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Sociodemographic Markers and Behavioral Correlates of Sexually Transmitted Infections in a Nonclinical Sample of Adolescent and Young Adult Women

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Background. We examined sociodemographic markers and 3-month behavioral correlates of sexually transmitted infections (STIs) in a nonclinical cross-section of adolescent and young adult women.

Methods. All women ($N = 2288$) enrolled in recruit training for the US Marine Corps during a 1-year period were asked to voluntarily participate in either a cognitive-behavioral, skills-building intervention to prevent STIs and unintended pregnancies or a nutrition and fitness program. Participants (94.2%) completed a self-administered questionnaire and were screened for *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Trichomonas vaginalis* infection. The present study presents only the baseline data from the larger study.

Results. One or more STIs was diagnosed in 14.1% of participants. Results of a logistic-regression model indicated that the presence of an STI at screening was significantly ($P \leq .05$) associated with the participants' type of residence (rural), age (17–18 and 21–23 years), years of sexual experience ($\geq$2 years), frequency of hormonal contraceptive use (never and sometimes), perception that their sex partners had other concurrent sex partners, and the race or ethnicity of their last sex partner (African American and Native American).

Conclusions. The high prevalence of STIs in this nonclinical sample of young women suggests the need for ongoing screening and prevention interventions that target young, healthy, sexually active women.

Of the estimated 15 million new cases of sexually transmitted infections (STIs) reported annually, adolescent and young adult women (ages 15–24 years) have the highest rates of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infection of any age group [1]. These STIs pose serious long-term consequences for young women because they are precursors of adverse reproductive-health outcomes associated with pelvic inflammatory disease (PID), including tubal infertility, ectopic pregnancy, chronic pain, and increased risk of exposure to HIV [1–3].

Adolescent and young adult women's exposure to STIs is the result of complex interrelationships among sociodemographic and behavioral risk factors. Sociodemographic risk factors associated with the acquisition of STIs among adolescents and young adults include younger age [1, 2, 4–7], female sex [1, 2, 4, 5, 8, 9], African American race [1, 2, 4, 8, 10–13], and urban residence [1, 2, 14–17]. Behavioral risk factors associated with STIs are prevalent among adolescents and young adults. These include sexual initiation at age $\leq$15 years [6, 18–20]; multiple, sequential, or concurrent sexual relationships [4, 8, 9, 20–25]; inconsistent use of condoms [21, 23]; characteristics of sex partners, such as older age and minority race or ethnicity [8, 11]; and frequent use of alcohol and illicit substances, which is often associated with sexual risk behaviors [11, 21, 26–30].

Much of what is known about the sociodemographic and behavioral factors associated with the risk and diagnosis of STIs has been reported from sexually transmitted disease clinics, family planning clinics, and ad-

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olescent medicine clinics in cities where STIs have a high incidence [25, 30–37] or has been based on population-based surveys [23, 38, 39]. Data derived from clinic-based studies may overestimate the prevalence of STIs in young women, because many patients are seeking treatment for STIs and other reproductive-health concerns. Conversely, data from population-based studies tend to elicit self-reported histories of STIs, which are prone to respondent biases and error that may inhibit the disclosure of STIs, resulting in an underestimation of STIs in women. Women entering recruit training for military service represent a potentially more ideal nonclinical cross-section of young women. Although recruits self-select for military service, they reflect a large, non–college-attending cohort of young, healthy women who are not seeking treatment for STIs or reproductive health care at the time of screening. Previous research has described correlates of *C. trachomatis* infection in female US Army recruits [4, 5]. Therefore, in an effort to contribute to this body of literature, we examined sociodemographic and behavioral correlates of STIs in young women enrolled in recruit training for the US Marine Corps. Unlike previous researchers, we screened for multiple STIs *(C. trachomatis, N. gonorrhoeae,* and *Trichomonas vaginalis)* and performed multiple-site testing (endocervical and urine samples and vaginal swabs). We expect that these strategies will together provide a better indication of the true prevalence of STIs in healthy adolescent and young adult women.

SUBJECTS AND METHODS

Study participants and procedures. All women ($N = 2288$) enrolled in recruit training for the US Marine Corps during a 1-year period were approached by a female civilian research assistant regarding participation in the study. Study enrollment occurred within 2 weeks of recruit training entry. Military personnel were not present during study enrollment. A total of 2157 (94.3%) women voluntarily agreed to participate in either a cognitive-behavioral, skills-building intervention for the prevention of STIs and unintended pregnancies or a nutrition and fitness intervention. Consent was obtained in accordance with the guidelines of our university's and the military's institutional review boards, which did not require parental consent for minors.

At baseline, before the intervention, participants completed a self-administered questionnaire and were screened for STIs. The questionnaire was administered immediately after enrollment in the study, and biological specimens were collected during a well-women's reproductive-health clinic visit within 10 days of study enrollment. The present study presents only the baseline data from the larger intervention study [40].

