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# Methamphetamine Use, Syphilis, and Specific Online Sex Partner Meeting Venues Are Associated With HIV Status Among Urban Black Gay and Bisexual Men Who Have Sex Men

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**Background:** In the context of increasing syphilis rates, particularly among Black men who have sex men (MSM), the objectives were to determine the associations between methamphetamine (meth) use and syphilis and HIV positivity, and to identify sex partner meeting venues as potential intervention access points among Black MSM in a mid-Atlantic US city.

**Methods:** This study is an ongoing longitudinal cohort study. Participants were recruited from clinical and nonclinical settings and included sexually active MSM aged 18 to 45 years. The baseline visit included a behavioral survey and testing for syphilis, HIV, gonorrhea, and chlamydia. Logistic regression analyses were used for hypothesis testing.

**Results:** Among 359 MSM completing baseline, 74.4% (268) Black MSM were included; 31% (84) were aged 24 to 29 years, 43.7% (117) reported unprotected anal intercourse at last sex, and 15.3% (41) reported meth use in the past 3 months. Sixteen percent (43) had syphilis, 46.6%

(125) were living with HIV, and 19.0% (51) had gonorrhea and/or chlamydia. Meth use was associated with sexual and drug risk behaviors and HIV, but not syphilis. In adjusted analyses, meth use increased the odds of HIV positivity by 6.43 (95% confidence interval, 2.30–17.98) and syphilis positivity by 2.57 (95% confidence interval, 1.23–5.37). Four online sex partner meeting venues were associated with meth use and HIV, whereas syphilis was associated with one.

**Conclusions:** Among Black MSM, meth use and syphilis positivity were associated with more than 6-fold and almost 3-fold increased adjusted odds of HIV positivity, respectively. Four specific sex partner meeting venues may be important access points for HIV/sexually transmitted infection and substance use prevention.

Syphilis rates have been rising in many urban settings globally and specifically among gay and bisexual men (men who have sex men, or MSM). Overall, more than 260,000 confirmed syphilis cases were reported from 30 European countries between 2007 and 2017.<sup>1</sup> In 2017, notification rates reached an all-time high in Europe with more than 33,000 reported cases of syphilis.<sup>1</sup> Men who have sex with men in Europe account for an increasing proportion of syphilis cases.<sup>1</sup> In the United States, from 2017 to 2018, there were more than 115,000 syphilis cases, and the number of primary and secondary (P&S) syphilis cases increased by 14% to more than 35,000 cases, which represented the highest number reported since 1991.<sup>2</sup> Nearly 86% (30,034) of all P&S syphilis cases in 2018 were among men, and MSM accounted for 54% (18,760) of all syphilis cases. Estimates suggest that in the United States about 50% of MSM infected with syphilis are also living with HIV, suggesting a syndemic. Although data suggest that multiple factors may be contributing to the syphilis epidemic among MSM, a handful of studies suggest that drug use and specifically stimulant use, such as methamphetamine (meth) use, in combination with sex may be a significant contributing factor.<sup>3</sup>

Methamphetamine is the most commonly used stimulant drug in the world.<sup>4</sup> Meth is a synthetic, potent, and highly addictive stimulant, which can be injected, snorted, or smoked. It is also commonly known as blue, ice, T, Tina, and crystal, and is a white, odorless, bitter-tasting crystalline powder that easily dissolves in water or alcohol.<sup>5</sup> Data from the National Survey on Drug Use and Health in 2017 found that approximately 5.4% of the US population (>14.7 million people) had tried meth at least once and that 1.6 million people had used meth in the past year.<sup>5,6</sup> Since 2011, meth use has increased in some urban areas including, for example, a doubling (4% to 9%) of meth use documented among MSM in New York City<sup>7</sup> and similar increases among MSM in

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San Diego.<sup>8</sup> Higher rates of stimulant use have been identified among Black MSM; between 2 studies, one found that 1 in 5 young Black MSM in 2 large cities in Texas reported stimulant use in the past 2 months<sup>9</sup> (Carrico et al.), and the other showed that 1 in 3 Black MSM in Massachusetts used stimulants (crack, cocaine, and/or crystal meth) during sex at least monthly (Mimiaga et al.).<sup>10</sup>

Among MSM, drug use and meth use specifically have been consistently found to be associated with increased sexual risk behaviors and an increased likelihood of sexually transmitted infections (STIs), including HIV infection.<sup>10–18</sup> In a study among 1683 sexually active MSM recruited online from the United States and Canada, meth use was significantly associated with unprotected anal intercourse (UAI).<sup>19</sup> Meth use has also been associated with use of other “party” drugs and chemsex.<sup>20–22</sup> In one study among Australian MSM, participants who reported regular (vs. less frequent) meth use were more likely to have used  $\gamma$ -hydroxybutyrate (or GHB), party drugs for sex, and injected drugs in the previous 6 months.<sup>23</sup> Notably, there has been a dearth of studies examining meth use specifically among Black MSM.<sup>10</sup>

Emerging work suggests that dating apps may facilitate drug use among MSM, creating a platform for interconnected drug and sexual networks. Among a sample of predominately White and Latino MSM who were dating app users, 48% reported using drugs or alcohol during sex.<sup>24</sup> The use of identifying terms in dating app profiles facilitates the identification of and connection with others who are using and seeking drug use during sex. Individuals indicate meth use and more generally chemsex in their personal dating app profiles by, for example, using the term “ParTy and Play (PnP),” with the capital T denoting T/Tina (meth use), or integrating capital T’s or crystal emojis elsewhere in their profiles.<sup>25,26</sup> Furthermore, the use of online venues to meet sex partners has increased over time among MSM, and associations between higher meth use and specific online venues (e.g., Adam4Adam and Manhunt) have been reported.<sup>27,28</sup>

In the context of increasing syphilis rates and the limited number of studies conducted among Black MSM, the objectives of these analyses were to determine the association between meth use, syphilis, and HIV positivity, and to identify sex partner meeting venues as potential intervention access points among Black MSM in one mid-Atlantic US city without documentation of these associations. Black MSM were the specific population of focus in this study because of high rates of syphilis and HIV in this population and severe long-standing racial disparities in STIs and HIV in this setting.

