

Risk Factors for Gonorrhea Among Heterosexuals—San Francisco, 2006

PENNAN M. BARRY, MD, MPH,*† CHARLOTTE K. KENT, PhD,† AND JEFFREY D. KLAUSNER, MD, MPH†‡

Goal: In San Francisco, coinciding with increases in the western United States, we observed substantial gonorrhea increases among young heterosexuals during 2003–2005. We conducted a case-control study to identify intervention strategies for prevention and control.

Study Design: We interviewed case patients with gonorrhea during February–July, 2006 and control subjects at the local Department of Motor Vehicles. We included sexually active heterosexuals aged 15 to 35 years in sex-stratified analyses.

Results: We interviewed 225 persons: 24 male and 28 female case patients and 98 male and 75 female control subjects. In multivariable analysis adjusting for black race and multiple partners among men, black race [adjusted odds ratio (AOR), 5.1; 95% confidence interval (CI), 1.7–15.0], having had multiple partners (AOR, 3.1; 95% CI, 1.1–8.5), having had an anonymous partner (AOR, 6.4; 95% CI, 1.9–21.4), and a long-term partnership (AOR, 0.3; 95% CI, 0.1–0.9) were associated with gonococcal infection. Among women, after adjustment for age, multiple partners, and black race (subject or partner), being black or having a black partner (AOR, 6.9; 95% CI, 2.2–21.8), having had a recently incarcerated partner (AOR, 6.2; 95% CI, 1.0–38.4), or meeting partners on the street (AOR, 19.0; 95% CI, 2.0–179.0) were associated with gonococcal infection.

Conclusions: Demographic and behavioral factors increase risk for gonorrhea among heterosexuals in San Francisco with partner characteristics being particularly important. Prevention and control efforts are focusing on blacks and incarcerated populations using street-based outreach and expanded screening and treatment.

GONORRHEA CONTINUES TO BE a critical public health problem: it is the second most common reportable disease in the United States. The number of gonorrhea cases reported in the United States had been declining, but in 2005, increased gonorrhea rates were observed in multiple western states, including California.^{1,2}

In San Francisco, gonorrhea rates had been decreasing until 2003.^{1,3} In 2005, during routine review of surveillance data, we

*From the *Epidemic Intelligence Service, Office of Workforce and Career Development, Centers for Disease Control and Prevention, Atlanta, Georgia; †San Francisco Department of Public Health, San Francisco, California; and ‡University of California, San Francisco, San Francisco, California*

noted a substantial increase in gonorrhea incidence that affected heterosexuals more than men who have sex with men. The largest increases were observed among young heterosexuals, particularly blacks. On the basis of surveillance data and with support from a newly formed group of community partners, we issued a health advisory to San Francisco medical practitioners alerting them to the increase and asking that providers screen all sexually active blacks aged <25 years for gonorrhea and chlamydia (<http://www.dph.sf.ca.us/sfcityclinic/providers/GCHealthAdvisoryFinal.pdf>). To further investigate potential causes for this increase and to identify possible intervention strategies, we conducted a case-control study of young, sexually active, heterosexual residents of San Francisco.

Methods

Study inclusion criteria for case patients and control subjects were as follows: aged 15 to 35 years, sexually active within the previous 3 months, and a San Francisco city resident for ≥ 3 months. We excluded men who had had sex with men during the previous 3 months and women who had not had sex with men during the previous 3 months.

We identified case patients prospectively as they were reported to the San Francisco Department of Public Health through routine gonorrhea surveillance. Persons meeting inclusion criteria on the basis of available case-report information were contacted for an interview. Persons were excluded after contact on the basis of additional information elicited in the survey (e.g., San Francisco nonresident or men who have sex with men). For persons whose gonorrhea was diagnosed or treated by the San Francisco Department of Public Health at the municipal sexually transmitted disease (STD) clinic, surveys were administered at the time of treatment by the nursing staff. For persons whose gonorrhea was diagnosed or treated elsewhere, San Francisco Department of Public Health staff attempted to contact patients by telephone or postal service mail or in person. Staff attempted to contact case patients until all contact leads were exhausted or a minimum of 4 times. Contact attempts were made at different times of day and different days of the week. After the interview, case patients were offered treatment packets to deliver to their sex partners.

