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Syphilis positivity among men who have sex with men (MSM) with direct, indirect, and no linkage to female sex partners: Exploring the potential for sex network bridging in Baltimore City, MD

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Abstract

Background—Syphilis epidemics among women and men-who-have-sex-with-men (MSM) may be connected, but these connections are poorly understood. Using egocentric network data from a U.S. urban MSM cohort, we examined socio-demographics, behaviors, and syphilis positivity among MSM with (1) direct (MSM who report sex with women, MSMW); (2) indirect (MSM who only report male partners, some of whom are MSMW, MSMO/W); and (3) no (MSM who only report male partners and whose partners only have sex with men, MSMO/O) connection to women.

Methods—Sexually-active MSM aged 18–45 years were administered behavioral and network interviews (recall period: three months) and syphilis/HIV testing. Syphilis positivity was defined as RPR titer ≥ 1:8. Modified Poisson regression was used to test for differences across groups.

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Results—Among 385 MSM, 14.5% were MSMW and 22.3% were MSMO/W. MSMW and MSMO/W were significantly more likely than MSMO/O to report sex behaviors associated with increased syphilis acquisition/transmission risk, including: ≥ 2 sex partners [MSMW aPR:1.28 (0.98–1.68); MSMO/W aPR:1.35 (1.09–1.69)], concurrent sex partners [MSMW aPR:1.50 (1.17–1.92); MSMO/W aPR:1.39 (1.11–1.74)], and for MSMW only, transactional sex [aPR:2.07 (1.11–3.88)]. Syphilis positivity was 16.4% and was lower among MSMW (9.4%) and MSMO/W (14.1%) than MSMO/O (18.5%), but differences were not significant.

Conclusions—There may be considerable connectivity between MSM and female sex partners that could facilitate syphilis transmission, and behaviors that increase acquisition/transmission risk among MSMW and MSMO/W may be distinct from MSMO/O. Future work should focus on examining the context and temporal patterns of sex partnerships among MSMW and MSMO/W.

Summary:

Among an MSM cohort 14.5% reported sex with women (MSMW), and 22.3% were MSM-only reporting MSMW partners(MSMO/W). Syphilis positivity was substantially but not significantly lower among MSMW (vs. MSMO)

Keywords

Syphilis; HIV; MSM; MSMW; sexual networks

Introduction

Syphilis transmission remains a major public health problem in the United States (U.S). For over two decades, reported syphilis diagnoses have increased among gay, bisexual, and other men who have sex with men (MSM),(1) including among men who have sex with men only (MSMO) and men who have sex with men and cisgender women (MSMW).(2) MSM account for nearly half of syphilis diagnoses in the U.S.,(1) though recent precipitous increases in syphilis diagnoses among women, mirrored by increases in congenital syphilis, have been observed. Syphilis epidemics among MSM and heterosexual men and women often have been studied separately. However, the recent observed increases among MSMO, MSMW, and women suggest that linkages between MSM and heterosexual networks – referred to as bridging – may be facilitating syphilis transmission.

In this context, network bridging is defined as sex partnerships across distinct sexual networks, which may accelerate transmission of syphilis and other sexually transmitted infections (STI) by connecting individuals in networks with different STI risk or prevalence.(3) Multiple studies have suggested that MSMW populations may serve as a bridge between MSM and heterosexual networks for STI and HIV transmission.(4–8) While the importance of this bridge for HIV transmission has been debated,(9, 10) the contribution of bridging to syphilis transmission in the context of the current syphilis epidemic remains unclear.

The potential for syphilis transmission bridging among MSMW populations depends on multiple factors, including: 1) the proportion of MSMW within high-prevalence syphilis networks; 2) disease prevalence among MSMW; 3) the extent to which MSMW engage in behaviors associated with increased STI acquisition/transmission (i.e., condomless sex,

transactional sex, and sex while under the influence of drugs) with both male and female partners; and 4) disease prevalence and behaviors among other individuals within MSMW sexual networks, (i.e., sex partners of MSMW and their partners' sex partners).(11) Prior work has suggested that about a third (34%) of MSM in the U.S. also report sex with women;(9) however, prior studies explicitly examining syphilis among MSMW and MSMO as distinct groups are limited. One recent study from Australia reported lower syphilis prevalence among MSMW (vs. MSMO).(12) Another study observed higher STI prevalence among MSMW compared to MSMO, but did not explicitly examine syphilis prevalence.(13) Other prior work has shown that MSMW compared to MSMO more frequently report behaviors associated with STI acquisition and transmission, such as higher numbers of sex partners, concurrent sex partnerships (multiple, overlapping sex partnerships), transactional sex partners, more dense sexual networks, substance use (including injection drug use), homelessness, lower educational attainment, incarceration, and depression.(4, 9, 10, 14–16)

