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## Assessing the Role of Gay Community Attachment, Stigma, and PrEP Stereotypes on Young Men Who Have Sex with Men's PrEP Uptake

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### Abstract

Negative stereotypes about pre-exposure prophylaxis (PrEP) hinder PrEP uptake among young men who have sex with men (YMSM). Prior research suggests community homophobia may be linked to negative PrEP attitudes. Conversely, individuals with high gay community attachments (GCA) may have more access to credible PrEP information/resources. Among 285 YMSM recruited online, we estimated structural equation models to test competing conceptual models that inform pathways from perceived stigmas, GCA, and negative PrEP stereotype endorsements to PrEP uptake. In Model A, perceived stigma was directly associated with PrEP uptake, partially mediated by stereotype endorsement ( $\beta = -0.05$ ; 95% CI  $[-0.09, -0.01]$ ) and GCA ( $\beta = -0.06$ ; 95% CI  $[-0.11, 0.02]$ ). In Model B, perceived stigma was associated with PrEP uptake ( $\beta = -0.07$ ; 95% CI  $[-0.14, -0.01]$ ) through stereotype endorsement among high GCA YMSM. Complemented by anti-stigma initiatives, PrEP outreach for YMSM should utilize sex-positive messaging and disentangle negative PrEP stereotypes within gay-centric social spaces.

### Resumen

Los estereotipos negativos sobre la profilaxis pre-exposición (PrEP) dificultan su uso entre hombres jóvenes que tienen sexo con otros hombres (YMSM). Investigaciones anteriores sugieren que la homofobia comunitaria puede estar relacionada a las actitudes negativas sobre PrEP. En cambio, personas con alto apego a la comunidad gay (GCA) pueden tener más acceso a información y recursos creíbles sobre PrEP. Entre los 285 YMSM reclutados en línea, estimamos varios modelos de ecuaciones estructurales para contrastar las asociaciones entre los estigmas

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percibidos, la GCA, los estereotipos negativos sobre PrEP, y el uso de PrEP entre diversos modelos conceptuales. En el Modelo A, el estigma percibido se asoció directamente con el uso de PrEP, siendo parcialmente mediado por el endoso a estereotipos ( $\beta = -0.05$ ; IC del 95% [- 0.09, - 0.01]) y GCA ( $\beta = -0.06$ ; IC del 95% [- 0.11, 0.02]). En el Modelo B, el estigma percibido se asoció con el uso de PrEP ( $\beta = -0.07$ ; IC del 95% [- 0.14, - 0.01]) a través de los estereotipos entre YMSM con puntajes altos en GCA. Complementado con iniciativas contra el estigma, el alcance de la PrEP para YMSM debe utilizar mensajes de sexo positivo y desenredar los estereotipos negativos de PrEP dentro de los espacios sociales centrados en la comunidad gay.

## Keywords

Young gay and bisexual men; PrEP stigma; Gay community; Sexual health; HIV

## Introduction

Pre-exposure prophylaxis (PrEP), a daily oral combination antiretroviral commercially offered as Truvada (emtricitabine and tenofovir disoproxil fumarate) or Descovy (emtricitabine and tenofovir alafenamide; not approved in the contexts of receptive vaginal intercourse), is a highly effective biomedical prevention strategy for populations disproportionately affected by the HIV epidemic [1–3]. Although high adherence to PrEP drastically reduces an individual's risk of HIV seroconversion if exposed to the virus via sexual contact or drug use [4, 5], HIV prevention experts continue to be challenged by incremental increases in PrEP uptake by young men who have sex with men (YMSM) in the United States [6, 7]. Youth 13 to 24 years of age still account for 21% of new HIV cases, most of which are attributed to male-to-male sexual contact and more specifically, among those from racial/ethnic minority backgrounds [8, 9]. Annual infection rates have decreased by only six percent since 2010 among youth 13 to 24 years of age who were assigned male sex at birth. Recent surveillance efforts continue to exhibit increasing trends in the proportion of YMSM 18–24 years of age who report engaging in condomless anal intercourse (CAI) with conservative (i.e., lower-limit) estimates, suggesting that close to half of YMSM reported recent CAI (e.g., at last sexual intercourse; within the past year) [10–12]. Even more concerning, a recent study observed that among PrEP-eligible YMSM who are engaged in healthcare, just over half who discussed PrEP with a provider reported PrEP uptake. These data suggest that local strategies to improve PrEP uptake among YMSM are not being maximized and underscore the need for ongoing efforts to identify and intervene on YMSM's barriers to PrEP access and adoption [13, 14].

