Published in final edited form as:
Sex Transm Dis. 2011 June ; 38(6): 503–509.

The Incidence and Correlates of Symptomatic and Asymptomatic *Chlamydia trachomatis* and *Neisseria gonorrhoeae* Infections in Selected Populations in Five Countries

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Abstract

Background—Asymptomatic *Chlamydia trachomatis* (chlamydia) and *Neisseria gonorrhoeae* (gonorrhea) infections pose diagnostic and control problems in developing countries.

Methods—Participants in China, India, Peru, Russia, and Zimbabwe were screened for *C. trachomatis* and *N. gonorrhoeae* infections and symptoms.

Results—A total of 18,014 participants were evaluated at baseline, 15,054 at 12 months, and 14,243 at 24 months. The incidence of chlamydia in men was 2.0 per 100 person years both from baseline to 12 months and from 12 to 24 months, and in women, 4.6 from baseline to 12 months and 3.6 from 12 to 24 months; a range of 31.2% to 100% reported no symptoms across the 5 countries. The incidence of gonorrhea in men was 0.3 per 100 person years both from baseline to 12 months and from 12 to 24 months, and in women, 1.4 from baseline to 12 months and 1.1 from 12 to 24 months; a range of 66.7% to 100% reported no symptoms. Being female, aged 18 to 24 years, and having more than 1 partner were associated with both the infections. In addition, being divorced, separated, or widowed was associated with gonorrhea. Being male, having 6+ years of education, and reporting only 1 partner were associated with having no symptoms among those infected with chlamydia. No variables correlated with asymptomatic gonorrhea among those infected.

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Conclusion—A high prevalence and incidence of asymptomatic sexually transmitted infections was identified among men and women in a wide variety of settings. More effective programs are needed to identify and treat chlamydia and gonorrhea infections, especially among women, young adults, those with multiple partners, those repeatedly infected, and particularly those at risk without symptoms. The risk of transmission from persons with no symptoms requires further study.

Sexually transmitted infections (STIs) are a major health problem in most countries of the world, but especially in developing countries where the resources and technology to diagnose and treat them are limited.[1] Currently, many countries, including China, are experiencing a resurgence of STIs, because of limited control efforts.[2,3]

In many of these countries, the major strategy for control of STIs has been through sexually transmitted disease clinics for the management of symptomatic genitourinary infections for individuals seeking treatment. However, an emphasis on this strategy has several limitations. First, because of the stigma associated with STIs, a high proportion (often 60 + %) of individuals with symptomatic STIs are reluctant to seek treatment from government clinics.[4] Second, these symptomatic individuals often seek treatment in pharmacies and from indigenous providers, where treatment is often inadequate, partner treatment is not offered, and no record of their treatment is kept.[5,6] Third, this strategy relies on individuals seeking treatment. Those who are asymptomatic are unlikely to seek any kind of treatment, and may have a long duration of infection, repeatedly exposing their regular partners and/or new partners to infection. For these reasons, studies of asymptomatic STIs require investigation of populations who do not seek care on the basis of symptoms. Several studies have reported high proportions of laboratory-confirmed *Chlamydia trachomatis*- and *Neisseria gonorrhoeae*-infected individuals who are asymptomatic, especially in women.[7–13] However, the proportions of asymptomatic *C. trachomatis* and *N. gonorrhoeae* infections may differ between different countries and groups.

The National Institute of Mental Health sponsored a trial of a community-level intervention based on the “popular opinion leader model” to prevent HIV/STIs among selected populations in 5 countries, China, India, Peru, Russia, and Zimbabwe.[14,15] The populations in this study were selected on the basis of reported sexual risk behaviors and/or prevalence of STIs in their respective countries, and therefore, the ages are not comparable. In some countries, the individuals at highest risk for STIs were young, whereas in other country settings, were older and had more discretionary income. As part of the assessment of the trial, a baseline and 2 follow-up surveys at 12 and 24 months were conducted, in which symptoms of STIs were solicited, and participants were tested for the presence of several STIs, including *C. trachomatis* and *N. gonorrhoeae*, using sensitive nucleic acid amplification tests. Because of the large sample size, this study provided an excellent opportunity to study the prevalence and incidence of both symptomatic and asymptomatic infections in community settings among individuals not selected on the basis of symptoms or high-risk activities. We report herein the prevalence and incidence of laboratory-confirmed *C. trachomatis* and *N. gonorrhoeae* in these 5 diverse populations, the proportions of those reporting symptoms by several demographic characteristics, and predictors of symptomatic and asymptomatic infection. This information should be useful for decision makers in these countries attempting to control the epidemics of STIs in their populations. The study was approved by the institutional review boards of the institutions in each of the 5 countries, and by those at each of the American academic institutions.