Because observed HIV and STI prevalence among MSM is higher than that of the general heterosexual population, some have hypothesized that transmission flows across the MSMW "bridge" from MSM to their female sex partners.(9, 10) However, ascertaining transmission directionality is difficult, and some prior work suggests behavior patterns among MSMW and their partners which may facilitate bidirectional transmission between MSM and their female sex partners. Two recent serial cross-sectional studies showed that MSMW reported increases in condomless anal sex with male partners and persistently high rates of condomless sex with female casual partners over time.(12, 17) Other studies have reported that female partners of MSM (compared to female partners of men who have sex with women only) more frequently report behaviors associated with STI acquisition/transmission, such as concurrent sex partnerships, multiple sex partners, transactional sex, and substance use.(6, 14, 18, 19) This suggests, perhaps, complex transmission dynamics whereby MSMW may be exposed to syphilis (and other STIs, including HIV) through both male and female partners.

Additionally, prior work has focused on direct sex network connectivity between MSM and cisgender women (i.e., MSMW), but to our knowledge, has not examined disease prevalence or behavior patterns among MSM who are indirectly linked to cisgender women through their sexual networks (i.e., MSMO who report MSMW sex partners, MSMO/W). Explicitly examining disease prevalence and behavior patterns among distinct groups of MSM reporting differing degrees of connectivity to female sex partners – those who report direct (MSMW), indirect (MSMO/W), or no (i.e., MSMO whose sex partners are exclusively MSMO, MSMO/O) linkages to women – may improve understanding of transmission potential within and across MSM and heterosexual networks and ultimately, will inform interventions aimed at disrupting transmission.

Our goal was to provide insight into current syphilis transmission dynamics that may link the ongoing MSM syphilis epidemic to the increasing epidemic among cisgender women by examining degrees of connectivity between MSM and female sex partners. Specifically, we used egocentric network data collected among an urban cohort of MSM to 1) determine the proportion of MSM with direct (MSMW), indirect (MSMO/W) and no (MSMO/O) connection to female sex partners; and 2) compare demographic, socioeconomic, sex

behavior and sex partner characteristics, substance use, and syphilis/HIV prevalence across these three groups.

Methods

Overview

The Understanding Sexual Health in Networks (USHINE) study was a prospective cohort study focused on elucidating the network epidemiology of syphilis among MSM to inform and strengthen local health department syphilis prevention programs.(20) This study was approved by the Johns Hopkins School of Medicine institutional review board (IRB).

Setting

At the time this study was conducted, Baltimore City, Maryland ranked among U.S. cities with the highest incidence of syphilis. In 2018, the P&S syphilis rate in Baltimore City was 4.2-fold higher than the national (45.3 versus 10.8 per 100,000).(21) Prior work also has shown the majority of all reported early syphilis cases (P&S and early latent) in Baltimore City were among MSM.(22)

Study Population

Participants were enrolled between July 20, 2018, and February 14, 2020, and recruited from two health department sexual health clinics, a federally qualified health center (FQHC), a community-based LGBTQ+ organization, community engagement events (i.e., passive recruitment at Pride or other festivals), and respondent driven sampling (RDS). Eligibility criteria included: male sex at birth and male gender identity, aged 18–45 years, residence in a zip code within or adjacent to Baltimore City, reporting sex with a man (past six months), and willingness and ability to provide informed consent. The baseline visit included an audio-computer self-assisted interview (ACASI) ascertaining demographic, socioeconomic and behavioral information, a face-to-face network interview about recent sex partners, and biologic testing for syphilis and HIV. This analysis included baseline data from participants who completed the ACASI and network interviews and who reported at least one sex partner in the past three months.

Substance use and sex behavior information was ascertained through ACASI and network interviews. Sex behaviors included number, type, and gender of sex partners, gender of sex partners' partners and sex repertoire (i.e., anal (receptive/insertive), vaginal or oral sex). During network interviews, participants were asked to nominate all sex partners (past 3 months) and asked the following for each nominated sex partner: "How would you describe the current gender identity of [Partner]?" and "What gender(s) does [Partner] have sex with?" (response options for both: cisgender male, cisgender female, transgender male, transgender female, other). A three-month recall period was used unless otherwise noted.