HIV prevention experts and community leaders met the initial rollout of PrEP with mixed responses toward its use [15]. Prior to the approval of PrEP, messages around HIV prevention focused on YMSM limiting their sexual activity, number of sexual partners, and occasions of CAI [16]. Though considered a sexual health promotion strategy, resistance to PrEP uptake by high-profile HIV organizations has been well documented [17]. These organizations reported fears that PrEP uptake would motivate risk compensation in communities disproportionately affected by the HIV epidemic [18]. Specifically, some organizational leaders forecasted that PrEP uptake would facilitate less condom use and

potentially result in perceptions of decreased susceptibility to HIV infection among men who have sex with men (MSM). Yet, in subsequent studies, researchers have observed limited evidence for adopting risk compensation behaviors among community samples of PrEP-using MSM compared to those without a prescription [19–22]. Nevertheless, PrEP stigmatization—that is, negative judgment cast on individuals who use PrEP [16]—persists among YMSM and those within the HIV prevention community [23]. Manifestations of PrEP stigma (e.g., perpetuating negative PrEP stereotypes and belief in subsequent risk compensation), especially among health care providers, can damage the uptake of PrEP among YMSM by minimizing opportunities to openly discuss HIV risk behaviors and limiting YMSM’s access to PrEP itself [24].

While researchers have observed substantial awareness of negative PrEP stereotypes among YMSM in prior studies, few have assessed the extent to which these youth endorse or ascribe to these beliefs [25, 26]. Negative PrEP stereotypes have arisen similarly to stereotypes that equated MSM with HIV with being sexually promiscuous and engaging in high-risk behaviors [25, 27, 28]. This parallel suggests that YMSM who have experienced or integrated negative community attitudes toward MSM or individuals living with HIV, may attribute similar beliefs to PrEP use. Despite awareness of negative PrEP stereotypes, MSM remain the predominant consumer base of the medication [29]; however, the extent to which negative PrEP stereotypes are linked to age-related inequity, particularly for those 25 and younger, in access and adoption warrant further investigation.

Urban-dwelling MSM may be integral to understanding how YMSM formulate attitudes, opinions, and motivations toward PrEP use [30, 31]. YMSM who have largely integrated themselves into, or have a greater attachment to, MSM networks are more likely to have friends who are PrEP consumers [32]. PrEP consumers may serve as ambassadors for PrEP by raising awareness, sharing personal reasons for use, relaying experiences they have had with using PrEP, and even providing recommendations for navigating PrEP medical care [33]. In fact, a prior study that assessed the social capital (i.e., access to social resources) contexts of HIV care found that among persons living with HIV, living in high social participation neighborhoods were associated with higher prevalence rates of HIV linkage-to-care [34]. However, the extent to which social participation, specifically via gay community attachment, is linked to PrEP uptake is poorly understood. In prior studies, researchers have frequently examined gay community attachment as predictors or mediators in assessments of social stressors and HIV-related outcomes [35–38]. While insightful, YMSM’s attachments and connectedness to their larger and local gay communities may contextualize how psychosocial factors (e.g., perceived stigma), sexual health-related experiences (e.g., exposure to PrEP), and their relationships manifest, suggesting gay community attachment as a moderator [30, 39]. Specifically, the social and psychosocial theoretical mechanisms that underlie access to PrEP may differ based on individual YMSM’s level of gay community attachment.

To address these gaps, we sought to characterize the extent to which YMSM in a high-HIV prevalence Mid-Atlantic urban corridor endorse negative stereotypes about MSM who use PrEP and reported lifetime PrEP uptake. The Mid-Atlantic corridor of Philadelphia, Baltimore, and Washington, DC reflects three priority jurisdictions identified in the *Ending*

*the HIV Epidemic by 2030* initiative for scaling up HIV prevention strategies, including PrEP rollout [40]. Additionally, we developed two competing conceptual models (Fig. 1) to test how YMSM's PrEP stereotype endorsement levels are linked to PrEP uptake in the contexts of perceived community stigmas and that attend to potential differences in the role of gay community attachment. In Model A, we conceptualized YMSM's perceived community stigmas to be associated with PrEP uptake through gay community attachment and subsequently through the endorsement of negative PrEP stereotypes. More specifically, we consider a potential direct link between gay community attachment and endorsement of negative PrEP stereotypes given prior findings that highlight positive peer networks' role in sexual health promotion [41]. In Model B, we conceptualized gay community attachment as a moderator for the associations that perceived community stigmas have with PrEP uptake through PrEP stereotype endorsement. Specifically, the associations that perceived community stigmas and endorsements of negative PrEP stereotypes have with PrEP uptake may differ by gay community attachment levels. Gay communities serve as formal (e.g., functional support) and informal social support (e.g., appraisal support through community norms) resources that may thwart the contributions of negative factors on YMSM's adoption of sexual health promotion strategies [30, 39]. The hypotheses for each model (Fig. 1) are listed as follows:

#### Model A

- Hypothesis [H]1: Gay community attachment will exhibit a direct, positive association (path e), whereas endorsement of negative PrEP stereotypes (path d) and perceived community stigmas (HIV and homophobia; path f) will have a direct, negative association with YMSM's PrEP uptake.
- H2: Gay community attachment (path b) and perceived community stigmas (path c) will have an inverse and positive association with endorsement levels of negative PrEP stereotypes, respectively.
- H3: Perceived community stigmas will have a positive association with negative PrEP stereotype endorsement through gay community attachment (path a \* b).
- H4: Perceived community stigmas will be negatively associated with gay community attachment, which in turn will be negatively associated with endorsement of negative PrEP stereotypes (path a \* e).
- H5: Perceived stigmas will be negatively associated with PrEP uptake through endorsement levels of negative PrEP stereotypes (path c \* d).
- H6: Endorsement of negative PrEP stereotypes will mediate the associations that gay community attachment and perceived stigmas have with YMSM's PrEP uptake (path a \* b \* d).

