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Prevalence of Sexually Transmitted Diseases and Risk Behaviors from the NIMH Collaborative HIV/STD Prevention Trial

David D. Celentano, ScD, MHS^a, Kenneth H. Mayer, MD^b, Willo Pequegnat, PhD^c, Nadia Abdala, DVM, PhD^d, Annette M. Green, MPH^e, H. Hunter Handsfield, MD^f, Tyler D. Hartwell, PhD^e, and National Institute of Mental Health Collaborative HIV/STD Prevention Trial Group

^aDepartment of Epidemiology, Bloomberg School of Public Health, The Johns Hopkins University, Baltimore, MD

^bMiriam Hospital/Brown University Medical School, Providence, RI

^cInternational AIDS Prevention Research, Center for Mental Health Research on AIDS, National Institute of Mental Health, Bethesda, MD

^dDepartment of Epidemiology and Public Health, Yale University School of Medicine, New Haven, CT

^eResearch Triangle Institute International, Durham, NC

^fBattelle Centers for Public Health Research and Evaluation, Seattle, WA

Abstract

This cross-sectional study describes the baseline prevalence and correlates of common bacterial and viral sexually transmitted diseases (STDs) and risk behaviors among individuals at high risk for HIV recruited in five low- and middle-income countries. Correlations of risk behaviors and demographic factors with prevalent STDs and the association of STDs with HIV prevalence are examined. Between 2,212 and 5,543 participants were recruited in each of five countries (China, India, Peru, Russia, and Zimbabwe). Standard protocols were used to collect behavioral risk information and biological samples for STD testing. Risk factors for HIV/STD prevalence were evaluated using logistic regression models. STD prevalence was significantly higher for women than men in all countries, and the most prevalent STD was Herpes simplex virus-type 2 (HSV-2). HIV prevalence was generally low (below 5%) except in Zimbabwe (30% among women, 11.7% among men). Prevalence of bacterial STDs was generally low (below 5% for gonorrhea and under 7% for syphilis in all sites), with the exception of syphilis among female sex workers in India. Behavioral and demographic risks for STDs varied widely across the five study sites. Common risks for STDs included female gender, increasing number of recent sex partners, and in some sites, older age, particularly for chronic STDs (i.e., HSV-2 and HIV). Prevalence of HIV was not associated with STDs except in Zimbabwe, which showed a modest correlation between HIV and HSV-2 prevalence (Pearson coefficient = .55). These findings underscore the heterogeneity of global STD and HIV epidemics and suggest that local, focused interventions are needed to achieve significant declines in these infections.

Keywords

HIV prevention; sexually transmitted diseases; behavioral risk factors; international

INTRODUCTION

The HIV epidemic continues to spread throughout the world despite the concerted efforts of governments, nongovernmental organizations, and international donor organizations. Global estimates are that 35 million individuals are currently infected, and 2.5 million new infections are expected next year (UNAIDS, 2008). Although hope existed that expanded treatment with highly active antiretroviral therapy might slow the epidemic (Granich, Gilks, Dye, De Cock, & Williams, 2009), it is estimated that for every person who receives treatment, six individuals become newly HIV infected (UNAIDS). Determining the biological and behavioral factors driving the epidemic will be pivotal in designing the next generation of HIV and sexually transmitted disease (STD) prevention programs.

This article is based on the U.S. National Institute of Mental Health (NIMH) Collaborative HIV/STD Prevention Trial, designed to test the efficacy of a community popular opinion leader (C-POL) intervention to reduce high-risk HIV-related behaviors in developing countries (NIMH Collaborative HIV/STD Prevention Trial Group, 2007c). The results of this trial are reported elsewhere (NIMH Collaborative HIV/STD Prevention Trial Group, 2010).

The aims of this article are to: (1) describe the distribution of viral and bacterial STDs and associated behavioral risk behaviors among participants recruited in five low- and middle income countries participating in this multisite community-randomized HIV and STD prevention trial; (2) develop models to associate the prevalence of viral and bacterial STDs with identified patterns of risk behaviors in and across the five sites; and (3) determine if the prevalence of STDs is associated with HIV in these five countries.

MATERIALS AND METHODS

Study Design

We conducted a two-arm clustered randomized trial to evaluate the efficacy of a C-POL HIV prevention intervention that was culturally adapted and tailored for use in five countries (China, India, Peru, Russia, and Zimbabwe) compared to a standard AIDS education intervention. Venues (clusters) and at-risk populations were identified in each country (NIMH Collaborative HIV/STD Prevention Trial Group, 2007b) after extensive ethnographic (NIMH Collaborative HIV/STD Prevention Trial Group, 2007d) and epidemiological (NIMH Collaborative HIV/STD Prevention Trial Group, 2007a) studies assessed sexual behavior and prevalent HIV/STDs. Venues were defined as geographically discrete locations in which members of the site's target population lived or extensively socialized. In each country, cohorts were enrolled in 20 to 40 venues and interviewed about HIV-related risk behavior and tested for HIV/STDs at baseline and after 12 and 24 months.

