» article in pdf

» table of contents

» search the FPP archive

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Correlates of Sexually Transmitted Bacterial Infections Among U.S. Women in 1995

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Context: Sexually transmitted diseases (STDs) of bacterial origin such as gonorrhea and chlamydial infection can lead to pelvic inflammatory disease (PID) and infertility. Identifying behaviors and characteristics associated with infection may assist in preventing these often asymptomatic diseases and their sequelae.

Methods: Data from 9,882 sexually active women who participated in the 1995 National Survey of Family Growth describe the characteristics of women who report a history of infection with a bacterial STD or of treatment for PID. Multivariate analysis is used to determine which demographic characteristics and sexual and health-related behaviors affect the likelihood of infection or the occurrence of complications.

Results: Overall, 6% of sexually active women reported a history of a bacterial STD, and 8% reported a history of PID. Women who first had sexual intercourse before age 15 were nearly four times as likely to report a bacterial STD, and more than twice as likely to report PID, as were women who first had sex after age 18. Having more than five lifetime sexual partners also was associated with both having an STD and having PID. PID was more common among women reporting a history of a bacterial STD (23%) than among women who reported no such history (7%). In multivariate analyses, age, race, age at first intercourse and lifetime number of sexual partners had a significant effect on the risk of a bacterial STD. Education, age, a history of IUD use, douching and a history of a bacterial STD had a significant impact on the risk of PID, but early onset of intercourse did not, and lifetime number of partners had only a marginal effect.

Conclusions: The pattern of characteristics and behaviors that place women at risk of infection with bacterial STDs is not uniform among groups of women. Further, the level of self-reported PID would suggest higher rates of gonorrhea and chlamydial infection than reported.

In the era of HIV, curable infections such as bacterial sexually transmitted diseases (STDs) may be perceived as relatively benign. For women, however, the reproductive health risks associated with two common bacterial STDs, *Neisseria gonorrhoeae* and *Chlamydia trachomatis,* are serious: If left untreated or unresolved, these infections can spread from the lower genital tract to the upper reproductive tract and can result

in pelvic inflammatory disease (PID).[1] Moreover, both gonorrhea and chlamydia can facilitate transmission of HIV.[2]

The dimensions of the public health problems posed by these bacterial STDs and their sequelae are not known with certainty. Recent surveillance data from the Centers for Disease Control and Prevention (CDC)[3] suggest that rates of gonorrhea and chlamydial infection among women are substantial (120 cases per 100,000 women and 322 cases per 100,000, respectively). Since not all infections are diagnosed or reported to the national surveillance system, however, these prevalence estimates are likely to underestimate the true burden of infection, perhaps by as much as 50%.[4] Moreover, some 50-80% of women infected with gonorrhea are asymptomatic, while more than 90% of women clinically determined to be infected with chlamydia report no symptoms.[5]

A number of demographic factors have been associated with an increased risk of bacterial STDs.[6] Black women are more than 20 times as likely as white women to have gonorrhea (728 cases per 100,000 women vs. 32 per 100,000) and about eight times as likely to have a chlamydial infection (1,171 cases per 100,000 vs. 145 per 100,000).[7]

Rates of gonorrhea and chlamydial infection are highest among women aged 15-19 (2,068 and 757 per 100,000, respectively),[8] reflecting physiological, social and behavioral risk factors associated with early initiation of intercourse.[9] Physiological risk for STDs among adolescent women is due to a number of factors, including the presence of columnar epithelial cells in the vagina and cervix prior to the onset of menarche. These cells are more vulnerable to bacterial STDs than are the stratified squamous cells that gradually replace them subsequent to estrogen stimulation in puberty.[10] In general, changes in vaginal physiology confer some protection as girls mature, but not enough to eliminate infection risk among adult women.