Measures. The self-administered questionnaire included measures of sociodemographic and behavioral correlates of STIs during the participants' lifetime and during the preceding 3 months [41]. Both the measures and time frames that we used have been widely reported in the literature and deemed to be appropriate and meaningful for the assessment of the behavioral risk factors associated with STIs [23, 42]. However, only analyses of the temporally more immediate 3-month measures are presented. The sociodemographic risk markers were the study participants' age, race or ethnicity, marital status, level of education, geographic location of residence (by region of the country and urban vs. rural community), age and race or ethnicity of the participant's last sex partner, and the difference in ages between the participant and her last sex partner.

Behavioral correlates were the participants' age at first sexual intercourse, years of sexual experience, history of pregnancy and STIs, number of sex partners, number of casual sex partners, frequency of condom and hormonal contraception use, the form of birth control used for the last sexual intercourse, frequency of sexual intercourse under the influence of alcohol and other substances, and whether the participant's sex partner(s) had an STI or had sexual intercourse with others. In addition, measures of alcohol and substance use during the month preceding the baseline assessment were also included, as has been suggested by other data [42, 43].

Specimens to test for *C. trachomatis, N. gonorrhoeae,* and *T. vaginalis* infection were obtained during a reproductive-health examination required of all female US Marine Corps recruits. The examination included a pelvic examination during which endocervical samples, first-void urine samples, and self-administered vaginal swabs were obtained for STI screening. All specimens were transported and processed in accordance with the manufacturer's guidelines (Abbott Laboratories) [44], which have been reported elsewhere [40, 45].

Data analyses. All statistical analyses were performed using data from participants who reported having had sexual intercourse during the preceding 3 months. Conventional descriptive statistics were used to assess the characteristics of participants. Bivariate comparisons between participants who tested positive and negative for STIs were made using χ^2 tests of differences in proportions. A logistic-regression model to assess significant correlates of STIs diagnosed at screening was determined by first entering the behavioral correlates as a block, using a backward stepwise procedure. Sociodemographic markers were entered as a second block, again using a backward stepwise procedure. The criterion for retention in the model was a likelihood-ratio test result of $P \leqslant .10$. The model's goodness-of-fit was determined using the Hosmer-Lemeshow statistic [46]. All data analyses were performed using the SPSS procedures CROSSTAB and LOGISTIC (version 6.14; SPSS).

RESULTS

Sociodemographic and behavioral characteristics of study participants. Of the 2157 women enrolled in the intervention, 1550 (71.9%) self-reported having had sexual intercourse

during the 3 months preceding the baseline assessment. On average, the participants were young (mean age, 19.1 years; range, 17–33 years), single, and of diverse racial and ethnic backgrounds. Although each state and US territory was represented, 40.6% of participants were from southern states, and 76.5% were from urban areas. Almost three-quarters (74.0%) had completed only high school or had a General Educational Development certificate, and the remainder had some additional vocational/technical or college education (table 1).

Study participants self-reported a number of sexual risk factors that placed them at increased risk for acquiring and transmitting STIs. Although only a small number of participants had initiated sexual intercourse at age <15 years (19.0%), most had been sexually experienced for ⩾2 years (75.4%). Multiple and casual sex partnerships were reported by 29.4% and 28.0% of study participants, respectively. Condom use at the last sexual intercourse was reported by 47.0% of participants, 47.6% reported usually or always having used a condom during intercourse during the preceding 3 months, and 61.6% reported usually or always having used hormonal contraception. Although 13.0% of participants reported heavy alcohol use (⩾5 drinks at least once per week) and 5.8% reported using illicit drugs during the month preceding to the study, 57.2% reported having had sexual intercourse after the use of alcohol or illicit drugs during the 3 months preceding the study. In addition, 18.2% reported that a sex partner had or may have had an STI, and 48.4% stated that a sex partner was having or may have had sexual intercourse with other partners (table 1).

STIs at screening. Results of the STI screening showed that 14.3% of the participants who reported having been sexually active during the 3 months preceding baseline assessment had ⩾1 STI: 12.2% had *C. trachomatis* infection, 2.1% had *N. gonorrhoeae* infection, and 1.7% had *T. vaginalis* infection. Of these individuals, 73.5% self-reported having no symptoms at the time of screening. The total positive rate for each STI was based on a positive result of ⩾1 specimen.

Bivariate correlates of STIs. Participants' age (the 17–18 and 21–23 age groups), race or ethnicity (African American and Native American), geographical location of residence (southern and rural), and the race or ethnicity of the last sex partner were significantly associated ($P < .05$) with having an STI. Age at first sexual intercourse (<15 years), years of sexual experience (⩾2 years), number of sex partners (⩾4), infrequent hormonal contraceptive use, a self-reported history of STIs, and the perception that sex partners had an STI or engaged in sexual intercourse with other partners were also associated with having an STI (table 1). There was no significant association between the frequency of condom use and testing positive for an STI.