## METHODS

### Overview

The data for this study are from the Understanding Sexual Health in Networks (USHINE) study, an ongoing prospective cohort study conducted by the Johns Hopkins Center for Child and Community Health Research in collaboration with the Baltimore City Health Department and the Centers for Disease Control and Prevention. The overall goal of the USHINE study is to understand the network epidemiology of syphilis among MSM to identify ways to alter and strengthen local health department practices regarding the syphilis prevention-care continuum. As a part of the study, there is an active Community Advisory Board (CAB) comprising 5 to 7 males who identify as Black MSM and are local city residents; results of these analyses were shared with the CAB informally to contextualize the findings. This study was approved by the Johns Hopkins School of Medicine institutional review board.

### Setting

Baltimore City, Maryland, ranks among US cities with the highest incidence of syphilis among MSM. In 2018, the P&S syphilis rate in Baltimore City was 4.2-fold higher than the national rate (45.3 vs. 10.8 per 100,000)<sup>29</sup> and 60.6% (348) of all reported early syphilis cases (P&S and early latent) were among MSM, among whom 81.9% (285) were Black MSM (Baltimore City Health Department Epidemiologist, personal communication, January 27, 2021).

### Study Population

Participants were recruited from 2 health department sexual health clinics, a federally qualified health center, a community-based LGBTQ+ organization, community engagement events, and respondent-driven sampling. Respondent-driven sampling is a peer referral method used commonly when recruiting harder to reach populations such as MSM.<sup>30</sup> Individuals were eligible to participate if they reported male sex at birth, current male gender, age 18 to 45 years, sex with a man in the past 6 months, residence in Baltimore City, and that they were willing and able to give informed consent for the study. Data for this analysis included baseline data from participants enrolled from July 20, 2018, to February 28, 2020. The baseline visit included testing for syphilis, HIV, gonorrhea, and chlamydia, as well as an audio-computer self-assisted interview behavioral survey and a social network interview of recent sex partners.

### Measures

The primary exposure was meth use, ascertained by 2 questions: “In the past three months, which of the following drugs did you use?” and “Have you used any of the following before or during sex in the past three months?” Methamphetamines (e.g., crystal, Tina, meth, and speed) was listed as one option, and the participant was coded as a meth user or nonuser in the past 3 months depending on their responses. The primary outcomes were (1) syphilis positivity defined as a reactive rapid plasma reagin titer followed by a reactive treponemal test and to better reflect active infection, a rapid plasma reagin titer cutoff of greater than or equal to 1:8 was used, and (2) HIV positivity defined as a positive HIV rapid test result with enzyme-linked immunosorbent assay confirmation at any study visit and/or medical record documentation of a prior positive HIV diagnosis. Information about sex partner meeting venues was ascertained by 2 questions: “In the past three months, which physical places like a bar or club did you meet sex partners?” and “In the past three months, which online places did you meet sex partners?” Other variables of interest included self-identified race, age, education, employment status, UAI at last sex, number of sex partners in the past 3 months, anonymous sex in the past 3 months, injection and noninjection drug use, any nonmeth party drug (ecstasy, E, Molly, MDMA, GHB, Special K), and chlamydia and/or gonorrhea positivity at any anatomical site, determined by a nucleic acid amplification test.

### Statistical Analysis

Summary statistics were generated, and  $\chi^2$  tests were conducted to test for significant associations between the primary exposure—meth use, participant characteristics (i.e., demographic, sexual and drug risk behaviors), and syphilis and HIV infection status. All statistical analyses were performed using Stata Version 14. Statistical significance for bivariate analyses and entry of factors into the multivariable regression was determined by a *P* value of less than 0.10, whereas statistical significance in regression analyses was determined by a confidence interval (CI) that

did not cross 1.0 and a *P* value of less than 0.05. Two sensitivity analyses were conducted on the final multivariable regression model. In the first, syphilis was redefined as any primary, secondary, and early latent syphilis diagnoses based on staging. In the second, employment was excluded given the potential for employment to be part of the broader construct of socioeconomic status and an upstream determinant in the relationship between meth use and STI/HIVs.

### RESULTS

A total of 567 individuals were recruited to participate, of whom 76.1% (432) were eligible and 98.8% (427) agreed to participate and signed an informed consent form. Among these 427 MSM, 84.1% (359) completed the baseline survey and biologic testing for syphilis and HIV. Of these 359 MSM, 74.7% (268) identified as Black MSM and represented the final study population.

Overall, the highest proportion of participants, 31.3% (84), were between 24 and 29 years of age, 30.6% (82) of participants had greater than a high school education, and 59.0% (158) reported that they were currently working (Table 1). Forty-four percent (117)

reported UAI at last sex, 30.6% (82) reported greater than 3 sex partners in the past 3 months, and 19.4% (52) reported anonymous sex in the past 3 months. In the past 3 months, 3.4% (9) reported injection drug use (IDU; of which all were reports of injection meth use), 33.2% (89) reported non-IUD (excluding meth use), 15.3% (41) reported meth use, and 10.8% (29) reported other nonmeth party drug use, not including meth use (i.e., ecstasy, E, Molly, MDMA, GHB, Special K). Sixteen percent (43) of participants were syphilis positive (active syphilis per definition), 46.6% (125) were HIV positive, and 19.0% (51/227) were gonorrhea and/or chlamydia positive. The top 5 sex partner meeting venues in the past 3 months were included in analyses and only included online sex partner meeting venues. The proportion of participants who reported using the following sex partner meeting venues in the past 3 months was as follows: 53.7% (144) for Jack'd, 36.2% (97) for Grindr, 22.8% (61) for Facebook, 28.0% (75) for Adam4Adam, and 17.5% (47) for Instagram.