In addition, younger women are at greater risk because they are less likely than older women to be married or in a stable union, and therefore are more likely to be exposed to new sexual partners. They also are more likely to encounter an infected partner, since the prevalence of many STDs is higher among adolescent males than among adult men.[11] Regardless of age, though, as the number of sexual partners increases, the likelihood of encountering an infected partner also increases.

Bacterial STDs are believed to be associated with most acute cases of PID diagnosed in American women each year.[12] Data from clinical studies indicate that 10-40% of women infected with gonorrhea and 20-40% of women with chlamydia will develop PID if these infections are not adequately treated.[13] Women with PID do not always have symptoms.[14] Various clinical studies suggest that the disease may be asymptomatic in 40-80% of cases.[15]

PID may lead to ectopic pregnancy and infertility: Women who have had the disease are 6-10 times more likely to experience an ectopic pregnancy than are women with no such history,[16] and an estimated 10-50% of PID cases result in infertility.[17] Moreover, as the number and severity of PID episodes increases, so does the likelihood of infertility.[18] Among cases of tubal infertility related to sexually transmitted infections, the majority are accounted for by asymptomatic infections of

the fallopian tubes.[19]

The true prevalence of PID is unknown. Accurate diagnostic procedures for the disease are complex and invasive, and interpretation of symptoms and signs can vary greatly by clinicians, by clinical setting and by time period.[20] In addition, because of recent shifts in the treatment of PID from hospitals to outpatient settings, it is difficult to use hospitalization data to estimate the prevalence of PID and its sequelae. Thus, the existing data provide at best a fragmented picture of the disease.

Douching and use of an IUD have been identified as antecedents to PID.[21] The risk associated with douching may be mechanical (i.e., that organisms from the lower tract are forced up through the cervix during douching) or ecological (i.e., that protective hydrogen peroxide-producing lactobacilli are selectively eliminated by douching, which facilitates colonization by pathogenic strains). The risk associated with an IUD may be related to the introduction of organisms from the vagina or cervix into the uterus during insertion,[22] and appears to be limited to the first three months after the device is put in place.[23]

In this article, we use data from the 1995 National Survey of Family Growth (NSFG) to estimate the prevalence of gonorrhea and chlamydial infection and upper tract sequelae. In addition, our analysis examines the demographic and behavioral factors correlated with bacterial STDs, PID and associated sequelae, including ectopic pregnancy and infertility. Together, these analyses represent an important step in examining the current reproductive health of a representative sample of American women.

DATA AND METHODS

Sample and Measures
The data for these analyses are from Cycle 5 of the NSFG, a cross-sectional national survey of the reproductive health and health-related behaviors of American women aged 15-44. Data collection for Cycle 5 began in January 1995 and ended in October of that year. Face-to-face interviews were conducted with 10,847 women, using a computer-assisted personal interviewing system. Black and Hispanic women were oversampled, and the overall response rate for the survey was 79%.

These analyses report on a subsample of 9,882 sexually experienced women[*] and focus on two primary health outcomes: a self-reported history of gonorrhea or chlamydial infection, and a self-reported history of treatment for PID and associated sequelae.

In this analysis, we examine the impact of race, socioeconomic status and age on the likelihood of infection. It is not clear whether the greater risk of infection among black women than among white women is related to race, socioeconomic status or other factors, because most STD studies do not have a sufficiently large sample to adequately assess these differences; we are able, however, to include both socioeconomic status and race. We use educational attainment as an estimate of socioeconomic status and participants' self-report for race.

The NSFG includes measures of age at first intercourse, number of sexual partners and frequency of intercourse, but does not provide information on the sexual behavior or

STD history of respondents' partners. Also, data on the frequency of intercourse in the NSFG sample are limited. To avoid accuracy problems associated with reports of frequent events or items covering long retrospective periods, the survey asked only those women who were sexually active during the three months prior to interview about their frequency of intercourse, and only for that three-month period.