Study Populations

Populations at the five sites were selected on the basis of behavioral risk and prevalence of STDs. The following criteria were applied to select populations: (1) sufficient base rate of STDs and/or sexual risk behavior as measured in epidemiological studies conducted prior to

community randomization; (2) a relatively stable population allowing high rates of follow-up over 24-months; and (3) similar demographic profiles across potential venues within a country (NIMH Collaborative HIV/STD Prevention Trial Group, 2007b, 2007c).

Data Collection

Study outcomes were measured with assessments of sexual risk behaviors using computer-assisted personal interviews administered by a trained interviewer and the testing of biologic specimens for common bacterial and viral STDs at baseline and at 12- and 24-month follow-up visits. At each interview, participants were asked to report their total number of vaginal and anal intercourse acts in the prior 3 months, as well as the number of times when a condom was used during these intercourse acts. Additional information was requested for up to five of the participants' most recent sexual partners during the 3-month recall period. All interviews were conducted in the participants' respective language (Mandarin, Tamil, Spanish, Russian, Shona, or Ndebele; NIMH Collaborative HIV/STD Prevention Trial Group, 2007c).

All participants were asked to provide blood and urine specimens at each assessment visit, and females additionally were asked for vaginal swab specimens. Testing in a study-certified local laboratory was performed to assess HIV, Herpes simplex virus-type 2 (HSV-2), syphilis, gonorrhea, Chlamydia, and *Trichomonas* (women only). HIV testing of blood specimens were performed using HIV enzyme-linked immunosorbent assay (ELISA) repeated at least once and followed by a Western blot confirmatory test if positive. HSV-2 testing of blood specimens was performed using Herpesselect 2 enzyme immunoassay (MRL Focus Technologies, Los Angeles, CA). When results were unclear (e.g., indeterminate, seroreverted), the samples were retested using the Kalon ELISA (Kalon Biological Ltd., Guilford, UK). Syphilis testing was performed by rapid plasma reagin and confirmed using the *Treponema pallidum* particle agglutination test. Vaginal swabs were cultured for *Trichomonas vaginalis* using the InPouch TV 20 test kit (Biomed, San Jose, CA). Urine samples from men and vaginal swabs from women were tested for Chlamydia and gonorrhea DNA using Amplicor CT/NG polymerase chain reaction (Roche, Branchburg, NJ; NIMH Collaborative HIV/STD Prevention Trial Group, 2007c).

Quality Assessment

The trial established and used well-defined quality control (QC) procedures to ensure consistency in data collection across personnel and over time, and it employed careful cross-site quality assessment (QA) monitoring procedures to ensure fidelity to the protocol in the areas of ethnography, assessment, intervention delivery, laboratory test procedures, and STD treatment (NIMH Collaborative HIV/STD Prevention Trial Group, 2007c).

Human Subjects Plan

Several strategies were used to identify and resolve ethical dilemmas in this international trial. First, in consultation with ethicists, the investigators identified key principles in protecting human participants and made recommendations to ensure ethical and equitable treatments to minimize physical, psychological, and social harm to participants. Second, each site had a community advisory board that identified local ethical issues and possible

resolutions for them. Third, the protocols were carefully reviewed by the steering committee, and decisions were carefully documented. Fourth, institutional review board from the United States and the five countries reviewed the protocol and all informed consent documents and strategies to ensure confidentiality (e.g., trained all personnel in ethical conduct, including the van drivers). Fifth, the NIMH established a data safety and monitoring board that had the ultimate responsibility for adjudicating ethical dilemmas and decisions. The primary issues that confronted investigators involved establishing community partnerships, establishing an acceptable standard of care and services offered to both experimental and control participants, and building capacity.

Statistical Analysis

Data were analyzed using statistical analysis system (SAS) (SAS Institute Inc., 2009) and SUDAAN (Research Triangle Institute, 2008) software packages. The percentage of participants testing positive for HIV and each STD (Chlamydia, gonorrhea, syphilis, Trichomonas, HSV-2) was determined separately for men and women. A binary variable (“any STD”) was created to indicate participants who tested positive for any of these STDs including HIV. If an individual had no positive test and more than a third of his/her tests were missing (not done or indeterminate), the composite variable was set to missing. Less than 1% (0.3%) of participants were missing the outcome. A second composite binary variable (“any non-viral STD”) was created to indicate participants who tested positive for Chlamydia, gonorrhea, syphilis, or Trichomonas—STDs treatable with simple pharmacological regimens. This variable was not available for 0.6% of participants due to missing test results.

