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# *Trichomonas vaginalis* Infection in a Probability Sample of Adolescents and Young Adults

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## Summary

A probability survey of residents of Baltimore MD aged 15 to 35 years found that 6.2 percent tested positive for *T. vaginalis.* Many behavioral factors were associated with infection.

## Abstract

**Background:** *T. vaginalis* is the most common curable sexually transmitted infection in the USA, although its epidemiology is not well understood. Surveillance data do not exist either for the national or local populations.

**Methods:** The Monitoring STIs Survey Program (MSSP) collects survey data and urine specimens to monitor trends in STIs among probability samples of residents of Baltimore, MD. We report population and sub-population estimates of *T. vaginalis* prevalence from the first year of MSSP.

**Results:** Among Baltimore residents aged 15 to 35 years, the estimated prevalence of *T. vaginalis* was 6.2% (95% CI 4.4, 8.1); among Black females, the estimated prevalence was 14.2% (95% CI 10.3, 19.3). Many behavioral factors were associated with increased risk of infection.

**Conclusions:** Undetected *T. vaginalis* is common in the Baltimore population. Our results provide strong support for routine screening for TV in populations at elevated risk of infection. The MSSP demonstrates a new approach to public health surveillance for monitoring the prevalence of undetected infections in populations.

## INTRODUCTION

*Trichomonas (T. vaginalis)* is the most common curable sexually transmitted infection (STI) in the U.S.A., with an estimated 7.4 million infections occurring annually [1, 2]. Untreated *T. vaginalis* infection has been associated with pelvic inflammatory disease, low birth weight, preterm delivery, and increased susceptibility to HIV [3-5].

Accurate monitoring of *T. vaginalis* in the population is crucial if we are to develop effective strategies for infection prevention and control. Currently there are no surveillance data monitoring *T. vaginalis*. The 2001-2002 National Longitudinal Study of Adolescent Health (Add Health) estimated a *T. vaginalis* prevalence of 2.3% for a cohort of 18 to 26 year-olds who were U.S. students in grades 7 through 12 in 1994-95 [6]. The National Health and Nutrition Examination Survey (NHANES) estimated that 3.1% of U.S. women aged 14 to 49 years during 2001-2004 carried an undiagnosed *T. vaginalis* infection [7]. Both surveys reported substantially higher rates of infection among African American females (AddHealth: 10.5%; NHANES: 13.3%) and the majority of infections were asymptomatic.

While these two national surveys provide important data on infection prevalence at single points in time, much remains unknown about the epidemiology of *T. vaginalis.* STI epidemics evolve within communities. National snapshots of prevalence obscure variations that arise over time in subpopulations due to local differences in behavior patterns, sexual networking, screening and case-management, as well as variation in the strains of the pathogen circulating in different communities.

In this paper, we report *T. vaginalis* results from the first year of the Monitoring STIs Survey Program (MSSP). The MSSP is designed to provide continuous monitoring of

trends in undiagnosed sexually transmitted infections among adolescents and young adults residing in Baltimore, MD – a metropolitan community with both a historically high incidence of diagnosed STIs based on reports to public health authorities and a high prevalence of undiagnosed STIs based on evidence from past population surveys [8-9].

## MATERIALS AND METHODS

**Study sample** The MSSP uses T-ACASI (telephone audio computer-assisted self-interviewing) technology and urine collection kits sent out and returned by U.S. mail to diagnose STIs from probability samples of adolescents and young adults residing in Baltimore, Maryland. Repeated surveys allow us to monitor infection prevalence over time for the overall study population as well as population subgroups.

MSSP data collection began in September 2006. A stratified, list-assisted, probability sampling design was used to maximize sample efficiency in identifying our target population --- English-speaking males and females between 15 and 35 years of age residing in Baltimore households with landline telephones. Four strata were sampled probabilistically. The first three strata were sampled with the assistance of commercially-available information on Baltimore households [10] which is updated every 3 months and include (1) households believed to contain someone aged 15-35 years, (2) households believed to contain no one aged 15-35, and (3) households in which the age of the residents was unknown. The fourth sample stratum was constructed by selecting all landline telephone numbers known to service Baltimore, and then removing any numbers that appeared on the commercial list sampling frame from which the three preceding strata were constructed. Inclusion of this fourth stratum ensures that the probability sample includes the entire universe of households with landline telephones, and that each telephone number is in one and only one stratum. Errors in list-sample

information (e.g., households that were erroneously thought to have a resident aged 15 to 35) were eliminated during survey screening.

