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Mengyuan Shi Date

Examining the prevalence of extragenital STI testing in the past 12 months by demographic, clinical, and behavioral factors among young, black men who have sex with men—Atlanta, GA

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By

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MD, Xiangya School of Medicine, Central South University, 2018

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ABSTRACT

Examining the prevalence of extragenital STI testing in the past 12 months by demographic, clinical, and behavioral factors among young, black men who have sex with men—Atlanta, GA

By Mengyuan Shi

Background: STI screening, i.e., testing for STIs in the absence of any clinical signs or symptoms, is an important public health intervention to decrease STI transmission. Current CDC guidelines recommend MSM be screened for STIs such as syphilis, gonorrhea, chlamydia at least annually. There is remarkable heterogeneity in STI prevalence among MSM, particularly young, black MSM (YBMSM), according to geography, race, and HIV status. In this study, we determined the prevalence of any STI testing in the past 12 months, and to compare the prevalence of urogenital STI screening to any extragenital STI screening and associated factors in Atlanta.

Methods: Study participants were enrolled in the EleMENt study, a prospective, observational cohort study that enrolled YBMSM in Atlanta, Georgia (GA) from 2015 to 2019. In total, there were 464 participants in our cross-sectional sample. We calculated the prevalence of participants having had a STI testing (other than HIV), a urogenital STI test and an extragenital STI test in the past 12 months and described the association of prevalence with demographic and behavioral characteristics. We used multivariate log-binomial regression models to calculate prevalence ratios (PRs) and corresponding 95% confidence intervals.

Results: Among the 451 participants who ever had a STI or HIV test, 383 (84.9%) were tested in the past 12 months for either one and 300 (66.5%) had been tested for STI other than HIV. Among the 300 participants who tt, 274 (60.8%), 193 (42.8%), and 259 (57.4%) had a urogenital, extragenital, and serology-based syphilis test, respectively. The prevalence of getting STI testing among participants with less than high school education, were half of that among participants attending up to college, post graduate, professional school (crude prevalence ratio (cPR = 0.5). YBMSM with no healthcare access had half the prevalence of urogenital or extragenital testing compared to YBMSM with some form of healthcare access (cPR = 0.5). MSM having STIs symptoms had 20% higher probability of getting extragenital testing compared to asymptomatic YBMSM (cPR = 1.2).

Conclusion: In this large cohort of YBMSM, about two-thirds reported STI testing in the past 12 months. More efforts are needed to increase prevalence of STI testing among YBMSM, especially among men with lower educational attainment, men without healthcare coverage, and asymptomatic men.

Key Words: STI testing, urogenital testing, extragenital testing

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Introduction

Sexually Transmitted Infections in the United States

Sexually transmitted infections (STIs) are a significant cause of morbidity and mortality in the United States. In 2017, there were over 100 million cases of STIs in the United States with almost 20 million new cases occurring annually [1]. In the United States, the four nationally notifiable STIs are chlamydia, gonorrhea, syphilis, and chancroid. Other common STIs occurring worldwide include human papillomavirus and herpes simplex virus [1].

Chlamydia, caused by infection with *Chlamydia trachomatis* (CT), is the most common reportable STI in the United States, with 1,758,668 chlamydial infections reported in 2017 and 16.9% attributed to Gay, bisexual, and other men who have sex with men, hereafter referred to as MSM [1]. Gonorrhea, an STI caused by infection with *Neisseria gonorrhoeae* (NG) can lead to similar complications as chlamydia, including pelvic inflammatory diseases, arthritis, meningitis, bacteremia, endocarditis, orchitis, ectopic pregnancy and infertility [2]. In 2018, there were 583,405 cases of gonorrhea reported in the United States and 42.4% were attributed to MSM. In addition to the complications resulting from an untreated gonococcal infection, NG has progressively developed resistance to the antibiotics used to treat it, such as fluoroquinolones, macrolides and cephalosporins [3]. In consideration of persistently high gonorrhea morbidity and decreased antimicrobial susceptibility, a better understanding of the epidemiological trends of gonorrhea is needed. Syphilis is caused by infection with the bacterium *Treponema pallidum*. In 2018, 35,063 cases of primary and secondary (P&S) syphilis, the most contagious stages of syphilis, were reported in the United States Early symptomatic syphilis cases are diagnosed based on both positive nontreponemal and specific treponemal tests with at least one clinical sign or symptom (primary: painless chancre; secondary: painless inguinal lymphadenopathy, syphilitic roseola, papular

syphilide or condyloma lata) [4]. Early diagnosis of P&S syphilis cases followed by immediate treatment is critical to prevent the transmission and development of new cases. Gay, bisexual, and other men who have sex with men, hereafter referred to as MSM, represent the greatest proportion (48%) of P&S syphilis cases in the United States [1]. All four of these nationally notifiable STIs (chlamydia, gonorrhea, syphilis, and chancroid) have been shown to facilitate human immunodeficiency virus (HIV) transmission.

STI screening and testing

STI screening, i.e., testing for STIs in the absence of any clinical signs or symptoms, is an important public health intervention to decrease STI transmission. STI screening recommendations by the United States Preventative Services Task Force (USPSTF) and the Centers for Diseases Control and Prevention (CDC) outline populations to be targeted for STI screening as well as the recommended screening frequency. Increased syphilis screening in MSM demonstrated a doubling of early syphilis detection, however, the majority of syphilis diagnoses (71%) still occur once patients seek medical care for STI-related symptoms [5]. STIs at extragenital sites, such as the rectum or throat, are often asymptomatic and tend to only be detected through STI screening [6]. HIV-infected MSM are more likely to be diagnosed with an extragenital STI compared to HIV-uninfected MSM [7], further underscoring the importance of screening for extragenital STIs among MSM. Despite this, in general, a lower proportion of MSM are tested for rectal or pharyngeal infections compared to urogenital infections [8]. In public health practice, genital STI testing is more common than extragenital (EG) testing [9]. Genital STI testing can either be urine-based or through the collection of a urethral swab, while EG testing is performed using either a provider-collected or self-collected rectal and/or oropharyngeal swab [10]. Specimens are analyzed through nuclei acid amplification tests (NAATs), the approach currently recommended by CDC for the detection of urethral, vaginal/cervical, rectal and pharyngeal STIs. The validity of NAATs has been well established, with 96.1% sensitivity, 97.7% specificity, 76.6% positive predictive value and a 99.7%

negative predictive value [4]. Recently, the Food and Drug Administration approved the Aptima Combo 2 Assay and the Xpert CT/NG tests for use with extragenital specimens. These are the first devices that have been cleared as safe and effective for testing for STIs at the throat or the rectum, knocking down a barrier to EG screening in public health [11]. EG sites are also thought to serve as hidden reservoirs contributing to the ongoing transmission of STIs.

Current CDC guidelines recommend that MSM be screened for STIs such as syphilis, gonorrhea, chlamydia at least annually, with increased screening for MSM at high risk (reporting any condomless sex or multiple sex partners). Furthermore, MSM should be screened at least annually at all sites of sexual contact regardless of condom use, including EG sites such as the rectum and throat [12]. Therefore, MSM who report engaging in receptive anal sex should be screened for STIs at rectal sites and MSM reporting receptive oral sex should be screened at pharyngeal sites. However, since most STIs in MSM are missed through genital-only screening [13], health care providers should take a comprehensive sexual history, specifically assessing the number of sex partners and sexual behaviors, previous STI testing and diagnosis, and access to health care, with patients guiding STI screening.

STIs/HIV among MSM

There is remarkable heterogeneity in STI prevalence among MSM according to geography, race, and HIV status. MSM, particularly young, black MSM (YBMSM), disproportionately suffer from high incidence [14, 15] and prevalence [16, 17] of HIV. Gaining a better understanding of subpopulations most affected by HIV/STIs helps to target HIV prevention interventions. MSM account for more than two-thirds of new HIV infections in the United States, with YBMSM experiencing the greatest burden [18]. MSM are disproportionately burdened by syphilis in the United States, with a higher incidence of P&S syphilis compared to women and men who have sex with women only [19]. MSM represented about 2% of the US population [20], but accounted for 68.2% of all reported P&S syphilis cases in the United States in

2017; 45.5% of cases were among men living with HIV [21]. According to state-level surveillance data in the United States, black MSM have the highest rates of HIV and syphilis and the largest disparities compared with white MSM [22]. There were greater disparities of either new or prevalent HIV diagnosis rates among black and white MSM in the southern United States, such as Georgia, compared with other parts of the United States. Disparity was overall attenuated for P&S syphilis although the prevalence of P&S syphilis was still more pronounced in the southern United States [23]. Consequently, between state variations suggested that states should tailor and focus their prevention responses to best address state-level data. Another study that used data from the American Community Survey to calculate population sizes for MSM by race suggested that black MSM had consistently and markedly higher rates of both syphilis and HIV when compared to white MSM, with the highest impacted states located in the southern United States [24]. In general, P&S syphilis, urogenital gonorrhea, and urogenital chlamydia are more prevalent among MSM living with diagnosed HIV infection than among HIV-negative MSM.