Unadjusted comparisons of demographic characteristics between men and women were made using Fisher’s exact or Wilcoxon tests. Possible risk factors were evaluated for each country separately using logistic regression models fit to the “any STD” outcome with statistical significance of covariates determined by Wald chi-square tests. A stepwise procedure was used to select from the following demographic and behavioral variables: venue, gender, marital status, age, education, any sexual act with a non-spousal partner in the past 3 months, any unprotected sex act with a non-spousal partner in the past 3 months, number of partners in the past 3 months, acknowledging exchanging sex for goods (money, shelter, food, drugs, or other in the last 3 months), alcohol use in the last 30 days (weekly or more, less than weekly, no alcohol), and voluntarily tested for HIV prior to the study. Associated variables with a p value $< .05$ were retained in the final models. All two-way interactions with gender were first included to test for differences by gender. Because several interactions with gender were found to be significant, models were then run separately by gender as well as main effect models with gender included. Adjusted odds ratios (ORs) with 95% confidence intervals for predictors that remained in the models are reported.

RESULTS

Population Characteristics and Behavioral Risks

Between 2,212 and 5,543 individuals participated in the study baseline assessment in each country for a total cohort of 18,147 participants (Table 1). Overall, 63% of the participants were men, with about half of the participants being male in China, Russia, and Zimbabwe and greater than 80% being male in India and Peru. The percentage of eligible individuals selected for assessment who participated ranged from 71.6% in Zimbabwe to 97.9% in India (89.4% overall). Participants in Peru, Russia, and Zimbabwe were younger (majority 24 years of age) than those in China and India, because ethnographic pre-baseline studies suggested that Indian and Chinese populations were riskier at older ages. Peruvian, Russian, and Zimbabwean participants were also more likely to be unmarried (75%) and have more years of education. Female participants in all countries but India (where female participants were sex workers) were significantly more likely than men to be married. Significantly more men than women had 7 or more years of education in China, India, and Peru ($p < .01$).

Patterns of risky sex were highly variable across the study sites. The prevalence of unprotected sex with a non-spousal partner in the last 3 months ranged from 6.5% in China to 56.5% in Peru (Table 2). In every country but India, men were more likely than women to report sex with a non-spousal partner in the last 3 months or unprotected sex with these partners. In India, the women participants usually provided sex in return for financial compensation from the men patronizing the wine shops. The number of sexual partners in the last 3 months also varied widely. In China, 91.4% reported only one sexual partner in the last 3 months, while in the other countries; only about half the participants reported that they were monogamous. In Peru, India, and Russia, the percentage reporting two or more partners was 42.1%, 41.6%, and 24.9%, respectively; this percentage was much lower in China and Zimbabwe. The percentage of participants who said they exchanged sex for goods was lower than 20% in all countries but India, where this percentage was 52.4%. Alcohol use was highest in India (representing recruitment of study participants who were wine shop patrons) and lowest in Zimbabwe (where recruitment often took place at or near “bottle shops”). In India, Peru, and Russia, between 6% and 9% of participants reported no alcohol consumption in the last 30 days in contrast to China (60%) and Zimbabwe (77.4%).

When asked if they had been voluntarily tested for HIV before today, most participants said no. Only 2.2% had been tested in China, 16.4% in India, 30.4% in Peru, 23.1% in Russia, and 11.3% in Zimbabwe.

Prevalence of HIV and Sexually Transmitted Diseases at Baseline Assessment

Participation rates for STD testing in this sample were very high in all countries at baseline (more than 97%). In almost all cases, women had higher STD prevalence rates for each STD than men (Table 3). STD prevalence rates varied widely by pathogen and by gender. Overall, HSV-2 infection was the most prevalent STD. Women had HSV-2 rates up to three times higher than men. HIV prevalence was very low in the four countries (less than 2.6%) with concentrated HIV epidemics; however, in Zimbabwe, 11.7% of men and 30.0% of women tested positive.

Chlamydia prevalence ranged from 0.4% among men in India to a high of 14.9% for women in Peru. In all countries, Chlamydia rates were higher for women than men. Gonorrhea rates were low in all countries for men and women (<4.5%), and syphilis rates were also low (<6.5%) for all participants except for women in India (18.0%). The prevalence of *Trichomonas* ranged from 0.8% for women in Russia to 26.1% for women in India.

For the six STDs evaluated (Table 3), rates were always higher for women and overall ranged from 8.3% in Russia to 37.8% in Zimbabwe. In Zimbabwe, rates for any STD for men were 20.9%, while for women, this rate was 57.1% ($p < .001$). Non-viral STD rates were also consistently higher for women across countries, particularly in India (3.7% for men, 40.1% for women) and Zimbabwe (4.1% for men, 25.3% for women; Table 3).