To examine risk-reduction behavior, we look at NSFG questions that elicited information on condom use. Women were asked if they had ever used a condom, and those who had were asked if they had used it for birth control only, for prevention of disease or for both. In addition, women who were sexually active in the three months prior to interview were asked if they had used a condom at last intercourse.

Women who indicated that they had ever been treated for PID were questioned about the number of different treatment episodes and related hospitalizations they had experienced. Unfortunately, several other risk factors associated with PID, including health behaviors and sexual practices such as unprotected intercourse during menses,[24] cannot be monitored using NSFG data. Moreover, for respondents reporting a history of gonorrhea or chlamydial infection, there are no data on timeliness of diagnosis, type of treatment or level of compliance with prescribed treatment. In addition, self-reported measures of PID are likely to underestimate the true dimension of the problem.

The NSFG also includes questions that permit us to estimate levels of infertility, by identifying women who are either surgically sterile for noncontraceptive purposes, nonsurgically sterile or subfecund.[†] Lastly, the NSFG includes a number of questions on gestational outcomes, such as ectopic pregnancy. Unfortunately, the survey does not include questions on tubal scarring or chronic pelvic pain associated with PID.

ANALYSES

In the first phase of our study, we performed univariate and bivariate analyses and tabulated distribution frequencies of demographic and behavioral risk factors for bacterial STDs and PID to obtain a descriptive profile of the sample. Prevalence estimates of bacterial STDs and PID were calculated for selected sexual and health-related risk characteristics.

In the second phase, we conducted multivariate modeling to determine which factors are the most significant indicators of each of the specific outcomes. We used logistic regression because the outcome variables of interest (bacterial STD and PID) are both dichotomous. We first estimated a model for bacterial STDs based on a combination of social, demographic and behavioral risk factors. We then conducted a similar analysis for PID. The PID analysis included many of the same predictors as the bacterial STD analysis but added douching, use of an IUD and history of a bacterial STD as predictors.

All estimates presented in this article are weighted to reflect the actual age, race, marital status and parity distributions of women in the United States as of October 1995, using sampling weights derived by the National Center for Health Statistics. Variance estimates were computed using SUDAAN,[25] because unlike standard statistical analysis packages that assume data are derived from simple random samples of the population, SUDAAN provides estimates and sampling errors that are

appropriate for the complex sample design used in the 1995 NSFG.‡

DATA LIMITATIONS

The NSFG has the advantage of using a large, nationally representative sample. Because of its cross-sectional design, the survey provides a snapshot of the sexual and reproductive history of women living in the United States at a particular point in time. However, for the purposes of this analysis, the NSFG presents a number of limitations. Most critically, it does not provide any time references for the sequence of events. We cannot determine, for example, when a respondent was diagnosed with gonorrhea, chlamydia or PID, how many times she had a bacterial STD, whether condom use occurred before or after an STD was diagnosed or if the bacterial STD reported in the interview preceded treatment for PID. The inability to establish a temporal order of events precludes an examination of causal relationships in this data set. Thus, the analyses presented below focus on correlates of the outcomes of interest.

There also are limitations with individual items. For example, data on the frequency of exposure to infection (i.e., frequency of intercourse) were obtained only if the woman indicated that she had been sexually active in the three months prior to the interview, and only for that time period. Consequently, we do not know about a respondent's coital frequency and potential exposure to STDs unless she had had sex in the recent past.§

Finally, there are problems associated with self-reported data on bacterial STDs. Prevalence estimates of gonorrhea and chlamydial infections were calculated from two questions: "Has a doctor ever told you that you have gonorrhea?" and "Has a doctor ever told you that you have chlamydia?" Self-reports are likely to underestimate the true prevalence of infection for several reasons: The stigma associated with STDs may reduce the likelihood that a woman will report a history of a bacterial STD to an interviewer; the ability to remember a specific diagnosis may decrease over time; the information delivered or understood at the time of diagnosis may have been incomplete; and the infection may have been asymptomatic and thus never diagnosed. Despite these limitations, the NSFG is the only current data set based on a nationally representative sample of women that contains information about bacterial STDs, PID and behavioral risk factors.