We surveyed control subjects during 2 full days at the only California Department of Motor Vehicles (DMV) office within the

The authors thank Joseph Courtney, PhD, for contributions to study design; Katherine Ahrens, MPH, for assistance with data collection and analysis; Sharon Penn and Monica Lee for assistance with data collection; Jolene Nakao, for assistance with survey piloting; Michael Samuel, PhD, for assistance with data interpretation; and the members of the Centers for Disease Control and Prevention STD Surveillance Network. We also thank the members of the San Francisco GC Team and the San Francisco Community Adolescent STD Partners Group. Additionally, we thank Ken Miyao of the California Department of Motor Vehicles and the staff at the San Francisco office of the California Department of Motor Vehicles.

Disclaimer: The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Correspondence: Pennan M. Barry, MD, MPH, 1360 Mission Street, Suite 401, San Francisco, CA 94114. E-mail: pennanbarry@gmail.com.

Received for publication June 3, 2007, and accepted October 24, 2007.

city limits of San Francisco. We received permission to conduct the survey on DMV property, but no DMV personnel were involved in survey administration. All DMV patrons appearing to be within the target age range were approached as they entered the DMV. Before receiving a survey, each potential respondent was informed regarding the nature of the survey, the reason for doing the survey, the survey being anonymous and voluntary, its not being related to his or her use of DMV services, and its being intended for San Francisco residents aged 15 to 35 years. As respondents returned surveys upon exiting the DMV, each survey was checked for completeness, and each respondent was given a chance to ask questions about the survey or to clarify survey responses. Respondents who did not meet inclusion criteria or who reported symptoms consistent with gonorrhea were excluded from analysis. To evaluate representativeness of control subjects, control subject characteristics were compared with data from the 2000 census.⁴

Data Analysis

Data were analyzed by using SAS 9.1 (SAS Institute, Inc., Cary, NC). Separate analyses were performed by sex. Each subject and partner variable that was statistically significant in univariate analysis ($P < 0.05$) was adjusted for statistically significant demographic variables (age or race) and having multiple sex partners by using multivariable logistic regression. As a result of sample size, we were unable to control for all potential confounders simultaneously. Adjustments were checked for significant interactions by using interaction terms.

Human Subjects

This study was performed as part of a public health response to an increase in a nationally notifiable disease and was determined to be nonresearch by the Centers for Disease Control and Prevention. All subjects were informed that providing information was voluntary and that their responses would be kept confidential. To compensate participants for their time, all participants received a \$5 gift card to a restaurant, a grocery store, or a coffee shop.

Results

A total of 67 (34%) of 197 eligible case patients were successfully interviewed, 15 of whom were subsequently excluded. Interviewed case patients were similar to case patients who were not interviewed in terms of race and reporting provider except that interviewed persons were more likely to have been tested at the municipal STD clinic (44% vs. 26%, $P = 0.01$). After exclusion criteria were applied, data regarding 24 male and 28 female case patients remained for analysis. The mean age of interviewees was 25.0 years [95% confidence interval (CI), 22.7–27.4] for men and 21.8 (95% CI, 20.1–23.5) years for women. Among male case patients, 79% were black whereas among females, 50% were black (Table 1).