In general, HIV prevalence was not related to the prevalence of the other STDs evaluated except in Zimbabwe, where more than 75% of participants positive for HIV were also positive for HSV-2. The lack of association in the other four countries may be due to the low prevalence of HIV in those countries.

Risk Factor Analysis

The possible risk factors associated with at least one of the six STDs were analyzed for each country separately (any STD in Table 3). The most significant risk factor across sites was gender (Table 4a), where females had an increased risk for having an STD in every country. The next most significant predictor was number of partners, where (except in China) participants with two or more sexual partners were at increased risk compared with those who reported no partners. The number of partners was a significant predictor in every country but India.

The number of partners as a correlate of any STD was examined separately for males and females, and number of partners was significantly associated with having an STD for females in all sites but India, with adjusted ORs ranging from 1.2 in China to 11.1 in Zimbabwe. These ORs were larger than for the model with gender included. For males, number of partners was only significant in Peru (OR = 2.3) and Russia (OR = 3.1).

In India, Peru, and Zimbabwe, younger participants were significantly less likely to have at least one STD compared with older participants. Age was also an important factor for males separately in India, Peru, and Zimbabwe and for females in India and Zimbabwe.

Exchanging sex for goods was a significant predictor of having at least one STD in Peru and Zimbabwe for males only but not for females, whereas drinking alcohol was significantly associated with having an STD in Zimbabwe. Having been previously voluntarily tested for HIV was a significant predictor of STDs in India and Peru.

The risk factors for acquiring a non-viral STD were separately examined. Again, the most significant risk factor was gender (Table 4b), with females having a significantly higher risk in every country. The number of partners in the past 3 months was significantly associated with the risk of having a non-viral STD in Peru, Russia, and Zimbabwe. Age was a significant predictor in India and Peru; for males, age was a significant predictor of having a

non-viral STD in India (OR = 3.6 for 35 years and older vs. 18- to 24- year-olds) and Peru (OR=2.8). For females, but not males, the number of partners was a significant predictor of having a non-viral STD (zero partners versus two or more partners) in every country but India. The ORs ranged from 3.0 in Zimbabwe to 6.0 in China.

DISCUSSION

This large five-country investigation of HIV and STD prevalence in high-risk persons found diverse correlates of infection. Most notably, the prevalence of STDs was significantly higher for women than men in all countries studied. This pattern has been noted previously (Buve, Gaurbin, & Laga, 2008) and underscores the need for proactive STD and HIV screening programs for vulnerable females and the need for public health authorities to garner the necessary resources to screen, diagnose, and treat large numbers of socially marginalized people, including the timely provision of antiretroviral therapy for chronic HIV care and access to culturally appropriate prevention services, such as medication to prevent mother-to-child HIV transmission.

The most prevalent STD detected in all five sites was HSV-2, which was twice as common among women compared with men. The disproportionate role of HSV-2 compared with other STDs in facilitating HIV transmission (Corey & Wald, 2008; van de Wijgert et al., 2009) and the high HSV-2 prevalence found in this study stress the importance of developing strategies to address HSV-2 globally through provider and patient education with prevention messages to increase awareness and through testing and treatment of HSV-2 for those with symptoms. Although few national programs in resource limited settings have sufficient infrastructure to routinely test at-risk persons for HSV-2, the results in this current study suggest that this may create an important gap in comprehensive sexual health prevention programs.

Although overall STD prevalence was relatively high in some populations in this study, such as female sex workers in India and men who have sex with men in Peru, HIV prevalence was low in four of the sites with concentrated epidemics. The only exception was Zimbabwe, where women were twice as likely to be infected as men (30% vs.11.7%), similar to the pattern seen in other generalized epidemics in sub-Saharan Africa (Asamoah-Odei, Garcia- Calleja, & Boerma, 2004; UNAIDS, 2008). Similar to other studies (Aral et al., 1999; Miller et al., 2004), *Chlamydia trachomatis* infection was also more common in women than men, with a wide geographic range from 0.4% among men in India to 15% among women in Peru. The prevalence of other non-viral STDs was generally low, with the exception of syphilis (18%) and Trichomonas (26%) among Indian female sex workers and syphilis (16%) in Zimbabwean females. These findings underscore the reality that STD and HIV epidemics tend to have local precipitants and that generalizations between communities and subpopulations are inappropriate. This means that effective HIV and STD control strategies should be informed by careful surveillance and field ethnography and that broad syndromic or empiric therapeutic interventions are unwarranted.