**Survey execution** Households with a known address were sent a lead letter describing the study. Telephone screening and recruitment were conducted by interview staff at the University of Massachusetts, Boston. Interviewers called sampled household numbers until the phone was answered, or until the number had been called a minimum of 14 times over a period of at least four weeks without being answered. Household screening was completed with an adult household member. In screened residences with more than one person aged 15 to 35 years, one member was probabilistically selected. Up to 75 call-backs were made to households in which the selected member was not present at the time of the call.

Interviewers described the survey and obtained verbal informed consent for the interview. Subjects agreeing to the urine collection also provided written consent and were informed that they would be re-contacted if their test result for gonococcal or chlamydial infection was positive. They were also informed that, as required by law, names and contact information of persons who tested positive would be reported to the local health department. Since the *T. vaginalis* assay has not been approved by the FDA, subjects were informed that they would not be re-contacted regarding their *T. vaginalis* result. Parental permission was obtained prior to recruitment of minors. Parents were informed that their child's study results were confidential and that neither survey data nor test results would be shared with them.

**T-ACASI interview** After obtaining consent, interviewers transferred respondents to a T-ACASI system [11-12]. T-ACASI has been shown to increase reporting of sensitive

and stigmatized behaviors compared to traditional telephone surveys conducted by human interviewers [13-16]. The survey took 13 minutes, on average, to complete. Respondents received $10 to $20 for completing the interview. (Payments for survey participation and urine specimens were increased over the course of the study) [17].

**Specimen collection** Participants who agreed to provide a urine specimen for STI testing were mailed a collection kit with instructions, a consent form, and monetary compensation for completing the telephone survey. Specimens were collected in containers with DNA/RNA Protect™ (Sierra Diagnostics, Sonora, CA), designed to prevent nucleic acid degradation for 7-10 days without refrigeration.

Participants mailed urine specimens in pre-addressed postage-paid shipping cartons to the University of North Carolina-Chapel Hill Hospitals' McLendon Clinical Laboratories via U.S. Postal Service first class mail. Only specimens submitted with a signed consent form were tested. Participants received $40 to $100 for mailing in the urine specimen.

All study procedures were approved by the Institutional Review Boards of Research Triangle Institute, the University of North Carolina at Chapel Hill, the University of Massachusetts, and the Johns Hopkins Medical Institutions.

**Laboratory testing**

*Specimen handling.* Urine specimens (2 mL) were transferred to APTIMA Combo 2 Assay urine specimen transport tubes (Gen-Probe, Inc., San Diego, CA) upon receipt at the UNC Hospitals laboratory. *T. vaginalis* nucleic acids were detected by transcription-mediated amplification (TMA) using analyte-specific reagents (ASR) as previously described using interpretive criteria previously established with vaginal swabs [18]. TMA

results < 10,000 relative light units (RLU) were considered negative, and specimens with ≥ 30,000 RLU were considered positive. Results from 10,000 to < 30,000 RLU were considered equivocal, and specimens were retested. Initially equivocal specimens with repeat test results < 10,000 RLU were considered negative; those with repeat results ≥ 10,000 RLU were considered positive. *T. vaginalis* infection was defined as a repeatedly positive test result. Using these criteria, *T. vaginalis* TMA is 98.2% sensitive and 98.0% specific in latent class analysis compared to wet mount, culture and a rapid antigen test [18].

Specimens were received in the laboratory an average of 5.6 ± 5.1 days (mean±sd; range: 1, 44 days) after urine collection. Average urine volume was 65.5 ± 22.0 mL (mean±sd; range: 10, 100 mL). Although most study specimens exceeded the recommended volume and time to transfer into urine transport tubes, the distributions of volume and specimen age at transfer were not different for urines with positive and negative TMA results, suggesting that assay sensitivity was not affected. The same processed urine specimen was used to detect *N. gonorrhoeae* and *C. trachomatis* nucleic acids using the FDA-cleared APTIMA Combo2 assay (Gen-Probe, Inc., San Diego, CA).

