



Prevalence and Correlates of PrEP Awareness and Use Among Black Men Who Have Sex with Men and Women (MSMW) in the United States

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Abstract

Men who have sex with men and women (MSMW), including those who are Black, experience HIV-related disparities compared to men who have sex with men only (MSMO). Few studies have assessed the prevalence and correlates of pre-exposure prophylaxis (PrEP) awareness and use among Black MSMW. We recruited MSM ≥ 18 attending Black Gay Pride events between 2014–2017. We conducted multivariable logistic regressions to assess differences in PrEP awareness and use among HIV-negative Black MSM ($n = 2398$) and within Black MSMW ($n = 419$). MSMW were less likely than MSMO to report PrEP awareness ($p < 0.001$). Among PrEP-aware MSM, MSMW were more likely than MSMO to report PrEP use ($p < 0.05$). MSMW receiving gay community support were more likely to be PrEP-aware ($p < 0.01$). MSMW reporting any past-year STI diagnoses were more likely to report PrEP use ($p < 0.01$). Findings suggest that PrEP awareness campaigns tailored for Black MSMW, concomitant with STI-to-PrEP interventions, will facilitate greater PrEP uptake in this population.

Keywords HIV prevention · Pre-exposure prophylaxis · Black/African American · Men who have sex with men (MSM) · Bisexuality

Resumen

Los hombres que tienen sexo con hombres y mujeres (MSMW, siglas en Inglés), incluyendo los que son Negros, experimentan disparidades relacionadas con el VIH en comparación con los hombres que tienen sexo con hombres solamente (MSMO, siglas en Inglés). Pocos estudios han evaluado la prevalencia y los correlatos de el conocimiento y el uso de la profilaxis pre-exposición (PrEP, siglas en Inglés) entre los MSMW Negros. Reclutamos a hombres que tienen sexo con hombres, o MSM (siglas en Inglés) ≥ 18 que asistieron a eventos del Orgullo Gay Negro entre 2014—2017. Realizamos regresiones logísticas multivariadas para evaluar las diferencias en el conocimiento y uso de PrEP entre los MSM Negros VIH-negativos ($n=2398$) y dentro de los MSMW Negros ($n=419$). Los MSMW fueron menos probables que los MSMO a reportar sobre el conocimiento de la PrEP ($p<.001$). Entre los MSM con reconocimiento de PrEP, los MSMW fueron más probables que los MSMO a reportar el uso de PrEP ($p<.05$). Los MSMW que recibieron apoyo de la comunidad gay tenían más probabilidades de ser conscientes de la PrEP ($p<.01$). Los MSMW que informaron sobre cualquier diagnóstico de ITS el año anterior tenían

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más probabilidades de informar el uso de PrEP ($p < .01$). Los hallazgos sugieren que las campañas de concientización sobre la PrEP adaptadas para los MSMW Negros, concomitantes con las intervenciones de ITS-a-PrEP, facilitarán una mayor captación de PrEP en esta población.

Introduction

The HIV epidemic in the United States (U.S.) remains a critical public health concern, in particular for marginalized populations. Black men who have sex with men (MSM) account for the highest incidence and prevalence of HIV infection among all groups at-risk for HIV [1]. In general, Black MSM experience poorer HIV care outcomes, including lower rates of antiretroviral treatment (ART) and viral suppression, and lower social support relative to White MSM [2, 3]. Considering the impact of discrimination and inequities in HIV risk factors, Black MSM constitute a key population in addressing the HIV epidemic. Pre-exposure prophylaxis (PrEP) was approved by the Food and Drug Administration in 2012 as a once-daily pill to prevent HIV acquisition among HIV-negative individuals. Research has shown that PrEP is highly efficacious in preventing HIV transmission when users are adherent [4]. Use among Black MSM, however, remains relatively low, despite interest in and willingness to use this prevention tool [5–8]. Barriers associated with PrEP use among Black MSM include concerns over the potential side effects of the drug, cost of PrEP, potential problems associated with missing doses, medical mistrust, distrust with the pharmaceutical industry, accessibility, and sexuality-related stigma [9–12].

Men who have sex with men and women (MSMW) comprise a population that has been generally ignored in HIV prevention intervention development and deployment [13, 14]. HIV prevention among MSM has historically focused on gay men, resulting in a severe shortage of interventions tailored for MSMW [14, 15]. Literature specific to correlates and prevalence of PrEP awareness and use among MSMW is limited, particularly among those who are Black; PrEP research has generally conflated Black MSMW with Black men who have sex with men only (MSMO), without disaggregating these populations [16–18]. However, Black MSMW experience unique health concerns [19]. Recent research has demonstrated that they are more likely to experience psychosocial health morbidities, such as depression symptoms, intimate partner violence, and polydrug use compared to Black MSMO, and that these psychosocial health disparities are substantially explained by lower rates of sexual minority community support [20]. Psychosocial morbidities have also been demonstrated to significantly contribute to HIV care continuum disparities among HIV-positive MSMW, including being more likely than MSMO to

be unaware of HIV-positive status, and being less likely than MSMO to have suppressed viral load [21]. Among HIV-negative Black MSM, MSMW are less likely than MSMO to have ever received an HIV test [22]. Considering the efficacy of PrEP in preventing HIV infection, it is essential to understand awareness and utilization patterns, especially among those at higher risk for HIV acquisition. As a biomedical prevention tool, PrEP may prove especially relevant for populations such as Black MSMW who have been traditionally underserved by behavioral HIV prevention interventions.