Meth use (vs. nonuse) in the past 3 months was significantly associated with older age (*P* < 0.0001) and no employment (*P* < 0.0001; Table 1). Meth use (vs. nonuse) was associated with the following sexual and drug behaviors in the past 3 months: report of

**TABLE 1.** Participant Characteristics Associated With Methamphetamine (Meth) Use\* Among Black Gay, Bisexual, and Other Men Who Have Sex With Men (MSM) in the USHINE Study, Baltimore City, 2018 to 2020 (n = 268)

Characteristics	Overall (n = 268), n (%)	Meth Use* (n = 41 [15.3%]), n (%)	No Meth Use (n = 227 [84.7%]), n (%)	<i>P</i> <sup>†</sup>
<b>Demographics</b>				
Age, y				
18–24	56 (20.9)	<b>1 (2.4)</b>	<b>55 (24.2)</b>	<0.0001
24–29	84 (31.3)	<b>10 (24.4)</b>	<b>74 (32.6)</b>	
30–34	65 (24.3)	<b>12 (29.3)</b>	<b>53 (23.4)</b>	
34–39	39 (14.6)	<b>12 (29.3)</b>	<b>27 (11.9)</b>	
≥39	24 (9.0)	<b>6 (14.6)</b>	<b>18 (7.9)</b>	
Education (n = 267), <high school	185 (69.0)	31 (75.6)	154 (68.1)	0.340
Employment status, not working	110 (41.0)	<b>27 (65.9)</b>	<b>83 (36.6)</b>	<0.0001
<b>Sexual risk behaviors</b>				
Unprotected anal intercourse, last sex	117 (43.7)	21 (51.2)	96 (42.3)	0.289
Sex partners, past 3 mo, >3 partners	82 (30.6)	<b>27 (65.9)</b>	<b>55 (24.2)</b>	<0.0001
Anonymous sex, past 3 mo	52 (19.4)	<b>15 (36.6)</b>	<b>37 (16.3)</b>	<b>0.003</b>
<b>Drug risk behaviors</b>				
Injection drug use, past 3 mo	9 (3.4)	<b>9 (22.0)</b>	<b>0 (0)</b>	<0.0001
Noninjection drug use, past 3 mo <sup>§</sup>	89 (33.2)	<b>27 (65.9)</b>	<b>62 (27.3)</b>	<0.0001
Nonmeth party drug (ecstasy, E, Molly, MDMA, GHB, Special K), past 3 mo	29 (10.8)	<b>15 (36.6)</b>	<b>14 (6.2)</b>	<0.0001
<b>STI/HIV infection status</b>				
Syphilis positive <sup>¶</sup>	43 (16.0)	8 (19.5)	35 (15.4)	0.511
HIV positive/person living with HIV <sup>  </sup>	125 (46.6)	<b>33 (80.5)</b>	<b>92 (40.5)</b>	<0.0001
Gonorrhea and/or chlamydia positive <sup>**</sup> (n = 227)	51 (19.0)	8 (19.5)	43 (18.9)	0.990
Sex partner meeting venues, past 3 mo <sup>††</sup>				
Jack'd	144 (53.7)	<b>30 (73.2)</b>	<b>114 (50.2)</b>	<b>0.007</b>
Grindr	97 (36.2)	<b>29 (70.7)</b>	<b>68 (30.0)</b>	<0.0001
Facebook	61 (22.8)	<b>23 (56.1)</b>	<b>38 (16.7)</b>	<0.0001
Adam4Adam	75 (28.0)	<b>16 (39.0)</b>	<b>59 (26.0)</b>	<b>0.087</b>
Instagram	47 (17.5)	4 (9.8)	43 (18.9)	0.155

Bold font indicates significance at *P* < 0.01.

\*Meth use defined as any use of meth use (e.g., crystal, T, Tina, and meth speed) including use before or during sex in the past 3 months.

<sup>†</sup>χ<sup>2</sup> Test to evaluate significance.

<sup>‡</sup>Employment defined as not working full-time, part-time, or as self-employed.

<sup>§</sup>Excluding meth use.

<sup>¶</sup>Syphilis positive defined as a reactive rapid plasma reagin titer followed by a reactive treponemal test and reflect active infection; a titer cutoff of greater than or equal to 1:8 was used.

<sup>||</sup>HIV positive/person living With HIV was defined as a positive HIV rapid test result with enzyme-linked immunosorbent assay confirmation at a study visit and/or medical record documentation of a prior positive HIV diagnosis.

<sup>\*\*</sup>Gonorrhea and/or chlamydia positive defined as a positive result by a nucleic acid amplification test at any anatomical site.

<sup>††</sup>Sex partner meeting venues defined as report of any venue including online and physical venues where the participant met a sex partner in the past 3 months and the top 5 reported venues were included.

more than 3 sex partners ( $P < 0.0001$ ), anonymous sex ( $P = 0.003$ ), IDU ( $P < 0.0001$ ), non-IUD ( $P < 0.0001$ ), and use of nonmeth party drugs ( $P < 0.0001$ ). Meth use (vs. nonuse) was associated with HIV positivity ( $P < 0.0001$ ), but not syphilis positivity ( $P = 0.511$ ) or gonorrhea and/or chlamydia positivity ( $P = 0.990$ ). Meth use (vs. nonuse) was also associated with report of the use of any of four sex partner meeting venues in the past 3 months including Jack'd ( $P = 0.007$ ), Grindr ( $P < 0.0001$ ), Facebook ( $P < 0.0001$ ), and Adam4Adam ( $P = 0.087$ ), but not Instagram ( $P = 0.155$ ).