Network connectivity group

Three network connectivity groups were defined: MSMW, MSMO/W, and MSMO/O. MSMW was defined as report of any cisgender female sex partner on the ACASI or network interviews; MSMO/W was defined as report of all male sex partners, with at least one

partner who reportedly had sex with cisgender females. MSMO/O was defined as report of all male sex partners who were also reportedly MSMO.

Demographic and socioeconomic characteristics included race/ethnicity (Black/Non-Black), age (≤ 30 years/ > 30 years), employment status (any employment/unemployed), educational attainment (completed/did not complete high school), current health insurance status (insured/uninsured), housing status (housed/unhoused, past 6 months), food insecurity (yes/no, past 6 months) and recent incarceration (yes/no; past year). Insured was defined as reporting any form of private or public (i.e., Medicare, Medicaid, military) health insurance at the time of survey. Unhoused was defined as reporting "living in a shelter, single room occupancy hotel, car, with friends, on the street or otherwise without a regular place to stay for at least one night." Food insecurity was defined as reporting "being worried that food would run out before having money to buy more".

Sex behaviors included number and type of sex partners and repertoire with male and female partners. Number/type of sex partners included: Number of total sex partners, number of casual partners, any anonymous sex (yes/no), concurrent sex partnerships (yes/no), sex partner concurrency (yes/no) and any transactional sex (giving or receiving money, drugs or other things in exchange for sex, yes/no). Number of partners were examined as discrete and dichotomous variables. Number of total partners was dichotomized as multiple (≥ 2) vs. one partner; number of casual partners was dichotomized as multiple (≥ 2) vs. 0–1 partners. Anonymous sex was defined as reporting any sex partner without knowing the partner's name or any other identifying information. Concurrency and sex partner concurrency were assessed for the three most recent partners. Sex repertoire measures included the number of male partners with whom the participant engaged in specific sex acts: receptive anal sex (bottoming), insertive anal sex (topping), receiving oral sex, and giving oral sex. Each sex repertoire variable was dichotomized as multiple (≥ 2) vs. 0–1 partner. The number of female partners with whom MSMW reported engaging in vaginal, anal, and oral sex (giving and receiving) also were examined.

Illicit substance use was defined as reporting use of crack/cocaine, methamphetamine (e.g., crystal, tina, meth, speed), heroin, painkillers (e.g., oxycodone, vicodin), downers (e.g., Valium, Ativan, Xanax), psychedelics, or party drugs (e.g., ecstasy, E, Molly, MDMA, GHB, or Special K, poppers) in response to any of the following: "In the past three months, which of the following drugs did you use?", "Have you used any of the following before or during sex in the past three months?", and "Have you used any of the following drugs before or during sex with [partner name] in the past 3 months?".

Syphilis positivity was defined as a reactive rapid plasma reagin (RPR) titer of greater than or equal to 1:8 followed by a reactive treponemal test. The RPR titer cut-off of 1:8 was used as a marker of recent vs. previous infection, consistent with prior seroprevalence surveys.(23) Individuals living with HIV were those with a positive HIV rapid test with ELISA confirmation and/or medical record documentation of a prior HIV diagnosis.

Statistical Analysis

Descriptive statistics were generated. To test for differences across groups, a series of modified Poisson regression models (i.e., with robust standard errors) were performed using network connectivity group as the exposure variable and each characteristic of interest as the outcome variable. Multivariable regression models were performed to examine differences across groups while adjusting for socioeconomic factors that may be associated with increased STI/HIV risk behaviors and that were significant using a p-value less than 0.10 in unadjusted models. In multivariable models, statistical significance was determined by a confidence interval that did not cross one and a p-value less than 0.05. All analyses were performed using Stata version 17.0 (Stata Corp, College Station, TX).

Results

Among 417 enrolled participants, 97.4% (406) completed the baseline ACASI and network interviews. Of these 406, 385 (94.8%) reported at least one sex partner in the past three months and represented the final study population.