Logistic regression models were used to evaluate risk factors for prevalent infection across the five sites and found some common themes, as well as significant local variation in the

relationships of risk taking and STD and HIV prevalence. For example, women were uniformly at greater risk for STD prevalence than men in all countries. Although the number of partners has been reported as an important risk for STDs in other studies (Aral, 2002) and this relationship was seen among females in most of the sites, men in Russia, China, and Zimbabwe who had multiple partners did not appear to be at increased risk for STDs, possibly due to the relatively low prevalence of most STDs in those countries and the decreased likelihood of encountering STD pathogens within their specific sexual networks (Kaumann & Youm, 1999).

Being older was associated with increased STD and HIV prevalence in three of the sites (India, Peru, and Zimbabwe), primarily due to the cumulative risk of acquiring HSV-2 or HIV during one's lifetime. Increased educational attainment was found to be protective against disease acquisition in India and China, but no differences were found in the other three sites. Education may be associated with improved socioeconomic status, and particularly for women, the ability to negotiate for protected sex, as well as the ability to seek care for genitourinary symptoms (Buve et al., 2008; Chesney & Smith, 1999; Moses et al., 1994). Transactional sex was associated with increased STD risk in Peru and Zimbabwe for men; being previously tested for HIV was associated with being diagnosed for an STD or HIV in India and Peru; and more frequent drinking was associated with STD risk in Zimbabwe (Cook & Clark, 2005; Kalichman, Simbayi, Jooste, Crain, & Cherry, 2006; Zenilman, Hook, Shepherd, Smith, Rompalo, & Celentano, 1994).; These results are helpful in identifying individuals at increased risk for HIV or STD acquisition within their local communities, emphasizing the need for interventions that are culturally tailored to increase condom access and consistent use among specific populations at increased risk for STDs and HIV and for programs that address the needs of economically vulnerable populations.

The selection of several STDs to create a composite endpoint in this study was intended to provide a wide array of biomarkers as appropriate targets for prevention interventions, which could be used to corroborate self-reported risk behaviors. However, we found that because each of these STDs differs in their mechanisms of transmission, ability to be treated, and in the role they play in potentiating HIV transmission in different settings, the associations of behaviors and STD or HIV prevalence was locally quite variable (Cohen & Pilcher, 2005; Garnett, 2002; Wasserheit & Aral, 1996). For example, some of the STDs measured in this study could have been chronic (e.g., HSV-2, HIV, and syphilis), whereas others may reflect recent behavior (e.g., Chlamydia), so that the cross-sectional measurements might have included infections acquired at different time points limiting inferences that could be made about disease prevalence and risk-taking behavior. Only Chlamydia clustered among the young, as seen in other studies, underscoring the generalizability of these findings (Aral et al., 1999).

The heterogeneity of the study populations created challenges in interpreting the relationship of behavioral risks and HIV/STD prevalence. The selection of each group studied was based on careful ethnographic and epidemiological analyses (NIMH Collaborative HIV/STD Prevention Trial Group, 2007a, 2007b, 2007d, 2007e). Because of the major differences in study populations; the use of matched pairs of venues produced a solution to allow for intra-site comparisons. The current study demonstrates that the global STD and HIV epidemics

reflect multiple local determinants and do not constitute one uniform set of risk populations, risk behaviors, and co-infections. Thus, strategies for HIV and STD control will need to develop locally specific interventions that may focus on different demographic and behavioral variables and may need to focus on different cofactors in each setting (e.g., alcohol abuse in Zimbabwe, where there is a generalized HIV epidemic, and interventions focused on transactional sex work in India, where the epidemic remains concentrated).

Several limitations are inherent to this evaluation of risks for prevalent STDs in these five settings. First, the characterization of risk factors is limited by the cross-sectional design of this study; the focus on prevalent infections allows only characterization of associations, with a limit to drawing temporal and causal inferences. Second, all reports of behavioral risk are based on participant self-report, which may be subject to recall bias, participant reticence to report risk, and cultural differences in self-report. The strengths of this study lie in the large sample sizes in each of the five countries evaluated, the very high completion rate, and the uniform methodology applied to data collection. Both behavioral and laboratory protocols were standardized, and common training and QA and QC measures were uniformly applied across the study sites (NIMH Collaborative HIV/STD Prevention Trial Group, 2007c).

These findings demonstrate that although the use of a combined STD outcome can be valuable in the analysis of data stemming from multiple study sites, the generalizations that can be drawn may be limited. Because STD micro-epidemics are local in nature, reflecting differences in sexual networks and risk behaviors, the role that one STD plays in the dynamics of HIV transmission may differ greatly among communities (Garnett, 2002). Thus, the interaction of risk taking and STD/HIV prevalence needs to be interpreted primarily in light of the relevant local characteristics.