Syphilis positivity was significantly associated with HIV positivity ( $P = 0.021$ ), gonorrhea and/or chlamydia positivity ( $P = 0.002$ ), and reported use in the past 3 months of Facebook to meet sex partners ( $P = 0.010$ ; Table 2).

HIV positivity was significantly associated with increased age ( $P < 0.0001$ ) and no employment ( $P = 0.001$ ; Table 3). HIV positivity was associated with IDU in the past 3 months ( $P = 0.057$ ), meth use in the past 3 months ( $P < 0.0001$ ), syphilis positivity ( $P < 0.021$ , as reported previously), and reported use of the following sex partner meeting venues in the past 3 months including Jack'd ( $P < 0.0001$ ), Grindr ( $P < 0.0001$ ), Facebook ( $P = 0.029$ ), and Adam4Adam ( $P = 0.056$ ).

Logistic regression analyses were conducted to determine factors associated with HIV positivity based on the bivariate results suggesting a significant relationship between meth use and HIV (Table 4). In unadjusted analyses, meth use (odds ratio [OR], 6.05; 95% CI, 2.68–13.70), syphilis positivity (OR, 2.19; 95% CI, 1.12–4.28), older age (OR, 1.07; 95% CI, 1.03–1.11), and employment status (OR, 2.36; 95% CI, 1.43–3.88) were significantly associated with HIV positivity. In a model with meth use and syphilis, meth use (adjusted OR [aOR], 6.06; 95% CI, 2.66–13.78) and syphilis positivity (aOR, 2.19; 95% CI, 1.09–4.40) were significantly associated with HIV positivity. After adjusting for age and employment, the odds of HIV positivity associated with meth use were 4.41 (95% CI, 1.88–10.33) and syphilis positivity was 2.64 (95% CI, 1.27–5.50). The association persisted (aOR, 5.96; 95% CI, 2.33–15.21) after adjusting for age, employment, UAI, number of sex partners, and anonymous sex in the past 3 months and remained significant after also adjusting for IDU (aOR, 6.41; 95% CI, 2.26–18.19). To explore the meth use, syphilis, and HIV relationship further, we ran an additional multivariable regression stratifying by meth use and syphilis with the reference category as no meth use and not syphilis positive (Table 5). In this final model

**TABLE 2.** Participant Characteristics Associated With Syphilis Positivity\* Among Black Gay, Bisexual, and Other Men Who Have Sex With Men (MSM) in the USHINE Study, Baltimore City, 2018 to 2020 (n = 268)

Characteristics	Overall (n = 268), n (%)	Syphilis Positive (n = 43 [16.0%]), n (%)	Syphilis Negative (n = 225 [84.0%]), n (%)	P†
<b>Demographics</b>				
Age, y				
18–24	56 (20.9)	11 (25.6)	45 (25.0)	0.799
24–29	84 (31.3)	15 (34.9)	69 (30.7)	
30–34	65 (24.3)	8 (18.6)	57 (25.3)	
34–39	39 (14.6)	6 (14.0)	33 (14.7)	
≥39	24 (9.0)	3 (7.0)	21 (9.3)	
Education (n = 267), ≤high school	185 (69.0)	26 (60.5)	159 (71.0)	0.171
Employment status, not working‡	110 (41.0)	27 (62.8)	131 (58.2)	0.577
<b>Sexual risk behaviors</b>				
Unprotected anal intercourse, last sex	117 (43.7)	23 (53.5)	94 (41.8)	0.156
Sex partners, past 3 mo, >3 partners	144 (46.3)	23 (53.5)	121 (53.8)	0.972
Anonymous sex, past 3 mo	52 (19.4)	7 (16.3)	45 (20.0)	0.572
<b>Drug risk behaviors</b>				
Injection drug use, past 3 mo	9 (3.4)	3 (7.0)	6 (2.7)	0.151
Noninjection drug use, past 3 mo§	89 (33.2)	15 (34.9)	74 (32.9)	0.799
Methamphetamine (meth) use, past 3 mo¶	41 (15.3)	8 (18.6)	33 (14.7)	0.511
Nonmeth party drug use (ecstasy, E, Molly, MDMA, GHB, Special K), past 3 mo	29 (10.8)	5 (11.6)	24 (10.7)	0.853
<b>HIV/STI infection status</b>				
HIV positive/person living with HIV	125 (46.6)	<b>27 (62.8)</b>	<b>98 (43.6)</b>	<b>0.021</b>
Gonorrhea and/or chlamydia positive** (n = 227)	51 (19.0)	<b>15 (42.9)</b>	<b>36 (18.8)</b>	<b>0.002</b>
Sex partner meeting venues, past 3 mo††				
Jack'd	144 (53.7)	24 (55.8)	120 (53.3)	0.765
Grindr	97 (36.2)	12 (27.9)	85 (37.8)	0.217
Facebook	61 (22.8)	<b>19 (44.2)</b>	<b>56 (24.9)</b>	<b>0.010</b>
Adam4Adam	75 (28.0)	10 (23.3)	51 (22.7)	0.933
Instagram	47 (17.5)	9 (20.9)	38 (16.9)	0.523

Bold font indicates significance at  $P < 0.01$ .

\*Syphilis positive defined as a reactive rapid plasma reagin titer followed by a reactive treponemal test and reflect active infection; a titer cutoff of greater than or equal to 1:8 was used.

† $\chi^2$  Test to evaluate significance.

‡Employment defined as not working full-time, part-time, or as self-employed.

§Excluding meth use.

¶Meth use defined as any use of meth use (e.g., crystal, T, Tina, and meth speed) including use before or during sex in the past 3 months.

||HIV positive/person living with HIV was defined as a positive HIV rapid test result with enzyme-linked immunosorbent assay confirmation at a study visit and/or medical record documentation of a prior positive HIV diagnosis.

\*\*Gonorrhea and/or chlamydia positive defined as a positive result by a nucleic acid amplification test at any anatomical site.

