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Risk factors predictive of sexually transmitted infection diagnosis in young compared to older patients attending sexually transmitted diseases clinics

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Abstract

Young people aged less than 25 years bear the highest burden of sexually transmitted infections (STIs) in the United States. Here we sought to characterize patients aged 15–24 compared with patients age 25 utilizing a database of first visits to two STI clinics in Baltimore, USA from 2011 to 2016. Acute STI (aSTI) was defined as gonorrhea (GC), trichomonas, or early syphilis (ES) in women and non-gonococcal urethritis, GC, Chlamydia (CT), and ES in men. Proportions were compared using the Chi square test and logistic regression was used to assess aSTI predictors in younger versus older groups, stratified by gender. Fifteen thousand four hundred and sixty-three first visits for patients <25 and 25,203 for patients 25 were analyzed. Participants <25 were more likely to be Black and less likely to self-identify as straight than those 25. While younger patients had more partners, they were less likely to report risk behaviors such as ‘Never’ using condoms, cocaine use, and sex with alcohol than older patients. Predictors of aSTI risk differed both by age and gender. STI prevention messages should be tailored, and access to screening should be optimized for young men and women, in order to address rising STI rates in this population.

Keywords

Young patient; sexually transmitted diseases; clinic

Introduction

Young people under age 25 bear the highest burden of sexually transmitted infections (STIs) in the United States, with individuals aged 15–24 acquiring approximately half of all newly

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Supplemental material

Supplemental material for this article is available online.

diagnosed STI cases annually.¹ Moreover, reported STI rates in this population continue to rise. From 2016 to 2017, according to Centers for Disease Control and Prevention (CDC) surveillance, among patients 15–24 years old, there was a 4.9% increase in women and an 8.9% increase in men in reported cases of Chlamydia (CT), a 14.3% increase in women and 13.5% increase in men in reported cases of gonorrhea (GC), and a 7.8% increase in women and a 8.3% increase in men in reported cases of primary and secondary syphilis.¹ These increases are concerning, not only in terms of short-term morbidity, but also due to potential long-term impacts on reproductive health. Women may face infertility, chronic pelvic pain, and poor obstetric outcomes related to untreated or inadequately treated STIs.^{2,3} More rarely, men may experience STI-associated prostatitis or rectal stricture.^{4,5} Furthermore, STIs have been shown to increase the risk of acquisition and transmission of human immunodeficiency virus (HIV) in both men and women.⁶

As compared to older adults, young men and women under age 25 are at higher risk of STI acquisition, likely due to a combination of cultural, behavioral, and biological reasons.¹ At the same time they may face significant barriers to accessing STI services, including cost.⁷ While young people may seek STI-related care from a variety of locations, including community and school clinics, free publicly-funded sexually transmitted diseases (STD) clinics remain an important resource for them as well as for older individuals.⁸ While several studies have examined risk behaviors and/or STIs in young patients coming in to STD clinics,^{9–22} few have systematically compared them to older patients.²³ There is a need to better characterize these individuals in order to understand how to better serve their needs in the STD clinic setting. Our goal was to compare demographic features, behavioral characteristics, and risk factors predictive of acute STI (aSTI) in patients aged 15–24 versus those aged 25 attending two STD clinics in Baltimore, Maryland.

Methods

Study setting

This study utilized data from a large electronic data base of all visits of patients aged 15 and over to two STD clinics located in Baltimore, Maryland between 1 January 2011 and 31 December 2016. Approval for this study was granted by the Institutional Review Board of the Johns Hopkins Medical Institutions and by the Baltimore City Health Department.

Data collection

All patients seeking care at the Baltimore STD clinics undergo a structured interview to evaluate current symptoms (discharge, dysuria, genital odor, genital itching, rashes, lesions, and/or abdominal pain), reason for visit (symptoms, referral for a positive HIV or STI test, contact with an STI-infected partner, or routine checkup), behavioral risk factors (condom use, number of sexual partners, site of sexual exposure, and substance use), and STI history, and then receive appropriate laboratory testing. Symptomatic patients undergo a directed physical examination; starting in 2013, asymptomatic patients became eligible for ‘express testing’ with self-collected specimens. All results are captured in the clinical electronic database.