In the natural history of gonococcal infection, there were higher infection rates at EG sites compared with urogenital sites in MSM and a higher presence of ciprofloxacin-resistance Neisseria gonorrhoeae in at least one anatomical site in men compared with women, highlighting the significance of testing for antimicrobial resistance at extragenital sites among MSM [25]. A previous study demonstrated that the prompt testing of NG-positive samples using real-time PCR would enable the ciprofloxacin status to be provided on the patient's return, aiding clinical management [26]. Given that EG STIs may be missed through urogenital-only screening and are thought to serve as reservoirs of infection contributing to the development of antimicrobial resistance, it is important to screen MSM at all exposed anatomic sites.

We used data from an observational cohort study of young black MSM in Atlanta to determine the prevalence of any STI testing in the past 12 months, and to compare the prevalence of urogenital-only STI screening to any extragenital STI screening and associated factors.

Methods

Study population and study design

Study participants for this analysis were enrolled in the EleMENt study. EleMENt was a prospective, observational cohort study that enrolled young black men who have sex with men (YBMSM) in Atlanta, Georgia (GA) from 2015 to 2017. EleMENt aimed to better understand patterns of substance use and HIV/sexually transmitted infections (STIs) [27]. Detailed recruitment and enrollment methods have been previously published [28, 29]. Briefly, this study was initiated in July 2015 with follow-up through February 2019. MSM were recruited via venue-day-time-space sampling and advertisements posted on Facebook, Grindr, and the Metropolitan Atlanta Rapid Transit Authority (MARTA).

In total, there were 476 participants recruited at baseline, comprising 300 HIV-negative MSM and 176 HIV-positive MSM. The baseline population was analyzed as a cross-sectional study. This secondary analysis was restricted to baseline participant data to explore the multi-level factors associated with STI testing in the 12 months before the baseline survey. Eligibility criteria for participation in EleMENt included male sex at birth, currently identifying as male, age ≥ 18 years and < 30 years, having had anal sex with a man in their lifetime, having had any sex with a man in the past 3 months, self-reported black/African American race, living in the Atlanta area and planning to remain for the next 2 years, able to complete the survey instruments in English, willing to provide at least 2 means of contact, willing to be re-contacted for the return of HIV/STI testing results, and not currently enrolled in an HIV prevention trial. Participants who self-reported multiple or non-black/African American race(s) or self-reported Hispanic ethnicity were excluded from the study. Two flowcharts of study exclusions are depicted in Figure 1a and Figure 1b. Study procedures and data collection occurred in several locations in Atlanta, arranged at the convenience of the participants, and included: Emory University Rollins School of Public

Health, Emory University Grady Infectious Disease Clinic (Ponce Clinic), AID Atlanta, Southside Medical Center, and SisterLove.

The Emory University Institutional Review Board reviewed and approved the primary study. The study protocol is sponsored by National Institutes of Health/National Institute on Drug Abuse, and all participants provided signed informed consent.

Demographics, STI symptoms and sexual risk variables

Participants were administered a baseline questionnaire that collected data on demographic, income, insurance status, attitude, condom use habits, prior HIV testing, and past sexual (see Appendix for relevant questions). Participants ranged from 18 to 29 years of age. Age was initially analyzed as a continuous variable; based on inspection of estimated logit plots, it was transformed to a three-level categorical variable (18-23 years, 24-25 years and 26-29 years). STI symptoms were documented by participants self-reported or the presence of one or more of the following symptoms: rectal bleeding, painful bowel movements, a burning sensation when urinating, white/yellow/green pus discharge from the rectum, sores on genitals, anus, rectum, anal itching, sores in mouth or on lips, pain and swelling in one or both testicles, and rectal pain/soreness [30]. Listed STI symptoms could either have been recent or present for some time. Discharge from penis was excluded from the filtering criterion of any STI symptoms due to a coding error in the original dataset. Employment status was divided into four groups, full-time, part-time, student and unemployed [31]. Participants who self-defined employment as full-time, on active duty in US Armed Forces, Reserves, or National Guard, or others were considered to be full-time employees. Part-time employees and part-time students were considered to be part-time employees. Full-time students were classified as students and participants who answered that they were unemployed or unable to work for health reasons were classified as unemployed. For the most recent visit with a doctor or a nurse in the past 12 months, participants who got medical care from a

primary care physician, service organization (AID Atlanta, Pride Medical, etc.), student health services, county health department or others were defined as having some form of access to health care. Otherwise, participants were defined by having used a healthcare facility and classified as either having gotten health care through emergency room access or as having no access to healthcare [32]. Based on the household income in the past 12 months from all source before taxes, according to the poverty line of Georgia, household income was classified into 0 to $1,667 (monthly)/0 to $19,999 (yearly), $1,668 to $4,167 (monthly)/$20,000 to $49,999 (yearly), and $4,168 or more (month)/$50,000 (yearly). The number of partners with anal or oral sex were limited to partners within the past 6 months and were divided into 3 groups, 1-2, 3-9, and ≥ 10 partners [33]. The cut-points selection were generated and further evaluated by plotting estimated logits. Participants who had anal sex, not fully protected by a condom at least once in the past 6 months were classified as having condomless anal sex (CAS) [31]. Sexual orientation was categorized as heterosexual or straight, homosexual or gay, bisexual, and other (fluid, pansexual, same gender loving, myself, two spirited, polysexual, androgynous male, normal, open, homoflexible, and free energy). The highest level in school that participants completed was defined as their education level, including college, post graduate, or professional school, some college, associate's degree, and/or technical school, high school or GED, and did not finish high school [29]. Awareness of HIV, defined as unaware and aware [34], was only asked of HIV-positive participants at baseline, and HIV status, defined as positive and negative, was confirmed among HIV-positive and HIV-negative participants. Participants with at least one female partner in the past 6 six months were classified as having a history of female sex partners [35]. Participants were also asked whether they had changed residence in the past 6 months [36].

STI Testing

STI testing is the analysis that refers to self-reported urogenital, extragenital tests for gonorrhea and chlamydia, and serology-based tests for syphilis. As part of study procedures, an FDA-approved HIV

rapid test (INSTI, Biolytical Laboratories, Richmond Canada) was used for HIV screening at the baseline visit [37], even for those who reported a previous HIV diagnosis. All HIV preliminary positive results were confirmed with Western blot, CD4, and HIV viral load testing [38-40]. All participants who screened negative on the INSTI test received qualitative HIV nucleic-acid amplification testing (NAAT), to rule out an acute HIV infection [41].

Statistical Analysis

In total, there were 464 participants in our cross-sectional sample. Participants were classified as reporting STI testing in the past 12 months before baseline interview (Table 1). All participants were further categorized into four groups based on the STI testing approach: have urogenital testing regardless of whether they also underwent extragenital testing, do not have urogenital testing regardless of whether they also underwent extragenital testing, have extragenital STI testing regardless of whether they also underwent urogenital testing, and do not have extragenital STI testing regardless of whether they also underwent urogenital testing (Table 2). Limiting to HIV-negative participants at baseline, they were categorized into four categories following the same previous criteria (Table 3).

We calculated the prevalence of participants having had a urogenital STI test and an extragenital STI test in the past 12 months and described the variation in the prevalence by demographic and behavioral characteristics. To further assess the association between demographic, clinical, and behavioral factors and the prevalence of STI testing, multivariate log-binomial regression models were used to calculate the prevalence ratios (PRs) and corresponding 95% confidence intervals (95% CI). Both crude and adjusted models were used to describe associations with each exposure. Confounder selection in adjusted models followed a standardized process. When exploring the prevalence of STI testing in the past 12 months (other than HIV testing), we determined collinearity between variables by evaluating values of tolerance, variance inflation, eigenvalue and condition index. The variables HIV testing history

and participants' awareness of their HIV status were collinear indicated by a close association of tolerance, variance inflation, eigenvalue and condition index and subsequently excluded following confounder selection. Furthermore, other variables were no longer considered as possible confounders because they were not associated with the outcome, of but the five variables (education level, having female sex partners in the past 6 months, healthcare access, number of sex partners in the past 6 months and baseline HIV status) were retained for subsequent confounder selection. Finally, only four variables (education level, having female sex partners in the past 6 months, healthcare access, number of sex partners in the past 6 months) were considered as confounders based on the same results from three different approaches (forward selection, backward selection and stepwise selection) for confounder selection. These four listed variables were retained in the final log-binomial analysis model; there was no significant interaction among them. Covariates including access to health care, number of sex partners in the past 6 months and any female partners in the past 6 months were included in the analysis of factors associated with urogenital STI tests. For the analysis of factors associated with extragenital STI tests in the past 12 months, access to health care and the number of sex partners in the past 6 months were considered as covariates. Analyses were run with three binary outcomes: (1) any (urogenital, extragenital, serological) STI testing; (2) urogenital STI testing (regardless of extragenital testing); (3) extragenital STI testing (regardless of urogenital testing). Collinearity checks, crude variable selection, confounders selection and interaction validation were used in the analysis, using PROC FREQ, PROC GPLOT, PROC LOGISTIC, PROC CORR, and PROC REG in SAS (version 9.4; SAS Institute, Cary, North Carolina). Multivariable log-binominal analysis was done using PROC GENMOD also in SAS (version 9.4; SAS Institute, Cary, North Carolina).