††Sex partner meeting venues defined as report of any venue including online and physical venues where the participant met a sex partner in the past 3 months and the top 5 reported venues were included.

**TABLE 3.** Participant Characteristics Associated With HIV Positivity\* Among Black Gay, Bisexual, and Other Men Who Have Sex With Men (MSM) in the USHINE Study, Baltimore City, 2018 to 2020 (n = 268)

Characteristics	Overall (n = 268), n (%)	HIV Positive* (n = 125 [46.6%]), n (%)	HIV Negative (n = 143 [53.4%]), n (%)	P†
<b>Demographics</b>				
Age, y				
18–24	56 (20.9)	<b>11 (8.8)</b>	<b>45 (31.5)</b>	<b>&lt;0.0001</b>
24–29	84 (31.3)	<b>43 (34.4)</b>	<b>41 (28.7)</b>	
30–34	65 (24.3)	<b>39 (31.2)</b>	<b>26 (18.2)</b>	
34–39	39 (14.6)	<b>17 (13.6)</b>	<b>22 (15.4)</b>	
≥39	24 (9.0)	<b>15 (12.0)</b>	<b>9 (6.3)</b>	
Education (n = 267), ≤high school	185 (69.0)	82 (66.1)	103 (72.0)	0.297
Employment status, not working‡	110 (41.0)	<b>65 (52.0)</b>	<b>45 (31.5)</b>	<b>0.001</b>
<b>Sexual risk behaviors</b>				
Unprotected anal intercourse, last sex	117 (43.7)	61 (48.8)	56 (39.2)	0.112
Sex partners, past 3 mo, >3 partners	82 (30.6)	38 (30.4)	44 (30.8)	0.948
Anonymous sex, past 3 mo	52 (19.4)	26 (20.8)	26 (18.2)	0.589
<b>Drug risk behaviors</b>				
Injection drug use, past 3 mo	9 (3.4)	<b>7 (5.6)</b>	<b>2 (1.4)</b>	<b>0.057</b>
Noninjection drug use, past 3 mo§	89 (33.2)	46 (36.8)	43 (30.1)	0.243
Methamphetamine (meth) use, past 3 mo¶	41 (15.3)	<b>33 (36.4)</b>	<b>8 (5.6)</b>	<b>&lt;0.0001</b>
Nonmeth party drug use (ecstasy, E, Molly, MDMA, GHB, Special K), past 3 mo	29 (10.8)	17 (13.6)	12 (8.4)	0.171
<b>STI infection status</b>				
Syphilis positive	43 (16.0)	<b>27 (21.6)</b>	<b>16 (11.2)</b>	<b>0.021</b>
Gonorrhea and/or chlamydia positive** (n = 227)	51 (19.0)	27 (26.2)	24 (19.4)	0.218
Sex partner meeting venues, past 3 mo††				
Jack'd	144 (53.7)	<b>87 (69.6)</b>	<b>57 (39.9)</b>	<b>&lt;0.0001</b>
Grindr	97 (36.2)	<b>47 (37.6)</b>	<b>50 (35.0)</b>	<b>&lt;0.0001</b>
Facebook	61 (22.8)	<b>43 (34.4)</b>	<b>32 (22.4)</b>	<b>0.029</b>
Adam4Adam	75 (28.0)	<b>35 (28.0)</b>	<b>26 (18.2)</b>	<b>0.056</b>
Instagram	47 (17.5)	17 (13.6)	30 (21.0)	0.113

Bold font indicates significance at  $P < 0.01$ .

\*HIV positive/person living with HIV was defined as a positive HIV rapid test result with enzyme-linked immunosorbent assay confirmation at a study visit and/or medical record documentation of a prior positive HIV diagnosis.

† $\chi^2$  Test to evaluate significance.

‡Employment defined as not working full-time, part-time, or as self-employed.

§Excluding meth use.

¶Meth use defined as any use of meth use (e.g., crystal, T, Tina, and meth speed) including use before or during sex in the past 3 months.

||Syphilis positive defined as a reactive rapid plasma reagin titer followed by a reactive treponemal test and reflect active infection; a titer cutoff of greater than or equal to 1:8 was used.

\*\*Gonorrhea and/or chlamydia positive defined as a positive result by a nucleic acid amplification test at any anatomical site.

††Sex partner meeting venues defined as report of any venue including online and physical venues where the participant met a sex partner in the past 3 months and the top 5 reported venues were included.

**TABLE 4.** The Unadjusted Odds Ratios (ORs) and Adjusted Odds Ratios (AORs) of HIV Positivity\* Associated With Methamphetamine (Meth) Use† and Syphilis Positivity‡ Adjusting for Age, Employment, and Sexual and Drug Risk Behaviors Among Black Gay, Bisexual, and Other Men Who Have Sex With Men (MSM) in the USHINE Study, Baltimore City, 2018 to 2020 (n = 268)

	OR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Meth use†, past 3 mo	<b>6.05</b>	<b>2.68–13.70</b>	<b>6.06</b>	<b>2.66–13.78</b>	<b>4.41</b>	<b>1.88–10.33</b>	<b>5.96</b>	<b>2.33–15.21</b>	<b>6.41</b>	<b>2.26–18.19</b>
Syphilis positive‡	<b>2.19</b>	<b>1.12–4.28</b>	<b>2.19</b>	<b>1.09–4.40</b>	<b>2.64</b>	<b>1.27–5.50</b>	<b>2.56</b>	<b>1.22–5.37</b>	<b>2.57</b>	<b>1.23–5.37</b>
Age, continuous	<b>1.07</b>	<b>1.03–1.11</b>			<b>1.05</b>	<b>1.01–1.10</b>	<b>1.05</b>	<b>1.00–1.10</b>	<b>1.05</b>	<b>1.00–1.10</b>
Employment status, not working§	<b>2.36</b>	<b>1.43–3.88</b>			<b>1.96</b>	<b>1.15–3.35</b>	<b>1.97</b>	<b>1.15–3.39</b>	<b>1.96</b>	<b>1.14–3.37</b>
Unprotected anal intercourse, last sex	1.48	0.91–2.41			1.48	0.86–2.54	1.49	0.87–2.56	1.49	0.87–2.56
Sex partners, past 3 mo, >3 partners	0.98	0.58–1.65			0.51	0.25–1.01	0.51	0.25–1.02	0.51	0.25–1.02
Anonymous sex, past 3 mo	1.18	0.64–2.17			1.22	0.59–2.56	1.22	0.59–2.55	1.22	0.59–2.55
Injection drug use, past 3 mo	4.18	0.85–20.52							0.72	0.11–4.81

Bold font indicates significance at  $P < 0.05$ .