We asked three key research questions. First, do Black MSMW have disparate rates of PrEP awareness and use relative to Black MSMO? Second, what factors explain differences in PrEP awareness and use between Black MSMW and Black MSMO? Third, what factors predict PrEP awareness and use within Black MSMW? For question one, we hypothesized that Black MSMW were less likely to be aware of and to use PrEP than Black MSMO, given previously described disparities among MSMW across the HIV prevention and care continuum [21–23]. For question two, we hypothesized that (a) differences in gay community support might explain differences in PrEP awareness between Black MSMW and MSMO, and that (b) differences in recent diagnoses of sexually transmitted infections (STI) between Black MSMW and MSMO might contribute to differential rates of PrEP use in these groups, as a result of the emergence of STI-to-PrEP programs [24–27]. For question three, we hypothesized that gay community support was associated with PrEP awareness and use within Black MSMW, as a result of substantial marketing to the gay community; and that recent history of STI was associated with PrEP use within MSMW. We assessed these research questions using data from POWER (Promoting Our Worth, Equality, and Resilience), a community-derived sample of Black MSM that includes a substantial proportion of MSMW.

Methods

Sample

Between 2014–2017, POWER used time-location sampling at Black Gay Pride events in six U.S. cities (Atlanta, GA; Detroit, MI; Houston, TX; Memphis, TN; Philadelphia, PA; and Washington, DC) to recruit MSM and transgender women, predominately those who identify as Black.

Eligibility criteria included being (1) 18 years or older; (2) having, in their lifetime, at least one male sexual partner; and (3) assigned male sex at birth. We used an analytic sample for this study including only those who: (1) had a current gender identity of “male”; (2) self-identified as “Black” or “African American”; (3) reported past-year anal sex with at least one other male; and (4) were confirmed to be HIV-negative via an onsite rapid HIV-testing procedure. Our analytic sub-sample included 2398 HIV-negative, sexually active Black MSM. Participants completed a self-administered questionnaire onsite via electronic tablet assessing psychosocial, behavioral, and biomedical domains. Further details on the study design can be found elsewhere [28]. All study procedures were approved by the Institutional Review Board at the University of Pittsburgh (protocol PRO13110137).

Measures

Sociodemographics

We used self-reported information conveying ethnicity, age, education, and yearly income. Covariates in multivariable models were consistent with sociodemographic differences that have been found among bisexually-behaving men in previous studies [15, 20] and that may act as confounders, including: Hispanic/Latino ethnicity, low income status (<\$10,000 per year), older age (≥ 40 years old), and city and year sampled.

PrEP Awareness and Use

We first asked participants whether they were aware of PrEP [*“Have you ever heard of PrEP (pre-exposure prophylaxis)? PrEP is when HIV-negative people take anti-HIV medications (anti-retrovirals like Truvada) BEFORE HAVING SEX to prevent HIV infection”*]. Men who reported not being aware of PrEP were considered to have no current or historical PrEP use patterns. Men who reported being PrEP-aware were then asked if they were currently using PrEP; those who were not currently using PrEP were asked if they had ever used PrEP [29].

Bisexual Behavior

Men reporting vaginal or anal sex with at least one female partner and anal sex with at least one male partner in the past year were classified as MSMW. Men reporting anal sex with at least one male partner but neither vaginal nor anal sex with at least one female partner in the past year were classified as MSMO [20, 21].

Gay Community Support

We assessed whether participants perceived receiving *any* gay community support, using a dichotomized version of a measure that has been shown to substantially explain psychosocial health disparities among Black MSMW [20].

Psychosocial Health Disparities

We assessed past-year experiences of intimate partner violence (IPV), physical assault victimization, current depression symptoms, and current polydrug use. Further details on these measures can be found elsewhere [20, 21]. Based on concurrent research on this sample demonstrating that psychosocial morbidity burden is associated with increased likelihood of PrEP use [30], we considered each of these psychosocial variables as independent dichotomous covariates for within-MSMW multivariable logistic regression analyses.

Sexually Transmitted Infections (STI)

We asked participants whether they had been diagnosed by a health care provider in the past year with (1) gonorrhea; (2) syphilis; (3) chlamydia; or (4) any other STI. Based on federal PrEP guidelines and emerging public health programs targeting STI-positive, but HIV-negative individuals for PrEP uptake [24–27], we created a dichotomous variable that denoted MSM who reported being diagnosed with at least one past-year STI.