Logistic-regression model assessing correlates of STIs. Results of the logistic-regression analysis showed that proportionally more rural residents than urban residents had an STI. Participants <19 years old and those 21–23 years old were more likely to have an STI than were those 19–20 years old. Participants who were ⩾2 years beyond their sexual debut had a greater probability of having an STI than did participants with ⩽1 year of sexual experience. Those who had used hormonal contraceptives only some of the time during the preceding 3 months had a greater probability of having an STI than did those who usually or always used hormonal contraceptives during this time frame. Participants who thought that their sex partner(s) during the past 3 months had other concurrent sex partners had a greater probability of being diagnosed with an STI than did participants who did not think that their sex partners had other partners. Participants whose last sex partners were African American and Native American were more likely to have an STI. Overall, the model shows goodness of fit ($P = .87$; table 2).

Entry of the race or ethnicity of the last sex partner into the regression model caused 2 behavioral correlates (history of STIs and alcohol use during the preceding month) to no longer achieve significance ($P > .10$). Bivariate analysis revealed that respondents with last sex partners of African American or Native American race or ethnicity were more likely to also report a history of STIs (24.7% and 13.2%, respectively) than were respondents whose last sex partners were of other ethnic groups (Latino, 9.2%; white, 8.5%; Asian/Pacific Islander, 5.9%). Having a last sex partner of Native American race or ethnicity was also associated with a greater likelihood of reporting heavy drinking during the preceding month (27.8% vs. 0%–16.3% for all other groups). In contrast, having a last sex partner of African American race or ethnicity was associated with abstention from drinking alcohol (46.7% vs. 16.7%–35.3% for all other groups). It should also be noted that the perception of sex partners having sex with others was somewhat redundant with reporting multiple sex partners in the preceding 3 months. Among respondents with ⩾2 sex partners, 83.3% reported that their sex partners were or may have been having sex with others. However, only 33.9% of respondents with a single sex partner thought that their partners were having sex with someone else. The stepwise algorithm chose the perception that partners had sex with others over multiple partnerships. We agree with this choice, because it is a more concise evaluation of risk for STIs.

DISCUSSION

STI screening. The results of the present study of a nonclinical cross-section of sexually active adolescent and young adult women self-selecting military service indicate that they are at considerable risk for acquiring and transmitting STIs. As expected, the rates of *C. trachomatis* and *N. gonorrhoeae* infection at the time of screening (12.2% and 2.1%, respectively) were slightly higher than the chlamydial screening rates previously reported for female US Army recruits (8.5%–9.9%) [4, 5] and

Table 1. Sociodemographic and behavioral risk factor correlates of sexually transmitted infections (STIs) among female US Marine Corps recruits who were sexually active during the preceding 3 months ($N = 1550$).

Characteristic	Participants, no. (%)	Positive for STIs, %	χ^2
Age			8.77[a]
17–18 years	792 (53.1)	15.5	
19–20 years	464 (31.1)	11.0	
21–23 years	156 (10.5)	19.2	
⩾24 years	79 (5.3)	11.4	
Race/ethnicity			62.61[b]
African American	253 (17.0)	29.6	
Asian/Pacific Islander	40 (2.7)	12.5	
White	862 (58.1)	10.2	
Latina/Hispanic	290 (19.5)	12.4	
Native American	39 (2.6)	20.5	
Marital status			2.88[c]
Married	129 (8.7)	9.3	
Single[d]	1360 (91.3)	14.8	
Education			0.01
High school diploma/GED	1103 (74.0)	14.2	
College/vocational/technical	388 (26.0)	14.4	
Region of residence			10.21[a]
Northeast	262 (17.6)	13.4	
Midwest	306 (20.6)	11.8	
South	604 (40.6)	17.7	
West	316 (21.2)	11.1	
Type of residence			4.43[a]
Urban	1139 (76.5)	13.3	
Rural	349 (23.5)	17.8	
Age of last sex partner			2.73[c]
<24 years	1114 (75.7)	13.6	
⩾24 years	357 (24.3)	17.1	
Age difference between participant and last sex partner			1.25
Participant younger	993 (67.5)	15.0	
Same age	298 (20.3)	12.4	
Participant older	180 (12.2)	14.4	
Race/ethnicity of last sex partner			85.88[b]
African American	282 (19.4)	31.2	
Asian/Pacific Islander	16 (1.1)	12.5	
White	843 (58.1)	9.3	
Latino/Hispanic	275 (18.9)	12.0	
Native American	36 (2.5)	22.2	
Age at first intercourse			5.36[a]
<15 years	281 (19.0)	18.5	
⩾15 years	1201 (81.0)	13.2	
Years of sexual experience			5.63[a]
⩽1 year	365 (24.6)	10.4	
⩾2 years	1117 (75.4)	15.4	
Sex partners, no.			4.09[a]
1	1042 (70.6)	13.1	
⩾2	433 (29.4)	17.1	

(continued)