#### Model B

- H7: Gay community attachment would moderate the association between perceived stigmas and PrEP uptake through PrEP stereotype endorsement (path a \* b), with the association being weaker for YMSM with high gay community attachment compared to YMSM with low levels of gay community attachment.

## Methods

### Procedures

This study's data come from a cross-sectional, observational study examining YMSM's PrEP uptake, social and community networks, and risk behaviors in a disproportionately HIV-affected region in the Mid-Atlantic. Participants were recruited from Grindr and Facebook between October 2018 and February 2019. Participants were eligible if they identified as a cisgender male, were 18–25 years old, self-reported as HIV-negative or HIV status unaware, had sex with a man in the past 6 months, and reported a residential zip code along the Philadelphia (PA), Baltimore (MD), or Washington (DC) metropolitan corridor. Those who completed an electronic informed consent were directed to complete a confidential web-survey, which lasted between 20 and 30 min. Participants were compensated with a \$10 Amazon e-gift card for their time. Participants' responses were protected within a University of Pennsylvania firewalled server. Study procedures were reviewed and approved by the University of Pennsylvania Institutional Review Board.

To prevent duplicate and falsified entries, we monitored the duplication of email and I.P. addresses and crosschecked I.P. addresses with the zip codes and residential addresses/cross-streets provided by participants [42]. Of the 1287 attempted web-survey entries, we removed cases in which prospective participants did not complete the screener survey ( $n = 585$ , 45.5%), were ineligible ( $n = 207$ , 16.1%), consented, but did not complete the survey ( $n = 112$ , 8.7%), and provided duplicate/falsified entries ( $n = 93$ , 7.2%). These exclusions yielded an analytic sample of  $N = 290$  YMSM (72.1% completion rate) in the Mid-Atlantic United States. We then conducted a missing-cases analysis and found that only five participants, which included those who had never heard of PrEP, provided incomplete responses to our variables of interest. Given this small number, we employed listwise deletion and removed these cases from our analysis, yielding a final analytic sample of  $N = 285$  YMSM.

### Measures

**PrEP Uptake**—Participants were asked a single item of whether they had ever taken PrEP before a sexual or drug use exposure to reduce the risk of getting HIV. Responses included: (1) Yes, I am on PrEP right now; (2) Yes, I have in the past, but I'm not on PrEP anymore; and (3) No, I have never taken PrEP. Those who reported being on PrEP or having taken PrEP in the past were collapsed to create a dichotomous variable for lifetime PrEP uptake (0 = No lifetime PrEP uptake; 1 = Any lifetime PrEP uptake).

**Endorsement of Negative PrEP Stereotypes**—We adopted a seven-item scale on community support for PrEP (e.g., “Men who have sex with men taking PrEP are being reckless”) to examine participants' endorsement of negative PrEP stereotypes [43]. Items were assessed on a 4-point scale (0 = Strongly disagree, 3 = Strongly agree); positively worded items were reverse-coded (e.g., “Men who have sex with men taking PrEP are being responsible”). The seven items yielded high internal consistency (Cronbach's alpha = 0.79). We developed a mean score of the items with higher scores reflecting greater endorsement levels and lower scores reflecting lower endorsement levels.

**Gay Community Attachment**—We included four items assessing gay community attachment (“I feel that I am part of my area’s LGBT community,” “Participating in my area’s LGBT community is a positive thing for me,” “I feel a bond with the LGBT community,” and “I am proud of my area’s LGBT community”). These items were presented on a 4-point scale (0 = Strongly disagree, 3 = Strongly agree) and exhibited high internal consistency (Cronbach’s alpha = 0.86). The four items were averaged together, with higher scores indicating greater gay community attachment.

**Community Stigma**—We included measures of perceived community stigmas given prior research that argues a parallel development between stigma toward MSM, persons living with HIV, and those who use PrEP. For *Perceived Sexual Prejudice* and *Perceived HIV Stigma*, we adapted the seven items of the *Perceptions of Local Stigma* scale to each construct (e.g., “Most people in my area think poorly of a(n) [man who has sex with men/HIV-positive person]”) [44]. These items were offered on a 4-point scale (0 = Strongly disagree, 3 = Strongly agree) and positively-worded items were reverse-coded. The seven items demonstrated high internal consistency for perceived community homophobia (Cronbach’s alpha = 0.91) and perceived HIV stigma (Cronbach’s alpha = 0.87). Items for each construct were averaged together with high scores indicating high perceived stigma.