METHODS

The populations enrolled in this trial were food market vendors in Fuzhou, China (18–49 years old), wine shop patrons and commercial sex workers in Chennai, India (18–40 years old), men who had sex with men, transgender persons, and low-income risky male and female youth in coastal areas of Peru (18–30 years old), vocational school dormitory residents in St. Petersburg, Russia (18–30 years), and men and women congregating at rural growth points in "bottle shops" in Zimbabwe (18–30 years old). In each country, the cohort was examined with a questionnaire and laboratory studies at baseline, and then 12 and 24 months later. All individuals found to be infected with a sexually transmitted agent, including *C. trachomatis* and *N. gonorrhoeae*, were notified to receive treatment after each cross-sectional survey, and were advised to refer their partners for treatment. Risk behaviors were assessed by a questionnaire, which was administered by trained research personnel, using computer-assisted personal interviews. A symptom questionnaire was then administered by trained research personnel after the computer-assisted personal interviews and before the biospecimens were obtained. The questions eliciting symptoms of *C. trachomatis* and *N. gonorrhoeae* were "Have you had genital discharge in the past week?" and "In the past week, have you had a sharp or burning pain when you pass urine?" Individuals were considered to be asymptomatic if they reported no episodes of either painful urination or genital discharge. Because there were no statistical differences overall in STI rates between the control and intervention arms of the study, the data from both have been combined in this report.[15]

Urine was collected from male participants and self-administered vaginal swabs from females for testing by polymerase chain reaction (Roche Amplicor PCR, Roche Molecular Diagnostics, Indianapolis, IN) for the presence of *N. gonorrhoeae* and *C. trachomatis*. Rigid quality control procedures were implemented across the laboratories in each of the countries and results were confirmed by the reference laboratory at Johns Hopkins University.[16,17]

Participants were categorized on the basis of the laboratory results and the symptom interview questions as laboratory-positive/symptom-positive, laboratory-positive/symptom-negative, or laboratory-negative/symptom-negative at baseline and at 12 and 24 months. The incidence of participants acquiring infection with either organism was determined from baseline to 12 months and from 12 to 24 months. The proportion of those laboratory-confirmed *C. trachomatis*- and *N. gonorrhoeae*-infected individuals who did not report symptoms was also determined at each visit. Only laboratory test-negative respondents and laboratory-positive respondents who were treated at the baseline and at the 12-month survey were eligible for determination of incident infection during the subsequent interval.

Data Analysis

Multivariate analysis was performed using SAS (SAS Institute Inc., 2009) and SUDAAN (Research Triangle Institute, 2009) software packages. These packages were used to account for the clustered data with repeated measures, using generalized estimating equations. A binary variable ("Any Incident Case") was created to indicate participants who had at least one incident case of *C. trachomatis*, as explained earlier. A corresponding variable was created for *N. gonorrhoeae*. A second binary variable ("Incident Asymptomatic Case") was also created for participants with an incident infection but who were asymptomatic (did not self-report genital discharge or painful urination) or were symptomatic (reported either symptom).

A stepwise procedure was used to determine the associations across countries with gender, age, years of education, marital status, and number of partners in the last 3 months, while controlling for country, venue, and repeated measures on individual participants. Adjusted

odds ratios with 95% confidence intervals are provided in Table 10 for *C. trachomatis* and Table 11 for *N. gonorrhoeae*. Associated variables with a $P < 0.05$ are indicated as well.