Table 1. ***(Continued.)***

Characteristic	Participants, no. (%)	Positive for STIs, %	χ^2
Casual sex partners, no.			0.72
0	1057 (72.0)	13.8	
⩾1	412 (28.0)	15.5	
Methods of contraception used during last sexual intercourse			0.62
None	493 (33.4)	14.6	
Condoms only	573 (38.9)	14.8	
Hormonal only	288 (19.5)	13.5	
Hormonal and condoms	120 (8.1)	12.5	
Frequency of hormonal contraception use			9.35[e]
Never/almost never	437 (29.5)	16.2	
Sometimes	131 (8.9)	21.4	
Usually/always	911 (61.6)	12.4	
Frequency of condom use			1.84
Never	375 (25.3)	12.3	
Almost never	270 (18.2)	14.8	
Sometimes	131 (8.8)	16.0	
Usually	302 (20.4)	14.9	
Always	403 (27.2)	14.9	
History of pregnancy			3.05[c]
Yes	253 (17.0)	17.8	
No	1238 (83.0)	13.6	
History of STIs			5.29[a]
Yes	175 (11.7)	20.0	
No	1316 (88.3)	13.5	
Sexual intercourse after alcohol/illicit drug use			2.01
Never	628 (42.8)	15.4	
Almost never	308 (21.0)	12.0	
Sometimes/usually/always	533 (36.3)	14.1	
Alcohol use (preceding month)			2.49
Heavy[f]	192 (13.0)	12.0	
Not heavy	875 (59.2)	13.7	
None	410 (27.8)	16.3	
Illicit drug use (preceding month)			0.52
Yes	86 (5.8)	11.6	
No	1386 (94.2)	14.4	
Partner(s) had sex with others			9.15[e]
Yes/not sure	712 (48.4)	17.1	
No	758 (51.6)	11.6	
Partner(s) had STIs			6.18[a]
Yes/not sure	267 (18.2)	19.1	
No	1203 (81.8)	13.2	

NOTE. Nos. vary for each characteristic because of missing data. GED, General Educational Development certificate.

[a] $P < .05$.
[b] $P < .001$.
[c] $P < .10$.
[d] Single, divorced, or separated.
[e] $P < .01$.
[f] Defined as ⩾5 drinks at least once per week.

Table 2. Logistic-regression model: association between selected 3-month risk correlates and sexually transmitted infections.

Variable	OR (95% CI)
Type of residence	
Urban[a]	1
Rural	1.64 (1.15–2.35)[b]
Age	
17–18 years	1.66 (1.14–2.43)[b]
19–20 years[a]	1
21–23 years	1.94 (1.14–3.31)[c]
⩾24 years	1.25 (0.57–2.77)
Years of sexual experience	
⩽1[a]	1
⩾2	1.78 (1.18–2.69)[b]
Frequency of hormonal contraceptive use	
Never/almost never	1.35 (0.96–1.91)[d]
Sometimes	1.86 (1.13–3.05)[c]
Usually/always[a]	1
Partner(s) had sex with others	
Yes/not sure	1.57 (1.15–2.14)[b]
No[a]	1
Race/ethnicity of last sex partner[f]	
African American	4.84 (3.38–6.94)[e]
Asian/Pacific Islander	1.85 (0.40–8.54)
White[a]	1
Latino/Hispanic	1.50 (0.95–2.36)[d]
Native American	2.58 (1.06–6.24)[c]

NOTE. Data were determined by Hosmer-Lemeshow goodness-of-fit test ($N = 1423$; $P = .87$, for overall model). CI, confidence interval; OR, odds ratio.

[a] Reference category.
[b] $P < .01$.
[c] $P < .05$.
[d] $P < .10$.
[e] $P < .001$.
[f] Comparison of African Americans with Latinas/Hispanics achieved $P < .001$ (OR, 3.23 [95% CI, 2.04–5.11]).

were much higher than national surveillance rates of chlamydial (5.6%) and gonorrheal (0.9%) infections identified among women 15–24 years old [1]. Also as expected, the overall STI rate in our sample (14.3%) was much higher than rates reported in a number of population-based studies of adolescent and young adult women 15–44 years old, which ranged from 8.0% reported in a study based on data from the National Survey of Family Growth database [23] to 4.7% in a study based on data from the National Longitudinal Survey of Adolescent Health [38]. Given the variation in the characteristics of study samples (military recruits vs. the general population), the sensitivity of techniques used in screening for STIs (multiple site vs. single site), and the mode of STI reporting (biological testing vs. self-reported histories), it is difficult to assess the comparability of the data. However, we performed multiple-site testing, which included vaginal swabs. Recent research has suggested that the use of vaginal swabs allows the detection of more STIs than does sampling of other sites [47]. Moreover, our use of an "infected patient standard" (multiple-site specimen testing), as opposed to a "specimen standard" (single-site specimen standard), provides a better indication of the true prevalence. Single-site evaluations will miss infections at other sites [48]. These factors may help to explain the high rate of STIs in the present study, compared with that found in other studies. Regardless of the variation in results, our findings underscore the fact that bacterial STIs, especially *C. trachomatis* infection, are very common among sexually active young women, many of whom do not seek reproductive health care, despite their level of risk. The high prevalence of STIs identified in our sample is of concern, given that 75.5% of participants with an STI also reported no STI-related symptoms at the time of screening. Although the US Marine Corps provides reproductive health care—including STI screening, treatment, and risk-reduction counseling—women in other branches of the military and those in the population at large who do not seek reproductive health care remain at risk for the development of PID and its sequelae [1, 3, 49]. Undetected, asymptomatically infected persons are the ones who continue to unknowingly transmit infections to their sex partners.