**Sociodemographic Characteristics and Other Covariates**—Participants self-reported their age, race/ethnicity (0 = Non-Hispanic White; 1 = Racial/Ethnic Minority [inclusive of Non-Hispanic Black, Hispanic/Latino—All Races, and Other or Multiple Races/Ethnicities due to low variance]), sexual identity (0 = Gay, queer, same-gender loving, or homosexual; 1 = Other MSM identity [inclusive of bisexual and pansexual due to low variance]), HIV status (0 = Negative, 1 = Unknown or Unaware), Relationship status (0 = Single, 1 = In a Monogamous Relationship, 2 = In a Non-monogamous Relationship), Education level (0 = Less than college degree; 1 = College degree or higher), and employment status (0 = Full-Time, 1 = Part-Time, 2 = Unemployed). Participants’ self-reported residential zip codes were recoded to reflect their home metropolitan area (0 = Baltimore, 1 = Philadelphia, 2 = Washington, DC). Lastly, participants were asked to report the number of sexual partners they had in which they did not use condoms as the insertive (i.e., top) and receptive (i.e., bottom) partner, respectively. We summed these values and then dichotomized the variable given its Poisson distribution to reflect participants who engaged in no condomless anal intercourse (0) and those who engaged in any (1) condomless anal intercourse (CAI) in the past 3 months.

### Data Analytic Strategies

To characterize participants’ endorsement of negative PrEP stereotypes and PrEP uptake, we first generated a descriptive account of YMSM’s sociodemographic characteristics, PrEP behaviors, parallel community stigmas, and gay community attachment. We tested bivariate associations (*chi-square*, *t-tests*, *Pearson’s correlation*) comparing differences in the endorsement of negative PrEP stereotypes and PrEP uptake by indicators of social participation (e.g., gay community attachment), parallel community stigmas (e.g., perceived sexual prejudice and HIV stigma), sociodemographic characteristics, and recent CAI.

To test our first conceptual model (Model A: Hypotheses 1–6), we developed structural equation models (SEM) using Mplus 8.0 [45] to test the direct and indirect pathways connecting PrEP stereotype endorsement, stigma, and gay community attachment to YMSM’s lifetime PrEP use. SEM permits simultaneous examination of pathways with endogenous latent variables (e.g., perceived community stigma, gay community attachment, and endorsement of negative PrEP stereotypes) [46]. Moreover, parceling, a technique to reduce the structural parameter bias by summing several items together, was used to explain stigma. We used parceling methods to produce fewer parameters, which produce stable parameter estimates and better model fit [47]. The parallel stigma factor is explained by two sub-factors: perceived community homophobia and HIV stigma. The seven items in each sub-factor were randomly categorized into two parcels: a 3-item parcel and a 4-item parcel. Therefore, four parcels served as indicators under stigma instead of using two sub-factors.

In addition, we included theoretically accepted modifications in the final model by allowing correlations and used robust weighted least squares (WLSMV) due to binary outcome [48]. With WLSMV, the probit regression was employed on the path with a binary outcome, and linear regression was utilized on the path with a latent continuous outcome. Indirect effects including a path with a binary outcome were interpreted as probit regression coefficients. The size of the indirect effect was estimated by the product of the effect of the independent variable on the mediator and the effect of the mediator on the dependent variable. The direct effect is the effect of the independent variable on the dependent variable controlling for the effect of the mediator [49]. We present our findings based on four goodness of fit indices: comparative fit index (CFI), Tucker-Lewis Index (TLI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA). Hu and Bentler suggested values of 0.90 or higher for CFI and TLI, a value of 0.08 or lower for SRMR, and a value of 0.06 or lower for RMSEA represents acceptable fit [50].

To test the second conceptual model (Model B: Hypothesis 7), we repeated these steps for a stratified sub-analysis, assessing the indirect effects of parallel community stigmas on lifetime PrEP use through endorsement levels of negative PrEP stereotypes by separating the sample into sub-groups based on participants’ levels of gay community attachment (low versus high). Stratified models provide an opportunity to assess effect modification when theoretical frameworks include hypotheses that specify how social circumstances (e.g., gay community attachment) may contribute to all or multiple pathways in the model [51, 52]. Given the range of the gay community attachment variable (mean scores between 1 and 4), we conducted a median split to classify participants as having low gay community attachment if they had a mean score between 1 and 2.49 ( $n = 111$ ; 38.9%) and classify participants as having high gay community attachment if they had a mean score between 2.50 and 4 ( $n = 174$ , 61.1%).

## Results

### Participants

A summary of participant characteristics is provided in detail in Table 1. The mean age of participants was 22.18 years (*standard deviation*,  $sd = 2.15$ ). Participants were predominantly Non-Hispanic White ( $n = 185$ , 64.9%) with smaller numbers of Non-

Hispanic Black ( $n = 23$ , 8.1%), Hispanic/Latino (All races;  $n = 40$ , 14.0%), and Other and Multiple Races/Ethnicities ( $n = 37$ , 13.0%). Most participants identified as gay, queer, same-gender loving, or homosexual ( $n = 230$ , 80.7%).

Most YMSM self-reported an HIV-negative status ( $n = 255$ , 89.5%), Over half of the sample identified as single ( $n = 185$ , 64.9%) and reported engaging in any CAI in the past 3 months ( $n = 209$ ; 73.3%). On average, participants reported moderate to high gay community attachment ( $m = 2.76$ ,  $sd = 0.73$ , *range* 1–4), and moderate levels of perceived stigma (community homophobia  $m = 1.90$ ,  $sd = 0.58$ , *range* 1–4; community HIV stigma  $m = 2.44$ ,  $sd = 0.55$ , *range* 1–4).