Using participant zip code obtained from the baseline questionnaire, geographic maps were drawn to spatially reflect the number of participants with/without any STI testing, other than HIV, in the past 12

months based on the approximate residence of the participant. All maps were generated using GIS (geographic information system) (ArcMap 10.7.1).

Result

Study Population

At baseline, a total of 464 were eligible to participant in this study and provided written consent (Figure 1a and Figure 1b). Among the 451 participants who had ever had a STI or HIV test, 383 (84.9%) were tested for STI or HIV in the past 12 months and 300 (66.5%) had been tested for STI other than HIV. For participants who had been tested for a STI other than HIV in the past 12 months, 274 (60.8%), 193 (42.8%), and 259 (57.4%) had a urogenital, extragenital, and serology-based syphilis STI test, respectively. Limiting to participants that tested HIV-negative at baseline, 164 (36.4%), 114 (25.3%), and 149 (33.0%) had urogenital, extragenital, and serology-based syphilis STI test in the past 12 months, respectively.

Urogenital, extragenital and serology-based syphilis tests for STIs were reported by participants in several combinations. Specifically, 163 (52.8%) reported having all three test types, and 67% (21.7%) reported having both urogenital and syphilis tests (Figure 2); 17 (5.5%) and 7 (2.3%) participants reported urogenital and extragenital tests, and extragenital and syphilis tests, respectively. The number of participants who reported only a urogenital, extragenital, or syphilis test were 27 (8.7%), 6(1.9%), and 22 (7.1%), respectively.

Demographic, Clinical, and Behavioral Characteristics at Baseline

At baseline, a total of 464 study participants met the inclusion criteria. Of these, the mean age was 25 years old (standard deviation (SD)), 3.0) and the mean age difference with partners was 5.2 years (SD 2.7). Overall, nearly 80% participants did not report any STI symptoms at baseline and the number of sex partners of EleMENt participants in the past 6 months ranged from 1 to 187. Overall, most participants had partners of the same race/ethnicity as themselves (80.3%), had both main and casual partners

(50.1%), had current health insurance (56.6%) and some form of healthcare access (75.3%), were employed full-time (60.1%), had a HIV test in the past 12 months (59.3%), had CAS in the past 12 months (82.0%), and had more than high school education (97.4%) (Table 1), while a minority of participants reported monthly income ≥ $4,168, having female sex partners in the past 6 months (5.4%), and having ever used PrEP (6.7%) (Table 1).

Stratified by Any STI Testing in the Past 12 months (other than HIV testing)

Demographic, clinical, and behavioral characteristics at baseline were stratified by whether participants had any STI testing in the past 12 months (regardless of HIV testing) (Table 1). Lower level of education was associated with lower probability of having STI testing in the past 12 months, other than HIV testing. Specifically, the prevalence of getting STI testing, other than HIV testing, among participants with less than high school education, were half of that among participants attending up to college, post graduate, professional school (crude prevalence ratio (cPR) = 0.5). A lack of healthcare access was also associated with approximately half the prevalence of having STI testing, compared to participants with some form of access (primary care, service organization, student health services, county health department, other physician's and others). An increased cumulative number of sex partners was closely associated with an increased prevalence of having STI testing other than HIV testing (3-9 partners: cPR = 1.2; ≥ 10 partners: cPR = 1.4). YBMSM were 67% more likely to report recent STI testing (regardless of HIV testing) compared to young black men having sex with both men and women (cPR = 0.6). Because HIV-positive MSM have higher rates of STI diagnoses than HIV-negative MSM [42], both EleMENt participants who tested for HIV in the past 12 months and HIV-positive participants at baseline had 1.2 times the probability of getting other STI testing (cPR = 1.2). Additionally, MSM having STIs symptoms, having only casual sex partners, or ever having used PrEP had slightly higher probability of getting STI testing (excluding HIV testing) in the past 12 months.

Demographic, clinical, and behavioral characteristics stratified by urogenital & extragenital STI testing

Demographic, clinical, and behavioral characteristics of YBMSM were classified according to whether the participants had urogenital/extragenital testing in the past 12 months (Table 2). Overall, 59.4% of participants had a urogenital STI test and 41.9% had an extragenital STI test in the past 12 months (Figure 2). YBMSM with no healthcare access or having sex with both men and women had half the prevalence of urogenital or extragenital testing compared to YBMSM with some form of healthcare access and YBMSM only having sex with men, respectively. An increased number of sex partners was associated with a clear increased trend of having either a urogenital (UG) or an extragenital testing (EG) (3-9 partners: cPR: UG: 1.2; EG: 1.3; ≥ 10 partners: cPR: UG: 1.5; EG: 1.6) compared to those with < 3 partners. However, there was no association of education level with the probability of having either a urogenital or extragenital testing. The prevalence of reporting either a urogenital or extragenital testing in the past 12 months was higher among HIV-positive MSM (cPR: UG: 1.3; EG: 1.3) compared to HIV-negative MSM, MSM who were aware of their HIV status (cPR: UG: 1.6; EG: 1.3) compared to those unaware, MSM who reported having CAS in the past 6 months (cPR: UG: 1.2; EG: 1.4) compared to those who did not report CAS, and men who reported ever having used PrEP (cPR: UG: 1.2; EG: 1.4) compared to those who never used PrEP. YBMSM who only had main sex partners were 20% less likely to report either a urogenital or extragenital testing compared to YBMSM who had both main and casual sex partners. The prevalence of extragenital testing was 1.3 times higher among unemployed YBMSM, compared to full-time employed YBMSM.

STI testing stratified by urogenital & extragenital testing among baseline HIV-negative participants

The prevalence of urogenital or extragenital STI testing in the past 12 months overall and by demographic, clinical, and behavioral characteristics are summarized among HIV-negative YBMSM in Table 3. Among HIV-negative participants, 55.4% were tested for a urogenital STI and 38.5% were tested for an extragenital STI in the past 12 months. HIV-negative MSM at baseline who reported a lack of healthcare access (cPR: UG: 1.5; EG: 0.5), had sex with both men and women (compared to YBMSM who only have sex with men, cPR: UG: 0.6; EG: 0.5), who did not report CAS (cPR: UG: 0.8; EG: 0.8) or who never used PrEP (cPR: UG: 0.7; EG: 0.7) had at least a 30% decreased prevalence of getting either a urogenital or extragenital testing. Lower educational attainment and an increased number of sex partners in the past 6 months were associated with an increased prevalence of reporting either a urogenital or extragenital testing (some college, associate's degree, technical school: cPR: UG: 0.8; EG: 0.7; high school of GED: cPR: UG: 0.8; EG: 0.7; less than high school: cPR: UG: 0.4; EG: 0.6) (3-9 partners: cPR: UG: 1.2; EG: 1.2; ≥ 10 partners: cPR: UG: 1.6; EG: 1.5). Unemployed HIV-negative YBMSM were 1.4 times more likely to report being tested at extragenital sites, compared to full-time employed YBMSM.

Geographical distribution

As shown in Figure 3, all five study sites enrolled roughly an equal number of participants, more than the number of participants enrolled from surrounding areas. The spatial distribution of STI testing (regardless of HIV) in the past 12 months was roughly superimposed onto the spatial distribution of where all participants were enrolled in. Specifically, most participants who got STI testing (regardless of HIV testing) in the past 12 months aggregated close to AID Atlanta, followed by individuals living near to SisterLove and Emory University Rollins School of Public Health (Figure 4). Participants without STI

testing in the past 12 months (regardless of HIV testing) mainly came from SisterLove, AID Atlanta, and Emory University Grady Infectious Disease Clinic.

Discussion

The overall prevalence of the four nationally notifiable STIs in the United States, chlamydia, gonorrhea, syphilis, and chancroid, have continued to increase since 2013 [1]. This cross-sectional study assessed how socio-behavioral factors are related to the prevalence of STI testing among YBMSM in Atlanta, GA. Although there are several factors known to be associated with STI testing, we will focus on three modifiable and actionable characteristics in detail: educational level, access to healthcare, and STIs symptoms. Our results highlight how these factors were associated with the prevalence of reporting urogenital or extragenital STI testing among YBMSM.

First, high school or lower educational level was associated with a lower prevalence any STI testing in the past 12 months. The association of lower education might be confounded with lower access to healthcare, or could be explained by lower awareness of the importance of safe intercourse, or lack of knowledge of recommendations of routine STI testing. This association persisted and was stronger for outcomes of urogenital or extragenital STI tests among HIV-negative men. However, educational level was not associated with the prevalence of having a urogenital or extragenital STI test among the total population of MSM (HIV-positive and HIV-negative participants at baseline). The results were in line with three web-based surveys in Brazil from 2016 to 2018 [43], calling attention to general education and sexual education via mobile applications and social media for STI prevention and treatment. Another feasibility study of the Easy Test model conducted in 14 Chinese provinces also reported that MSM with more than 12 years of education had a higher likelihood of receiving a HIV test [44]. Therefore, low educational level should be considered as a marker of lower prevalence of reporting any STI testing, and consideration should be given to increased offering of STI testing for YBMSM with lower educational levels and for increasing educational efforts to promote more routine STI testing.