Sociodemographic risk factors. Our findings are consistent with those of national STI surveillance studies and previous research, which reported the highest risk of exposure to chlamydial and gonorrheal infection among African American adolescents [1, 4, 5, 10, 11], as well as more recent research that showed high rates of STIs among Native American adolescents [10, 38]. In contrast, although previous research has consistently identified the highest rates of STIs among younger adolescents (ages 15–19 years), our participants aged 21–23 years had the highest proportion of STIs, followed by the youngest participants (ages 17–18 years). We explored the possibility that this result is an artifact of marital status or accession to legal drinking age. However, the spike in rate for 21–23-year-olds remained when the analysis was restricted to unmarried participants or drinkers. These results suggest that traditional age groupings may be obscuring possibly important variations in the prevalence and incidence of STIs among adolescent and young adult women.

Geographic variation in STIs has long been a public health concern. Our findings are consistent with those of national surveillance reports, population-based studies, and studies of female Army recruits, which showed higher rates of STIs among women in the south [1, 4, 5, 23]. However, our data also revealed that study participants who reported ZIP codes that matched nonmetropolitan (rural) communities had higher rates of STIs than did participants who reported metropolitan (urban) ZIP codes. These findings are in contrast to those of national surveillance reports and those of clinic- and population-based studies, which have overwhelmingly identified higher rates of STIs

in urban populations, where clinical services and STI screening are more readily accessible [1, 14]. Other research has suggested that individuals living in rural communities may face specific challenges that discourage the seeking of treatment, including poverty, a lack of access to reproductive health care, and a lack of anonymity that may discourage the disclosure of risk-related sexual practices in clinical settings [50]. These factors may help to explain the significantly higher rates of STIs that we identified in participants residing in rural communities, as well as why this may manifest in a sample of women not seeking treatment for STIs.

Behavioral risk factors. Numerous studies have identified multiple sex partners as a risk factor for the acquisition of STIs [23, 24] and as a correlate of a self-reported history [8, 12, 13, 20, 22, 24] and the diagnosis [4, 5, 11, 25, 51] of STIs among adolescent and young adult women. In our sample, the significant bivariate relationship between having multiple partners and a diagnosis of STI was superseded by the perception of sex partners' risk behavior, which suggests that the characteristics of partners (vis-à-vis STIs) are more important than the quantity of partners. Similarly, and consistent with previous research, we found a significant bivariate association between a self-reported history of STIs and current diagnosis of STI [4, 5, 8, 21, 38], which was superseded by the race or ethnicity of the participants' last sex partner (another index of partners' risk). It should be noted that these relationships held even when we statistically adjusted for the significant relationship between the length of sexual experience and a diagnosis of STI. The precedence of partner-related factors may suggest that the risk for STIs may not be fully recognized by young women if they focus solely on their own "risk in the moment" and not the risk incumbent in their sex partnerships. The issues of partner selection, partner history, and negotiation of safer sex with partners may well be in need of renewed emphasis in risk-reduction counseling and prevention interventions.

Our finding of the relationship between hormonal contraception use and a diagnosis of STI is difficult to interpret, because the relationship is nonlinear. Research on hormonal contraception use and the risk for STIs and PID have been inconclusive. Some studies have suggested that the use of oral contraceptives increases the risk for *C. trachomatis* cervical infection [52, 53], others suggested that they decrease the risk for *C. trachomatis* cervical infection [54, 55], and yet others found no effect [56]. Other research has suggested that oral contraceptives do not appear to increase the risk for *N. gonorrhoeae* cervical infection [57–59]. The importance of oral contraceptives and cervical STI lies in the question of the link to PID [60]. Although contraception use was originally thought to be protective against PID, current evidence suggests that no form of barrier or hormonal contraceptive protects against the development of PID. Clearly, there is a need for further research on the relationship between hormonal contraceptives and the acquisition of STIs.

Finally, the lack of association between condom use and STIs was unexpected, given its obvious role as a barrier to STI transmission and given the numerous other studies that have identified condom use in STI prevention and risk reduction [5, 21, 23, 61]. For the present study, we focused on use of the male condom, but we did not take into consideration the role of communication with sex partners and condom negotiation, which may help to explain our nonsignificant finding.

Implications and recommendations. Our findings suggest that aggressive STI screening programs for sexually active adolescent and young adult women should be implemented in rural settings and for all young women of reproductive age. Considerable attention should be given to young women who do not actively seek reproductive health care. As previously noted, for rural communities, barriers to health care must be addressed for STI screening efforts to be successful. As is suggested by national guidelines, health-care providers should actively screen women of reproductive age, regardless of their reason for accessing the health system. Furthermore, community-wide strategies—including health media advocacy campaigns that use local radio programs and health outreach efforts that target women in nonclinic settings, such as job-training programs, dance clubs, church functions, and other social settings—may be excellent venues in which to educate adolescent and young adult women about the prevalence and potential health and social consequences of asymptomatic STIs. Similarly, our data also may directly assist clinicians in determining which questions to ask during risk assessments. For example, questions about current sex partners can reveal patterns of behavior that may be indicative of a risk for STI.