To verify that specimen collection, mailing and processing procedures were acceptable for APTIMA testing, we spiked negative urine specimens (60 mL) in study containers with *T. vaginalis* (*n*=10) or *N. gonorrhoeae* (n=12). APTIMA TV ASR test results from these spiked specimens and 12 negative control urines that were mailed to the UNC Hospitals laboratory were indistinguishable from test results obtained from the same specimens prior to mailing.

**Sample Weighting** Two sets of sample weights were constructed to adjust for the unequal probabilities of selection based on our stratified sample design and survey and specimen nonresponse An initial set of survey weights was developed as the inverse of the probability of selection within each of the four sample stratum with adjustments for the differing probabilities of selection within households, the number of landline telephones within the household, and survey nonresponse. A post-stratification adjustment was applied to match the sample distribution to the 2006 American Community Survey [19] for the Baltimore population by age, gender, race/ethnicity, and education. A second set of weights was constructed to compensate for additional differences in the provision of a urine specimen for STI testing among respondents who completed the survey interview.

**Statistical Analyses** We include all completed interviews and specimens collected from the first year's allocation of sample (i.e., telephone numbers released between September 8, 2006 and September 7, 2007 and specimens received prior to February 1, 2008). Survey estimates of infection prevalence were derived using sample weights to adjust for unequal probabilities of selection and nonresponse. Weighted distributions of demographic, behavioral, or health characteristics of respondents and their association with infection status were tabulated and chi-square tests of independence and prevalence ratios were calculated. We subsequently performed multivariable analyses using poisson regression models to generate prevalence ratios 1) adjusted for all sociodemographic variables and 2) as a function of each behavioral or health outcome adjusted for demographic variables whose association with infection status in bivariable analyses was $p < 0.1$, e.g., race/ethnicity, gender, age, and education. All statistical analyses accounted for the complex survey design and used Stata version 10 [20].

**Assessment of Impact of Missing Urine Specimens** To assess the impact of urine nonresponse on prevalence estimates, we fit logistic regression models to calculate the probability that urine nonrespondents would have tested positive if they had provided a specimen. These models included a range of sociodemographic, behavioral, and health-related variables[a], and were estimated using survey data from respondents who provided specimens for testing. The parameter estimates from these models were used to impute the probability that individual urine nonrespondents would have tested positive if they had provided a urine specimen. These imputed probabilities were combined with the test results for respondents who provided a urine specimen to estimate the expected *T. vaginalis* infection prevalence that would have been obtained if all subjects had provided a urine specimen.

## RESULTS

**Survey execution** A sample of 30,617 telephone numbers was released during Year 1 -- 19,680 (64%) were determined to be non-residential (out of service numbers, business telephones, faxes, etc.), 8,787 (29%) were confirmed as residential, and the status of 2,150 (7%) numbers could not be determined after repeated attempts. Of the 8,787 residential numbers, 6,271 (71%) were screened for eligibility and 2,176 included one or more eligible household members aged 15 to 35 years. Survey interviews were

[a] For 370 of the 385 urine nonrespondents, we estimated the likelihood of *T. vaginalis* infection using a logistic regression model that included as predictor variables: race, gender, education, age, past history of *T. vaginalis* infection, antibiotic use in past month, gender of sexual partners, having two or more sex partners in past year, having a new sexual partner in past three months, experience of forced sex, ignorance of partner's STI history, history of incarceration (respondent or partner) and having a physician's visit in the past three months. For 13 urine nonrespondents, complete data were not available for all these predictor variables so a simpler model was used. It predicted the likelihood of infection based on race, gender, education, age, and having two or more partners in the past year. Two urine nonrespondents did not have complete data to fit this second model, so an even simpler model predicting the likelihood of infection as a function of race, gender, and age was used.

completed with 1,248 (57%) eligible respondents. Non-interviews occurred due to respondent refusal (n=560; 26%), parental refusal to provide assent (n=101; 5%), and inability to contact the respondent after repeated attempts (n=267; 12%).

Of the 1,248 respondents completing the interview, 1064 agreed to provide urine specimens for STI testing and 866 of those (81%) mailed in their specimens to the laboratory. Two specimens that were damaged and leaked during transit and one non-urine specimen were not tested by the laboratory.