\*HIV positivity was defined as a positive HIV rapid test result with enzyme-linked immunosorbent assay confirmation at a study visit and/or medical record documentation of a prior positive HIV diagnosis, that is, person living with HIV.

†Meth use defined as any use of meth use (e.g., crystal, T, Tina, and meth speed) including use before or during sex in the past 3 months.

‡Syphilis positive defined as a reactive rapid plasma reagin titer followed by a reactive treponemal test and reflect active infection; a titer cutoff of greater than or equal to 1:8 was used.

§Employment defined as not working full-time, part-time, or as self-employed.

**TABLE 5.** The Adjusted Odds Ratios (AORs) of HIV Positivity\* Associated With Methamphetamine (Meth) Use<sup>†</sup> and Syphilis Positivity<sup>‡</sup> Adjusting for Age, Employment, and Sexual and Drug Risk Behaviors Among Black Gay, Bisexual, and Other Men Who Have Sex With Men (MSM) in the USHINE Study, Baltimore City, 2018 to 2020 (n = 268)

	OR	95% CI	AOR	95% CI
No meth use, not syphilis positive	Reference	Reference	Reference	Reference
No meth use, syphilis positive	<b>2.22</b>	<b>1.07–4.61</b>	<b>2.70</b>	<b>1.25–5.84</b>
Meth use, not syphilis positive	<b>6.19</b>	<b>2.56–14.99</b>	<b>6.84</b>	<b>2.30–20.34</b>
Meth use, syphilis positive	<b>11.67</b>	<b>1.41–96.77</b>	<b>10.56</b>	<b>1.11–100.18</b>
Age, continuous	<b>1.07</b>	<b>1.03–1.11</b>	<b>1.05</b>	<b>1.00–1.09</b>
Employment status, not working <sup>§</sup>	<b>2.36</b>	<b>1.43–3.88</b>	<b>1.98</b>	<b>1.15–3.42</b>
Unprotected anal intercourse, last sex	1.48	0.91–2.41	1.50	0.87–2.58
Sex partners, past 3 mo, >3 partners	0.98	0.58–1.65	0.50	0.25–1.01
Anonymous sex, past 3 mo	1.18	0.64–2.17	1.24	0.59–2.58
Injection drug use, past 3 mo	4.18	0.85–20.52	0.75	0.11–4.89

Bold font indicates significance at  $P < 0.05$ .

\*HIV positivity was defined as a positive HIV rapid test result with enzyme-linked immunosorbent assay confirmation at a study visit and/or medical record documentation of a prior positive HIV diagnosis, that is, person living with HIV.

<sup>†</sup>Meth use defined as any use of meth use (e.g., crystal, T, Tina, and meth speed) including use before or during sex in the past 3 months.

<sup>‡</sup>Syphilis positive defined as a reactive rapid plasma reagin titer followed by a reactive treponemal test and reflect active infection; a titer cutoff of greater than or equal to 1:8 was used.

<sup>§</sup>Employment defined as not working full-time, part-time, or as self-employed.

compared with the reference, the adjusted odds of HIV positivity significantly increased by 2.70 (95% CI, 1.25–5.84) for no meth use and syphilis positivity, by 6.84 (95% CI, 2.30–20.34) for meth use and no syphilis positivity, and by 10.56 (95% CI, 1.11–100.18) for meth use and syphilis positivity.

In sensitivity analysis with syphilis defined as primary, secondary, and early latent by staging, meth use (aOR, 5.96; 95% CI, 2.34–15.20) and syphilis positivity (aOR, 3.58; 95% CI, 1.47–6.75) remained significantly associated with HIV positivity (data not shown in Table 4). After excluding employment from the final multivariable model, the associations also remained similar (meth use: aOR, 6.91 [95% CI, 2.51–18.98]; syphilis positivity: aOR < 2.41 [95% CI, 1.17–4.96]) to the model including employment (data not shown in Table 4).

## DISCUSSION

The overall goal of the USHINE study is to inform public health prevention and control activities in the context of increasing rates of syphilis among MSM, an overlapping epidemic of HIV and long-standing, severe racial disparities in STIs and HIV in this setting. The objective of this analysis was to determine the association between meth use and syphilis and HIV positivity. In addition, analyses were included to determine whether specific sex partner meeting venues were associated with meth use, syphilis positivity, and HIV positivity. These analyses were conducted to explore which venues may be acting as facilitators of drug use and STI/HIV transmission networks as well as which may be important access points for prevention and control interventions.