RESULTS

Table 1 summarizes the demographic and behavioral characteristics of the women in our sample. Three-quarters of participants were aged 25-44. Approximately one-quarter had completed college, one-quarter had some college education, one-third had completed high school and 17% had not obtained a high school diploma. The majority of participants were white (80%); the proportion of black participants (14%) was slightly higher than that found nationally. More than half of respondents (55%) were married or living with a partner, and slightly less than one-third of sexually active women (30%) had never been married.

Table 1. Percentage distributions of sexually active U.S. women aged 15-44, by selected characteristics, National Survey of Family Growth, 1995	
Characteristic	%

Age	
15-24	23.4
25-34	37.4
35-44	39.1
Education	
<high school	17.0
High school	32.2
Some college	26.8
College graduate	24.0
Race†	
White	80.0
Black	14.3
Other	5.7
Marital status	
Married/cohabiting	55.2
Widowed/separated/divorced	14.6
Never-married	30.2
Age at first intercourse	
<15	13.5
15-16	28.6
17-18	29.2
>=19	28.6
Lifetime number of sexual partners	
1	27.6
2-3	25.5
4-5	19.0
>5	27.8
Frequency of intercourse in past 3 months‡	
<once per week	37.9
Once per week	22.7
<once per week	39.4
Ever used a condom	
Yes	82.1
No	17.9
Ever used a condom to prevent STDs§	
Yes	46.5
No	53.5
Used condom at last intercourse††	
Yes	37.4
No	62.6
Ever used IUD	
No	90.0
Yes	10.0
Screened for STD in past 12 months	
No	91.6
Yes	8.4
Total	100.0

SEXUAL BEHAVIOR

On average, women initiated intercourse at 17.4 years of age (not shown). The majority (71%) were sexually active before age 19; 14% first had intercourse before age 15. Twenty-eight percent of respondents had had one sexual partner in their life, and an equal proportion of women had had more than five partners. For women who were sexually active during the three months prior to interview, almost 40% had intercourse more than once a week, while about the same proportion (38%) had intercourse less than once per week.

The vast majority of women (82%) had used a condom at some time in their life, and almost half had done so to prevent disease. Thirty-seven percent of women who were sexually active in the three months prior to interview had used a condom at last intercourse.

Black women initiated intercourse at a younger age than did white women (16.4 years vs. 17.5 years, not shown), and the proportion of black participants initiating sex before age 15 was almost twice that of white participants (22.8% vs. 11.8%).

RISK FACTORS AND DISEASE PREVALENCE

Six percent of sexually active women had a history of a bacterial STD: Five percent had a history of chlamydia, 2% had a history of gonorrhea and fewer than 1% had a history of both. Eight percent of sexually active women had been treated for PID; 5% (approximately 60% of those with a history of PID) had been treated once, 2% had been treated 2-3 times and 1% had received treatment more than three times. Twenty-four percent of women diagnosed with PID had been hospitalized for the condition (not shown).

Thirteen percent of women whose first sexual experience occurred before age 15 reported a bacterial STD, compared with 3% of women who initiated intercourse after age 18 (Table 2). Women who had had more than five sexual partners were 10 times as likely as women who had had one partner to report a history of infection.

Table 2. Percentage of sexually active women who reported a bacterial STD or treatment for PID, by selected risk characteristics

Characteristic	Bacterial STD	PID
Age at first intercourse		
<15	13.0	12.1
15-16	7.0	9.9
17-18	5.3	7.8
<=19	3.4	5.6
Lifetime number of sexual partners		
1	1.4	5.0
2-3	3.2	6.8