**Population Prevalence of *T. vaginalis* Infection** Among Baltimore residents aged 15 to 35 years, the estimated prevalence of *T. vaginalis* was 6.2% (95% CI 4.4, 8.1; Table 1). The synthetic estimate (6.196%) derived using imputation procedures to adjust for missing urine specimens was similar to that obtained from the tested specimens alone (6.225%). In subsequent analyses, we present only estimates derived from subjects providing specimens for testing.

**Variation in Prevalence of *T. vaginalis*.** The prevalence of *T. vaginalis* infection among non-Hispanic Blacks was six times higher (9.3% vs. 1.5%; prevalence ratio (PR)=6.1, 95% CI 2.2, 16.9) than among other racial/ethnic groups (Table 2). Overall, the prevalence of infection among women was five times higher than among men (10.1 vs. 2.0%; PR=5.1, 95% CI 2.0, 13.0). For subpopulations defined by race and sex, we estimate the prevalence to be: 14.2% for non-Hispanic Black females; 3.5% for non-Hispanic Black males; and 3.1% for non-Black females. Only 6 cases of *T. vaginalis* were detected among males; no cases were detected among non-Black males.

There were no statistically significant differences in *T. vaginalis* prevalence by age or

employment status. However, those with some college (or more) had an infection prevalence (3.0%) one-third that of high school graduates and dropouts (9.2% and 8.5%; *p* =.003 and .004). The significant associations between *T. vaginalis* and gender, race/ethnicity, and education remained after adjusting for other sociodemographic variables in regression analyses (Table 2).

**Behavioral risk factors for *T. vaginalis* infection.** In bivariable analyses, the number and gender of sexual partners were associated with the likelihood of infection (Table 3). Respondents reporting two or more partners in the past year were 3.3 times more likely than respondents with fewer partners to test positive for *T. vaginalis* (95%CI 1.8, 6.1). Similarly, respondents who reported a recent new partner were more likely to test positive (PR=2.1, 95%CI 1.1, 3.8) as were respondents who were uncertain whether a sexual partner in the past year had an STI (PR=2.5, 95%CI 1.2, 5.3). Having been incarcerated (the respondent or a sex partner) was positively associated with *T. vaginalis* (PR=2.5, 95%CI 1.4, 4.6), as was ever being forced to have sex (PR=2.9, 95% CI 1.6, 5.3).

Reports of previous STIs were strongly associated with a current positive *T. vaginalis* result. Respondents reporting a prior diagnosis of *T. vaginalis* were 4.3 times more likely to have a current infection (95%CI 2.3, 7.9). Infection with *T. vaginalis* in this population was more common than infection with *C. trachomatis* (4.6%, 95%CI 2.8, 6.5). Concomitant infection with *C. trachomatis* was detected in 16.7% of respondents with *T. vaginalis* (PR=2.9, 95%CI 1.3, 6.8).

The majority (76%) of respondents with *T. vaginalis* reported no discharge or dysuria in the past three months. Recent symptoms were associated with infection among women,

however, no man diagnosed with *T. vaginalis* reported recent symptoms. (This lack of symptoms among males does not appear to be a reporting error since 16% of males with a current chlamydial infection reported recent symptoms.)

**Multiple regression analysis of risk factors for *T. vaginalis***. Bivariable analyses identified numerous risk behaviors associated with *T. vaginalis*. Many of these behavioral variables (e.g., having a recent new sexual partner, multiple partners in the past year) are both logically and statistically intertwined. Table 2 shows the relationship of *T. vaginalis* to demographic variables before and after adjustment for other demographic variables. Individual sexual and health behaviors are also strongly correlated with the prevalence of *T. vaginalis*, but their simultaneous inclusion in any prediction model obscures individual factor effects due to a high degree of multicollinearity. In Table 3, the individual sexual and health behaviors are modeled against demographic variables. Multivariable models adjusting for these factors found that having two or more partners in the past year (PR=2.6, 95%CI 1.4, 4.8), a new partner in the past three months (PR=2.0, 95%CI 1.1, 3.6), not knowing whether a partner had a previous STI (PR=2.2, 95%CI 1.1, 4.8), and being forced to have sex (PR=1.9, 95%CI 1.1, 3.4) significantly increased the predicted likelihood of a current *T. vaginalis* infection.

Although we recognize the importance of examining TV-related characteristics and behaviors of males and females separately, gender specific analyses were limited by the small number of TV+ male cases in these Year One data (2%, or n=6, with zero cases among non-Black males). We note that analyses limited to female respondents produced results similar to those including all subjects and are not presented in Table 3.