Study limitations. Several limitations to the study should be noted. Because the study design was cross-sectional, causal associations between the sociodemographic and behavioral factors and STIs should not be inferred. Also, because the questionnaire was self-reported, the veracity of the study participants' responses may be questioned, because they involved sensitive sexual behaviors and use of alcohol or illicit drugs that were discussed during military training, where policies inhibit the disclosure of such behaviors. Some of these questions are also subject to recall bias, because they involved temporally distant behaviors. To minimize these potential limitations, precautionary measures were taken to increase participants' willingness to answer each question as honestly as possible. These included emphasizing that the questions pertained to behaviors preceding entry into military service, hiring a civilian research staff that had no official connection to the military, and assuring participants that their data would be held in the strictest of confidence. Only their STI results would be shared with military medical staff, to ensure that any STI identified in the context of the study

would be treated and to make certain that each STI-positive participant received risk-reduction counseling, which is the standard of care for all female US Marine Corps recruits. However, despite the limitations of the research, with few exceptions, our findings are consistent with those of previous research. To our knowledge, our study is unique in that it focuses on female US Marine Corps recruits; to date, no study has focused on correlates of diagnosed STIs in this group. Moreover, to our knowledge, no other study of sexually active adolescent and young adult women has used multiple STI screening sites (endocervical and urine samples and self-administered vaginal swabs) in the same study, which increased the sensitivity of the STI tests.

Conclusions. The present study contributes to the growing body of literature describing factors associated with STIs in adolescent and young adult women. The results support the need for ongoing prevention interventions, including STI screening and behavioral risk-reduction programs that target young, healthy, sexually active women who may not otherwise seek reproductive health care. With the development of risk assessments that include factors such as those examined in the present study and with advances in noninvasive screening for common bacterial STIs, it is possible to apply STI screening in nonclinical settings where young women congregate for social, educational, and job-training purposes. It is with such approaches that asymptomatic STIs can be detected and treated and STI risk-reduction strategies can be implemented.