Statistical Analysis

First, we conducted Chi square and t-tests to delineate bivariate associations between bisexual behavior and sociodemographic covariates, and between bisexual behavior and PrEP awareness and use patterns. Then, we conducted multivariable logistic regressions to compare HIV-negative, sexually active Black MSMW with their MSMO counterparts in patterns of PrEP awareness and current PrEP use. Based on results from these analyses, we constructed two structural equation models (SEM) to assess (1) whether the relationship between bisexual behavior and PrEP awareness was mediated by gay community support; and (2) whether, among PrEP-aware participants, the relationship between bisexual behavior and current PrEP use was mediated by past-year STI history. Each of these SEM consisted of an observed predictor variable (MSMW status); an observed mediator (Model 1: gay community support; Model 2: any past-year STI diagnosis); and an observed outcome variable (Model 1: PrEP awareness; Model 2: current PrEP use). Each SEM was conducted using maximum likelihood estimation (SEM-ML) with an

observed information matrix (OIM), and controlled for effects of covariates (older age; low-income status; Hispanic/Latino ethnicity; city; and year sampled) on both the mediator and outcome variables. Model fit for SEM was assessed via standardized root mean residuals (SRMR), assuming acceptable model fit at $SRMR < 0.08$; each model's χ^2 , comparative fit index (CFI), and root mean squared error of approximation (RMSEA) were also assessed, as the literature recommends [31, 32]. Finally, we conducted separate multivariable logistic regressions specifically within Black MSMW to assess whether gay community support, psychosocial factors, and past-year STI history were associated with (a) PrEP awareness (using the analytic sample of HIV-negative, sexually active Black MSMW); and (b) current PrEP use (using the sub-sample of HIV-negative, sexually active, PrEP-aware MSMW). All multivariable models controlled for ethnicity, age, income, and city and year sampled. Within-MSMW models additionally controlled for psychosocial health conditions. Statistical analyses, including SEM, were conducted using Stata (StataCorp, 2015; Stata Statistical Software: Release 14; College Station, TX: StataCorp LP).

Results

Of the 2398 HIV-negative, Black MSM in this analytic sample, 82.5% ($n = 1979$) were MSMO and 17.5% ($n = 419$) were MSMW. Table 1 shows that MSMW were more likely than MSMO to identify as Hispanic/Latino ($\chi^2 = 3.90$; $p < 0.05$), to be older (30.7 years vs. 28.8; $t = 3.83$; $p < 0.001$), and to report annual income $< \$10,000$ ($\chi^2 = 14.82$; $p < 0.001$). There were no significant differences in MSMW/MSMO proportions by year, although there were significant differences by city ($\chi^2 = 45.10$; $p < 0.001$), with higher relative proportions of MSMW in Detroit. MSMW were less likely to report being PrEP-aware than MSMO (46.3% vs. 55.2%; $\chi^2 = 10.96$; $p < 0.01$). A total of 1278 MSM (53.3%) reported being PrEP-aware; 189 MSM (7.9%) reported currently using PrEP. Overall, MSMW reported slightly higher rates than MSMO of historical PrEP use (10.1% vs. 9.6%) and current PrEP use (9.6% vs. 7.6%), although these differences were not significant in bivariate testing of associations. MSMW were significantly more likely than MSMO to report any past-year STI (22.5% vs. 16.4%; $\chi^2 = 8.88$; $p < 0.01$).

Table 1 Sociodemographics and sexual health characteristics of HIV-negative, sexually active Black MSMW ($n = 419$) and MSMO ($n = 1979$) in POWER, 2014–2017

Sociodemographics	Subcategory	MSMW (419)	MSMO (1979)	Chi square or <i>t</i> test value
Ethnicity				3.90*
	Hispanic/Latino	21 (5.0%)	61 (3.1%)	
City				45.10***
	Philadelphia	69 (16.5%)	287 (14.5%)	
	Houston	77 (18.4%)	416 (21.0%)	
	Washington, DC	78 (18.6%)	476 (24.1%)	
	Detroit	71 (16.9%)	142 (7.2%)	
	Atlanta	118 (28.2%)	624 (31.5%)	
	Memphis	6 (1.4%)	34 (1.7%)	
Year				2.30
	2014	121 (28.9%)	528 (26.7%)	
	2015	156 (37.2%)	717 (36.2%)	
	2016	100 (23.9%)	541 (27.3%)	
	2017	42 (10.0%)	193 (9.8%)	
Age				$t = 3.83$ ***
	Mean age (SD)	30.7 (0.5)	28.8 (0.2)	
Annual income				14.82***
	$< \$10,000$	105 (25.4%)	337 (17.2%)	
Sexual health				
	PrEP-aware	192 (46.3%)	1086 (55.2%)	10.96**
	Ever used PrEP	42 (10.1%)	190 (9.6%)	0.10
	Current PrEP use	40 (9.6%)	149 (7.6%)	2.01
	Any past-year STI	93 (22.5%)	322 (16.4%)	8.88**