In men, gonococcal urethritis was diagnosed by a combination of culture and nucleic acid amplification (NAAT) testing. Starting in 2013, asymptomatic men were tested for urethral GC and CT using urine NAATs. Symptomatic men were diagnosed with non-gonococcal urethritis (NGU) by Gram's stain (defined as WBC 2/hpf) without Gram negative diplococci; CT was not routinely tested for in these men. Women had gonococcal cervicitis diagnosed with culture (until mid-2013) or NAATs (mid-2013 on). NAAT testing for CT cervicitis was done in all women under age 30, but was not uniformly done in women over 30 until 2014. Extragenital GC and CT was diagnosed through NAATs. Trichomoniasis (TV) in women was diagnosed through microscopy. Primary and secondary syphilis were diagnosed clinically, and blood samples were also sent for rapid plasma reagin and fluorescent treponemal absorption testing. Early syphilis (ES) was defined as primary, secondary, or early latent syphilis. Primary and secondary syphilis were diagnosed clinically, while early latent syphilis was diagnosed in asymptomatic patients with syphilis serologies which were newly positive in the last year. HIV serologic testing was performed with a screening enzyme immunoassay, followed by a Western Blot. aSTI was defined as positive testing for GC, TV, or ES in women and NGU, GC, CT, and ES in men.

Data analysis

Chi square statistics were used to assess potential differences in demographic and behavioral factors between different age groups and between those who did and did not have an aSTI. P values less than 0.05 were assumed to represent statistical significance. In order to assess which factors were most predictive of being diagnosed with an aSTI (including positive testing for GC, TV, or ES in women and NGU, GC, CT, and ES in men), we utilized logistic regression models. Univariable logistic regression was done initially to explore potential associations with aSTI, stratified by age <25 or 25. Factors that were statistically significant at $p < 0.20$ in univariate analysis (i.e. sex with alcohol, cocaine use, intravenous drug use [IVDU], sex for drugs/money/goods, and symptoms at visit) or were known to be important predictors (i.e. race, sexual identity, condom use, and number of sex partners) were included in a multivariable logistic regression model, which was then applied separately to each age group (<25 and 25) stratified by gender. Collinearity was checked by using the variance inflation factor²⁴ in the final multivariable model. Since CT testing was not uniformly done in women >30 until 2014, CT was not included in the aSTI definition for women. Consequently, a sensitivity analysis which included CT in the aSTI definition for women was conducted for samples collected from 2014 to 2016. Stata v15 was used for all analysis (College Station, Texas).

Results

There were 114,260 total visits from patients 15 years of age in the STD database during the period 2011–2016, 35% of which were in those aged < 25. We selected the first visit to the STD clinic for each patient from 2011 to 2016 (68,994 or 60.4% were repeat visits and were excluded). An additional 4600 (4.0%) visits with incomplete information on key variables were excluded, leaving $N = 40,666$ visits available for analysis. Among these, 15,463 (38.0%) occurred in those < age 25 and $N = 25,203$ (62.0%) in those age 25.

Differences in demographic factors, behavioral factors, and reasons for visit

Demographic and behavioral risk factors as well as reasons for STD clinic visit are shown in Tables 1 and 2, stratified by age and gender. P values for all associations described below are <0.05 unless otherwise stated. Younger patients were more likely to be Black and less likely to self-identify as 'straight' than older patients. Younger patients were more likely to be asymptomatic at the time of visit and less likely to be HIV-positive. Younger patients were more likely to be self-referring for a 'checkup' (meaning they requested general STI testing not prompted by symptoms or by a known STI positive partner) or to be coming in to the clinic as an STI contact than older patients. Older patients were more likely to self-refer for just for an HIV test or to come in as a contact of HIV. Younger men were more likely to report anal sex, but younger women were less likely to report anal sex than their older counterparts. Younger patients had more sexual partners, but were less likely to report 'never' using condoms than older patients. Younger patients were less likely to report binge drinking; sex with alcohol; cocaine use; IVDU; or exchanging sex for money, drugs, or goods than older patients. A larger percentage of older women reported being a victim of sexual assault, but numbers were similar for men in both age groups.

