetes, and recent treatment with antibiotics (9). Our research indicated that abortion and an age of 20-39 years were risk factors for candidiasis and BV. There was a positive interaction between younger age and increased number of abortions for women with candidiasis and BV in the present study. For women with two of more abortions, younger age was associated with a significantly increased risk of candidiasis and BV.

In our study the calculated prevalence of STDs was low, and in fact it may have been underestimated. If so, this may have been because it was difficult to get accurate information in regard to sex partners. In the survey, only two women in the control group and five in the disease groups reported that they had other sexual partners. We also found that women who had extramarital sex partners were at increased risk for candidiasis and BV. However, the rate of women with extramarital sex partners in the control group was 0.2%, while the rate of husbands with extramarital sex partners was 2.7%. However, a study with a large sample will be needed to evaluate this factor.

Before the establishment of the People's Republic of China, 10% of the population in major cities had syphilis, and in rural areas the incidence rate was sometimes as high as 50%. By 1964 STDs in China were virtually eliminated (10). However, STDs reappeared following the economic reform that began in the 1980s. The prevalence of RTIs was high, although gonorrhea and syphilis morbidity was low in the present study. We found the risk factors for RTIs were related to poor perineal and sexual hygiene behaviors and lack of hygiene knowledge. With the introduction of the "One Child Family" and "Reform and Open" campaigns at the end of the 20th century, attitudes toward sex and sexuality changed again. The Chinese have widely accepted premarital sex and have become more tolerant toward extramarital sex. Attitudes towards sex and sexual behavior have been recognized as an individual's responsibility as long as no offense occurs against society or other individuals, and as a result, the diversity of sexual behavior has increased. Heterosexual transmission of STDs is expected to rapidly increase and become the most important route of transmission in rural area (11-14).

The finding in the present study of relatively low levels of STIs and no HIV provides a unique opportunity to prevent a potential epidemic in a rural area. However, the STD rates have increased in recent years and the low level of condom use in the rural areas of modern-day China means that there is no room for complacency. There is a great need for emphasizing culturally acceptable reproductive health education to improve the ability of women to care for themselves in rural areas.

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