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 2 shows associations between MSMW status and PrEP awareness among HIV-negative, sexually active Black MSM. MSMW were significantly less likely than MSMO to be PrEP-aware (aOR 0.76; 95% CI 0.60, 0.95). MSM who were age 40 or older (aOR 0.71; 95% CI 0.54, 0.93), who reported annual income < \$10,000 (aOR 0.61; 95% CI 0.49, 0.77), and who were sampled in Detroit (aOR 0.64; 95% CI 0.44, 0.92) were significantly less likely than their respective reference groups to report being PrEP-aware. Hispanic/Latino MSM were more likely to report being aware of PrEP (aOR 1.75; 95% CI 1.09, 2.81). Compared with MSM sampled in 2014, those sampled in 2015 (aOR 1.71; 95% CI 1.38, 2.13), 2016 (aOR 3.22; 95% CI 2.55, 4.07), and 2017 (aOR 3.23; 95% CI 2.31, 4.51) were significantly more likely to report being PrEP-aware.

Table 3 shows associations between MSMW status and current PrEP use among HIV-negative, sexually active Black MSM who reported being PrEP-aware. Among this sub-sample of PrEP-aware MSM, MSMW were significantly more likely than MSMO to report currently using PrEP (aOR 1.66; 95% CI 1.11, 2.47). In this sub-sample of PrEP-aware MSM, those who identified as Hispanic/Latino were also significantly more likely than their non-Hispanic/Latino counterparts to report PrEP use (aOR 3.36; 95% CI 1.78, 6.35). There were no significant differences in current PrEP use among PrEP-aware MSM by low-income status, older age, or city and year sampled.

Structural equation model results are presented in Figures I and II and in Appendices (Supplementary Materials). Figure 1 illustrates the total and indirect effects of

Table 2 Adjusted odds ratios (aOR) from multivariable logistic regression model assessing association between bisexual behavior (predictor) and PrEP awareness (outcome) among HIV-negative, sexually active Black MSM in POWER, 2014–2017 (n = 2398)

Outcome	Predictor/covariate	Subcategory	aOR (95% CI)	
PrEP-aware	MSMW		0.76 (0.60, 0.95)	
		Age 40 or older	0.71 (0.54, 0.93)	
		Annual income < \$10,000	0.61 (0.49, 0.77)	
		Hispanic/Latino ethnicity	1.75 (1.09, 2.81)	
	City	Philadelphia (ref)	1.00	
		Houston	0.89 (0.66, 1.19)	
		Washington, DC	0.79 (0.59, 1.04)	
		Detroit	0.64 (0.44, 0.92)	
		Atlanta	1.09 (0.83, 1.43)	
		Memphis	0.62 (0.31, 1.23)	
		Year	2014 (ref)	1.00
			2015	1.71 (1.38, 2.13)
			2016	3.22 (2.55, 4.07)
			2017	3.23 (2.31, 4.51)

Bold aOR values indicate significance at $p < 0.05$

Table 3 Adjusted odds ratios (aOR) from multivariable logistic regression model assessing association between bisexual behavior (predictor) and current PrEP use (outcome) among PrEP-aware, HIV-negative, sexually active Black MSM in POWER, 2014–2017 (n = 1278)

Outcome	Predictor/covariate	Subcategory	aOR (95% CI)	
Current PrEP use	MSMW		1.66 (1.11, 2.47)	
		Age 40 or older	1.10 (0.65, 1.87)	
		Annual income < \$10,000	1.22 (0.78, 1.89)	
		Hispanic/Latino ethnicity	3.36 (1.78, 6.35)	
	City	Philadelphia (ref)	1.00	
		Houston	0.82 (0.49, 1.39)	
		Washington, DC	0.77 (0.46, 1.29)	
		Detroit	0.68 (0.32, 1.47)	
		Atlanta	0.79 (0.49, 1.27)	
		Memphis	0.32 (0.04, 2.56)	
		Year	2014 (ref)	1.00
			2015	1.33 (0.82, 2.16)
			2016	1.36 (0.85, 2.19)
			2017	1.68 (0.84, 2.99)

Bold aOR values indicate significance at $p < 0.05$

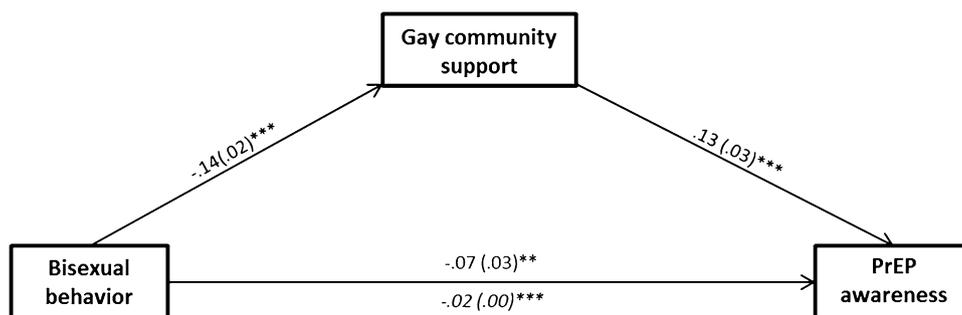


Fig. 1 Structural equation model assessing total and indirect effects between bisexual behavior, reporting any gay community support, and PrEP awareness among HIV-negative, sexually active Black MSM in POWER, 2014–2017. Path coefficients and standard errors (parenthesized) shown: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. Model