Among these 385, the majority was recruited from clinical sites (52.5%, 202), Black/African American (73.8%, 284), aged ≥ 30 years (56.9%, 219) and completed at least a high school education (91.4%, 351/384) (Table 1). Behaviors associated with syphilis acquisition/transmission were common. The median number of sex partners was 3 (IQR: 1–5), 50.7% (195) reported concurrent partners, 64.2% (247) reported sex partner concurrency, and 40.3% (155) reported any substance use. Forty-one percent (40.7%, 154/378) were living with HIV. Among the 371 who were syphilis tested, 31.1% (115) had a reactive RPR; 16.2% (60) had an RPR titer ≥ 1:8 and were considered to be syphilis positive.

Nearly fifteen percent (14.5%, 56) of participants were MSMW and 22.3% (86) were MSMO/W (Table 1). Combined, nearly two-fifths (36.9%, 142) had direct or indirect connections to a female sex partner. Among the 56 MSMW, the median number of total sex partners was 3 (IQR: 2–6) compared to 2 (1–4) among MSMO/W and 3 (2–5) among MSMO/O. MSMW reported vaginal sex with a median of 1 (0–2.5) female partners and anal sex with a median of 0 (0–1) female partners. The median number of female partners with whom MSMW reported oral sex was 1 (0–2) for both giving and receiving oral sex.

Characteristics across network connectivity groups are shown in Table 2. In unadjusted models, MSMW and MSMO/O were similar by age, employment status, and educational attainment. Compared to MSMO/O, MSMW more frequently reported Black race [89.3% vs. 69.8%; prevalence ratio (PR) 1.25, 95% Confidence Interval (1.11–1.41)], being unhoused [48.2% vs. 21.0%, PR 2.30 (1.59–3.31)], food insecurity [66.1% vs. 44.4%, PR 1.49 (1.18–1.88)] and recent incarceration [21.4% vs. 7.0%, PR 3.06 (1.55–6.05)]. Demographic and socioeconomic characteristics among MSMO/W and MSMO/O were similar.

Some differences in sex behaviors were observed. Both MSMW and MSMO/W more frequently reported multiple total sex partners in the prior 3 months [MSMW: 58.9%, PR 1.31 (1.01–1.70)]; MSMO/W: 60.5%, PR 1.34 (1.08–1.67); MSMO/O: 45.0%], and multiple casual partners [MSMW: 42.9%, PR 1.30 (0.91–1.84); MSMO/W: 43.0%, PR 1.30

(0.96–1.76), MSMO/O: 33.1%]. Only differences in reported total partners was statistically significant. Over one-quarter (26.8%) of MSMW reported any transactional sex compared to 8.6% of MSMO/O [PR 3.10 (1.71–5.63)]. MSMW were 51% and MSMO/W 39% more likely than MSMO/O to report concurrent sex partnerships [MSMW: 66.1%, PR 1.51 (1.20–1.92); MSMO/W: 60.5%, PR 1.39 (1.11–1.73); MSMO/O: 43.6%]. MSMW and MSMO/W more frequently reported sex partner concurrency than MSMO/O, [MSMW: 67.9%, PR 1.12 (0.91–1.38); MSMO/W: 72.1%, PR: 1.19 (1.01–1.41), MSMO/O: 60.5%]; however, this difference was only statistically significant among MSMO/W. Reported sex positioning with male partners was similar among MSMW and MSMO/O. MSMO/W were 60% more likely than MSMO/O to report insertive anal sex with multiple partners [34.9% vs. 21.8%, PR 1.60 (1.10–2.34)] and 57% more likely to report giving oral sex to multiple partners [50.6% vs. 32.2%, PR 1.57(1.19–2.07)] compared to MSMO/O. Substance use was similar across groups.

Among the 371 tested, Syphilis positivity was 9.4% (5/53) among MSMW, 14.1% (12/85) among MSMO/W and 18.5% among MSMO/O (43/233); these differences were not statistically significant. MSMW were significantly less frequently living with HIV compared to MSMO/O (24.1% vs. 42.7%; PR 0.56 (0.34–0.93)]. HIV prevalence among MSMO/W and MSMO/O was similar [45.9% vs. 42.7%, PR 1.08 (0.82–1.41)].

Multivariable models were adjusted for housing status and food insecurity (Table 2). Incarceration was not included in multivariable models due to the small sample size among MSMO/W (n=5). Results from multivariable models were similar to those observed in unadjusted models with some exceptions. MSMW compared to MSMO/O were more likely to report multiple sex partners, but this difference was not statistically significant [aPR: 1.28 (0.98–1.68)]. The association between MSMW (vs. MSMO/O) and transactional sex was attenuated but remained statistically significant [aPR: 2.07 (1.11–3.88)].