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TABLE 1
Baseline demographic characteristics of eligible participants by study site and overall

Participant Characteristic	China	India	Peru	Russia	Zimbabwe	Overall
Sample size	3,912	3,521	2,959	2,212	5,543	18,147
Response rate (%)	89.4	97.6	94.9	93.7	71.6	89.4
Male (%)	45.4	82.8	90.0	51.4	53.1	63.0
Age, years (%)						
18–24	8.6	21.0	61.3	97.6	76.6	51.2
25–34	37.6	50.9	30.9	2.4	23.4	30.5
35	53.8	28.1	7.8	0.0	0.0	18.3
Median, years						
Men	35*	29*	23*	20*	21	24
Women	36	32	25	19	21	25
Married ^a (%)	92.7	59.4	26.9	6.7	25.4	44.4
Men	87.2*	61.6*	23.8*	4.7*	18.7*	40.1*
Women	97.4	48.4	54.6	8.8	32.9	51.9
Education ^b (%)						
None	9.1	12.4	0.3	0	0.4	4.6
1–6 years	39.5	34.9	12.9	0	3.8	18.5
7–12 years	50.9	48.4	85.7	41.7	91.2	67.3
> 12 years	0.5	4.2	1.1	58.3	4.6	9.6
7 or more years of education						
Men	62.5*	57.4*	87.7*	100.0	95.6	79.3*
Women	42.2	29.8	78.9	100.0	96.0	72.8

^a Marital status includes live-in partner.

^b Education in number of years

* p .05 for a difference between men and women by Fisher's exact tests or Wilcoxon test (age).

TABLE 2
Behavioral risks for sexually transmitted disease acquisition in participants by study site at baseline

Behavior risk	China <i>n</i> (%)	India <i>n</i> (%)	Peru <i>n</i> (%)	Russia <i>n</i> (%)	Zimbabwe <i>n</i> (%)
Any sex act with nonspousal/live-in partner in past 3 months	360 (9.2)	1,956 (55.6)	2,067 (69.9)	1,320 (59.7)	2,030 (36.6)
Men	291 (16.4)*	1,379 (47.3)*	1,942 (72.9)*	811 (71.4)*	1,285 (43.6)*
Women	69 (3.2)	577 (95.1)	125 (42.4)	509 (47.3)	745 (28.7)
Any unprotected sex act with nonspousal/live-in partner in past 3 months	255 (6.5)	1,547 (44.0)	1,668 (56.5)	795 (36.0)	1,231 (22.2)
Men	204 (11.5)*	1,116 (38.3)*	1,563 (58.7)*	474 (41.7)*	774 (26.3)*
Women	51 (2.4)	431 (71.1)	109 (37.1)	321 (29.9)	459 (17.7)
No. of Partners in Past 3 Months					
0	192 (4.9)	475 (13.5)	220 (7.4)	591 (26.8)	2,259 (40.8)
1	3,576 (91.4)	1,582 (44.9)	1,492 (50.5)	1,067 (48.3)	2,613 (47.2)
2	144 (3.7)	1,464 (41.6)	1,245 (42.1)	549 (24.9)	669 (12.1)
Exchanged Sex for Goods					
Yes	177 (4.6)	1,690 (52.4)	532 (18.2)	19 (1.1)	323 (9.0)
No	3,664 (95.4)	1,535 (47.6)	2,395 (81.8)	1,732 (98.9)	3,266 (91.0)
Frequency of Drinks Last 30 Days					
Weekly +	969 (24.8)	3,149 (89.4)	1,452 (49.1)	1,223 (55.4)	817 (14.7)
Less than weekly	594 (15.2)	172 (4.9)	1,266 (42.8)	779 (35.3)	435 (7.9)
No drinks	2,348 (60.0)	200 (5.7)	237 (8.0)	207 (9.4)	4,289 (77.4)
Voluntarily tested for HIV before today					
Yes	85 (2.2)	577 (16.4)	899 (30.4)	510 (23.1)	626 (11.3)
No	3,826 (97.8)	2,944 (83.6)	2,060 (69.6)	1,702 (76.9)	4,916 (88.7)

* *p* .05 for a difference between men and women by Fisher's exact test.

TABLE 3

Prevalence of selected sexually transmitted diseases by sex and study site at baseline