Second, YBMSM without access to health care were more likely to report not having any STI testing, any urogenital testing, and any extragenital testing. These associations were not explained by confounding with related socio-behavioral factors. Our results are consistent with the conclusion from Australia's universal healthcare system [45] that inequitable access influences use of HIV prevention. This Australian study found out that improving in return HIV testing among Medicare eligible clients did not affect individuals out the range of Medicare. Medicaid expansion is needed in Georgia to support the health of YBMSM, including as a strategy to increase the accessibility of STI testing overall, and of urogenital testing and extragenital testing. However, another Rhode Island study pointed out that barriers still existed among insured individuals because of anonymity and out-of-pocket costs even for people who had health insurance [46], emphasizing that more efforts from public and private insurers are needed to address financial barriers and reduce barriers to care.

Third, YBMSM who experienced any STIs symptoms were more likely to report STI testing, both urogenital and extragenital. Most STIs in men have no symptoms or only mild symptoms, and the WHO recommends that MSM should be tested for STIs at least annually regardless of symptoms [1]. In our study, over 60% of participants had been tested for STIs in the past year and over 90% of participants had been tested for either STIs or HIV. Our data indicate that YBMSM in our study did not adhere to CDC recommendations for syphilis, gonorrhea, chlamydia testing at least annually for MSM. Specifically, there were 40% of participants who had not had a urogenital test, and 60% of participants who had not had an extragenital test in the past 12 months. The prevalence of reporting a urogenital or extragenital STI test was lower among HIV-negative participants, especially for extragenital tests. This might be because men in care for HIV infection are very likely to be tested for STIs as part of their HIV care. A previous behavioral surveillance study further pointed out that it was not reliable to use self-reported symptoms as screening indicators, but prevention activities should focus on symptoms recognition instead of symptoms reporting by patients [47], which is compatible with our advocation that providers

should take a detailed sexual history (including sexual behaviors and STI symptoms), rather than relying on patients reporting STI symptoms. Routine STI screening should be strongly recommended for high-risk populations, including YBMSM, to identify and treat STIs in the early stages of infection and to prevent long-term sequelae and to reduce risks of HIV acquisition.

We noted several limitations of this study. First, we might have selection bias in our study because data were only collected from men who agreed to participate in a longitudinal research study of MSM. The results not be generalizable to other parts of the United States. Several studies have shown a significant association of residential location with the likelihood of receiving STI testing [36] [48]. Second, there may be a number of potential confounders for which we did not have any data and could not adjust for in our analysis. Finally, although our confounders were identified by both statistical results and conceptual processes, it is possible that there was residual confounding in our analysis. Third, only prevalence estimates were appropriate to calculate and interpret due to the limitations of cross-sectional analysis of baseline data, and we therefore could not estimate the incidence of STI testing in this population.

Conclusion

Our analysis of a large community-recruited study of YBMSM provided evidence that there are several socio-behavioral factors associated with STI testing, including urogenital and extragenital testing. Educational attainment, access to healthcare and the presence of STIs symptoms were the three most modifiable and actionable factors associated with STI testing. These insights could help identify YBMSM with a decreased likelihood of getting STI testing, provides evidence to call for the expansion of healthcare coverage, and emphasizes the need for routine STI screening among YBMSM.

Acknowledgement

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Figure

Figure 1a. Flow diagram of young black men who have sex with men and their self-reported STI testing patterns, EleMENt cohort, Atlanta, GA, 2015-2019

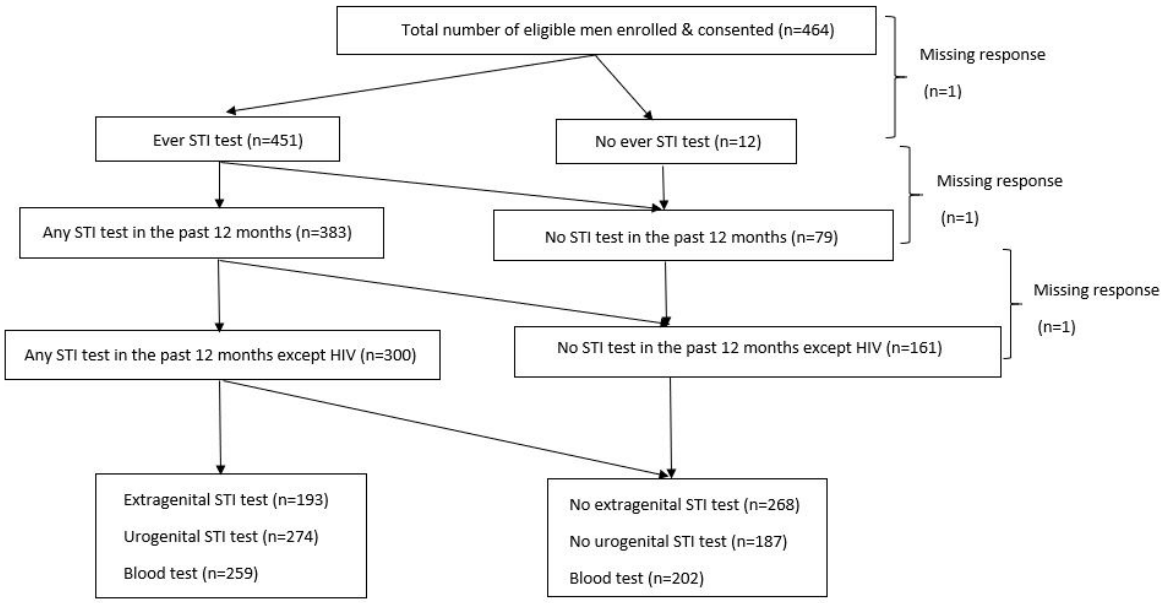


Figure 1b. Flow diagram of young black men who have sex with men and their self-reported STI testing patterns, EleMENt cohort, Atlanta, GA, 2015-2019

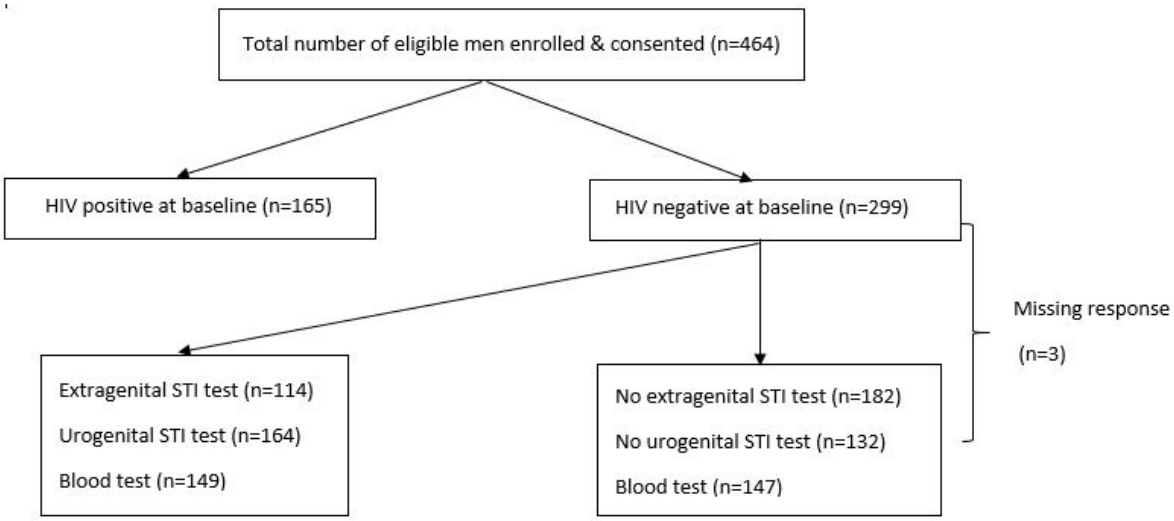


Figure 2. Venne diagram illustrating the number of participants getting urogenital, extragenital and blood test, in young black men who have sex with men, EleMENt cohort, Atlanta, GA, 2015-2019