### Endorsement of Negative PrEP Stereotypes

Our sample exhibited, on average, a moderate level of PrEP stereotype endorsement ( $m = 1.93$ ,  $sd = 0.60$ , *range* 1–4). Bivariate tests (Table 2) demonstrated that racial/ethnic minority participants had higher endorsements of negative PrEP stereotypes compared to Non-Hispanic White participants ( $t = -2.11$ ,  $p = 0.036$ ). YMSM who reported any lifetime PrEP use on average, had less endorsement of negative PrEP stereotypes than those with no prior PrEP use ( $t = 2.38$ ,  $p = 0.018$ ). Participants who reported any recent CAI on average, reported less endorsement of PrEP stigma, compared to those who reported no recent CAI ( $t = 2.72$ ,  $p = 0.007$ ). Age ( $r = -0.16$ ,  $p = 0.006$ ) was negatively correlated with endorsement of negative PrEP stereotypes. Of the two stigma variables, only perceived community homophobia was positively correlated with the endorsement of negative PrEP stereotypes ( $r = 0.19$ ,  $p = 0.002$ ). We observed no bivariate differences in stereotype endorsement by sexual identity, HIV status, relationship status, education level, employment status, metro area, gay community attachment, or perceived community HIV stigma.

### PrEP Uptake

Over one-third ( $n = 103$ ; 36.1%) of participants reported lifetime PrEP uptake. Bivariate tests (Table 2) indicated that PrEP uptake was associated with older age ( $t = -5.63$ ,  $p < 0.001$ ), being Non-Hispanic White compared to racial/ethnic minority YMSM ( $\chi^2 = 4.42$ ,  $p = 0.035$ ), identifying as gay compared to another MSM identity ( $\chi^2 = 7.69$ ,  $p = 0.006$ ), higher education ( $\chi^2 = 18.08$ ,  $p < 0.001$ ), and being full-time employed ( $\chi^2 = 24.18$ ,  $p < 0.001$ ). A greater proportion of participants who had ever taken PrEP reported being in non-monogamous relationships or identified as single compared to those who were currently in monogamous relationships ( $\chi^2 = 12.12$ ,  $p = 0.002$ ). Similarly, a greater proportion of participants who reported any recent CAI also reported any lifetime PrEP uptake compared to participants who reported no recent CAI ( $\chi^2 = 12.08$ ,  $p = 0.001$ ). PrEP uptake was associated with higher levels of gay community attachment ( $t = -4.09$ ,  $p < 0.001$ ), lower perceived community homophobia ( $t = 4.08$ ,  $p < 0.001$ ), and lower endorsement of negative PrEP stereotypes ( $t = 2.38$ ,  $p = 0.018$ ). Perceived community HIV stigma approached, but did not achieve statistical significance in its association with PrEP uptake ( $t = 1.94$ ,  $p = 0.053$ ).

### Structural Equation Models

The final SEM results are presented in Table 3 and Figs. 2 (Model A) and 3 (Model B).



**Model A**—The final SEM model was adjusted for age, race/ethnicity, sexual identity, employment status, relationship status, and recent CAI (CFI = 0.94; TLI = 0.93; SRMR = 0.08; RMSEA = 0.06 [CI = 0.05, 0.07]). As shown in Fig. 2, greater perceived community stigmas were associated with greater endorsement of negative PrEP stereotype (path c:  $\beta = 0.21$ ; 95% CI [0.08, 0.34];  $p = 0.002$ ) and less attachment to gay community (path a:  $\beta = -0.25$ ; 95% CI [-0.37, -0.13];  $p < 0.001$ ). However, there was no significant associations between gay community attachment and endorsement of negative PrEP stereotype (path b:  $\beta = -0.07$ ; 95% CI [-0.19, 0.06];  $p = 0.30$ ). In addition, greater attachment to the gay community was associated with lifetime PrEP use (path e:  $\beta = 0.25$ ; 95% CI [0.11, 0.40];  $p = 0.001$ ), while greater endorsement to negative PrEP stereotypes (path d:  $\beta = -0.22$ ; 95% CI [-0.37, -0.08];  $p = 0.002$ ) and greater perceived community stigma (path f:  $\beta = -0.19$ ; 95% CI [-0.36, -0.02];  $p = 0.03$ ) were associated with no life time PrEP use.