adjusted for age, ethnicity, income, and city and year sampled (covariate effects not shown). Indirect effects and standard errors (c' path, parenthesized) shown in italics. SRMR < 0.001; $\chi^2 < 0.001$; RMSEA < 0.001; CFI = 1.00

paths between bisexual behavior, gay community support, and PrEP awareness. Model fit was considered to be very good, with an SRMR < 0.001; $\chi^2 = 252.78$ (df = 13), $p < 0.001$; RMSEA < 0.001; and CFI = 1.00. Among HIV-negative, sexually active Black MSM, there were significant inverse total effects between bisexual behavior and PrEP awareness ($\beta = -0.07 \pm 0.03$; $p < 0.01$). Significant inverse total effects were found to exist between bisexual behavior and any gay community support ($\beta = -0.14 \pm 0.02$; $p < 0.001$). There were significant positive total effects between gay community support and PrEP awareness ($\beta = 0.13 \pm 0.03$; $p < 0.001$). Gay community support mediated the relationship between bisexual behavior and PrEP awareness, constituting a significant indirect effect ($\beta = -0.02 \pm 0.00$; $p < 0.001$). Gay community support accounted for a substantial proportion (25.4%) of the total effect between bisexual behavior and PrEP awareness. Full data reflecting total, direct, and indirect effects pathways can be found in Appendix A; the model's variance/covariance matrix and matrix of correlation coefficients

can be found in Appendices B and C, respectively (Supplementary Materials).

Figure 2 illustrates total and indirect effects of the relationships between bisexual behavior, any past-year STI diagnosis, and current PrEP use among HIV-negative, PrEP-aware Black MSM. Model fit was considered to be very good, with an SRMR < 0.001; $\chi^2 = 143.86$ (df = 13), $p < 0.001$; RMSEA < 0.001; and CFI = 1.00. There were significant total effects between bisexual behavior and current PrEP use ($\beta = 0.07 \pm 0.03$; $p < 0.05$). Significant relationships were found to exist between bisexual behavior and reporting any past-year STI diagnoses ($\beta = 0.09 \pm 0.03$; $p < 0.01$) and between any past-year STI diagnosis and current PrEP use ($\beta = 0.18 \pm 0.02$; $p < 0.001$). Reporting any past-year STI diagnosis mediated the relationship between bisexual behavior and current PrEP use, constituting a significant indirect effect ($\beta = 0.02 \pm 0.01$; $p < 0.01$). Past-year STI burden accounted for a substantial proportion (23.1%) of the total effect between bisexual behavior and current PrEP use. Full data reflecting total, direct, and indirect effects pathways

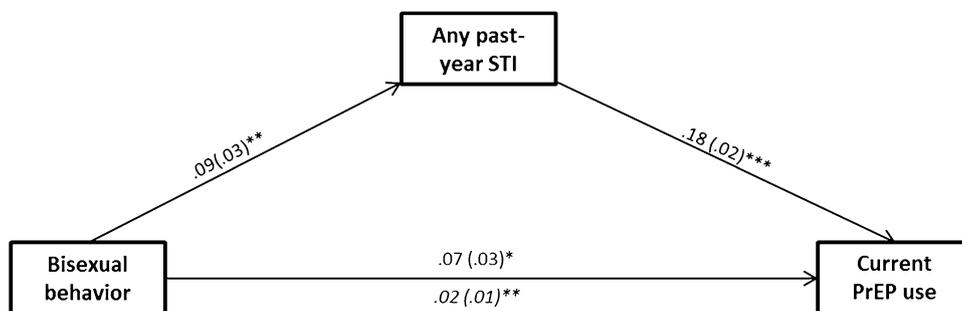


Fig. 2 Structural equation model assessing total and indirect effects between bisexual behavior, past-year sexually transmitted infection burden, and current PrEP use among HIV-negative, sexually active, PrEP-aware Black MSM in POWER, 2014–2017. Path coefficients and standard errors (parenthesized) shown: *** $p < 0.001$;

** $p < 0.01$; * $p < 0.05$. Model adjusted for age, ethnicity, income, and city and year sampled (covariate effects not shown). Indirect effects and standard errors (c' path, parenthesized) shown in italics. SRMR < 0.001. $\chi^2 < 0.001$; RMSEA < 0.001; CFI = 1.00

can be found in Appendix D; the model's variance/covariance matrix and matrix of correlation coefficients can be found in Appendices E and F, respectively (Supplementary Materials).