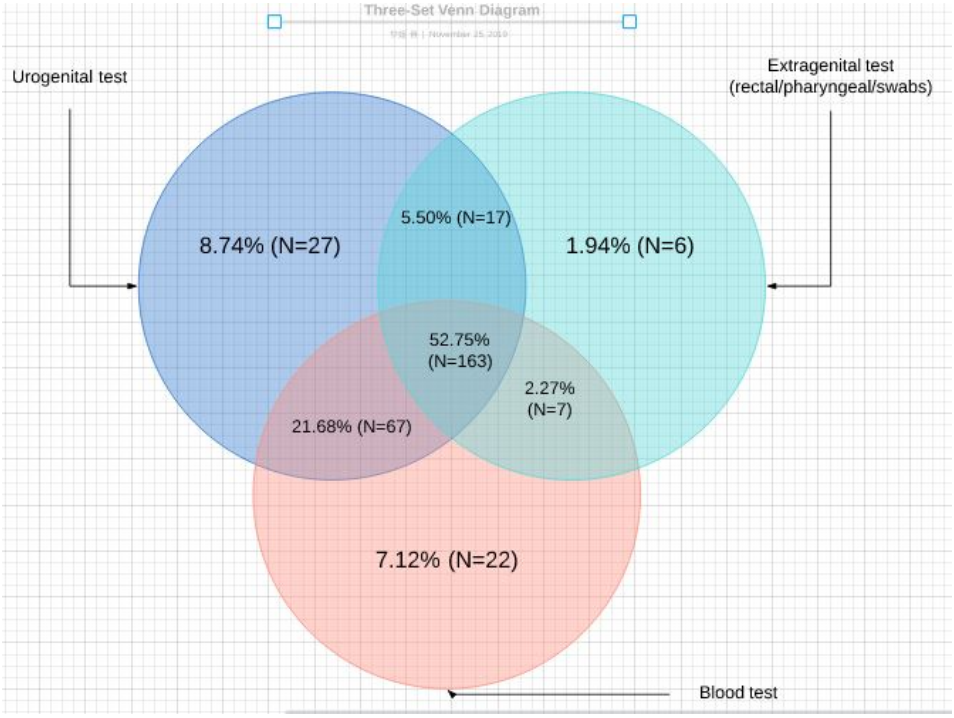


Figure 3. Spatial distribution of the sources of EleMENt participants, in young black men who have sex with men, Atlanta, GA, 2015-2019

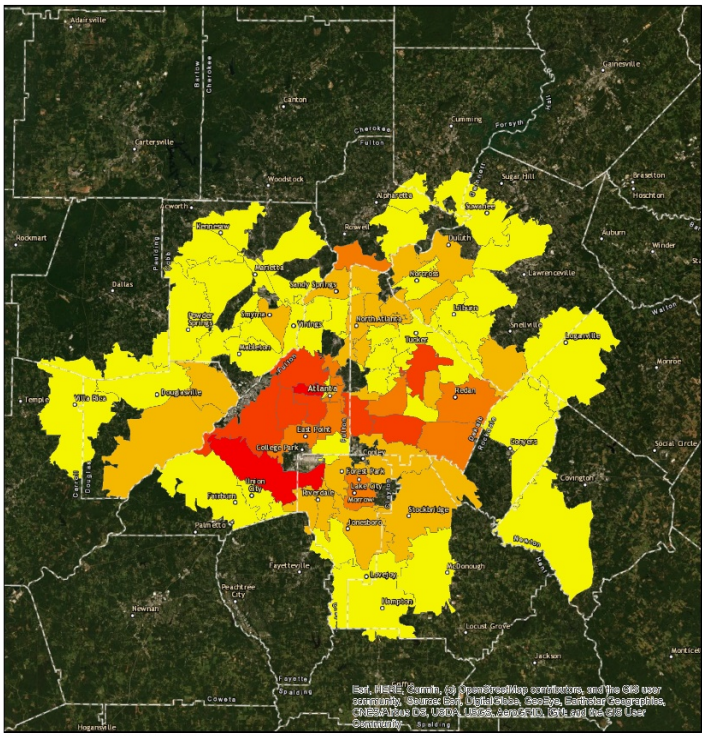


Figure 4a. Spatial distribution of EleMENt participants who did not have STI testing (regardless of HIV testing) in the past 12 months, in young black men who have sex with men, Atlanta, GA, 2015-2019

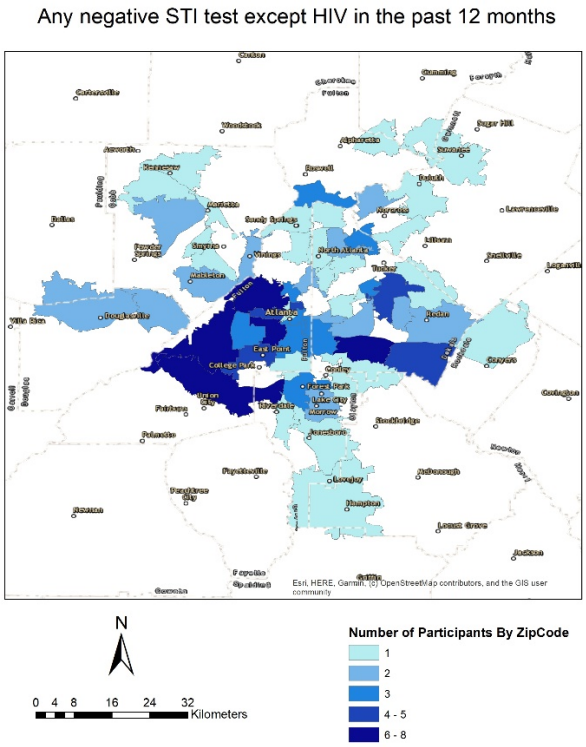
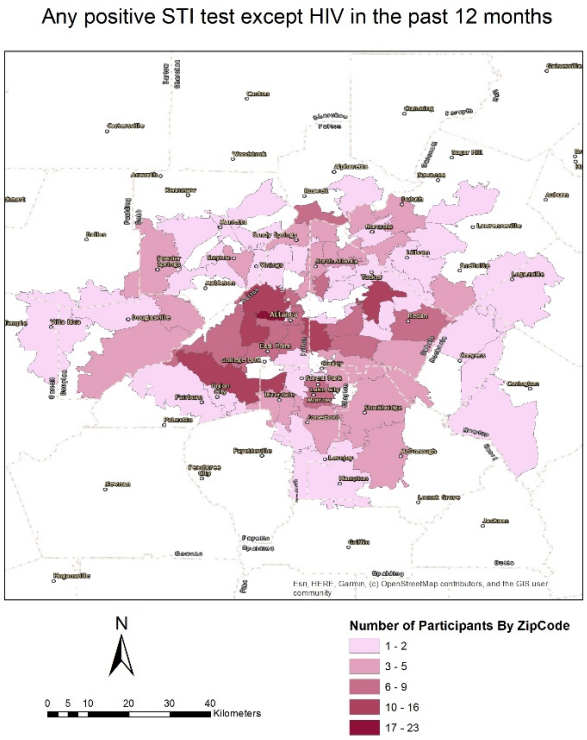


Figure 4b. Spatial distribution of EleMENt participants who had STI testing (regardless of HIV testing) in the past 12 months, in young black men who have sex with men, Atlanta, GA, 2015-2019



Table

Table 1. Demographic, clinical and behavioral characteristics of EleMENt participants at baseline, in young black men who have sex with men, Atlanta, GA, 2015-2019

