Knock-Knock: A Population-Based Survey of Risk Behavior, Health Care Access, and Chlamydia trachomatis Infection among Low-Income Women in the San Francisco Bay Area.

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To estimate the prevalence of urogenital chlamydial infection among young, low-income women in northern California and to describe correlates of infection, a population-based door-to-door household cluster survey was conducted from 1996 through 1998. The participants included 1439 women 18-29 years of age, with a mean age of 24 years, most of whom were African American (43%) or Latina (23%) and had a median income of $500-$999 per month. Most (94%) had received health care in the past year, and [sim]50% was covered by state insurance programs. Although more than half (62%) had had a recent pelvic examination, only 42% had recently used a condom with a new partner. The prevalence of urogenital chlamydial infection was 3.2% (95% confidence interval, 2.2%-4.2%). Women with chlamydia were more likely to be younger (18-21 years of age) and nonwhite and to have lower socioeconomic status. These data demonstrated an [sim]2-3-fold greater burden of infection than routine surveillance data have suggested.

Chlamydia trachomatis infection is the most common reportable disease in the United States [1]. In 1999, [greater than]659,441 cases of C. trachomatis infection were reported to the Centers for Disease Control and Prevention (CDC) [1]. Nevertheless, estimates of annual incidence are as high as 3 million cases per year [2]. Knowing the population burden of C. trachomatis is important, because the limited resources of sexually transmitted disease (STD) control programs are targeted toward disease prevention on the basis of the demographic localization of infection. Among women, chlamydial infections are a common cause of pelvic inflammatory disease, ectopic pregnancy, chronic pelvic pain, and infertility [3]. In addition, genital inflammation enhances the sexual transmission of human immunodeficiency virus (HIV), and reducing the level of bacterial STDs in the population may reduce HIV transmission [4].

Surveillance for STDs such as C. trachomatis infection has been dependent on reporting. All states, except New York, currently require providers and laboratories to report cases of chlamydia, gonorrhea, and syphilis [1]. Reports from providers and laboratories indicate the number of persons tested, but, because of the asymptomatic nature of most of these infections, case-based surveillance may substantially underestimate the true population burden of the disease. In 1999, the reported case rate of C. trachomatis infection among US women 20-24 years of age was 2187.1 per 100,000, or [sim]2.2%; however, a recent study of female military recruits in this same age group found positivity rates of 7%-11% [1, 5].

Prevalence monitoring among select populations is the second major method of STD surveillance. Routine screening at family planning clinics has allowed the monitoring of disease trends over time [1]. Regular screening at these clinics has been associated with a decrease in chlamydia positivity rates in the Pacific Northwest [1]. The advent of noninvasive and more-sensitive nucleic acid amplification tests for the presence of C. trachomatis has enabled STD control programs to perform surveillance and case finding among groups other than typical clinic-based populations, such as among students and prison inmates [6-8].

Case-based reporting and prevalence monitoring are useful for prevalence surveillance of C. trachomatis but are limited to groups that access care and are screened. C. trachomatis surveillance data for the general population are rare and difficult to acquire [9]. Population-based surveillance is costly and not available to most STD control programs. However, population-based data are the best information on which to base health policy and to allocate prevention and control resources. True population-based studies remain the gold standard of surveillance and quantification of disease burden. With the advent of urine-based testing and the need to determine the feasibility of population-based prevalence surveillance for C. trachomatis, we conducted a door-to-door household survey of risk behavior and C. trachomatis prevalence among young women living in low-income neighborhoods in the San Francisco Bay Area.

Methods

Study population. From April 1996 through January 1998, staff of 5 San Francisco Bay Area county health departments conducted a random population-based household survey of young women living in low-income census blocks in Alameda,

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Contra Costa, San Francisco, San Joaquin, and San Mateo Counties (n = 2546). The analysis reported here was limited to counties in which testing for C. trachomatis was conducted--namely, Alameda, San Francisco, and San Mateo Counties. Details of the methodology used and of additional analyses based on behavior and disease outcomes are discussed elsewhere [10]. In brief, the sampling unit was defined as city blocks within the census block groups, from 1990 census data, with a median household income in the [less than]10th percentile for each county. City blocks within the census block groups were numbered sequentially and randomly selected using a list of computer-generated random numbers. Field workers then mapped the selected city blocks and counted households. All English- or Spa nish-speaking women 18-29 years of age who resided in a household and had no other home were invited to participate in a 45-mm face-to-face interview and were asked to submit blood and urine specimens. For participating in the study, participants received $25-$50 or the equivalent in food coupons, as decided by each county.