At the DMV, 254 (74%) of 343 distributed surveys were returned, 81 of which did not meet inclusion criteria, leaving 173 for analysis. The most frequent reasons for exclusion were not being sexually active during the previous 3 months ($n = 26$), not being heterosexual ($n = 21$), and not being a San Francisco resident ($n = 12$). Three surveys were excluded because they reported symptoms consistent with gonorrhea. Control subjects who returned a survey were more likely to be black or Hispanic, less likely to be white or Asian, and tended to be younger than 15- to 35-year-old San Francisco residents (information from 2000 census data). The mean age of respondents was 24.2 years (95% CI, 23.1–25.4) for

men and 24.9 (95% CI, 23.7–26.1) for women. For men, 40% of control subjects were black whereas for women, 28% were black.

Among men, no association was identified between gonococcal infection and age. In univariate analysis, male case patients were significantly more likely to report having more than 1 sex partner during the previous 3 months and to be black than male control subjects (Table 1). After adjusting for multiple partners and black race, male case patients were more likely to report having an anonymous partner than control subjects [adjusted odds ratio (AOR), 6.4; 95% CI, 1.9–21.4]. After adjustment, male case patients were 70% less likely to report having a long-term partner for the previous 3 months compared with control subjects (AOR, 0.3; 95% CI, 0.1–0.9). Variables that were statistically significant in univariate but not adjusted analyses were recent incarceration, meeting partners in a bar or club, and meeting partners on the street, i.e., a casual, chance encounter on the street, sidewalk, or park.

Unlike men, among women, age was significantly associated with gonococcal infection. Female case patients were approximately 3 times more likely to be aged 15 to 19 years than female control subjects (OR, 2.8; 95% CI, 1.1–7.3). Black race was a significant factor among women and their sex partners. In univariate analysis, female case patients were more likely to be of black race (OR, 2.6; 95% CI, 1.0–6.3) or to have had their last sex partner be black (OR, 8.3; 95% CI, 3.0–23.2) than female control subjects. In addition, in univariate analysis, having multiple partners was significantly more common among female case patients than control subjects (OR, 3.5; 95% CI, 1.4–8.8). After adjusting for age 15 to 19 years, black race in subject or last partner, and having had multiple partners, female case patients were more likely to report having a partner who had been recently (defined by respondent) incarcerated (AOR, 6.2; 95% CI, 1.01–38.4) or meeting their sex partners on the street (AOR, 19.0; 95% CI, 2.0–179.0) compared with female control subjects. Six female case patients but no female control subjects reported being incarcerated in the previous 3 months. Variables that were significantly associated with gonorrhea in univariate but not adjusted analyses included age, having multiple partners, and having anonymous partners. In addition, among women, reporting a long-term partner was protective in univariate but not adjusted analysis.

No case patients or control subjects reported crack cocaine use or being human immunodeficiency virus infected. Illicit drug use, meeting partners on the Internet, anal sex, oral sex, and condom use were not statistically associated with gonococcal infection.

Discussion

This case-control study of risk factors for gonococcal infection among young San Francisco heterosexuals was part of the San Francisco Department of Public Health's investigation and response to recent gonorrhea increases in San Francisco and regionally.¹ This study confirmed that well known risk factors (e.g., having multiple or anonymous sex partners, black race, and young age) are key contributors. We also identified other lesser-known risk factors (e.g., recent incarceration and meeting partners on the street). These results are useful for prevention and control program planning, and they reinforce San Francisco Department of Public Health's existing intervention efforts (e.g., gonorrhea screening in jails, street outreach programs, and an emphasis on reducing racial disparities in STD rates). This study also demonstrates that other risk factors [e.g., methamphetamine or cocaine (including crack) use or meeting partners online] might be less important risk factors among young San Francisco heterosexuals. Additionally, we successfully surveyed control subjects at the local DMV, a location we had not used before.