	Overall, n (col%)	Any STIs test except HIV, n (row%)	None STIs test except HIV, n (row%)	Crude PR (95% CI)	Adjusted PR (95% CI)
Total	464	300 (65.1)	161 (34.9)		
Age (mean, SD)	24.88 (2.97)	24.92 (3.03)	24.82 (2.90)		
Age (years), %					
18-23	143 (30.8)	91 (63.6)	52 (36.4)	Reference	Reference
24-25	107 (23.1)	71 (67.6)	34 (32.4)	1.1 (0.9-1.3)	1.0 (0.9-1.2)
26-29	214 (46.1)	138 (64.8)	75 (35.2)	1.0 (0.9-1.2)	1.0 (0.9-1.1)
Partner age difference (mean, SD)	5.21 (2.72)	5.00 (2.71)	5.90 (2.73)		
STIs symptoms, %					
No	359 (79.4)	229 (64.0)	129 (36.0)	Reference	Reference
Yes	93 (20.6)	64 (68.8)	29 (31.2)	1.1 (0.9-1.3)	1.1 (1.0-1.3)
Relationship type, %					
Main and causal	225 (50.1)	157 (69.8)	68 (30.2)	Reference	Reference
Main no causal	80 (17.8)	46 (57.5)	34 (42.5)	0.8 (0.7-1.0)	0.9 (0.7-1.2)
Causal no main	144 (32.1)	88 (61.1)	56 (38.9)	0.9 (0.8-1.0)	0.9 (0.8-1.0)
Education level, %					
College, post graduate, professional school	142 (30.7)	104 (73.2)	38 (26.8)	Reference	Reference
Some college, associate's degree, techincal school	192 (41.5)	123 (64.7)	67 (35.3)	0.9 (0.8-1.1)	1.0 (0.8-1.1)
High school of GED	117 (25.3)	69 (59.5)	47 (40.5)	0.8 (0.7-1.0)	0.9 (0.7-1.0)
Less than high school	12 (2.6)	4 (33.3)	8 (66.7)	0.5 (0.2-1.0)	0.5 (0.2-1.2)
Current health insurance, %					
No	201 (43.4)	132 (66.3)	67 (33.7)	Reference	Reference
Yes	262 (56.6)	168 (64.1)	94 (35.9)	1.0 (0.9-1.1)	0.9 (0.8-1.0)
Access to health care, %					
Some form of access***	347 (75.3)	246 (70.9)	101 (29.1)	Reference	Reference
Emergency room	19 (4.1)	13 (68.4)	6 (31.6)	1.0 (0.7-1.3)	1.0 (0.7-1.4)
No access	95 (20.2)	40 (42.6)	54 (57.5)	0.6 (0.5-0.8)	0.6 (0.5-0.8)
Employment status, %					
Full-time	279 (60.1)	180 (64.8)	98 (35.3)	Reference	Reference
Part-time	103 (22.2)	67 (65.7)	35 (34.3)	1.0 (0.9-1.2)	1.1 (1.0-1.3)
Student	28 (6.0)	18 (64.3)	10 (35.7)	1.0 (0.7-1.3)	1.0 (0.8-1.3)
Unemployed	54 (11.6)	35 (66.0)	18 (34.0)	1.0 (0.8-1.3)	1.0 (0.8-1.3)
Income, %					
0 to $1667 (monthly) / 0 to $19,999 (yearly)	199 (46.2)	130 (65.7)	68 (34.3)	Reference	Reference
$1668 to $4167 (monthly) / $20,000 to $49,999 (yearly)	187 (43.4)	125 (66.8)	62 (33.2)	1.0 (0.9-1.2)	1.0 (0.8-1.1)
$4168 or more (monthly) / $50,000 or more (yearly)	45 (10.4)	28 (62.2)	17 (37.8)	1.0 (0.7-1.2)	0.9 (0.7-1.1)
Moved in the past 6 months, %					
No	310 (67.0)	201 (64.8)	109 (35.2)	Reference	Reference
Yes	153 (33.1)	99 (65.6)	52 (34.4)	1.0 (0.9-1.2)	1.0 (0.9-1.1)
Number of sex partners duing the last 6 months, %					
1-2	171 (37.3)	95 (55.9)	75 (44.1)	Reference	Reference
3-9	213 (46.5)	146 (68.5)	67 (31.5)	1.2 (1.0-1.4)	1.2 (1.1-1.4)
>=10	74 (16.2)	57 (77.0)	17 (23.0)	1.4 (1.1-1.7)	1.3 (1.1-1.5)
Any HIV test in the past 12 months, %					
No	189 (40.7)	108 (57.8)	79 (42.3)	Reference	Reference
Yes	275 (59.3)	192 (70.1)	82 (29.9)	1.2 (1.1-1.4)	1.1 (1.0-1.3)
HIV tested status, %					
Positive	165 (35.6)	116 (70.3)	49 (29.7)	Reference	Reference
Negative	299 (64.4)	184 (62.2)	112 (37.8)	0.9 (0.8-1.0)	0.9 (0.8-1.0)
HIV self-reported status, %					
Unaware	18 (3.9)	11 (61.1)	7 (38.9)	Reference	Reference
Aware	144 (31.0)	104 (72.2)	40 (27.8)	1.2 (0.8-1.7)	1.0 (0.7-1.6)
Sexual identity, %					
Homosexual/gay	353 (76.7)	230 (65.2)	123 (34.8)	Reference	Reference
Bisexual	88 (19.1)	57 (64.8)	31 (35.2)	1.0 (0.8-1.2)	1.1 (1.0-1.3)
Other specific number*	19 (4.1)	12 (66.7)	6 (33.3)	1.0 (0.7-1.4)	1.1 (0.8-1.5)
Any female sex partners during the last 6 months, %					
No	439 (94.6)	291 (66.4)	147 (33.6)	Reference	Reference
Yes	25 (5.4)	9 (39.1)	14 (60.9)	0.6 (0.4-1.0)	0.7 (0.4-1.1)
Condomless anal sex, %					
No	77 (18.0)	47 (61.0)	30 (39.0)	Reference	Reference
Yes	350 (82.0)	231 (66.0)	119 (34.0)	1.1 (0.9-1.3)	1.1 (0.9-1.3)
Ever used PrEP, %					
No	433 (93.3)	277 (64.4)	153 (35.6)	Reference	Reference
Yes	31 (6.7)	23 (74.2)	8 (25.8)	1.2 (0.9-1.4)	1.0 (0.8-1.2)

Table 2. Demographic, clinical and behavioral characteristics of EleMENt participants stratified by urogenital and extragenital testing, in young black men who have sex with men, Atlanta, GA, 2015-2019

	Urogenital test, n (row%)	No Urogenital test, n (row%)	Crude PR (95% CI)	Adjusted PR (95% CI)	Extragenital test, n (row%)	No Extragenital test, n (row%)	Crude PR (95% CI)	Adjusted PR (95% CI)
Total	274 (59.4)	187 (40.6)			193 (41.9)	268 (58.1)		
Age (mean, SD)	24.92 (2.99)	24.83 (2.97)			25.16(2.91)	24.68 (3.02)		
Age (years), %								
18-23	84 (58.7)	59 (41.3)	Reference	Reference	57 (39.9)	86 (60.1)	Reference	Reference
24-25	65 (61.9)	40 (38.1)	1.1 (0.9-1.3)	1.0 (0.8-1.2)	43 (41.0)	62 (59.1)	1.0 (0.8-1.4)	1.0 (0.7-1.3)
26-29	125 (58.7)	88 (41.3)	1.0 (0.8-1.2)	1.0 (0.8-1.1)	93 (43.7)	120 (56.3)	1.1 (0.9-1.4)	1.1 (0.9-1.4)
Partner age difference (mean, SD)	4.72 (2.58)	6.30 (2.76)			5.19 (2.78)	5.22 (2.72)		
STIs symptoms, %								
No	205 (57.3)	153 (42.7)	Reference	Reference	143 (39.9)	215 (60.1)	Reference	Reference
Yes	61 (65.6)	32 (34.4)	1.1 (1.0-1.4)	1.1 (1.0-1.3)	43 (46.2)	50 (53.8)	1.2 (0.9-1.5)	1.1 (0.9-1.4)
Relationship type, %								
Main and causal	144 (64.0)	81 (36.0)	Reference	Reference	105 (46.7)	120 (53.3)	Reference	Reference
Main no causal	41 (51.3)	39 (48.8)	0.8 (0.6-1.0)	0.9 (0.7-1.2)	26 (32.5)	54 (67.5)	0.7 (0.5-1.0)	0.8 (0.6-1.2)
Causal no main	83 (57.6)	61 (42.4)	0.9 (0.8-1.1)	0.9 (0.8-1.1)	59 (41.0)	85 (59.0)	0.9 (0.7-1.1)	0.9 (0.7-1.1)
Education level, %								
College, post graduate, professional school	95 (66.9)	47 (33.1)	Reference	Reference	66 (46.5)	76 (53.5)	Reference	Reference
Some college, associate's degree, techincal school	109 (57.4)	81 (42.6)	0.9 (0.7-1.0)	0.9 (0.8-1.1)	74 (39.0)	116 (61.1)	0.8 (0.7-1.1)	0.9 (0.7-1.2)
High school of GED	65 (56.0)	51 (44.0)	0.8 (0.7-1.0)	0.9 (0.8-1.1)	49 (42.2)	67 (57.8)	0.9 (0.7-1.2)	1.0 (0.8-1.3)
Less than high school	5 (41.7)	7 (58.3)	0.6 (0.3-1.2)	0.8 (0.4-1.5)	4 (33.3)	8 (66.7)	0.7 (0.3-1.6)	0.8 (0.4-1.8)
Current health insurance, %								
No	118 (59.3)	81 (40.7)	Reference	Reference	83 (41.7)	116 (58.3)	Reference	Reference
Yes	156 (59.5)	106 (40.5)	1.0 (0.9-1.2)	0.9 (0.8-1.1)	110 (42.0)	152 (58.0)	1.0 (0.8-1.3)	0.9 (0.8-1.1)
Access to health care %								
Some form of access	227 (65.4)	120 (34.6)	Reference	Reference	162 (46.7)	185 (53.3)	Reference	Reference
Emergency room	13 (68.4)	6 (31.6)	1.1 (0.8-1.4)	1.1 (0.8-1.5)	8 (42.1)	11 (57.9)	0.9 (0.5-1.6)	0.9 (0.5-1.6)
No access	33 (35.1)	61 (64.9)	0.5 (0.4-0.7)	0.6 (0.4-0.7)	23 (24.5)	71 (75.5)	0.5 (0.4-0.8)	0.5 (0.4-0.8)
Employment status, %								
Full-time	162 (58.3)	116 (41.7)	Reference	Reference	116 (41.7)	162 (58.3)	Reference	Reference
Part-time	63 (61.8)	39 (38.2)	1.1 (0.9-1.3)	1.1 (1.0-1.3)	37 (36.3)	65 (63.7)	0.9 (0.7-1.2)	0.9 (0.7-1.2)
Student	16 (57.1)	12 (42.9)	1.0 (0.7-1.4)	0.9 (0.7-1.2)	11 (39.3)	17 (60.7)	0.9 (0.6-1.5)	0.9 (0.5-1.4)
Unemployed	33 (62.3)	20 (37.7)	1.1 (0.9-1.4)	1.0 (0.8-1.2)	29 (54.7)	24 (45.3)	1.3 (1.0-1.7)	1.3 (1.0-1.6)
Income, %								
0 to $1667 (monthly) / 0 to $19,999 (yearly)	120 (60.6)	78 (39.4)	Reference	Reference	84 (42.4)	114 (57.6)	Reference	Reference
$1668 to $4167 (monthly) / $20,000 to $49,999 (yearly)	110 (58.8)	77 (41.2)	1.0 (0.8-1.1)	1.0 (0.8-1.1)	79 (42.3)	108 (57.8)	1.0 (0.8-1.3)	1.0 (0.8-1.2)
$4168 or more (monthly) / $50,000 or more (yearly)	28 (62.2)	17 (37.8)	1.0 (0.8-1.3)	1.0 (0.8-1.3)	17 (37.8)	28 (62.2)	0.9 (0.6-1.3)	0.8 (0.5-1.2)
Moved in the past 6 months, %								
No	179 (57.7)	131 (42.3)	Reference	Reference	133 (42.9)	177 (57.1)	Reference	Reference
Yes	95 (62.9)	56 (37.1)	1.1 (0.9-1.3)	1.0 (0.9-1.2)	60 (39.7)	91 (60.3)	0.9 (0.7-1.2)	0.9 (0.7-1.1)
Number of sex partners duing the last 6 months, %								
1-2	86 (50.6)	84 (49.4)	Reference	Reference	59 (34.7)	111 (65.3)	Reference	Reference
3-9	132 (62.0)	81 (38.0)	1.2 (1.0-1.5)	1.2 (1.0-1.5)	93 (43.7)	120 (56.3)	1.3 (1.0-1.6)	1.3 (1.0-1.7)
>=10	55 (74.3)	19 (25.7)	1.5 (1.2-1.8)	1.4 (1.2-1.7)	41 (55.4)	33 (44.6)	1.6 (1.2-2.1)	1.5 (1.1-2.0)
Any HIV test in the past 12 months, %								
No	99 (52.9)	88 (47.1)	Reference	Reference	74 (39.6)	113 (60.4)	Reference	Reference
Yes	175 (63.9)	99 (36.1)	1.2 (1.0-1.4)	1.2 (1.0-1.4)	119 (43.4)	155 (56.6)	1.1 (0.9-1.4)	1.1 (0.9-1.3)