4-5	5.9	7.3
<5	14.0	14.0
Frequency of intercourse in past 3 months†		
None	3.6	3.9
<once per week	6.9	8.7
Once per week	4.6	7.5
<once per week	6.5	9.0
Ever used a condom		
No	2.9	7.3
Yes	7.0	8.6
Used condom at last intercourse‡		
No	6.4	6.4
Yes	4.7	4.6
Ever used a condom to prevent STDs§		
No	4.5	6.8
Yes	9.9	10.7
Screened for STD in past 12 months		
No	4.6	7.2
Yes	17.7	11.6
Ever used IUD		
No	6.0	7.4
Yes	8.8	17.3
Frequency of douching		
Never	5.5	6.0
<weekly	6.3	12.1
<weekly	5.7	10.9
Had a bacterial STD		
Never	0.0	7.4
Ever	100.0	23.0

†Frequency indicated only for those reporting intercourse in the three months before the survey. ‡Based on women who reported intercourse in the three months before the survey and who used a contraceptive at last intercourse. §Includes women who reported use for both contraception and disease prevention. *Note:* Estimates are weighted.

Women who had ever used a condom were more likely to have a history of bacterial STD infection than were those who had never used a condom (7% vs. 3%), and those who had ever used a condom to prevent disease transmission were more likely to report a history of infection than were those who had never done so. These findings may be explained by limitations in the data set that make it impossible to determine the order of events. Women with a history of STD infection were probably urged to take precautions, and therefore changed their behavior so as to prevent other infections. Furthermore, women who had been screened for an STD in the past year were more likely to have had a bacterial infection than were women who had not been screened (18% vs. 5%). Again, the inability to sequence these events makes interpretation difficu< the recent screening, for example, may have been associated with the reported STD.

Table 2 also indicates that the risk factors associated with a history of PID are similar

to those associated with bacterial STD infection. Women who had first intercourse before age 15 were twice as likely to have had PID as were those who had first intercourse after age 18, and women with more than five partners were almost three times as likely as those with one partner to have had PID. In addition, black women were more likely to have had PID than were white women (10.6% vs. 7.2%, not shown).

Women who had ever used an IUD were more than twice as likely to have had PID as were women who had not done so, and women who douched were about twice as likely to have had the condition as were women who had never douched. PID was three times as common among women with a history of bacterial infection as among those with no such history.

MULTIVARIATE ANALYSES

In an initial set of regression analyses, lifetime condom use, frequency of intercourse and marital status were not significant predictors of bacterial STD infection and were therefore not included in the final analysis. (Presumably, condom use contributed little because the vast majority of women—82%—reported having used a condom at some time.)

The first panel of Table 3 indicates that race and age contributed significantly to the likelihood of infection with a bacterial STD. Once the effects of all other variables are controlled, the estimated odds of a bacterial STD among black women were 1.7 times the odds among white women. Similarly, women aged 25-34 were nearly 1.3 times as likely as women aged 35-44 to report having a bacterial STD.

Table 3. Logistic regression results showing women's likelihood of having had a bacterial STD or having received treatment for PID, by selected demographic and behavioral risk factors						
Characteristic	Bacterial STD			PID		
	Estimate	Standard error	Odds ratio	Estimate	Standard error	Odds ratio
Race						
Black	0.54	0.11	1.71***	0.14	0.10	1.15
White	na	na	1.00	na	na	1.00
Age						
15-24	0.17	0.14	1.19	-0.43	0.14	0.65**
25-34	0.22	0.11	1.25*	-0.22	0.10	0.81*
35-44	na	na	1.00	na	na	1.00
Education						
<high school	0.03	0.16	1.03	0.56	0.16	1.76***
High school	-0.13	0.14	0.88	0.32	0.13	1.37*
Some college	-0.10	0.13	0.91	0.24	0.14	1.28
College graduate	na	na	1.00	na	na	1.00
Age at first intercourse†	-0.06	0.02	0.94**	-0.02	0.02	0.98
Lifetime number of sexual partners						
1	na	na	1.00	na	na	1.00
2-3	0.68	0.23	1.98**	0.18	0.14	1.20
4-5	1.27	0.22	3.56***	0.19	0.14	1.20