Questionnaire. Using a standardized questionnaire, field workers interviewed the participants either in their homes or at another private location and collected basic demographic data and information regarding access to health care, gynecologic and obstetric history, history of STDs, sexual behavior, condom use, and history of sexual coercion.

Laboratory procedures. At the participants' homes, field workers collected blood and urine samples for C. trachomatis screening. Urine from participants was transported at 4[degrees]C to the San Francisco Department of Public Heatth Laboratory, where routine clinical testing of specimens for chiamydia is performed daily for the municipal STD clinic, county detention facilities, and primary care clinics. Specimens were tested for chlamydial DNA by ligase chain reaction, in accordance with the manufacturer's directions (LCx, Abbott Laboratories). Quality assurance procedures were practiced in accordance with guidelines described in the Clinical Laboratory Improvement Act [11].

Field workers scheduled follow-up appointments with all study participants, during which participants were informed of their test results and, if necessary, were referred to a clinic for treatment. All identified cases of disease were treated in accordance with published guidelines [12].

Statistical analysis. Data were entered into Epi Info 6.0 (CDC). The sample percentages and 95% confidence intervals for selected characteristics were weighted by the target sample size of each county, on the basis of 1990 census data, by use of the CSAMPLE program of Epi Info. For groups in which the prevalence of infection was 0%, regular unweighted upper 95% confidence limits were calculated. Backward stepwise multivariate logistic regression was used to identify variables independently associated with chlamydial infection (SAS 6.12, SAS Institute). Proportions and means were compared by means of the [[chi].sup.2] test and the t test or Wilcoxon rank sum test for parametric or nonparametric data. Data from case-based reporting of chlamydial infection to the California Department of Health Services and the Office of Family Planning were compared with prevalence data from the Young Women's Survey (YWS).

Results

Characteristics of the county target populations. The 10th percentile for household income for Alameda, San Francisco, and San Mateo Counties was $17,969, $20,473, and $30,490, respectively, and encompassed 780, 597, and 720 city blocks, respectively. The estimated number of women 18-29 years of age living in the selected census block groups was 15,263 for Alameda County, 9631 for San Francisco County, and 11,119 for San Mateo County.

Characteristics of survey participants. From April 1996 through January 1998, field workers counted 14,438 dwellings, of which 10,919 (76%) were contacted successfully. During this time period, 2148 eligible women were identified and asked to participate in the study, of whom 1439 (67%) enrolled and 1314 (91%) underwent urine testing. The proportion of dwellings contacted was highest in San Francisco County (80%), followed by San Mateo County (77%) and Alameda County (66%). Participant enrollment rates were highest in Alameda and San Mateo Counties (76% each), followed by San Francisco County (57%). The characteristics of the study population are summarized in table 1. The mean age [+ or -] SD of the study population was 24 [+ or -] 3 years.

STD prevalence. Table 1 shows the prevalence of chlamydia, weighted by county size and restricted to those women who reported ever being sexually active (n = 1314). The prevalence estimates of chlamydia in this study can be used to

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estimate the burden of chlamydial infection among the target population in each county; for example, during the study period, San Francisco County would have had -221 cases of chlamydia among women 18-29 years of age who were living in the census tracts and who had a household income in the [less than or equal to]10th percentile (i.e., -2.3% of 9631 women). Table 2 summarizes data from case-based reporting of chlamydia to the California Department of Health Services and the Office of Family Planning, in addition to the results of our survey.

Correlates of chlamydial infection. Prevalence rates of chlamydial infection, by selected demographic and behavioral characteristics, are given in table 1. Women with chlamydial infection were more likely to be younger (18-21 years of age) and nonwhite and to have lower socioeconomic status (income and education). Nearly 6% of the women who were pregnant (n = 89) were infected. Reporting a recent pelvic examination was associated with a marginal decrease in current infection. Bisexual women and lesbians had very low rates of infection (0.6% and 0%, respectively), which validated participants' reports of sexual practices. Number of lifetime or recent sexual partners was not associated with current chlamydial infection; however, recent condom use appeared to be associated with a substantially lower rate of infection. A history of bacterial STDs--in particular, gonorrhea--was associated with current chlamydial infection. Current infection was not associated with the presence of STD symptoms--such as vaginal disc harge, odor, spotting, severe pain or burning with sex or urination, or severe lower abdominal pain--during the past year. When stepwise logistic regression was used, independent correlates of infection were not identified. On the basis of the sample size in this study, the power to detect an odds ratio [greater than]2.0 was [sim]77%.