RESULTS

A total of 18,014 participants were interviewed and tested for *C. trachomatis* or *N. gonorrhoeae* at baseline, and 15,054 (83.6%) were followed up at 12 months and 14,243 (79.1%) at 24 months. The demographic characteristics of the participants at baseline and percent follow-up at 12 and 24 months are given in Table 1. The distribution of participant characteristics was similar in the 3 surveys. Follow-up rates at 24 months were generally 75% or higher, except among highly educated individuals and Russian students. The number of specimens tested is given in Table 2 by country. A total of 47,511 specimens were tested. The incidence of *C. trachomatis* infection was 2.9 per 100 person years from baseline to 12 months, and 2.6 per 100 person years from 12 to 24 months (Table 3). The incidence of *N. gonorrhoeae* infection was 0.7 per 100 person years from baseline to 12 months, and 0.6 per 100 person years from 12 to 24 months (Table 4). The incidence of both the infections was higher in women than men. The incidence of *C. trachomatis* was highest in Russia and China, and lowest in India, whereas the incidence of *N. gonorrhoeae* was highest in Zimbabwe and lowest in India. Of those followed up for both time periods (i.e., over 2 years), 16.4% had a second infection with either *C. trachomatis* or *N. gonorrhoeae* following their prior infection.

Asymptomatic Infections

C. trachomatis. The proportion of infected participants with incident *C. trachomatis* not reporting symptoms during both time periods ranged from 31.2% among women in India, many of whom were sex workers, to 100% among men in China and Zimbabwe during the 12 to 24-month period after baseline (Table 5). Generally the proportion was over 80% in both time periods in all 5 countries, except for women in India. Except for Russia, the proportion of asymptomatic infections was higher in men than women, although high for both the genders. The proportion reporting no symptoms was high in all demographic subgroups (Table 6). The prevalence at baseline, 12 months, and 24 months, and proportion of participants without symptoms among prevalent and incident (baseline to 12 months and 12–24 months) is given in Table 7. The proportion of participants without symptoms was slightly lower among prevalent cases than among incident cases.

N. gonorhoeae. The proportion of infected participants with incident *N. gonorrhoeae* not reporting symptoms during both time periods ranged from 66.7% to 100%. Generally the proportion of participants not reporting symptoms was higher in men than women (Tables 7, 8). Except for women in India at 0 to 12 months, the proportion of participants not reporting symptoms was over 75% or higher (Table 9). The proportion of participants reporting no symptoms was high in all demographic subgroups, although there was some fluctuation between the time periods, probably due to low incidence.

The prevalence of *C. trachomatis* and *N. gonorrhoeae* at baseline, 12 months, and 24 months, and proportion of participants without symptoms among prevalent and incident cases is given in Table 7. The proportion of participants without symptoms was lower among prevalent cases than among incident cases.

The proportion of participants not infected with chlamydia or gonorrhea reporting symptoms was 7.65%; for women, it was 14.1%. Thus, for these groups, the predictive value positive of symptoms at baseline was approximately 58%.

Treatment

At baseline, the proportion of participants infected with *C. trachomatis* who were confirmed to have received treatment was 78.5%, and ranged from 92.0% in China to 62.6% in Zimbabwe. For *N. gonorrhoeae*, it was 68%, and ranged from 89% in India and China to 33% in Russia. In India, patients were treated in the study clinic, in China participants were confirmed to have gone to the local clinic, and in Peru and Russia participants were informed that they needed to seek treatment. In Zimbabwe, pregnant participants were given a voucher for treatment, and the others were referred for treatment. The average interval between collection of specimens for testing and informing the participants of their test results was 38 days.

Multivariate Analysis

C. trachomatis. The results of multivariate analysis indicated that female gender, young age (18–24 years), and reporting more than 1 partner in the 3 months before laboratory screening were all significantly associated with a greater likelihood of *C. trachomatis* infection (Table 10). Factors significantly associated with having infection without symptoms among those infected were male gender, more than 6 years of schooling, and reporting 1 or no partners in the 3 months before screening.

N. gonorrhoeae. The results of multivariate analysis indicated that female gender, young age (18–24 years), being divorced, separated, or widowed, and reporting more than 1 partner in the 3 months before screening were all significantly associated with a greater likelihood of incident *N. gonorrhoeae* infection (Table 11). There were no significant predictors of infection without symptoms.