Within-MSMW predictors of PrEP awareness are shown in Table 4. In a multivariable logistic regression model controlling for sociodemographics and psychosocial health conditions, we found that Black MSMW who reported receiving any gay community support were significantly more likely to be PrEP-aware than those who did not (aOR 2.24; 95% CI 1.34, 3.76). In addition, MSMW who reported any past-year STI diagnosis were significantly more likely to report being PrEP-aware (aOR 2.34; 95% CI 1.32, 4.14). MSMW who reported recent polydrug use were significantly less likely than those who did not to be PrEP-aware (aOR 0.38; 95% CI 0.17, 0.83). There were no significant differences in PrEP awareness within Black MSMW by income, age, ethnicity, city, depression symptoms, recent violence victimization, or recent IPV, and no consistent increase in PrEP awareness by year, though MSMW sampled in 2016 had higher levels of PrEP awareness than those sampled in 2014 (aOR 2.70; 95% CI 1.47, 4.99).

Table 5 shows results from a multivariable logistic regression model assessing correlates of current PrEP use within HIV-negative, sexually active Black MSMW who reported being PrEP-aware. In this model, adjusting for sociodemographics and psychosocial health conditions, only reporting a past-year STI diagnosis was significantly associated with current PrEP use (aOR 5.11; 95% CI 1.95, 13.39). Gay

community support was not significantly associated with current PrEP use in this model. There were no differences in current PrEP use within Black MSMW by income, age, ethnicity, depression symptoms, recent violence victimization, or recent IPV, and no significant differences in current PrEP use among MSMW by city or year sampled.

Discussion

Low rates of PrEP awareness and use among HIV-negative Black MSM persist in the U.S. Our results, demonstrating that, overall, only 8% of HIV-negative Black MSM report currently using PrEP, are consistent with recent literature indicating low rates of PrEP use among HIV-negative Black MSM. For example, research has shown that rates of PrEP use among Black MSM range from 1% nationwide in 2015/2016 [33], to 2% in Atlanta in 2014 [34], to 2.5% in the 2014 National HIV Behavioral Surveillance System, representing a significantly lower use rate than that found among HIV-negative White MSM (5.3%) [8]. The proportion of HIV-negative Black MSM in the POWER sample reporting current PrEP use is somewhat higher, however, than in these other samples. This may reflect the contemporaneity of this sample, which includes data from 2017, when almost 13% of the HIV-negative sample reported current PrEP use; it may also reflect the social marketing of PrEP to urban gay communities in the U.S., which likely aligns with the population attending Black Gay Pride events. We note also that Black

Table 4 Adjusted odds ratios (aOR) from multivariable logistic regression model assessing predictors of PrEP awareness within HIV-negative, sexually active Black MSMW in POWER, 2014–2017 (n = 404)

Outcome	Predictor/covariate	Subcategory	aOR (95% CI)	
PrEP-aware	Any gay community support		2.24 (1.34, 3.76)	
	Any past-year STI diagnoses		2.34 (1.32, 4.14)	
	Intimate partner violence, past year		1.78 (0.81, 3.92)	
	Physically assaulted, past year		0.71 (0.31, 1.63)	
	Polydrug use, past 3 months		0.38 (0.17, 0.83)	
	Depression symptoms		0.71 (0.42, 1.22)	
	Age 40 or older		0.71 (0.39, 1.30)	
	Annual income < \$10,000		0.65 (0.37, 1.13)	
	Hispanic ethnicity		1.64 (0.61, 4.42)	
	City		Philadelphia (REF)	1.00
			Houston	0.86 (0.42, 1.77)
			Washington, DC	0.72 (0.35, 1.49)
			Detroit	0.45 (0.20, 1.01)
			Atlanta	1.22 (0.63, 2.38)
			Memphis	0.65 (0.09, 4.48)
	Year		2014 (REF)	1.00
2015			1.58 (0.91, 2.75)	
2016			2.70 (1.47, 4.99)	
2017			1.46 (0.65, 3.27)	

Bold aOR values indicate significance at $p < 0.05$

Table 5 Adjusted odds ratios (aOR) from multivariable logistic regression model assessing predictors of current PrEP use within HIV-negative, sexually active, PrEP-aware Black MSMW in POWER, 2014–2017 (n = 187)

Outcome	Predictor	Subcategory	aOR (95% CI)
Current PrEP use	Any gay community support		1.42 (0.42, 4.77)
		Any past-year STI diagnoses	5.11 (1.95, 13.39)
		Intimate partner violence, past year	2.50 (0.62, 10.02)
		Physically assaulted, past year	2.30 (0.51, 10.33)
		Polydrug use, past 3 months	3.87 (0.82, 18.17)
		Depression symptoms	0.69 (0.23, 2.11)
		Age 40 or older	1.19 (0.28, 5.00)
		Hispanic ethnicity	1.04 (0.18, 5.85)
	City	Philadelphia (REF)	1.00
		Houston	0.98 (0.26, 3.65)
		Washington, DC	0.40 (0.09, 1.81)
		Detroit	0.35 (0.04, 2.92)
		Atlanta	1.35 (0.42, 4.39)
		Memphis	1.09 (0.04, 32.54)
	Year	2014 (REF)	1.00
		2015	1.28 (0.38, 4.32)
		2016	1.17 (0.33, 4.16)
2017		0.99 (0.18, 5.56)	