<5	2.21	0.19	9.12***	0.79	0.13	2.20***
IUD use						
No	na	na	na	-0.69	0.11	0.50***
Yes	na	na	na	na	na	1.00
Douching						
Yes	na	na	na	0.46	0.09	1.59***
No	na	na	na	na	na	1.00
Bacterial STD						
Yes	na	na	na	1.05	0.14	2.19***
No	na	na	na	na	na	1.00
Intercept	-3.20			-2.14		

*p<.05. **p<.01. ***p<.001. †Entered as a continuous variable*Notes:* IUD use, history of douching and history of a bacterial STD were not included as explanatory variables in the analyses of bacterial STD risk. na=not applicable.

Age at first intercourse and lifetime number of sexual partners were highly significant predictor variables. Each year of age that women delayed first intercourse reduced the odds of a bacterial STD by 6%, and women with more than five partners were approximately nine times as likely to report a bacterial STD as were women with one partner.

To further examine the contribution of race to the risk for bacterial STDs, we estimated logistic regression models of bacterial STD infection separately for black and white participants (not shown). Both analyses included age, education, age at first sex and lifetime number of sexual partners.

For white females, only the lifetime number of partners achieved statistical significance: Women with more than five partners were nearly 10 times as likely to report a history of infection as were those with one partner, and those with 2-3 partners were twice as likely.

However, for black females, lifetime number of partners, age at first sex and educational attainment all had statistically significant effects. The odds ratios for number of sexual partners were similar to those observed in the model for white women, while each year of age that initiation of intercourse was delayed reduced the odds of bacterial STD infection about 10%. The effect of education on risk for bacterial STDs among black women is unclear: Black females with a high school diploma were about half as likely to report a bacterial STD as were those with a college degree, but black women with less than a high school education and those reporting some college education did not differ significantly.

The second panel of Table 3 indicates that the characteristics affecting the odds of PID differed from those influencing infection with bacterial STDs. Race, for example, had no significant effect on PID risk, while education had a linear and significant negative effect: Women who had not completed high school were 1.8 times as likely to report treatment for PID as were women who were college graduates, while those who had completed high school had a risk 1.4 times as great as that of college graduates. Women who had obtained some college education had a marginally higher risk than college graduates.

Age at first intercourse did not contribute significantly to the risk of PID, and lifetime number of partners had a limited effect: Women who had had more than five partners

were 2.2 times as likely as those who had one lifetime partner to report having been treated for PID. Women with five partners or less were no more likely to have had PID than were those with only one partner.

The odds of having had PID were twice as great for women who had used an IUD as for women who had not. Similarly, women who had ever douched were 60% more likely to have had PID than were those who had never douched. Finally, women who had had either gonorrhea or chlamydial infection were more than twice as likely to have been diagnosed with PID as those without such a history.

EFFECTS OF PID

Women with a history of PID were more than twice as likely to have had an ectopic pregnancy as were all sexually active women (5% vs. 2%, not shown), and were slightly more likely than women with a history of a bacterial STD to report having had one (4%). Thus, there appears to be some association between ectopic pregnancy and PID, although the NSFG data do not permit us to establish a temporal or causal relationship.

Women with a history of PID were less likely than women without such a history to be fecund (Table 4). This situation is reflected in the higher rates of both surgical and nonsurgical sterility among women with a history of PID than among either women with a history of a bacterial STD or the larger sample of all sexually active women. However, women with a history of PID also were more likely to be contraceptively sterile than were those with a history of bacterial STD infection or all sexually active women.

Table 4. Percentage distribution of sexually active women aged 15-44, by fecundity status, according to bacterial STD or PID history

Fecundity status	All	Bacterial STD	PID
Fecund	58.6	59.3	38.5
Contraceptively sterile	27.0	19.6	34.1
Surgically sterile	3.3	4.3	8.9
Nonsurgically sterile	1.8	3.8	5.1
Subfecund	8.3	12.1	12.8
Long-interval subfecund	1.0	0.8	0.6
Total	100.0	100.0	100.0

Note: Prevalence estimates are weighted.