TABLE 1. Number, Percentage, Odds Ratio (OR), Adjusted Odds Ratio (AOR), and 95% Confidence Interval (CI) of Risk Factors for Gonorrhea Among Heterosexuals Aged 15–35 years—San Francisco, 2006

	Males				Females						
	Control Subject No. (%)	Case-Patient No. (%)	OR	95% CI	AOR*	95% CI	Case-Patient No. (%)	OR	95% CI	AOR†	95% CI
Total	98	24					75				
Subject characteristics†											
Age (yr)											
15–19	23 (23.5)	3 (12.5)	0.4	(0.1–1.6)			14 (18.7)				
20–29	56 (57.1)	14 (58.3)	0.7	(0.2–1.9)			44 (58.7)				
30–35	19 (19.4)	7 (29.2)	Ref.				17 (22.7)				
Age group 15–19 yr	23 (23.5)	3 (12.5)	0.5	(0.1–1.7)	2.1	(0.6–7.1)	14 18.7			1.4	(0.5–4.3)
Incarcerated	9 (9.2)	6 (25.0)	3.3	(1.04–10.4)			0 (0.0)				
Oral sex‡	64 (65.3)	18 (75.0)	1.5	(0.6–4.3)			43 (57.3)				
Anal sex§	17 (17.3)	4 (16.7)	0.9	(0.3–2.9)			13 (17.3)				
Gave money or drugs for sex	2 (2.0)	2 (8.3)	4.4	(0.6–32.7)			0				
Received money or drugs for sex	1 (1.0)	0					0				
Condom with last partner	47 (48.0)	9 (37.5)	0.6	(0.3–1.6)			31 (41.3)				
Drug use†											
Any drug use	13 (13.3)	6 (25.0)	2.2	(0.7–6.5)			8 (10.7)				
Methamphetamine use	3 (3.1)	2 (8.3)	3.0	(0.5–19.2)			4 (5.3)				
Black race											
Subject	39 (39.8)	19 (79.2)	5.7	(2.0–16.7)	5.1	(1.7–15.0)	21 (28.0)				
Last partner	28 (28.6)	12 (50.0)	2.5	(1.00–6.2)			23 (30.7)				
Subject or last partner	44 (44.9)	19 (79.2)	4.7	(1.6–13.5)			26 (34.7)			6.9	(2.2–21.8)
Partner characteristics†											
More than 1 partner	39 (39.8)	17 (70.8)	3.7	(1.4–9.7)	3.1	(1.1–8.5)	15 (20.0)				
More than 2 partners	19 (19.4)	12 (50.0)	4.2	(1.6–10.7)			6 (8.0)				
Partner incarcerated	0	0					2 (2.7)				
Anonymous partner	12 (12.2)	10 (41.7)	5.1	(1.9–14.1)	6.4	(1.9–21.4)	2 (2.7)				
Long-term partner (>3 mo)	60 (61.2)	6 (25.0)	0.2	(0.1–0.6)	0.3	(0.1–0.9)	49 (65.3)				
Venue where partner met†											
Bar/club	13 (13.3)	9 (37.5)	3.7	(1.3–10.2)	3.3	(0.97–11.3)	5 (6.7)				
Internet	4 (4.1)	2 (8.3)	2.1	(0.3–12.0)			2 (2.7)				
Street	11 (11.2)	7 (29.2)	3.0	(1.00–8.9)	1.7	(0.5–5.8)	1 (1.3)				

*AOR adjusted for more than one sex partner and black race. AOR presented for these variables are results from a model including only more than 1 sex partner and black race.
 †AOR adjusted for more than 1 sex partner, ages 15–19 years, and black race in subject or last partner. AOR presented for these variables are results from a model including only more than 1 sex partner, ages 15–19 years, and black race in subject or last partner.

‡During previous 3 months.

§Oral sex included only receiving oral sex for men and performing oral sex for women.

¶Anal sex included only insertive anal sex for men and receptive anal sex for women.