In this study population of Black MSM drawn from clinical and nonclinical settings, the prevalence of meth use was 15.3% including 3.4% reported as injection meth use. Members of the CAB suggested that the prevalence of meth use among their MSM community members had increased since 2015 (USHINE CAB, personal communication, July 18, 2019). Evidence from the National Health Behavioral study in 2012 and 2015 suggests that injection meth use may be increasing among MSM.<sup>14,17,31s</sup> The prevalence of meth use identified is significantly higher than a national survey, suggesting the rates of meth use at 0.5% to 2.6% among MSM,<sup>9</sup> but lower than the estimate of approximately 20% of young Black MSM in Texas reporting stimulant use.<sup>31s</sup> Recent new research suggests that meth alters innate immune pathways that facilitate HIV replication within an individual, suggesting potentially increased

transmission efficiency of HIV among HIV-infected meth users.<sup>32s</sup> The participants also reported high levels of other substance use; 33.2% reported noninjection nonmeth substance use and other substance use including party drugs were significantly associated with meth use. Like meth alone, use of other party drugs and chemsex is prevalent among MSM and highly associated with sexual risk-taking behavior and diagnoses and self-reported STIs and HIV.<sup>14,33s–37s</sup> Interestingly, in contrast to other studies, the association between meth use and HIV positivity was not completely explained (i.e., mediated) by sexual risk behaviors and injection meth.<sup>13,14</sup>

Syphilis, HIV, and gonorrhea and/or chlamydia positivity rates were high (16.0%, 46.6%, and 19%, respectively) in this study population. In addition, participants reported high levels of sexual risk behaviors; for example, 43.7% reported UAI at last sex. This was higher than a large study among MSM recruited online from the United States and Canada, where approximately one-quarter of men reported UAI at last sex.<sup>19</sup> Meth use was significantly associated sexual risk behaviors in the past 3 months (i.e., >3 sex partners, anonymous sex) and with HIV positivity, although not syphilis positivity. HIV positivity was significantly associated with meth use and syphilis positivity in multivariable regression after adjusting for sexual and drug risk behaviors. The odds of HIV positivity were highest for those who were meth users and syphilis positive compared with those who were not meth users or syphilis positive. The high prevalence of sexual and drug risk behaviors including meth use, specifically and HIV and syphilis positivity, suggests a high probability of STI/HIV acquisition and transmission risk among these men.

Evidence suggests that Black MSM frequently use dating apps to find sex partners.<sup>38s</sup> This was confirmed in our study where recent use of online venues to meet sex partners (i.e., dating apps) was common. Jack'd was reported as the most frequently (53.7%) used venue followed by Grindr (36.2%). This is similar to a study among MSM recruited from clinic and nonclinic settings in London, where 40% to 50% of the males surveyed used the Internet to meet sex partners, although more than a longer time frame of 12 months.<sup>39s</sup> Meth use and HIV positivity were associated with meeting a sex partner in the past 3 months on Jack'd, Grindr, Facebook, and Adam4Adam, whereas syphilis positivity was associated with only Facebook. This finding supports other findings suggesting that MSM may use dating apps to facilitate engagement in chemsex and may increase transmission risks for

STIs/HIV.<sup>26,28</sup> One study, for example, found an increased odds (OR, 2.36; 95% CI, 1.02–5.45) of an STI diagnosis in the past year associated with using the Internet to find a sex partner among MSM.<sup>40s</sup> In contrast, however, another study among urban HIV-uninfected clinic-attending MSM found that HIV and syphilis positivity was not associated with meeting a partner online or on geosocial networking apps (like Grindr).<sup>41s</sup> Our data suggest that specific online sex partner meeting venues such as dating apps may connect MSM not only to risky sexual networks but also to drug-using networks. This network homophily may amplify risk. With the high number of sex partners, unprotected sex, and high HIV rates and overlapping active syphilis positivity, without PrEP, the HIV transmission is likely to continue along with syphilis. It also suggests that these venues may be important access points for STI/HIV and substance use prevention.

These findings should be interpreted in light of the study limitations. Like most other studies of MSM, our study population represents a convenience sample from one city. Because the general population of MSM has not been enumerated or described, it is not possible to ascertain whether the findings from this study are generalizable to all MSM in this setting or to MSM in other urban settings.<sup>42s</sup> We did, however, attempt to maximize the possibility of generalizability at least in this setting by recruiting from multiple sites, including clinical and nonclinical settings. In addition, these findings represent data from the baseline only and because the cross-sectional study design does not allow for causal inferences of STI/HIV positivity and meth use or other factors. In addition, although sexual and drug risk behaviors were measured within the past 3 months, we cannot rule out the potential for recall bias. An audio-computer self-assisted interview was used for the study, as this modality has been shown to increase the likelihood of report of confidential information.<sup>43s</sup> However, we also cannot rule out the possibility of social desirability bias.

Despite these limitations, this study provides important findings for a setting plagued by a syndemic of HIV, syphilis, and meth use, and high unemployment among MSM, a setting that has long-standing racial disparities in STIs and HIV driven by structural factors including structural racism and violence.<sup>44s–46s</sup> The findings point to specific venues that may provide access points for public health interventions to limit transmission and acquisition of STIs/HIV and substance misuse. Future research is needed to further elucidate out the complexity of the overlapping HIV/STI transmission and substance use networks (i.e., networks of sex and economy) within the social, spatial, and social media context of MSM, as well as the differential HIV/STI risk by online venue. In addition, interdisciplinary interventions are needed to target transmission risks in specific key populations, populations like the one highlighted in this study with networks that may be associated with a likelihood of high HIV, syphilis, and other STI transmission.<sup>47</sup>