Indirect effects of perceived community stigma on the endorsement of negative PrEP stereotypes through gay community attachments were not statistically significant (path a \* b:  $\beta = 0.02$ ; 95% CI [-0.02, 0.05];  $p = 0.32$ ). In addition, the indirect effect of gay community attachment on lifetime PrEP use through the endorsement of negative PrEP stereotype was not statistically significant (path b \* d:  $\beta = 0.02$ ; 95% CI [-0.01, 0.04];  $p = 0.32$ ). However, the total indirect effect of perceived community stigma on PrEP uptake was statistically significant ( $\beta = -0.11$ ; 95% CI [-0.17, -0.05];  $p < 0.001$ ). The relationship between stigma and PrEP uptake was partially mediated by endorsement of negative PrEP stereotype and gay community attachment. Specifically, YMSM who perceived greater community stigma were more likely to endorse negative PrEP stereotype which in turn was negatively associated with PrEP uptake (path c \* d:  $\beta = -0.05$ ; 95% CI [-0.09, -0.01];  $p = 0.03$ ). Additionally, YMSM who reported greater stigma reported less gay community attachment, which was inversely associated with lifetime PrEP use (path a \* e:  $\beta = -0.06$ ; 95% CI [-0.11, -0.02];  $p = 0.01$ ). Among covariates, age ( $\beta = 0.41$ ; 95% CI [0.28, 0.53];  $p < 0.001$ ), being in a non-monogamous relationship as opposed to being single ( $\beta = 0.19$ ; 95% CI [0.06, 0.33];  $p = 0.005$ ), and reporting any recent CAI ( $\beta = 0.27$ ; 95% CI [0.13, 0.41];  $p < 0.001$ ) were positively associated with PrEP uptake. Racial/ethnic minority identity ( $\beta = -0.16$ ; 95% CI [-0.31, -0.02];  $p = 0.03$ ), identifying as Other sexual identity as opposed to gay or homosexual ( $\beta = -0.23$ ; 95% CI [-0.38, -0.08];  $p = 0.003$ ), part-time ( $\beta = -0.41$ ; 95% CI [-0.57, -0.24];  $p < 0.001$ ) and unemployment/student ( $\beta = -0.25$ ; 95% CI [-0.42, -0.08];  $p = 0.004$ ) compared to full-time, and being a non-monogamous relationship compared to those who identified as single ( $\beta = -0.22$ ; 95% CI [-0.37, -0.08];  $p = 0.003$ ) remained negatively associated with PrEP uptake.

**Model B**—We observed no statistically significant pathways linking perceived community stigmas and endorsement of negative PrEP stereotypes among participants who reported low levels of gay community attachment ( $n = 111$ , 38.9%). However, among these men, age ( $\beta = 0.31$ ; 95% CI [0.09, 0.52];  $p = 0.01$ ) and any recent CAI ( $\beta = 0.52$ ; 95% CI [0.28, 0.77];  $p < 0.001$ ) were positively associated, and being in a monogamous relationship compared to being single ( $\beta = -0.30$ ; 95% CI [-0.57, -0.03];  $p = 0.03$ ) was negatively associated with PrEP uptake (CFI = 0.95; TLI = 0.94; SRMR = 0.09; RMSEA = 0.05 [CI = 0.02, 0.07]). Among YMSM who reported high levels of gay community attachment ( $n = 174$ , 61.1%),

the association between perceived community stigmas and lifetime PrEP uptake was partially mediated by endorsement levels of negative PrEP stereotypes (path a \* b:  $\beta = -0.07$ ; 95% CI [- 0.13, - 0.01];  $p = 0.03$ ) after adjusting for age, race/ethnicity, sexual identity, relationship status, employment status, and recent CAI (CFI = 0.90; TLI = 0.87; SRMR = 0.10; RMSEA = 0.08 [CI = 0.06, 0.09]). In this model, greater stigma was positively associated endorsement of negative PrEP stereotype (path a:  $\beta = 0.26$ ; 95% CI [0.10, 0.41];  $p = 0.001$ ), which was inversely associated with PrEP uptake (path b:  $\beta = -0.27$ ; 95% CI [- 0.44, - 0.09];  $p = 0.003$ ). There was a statistically significant, negative direct effect between perceived community stigmas and PrEP uptake (path c:  $\beta = -0.26$ ; 95% CI [- 0.47, - 0.06];  $p = 0.01$ ). Among covariates, age ( $\beta = 0.43$ ; 95% CI [0.28, 0.59];  $p < 0.0001$ ), being in a non-monogamous relationship as opposed to being single ( $\beta = 0.18$ ; 95% CI [0.01, 0.34];  $p = 0.04$ ), and reporting any recent CAI ( $\beta = 0.20$ ; 95% CI [0.02, 0.37];  $p = 0.03$ ) were positively associated with PrEP uptake. Racial/ethnic minority identity ( $\beta = -0.20$ ; 95% CI [- 0.38, - 0.01];  $p = 0.04$ ), identifying as Other sexual identity as opposed to gay or homosexual ( $\beta = -0.25$ ; 95% CI [- 0.44, - 0.06];  $p = 0.01$ ), being a monogamous relationship compared to those who identified as single ( $\beta = -0.18$ ; 95% CI [- 0.36, - 0.004];  $p = 0.05$ ), and part-time employment ( $\beta = -0.53$ ; 95% CI [- 0.72, - 0.34];  $p < 0.001$ ), and unemployment/student ( $\beta = -0.27$ ; 95% CI [- 0.50, - 0.05];  $p = 0.02$ ) compared to full-time employment remained negatively associated with PrEP uptake.