## DISCUSSION

Results from the first year of the MSSP suggest that untreated infections with *T. vaginalis* are common among adolescents and young adults in Baltimore, MD. One in 10 women (10.1%) tested positive for *T. vaginalis.* As in other population-based and clinical studies [4-7, 21-22], infection prevalence was significantly higher among Black females. Our estimates suggest that one in seven (14.2%) Black women ages 15 to 35 in Baltimore has a current and untreated *T. vaginalis* infection. These results are particularly troublesome since *T. vaginalis* infection is associated with significant morbidity, and they provide strong support for calls [23-24] for routine screening for TV in populations at elevated risk of infection, including sexually active adolescent and young women in Baltimore and similar venues.

Most of the *T. vaginalis* infections were asymptomatic. Unlike gonococcal and chlamydial infections, which also may be asymptomatic, *T. vaginalis* is not reportable in the U.S. Thus, our understanding of the epidemiology of this infection in the general population is poor. Population-based studies provide estimates of untreated infection at a given point in time, and do not require symptomatic infections nor visits to health care providers to be counted. In our study, infection with *T. vaginalis* (6.2%, 95%CI 4.4, 8.1) was more common than infections with *C. trachomatis* and *N. gonorrhoeae* combined (4.8%, 95%CI 2.9, 6.7).

The MSSP is designed to monitor the prevalence of *T. vaginalis* in a population typically identified as being at high risk for STIs – young adults residing in an urban center with high rates of STI and HIV. Within our study population, female gender, Black race, and having a high school education or less were significantly associated with likelihood of *T. vaginalis* infection -- as were several behavioral attributes.

We used a highly sensitive and specific nucleic acid amplification technique, TMA, to estimate the population prevalence of *T. vaginalis* infection. In contrast to traditional techniques, TMA has been demonstrated to maintain its high performance equally well in patients with and without symptoms [18]. Quality control procedures confirmed that our specimen collection and transport procedures were acceptable for APTIMA testing.

The first year of the MSSP experienced a moderate level of non-response. The impact of screening and interview nonresponse on our prevalence estimates was reduced by the use of poststratification weights to align our sample to the age, race, and education distribution of the Baltimore population. Generalization of our findings may be further limited by incomplete recruitment of subjects for urine testing, although imputation of the expected infection status of the survey respondents who did not provide a urine specimen indicates that the likely impact of urine nonresponse was ignorable.

Data from this first year of the MSSP confirm that *T. vaginalis* is highly prevalent among African American women. Vigorous public health interventions to reduce this prevalence are clearly warranted. MSSP or similar programs of repeated population surveys provide a mechanism for monitoring the impact of such interventions on the prevalence of untreated and largely asymptomatic infections that persist in the population.

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**TABLE 1. Estimated prevalence of *T. vaginalis* infections by race/ethnicity and gender: MSSP -- Year One**

| | | *T. vaginalis* | | |
|---|---|---|---|---|
| | | **%** | **95% CI** | ***N*** |
| Black | Female | 14.2 | (9.8, 18.7) | 348 |
| | Male | 3.5 | (0.4, 6.5) | 185 |
| Non-Black | Female | 3.1 | (0.1, 6.1) | 203 |
| | Male | 0 | na | 127 |
| *TOTAL* | | 6.2 | (4.4, 8.1) | 863 |

**Notes.** Estimates based on respondents who provided urine specimens for testing. Estimates are weighted to account for differing probabilities of selection and postratification adjustment to match 2007 ACS marginals for Baltimore, Md (see text). Base Ns are unweighted.

[a] Persons describing themselves as Hispanic are coded as Non-Black.