STI diagnoses at visit

The percentage positive of the patients tested for each STI and comparisons between age groups stratified by gender are detailed in Supplementary Table 1. Women aged under 30, as per clinic guidelines, were more likely to be tested at the urogenital site for CT than women over 30. A higher percentage of younger patients tested were positive for GC and CT (at the urogenital, rectal, and pharyngeal sites). Younger men were more likely to be diagnosed with NGU than older men. Relatively few patients were diagnosed with ES, and there were no statistically significant differences between younger and older patients when stratified by sex. Of those tested, older women were more likely to be diagnosed with TV and bacterial vaginosis than younger women.

Predictors of aSTI

We first compared demographics, risk factors, and reasons for visit in patients with and without a diagnosis of aSTI (see Supplementary Table 2). Those diagnosed with an aSTI were slightly younger, more likely to be gay, HIV-positive and Black, had a higher number of partners, were more likely to report binge drinking or sex with alcohol, transactional sex, symptoms at visit, genital sex, and to be coming in as a contact of an STI, but were less likely to report oral sex, both never and always using condoms, sexual assault, and to be self-referring for a checkup or HIV test than those who did not have an aSTI diagnosed.

We then compared predictors of aSTI in groups stratified by age and gender based on multiple logistic regression (see Table 3). Having symptoms on presentation as well as increasing number of sexual partners predicted aSTI across gender and age groups. Black race was predictive of aSTI in men across age groups, but only in younger women, while Hispanic ethnicity was protective against aSTI diagnosis only in older men and women. Self-identifying as gay was protective (relative to self-identifying as straight) against aSTI diagnosis in women, and predictive of aSTI in men, regardless of the age group. 'Always' using condoms was protective against aSTI diagnosis in men and younger women, but not in

women 25. Cocaine use was strongly predictive of aSTI in women of all ages, but was protective in older men. However, when we evaluated each STI as the outcome in men 25 (based only on subjects tested), cocaine use was not statistically significantly associated with aSTI (see Supplementary Table 3). Finally, when we conducted a sensitivity analysis including CT as part of the definition of aSTI for women, results were largely consistent, although black race was protective in older women, cocaine use was only borderline statistically significantly predictive of aSTI in older women, and symptoms were not predictive in younger women (see Supplementary Table 4).

Discussion

Importantly, in this study comparing young (<age 25) to older (age 25) patients attending STI clinics in Baltimore, MD, reported prevalence of specific risk behaviors and how well these risk behaviors or demographic factors predicted aSTI diagnosis differed both by age group and by gender. That these differences exist is supported by a previous study, which also found different associations by age and gender between crack cocaine use and diagnosed STIs.²³ As STI rates continue to rise, unabated, these differences suggest that interventions aimed at reducing STIs need to be tailored to specific patient populations.

In our cohort, young patients were less likely than their older counterparts to endorse many risk behaviors; additionally, risk behaviors which predicted aSTI diagnosis in older age groups were not always predictive across gender in this group. While two other studies in young patients have shown that binge drinking or alcohol use disorder is correlated with risky sexual behaviors²⁰ and STI diagnosis,¹¹ self-reported alcohol use with sex was not predictive of aSTI in our cohort. Of note, a previous analysis from an earlier cohort recruited from the same STD clinics which did not control for age found that binge drinking was associated with syphilis and new HIV diagnosis, but not GC or CT.²⁵ Cocaine was not predictive of aSTI diagnosis when CT was included together with GC, NGU, ES, and TV in young men or women, though when CT was excluded, cocaine was associated with aSTI diagnosis (primarily TV and GC) in young women. Surprisingly, cocaine use was actually protective against aSTI in men 25 overall analysis, though not when regression models were run for individual STIs, utilizing only patients who were tested for each. However, a small percentage of patients reported cocaine use in this group (3%). Additionally, previous associations between cocaine use and STIs in the literature have been inconsistent,²⁶ though the relationship between cocaine use and syphilis seems to be stronger than for other STIs.^{25,27}