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References

1. Centers for Disease Control and Prevention. Sexually transmitted disease surveillance, 2002. Atlanta: US Department of Health and Human Services, **2003**.
2. Centers for Disease Control and Prevention. Tracking the hidden epidemics: trends in STDs in the United States. Atlanta: US Department of Health and Human Services, **2000**.
3. Centers for Disease Control and Prevention. HIV/AIDS surveillance report, 2001. Atlanta: US Department of Health and Human Services, **2001**.
4. Gaydos C, Howell R, Pare B, et al. *Chlamydia trachomatis* infections in female military recruits. N Engl J Med **1998**; 339:739–44.
5. Gaydos CA, Howell MR, Quinn TC, McKee KT, Gaydos JC. Sustained high prevalence of *Chlamydia trachomatis* infections in female Army recruits. Sex Transm Dis **2003**; 30:539–44.
6. Ford K, Norris A. Sexually transmitted diseases: experience and risk factors among urban, low income, African American and Hispanic youth. Ethn Health **1996**; 1:175–84.
7. Jonsson M, Karlsson R, Persson K, et al. The influence of sexual and social factors on the risk of *Chlamydia trachomatis* infections: a population-based serologic study. Sex Transm Dis **1995**; 22:355–63.
8. Boyer C, Shafer M, Seeberg D, Wibbelsman C, Teitle E, Lovell N. Associations of sociodemographic, psychosocial and behavioral factors with sexual risk and sexually transmitted diseases in teen clinic patients. J Adolesc Health **2000**; 27:102–11.
9. Rosenthal S, Biro F, Succop P, Bernstein D, Stanberry L. Impact of demographics, sexual history, and psychological functioning on the acquisition of STDs in adolescents. Adolescence **1997**; 32:757–69.
10. Lifson A, Halcon L, Hannan P, St. Louis M, Hayman C. Screening for sexually transmitted infections among economically disadvantaged youth in a national job training program. J Adolesc Health **2001**; 28:190–6.
11. Boyer C, Tschann J, Shafer M. Predictors of risk for sexually transmitted diseases in urban high school students. J Adolesc Res **1999**; 14:448–65.
12. Laumann E, Youm Y. Racial/ethnic group differences in the prevalence of sexually transmitted diseases in the United States: a network explanation. Sex Transm Dis **1999**; 26:250–61.
13. Harawa N, Greenland S, Cochran S, Cunningham W, Wisscher B. Do differences in relationship and partner attributes explain disparities in sexually transmitted disease among young white and black women? J Adolesc Health **2003**; 32:187–91.
14. Becker K, Glass G, Brathwaite W, Zenilman J. Geographic epidemiology of gonorrhea in Baltimore, Maryland, using a geographic information system. Am J Epidemiol **1998**; 147:709–16.
15. Bernstein K, Curriero F, Jennings J, Olthoff G, Erbelding E, Zenilman J. Defining core gonorrhea transmission utilizing spatial data. Am J Epidemiol **2004**; 160:51–8.
16. Rice R, Roberts P, Handsfield H, Holmes K. Sociodemographic distribution of gonorrhea incidence: implications for prevention and behavioral research. Am J Public Health **1991**; 81:1252–8.
17. Rothenberg R. The geography of gonorrhea: empirical demonstration of core group transmission. Am J Epidemiol **1983**; 117:688–94.
18. Kenney J, Reinholtz C, Angelini P. Sexual abuse, sex before age 16, and high-risk behaviors of young females with sexually transmitted diseases. J Obstet Gynecol Neonatal Nurs **1998**; 27:54–63.
19. Tideman R, Taylor J, Marks C, et al. Sexual and demographic risk factors for herpes simplex type 1 and 2 in women attending an antenatal clinic. Sex Transm Infect **2001**; 77:413–6.
20. Upchurch DM, Kusunoki Y. Associations between forced sex, sexual and protective practices, and sexually transmitted diseases among a national sample of adolescent girls. Womens Health Issues **2004**; 14: 75–84.
21. Diclemente R, Wingood G, Sionean C, et al. Association of adolescents' history of sexually transmitted disease (STD) and their current high-risk behavior and STD status: a case for intensifying clinic-based prevention efforts. Sex Transm Dis **2002**; 29:503–9.
22. Ford K, Lepkowski J. Characteristics of sexual partners and STD infection among American adolescents. Int J STD AIDS **2004**; 15:260–5.
23. Finer L, Darroch J, Singh S. Sexual partnership patterns as a behavioral risk factor for sexually transmitted diseases. Fam Plann Perspect **1999**; 31:228–36.
24. Kelley S, Borawski E, Flocke S, Keen K. The role of sequential and concurrent sexual relationships in the risk of sexually transmitted diseases among adolescents. J Adolesc Health **2003**; 32:296–305.
25. Rosenberg M, Gurvey J, Adler N, Dunlop M, Ellen J. Concurrent sex partners and risk for sexually transmitted diseases among adolescents. Sex Transm Dis **1999**; 26:208–12.
26. Ericksen K, Trocki K. Sex, alcohol and sexually transmitted diseases: a national survey. Fam Plann Perspect **1994**; 26:257–63.
27. Ellen J, Langer L, Zimmerman R, Cabral R, Fitchner R. The link between the use of crack cocaine and the sexually transmitted diseases of a clinic population: a comparison of adolescents with adults. Sex Transm Dis **1996**; 23:511–6.
28. Liau A, Diclemente R, Wingood G, et al. Associations between biologically confirmed marijuana use and laboratory-confirmed sexually