**TABLE 2. Estimated prevalence of *T. vaginalis* infections by sociodemographic charateristics: MSSP -- Year One**

| Subpopulation | *T. vaginalis* | | Base N (unweighted) | Raw PR | | | Adjusted PR | | |
|---|---|---|---|---|---|---|---|---|---|
| | % | 95% CI | | PR [a] | 95% CI | p | PR [a] | 95% CI | p |
| **ALL** | 6.2 | (4.4, 8.1) | 863 | | | | | | |
| **Gender** | | | | | | | | | |
| Female | 10.1 | (7.4, 13.6) | 533 | 5.1 | (2.0, 13.0) | 0.001 | 5.1 | (2.1, 12.4) | <.001 |
| Male | 2.0 | (0.8, 4.7) | 330 | referent | | | referent | | |
| **Race** [b] | | | | | | | | | |
| Black | 9.3 | (6.8, 12.6) | 330 | 6.1 | (2.2, 16.9) | <0.001 | 5.0 | (1.7, 14.7) | 0.003 |
| Non-Black | 1.5 | (0.6, 4.0) | 533 | referent | | | referent | | |
| **Age (years)** | | | | | | | | | |
| 15-17 | 3.8% | (1.4, 10.0) | 151 | 0.8 | (0.3, 2.5) | 0.7 | 0.3 | (0.1, 1.1) | 0.06 |
| 18-21 | 6.1% | (3.3, 11.1) | 157 | 1.3 | (0.5, 3.0) | 0.6 | 0.7 | (0.3, 1.7) | 0.4 |
| 22-29 | 8.4% | (5.3, 12.9) | 321 | 1.8 | (0.8, 3.7) | 0.13 | 1.2 | (0.6, 2.4) | 0.6 |
| 30-35 | 4.8% | (2.6, 8.5) | 234 | referent | | | referent | | |
| **Education** [d] | | | | | | | | | |
| <high school | 8.5% | (5.3, 13.5) | 255 | 2.8 | (1.4, 5.8) | 0.004 | 3.3 | (1.5, 7.4) | 0.003 |
| high school | 9.2% | (5.6, 14.9) | 208 | 3.1 | (1.5, 6.4) | 0.003 | 2.2 | (1.0, 4.5) | 0.04 |
| some college | 3.0% | (1.7, 5.1) | 396 | referent | | | referent | | |
| **Employed** | | | | | | | | | |
| full-time | 5.0% | (3.0, 8.3) | 403 | 0.6 | (0.3, 1.3) | 0.2 | 0.8 | (0.4, 1.6) | 0.5 |
| part-time | 6.5% | (3.6, 11.5) | 180 | 0.8 | (0.4, 1.7) | 0.6 | 0.9 | (0.4, 1.9) | 0.8 |
| Unemployed | 7.8% | (4.9, 12.3) | 279 | referent | | | referent | | |

***Notes:*** Estimates based on respondents who provided urine specimens for testing. Estimates are weighted to account for differing probabilities of selection and postratification adjustment to match 2007 ACS marginals for Baltimore, Md (see text). Base Ns are unweighted.

[a] Prevalence ratios (PR) calculated using individual poisson regression models to predict infection status. Adjusted PRs calculated from a single multivariable model including controls for all sociodemographic variables.

[b] Persons describing themselves as Hispanic are coded as Non-Black.

[d] Using the age groupings 15-24 and 25-35 as more commonly reported in surveillance statistics, TV prevalence was 6.8% (95% CI 4.5, 10.1) for 15 to 24 year olds and 5.6% (95% CI 3.7, 8.7) for 25 to 35 year olds.

[d] Highest grade completed.

**TABLE 3. Estimated prevalence of T*. vaginalis* and raw and adjusted prevalence ratios by behavioral and health outcomes: MSSP -- Year One**