HIV tested status, %								
Positive	110 (66.7)	55 (33.3)	Reference	Reference	79 (47.9)	86 (52.1)	Reference	Reference
Negative	164 (55.4)	132 (44.6)	0.8 (0.7-1.0)	1.0 (0.8-1.1)	114 (38.5)	182 (61.5)	0.8 (0.7-1.0)	0.9 (0.7-1.1)
HIV self-reported status, %								
Unaware	8 (44.4)	10 (55.6)	Reference	Reference	7 (38.9)	11 (61.1)	Reference	Reference
Aware	101 (70.1)	43 (29.9)	1.6 (0.9-2.7)	1.4 (0.8-2.5)	72 (50.0)	72 (50.0)	1.3 (0.7-2.4)	1.3 (0.7-2.3)
Sexual identity, %								
Homosexual/gay	208 (58.9)	145 (41.1)	Reference	Reference	146 (41.4)	207 (58.6)	Reference	Reference
Bisexual	53 (60.2)	35 (39.8)	1.0 (0.8-1.2)	1.1 (1.0-1.3)	40 (45.5)	48 (54.6)	1.1 (0.8-1.4)	1.1 (0.8-1.4)
Other	12 (66.7)	6 (33.3)	1.1 (0.8-1.6)	1.2 (0.9-1.7)	6 (33.3)	12 (66.7)	0.8 (0.4-1.6)	0.8 (0.4-1.6)
Any female sex partners during the last 6 months, %								
No	266 (60.7)	172 (39.3)	Reference	Reference	188 (42.9)	250 (57.1)	Reference	Reference
Yes	8 (34.8)	15 (65.2)	0.6 (0.3-1.0)	0.6 (0.4-1.0)	5 (21.7)	18 (78.3)	0.5 (0.2-1.1)	0.5 (0.2-1.1)
Condomless anal sex, %								
No	40 (52.0)	37 (48.1)	Reference	Reference	25 (32.5)	52 (67.5)	Reference	Reference
Yes	214 (61.1)	136 (38.9)	1.2 (0.9-1.5)	1.1 (0.9-1.4)	159 (45.4)	191 (54.6)	1.4 (1.0-2.0)	1.4 (1.0-1.9)
Ever used PrEP, %								
No	252 (58.6)	178 (41.4)	Reference	Reference	175 (40.7)	255 (59.3)	Reference	Reference
Yes	22 (71.0)	9 (29.0)	1.2 (1.0-1.5)	1.1 (0.9-1.3)	18 (58.1)	13 (41.9)	1.4 (1.0-2.0)	1.2 (0.9-1.7)

Table 3. Demographic, clinical and behavioral characteristics of HIV-negative EleMENt participants stratified by urogenital and extragenital testing, in young black men who have sex with men, Atlanta, GA, 2015-2019