transmitted diseases among African American adolescent females. Sex Transm Dis **2002**; 29:387–90.
29. Millstein S, Moscicki A. Sexually transmitted disease in female adolescents: effects of psychosocial factors and high risk behaviors. J Adolesc Health **1995**; 17:83–90.
30. Wagstaff D, Delameter J, Havens K. Subsequent infection among adolescent African-American males attending a sexually transmitted disease clinic. J Adolesc Health **1999**; 25:217–26.
31. Burstein G, Gaydos C, Diener-West M, Howell M, Zenilman J, Quinn T. Incident *Chlamydia trachomatis* infections among inner-city adolescent females. JAMA **1998**; 280:521–6.
32. Green J, Fulop N, Kocsis A. Determinants of unsafe sex in women. Int J STD AIDS **2000**; 11:777–83.
33. Howell M, Quinn T, Gaydos C. Screening for *Chlamydia trachomatis* in asymptomatic women attending family planning clinics: a cost-effectiveness analysis of three strategies. Ann Intern Med **1998**; 128:277–84.
34. Minnis A, Padian N. Choice of female-controlled barrier methods among young women and their male sexual partners. Fam Plann Perspect **2001**; 33:28–34.
35. Oh M, Cloud G, Fleenor M, Sturdevant M, Nesmith J, Feinstein R. Risk of gonococcal and chlamydia cervicitis in adolescent females: incidence and recurrence in a prospective cohort study. J Adolesc Health **1996**; 18:270–5.
36. Posner S, Pulley L, Artz L, Cabral R, Macaluso M. Psychosocial factors associated with self-reported male condom use among women attending public health clinics. Sex Transm Dis **2001**; 28:387–93.
37. Shrier L, Goodman E, Emans S. Partner condom use among adolescent girls with sexually transmitted diseases. J Adolesc Health **1999**; 24:357–61.
38. Crosby R, Diclemente R, Wingood G, Rose E, Levine D. Adjudication history and African American adolescents' risk for acquiring sexually transmitted diseases: an exploratory analysis. Sex Transm Dis **2003**; 30: 634–8.
39. Ellen J, Aral S, Madger L. Do differences in sexual behaviors account for the racial/ethnic difference in adolescents' self-reported history of a sexually transmitted diseases? Sex Transm Dis **1998**; 25:125–9.
40. Boyer CB, Shafer MA, Shaffer RA, et al. Evaluation of a cognitive-behavioral, group, randomized controlled intervention trial to prevent sexually transmitted infections and unintended pregnancies in young women. Prev Med **2005**; 40:420–31.
41. Aral S, Holmes K. Epidemiology of sexual behavior and sexually transmitted diseases. In: Holmes KK, Mardh P-A, Sparling PF, et al., eds. Sexually transmitted diseases. New York: McGraw-Hill, 1990:19–36.
42. Greenbaum JA, Kann L, Kinchen S, et al. Youth risk behavior surveillance—United States, 2003. MMWR Surveill Summ **2004**; 53:1–96 (erratum: MMWR Morb Mortal Wkly Rep 2004; 53:536).
43. US Department of Health and Human Services. Alcohol research and health: highlights from the tenth special report to Congress. Health risks and benefits of alcohol consumption. Vol 24. Washington, DC: US Government Printing Office, **2000**.
44. Carroll KC, Aldeen WE, Morrison M, Anderson R, Lee D, Mottice S. Evaluation of the Abbott LCx ligase chain reaction assay for detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* in urine and genital swab specimens from a sexually transmitted disease clinic population. J Clin Microbiol **1998**; 36:1630–3.
45. Shafer MA, Moncada J, Boyer CB, Betsinger K, Flinn SD, Schachter J. Comparing the FVU, self-collected vaginal swabs and endocervical specimens to detect *C. trachomatis* and *N. gonorrhoeae* using nucleic acid amplification tests. J Clin Microbiol **2003**; 41:4395–9.
46. Hosmer D, Lemeshow S. Applied logistic regression. 2nd ed. New York: Wiley, **2000**.
47. Schachter J, McCormack WM, Chernesky MA, et al. Vaginal swabs are appropriate specimens for diagnosis of genital tract infection with *Chlamydia trachomatis.* J Clin Microbiol **2003**; 41:3784–9.
48. Moncada J, Schachter J, Hook EW, et al. The effect of urine testing in evaluations of the sensitivity of the Gen-ProbeR Combo 2 assay on endocervical swabs for *Chlamydia trachomatis* and *Neisseria gonorrhoeae:* the infected patient standard reduces sensitivity of single site evaluation. Sex Transm Dis **2004**; 31:273–7.
49. Scholes D, Stergachis A, Heidrich FE, Andrilla H, Holmes KK, Stamm WE. Prevention of pelvic inflammatory disease by screening for chlamydial infection. N Engl J Med **1996**; 334:1399–401.
50. Thomas J, Schoenbach V, Weiner D, Parker E, Earp J. Rural gonorrhea in the southeastern United States: a neglected epidemic? Am J Epidemiol **1996**; 143:269–77.
51. Drumright L, Gorbach P, Holmes K. Do people really know their sex partners: concurrency, knowledge of partner behavior, and sexually transmitted infections within partnerships. Sex Transm Dis **2004**; 31: 437–42.
52. Avonts D, Sercu M, Heyerick P, Vandermeeren I, Meheus A, Piot P. Incidence of uncomplicated genital infections in women using oral contraception or an intrauterine device: a prospective study. Sex Transm Dis **1990**; 17:23–9.
53. Blum M, Pery J, Kitai E. The link between contraceptive methods and *Chlamydia trachomatis* infection. Adv Contracept **1988**; 4:233–9.
54. Richey C, Macaluso M, Hook E. Determinants of reinfection with *Chlamydia trachomatis.* Sex Transm Dis **1999**; 26:4–11.
55. Neu N, Grumet S, Saiman L, McMahon D, Westhoff C. Genital chlamydial disease in an urban, primarily Hispanic, family planning clinic. Sex Transm Dis **1998**; 25:317–21.
56. Park B, Stergachis A, Scholes D, Heidrich F, Holmes K, Stamm W. Contraceptive methods and the risk of *Chlamydia trachomatis* infection in young women. Am J Epidemiol **1995**; 142:771–8.
57. Wolner-Hanssen P, Eschenbach D, Paavonen J, et al. Decreased risk of symptomatic chlamydial pelvic inflammatory disease associated with oral contraceptive use. JAMA **1990**; 263:54–9.
58. Louv W, Austin H, Perlman J, Alexander W. Oral contraceptive use and the risk of chlamydial and gonococcal infections. Am J Obstet Gynecol **1989**; 160:396–402.
59. Hart G. Factors associated with genital chlamydial and gonococcal infection in females. Genitourin Med **1992**; 68:217–20.
60. Ness RB, Soper DE, Holley RL, et al. Hormonal and barrier contraception and risk of upper genital tract disease in the PID Evaluation and Clinical Health (PEACH) study. Am J Obstet Gynecol **2001**; 185: 121–7.
61. Shlay J, McClung M, Patnaik J, Douglas JJ. Comparison of sexually transmitted disease prevalence by reported level of condom use among patients attending an urban sexually transmitted disease clinic. Sex Transm Dis **2004**; 31:154–60.