Bold aOR values indicate significance at $p < 0.05$

Gay Pride attendees may be more likely than non-attendees to be socially connected to gay communities, which is likely associated with this sample's higher relative propensity for PrEP use.

Our findings suggest that although Black MSM appear to have relatively slow or stalled uptake of PrEP, some encouraging patterns have emerged. While MSMW in this sample had lower rates of PrEP awareness than MSMO, when MSMW were aware of PrEP, they had higher rates of use. These findings present an opportunity to delineate the unique factors for biomedical prevention among MSMW and the historical and practical explanations for observed PrEP differences. Our study is among the first to demonstrate rates of PrEP awareness and use among MSMW, particularly among MSMW who are Black. Social-behavioral and biobehavioral HIV prevention and care programs have not historically targeted MSMW [13–15, 35], tending to concentrate instead on men who have sex with men only (MSMO) during intervention design, recruitment, implementation, and evaluation. This may be a factor in the consistent disparities seen in HIV testing and care outcomes found among MSMW, including higher rates of being HIV-positive unaware, and lower rates of viral suppression [19, 21, 23]. In this context, our findings that HIV-negative Black MSMW were less likely than their MSMO peers to report being aware of PrEP is unsurprising.

However, our findings show that, when they become aware of PrEP, Black MSMW may be even more likely than Black MSMO to use it. This promising finding highlights the potential impact of biobehavioral interventions for communities that have been traditionally underserved by HIV

prevention programming and research initiatives, but who face substantial HIV acquisition and transmission risks, including MSMW, transgender women, sex workers, and injection drug users. While our findings demonstrate that higher past-year STI prevalence significantly contributes to higher relative odds of current PrEP use among MSMW, a majority of the variance in the relationship between MSMW status and PrEP use remains unexplained. The literature suggests that MSMW, particularly those who are Black, have been highly stigmatized for their perceived potential to acquire HIV from MSM and transmit it to female partners [15, 36–38]. At the same time, behavioral HIV prevention interventions tailored for MSMW are thin on the ground [13–15]. PrEP may offer Black MSMW a wider-scale opportunity to receive efficacious HIV prevention, thereby lowering their risk for HIV acquisition and transmission and associated internalized bi-negativity [39], than existing behavioral interventions may offer them. Our results demonstrating that gay community support mediates the relationship between bisexual behavior and PrEP awareness among Black MSM provides additional confirmation for the value of sexual minority community support networks for public health promotion within sexual and gender minority communities. PrEP awareness and linkage campaigns tailored for Black MSMW [14], in conjunction with practitioner-based STI-to-PrEP interventions, will likely increase PrEP uptake in this group.

We found a significant association between PrEP use and past-year STI among MSMW. Because recent STI history has been associated with HIV incidence among MSM [40],

federal guidelines include diagnosed bacterial STI within the past 6 months as a recommended indicator for PrEP prescribing to MSM [41]. In response, state health departments are beginning to develop protocols to connect STI-positive individuals to PrEP programs; for example, the Pennsylvania Department of Health is piloting a demonstration project that targets individuals with multiple past-year STI for enhanced PrEP navigation services, given state surveillance data suggesting that time to HIV seroconversion is truncated for HIV-negative individuals with a fourth incident past-year STI [42]. Our results may indicate substantial STI clinic-based PrEP delivery for populations at risk for HIV infection, an approach that has been pioneered by health departments [24–27]. It is possible that national PrEP guidelines, which recommend STI testing every 3 months, may lead to more timely diagnoses of existing STI for those who are using PrEP compared to those who are not. However, we cannot discount the possibility of reverse causation, e.g. that PrEP use among Black MSMW in this study was associated with increased sexual risk-taking and lower rates of condom use, leading to higher STI incidence, as has been indicated in other populations using PrEP [43–45]. We also note that our results demonstrate that Black MSMW were significantly more likely than Black MSMO to report any past-year STI diagnoses, and that a past-year STI diagnosis significantly mediated the effect found between bisexual behavior and higher PrEP use among PrEP-aware MSM. These findings contravene results from a recent meta-analysis that found no significant differences in STI prevalence between MSMW and MSMO [46], suggesting that STI disparities among MSMW in Black communities require additional inquiry. Given our findings that MSMW in this sample were more likely to report recent STI, a potentially promising new strategy is engaging this population into HIV prevention, including PrEP uptake, at point of STI diagnosis. Furthermore, strategies that utilize reportable STI health department data to identify individuals who are HIV-negative but STI-positive (e.g., STI data-to-PrEP strategies) may prove effective in recruiting substantial proportions of MSMW into HIV prevention interventions that include PrEP awareness and linkage. Future research on PrEP use among MSMW, including those who are Black, should prospectively explore the relationships between uptake, sexual risk behavior, HIV risk perception, and STI diagnosis and treatment.