DISCUSSION

In this article, we describe the characteristics of women who report a history either of gonorrhea or chlamydia or of treatment for PID. Not all women who had an STD risk factor also had a history of a sexually transmitted infection. In 1995, a minority of sexually active women (only 6%) reported ever having been diagnosed with gonorrhea or chlamydia, while almost half had had four or more sexual partners, a significant predictor for these diseases. Clearly, the risk profile suggested by these data is not uniform, nor is it as startling as the profile documented in studies of high-risk populations.**[26] Nevertheless, some groups of women are at high risk for both short- and long-term reproductive health problems.

Age at first intercourse and lifetime number of sexual partners are the most

appropriate measures from the NSFG for studying lifetime prevalence of bacterial STDs. Indeed, both were significant predictors of infection. Moreover, number of sexual partners demonstrated a clear "dose effect": As the number of sexual partners increased, so did the probability of reporting a bacterial STD.

Unfortunately, the measures of condom use included in the NSFG are not very suitable for studying bacterial STDs, and information on contextual factors associated with condom use was not collected. For example, it is not clear if women used condoms with new partners to prevent an STD or with steady partners to prevent pregnancy. Whether condoms were used before a women contracted an STD or after she had been treated for one is equally unclear. Moreover, the vast majority of women (82% of all sexually active women and 92% of women reporting a history of a bacterial STD) had used a condom during their lifetime. The lack of information associated with use of condoms leaves us unable to explore the context in which risk-taking and preventive behaviors occur.

Consistent with other studies of STDs, race was a strong predictor of bacterial STDs: Black women were significantly more likely than white women to report a history of a bacterial STD. Although socioeconomic status (as measured by education) did not predict bacterial STDs in either univariate or multivariate analyses for the sample as a whole, education emerged as a significant, but not linear, predictor among black women. Surprisingly, black high school graduates had a lower risk for bacterial STDs than did black college graduates. It is possible that black women with increased education have access to different partner populations or health care resources than women with a high school diploma; distinct partner populations can confer different probabilities of infection, while differential access to health care may shift the likelihood of detection. The education measure could also be masking other, unidentified factors, or the measure itself may be inadequate to detect a clear association between education and risk for bacterial STDs among black women.

We were somewhat surprised to find that more women reported a history of PID than a history of bacterial STDs. There are several factors that may account for this. First, the majority of women may not be aware that PID can be caused by an STD; thus, the social desirability bias associated with the stigma of STDs may not be operating in the same fashion with PID. In addition, women may differentially remember PID, because of the severe lower abdominal pain that can be associated with it. Finally, women may be reporting cases of PID that are not associated with an STD, but with other types of infection.

Clinical studies estimate that approximately one-third of women with a history of gonorrhea or chlamydia will develop PID,[27] yet the NSFG data produced a lower estimate: Among women who had a history of gonorrhea or chlamydia, 23% also had a history of PID. Nonetheless, a history of bacterial STDs was an important predictor of PID in multivariate analyses.

Not all factors associated with risk for bacterial STDs had a significant effect in predicting PID. Age at first intercourse, an important contributor to the bacterial STD analysis, was not significant in the multivariate model of PID, and in analysis of PID risk, number of sexual partners did not demonstrate the dose effect observed in the bacterial STD model. Indeed, only women with the highest lifetime number of sexual

partners (i.e., six or more) had a significantly increased PID risk. In addition, while education was a significant predictor of PID, race was not.