| | | | RAW PR | | | ADJUSTED PR | | |
|---|---|---|---|---|---|---|---|---|
| **Characteristic** | **N** | **% Tv+** | **PR [a]** | **(95% CI)** | ***p*** | **PR [a]** | **(95% CI)** | ***p*** |
| ***Sexual Behaviors*** | | | | | | | | |
| Lifetime partners include both Males & Females [b] | | | | | | | | |
| Yes | 61 | 13.3% | 2.3 | (1.1, 5.0) | 0.03 | 1.6 | (0.8, 3.2) | 0.18 |
| No | 802 | 5.7% | | referent | | | referent | |
| Had 2+ partners last year [c] | | | | | | | | |
| Yes | 300 | 11.3% | 3.3 | (1.8, 6.1) | <0.001 | 2.6 | (1.4, 4.8) | 0.002 |
| No | 563 | 3.4% | | referent | | | referent | |
| Had a new partner past 3 months [d] | | | | | | | | |
| Yes | 173 | 10.6% | 2.1 | (1.1, 3.8) | 0.02 | 2.0 | (1.1, 3.6) | 0.03 |
| No | 679 | 5.2% | | referent | | | referent | |
| Don't know if partner had STI in past year [e] | | | | | | | | |
| Yes | 66 | 14.4% | 2.5 | (1.2, 5.3) | 0.02 | 2.2 | (1.1, 4.8) | 0.03 |
| No | 797 | 5.7% | | referent | | | referent | |
| Ever forced to have sex [f] | | | | | | | | |
| Yes | 110 | 15.1% | 2.9 | (1.6, 5.3) | 0.001 | 1.9 | (1.1, 3.4) | 0.03 |
| No | 750 | 5.2% | | referent | | | referent | |
| Respondent or partner ever incarcerated [g] | | | | | | | | |
| Yes | 295 | 10.4% | 2.5 | (1.4, 4.6) | 0.002 | 1.2 | (0.7, 2.3) | 0.47 |
| No | 562 | 4.1% | | referent | | | referent | |
| ***Health Outcomes*** | | | | | | | | |
| Previously had an STI [h] | | | | | | | | |
| yes | 215 | 13.7% | 3.4 | (1.9, 6.1) | <0.001 | 1.3 | (0.6, 2.6) | 0.47 |
| no | 647 | 4.0% | | referent | | | referent | |
| Previously had *T. vaginalis* [i] | | | | | | | | |
| yes | 90 | 20.6% | 4.3 | (2.3, 7.9) | <0.001 | 1.7 | (0.9, 3.4) | 0.11 |
| no | 772 | 4.8% | | referent | | | referent | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Current chlamydial infection | | | | | | | | |
| yes | 33 | 16.7% | 2.9 | (1.3, 6.8) | 0.013 | 2.2 | (0.97, 5.2) | 0.06 |
| no | 830 | 5.7% | | referent | | | referent | |
| Symptoms in past 3 mo | | | | | | | | |
| Yes | 109 | 13.1% | | **no Tv+ males reported symp past 3 mos | | | | |
| No | 754 | 5.3% | | | | | | |
| Doctor/clinic visit in past 3 mo | | | | | | | | |
| Yes | 498 | 8.2% | 2.1 | (1.1, 4.1) | 0.03 | 1.5 | (0.8, 2.7) | 0.21 |
| No | 362 | 3.9% | | referent | | | referent | |
| Antibiotic use in past mo | | | | | | | | |
| Yes | 117 | 11.1% | 2.0 | (1.0, 3.8) | 0.04 | 1.7 | (0.9, 3.1) | 0.1 |
| No | 744 | 5.6% | | referent | | | referent | |

***Notes:*** All estimates are weighted to account for complex survey design and differing probabilities of providing a urine specimen for STI testing (see text). Some Ns do not total to 863 because of missing data.

[a] Prevalence ratios (PR) calculated using poisson regression model. Adjusted PRs calculated from separate multivariable models controlling for each behavioral and health outcome, race/ethnicity, gender, age, and education.

[b] Referent group includes respondents who reported solely either male or female lifetime sexual partners. Respondents with no lifetime partners (n=105) recoded as 'no'; 4 respondents skipped the question on number of lifetime partners but included a response to gender. One respondent testing Tv+ reported no lifetime sexual partners.

[c] Referent group includes respondents reporting less than 2 partners in the past year. Respondents with no lifetime partners recoded to no partners last year. One respondent testing Tv+ reported no lifetime partners and another reported no sexual partners in the past year.

[d] Respondents reporting no lifetime partners (n=105) or no partners in the past year (n=55) recoded to no new partners in the past 3 months. 11 respondents had missing values.

[e] Referent group includes respondents who reported knowing whether or not their partner(s) in the past year had a STI. Respondents with no lifetime partners (n=105) and no partners in the past year (n=55) recoded as 'no'.

[f] Referent group includes respondents who reported never having sex with someone when they didn't want to. Respondents with no lifetime partners recoded as never having forced sex. 3 respondents had missing values.

[g] Respondents with no lifetime partners recoded as never having partners incarcerated. 3 respondents had missing values to both questions.

[h] Previous STI includes self-reported diagnoses of *C. trachomatis, N. gonorrhoeae,* and/or *T. vaginalis*

[i] Self-reported previous diagnois of *T. vaginalis* infection