DISCUSSION

We were able to determine the laboratory-confirmed incidence of these 2 infections over 2 separate time periods, which allowed us to identify both the incidence and the proportion of incident laboratory-confirmed infections that were asymptomatic. We also were able to determine the proportion of those uninfected or treated at baseline and 12 months who subsequently became reinfected with either organism. The high incidence of *C. trachomatis* infection confirmed the need for more aggressive routine screening and treatment of STIs in these populations. A public health strategy would need to include methods that encouraged asymptomatic individuals who engage in risky behaviors to seek screening for STIs. The relatively low incidence of *N. gonorrhoeae* limited our ability to evaluate predictors of asymptomatic infections with this organism, but the comparable incidence between the baseline and 12 month assessments and between 12 and 24 months visits suggest the need for enhanced efforts to control the spread of this organism as well.

The high proportion of participants (16.4%) reinfected with either *C. trachomatis* or *N. gonorrhoeae* within 1 year confirms the observation by others that there are core transmitters of STIs who are part of high-prevalence pools.[1] STI control efforts should identify these core transmitters for more intensive interventions including contact tracing, partner notification, and treatment.

The high proportion of participants infected with either *C. trachomatis* or *N. gonorrhoeae* with no reported symptoms is particularly disturbing as it complicates identification and treatment of infected individuals. Individuals who have no symptoms are unlikely to seek testing and treatment unless they are motivated by public health messages, community health educators, or health care providers. The higher proportion of asymptomatic *C. trachomatis* infection and asymptomatic gonorrhea in men has been previously

reported.[18–20] Potterat et al estimated that approximately 35% of gonorrhea transmitted from men is from those who are asymptomatic,[21] and Wiesner and Thompson estimated that 60% to 80% of transmission of gonorrhea was from asymptomatic men.[22] While upper-income countries have implemented programs to identify and treat asymptomatic infections with screening programs, in low-income countries, the proportion of those with asymptomatic infection who may transmit infection to others needs to be evaluated, and the cost-effectiveness of interventions to control them needs to be assessed.

Multivariate analysis for the predictors of these infections underscores the need to focus on women, those with multiple partners, and younger age groups for intervention efforts, as well as on high-risk men reporting no symptoms. Women are vulnerable to infection through their male partners, and youth are likely to experiment with sex in the absence of knowledge and trust their partners; thus, they are unlikely to use condoms.[23] Clearly, age-appropriate education about safer sexual methods and symptomatic and asymptomatic STIs needs to be implemented before initiation of sexual activity which often begins shortly after puberty.

The apparently disparate results of the multivariate analysis indicating an association with multiple partners with incident infection but with fewer partners among those with incident infection who report no symptoms suggests that the likelihood of symptomatic infection is associated with intensity of exposure. This is reinforced by the considerably higher proportion of women in India who were sex workers (who have many more partners than those engaging in casual sex) who report symptoms, compared to the other study areas where few of the participants identified themselves as sex workers. However, this observation could also reflect a greater likelihood that sex workers are more aware of the symptoms of sexually transmitted diseases and more likely to report them. Since the sex workers in India were not establishment-based, however, it is unlikely that they received preemptive treatment.

The quality of the laboratory findings of these 2 infections is likely to be very accurate (i.e., it is unlikely that false positives or negatives substantially affected the study results).[24] The laboratories in the 5 countries were rigorously standardized and an ongoing quality control program was in place including retesting of a sample of positive and negative specimens and blind testing of standard specimens at the Johns Hopkins Reference Laboratory.[16,17,25]

Although this was not a clinic-based study, the particular groups selected in each country were selected on the likelihood that many in their group engaged in sex with multiple partners. Thus, these results may be most applicable to the riskier populations in these countries. Another consideration is the impact of spontaneous cure of *C. trachomatis* infection in the absence of treatment, which has been reported in 18% to 44% of infected individuals and increases with time since diagnosis.[26–29] Thus, we may have missed some incident infections, including those that were treated in the 12-month intervals between the surveys, which would have affected the numerator for determining both incidence and the proportion of symptomatic incident infections.[30] The comparability of the proportion of prevalent asymptomatic infections and incident asymptomatic infections, however, suggests that incident infection only modestly overestimates the proportion who are asymptomatic, especially for *C. trachomatis* infections, assuming that the cross-sectional data from the 3 surveys reflect the proportion of asymptomatic infections occurring during the 2 incident intervals.