We determined that black race was a significant marker of gonococcal infection risk. Black race has been identified as a risk factor in multiple previous studies of both initial and subsequent infection and is observed in STD surveillance data.^{2,3,5} Gonorrhea rates have the largest racial/ethnic disparity among nationally notifiable diseases.⁶ The causes of this racial/ethnic disparity are likely multifactorial. However, a major contributor to maintaining this disparity is probably the combination of high prevalence of disease among blacks and partner mixing patterns. Because persons are likely to choose sex partners of the same race as themselves, after prevalence becomes high among a population subgroup, in the absence of effective measures to stop transmission and reduce prevalence, rates are likely to stay high among that subgroup.⁷ Black women are least likely to have a sex partner of a different race/ethnicity and thus are probably more vulnerable to infection as a result of high rates among blacks.^{8,9}

Our results underscore the importance of partner characteristics in determining STD risks. This was especially true for women, among whom having a black partner or having a recently incarcerated partner were risk factors. In the case of black race, having a black partner had a stronger association with gonococcal infection than being black herself. The importance of partner characteristics among young San Francisco blacks was recently highlighted by Auerswald et al.,¹⁰ who reported that partner characteristics of race and incarceration were important determinants of STD risk. Additionally, Aral et al. determined that among populations with low gonorrhea prevalence, the majority of the burden comes from mixing with members of a group with high prevalence⁸; therefore, women with a limited number of STD risk behaviors can have significant gonorrhea risk by having partners who are in a group at high risk.

We also confirmed that recent incarceration is a marker for increased gonorrhea risk whether subjects or their sex partners were incarcerated. This is not a new finding and has been reported by other researchers in California^{10,11} and elsewhere.¹² Our findings reinforce the value of screening programs in correctional facilities as a means to reduce community STD rates. The San Francisco Department of Public Health has been screening and treating persons entering jail for chlamydia and gonorrhea since 1997, and has shown that the program is feasible, is acceptable to persons entering jail, and is able to treat >80% of those who test positive.¹³

The most striking risk factor for women was meeting a partner on the street. Multiple qualitative interviews confirmed that this was not a proxy for sex work (only 1 female case-patient reported receiving money or drugs for sex), and meeting on the street usually involved exchange of contact information, not a meeting intended to immediately result in sex. These partners were rarely anonymous. Other researchers demonstrated that meeting partners on the street was associated with partner age and racial/ethnic discordance among women and concordance among men.⁹ This might be one way in which meeting partners on the street could impact gonorrhea risk. In our study, the strength of association between gonorrhea and meeting a partner on the street for women indicates a need for further investigation and highlights the potential value of such street-based interventions among youth as those performed in San Francisco.^{14,15}

The source of control subjects for the study was the local DMV office. We anticipated that using this venue to survey control subjects might maximize generalizability because the majority of city residents visit the DMV eventually to obtain drivers' licenses or identity cards. In addition, time spent waiting likely increased our response rate. However, because certain DMV services can now be performed by using the Internet, persons without Internet access were likely overrepresented. Additionally, because initial

application for a driver's license must be done in person, our survey sample contained adolescents aged approximately 16 years. The resulting control group had an increased representation of blacks and was younger than the general population. This makes even more striking that age and black race were identified as significant risk factors for gonococcal infection, because the magnitude of association we report is likely a substantial underestimate.

This study is subject to limitations. Despite multiple efforts and methods, we were only able to contact one third of the eligible case patients. However, the low follow-up rate for patients with gonorrhea has been documented multiple times, even using aggressive efforts and incentives.^{16–18} The resulting sample size of this study was limiting in 2 ways. Although we identified significant associations, a larger sample probably would have identified other key risk factors. However, this does not affect the validity of the statistically significant associations we identified. Additionally, limited sample size meant that we were unable to simultaneously control for all potential confounders.

In conclusion, this study reinforces certain well known risk factors for heterosexual acquisition of gonococcal infection, including black race as a marker of gonorrhea risk, and reinforces the importance of assessing partner characteristics when assessing STD risk. It also underscores the potential value of STD screening programs in correctional facilities and street outreach efforts. Lastly, DMV offices can serve as a useful venue for additional public health surveys.