What, practically, might an STD clinic manager or public health practitioner take from these data? First, given the unique needs of patients <25, partnerships with local groups with additional access to this population (e.g. high schools and college health services) could be developed in order to deliver education and awareness messages tailored specifically to young women, men who have sex with women, and MSM. Second, promoting condoms and addressing substance abuse will always be important in this population. However, given the high rates of STI test positivity in young patients despite lower prevalence of 'never' condom use and drug-related risk behaviors than in older populations, it may be as or more important to focus STI-related messages on empowering a broader range of young patients

to seek appropriate screening. Indeed, rather than focus on subgroups with specific risk factors, both the USPSTF and the CDC have recommended screening for GC and CT in all sexually active women under 25, in order to achieve better population-wide screening coverage of this group.^{28,29} In our study, there was already interest in screening (almost 40% of patients <25 coming to our STD clinics just wanted ‘a checkup’) and test positivity was high. Access to testing services should be optimized for young patients. Importantly, testing services should consider patient anonymity, with many adolescent and young adults remaining on parents’ insurance, provision of STI services in STD clinics and beyond (such as at-home/over the counter³⁰ or school-based testing) that will not be identified on insurance may eliminate perceived barriers to testing and treatment.

There are some limitations to this study. It was a retrospective analysis from a clinical database, hence we utilized clinician documentation of patient self-reported behaviors which could have been incomplete or unreliable. During this time period, data on trans gender identity were not consistently collected. Due to budgetary constraints, older women were not routinely tested for CT until later in the study. Despite the sensitivity analysis, this may have introduced bias. Furthermore, NAAT testing for GC and CT was not routinely done in symptomatic men, and it is possible that causes of NGU could have differed between older and younger men. Finally, this study represents an inner city, predominantly African American patient population, so our findings may not be generalizable to other settings.

Despite these limitations, our study suggests that demographic and risk behaviors, and how well these factors predict aSTI diagnosis differ by gender and by age <25. STD clinic providers should be aware of these findings. Importantly, educational messages should be tailored, and access to screening should be optimized for young men and women, in order to address rising STI rates in this population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Patient clinical/demographic factors and reasons for attending: first visit to STD clinic 2011–2016.

	Overall		Female		Male	
	<25	≥25	p value	<25	≥25	p value
Total	15,463	25,203		7340	8385	
Age mean (SD)	21.19 (2.39)	37.20 (10.36)		20.89 (2.46)	36.21 (9.69)	
Race			<0.01			<0.01
White non-Hispanic	927 (5.99%)	2075 (8.23%)		453 (6.17%)	713 (8.50%)	
Black non-Hispanic	13,795 (89.21%)	21,226 (84.22%)		6550 (89.24%)	7024 (83.77%)	
Hispanic	507 (3.28%)	1348 (5.35%)		225 (3.07%)	455 (5.43%)	
Other	234 (1.51%)	554 (2.20%)		112 (1.53%)	193 (2.30%)	
Sexual Identity			<0.01			<0.01
Straight	13,827 (89.42%)	23,245 (92.23%)		6590 (89.78%)	7733 (92.22%)	
Gay	885 (5.72%)	1133 (4.50%)		246 (3.35%)	209 (2.49%)	
Bisexual	751 (4.86%)	825 (3.27%)		504 (6.87%)	443 (5.28%)	
Symptoms at visit	5799 (37.50%)	10,608 (42.09%)	<0.01	3082 (41.99%)	4283 (51.08%)	<0.01
HIV-positive	132 (0.85%)	730 (2.90%)	<0.01	21 (0.29%)	135 (1.61%)	<0.01
Reasons for visit (other than symptoms)						
Contact STI (not HIV)	2735 (17.69%)	4188 (16.62%)	0.01	950 (12.94%)	902 (10.76%)	<0.01
Contact HIV	75 (0.49%)	221 (0.88%)	<0.01	18 (0.25%)	58 (0.69%)	<0.01
Self-referral for checkup ^a	6066 (39.23%)	7786 (30.89%)	<0.01	2904 (39.56%)	2432 (29.00%)	<0.01
Self-referral for HIV test	486 (3.14%)	1556 (6.17%)	<0.01	217 (2.96%)	590 (7.04%)	<0.01

^a Asymptomatic, and not a contact of an individual with an STI, just asking for STI testing.