Discussion

In this cohort of urban, cisgender MSM with elevated syphilis acquisition risk, approximately one-in-seven reported a female sex partner, and just under one-quarter were MSMO who reported a sex partner who was MSMW in the past three months. In total, nearly two-fifths of participants reported recent direct (MSMW) or indirect (MSMO/W) connections to a female sex partner. In bivariate and adjusted analyses, MSMW and MSMO/W were significantly more likely than MSMO/O to report some sex behaviors that may indicate an increased syphilis acquisition/transmission risk. However, syphilis positivity among MSMW was substantially but not significantly lower than that observed among MSMO/O and MSMO/W. This study is one of few that explicitly examines syphilis and related risk factors among MSMW compared to MSMO. Findings suggest there may be considerable overlap between some high prevalence MSM and heterosexual networks that may facilitate syphilis transmission.

These results also underscore the importance of sexual network information in elucidating syphilis (and other STI) transmission dynamics. Including MSMO/W as a distinct MSM subpopulation allowed for observation of indirect connectivity, which substantially increased

the overall estimate of connectivity between MSM and cisgender females. This suggests that prior work examining direct linkages between MSM and female sex partners (i.e., only comparing MSMW and MSMO) may substantially underestimate the potential for sex network connectivity between MSM and women. In addition, the observed syphilis positivity among MSMW and MSMO/W in this study was higher than positivity previously observed among MSM in Baltimore and other settings.(24–26) This combination of observed high disease prevalence and increased frequency of concurrent partnerships suggests that MSMW and MSMO/W may be an important subpopulation for interventions. More research is needed to explore differing degrees of sex network connectivity between MSM and female sex partners to improve understanding of syphilis transmission dynamics.

Our findings add to existing evidence that MSM commonly report recent female sex partners,(9) and that syphilis acquisition/transmission risk among MSMW may be distinct from that experienced by MSMO. Our findings are consistent with prior work showing lower syphilis and HIV prevalence among MSMW compared to MSMO/O(12, 13) and that MSMW (vs. MSMO/O) reported significantly more sex behaviors and socioeconomic characteristics associated with increased risk of syphilis acquisition.(4, 9, 10, 12–15) This may indicate there is less potential for syphilis transmission bridging than has been previously hypothesized; however, transmission bridging between otherwise disconnected groups may still occur even with low disease prevalence among a bridge “group”.(27) Larger studies are needed to explore the context of sex partnerships between MSMW and their male and female partners as well as to confirm findings of lower syphilis prevalence among MSMW compared to MSMO.

The observed frequency of reported sex behaviors such as concurrency, sex partner concurrency and transactional sex among MSMW and MSMO/W combined with the direct and indirect connectivity to female sex partners suggest an underlying sexual network structure that could facilitate syphilis (and other STI) transmission between MSM and their female partners. In this study, MSMW reported any transactional sex twice as frequently compared to MSMO/O, suggesting it is possible that MSMW may experience elevated risk of syphilis acquisition from male or female transactional sex partners.(28) We were limited in our ability to examine whether reported transactional sex consisted of buying or selling sex, and the extent to which transactional sex was occurring with male or female sex partners. Nonetheless, MSMW engaged in transactional sex may be part of networks with high syphilis transmission potential. Focusing interventions (i.e., doxycycline post exposure prophylaxis) toward MSMW engaged in transactional sex and their partners may be effective in reducing syphilis incidence among MSMW,(25) and may alter the bridging potential of MSMW. Future network studies among MSM populations that recruit both male and female sex partners are needed to directly examine the potential for bidirectional transmission risk between MSM and female sex partners.