References

- Centers for Disease Control and Prevention. Increases in gonorrhea—Eight western states, 2000–2005. *MMWR Morb Mortal Wkly Rep* 2007; 56:222–225.
- Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance, 2005. Atlanta, GA: U.S. Department of Health and Human Services, 2006.
- San Francisco STD Prevention and Control Services. San Francisco Sexually Transmitted Disease Annual Summary, 2005. San Francisco, CA: San Francisco Department of Public Health, 2006. Available at: <http://www.dph.sf.ca.us/Reports/STD/SFSTDAnnSum2005.pdf>.
- US Census Bureau, United States Census 2000. U.S. Census Bureau. Washington, DC. Available at: <http://www.census.gov/main/www/cen2000.html>. Accessed June 15, 2006.
- Klausner JD, Barrett DC, Dithmer D, et al. Risk factors for repeated gonococcal infections: San Francisco, 1990–1992. *J Infect Dis* 1998; 177:1766–1769.
- Centers for Disease Control and Prevention. Racial disparities in nationally notifiable diseases—United States, 2002. *MMWR Morb Mortal Wkly Rep* 2005; 54:9–11.
- Laumann EO, Youm Y. Racial/ethnic group differences in the prevalence of sexually transmitted diseases in the United States: A network explanation. *Sex Transm Dis* 1999; 26:250–261.
- Aral SO, Hughes JP, Stoner B, et al. Sexual mixing patterns in the spread of gonococcal and chlamydial infections. *Am J Public Health* 1999; 89:825–833.
- Lee JK, Jennings JM, Ellen JM. Discordant sexual partnering: A study of high-risk adolescents in San Francisco. *Sex Transm Dis* 2003; 30:234–240.
- Auerswald CL, Muth SQ, Brown B, et al. Does partner selection contribute to sex differences in sexually transmitted infection rates among African American adolescents in San Francisco? *Sex Transm Dis* 2006; 33:480–484.
- Samuel M, Chase J, Lundberg M, et al. Investigation of steady and epidemic increases in gonorrhea in California, 1999–2004. Paper presented at: ISSTD. Amsterdam, 2005.
- Manhart LE, Aral SO, Holmes KK, et al. Influence of study population on the identification of risk factors for sexually transmitted diseases

- using a case-control design: The example of gonorrhea. *Am J Epidemiol* 2004; 160:393–402.
13. Barry P, Kent CK, Scott K, et al. Sexually transmitted infection screening in county jails is associated with a decrease in community prevalence of gonorrhea and chlamydia—San Francisco, 1997–2004. Paper presented at: National STD Prevention Conference. Jacksonville, FL, 2006.
 14. Moss NJ, Gallaread A, Siller J, et al. “Street medicine”: Collaborating with a faith-based organization to screen at-risk youths for sexually transmitted diseases. *Am J Public Health* 2004; 94:1081–1084.
 15. Boyer CB, Sieverding J, Siller J, et al. Youth united through health education: Community-level, peer-led outreach to increase awareness and improve noninvasive sexually transmitted infection screening in urban African American youth. *J Adolesc Health* 2007; 40:499–505.
 16. Bernstein KT, Zenilman J, Olthoff G, et al. Gonorrhea reinfection among sexually transmitted disease clinic attendees in Baltimore, Maryland. *Sex Transm Dis* 2006; 33:80–86.
 17. Malotte CK, Ledsky R, Hogben M, et al. Comparison of methods to increase repeat testing in persons treated for gonorrhea and/or chlamydia at public sexually transmitted disease clinics. *Sex Transm Dis* 2004; 31:637–642.
 18. Sparks R, Helmers JR, Handsfield HH, et al. Rescreening for gonorrhea and chlamydial infection through the mail: A randomized trial. *Sex Transm Dis* 2004; 31:113–116.