Table 2.

Patient self-reported risk factors: sexual and substance use related.

	Overall			Female			Male		
	<25	25	p value	<25	25	p value	<25	25	p value
Total	15,463	25203		7340	8385		8123	16,818	
Sexual behaviors									
Genital sex	15,168 (98.09%)	24,633 (97.74%)	0.02	7215 (98.30%)	8201 (97.81%)	0.03	7953 (97.91%)	16,432 (97.70%)	0.31
Oral sex	8073 (52.21%)	12,746 (50.57%)	<0.01	3968 (54.06%)	4429 (52.82%)	0.12	4105 (50.54%)	8317 (49.45%)	0.11
Anal sex	1082 (7.00%)	1643 (6.52%)	0.06	482 (6.57%)	847 (10.10%)	<0.01	600 (7.39%)	796 (4.73%)	<0.01
Number of partners			<0.01			<0.01			<0.01
0	638 (4.13%)	1559 (6.19%)		244 (3.32%)	536 (6.39%)		394 (4.85%)	1023 (6.08%)	
1	5866 (37.94%)	11,168 (44.31%)		3682 (50.16%)	4937 (58.88%)		2184 (26.89%)	6231 (37.05%)	
2	4248 (27.47%)	6887 (27.33%)		2142 (29.18%)	2004 (23.90%)		2106 (25.93%)	4883 (29.03%)	
3	4711 (30.47%)	5589 (22.18%)		1272 (17.33%)	908 (10.83%)		3439 (42.34%)	4681 (27.83%)	
Average condom use			<0.01			<0.01			<0.01
Never	3337 (21.58%)	7820 (31.03%)		2023 (27.56%)	3481 (41.51%)		1314 (16.18%)	4339 (25.80%)	
Sometimes	5858 (37.88%)	8043 (31.91%)		2697 (36.74%)	2441 (29.11%)		3161 (38.91%)	5602 (33.31%)	
Often	4172 (26.98%)	5788 (22.97%)		1627 (22.17%)	1445 (17.23%)		2545 (31.33%)	4343 (25.82%)	
Always	2096 (13.55%)	3552 (14.09%)		993 (13.53%)	1018 (12.14%)		1103 (13.58%)	2534 (15.07%)	
Substance use									
Binge drinking ^a	2404 (15.55%)	4959 (19.68%)	<0.01	922 (12.56%)	1232 (14.69%)	<0.01	1482 (18.24%)	3727 (22.16%)	<0.01
Sex with alcohol ^b	2271 (14.69%)	4641 (18.41%)	<0.01	896 (12.21%)	1238 (14.76%)	<0.01	1375 (16.93%)	3403 (20.23%)	<0.01
Cocaine use ^c	95 (0.61%)	785 (3.11%)	<0.01	30 (0.41%)	353 (4.21%)	<0.01	65 (0.80%)	432 (2.57%)	<0.01
IVDU ^d	30 (0.19%)	208 (0.83%)	<0.01	13 (0.18%)	113 (1.35%)	<0.01	17 (0.21%)	95 (0.56%)	<0.01
Sex for drugs/money/goods ^e	129 (0.83%)	611 (2.42%)	<0.01	51 (0.69%)	192 (2.29%)	<0.01	78 (0.96%)	419 (2.49%)	<0.01
Other									
Victim of sexual assault ^f	335 (2.17%)	571 (2.27%)	0.51	289 (3.94%)	464 (5.53%)	<0.01	46 (0.57%)	107 (0.64%)	0.51

^aBinge drinking defined as ≥4–5 drinks in one sitting in the last 30 days.^bSex with alcohol in the last month.

- ^c Cocaine use in the past 1–12 months.
- ^d IVDU in the past 1–12 months.
- ^e Sex for drugs, money, or goods in the past 1–12 months.
- ^f Ever been an victim of sexual assault.

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Table 3.

Predictors of acute STI diagnosis at first STD clinic visit during 2011–2016. acute STI: gonorrhea, trichomonas, and early syphilis in women and gonorrhea, Chlamydia, non-gonococcal urethritis, and early syphilis in men; aOR: adjusted OR; uOR: univariate OR.