This study contains limitations. These data come from a community-based sample of Black Gay Pride attendees in six cities, and thus may not be generalizable to HIV-negative Black MSM in the U.S. While we initially recruited participants using time-location sampling techniques to optimize representativeness, these techniques only account for individual venues and years; for this reason, we did not use pooled TLS weights in our analyses. The POWER sample was not specifically intended to characterize MSMW, and

recruitment techniques did not engage in processes, such as oversampling, to better represent these men; therefore results may not be generalizable to groups of MSMW, such as those with lower affinities to LGBT communities, who do not attend Black Gay Pride events. Other than assessing HIV status via onsite HIV-antibody testing, our measures were self-reported. Though our anonymous, self-administered questionnaire was designed to reduce social desirability bias in response patterns, self-reported measures may not accurately reflect the true extent of PrEP use or of past-year STI diagnoses and/or current STI burden; for this reason, the STI data collected should be considered highly conservative, as it likely underestimates the actual proportion of MSM with recent STI history. Our mediation analyses, which considered gay community support as a mediator of the relationship between bisexual behavior and PrEP awareness, and any past-year STI as a mediator of the relationship between bisexual behavior and PrEP use, were cross-sectional, and thus should not be regarded as confirmation of potential causal or temporal associations. Though these models had substantial theoretical basis, we note that our mediators and outcomes may be bidirectional in nature, and that we were unable, given the measures used, to situate PrEP initiation and STI diagnosis, for example, in a clear temporal framework. Though we have shown that PrEP-aware MSMW were more likely to report current PrEP use than PrEP-aware MSMO, that they experienced higher STI burden than PrEP-aware MSMO, and that their higher STI burden had a significant indirect effect on their higher rates of current PrEP use, we cannot infer with certainty that MSMW were linked to PrEP at higher rates due to their relatively higher STI burden (e.g., from STI-to-PrEP programs). Increased STI screenings for PrEP users in general may explain these differences in reported STI diagnoses; even though MSMW and MSMO may be assumed to have equivalent STI screening protocols while on PrEP, it is possible that our results indicate background STI disparities between these populations that are magnified by increased STI screening frequency for PrEP users. Finally, though the serial cross-sectional design allowed us to assess trends over time, it did not allow us to longitudinally assess intra-individual patterns of PrEP awareness and use or STI diagnoses.

The results of our study are both disconcerting and promising for bibehavioral HIV prevention among HIV-negative Black MSMW. It is promising that PrEP use was comparatively higher among MSMW when they were PrEP-aware, but disconcerting that the disparate STI rates reported by MSMW substantially accounted for their higher current PrEP use. It is also concerning that PrEP awareness campaigns may be following a well-tread path of HIV prevention efforts detouring around communities that may derive the greatest benefits. Our results point to several topic areas that future research studies can explore. These

include assessing whether associations between STI burden and PrEP use among Black MSMW are related to risk compensation; reflective of increased rates of STI testing while on PrEP; or associated with STI-to-PrEP initiatives. In addition, it is paramount to explore whether high-volume, community-based venues, such as Black Gay Pride events, can provide feasible recruitment opportunities for both longitudinal research efforts and dedicated PrEP awareness and culturally congruent intervention delivery for traditionally under-researched and underserved populations such as Black MSMW. Finally, it remains unknown whether STI-to-PrEP (including STI data-to-PrEP) initiatives can meaningfully increase PrEP uptake among underserved key populations, including Black MSMW, and impact HIV incidence rates in the United States. Future research that concentrates on assessing and developing biobehavioral prevention campaigns for MSMW specific to their cultural understandings is critical. Such inquiry will ensure that MSMW, including those who are Black, are provided the public health resources and attention necessary to reduce the sexual health disparities that they have been shown so consistently to face.

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Compliance with Ethical Standards

Conflict of interest Author MRF has received an honorarium and travel expenses reimbursement for serving as a consultant to Gilead Sciences, Inc. in June 2018 for the purposes of providing scientific input for a grant mechanism in development concentrating on HIV and aging. Authors MRF and RDS received travel expenses reimbursements from Gilead Sciences, Inc. for the purposes of speaking at AIDSImpact conference in July 2015, specifically for a symposium on syndemics and the HIV prevention and care continuum. Authors JMS, LAB, DDM, LAE, CJC, JEE, KH, and HRF have no conflicts of interest to declare.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was approved by the University of Pittsburgh Human Research Protection Office (protocol number PRO13110137).

Informed Consent Informed consent was obtained from all individual participants included in the study.

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