STD	China		India		Peru		Russia		Zimbabwe	
	N	n (%)	N	n (%)	N	n (%)	N	n (%)	N	n (%)
Chlamydia										
Men	1,774	135 (7.6)	2,913	12 (0.4)	2,660	124 (4.7)	1,136	51 (4.5)	2,918	72 (2.5)
Women	2,108	263 (12.5)	600	29 (4.8)	295	44 (14.9)	1,076	68 (6.3)	2,503	150 (6.0)
Gonorrhea										
Men	1,774	12 (0.7)	2,913	5 (0.2)	2,660	13 (0.5)	1,136	1 (0.1)	2,912	44 (1.5)
Women	2,110	32 (1.5)	600	4 (0.7)	291	9 (3.1)	1,076	5 (0.5)	2,475	105 (4.2)
HSV-2										
Men	1,775	109 (6.1)	2,913	250 (8.6)	2,645	645 (24.4)	1,136	16 (1.4)	2,940	396 (13.5)
Women	2,136	206 (9.6)	607	345 (56.8)	294	128 (43.5)	1,068	43 (4.0)	2,596	1,069 (41.2)
Trichomonas										
Women	2,087	104 (5.0)	598	156 (26.1)	295	28 (9.5)	759	6 (0.8)	2,595	426 (16.4)
Syphilis										
Men	1,775	26 (1.5)	2,909	93 (3.2)	2,649	167 (6.3)	1,136	1 (0.1)	2,942	15 (0.5)
Women	2,136	33 (1.5)	605	109 (18.0)	295	11 (3.7)	1,068	2 (0.2)	2,594	47 (1.8)
HIV										
Men	1,775	3 (0.2)	2,913	63 (2.2)	2,649	76 (2.9)	1,136	0 (0.0)	2,942	344 (11.7)
Women	2,136	1 (0.0)	607	28 (4.6)	295	1 (0.3)	1,067	0 (0.0)	2,596	779 (30.0)
Any STD ^a										
Men	1,774	255 (14.4)	2,912	366 (12.6)	2,650	803 (30.3)	1,136	69 (6.1)	2,928	613 (20.9)
Women	2,136	510 (23.9)	604	411 (68.0)	295	166 (56.3)	1,069	113 (10.6)	2,594	1,482 (57.1)
Any Nonviral STD ^b										
Men	1,774	162 (9.1)	2,913	107 (3.7)	2,661	297 (11.2)	1,136	53 (4.7)	2,924	120 (4.1)
Women	2,113	372 (17.6)	603	242 (40.1)	295	79 (26.8)	1,072	75 (7.0)	2,539	643 (25.3)
Any Viral STD ^c										
Men	1,761	112 (6.4)	2,851	292 (10.2)	2,573	656 (25.5)	1,118	16 (1.4)	2,882	541 (18.8)
Women	2,106	206 (9.8)	594	349 (58.8)	288	128 (44.4)	1,049	43 (4.1)	2,557	1,231 (48.1)

HSV-2 = Herpes simplex virus-type 2; STD = sexually transmitted disease.

^a Any positive test for Chlamydia, gonorrhea, HSV-2, Trichomonas, syphilis, or HIV. Variable was calculated if at least four (females) or three (males) test results were nonmissing.

^b Any positive test for Chlamydia, gonorrhea, Trichomonas, or syphilis. Variable was calculated if at least three (females) or two (males) test results were nonmissing.

^c Any positive test for HSV-2 or HIV.

TABLE 4a

Demographic and behavioral risks for sexually transmitted disease acquisition in participants by study site at baseline[†]—Any positive STD^{**}

Behavior risk	China		India		Peru		Russia		Zimbabwe	
	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)
Gender										
Male	255 (14.4)	1.0	366 (12.6)	1.0	803 (30.3)	1.0	69 (6.1)	1.0	613 (20.9)	1.0
Female	510 (23.9)	2.1 (1.8–2.5)*	411 (68.1)	12.7 (10.0–16.0)*	166 (56.3)	3.3 (2.5–4.3)*	113 (10.6)	2.4 (1.7–3.4)*	1,482 (57.1)	9.1 (7.5–11.1)*
Age										
18–24 years			55 (7.4)	1.0	420 (23.2)	1.0			1,288 (30.5)	1.0
25–34 years			362 (20.2)	2.9 (2.1–4.2)*	404 (44.5)	2.5 (2.1–3.0)*			807 (62.4)	3.2 (2.7–3.8)*
35 years			360 (36.5)	6.0 (4.1–8.6)*	145 (63.0)	5.3 (3.9–7.4)*				
Married										
Yes										
No										
Education										
7 years	361 (18.0)	0.8 (0.7–1.0)*	291 (15.7)	0.8 (0.7–0.9)*			+			
0–6 years	404 (21.3)	1.0	486 (29.2)	1.0						
Any sex act with nonspousal/live-in partner in last 3 months										
Yes	91 (25.3)	1.0								
No	674 (19.0)	0.6 (0.4–0.8)*								
No. of Partners in Past 3 Months										
0	90 (46.9)	1.0			43 (19.7)	1.0	25 (4.3)	1.0	539 (24.0)	1.0
1	631 (17.7)	0.2 (0.2–0.3)*			421 (28.4)	1.4 (1.0–2.1)	92 (8.7)	2.3 (1.5–3.7)*	1,248 (47.9)	1.2 (0.9–1.5)
2	44 (30.6)	0.4 (0.2–0.7)*			503 (40.5)	2.5 (1.7–3.7)*	65 (11.8)	4.3 (2.6–7.2)*	306 (46.1)	1.7 (1.3–2.2)*
Exchanged Sex for Goods										
Yes					229 (43.3)	1.0			181 (56.4)	1.0
No					731 (30.7)	0.8 (0.6–0.9)*			1,489 (45.7)	0.6 (0.5–0.9)*
Drinking habit last 30 days										