## Discussion

Our study's goal was to characterize YMSM's endorsement of negative stereotypes about PrEP and how these attitudes are linked to lifetime PrEP use. We found moderate levels of endorsement of negative PrEP stereotypes among the study cohort and a connection between negative PrEP stereotype endorsement and lower uptake with PrEP. Consistent with prior studies, our results highlight how negative stereotypes attributed to PrEP use remain an ongoing barrier to YMSM's PrEP uptake [16, 26]. These findings pose negative PrEP stereotypes as potential challenges to PrEP rollout efforts in the Mid-Atlantic region where local initiatives have increased the availability and accessibility of PrEP (e.g., financial/co-pay assistance programs, PrEP clinic locators). Despite these initiatives, negative PrEP stereotypes may inhibit many YMSM, especially those who would benefit the most from the medication, from seeking and initiating PrEP. However, the extent to which negative stereotypes interact with awareness and consumption of PrEP-related initiatives warrant further exploration.

We observed support for our hypothesis that stigma was directly and positively associated with endorsing negative PrEP stereotypes. These findings suggest that continued and scaled-up anti-homophobic and HIV-related stigma interventions may be critical to disentangling negative PrEP-related stereotypes and improving PrEP uptake. Many YMSM who have never used PrEP, however, reported no or low endorsement of negative stereotypes, underscoring that there remain alternative and multilevel barriers to PrEP linkage-to-care and uptake that must be addressed to increase PrEP adoption [53, 54]. Given that youth reflect only 11% of current PrEP users [13], our findings advocate for multilevel interventions to improve PrEP initiation among YMSM.

We found support for our hypothesis that higher scores on gay community attachment would be directly associated with lifetime PrEP use. Participants were recruited predominantly from urban metropolitan areas known for having queer-centric and lesbian, gay, bisexual, transgender, and queer (LGBTQ)-friendly spaces (e.g., “gayborhoods”) [55–57]. YMSM in these areas are not only more likely to have encountered many MSM who are currently on PrEP compared to those living in areas with limited queer communities, but these youth may also have access and exposure to a greater variety (i.e., in-person) sexual health or PrEP-affirming messages [58, 59]. However, our hypothesis that PrEP stereotype endorsements would mediate the association between gay community attachment and PrEP use was not supported by the data. In fact, our analysis suggests that gay community attachment operated as a moderator in the model. In our stratified analysis (Fig. 1 Model B), we observed negative associations between PrEP use and stigma and PrEP stereotype endorsement, respectively, among YMSM who reported high gay community attachment levels. We did not observe this relationship among YMSM with low levels of gay community attachment. These findings align with prior studies pointing to the complex role of gay community attachment and connectedness as sources of both risk and resilience with regard to sexual health [37, 59]. One possible interpretation of this finding may be that highly-attached/connected YMSM who perceive more stigma may have less evolved conceptualizations of sexual risk, particularly in light of newer biomedical HIV prevention modalities. These YMSM may be more critical of their peers’ self-expressions of sexuality and sexual behaviors with greater attention to how their networks’ behaviors align with negative PrEP stereotypes. YMSM may forego linkage-to-PrEP to distance themselves from negative PrEP-related stereotypes, similar to how many individuals from other marginalized backgrounds (e.g., racial/ethnic minorities) minimize threats of stigmatization by behaving in a way that distances themselves from pervasive stereotypes [60]. Studies that aim to explore the mechanisms by which YMSM tap into social network resources to overcome negative attitudes and beliefs about PrEP are needed to inform PrEP interventions in queer-centric spaces and neighborhoods.

Beyond our hypotheses, our findings provide insight into sociodemographic and behavioral differences in endorsement of negative PrEP stereotypes and PrEP uptake. Though researchers have described PrEP-related stigma and stereotyping experiences among racial/ethnic minority MSM, few have informed the extent to which MSM from communities of color hold stereotyped beliefs [21, 61, 62]. Our findings indicate that endorsement levels of negative PrEP stereotypes were higher among racial/ethnic minority participants than their Non-Hispanic counterparts. These data are particularly concerning as racial/ethnic minority YMSM, particularly Black and Latino YMSM, are disproportionately affected by the HIV epidemic in the region [63]. Furthermore, our findings support prior research that has exhibited limited PrEP uptake in younger age groups, racial and ethnic minority men who have sex with men (MSM) compared to Non-Hispanic White MSM, and in socio-economic disadvantaged communities [3, 64, 65]. We also found that participants’ relationship statuses were associated with PrEP uptake indicating YMSM who were single or in non-monogamous relationships were more likely to report ever using PrEP. However, relationship status was a self-reported measure that does not imply behavior (e.g., YMSM who have consensually agreed to non-monogamy but have not engaged in sexual intercourse

with a non-main partner), and prior studies have argued that relationship monogamy statuses are not static among MSM populations [66, 67]. Participants who reported recent CAI were more likely to report PrEP uptake than those who did not, which suggests that PrEP efforts in the region, despite low uptake, are reaching those who are likely to benefit from the medicine. Our measure of CAI, however, was limited to the past three months; therefore, we advocate for ongoing surveillance to assess how YMSM navigate sexual risk and sexual health promotion over time.