Discussion

This study measured population-based rates of sexual risk behavior and urogenital C. trachomatis infection among young women living in low-income neighborhoods of a large urban area. The household contact and participation rate allowed relatively unbiased measurements of risk and disease burden; however, in view of the low measured prevalence of disease, biases may remain. Traditional correlates of STDs among women in clinics--such as young age, nonwhite race/ethnicity, and low socioeconomic status--were validated in this large, population-based survey.

The prevalence estimates of chlamydia in this study can be used to estimate the burden of chlamydial infection among the target population in each county. For example, during the study period, San Francisco County would have had [sim]221 cases of chlamydia among women 18-29 years of age who were living in the census tracts and who had a household income in the [lesser than or equal to]10th percentile (i.e., [sim]2.3% of 9631 women). In 1997, San Francisco County had 689 reported cases of chlamydia among women from all income groups who were 20-29 years of age. Although data on reported cases of chlamydia are not available for a comparable population on the basis of income, it is unlikely that the population in our study accounted for nearly one-third (221 of 689) of reported cases. The estimation of disease burden from reported cases underestimates the population burden of disease. The actual extent of this underestimation is unknown.

The YWS estimates of disease prevalence were higher than the positivity rates among women seen at family planning clinics in Alameda and San Mateo Counties but were lower than the estimates from San Francisco County. This suggests that positivity rates among women attending family planning clinics may vary by county and that population-based estimates derived from clinic-based data must be interpreted with caution.

The different population-based estimates of disease--namely, case-based reporting, prevalence monitoring, and random population-based survey--offered a range of estimates, from [sim]1% to 5%, and varied by [sim]2-fold within each county. Thus, although case-based reporting may offer an underestimate of disease burden by as much as 50%, family planning data may overestimate disease burden by a similar percentage. The true disease burden is likely to be in between, as measured by our population-based random survey. Therefore, where population-based measurements are not available for chlamydia, policy makers, public health practitioners, and researchers probably should use estimates of disease from prevalence monitoring and not from case-based reporting, because the latter provides a substantial underestimate of disease burden. The different rates of infection across counties may reflect differences in the screening practices of family planning clinics, in countywide chlamydia control activities, or in sociodem ographic factors related to disease transmission [14]. The exploration of county-specific correlates of infection was beyond the scope of this study.

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In summary, this population-based survey provided estimates for the prevalence of both sexual risk behavior and chlamydia in a household-based sample of young, minority women. The chlamydia estimates were similar to data from family planning clinics but increased in comparison with estimates reported from the medical care system. Although population-based studies are costly and time consuming, they provide an important means for the estimation of disease burden in the population. It is critical that STD control programs have data that at least approximate the point prevalence. This suggests that periodic population-based surveys should continue to be conducted in different jurisdictions, to validate more-routine surveillance activities and to enable health departments to perform their essential functions of assessment and control of disease.

Young Women's Survey (YWS) Team

The YWS team also includes Geneva Bell-Sanford and Hypolitta Villa (San Joaquin County Department of Health, Stockton, CA); Cynthia Cossen (California Department of Health Services, Berkeley); Viva Delgado (San Francisco Department of Public Health, San Francisco); Carla Dillard Smith (California Prostitution Education Project, Oakland); Tanya Holmes (Alameda County Health Department, Oakland); Martin Lynch and Juan Reardon (Contra Costa County Health Department, Martinez, CA); and Charlotte Smith and Francis Wiser (San Mateo County Health Department, San Mateo, CA).

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Characteristics of and Chlamydia trachomatis prevalence among 1314 study participants, Young Women's Survey, San Francisco Bay Area (Alameda, San Francisco, and San Mateo Counties), 1996-1998.

Characteristic	Weighted percentage (95% CI)
Demographics	
County	
Alameda	339
San Francisco	513
San Mateo	462
Age, years	
18-21	34.0 (31.5-36.5)
22-25	33.5 (31.0-35.9)
26-29	32.5 (30.1-35.0)
Race or ethnic group	
Latina	28.9 (26.8-31.1)
Black	43.2 (41.0-45.5)
White	14.7 (13.0-16.4)
Asian or Pacific Islander	6.6 (5.4-7.8)
Mixed or other	6.6 (5.3-7.8)
Monthly household income, USS	
[less than]499	25.4 (23.0-27.7)
500-999	31.9 (29.4-34.3)
1000-1999	23.7 (21.5-26.0)
Education	
Some high school or less	37.6 (35.1-40.1)
High school or more	62.4 (59.9-64.9)
Partnership status	
Currently married	18.4 (16.4-20.3)
Member of unmarried couple	8.7 (7.3-10.2)
Single and never married	64.7 (62.3-67.1)
Separated, divorced, or widowed	8.2 (6.7-9.7)
Health care access, by type of insurance or	