Results should be interpreted considering several limitations. Sex behavior and sex partner gender information was obtained through self-report; however, use of ACASI and rapport established between interviewers and participants should minimize recall and social desirability biases. Some participants disclosed female sex partners during the ACASI but not the network interview, which could be due to interviewer error, recall bias,

interview fatigue or participant reluctance to disclose female sex partners during face-to-face interviews. Participants who have sex with women occasionally, but not within the recall period may have been misclassified as MSMO/W or MSMO/O. Participants may have been unaware or misinformed as to whether their male partners also had sex with women, leading to misclassification of partners as MSMO or MSMW. Information on concurrency and sex partner concurrency was assessed only for the participant's three most recent partners, and observed results may underestimate these measures. Syphilis (and HIV) positivity among participants recruited from clinical sites may have been higher than among those recruited from the CBO or RDS, and fewer MSMW were recruited from clinical sites compared to the CBO or through RDS. However, when stratified by recruitment site/method, the trend of lower syphilis and HIV positivity among MSMW (vs. MSMO/O and MSMO/W) remained (data not shown). Our measure of syphilis positivity was based on RPR titers; some individuals with new infections but low titers may have been misclassified. However, any misclassification is likely to be non-differential across groups. Finally, this study population was drawn from a convenience sample of cisgender MSM in one U.S. city; results may not be generalizable to all MSM in this or other urban settings.

This study provides information on potential linkages between MSM and female sex partners that may impact syphilis transmission and demonstrates the importance of network data in elucidating transmission dynamics. Findings indicate there may be considerable overlap between MSM sexual networks with high syphilis prevalence and heterosexual networks that could facilitate syphilis transmission. Findings also concur with previous work demonstrating that syphilis acquisition risk among MSMW may be distinct from those of MSMO/O and suggest that MSMO/W also may have distinct syphilis acquisition/transmission risk. Future work should focus on examining the context and temporal patterns of sex partnerships among MSMW and their male and female sex partners to improve understanding of syphilis transmission dynamics across MSM and heterosexual networks.

Conflicts of Interest and Sources of Support:

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Table 1.

Baseline Characteristics and HIV/STI prevalence among Men who Have Sex with Men, USHINE study, Baltimore, Maryland, July 2018 – February 2020 (N = 385)

	n	%
Network connectivity group [a]		
MSMO/O	243	63.1
MSMW	56	14.5
MSMO/W	86	22.3
Demographic characteristics		
Black Race	284	73.8
Age ≤ 30 years	219	56.9
Socioeconomic characteristics		
Unemployed	138	35.8
Completed ≥ High School, (n=384)	351	91.4
Unhoused, past 6 months	97	25.2
Food insecure, past 6 months	189	49.1
Insured	336	87.3
Incarcerated, past 12 months	34	8.8
Number/Type of sex partners, past 3m		
Multiple[b] sex partners, (n=384)	194	50.5
Multiple[b] casual sex partners, (n=384)	141	36.7
Any anonymous sex	71	18.4
Any transactional sex	47	12.2
Concurrent sex partnerships[c]	195	50.7
Sex partner concurrency[c]	247	64.2
Sexual Repertoire with male partners, past 3m		
Receptive anal sex/bottomed with multiple[b] partners, (n=381)	81	21.3
Insertive anal sex/topped with multiple[b] partners, (n=380)	97	25.5
Received oral sex with multiple[b] partners, (n=379)	141	37.2
Gave oral sex to multiple[b] partners, (n=381)	134	35.2
Any Substance Use[d], past 3m	155	40.3
Syphilis positive[e] (n=371)	60	16.2
Living with HIV[f] (n=378)	154	40.7

[a]Network connectivity groups defined as MSMO/O: men who have sex with men only who report all sex partners are MSMO; MSMW: men who have sex with men and women; MSMO/W: men who have sex with men only and report at least one sex partner who is MSMW.

[b]Multiple sex partners defined as reporting 2 or more sex partners.

[c]Concurrent sex partners defined as reporting 2 or more overlapping sex partnerships in the past 3 months; Sex partner concurrency defined as reporting sex partners who have multiple sex partnerships. Assessed for three most recent partners only.

[d] Includes reported use of crack/cocaine, speedball, heroin, methamphetamine (crystal, tina, meth, speed), non-methamphetamine party drugs (Ecstasy, E, Molly, MDMA, GHB, Special K), psychedelics (acid, LSD, mushrooms, PCP), poppers/nitrates, prescription painkillers, or erectile dysfunction drugs.

[e] Syphilis Positive: rapid plasma reagin (RPR) titer ≥ 1:8 followed by reactive treponemal test. Positivity calculated among the 371 who were tested for syphilis.

[f] Living with HIV: positive HIV rapid test with ELISA confirmation and/or medical record documentation of a prior HIV diagnosis on or before study visit. Proportion living with HIV calculated among the 378 whose HIV status was known through testing or medical record documentation.