## REFERENCES

1. European Centre for Disease Prevention and Control. Syphilis and Congenital Syphilis in Europe—A Review of Epidemiological Trends (2007–2018) and Options for Response. Stockholm: ECDC, 2019.
2. Centers for Disease Control and Prevention. Reported STDs in the United States, 2018. Available at: <https://www.cdc.gov/nchstp/newsroom/docs/factsheets/STD-Trends-508.pdf>. Accessed January 29, 2021.
3. Drückler S, van Rooijen MS, de Vries HJC. Chemsex among men who have sex with men: A sexualized drug use survey among clients of the sexually transmitted infection outpatient clinic and users of a gay dating app in Amsterdam, the Netherlands. *Sex Transm Dis* 2018; 45:325–331.
4. Chomchai C, Chomchai S. Global patterns of methamphetamine use. *Curr Opin Psychiatry* 2015; 28:269–274.
5. U.S. Drug Enforcement Administration, Diversion Control Division. National Forensic Laboratory Information System: Year 2016 Annual Report. Springfield, VA: U.S. Drug Enforcement Administration, 2017.
6. Substance Abuse and Mental Health Services Administration (SAMHSA) Center for Behavioral Health Statistics and Quality. 2016 National Survey on Drug Use and Health: Detailed Tables. Rockville, MD: Substance Abuse and Mental Health Services Administration, 2017.
7. Centers for Disease Control and Prevention. HIV infection risk, prevention, and testing behaviors among men who have sex with men—National HIV Behavioral Surveillance, 20 U.S. Cities, 2014. HIV Surveillance Special Report 15. Available at: <http://www.cdc.gov/hiv/library/reports/surveillance/#panel2>. Published January 2016. Accessed January 21, 2021.
8. Hoening M, Chaillon A, Moore DJ, et al. Clear links between starting methamphetamine and increasing sexual risk behavior: A cohort study among men who have sex with men. *J Acquir Immune Defic Syndr* 2016; 71:551–557.
9. Carrico AW, Storholm ED, Flentje A, et al. Spirituality/religiosity, substance use, and HIV testing among young black men who have sex with men. *Drug Alcohol Depend* 2017; 174:106–112.
10. Mimiaga MJ, Reiser SL, Fontaine YM, et al. Walking the line: Stimulant use during sex and HIV risk behavior among black urban MSM. *Drug Alcohol Depend* 2010; 110(1–2):30–37.
11. Colfax G, Santos GM, Chu P, et al. Amphetamine-group substances and HIV. *Lancet* 2010; 376:458–474.
12. Colfax G, Shoptaw S. The methamphetamine epidemic: Implications for HIV prevention and treatment. *Curr HIV/AIDS Rep* 2005; 2: 194–199.
13. Al-Tayyib A, Koester S, Langegger S, et al. Heroin and methamphetamine injection: An emerging drug use pattern. *Subst Use Misuse* 2017; 52:1051–1058.
14. Nerlander LMC, Hoots BE, Bradley H, et al. HIV infection among MSM who inject methamphetamine in 8 US cities. *Drug Alcohol Depend* 2018; 190:216–223.
15. Hegazi A, Lee MJ, Whittaker W, et al. Chemsex and the city: Sexualised substance use in gay bisexual and other men who have sex with men attending sexual health clinics. *Int J STD AIDS* 2017; 28:362–366.
16. Pufall EL, Kall M, Shahmanesh M, et al. Sexualized drug use (“chemsex”) and high-risk sexual behaviours in HIV-positive men who have sex with men. *HIV Med* 2018; 19:261–270.
17. Purcell DW, Parsons JT, Halkitis PN, et al. Substance use and sexual transmission risk behavior of HIV-positive men who have sex with men. *J Subst Abuse* 2001; 13(1–2):185–200.
18. Sewell J, Miltz A, Lampe FC, et al. Attitudes to and Understanding of Risk of Acquisition of HIV (AURAH) Study Group. Poly drug use, chemsex drug use, and associations with sexual risk behaviour in HIV-negative men who have sex with men attending sexual health clinics. *Int J Drug Policy* 2017; 43:33–43.
19. Chiasson MA, Hirshfield S, Remien R, et al. A comparison of on-line and off-line sexual risk in men who have sex with men: An event-based on-line survey. *J Acquir Immune Defic Syndr* 2007; 44:235–243.
20. Bourne A, Reid D, Hickson F, et al. “Chemsex” and harm reduction need among gay men in South London. *Int J Drug Policy* 2015; 26: 1171–1176.
21. Ahmed AK, Weatherburn P, Reid D, et al. Social norms related to combining drugs and sex (“chemsex”) among gay men in South London. *Int J Drug Policy* 2016; 38:29–35.
22. Glynn RW, Byrne N, O’Dea S, et al. Chemsex, risk behaviours and sexually transmitted infections among men who have sex with men in Dublin, Ireland. *Int J Drug Policy* 2018; 52:9–15.
23. Lea T, Mao L, Hopwood M, et al. Methamphetamine use among gay and bisexual men in Australia: Trends in recent and regular use from the gay community periodic surveys. *Int J Drug Policy* 2016; 29:66–72.
24. Landovitz RJ, Tseng CH, Weissman M, et al. Epidemiology, sexual risk behavior, and HIV prevention practices of men who have sex with men using GRINDR in Los Angeles, California. *J Urban Health* 2013; 90:729–739.
25. Bourne A, Ong J, Pakianathan M. Sharing solutions for a reasoned and evidence-based response: Chemsex/party and play among gay and bisexual men. *Sex Health* 2018; 15:99–101.

26. Race K. 'Party and play': Online hook-up devices and the emergence of PNP practices among gay men. *Sexualities* 2015; 18: 253–275.
27. Jennings JM, Reilly ML, Perin J, et al. Sex partner meeting places over time among newly HIV-diagnosed men who have sex with men in Baltimore, Maryland. *Sex Transm Dis* 2015; 42:549–553.
28. Chew Ng RA, Samuel MC, Lo T, et al. Sex, drugs (methamphetamines), and the Internet: Increasing syphilis among men who have sex with men in California, 2004–2008. *Am J Public Health* 2013; 103:1450–1456.
29. Centers for Disease Control and Prevention. *Sexually Transmitted Disease Surveillance 2018*. Atlanta, GA: U.S. Department of Health and Human Services, 2019. Available at: <https://www.cdc.gov/std/stats>. Accessed January 29, 2021.
30. Heckathorn D. Respondent-driven sampling: A new approach to the study of hidden populations. *Soc Probl* 1997; 44:174–199.

For further references, please see “Supplemental References,” <http://links.lww.com/OLQ/A685>.