Behavior risk	China		India		Peru		Russia		Zimbabwe	
	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)
Weekly [†]									327 (40.1)	1.9 (1.5–2.5) [*]
Less than weekly									144 (33.5)	1.7 (1.3–2.2) [*]
No drinks									1,622 (37.9)	1.0
Voluntarily tested for HIV before today										
Yes			248 (43.1)	1.0	386 (43.2)	1.0				
No			529 (18.0)	0.6 (0.5–0.8) [*]	583 (28.4)	0.6 (0.5–0.7) [*]				

[†] Odds ratios (OR) for any positive STD (with 95% CI) from logistic regression models. Separate models were fit for each country. ORs were adjusted for the significant variables in the final model (e.g., in China, ORs were adjusted for gender, education, any sex in past 3 months with nonspousal partner, and number of partners in last 3 months).

^{*} Denotes significant OR. Note, due to rounding, some ORs become 1.0.

^{**} Only significant ($p < .05$) demographic and behavioral risk variables are presented in the table.

⁺ All participants from Russia had completed high school.

TABLE 4b

Demographic and behavioral risks for sexually transmitted disease acquisition in participants by study site at baseline[†]—Any positive nonviral STD^{**}

Behavior risk	China		India		Peru		Russia		Zimbabwe	
	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)
Gender										
Male	162 (9.1)	1.0	107 (3.7)	1.0	297 (11.2)	1.0	53 (4.7)	1.0	120 (4.1)	1.0
Female	372 (17.6)	2.5 (2.0–3.1)*	242 (40.1)	17.7 (13.3–23.5)*	79 (26.8)	3.5 (2.6–4.8)*	75 (7.0)	2.0 (1.4–3.1)*	643 (25.3)	9.2 (7.4–11.5)*
Age										
18–24 years			30 (4.1)	1.0	188 (10.4)	1.0			595 (14.2)	1.0
25–34 years			180 (10.1)	2.1 (1.4–3.1)*	142 (15.6)	1.6 (1.3–2.1)*			168 (13.1)	0.8 (0.6–0.9)*
35 years			139 (14.1)	2.1 (1.3–3.2)*	46 (19.8)	1.9 (1.3–2.8)*				
Married										
Yes							92 (11.6)			
No							284 (13.2)	1.6 (1.2–2.1)*		
Education								+		
7 years			103 (5.6)	0.6 (0.5–0.8)*						
0–6 years			246 (14.8)	1.0						
Any sex act with nonspousal/live-in partner in last 3 months										
Yes	60 (16.7)	1.0								
No	474 (13.4)	0.5 (0.4–0.7)*								
No. of Partners in Past 3 Months										
0					13 (5.9)	1.0	14 (2.4)	1.0	245 (11.0)	1.0
1					169 (11.3)	2.0 (1.1–3.7)*	66 (6.2)	2.9 (1.6–5.2)*	415 (16.1)	1.4 (1.2–1.7)*
2					193 (15.5)	3.2 (1.7–5.8)*	48 (8.7)	5.2 (2.8–9.7)*	102 (15.5)	3.1 (2.3–4.0)*
Exchanged Sex for Goods										
Yes										
No										
Drinking habit last 30 days										

Behavior risk	China		India		Peru		Russia		Zimbabwe	
	<i>n</i> (%)	Adjusted OR (95% CI)	<i>n</i> (%)	Adjusted OR (95% CI)	<i>n</i> (%)	Adjusted OR (95% CI)	<i>n</i> (%)	Adjusted OR (95% CI)	<i>n</i> (%)	Adjusted OR (95% CI)
Weekly [†]			279 (8.9)	2.0 (1.4–3.1) [*]						
Less than weekly			30 (17.4)	1.6 (0.9–2.9)						
No drinks			40 (20.0)	1.0						
Voluntarily tested for HIV before today										
Yes										
No										

[†] Odds ratios (OR) for any positive nonviral STD (with 95% CI) from logistic regression models. Separate models were fit for each country. ORs were adjusted for the significant variables in the final model (e.g., in China, ORs were adjusted for gender and any sex in past 3 months with nonspousal partner).

^{*} Denotes significant OR. Note, due to rounding some ORs become 1.0.

^{**} Only significant ($p < .05$) demographic and behavioral risk variables are presented in the table.

⁺ All participants from Russia had completed high school.