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payment	
State of California	41.2 (38.7-43.7)
Private	27.5 (25.3-29.8)
Cash or no payment	26.0 (23.8-28.3)
Not specified	5.2 (4.1-6.4)
History of reproductive health	
Currently pregnant [a]	
Yes	7.5 (6.0-9.0)
No	92.5 (91.0-94.0)
Previous pelvic exam	
[less than]6 Months	32.8 (30.3-35.2)
6 Months to 1 year	28.7 (26.3-31.1)
1-5 Years	18.8 (16.8-20.9)
Never	19.8 (17.7-21.9)
History of infertility [a]	
Yes	11.7 (9.9-13.5)
No	88.3 (86.5-90.1)
Sexual history	
Gender of previous partners [b]	
Male only	88.0 (86.3-89.7)
Male and female	11.1 (9.5-12.8)
Female only	0.9 (0.4-1.4)
Age at first vaginal intercourse, years [b]	
[less than]12	3.4 (2.3-4.4)
12-14	22.2 (20.2-24.5)
15-17	48.0 (45.3-50.7)
[greater than]17	26.4 (24.1-28.8)
History of receiving money or drugs for sex [b]	
Yes	13.1 (11.3-15.0)
No	86.9 (85.0-88.7)
Lifetime no. of male partners [c]	
None	5.3 (4.0-6.6)
1	20.9 (18.7-23.1)
2	10.9 (9.1-12.7)
3	8.8 (7.1-10.4)
[greater than or equal to]4	54.1 (51.4-56.9)

Characteristic	No. of participants tested
Demographics	
County	
Alameda	
San Francisco	
San Mateo	
Age, years	
18-21	424
22-25	447
26-29	441
Race or ethnic group	
Latina	368
Black	524
White	229
Asian or Pacific Islander	91
Mixed or other	98
Monthly household income, USS	
[less than]499	311
500-999	401
1000-1999	318
Education	
Some high school or less	482
High school or more	828

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Partnership status	
Currently married	253
Member of unmarried couple	119
Single and never married	823
Separated, divorced, or widowed	107
Health care access, by type of insuranceor payment	
State of California	521
Private	368
Cash or no payment	349
Not specified	65
History of reproductive health	
Currently pregnant [a]	
Yes	89
No	1147
Previous pelvic exam	
[less than]6 Months	434
6 Months to 1 year	371
1-5 Years	252
Never	238
History of infertility [a]	
Yes	152
No	1137
Sexual history	
Gender of previous partners [b]	
Male only	1141
Male and female	153
Female only	12
Age at first vaginal intercourse, years [b]	
[less than] 12	43
12-14	276
15-17	617
[greater than] 17	346
History of receiving money or drugs for sex [b]	
Yes	158
No	1138
Lifetime no. of male partners [c]	
None	1
1	251
2	125
3	98
[greater than or equal to]4	645

Characteristic	Weighted C. trachomatis prevalence, % (95% CI)
Demographics	
County	
Alameda	4.7 (2.5-7.0)
San Francisco	2.3 (1.0-3.6)
San Mateo	2.3 (1.0-3.6)
Age, years	
18-21	5.0 (2.8-7.2)
22-25	2.3 (0.8-3.7)
26-29	2.5 (1.0-4.0)
Race or ethnic group	
Latina	2.6 (0.9-4.2)
Black	4.2 (2.4-5.0)
White	1.4 (0-2.9)