Table 2.

Baseline Characteristics and STI/HIV Prevalence by Network Connectivity Group[a], USHINE study, Baltimore City Maryland, July 2018-February 2020 (N=385)

	N	Row %	PR (95% CI)[g]		aPR (95%CI)[g]	
Demographic characteristics						
Black Race						
MSMO/O	174	71.6	Ref		Ref	
MSMW	50	89.3	**1.25**	**(1.11 – 1.41)** ‡	**1.17**	**(1.03 – 1.32)** *
MSMO/W	60	69.8	0.97	(0.83 – 1.14)	0.96	(0.82 – 1.11)
Age ≤ 30 years						
MSMO/O	139	57.2	Ref		Ref	
MSMW	26	46.4	0.81	(0.60 – 1.10)	0.84	(0.62 – 1.14)
MSMO/W	54	62.8	1.10	(0.90 – 1.34)	1.09	(0.90 – 1.33)
Socioeconomic characteristics						
Unemployed						
MSMO/O	82	33.7	Ref		Ref	
MSMW	24	42.9	1.27	(0.89 – 1.80)	0.99	(0.69 – 1.43)
MSMO/W	32	37.2	1.10	(0.80 – 1.53)	1.06	(0.78 – 1.44)
Completed ≥ High School						
MSMO/O	223	91.8	Ref		Ref	
MSMW	48	87.3	0.95	(0.85 – 1.06)	1.00	(0.88 – 1.13)
MSMO/W	80	93.0	1.01	(0.95 – 1.09)	1.02	(0.95 – 1.09)
Unhoused, past 6m						
MSMO/O	51	21.0	Ref			
MSMW	27	48.2	**2.30**	**(1.59 – 3.31)** ‡		
MSMO/W	19	22.1	1.05	(0.66 – 1.68)		
Food insecure, past 6m						
MSMO/O	108	44.4	Ref			
MSMW	37	66.1	**1.49**	**(1.18 – 1.88)** †		
MSMO/W	44	51.2	1.15	(0.90 – 1.48)		
Insured						
MSMO/O	215	88.5	Ref		Ref	
MSMW	47	83.9	0.95	(0.84 – 1.07)	0.96	(0.85 – 1.09)
MSMO/W	74	86.1	0.97	(0.88 – 1.07)	0.98	(0.89 – 1.08)
Incarcerated, past 12m						
MSMO/O	17	7.0	Ref			
MSMW	12	21.4	**3.06**	**(1.55 – 6.05)** †		
MSMO/W	5	5.8	0.83	(0.32 – 2.19)		
Number/Type of Sex Partners, past 3m						
Multiple[b] sex partners						
MSMO/O	109	45	Ref		Ref	