Generalization of the findings across different populations in 5 countries should be done with caution. However, the high proportion of asymptomatic infections across all 5 countries

among both men and women suggests that high levels of asymptomatic infections occur in most populations and settings.

In conclusion, this study reinforces the need to implement more aggressive public health programs to identify, treat, and control STIs in these countries, and underscores the need to target women, younger persons, those with multiple partners, and "core transmitters." The study also reveals the urgent need to determine the extent to which infected individuals without symptoms in low- and middle-income countries can transmit their infections to others and the benefits of screening programs of high-risk populations.

Acknowledgments

The NIMH Collaborative HIV/STD Prevention Trial was supported using the cooperative agreement mechanism. The National Institutes of Health use this mechanism to support large-scale, multisite, phase III randomized-controlled studies when substantial resources are required and when the funding institute wants both to participate actively in the scientific development of the study and provide administrative oversight.

Supported by NIH/NIMH grant U10 MH61513, a 5-country Cooperative Agreement conducted in China, India, Peru, Russia, and Zimbabwe. Each site selected a different venue and population with which to implement the prevention program entitled "The Community Public Opinion Leader (C-POL) Intervention."

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TABLE 1

Demographic Characteristics of Participants

Participant Characteristic	Baseline*	Percent Followed up†	
		12 mo	24 mo
Overall	18,014[1]	83.6%	79.1%
Gender			
Males	11,408	82.6%	77.8%
Females	6606	85.2%	81.3%
Age			
18–24 yr	9211	80.2%	73.7%
25–34 yr	5494	85.1%	82.3%
35+ yr	3309	90.3%	88.6%
Marital status			
Married/live with partner	8013	86.9%	85.1%
Never married/single	8913	80.9%	73.7%
Divorced/separated/widowed	1087	80.8%	78.7%
Education			
None	823	87.0%	83.6%
1–6 yr	3343	86.4%	84.5%
7–12 yr	12,100	83.0%	79.5%
>12 yr	1744	80.3%	63.5%
No. partners (last 3 mo)			
0–1	13,954	83.3%	79.9%
2 or more	4051	84.5%	76.4%
Country			
China	3885	86.1%	84.9%
India	3513	86.6%	83.3%
Peru	2956	87.6%	79.8%
Russia	2212	83.2%	58.0%
Zimbabwe	5448	77.8%	80.3%

*Number at baseline with a chlamydia or gonorrhoeae test result.

†Percentage of those seen at baseline with test results at 12- and 24-months follow-ups.

TABLE 2

Number of Specimens Tested at Baseline, 12 Months, and 24 Months

	Baseline	12 mo	24 mo
China	3912	3366	3310
India	3513	3042	2928
Peru	2956	2590	2360
Russia	2212	1841	1284
Zimbabwe	5536	4243	4418
Total	18,129	15,082	14,300

TABLE 3

Incidence of *Chlamydia trachomatis* Infection

	Prevalence at Baseline (%)	Baseline to 12 mo (per 100 Person Years)	12–24 mo (per 100 Person Years)
Overall		2.9	2.6
Males	3.4	2.0	2.0
Females	7.8	4.6	3.6
Age			
18–24 yr	4.8	3.7	3.5
25–34 yr	4.3	2.3	1.9
≥35 yr	6.1	2.3	1.9
Marital status			
Married/living with partner	5.8	2.6	2.1
Never married/single	4.0	3.2	3.0
Divorced/separated/widowed	5.8	3.5	4.3
Education			
<1 yr	6.5	3.7	2.1
1–6 yr	5.7	2.6	2.3
7–12 yr	4.6	2.9	2.6
>12 yr	4.7	3.9	3.8
No. partners (last 3 mo)			
0–1	5.4	2.9	2.5
2+	4.9	3.0	3.0
Countries			
China	9.3	4.0	3.1
India	0.9	0.9	0.5
Peru	4.8	3.7	3.1
Russia	4.9	4.6	4.8
Zimbabwe	3.8	2.5	2.8