	Urogenital test, n (row%)	No Urogenital test, n (row%)	Crude PR (95% CI)	Adjusted PR (95% CI)	Extragenital test, n (row%)	No Extragenital test, n (row%)	Crude PR (95% CI)	Adjusted PR (95% CI)
Total	164 (55.4)	132 (44.6)			114 (38.5)	182 (61.5)		
Age (mean, SD)	24.35 (3.05)	24.29 (3.05)			24.61 (2.90)	24.14 (3.13)		
Age (years), %								
18-23	62 (54.9)	51 (45.1)	Reference	Reference	41 (36.3)	72 (63.7)	Reference	Reference
24-25	41 (56.9)	31 (43.1)	1.0 (0.8-1.3)	1.0 (0.8-1.3)	28 (38.9)	44 (61.1)	1.1 (0.7-1.6)	1.0 (0.7-1.5)
26-29	61 (55.0)	50 ((45.1)	1.0 (0.8-1.3)	1.0 (0.8-1.2)	45 (40.5)	66 (59.5)	1.1 (0.8-1.6)	1.1 (0.8-1.5)
Partner age difference (mean, SD)	4.66 (2.51)	7.07 (2.49)			4.71 (2.74)	5.75 (2.65)		
STIs symptoms, %								
No	129 (54.2)	109 (45.8)	Reference	Reference	91 (38.2)	147 (61.8)	Reference	Reference
Yes	32 (60.4)	21 (39.6)	1.1 (0.9-1.4)	1.1 (0.9-1.3)	20 (37.7)	33 (62.3)	1.0 (0.7-1.4)	1.0 (0.7-1.5)
Relationship type, %								
Main and causal	83 (59.7)	56 (40.3)	Reference	Reference	59 (42.5)	80 (57.6)	Reference	Reference
Main no causal	27 (48.2)	29 (51.8)	0.8 (0.6-1.1)	1.0 (0.7-1.4)	19 (33.9)	37 (66.1)	0.8 (0.5-1.2)	0.9 (0.6-1.5)
Causal no main	50 (54.4)	42 (45.7)	0.9 (0.7-1.1)	0.9 (0.7-1.1)	35 (38.0)	57 (62.0)	0.9 (0.6-1.2)	0.9 (0.7-1.2)
Education level, %								
College, post graduate, professional school	70 (65.4)	37 (34.6)	Reference	Reference	50 (46.7)	57 (53.3)	Reference	Reference
Some college, associate's degree, techincal school	57 (50.9)	55 (49.1)	0.8 (0.6-1.0)	0.9 (0.8-1.2)	39 (34.8)	73 (65.2)	0.7 (0.5-1.0)	0.8 (0.6-1.1)
High school of GED	35 (50.7)	34 (49.3)	0.8 (0.6-1.0)	0.9 (0.7-1.2)	23 (33.3)	46 (66.7)	0.7 (0.5-1.1)	0.8 (0.5-1.2)
Less than high school	2 (28.6)	5 (71.4)	0.4 (0.1-1.4)	0.6 (0.2-1.9)	2 (28.6)	5 (71.4)	0.6 (0.2-2.0)	0.8 (0.3-2.6)
Current health insurance, %								
No	60 (54.6)	50 (45.5)	Reference	Reference	44 (40.0)	66 (60.0)	Reference	Reference
Yes	104 (55.9)	82 (44.1)	1.0 (0.8-1.3)	1.0 (0.8-1.2)	70 (37.6)	116 (62.4)	0.9 (0.7-1.3)	0.9 (0.6-1.1)
Access to health care, %								
Some form of access	133 (63.3)	77 (36.7)	Reference	Reference	91 (43.3)	119 (56.7)	Reference	Reference
Emergency room	10 (71.4)	4 (28.6)	1.1 (0.8-1.6)	1.2 (0.8-1.6)	7 (50.0)	7 (50.0)	1.2 (0.7-2.0)	1.1 (0.7-1.9)
No access	21 (29.2)	51 (70.8)	0.5 (0.3-0.7)	0.5 (0.3-0.7)	16 (22.2)	56 (77.8)	0.5 (0.3-0.8)	0.5 (0.3-0.8)
Employment status, %								
Full-time	100 (54.4)	84 (45.7)	Reference	Reference	71 (38.6)	113 (61.4)	Reference	Reference
Part-time	39 (56.5)	30 (43.5)	1.0 (0.8-1.3)	1.2 (1.0-1.5)	23 (33.3)	46 (66.7)	0.9 (0.6-1.3)	0.9 (0.6-1.3)
Student	11 (55.0)	9 (45.0)	1.0 (0.7-1.5)	0.9 (0.6-1.3)	8 (40.0)	12 (60.0)	1.0 (0.6-1.8)	1.0 (0.6-1.7)
Unemployed	14 (60.9)	9 (39.1)	1.1 (0.8-1.6)	1.0 (0.7-1.3)	12 (52.2)	11 (47.8)	1.4 (0.9-2.1)	1.3 (0.8-1.9)
Income, %								
0 to $1667 (monthly) / 0 to $19,999 (yearly)	65 (57.0)	49 (43.0)	Reference	Reference	44 (38.6)	70 (61.4)	Reference	Reference
$1668 to $4167 (monthly) / $20,000 to $49,999 (yearly)	70 (54.7)	58 (45.3)	1.0 (0.8-1.2)	0.9 (0.7-1.1)	52 (40.6)	76 (59.4)	1.1 (0.8-1.4)	1.0 (0.7-1.3)
$4168 or more (monthly) / $50,000 or more (yearly)	22 (59.5)	15 (40.5)	1.0 (0.8-1.4)	1.0 (0.8-1.3)	13 (35.1)	24 (64.9)	0.9 (0.6-1.5)	0.8 (0.5-1.3)
Moved in the past 6 months, %								
No	107 (55.4)	86 (44.6)	Reference	Reference	79 (40.9)	114 (59.1)	Reference	Reference
Yes	57 (55.3)	46 (44.7)	1.0 (0.8-1.2)	1.0 (0.8-1.2)	35 (34.0)	68 (66.0)	0.8 (0.6-1.1)	0.8 (0.6-1.1)
Number of sex partners duing the last 6 months, %								
1-2	53 (46.9)	60 (53.1)	Reference	Reference	38 (33.6)	75 (66.4)	Reference	Reference
3-9	76 (55.9)	60 (44.1)	1.2 (0.9-1.5)	1.2 (0.9-1.5)	54 (39.7)	82 (60.3)	1.2 (0.8-1.6)	1.2 (0.9-1.6)
>=10	34 (77.3)	10 (22.7)	1.6 (1.3-2.1)	1.5 (1.2-1.9)	22 (50.0)	22 (50.0)	1.5 (1.0-2.2)	1.4 (1.0-2.1)
Sexual identity, %								
Homosexual/gay	119 (55.1)	97 (44.9)	Reference	Reference	83 (38.4)	133 (61.6)	Reference	Reference
Bisexual	36 (55.4)	29 (44.6)	1.0 (0.8-1.3)	1.1 (0.9-1.3)	26 (40.0)	39 (60.0)	1.0 (0.7-1.5)	1.0 (0.7-1.4)
Other	8 (61.5)	5 (38.5)	1.1 (0.7-1.7)	1.2 (0.8-1.8)	4 (30.8)	9 (69.2)	0.8 (0.3-1.8)	0.8 (0.4-1.8)

Any female sex partners during the last 6 months, %								
No	157 (57.1)	118 (42.9)	Reference	Reference	110 (40.0)	165 (60.0)	Reference	Reference
Yes	7 (33.3)	14 (66.7)	0.6 (0.3-1.1)	0.6 (0.4-1.1)	4 (19.1)	17 (81.0)	0.5 (0.2-1.2)	0.5 (0.2-1.2)
Condomless anal sex, %								
No	20 (44.4)	25 (55.6)	Reference	Reference	14 (31.1)	31 (68.9)	Reference	Reference
Yes	130 (56.5)	100 (43.5)	1.3 (0.9-1.8)	1.1 (0.8-1.6)	95 (41.3)	135 (58.7)	1.3 (0.8-2.1)	1.3 (0.8-2.0)
Ever used PrEP, %								
No	143 (53.6)	124 (46.4)	Reference	Reference	98 (36.7)	169 (63.3)	Reference	Reference
Yes	21 (72.4)	8 (27.6)	1.4 (1.1-1.7)	1.1 (0.9-1.4)	16 (55.2)	13 (44.8)	1.5 (1.0-2.2)	1.3 (0.9-1.9)

Appendix

Selected Questions from EleMENt Questionnaire

Education	Question: What is the highest level in school that you completed?
	Answer: ( ) College, post graduate, or professional school ( ) Some college, Associate's degree and/or Technical School ( ) High school or GED ( ) Did not finish high school ( ) Don't know
Employment	Question: What best describes your employment status? Are you:
	Answer: [ ] Employed full-time [ ] Employed part-time [ ] A full-time student [ ] A part-time student [ ] On active duty in US Armed Forces, Reserves, or National Guard [ ] Unable to work for health reasons [ ] Unemployed [ ] Other:

	[ ] Don't know
Income	Question: What was your household income last year from all sources before taxes? (monthly/yearly)
	Answer: ( ) 0 to $417 (monthly) / 0 to $4,999 (yearly) ( ) $418 to $833 (monthly) / $5,000 to $9,999 (yearly) ( ) $834 to $1250 (monthly) / $10,000 to $14,999 (yearly) ( ) $1251 to $1667 (monthly) / $15,000 to $19,999 (yearly) ( ) $1668 to $2500 (monthly) / $20,000 to $29,999 (yearly) ( ) $2501 to $3333 (monthly) / $30,000 to $39,999 (yearly) ( ) $3334 to $4167 (monthly) / $40,000 to $49,999 (yearly) ( ) $4168 to $6250 (monthly) / $50,000 to $74,999 (yearly) ( ) $6251 or more (monthly) / $75,000 or more (yearly) ( ) Don't know
Insurance	Question: Do you currently have health insurance? This includes Medicare or Medicaid.
	Answer: ( ) Yes ( ) No ( ) Don't know
Sex Identity	Question: Do you think of yourself as:

	Answer: ( ) Heterosexual or straight ( ) Homosexual or gay ( ) Bisexual ( ) Other, please specify::
Condomless anal sex	Question: Of the [question("value"), id="398"] partners you had anal sex with in the last 6 months, with how many did you have anal sex not fully protected by a condom?
	Answer: __ (number)
Number of sex partners	Question: During the last 6 months, with how many men did you have anal or oral sex?
	Answer: __ (number)
Symptoms of STIs	Question: Scores in mouth or on lips? Question: Scores on genitals, anus, rectum? Question: Painful bowel movements? Questions: Rectal bleeding? Questions: Anal itching? Questions: Discharge from the rectum (white/yellow/green pus)? Questions: Rectal pain/soreness?

	Questions: Discharge from penis (white/yellow/green pus)? Questions: Burning sensation when urinating? Questions: Pain and swelling in one or both testicles?
	Answer: ( ) Yes, I have this and it's new ( ) Yes, I've had this for a while ( ) N/A
Relation type	Question: The total number of main sex partners. A main partner is someone that you feel committed to above all others -- this is someone you might call your boyfriend, significant other, or life partner.) Question: The total number of non-main sex partners you had sex with only 1 time cannot be more than the total number of non-main sex partners
	Answer: ___ (number)
Ever used PrEP	Question: Have you ever taken anti-HIV medication (pre-exposure prophylaxis or PrEP, e.g. Truvada) to prevent getting HIV? Question: Are you currently taking anti-HIV medication (pre-exposure prophylaxis or PrEP, e.g. Truvada)?
	Answer: ( ) Yes ( ) No

	( ) Don’t know
Access to healthcare	Question: In the past 12 months (since [question("value"), id="1130"]), have you been to a doctor or nurse for a medical issue (for a check-up, routine care, or a specific concern)? Question: Where have you gone to see a doctor or nurse for a medical issue in the past 12 months?
	Answer: ( ) Yes ( ) No Answer: [ ] Primary care physician (doctor) [ ] Emergency room [ ] Service organization (AID Atlanta, Pride Medical, etc [ ] Student health services [ ] County health department [ ] Other physician’s (doctor’s) office
Moved status	Question: Have you moved in the past 6 months? (By “moved”, we mean you changed your residence.)
	Answer: ( ) Yes ( ) No

HIV self-reported status	Question: Are you aware of HIV Infection?
	Answer: ( ) Unaware ( ) Aware
Female sex partners	Question: During the last 6 months, did you have sex with a person who was female?
	Answer: ( ) Yes ( ) No

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