	N	Row %	PR (95% CI)[g]		aPR (95%CI)[g]	
MSMW	33	58.9	**1.31**	**(1.01 – 1.70)** *	1.28	(0.98 – 1.68)
MSMO/W	52	60.5	**1.34**	**(1.08 – 1.67)** †	**1.35**	**(1.09 – 1.69)** †
Multiple[b] casual partners						
MSMO/O	80	33.1	Ref		Ref	
MSMW	24	42.9	1.30	(0.91 – 1.84)	1.30	(0.90 – 1.88)
MSMO/W	37	43.0	1.30	(0.96 – 1.76)	1.31	(0.97 – 1.77)
Any anonymous sex						
MSMO/O	48	19.8	Ref		Ref	
MSMW	10	17.9	0.90	(0.49 – 1.68)	0.77	(0.40 – 1.48)
MSMO/W	13	15.1	0.77	(0.44 – 1.34)	0.76	(0.44 – 1.32)
Any transactional sex (buying or selling)						
MSMO/O	21	8.6	Ref		Ref	
MSMW	15	26.8	**3.10**	**(1.71 – 5.63)** ‡	**2.07**	**(1.11 – 3.88)** *
MSMO/W	11	12.8	1.48	(0.74 – 2.94)	1.44	(0.74 – 2.83)
Concurrent sex partnerships[c]						
MSMO/O	106	43.6	Ref		Ref	
MSMW	37	66.1	**1.51**	**(1.20 – 1.92)** †	**1.50**	**(1.17 – 1.92)** †
MSMO/W	52	60.5	**1.39**	**(1.11 – 1.73)** †	**1.39**	**(1.11 – 1.74)** †
Sex partner concurrency[c]						
MSMO/O	147	60.5	Ref		Ref	
MSMW	38	67.9	1.12	(0.91 – 1.38)	1.11	(0.90 – 1.38)
MSMO/W	62	72.1	**1.19**	**(1.01 – 1.41)** *	**1.19**	**(1.01 – 1.41)** *
Sexual repertoire with male partners, past 3m						
Receptive anal sex/bottomed with multiple[b] partners						
MSMO/O	47	19.7	Ref		Ref	
MSMW	10	17.9	0.91	(0.49 – 1.69)	0.78	(0.42 – 1.45)
MSMO/W	24	27.9	1.42	(0.93 – 2.17)	1.42	(0.93 – 2.18)
Insertive anal sex/topped with multiple[b] partners						
MSMO/O	52	21.8	Ref		Ref	
MSMW	15	27.3	1.25	(0.76 – 2.06)	1.13	(0.68 – 1.88)
MSMO/W	30	34.9	**1.60**	**(1.10 – 2.34)** *	**1.60**	**(1.10 – 2.32)** *
Received oral sex with multiple[b] partners						
MSMO/O	84	35.0	Ref		Ref	
MSMW	20	37.0	1.06	(0.72 – 1.56)	0.97	(0.65 – 1.44)
MSMO/W	37	43.5	1.24	(0.92 – 1.67)	1.25	(0.93 – 1.68)
Gave oral sex to multiple[b] partners						
MSMO/O	78	32.2	Ref		Ref	
MSMW	13	24.1	0.75	(0.45 – 1.24)	0.74	(0.44 – 1.24)
MSMO/W	43	50.6	**1.57**	**(1.19 – 2.07)** †	**1.56**	**(1.18 – 2.07)** †

	N	Row %	PR (95% CI)[g]		aPR (95%CI)[g]	
Any Substance Use, past 3m [d]						
MSMO/O	94	36.7	Ref		Ref	
MSMW	25	44.6	1.15	(0.83 – 1.61)	1.04	(0.75 – 1.46)
MSMO/W	36	41.9	1.08	(0.81 – 1.45)	1.08	(0.80 – 1.45)
Syphilis Positive [e]						
MSMO/O	43	18.5	Ref		Ref	
MSMW	5	9.4	0.51	(0.21–1.23)		
MSMO/W	12	14.1	0.76	(0.42–1.38)		
Living with HIV [f]						
MSMO/O	102	42.7	Ref		Ref	
MSMW	13	24.1	**0.56**	**(0.34 – 0.93)** *	**0.49**	**(0.30 – 0.80)** †
MSMO/W	39	45.9	1.08	(0.82 – 1.41)	1.04	(0.80 – 1.37)

[a] Network connectivity group defined as MSMO/O: men who have sex with men only who report all sex partners are MSMO, n=243; MSMW: men who have sex with men and women n=56; MSMO/W: men who have sex with men only and report at least on sex partner who is MSMW, n=86.

[b] Multiple sex partners defined as reporting 2 or more sex partners.

[c] Concurrent sex partners defined as reporting multiple overlapping sex partnerships in the past 3 months; Sex partner concurrency defined as reporting sex partners who have multiple sex partnerships.

[d] Includes reported use of crack/cocaine, speedball, heroin, methamphetamine (crystal, tina, meth, speed), non-methamphetamine party drugs (Ecstasy, E, Molly, MDMA, GHB, Special K), Psychedelics (acid, LSD, mushrooms, PCP), poppers/nitrates, Prescription painkillers, erectile dysfunction drugs.

[e] Syphilis Positive: rapid plasma reagin (RPR) titer ≥ 1:8 followed by reactive treponemal test. Positivity calculated among the 233 MSMO/O, 53 MSMW and 85 MSMO/W who were tested for syphilis.

[f] Living with HIV: positive HIV rapid test with ELISA confirmation and/or medical record documentation of a prior HIV diagnosis on or before study visit. Proportion living with HIV calculated among the 239 MSMO/O, 54 MSMW and 85 MSMO/W whose HIV status was known through testing or medical record documentation.

[g] Prevalence ratios calculated using modified Poisson regression; Adjusted models control for housing status and food insecurity. Multivariable models were not performed for recent incarceration or syphilis positivity due to small cell sizes.

* $p < 0.05$

† $p<0.01$

‡ $p < 0.001$