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Asian or Pacific Islander	4.2 (0.2-8.2)	
Mixed or other	3.3 (0-7.2)	
Monthly household income, USS		
[less than]499	4.4 (1.9-6.8)	
500-999	3.0 (1.3-4.8)	
1000-1999	2.5 (0.8-4.2)	
Education		
Some high school or less	4.3 (2.4-6.2)	
High school or more	2.6 (1.5-3.8)	
Partnership status		
Currently married	1.7 (0.02-3.3)	
Member of unmarried couple	3.8 (0.1-7.6)	
Single and never married	3.8 (2.5-5.2)	
Separated, divorced, or widowed	1.9 (0-4.7)	
Health care access, by type of insuranceor payment		
State of California	3.8 (2.1-5.6)	
Private	3.3 (1.4-5.2)	
Cash or no payment	2.4 (0.6-4.1)	
Not specified	2.8 (0-6.7)	
History of reproductive health		
Currently pregnant [a]		
Yes	5.7 (0.7-10.7)	
No	3.0 (2.0-4.1)	
Previous pelvic exam		
[less than]6 Months	2.5 (1.0-4.1)	
6 Months to 1 year	3.9 (1.9-6.0)	
1-5 Years	3.1 (0.8-5.4)	
Never	3.8 (1.2-6.4)	
History of infertility [a]		
Yes	2.9 (0.05-5.7)	
No	3.4 (2.3-4.4)	
Sexual history		
Gender of previous partners [b]		
Male only	3.6 (2.5-4.8)	
Male and female	0.6 (0-1.7)	
Female only	0 (0-0.3)	
Age at first vaginal intercourse, years [b]		
[less than] 12	4.7 (0-11.3)	
12-14	2.6 (0.6-4.7)	
15-17	4.4 (2.7-6.1	
[greater than] 17	1.0 (0.02-2.0)	
History of receiving money or drugs for sex [b]		
Yes	3.9 (0.8-7.0)	
No	3.1 (2.0-4.1)	
Lifetime no. of male partners [c]		
None	0	
1	1.8 (0.02-3.6)	
2	4.0 (0.5-7.4)	
3	2.9 (0-6.2)	
[greater than or equal to]4	3.1 (1.7-4.6)	
No. of male partners in past 2 months [c]		
None	20.9 (18.6-23.1)	194
1	73.3 (70.8-75.8)	872
2	4.2 (3.1-5.3)	54
[greater than or equal to]3	1.7 (0.9-2.4)	18
Condom use with new male partner, last vaginal intercourse [c]		
Yes	41.7 (29.9-53.4)	31
No	58.3 (46.6-70.1)	35
Lifetime history of sexual coercion [b]		

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Threatened to have sex	31.4 (28.9-33.8)	404
Physically forced to have sex	26.4 (24.0-28.8)	344
Lifetime history of specific STD [b]		
Chlamydia	18.7 (16.6-20.9)	241
Genital herpes	3.3 (2.4-4.2)	50
Genital warts	4.3 (3.3-5.4)	65
Gonorrhea	10.6 (9.0-12.3)	131
Hepatitis B	1.4 (0.8-2.0)	20
PID	4.4 (3.3-5.5)	59
Syphilis	2.9 (2.0-3.8)	36
Trichomoniasis	11.8 (10.1-13.6)	138
History of STD signs or symptoms in previous year [b]		
Yes	27.3 (24.9-29.7)	368
No	72.7 (70.2-75.1)	933
No. of male partners in past 2 months [c]		
None		
1	2.9 (1.7-4.0)	
2	4.2 (0-9.9)	
[greater than or equal to]3	0	
Condom use with new male partner, last vaginal intercourse [c]		
Yes	0 (0-0.1)	
No	3.5 (0-10.2)	
Lifetime history of sexual coercion [b]		
Threatened to have sex	3.4 (1.6-5.2)	
Physically forced to have sex	3.0 (1.9-4.1)	
Lifetime history of specific STD [b]		
Chlamydia	3.6 (1.2-5.9)	
Genital herpes	0 (0-0.09) [a]	
Genital warts	0 (0-0.07) [a]	
Gonorrhea	8.6 (3.6-l3.5)	
Hepatitis B	4.2 (0-12.3)	
PID	2.8 (0-6.6)	
Syphilis	6.7 (0-15.6)	
Trichomoniasis	4.5 (1.2-7.9)	
History of STD signs or symptoms in previous year [b]		
Yes	2.5 (0.9-4.2)	
No	3.6 (2.3-4.8)	

NOTE. CI, confidence interval; PID, pelvic inflammatory disease; STD, sexually transmitted disease.
(a.)Among those sexually active with men.
(b.)Among those sexually active.
(c.)Among those sexually active and never reporting exchange of money or drugs for sex.

Chlamydia surveillance data among young women in the San Francisco Bay Area, by county, 1997-1998.

County	No. of reported cases, 1997 [a]	Reported case rate, 1997, % [a]	Positivity at family planning clinics, 1997, % [b]
Alameda	1242	1.4	3.4
San Mateo	359	0.86	2.2
San Francisco	689	1.0	3.6

County	Prevalence in Young Women's Survey, 1997-1998, %
Alameda	4.7
San Mateo	2.3
San Francisco	2.3

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(a.)Reported cases among women 20-29 years of age in 1997, according to the California Department of Health Services [13].

(b.)Chlamydia positivity among females at family planning clinics, according to the California Infertility Prevention Project (J. McAvoy, personal communication).