TABLE 4

Incidence of *Neisseria gonorrhoeae* Infection

	Prevalence at Baseline (%)	Baseline to 12 mo (per 100 Person Years)	12–24 mo (per 100 Person Years)
Gender		0.7	0.6
Male	0.4	0.3	0.3
Female	1.9	1.4	1.1
Age			
18–24 yr	1.1	0.9	0.8
25–34 yr	0.9	0.6	0.5
≥35 yr	0.5	0.3	0.4
Marital status			
Married/living with partner	0.7	0.5	0.5
Never married/single	1.0	0.7	0.5
Divorced/separated/widowed	2.7	1.9	2.1
Education			
0–6 yr	0.8	0.4	0.4
≥7 yr	0.9	0.8	0.6
No. partners (last 3 mo)			
0–1	1.2	0.7	0.6
2+	1.6	0.7	0.7
Countries			
China	0.8	0.5	0.6
India	0.3	0.1	0.1
Peru	0.3	0.5	0.6
Russia	0.2	0.2	0.2
Zimbabwe	2.1	1.5	1.1

TABLE 5

Proportion of Incident *C. trachomatis* Cases (by Country) Reporting No Symptoms

	Baseline to 12 mo	12–24 mo
China		
Males	95.6%	100.0%
Females	86.0%	98.4%
India		
Males	90.9%	87.5%
Females*	31.2%	66.7%
Peru		
Males	95.8%	98.2%
Females	73.9%	86.7%
Russia		
Males	89.7%	95.5%
Females	90.9%	90.0%
Zimbabwe		
Males	93.3%	100.0%
Females	94.3%	93.0%

*The majority of the women surveyed in India were sex workers.

TABLE 6

Proportion of Incident *C. trachomatis* Reporting No Symptoms

	Baseline to 12 mo	12–24 mo
Gender		
Male	94.1%	98.2%
Female	84.8%	92.9%
Age		
18–24 yr	91.3%	95.1%
25–34 yr	85.9%	96.2%
≥35 yr	83.6%	96.2%
Marital status		
Married/living with partner	87.9%	96.2%
Never married/single	90.6%	95.9%
Divorced/separated/widowed	80.0%	90.6%
Education		
<1 yr	69.2%	92.9%
1–6 yr	81.1%	93.6%
7–12 yr	91.8%	96.9%
>12 yr	92.6%	91.7%
No. partners (last 3 mo)		
0–1	90.1%	96.4%
2+	84.3%	92.8%

TABLE 7

Proportion of Asymptomatic for *C. trachomatis* and *N. gonorrhoeae* at Baseline, 12 Months, and 24 Months

	Baseline	12 mo	24 mo
C. trachomatis			
Prevalence	5.3%	3.2%	2.9%
Proportion of prevalent infections reporting no symptoms	70.0%	73.7%	82.3%
Proportion of incident cases reporting no symptoms	—	88.8%	87.2%
N. gonorrhoeae			
Prevalence	1.3%	0.7%	0.6%
Proportion of prevalent infections reporting no symptoms	55.7%	69.5%	67.5%
Proportion of incident cases reporting no symptoms	—	85.3%	86.8%

TABLE 8

Proportion of Incident *N. gonorrhoeae* Reporting No Symptoms

	Baseline to 12 mo	12–24 mo
Gender		
Male	88.5%	86.4%
Female	84.2%	92.6%
Age		
18–24 yr	87.7%	86.4%
25–34 yr	85.7%	95.2%
≥35 yr	66.7%	100.0%
Marital status		
Married/living with partner	91.9%	90.0%
Never married/single	81.6%	90.0%
Divorced/separated/widowed	81.3%	93.8%
Education		
0–6 yr	84.6%	93.3%
≥7 yr	85.4%	90.2%
No. partners (last 3 mo)		
0–1	89.7%	93.0%
≥2	70.8%	84.2%

TABLE 9

Proportion of Incident *N. gonorrhoeae* (by Country) Reporting No Symptoms

	Baseline to 12 mo	12–24 mo
China		
Males	100.0%	100.0%
Females	87.5%	100.0%
India		
Males	100.0%	—
Females*	66.7%	66.7%
Peru		
Males	100.0%	87.5%
Females	66.7%	83.3%
Russia		
Males	100.0%	100.0%
Females	100.0%	100.0%
Zimbabwe		
Males	78.6%	83.3%
Females	85.4%	93.3%

*The majority of the women surveyed in India were sex workers.