	Female<25		Female>25		Male<25		Male>25	
	uOR (pval)	aOR (pval)	uOR (pval)	aOR (pval)	uOR (pval)	aOR (pval)	uOR (pval)	aOR (pval)
Race								
White non-Hispanic	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Black non-Hispanic	1.82 (<0.01)	2.19 (<0.01)	0.96 (0.75)	1.06 (0.62)	2.35 (<0.01)	2.31 (<0.01)	1.55 (<0.01)	1.49 (<0.01)
Hispanic	0.75 (0.43)	0.90 (0.77)	0.28 (<0.01)	0.32 (<0.01)	1.26 (0.18)	1.30 (0.14)	0.68 (<0.01)	0.68 (<0.01)
Other	0.68 (0.44)	0.85 (0.75)	0.43 (0.01)	0.49 (0.03)	1.11 (0.65)	1.11 (0.67)	0.88 (0.39)	0.96 (0.79)
Sexual identity								
Straight	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Gay	0.60 (0.05)	0.54 (0.02)	0.51 (0.02)	0.48 (0.01)	0.98 (0.78)	1.24 (0.02)	1.10 (0.21)	1.34 (<0.01)
Bisexual	1.32 (0.04)	1.13 (0.40)	1.07 (0.64)	0.94 (0.70)	1.10 (0.48)	1.21 (0.16)	1.47 (<0.01)	1.62 (<0.01)
Number of partners								
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	1.36 (0.25)	1.26 (0.39)	1.42 (0.04)	1.39 (0.05)	1.48 (<0.01)	1.50 (<0.01)	1.91 (<0.01)	1.77 (<0.01)
2	1.88 (0.02)	1.81 (0.03)	1.66 (<0.01)	1.57 (0.01)	1.84 (<0.01)	1.76 (<0.01)	2.64 (<0.01)	2.18 (<0.01)
3	2.38 (<0.01)	2.33 (<0.01)	2.00 (<0.01)	1.68 (0.01)	2.20 (<0.01)	2.09 (<0.01)	3.09 (<0.01)	2.49 (<0.01)
Average condom use								
Never	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sometimes	0.87	0.74	1.01	0.92	1.14	0.98	1.32	1.10

	Female<25		Female≥25		Male<25		Male≥25	
	uOR	aOR	uOR	aOR	uOR	aOR	uOR	aOR
	(pval)	(pval)	(pval)	(pval)	(pval)	(pval)	(pval)	(pval)
Often	(0.13)	(0.01)	(0.94)	(0.36)	(0.05)	(0.73)	(0.01)	(0.06)
	1.05	0.85	1.02	0.89	1.10	0.89	1.49	1.13
	(0.66)	(0.14)	(0.83)	(0.27)	(0.18)	(0.11)	(0.01)	(0.02)
Always	0.72	0.64	1.10	1.09	0.77	0.71	0.91	0.81
	(0.01)	(0.01)	(0.39)	(0.43)	(0.01)	(0.01)	(0.12)	(0.01)
Sex with alcohol ^a	0.97	0.87	1.29	1.15	1.04	1.01	1.23	1.07
	(0.83)	(0.24)	(0.01)	(0.13)	(0.52)	(0.86)	(0.01)	(0.11)
Cocaine use ^b	3.69	3.97	3.07	2.36	0.55	0.70	0.70	0.71
	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.23)	(0.01)	(0.01)
IV drug use ^c	2.57	2.16	2.74	1.32	0.31	0.52	0.67	0.79
	(0.15)	(0.29)	(0.01)	(0.27)	(0.06)	(0.34)	(0.10)	(0.37)
Sex for drugs/money/goods ^d	1.84	1.21	2.84	1.36	NA	NA	NA	NA
	(0.10)	(0.63)	(0.01)	(0.15)	(NA)	(NA)	(NA)	(NA)
Symptoms at visit	1.63	1.56	1.84	1.77	2.83	2.81	4.07	3.97
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

^aSex with alcohol in the last month.

^bCocaine use in the past 1–12 months.

^cIVDU in the past 1–12 months.

^dSex for drugs, money, or goods in the past 1–12 months.