The effect of race on PID seems to be mediated by its strong effect on bacterial STDs. PID does not appear to be the "equal opportunity" disease that bacterial STDs are. Women who had more education (and presumably are of higher socioeconomic status) were less likely to report a history of PID than were less-educated women. Because the diagnosis and treatment of PID are much more complex than that of bacterial STDs, access to care may play a role in prevalence estimates for PID. However, in both models, the risk of either outcome was higher among women aged 25-34 than among those aged 15-24, making self-reported bacterial STD and PID consistent with accrual of lifetime risk.

Two important behavioral predictors of PID were measured in the NSFG: douching and use of an IUD, and both regular douching and a lifetime history of IUD use were significantly associated with self-reported PID. According to analyses of the 1988 NSFG,[28] rates of douching appear to increase as women mature into young adulthood; thereafter, rates remain more or less constant. In addition, douching varies with education and race, with the prevalence of douching decreasing as education and socioeconomic status increase. But, regardless of modifying factors, black women are significantly more likely than white women to douche regularly. Although race itself did not contribute significantly to the PID analysis, it may have an effect through socioeconomic status and douching behaviors.

Data from the NSFG confirm an association between PID and ectopic pregnancy. It is more difficult, however, to make a similarly clear statement about infertility. As noted above, the NSFG fecundity measures are crude and do not allow us to focus exclusively on infertility of infectious etiology. Nevertheless, the NSFG data indicate that women who have been treated for PID are more likely to be infertile for both surgical and nonsurgical reasons than are other sexually active women.

In summary, this cross-sectional "snapshot" of the correlates and consequences of bacterial STD infection presents a troubling picture of the reproductive health of American women. Many women have one or more risk factors for gonorrhea or chlamydia, yet the low rates of self-reported bacterial STDs suggest that some women are unaware of having been infected or may be unwilling to disclose such a history. The level of self-reported PID would suggest higher rates of gonorrhea and chlamydial infection.

In the future, it would be useful to collect data on partner characteristics, the context in which sexual risk-taking and condom use occur, and the temporal sequence of risk-related events. Although comparisons of data collected in different waves of the NSFG can provide some insight into changes in women's sexual behavior, longitudinal data that indicate the timing of these critical health events and their correlates over the life course are needed to elucidate the relationships between bacterial STD risk factors and their short- and long-term reproductive health consequences.

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*The number of sexually experienced women included in these analyses is derived from the NSFG variable HADSEX. A preliminary comparison of our tabulations with those produced by other investigators indicated a discrepancy of one case in the count of sexually active women; this was related to the other investigator's use of a different variable (SEXEVER) to determine the number of sexually experienced women (source: Mosher W, National Center for Health Statistics, Hyattsville, MD, personal communication, Feb. 1998).

†Women who are surgically sterile for noncontraceptive purposes cannot have a baby because of a sterilizing operation that was done for noncontraceptive reasons. (This would include women who had undergone surgery for ectopic pregnancies.) Women are nonsurgically sterile if they cannot have a baby for reasons other than surgical sterilization. Subfecund women are those who report that it is difficult to conceive or deliver a baby, or who were medically advised not to become pregnant.

‡This analysis represents a first approximation of a model predicting PID. We were constrained methodologically by the fact that while SUDAAN is one of the few software packages that takes into account complex sample designs in calculating parameter estimates and standard errors, it does not include a procedure to estimate probit models, which, when used in a two-stage procedure, would be an appropriate way of addressing the problem of endogeneity existing in the PID model.

§We used marital status as an imperfect proxy for coital frequency, but it did not contribute significantly to the bacterial STD model. Therefore, we do not include this proxy measure in the final analyses.

**Rates of gonorrhea, chlamydial infection and sexual risk-taking are higher among women attending STD clinics than among female participants in population-based surveys. For example, even after excluding women known to have been exposed to an infected partner, clinicians found that 35% of female patients were currently infected with gonorrhea, chlamydia, trichomonas or a combination of these STDs and that 77% reported a history of prior sexually transmitted infection; more than half (51%) reported six or more lifetime sexual partners (source: reference 26).