TABLE 10

Multivariate Analysis for Factors Associated With Incident *C. trachomatis* Infection

	Any Infection (n = 28,904)*		Infection With No Symptoms (n = 812)†	
	N (%)	Adjusted OR (95% CI)	N (%)	Adjusted OR (95% CI)
Gender				
Male	374 (2.1)	1.0	356 (96.2)	2.0 (1.4–2.8)‡
Female	448 (4.2)	1.5 (1.4–1.6)‡	390 (88.0)	1.0
Age				
18–24 yr	505 (3.6)	1.5 (1.4–1.7)‡	462 (92.8)	1.1 (0.7–2.0)
25–34 yr	197 (2.2)	0.9 (0.8–1.0)	178 (90.8)	1.0 (0.7–1.5)
≥35 yr	120 (2.0)	1.0	106 (89.1)	1.0
Marital status				
Married/living with partner	329 (2.4)	1.0	300 (91.7)	1.6 (0.9–2.7)
Never married/single	427 (3.2)	1.0 (0.9–1.1)	391 (92.9)	0.9 (0.6–1.4)
Divorced/separated/widowed	66 (3.9	1.1 (0.9–1.3)	55 (84.6)	1.0
Education				
0–6 yr	184 (2.6)	1.1 (1.0–1.2)	155 (84.7)	1.0
≥7 yr	638 (2.9)	1.0	591 (93.8)	1.7 (1.2–2.4)‡
No. partners (last 3 mo)				
0–1	625 (2.8)	1.0	576 (92.9)	2.5 (1.4–4.6)‡
≥2	196 (3.0)	1.3 (1.1–1.6)‡	169 (88.0)	1.0

*Predicting whether participants had an incident infection.

†Predicting whether participants had no symptoms among infected individuals; odds ratios adjusted for country, venue, and repeated measurements.

‡Significant at $P < 0.05$ or less.

TABLE 11

Multivariate Analysis for Factors Associated With Incident *N. gonorrhoeae* Infection

	Any Infection (n = 228,972)*		Infection With No Symptoms (n = 182)†	
	N (%)	Adjusted OR (95% CI)	N (%)	Adjusted OR (95% CI)
Gender				
Male	52 (0.3)	1.0	45 (86.5)	1.0 (0.6–1.7)
Female	131 (1.2)	2.1 (1.8–2.5)‡	114 (87.7)	1.0
Age				
18–24 yr	112 (0.8)	1.5 (1.2–2.0)‡	96 (86.5)	1.0
25–34 yr	51 (0.6)	1.1 (0.8–1.4)	63 (88.7)	1.0 (0.6–1.7) (25+ yr)
≥35 yr	20 (0.3)	1.0		
Marital status				
Married/living with partner	69 (0.5)	1.0	63 (91.3)	1.2 (0.7–2.3)
Never married/single	82 (0.6)	0.7 (0.6–0.9)‡	96 (85.0)	1.0 (never married/other)
Divorced/separated/widowed	32 (1.9)	1.7 (1.3–2.2)‡		
Education				
0–6 yr	28 (0.4)	1.0	25§ (89.3)	
≥7 yr	155 (0.7)	1.3 (1.0–1.6)	134 (87.0)	
No. partners (last 3 mo)				
0–1	138 (0.6)	1.0	124 (90.5)	2.5 (0.9–6.7)
≥2	45 (0.7)	1.6 (1.1–2.3)‡	35 (77.8)	1.0

*Predicting whether participants had an incident infection.

†Predicting whether participants had no symptoms among infected individuals; odds ratios adjusted for country, venue, and repeated measurements.

‡Significant at $P < 0.05$ or less.

§Cell counts too low to be included in analysis.