Our study's findings underscore the need to support future research in this area. Prevention experts seeking to unpack the role of negative PrEP stereotypes on PrEP adoption should aim to explore who within high-risk YMSM's social networks have the strongest influence, both positively and negatively, to elicit effective sexual health promotion. Identifying network members with whom YMSM consider trustworthy informational resources about PrEP may be integral to capitalizing on these resources to minimize PrEP misinformation [68]. Furthermore, our measurement of gay community attachment reflects YMSM's psychological affiliations to the gay community, thereby providing limited insight into their social integration within physical gay spaces and the interactions or conversations that occur between one another related to sexual health (e.g., general positivity, advocating, and altruistic motivations). While gay communities often serve as a sexuality-affirming resource for many YMSM [69, 70], personal attachments do not necessarily convey community trustworthiness or the idiosyncratic norms that arise from one's active, social involvement [71, 72]. This disconnect limits how we understand ingroup communication pathways for stigmatizing attitudes, beliefs, and stereotypes, warranting further investigation.

Furthermore, psychological attachments to the gay community fail to capture whether YMSM know who in their network, if any, are taking or have ever taken PrEP. On the one hand, knowing the extent to which individuals in one's network have taken PrEP may elicit descriptive norms in YMSM that promote positive beliefs about or motivations to seek PrEP. Similarly, intergroup contact theory suggests that increased contact with members of stigmatized statuses reduces intergroup prejudice [73]; therefore, linking positive attributions to PrEP use may be facilitated more easily among YMSM who are connected to PrEP-consuming peers. Qualitative accounts may be informative to understanding how individual and network attitudes toward PrEP emerge and whether MSM networks provide various types of PrEP-related social support (e.g., raising awareness, information on with whom to talk to about PrEP).

Another potential factor that may inform the theoretical pathways that community stigmas, gay community attachment, and PrEP stereotypes have with PrEP uptake in future studies is internalized homonegativity. In a recent study, internalized homonegativity was associated with being in earlier stages along the PrEP continuum among YMSM [74]. Elevated levels of internalized homonegativity may exacerbate the direct association that perceived community stigmas have with PrEP uptake. Internalized homonegativity may also inform the extent to which YMSM create psychological and physical attachments to the gay community, thereby limiting potential and critical resources for sexual health-related social support [75]. Necessary support may include informational support from peers who facilitate acquiring facts that dispel myths and misinformation about PrEP.

Additional studies may also shed light on how YMSM perceive their PrEP-using peers and whether these perceptions inform their PrEP beliefs. Alternatively, our participants may also be more involved in discussing PrEP with network members outside of the gay community that they have identified as credible health resources (e.g., family members, community leaders, medical providers, and HIV prevention organizations) [76]. Identifying trusted resources for health information, especially in queer-centric neighborhoods, may inform the development of interventions that foster more open, honest, and productive conversations about sexual health and biomedical HIV prevention.

Our study's findings provide implications for interventions that aim to reduce PrEP stigma and motivate PrEP uptake in YMSM. Several PrEP interventions and strategies continue to emerge to facilitate PrEP uptake, including peer-navigation services and locator tools to help interested individuals identify local PrEP providers [77, 78]; however, these initiatives must be complemented by strategies that counter against social barriers like PrEP stigma and negative stereotypes. Interventions aiming to reduce negative PrEP stereotypes must lean on strategies that promote encouraging or favorable PrEP discussions within MSM social networks and within other networks through which MSM navigate their sexual health (e.g., health providers and familial networks). Mass media campaigns have historically been integral to eliciting productive community conversations in HIV prevention and treatment [79]. Though local health campaigns have facilitated the production of positive PrEP norms (e.g., #PrEP4Love campaign), HIV implementation experts must scale up PrEP messages to be sex-positive, combat negative stereotypes, link PrEP use to altruistic motivations (i.e., keeping those in one's sexual networks safe), and culturally resonate with local YMSM [80, 81]. Capitalizing on resources like social media and partner-seeking mobile applications may be critical for disseminating credible information and building skills to discuss PrEP within YMSM's social networks. However, these interventions must also address sexuality (and perhaps HIV) stigmas, given their parallel attributions to negative PrEP stereotypes.

Lastly, while our findings provided important insight into the role of PrEP stereotypes and PrEP use among YMSM, our study had several limitations. First, our results are unlikely generalizable given that our sample's catchment area was the Mid-Atlantic Corridor of the US, which despite high HIV prevalence also exhibits greater PrEP uptake than regions in the nation like the Deep South [13]. Therefore, participants' responses may differ from other YMSM living in other areas across the country. Second, we recruited using Grindr and Facebook advertisements. It remains unclear whether YMSM who do not use these two social media platforms have different perspectives about PrEP. Third, our study's recruitment materials explicitly referenced sexual health, which may have led to selection bias of young men who are already highly educated about PrEP, resulting in limited variability regarding participants' perceptions of their peers' PrEP attitudes and discussions. Fourth, our sample had limited variation in race/ethnicity, education level, and HIV status (negative versus unaware/unknown). This limited our capacity to perform within-group differences beyond two categories and yielding potential Type II errors [82]. Similar analyses should be conducted in samples from other communities of YMSM to explore the dynamics of negative PrEP stereotypes in other settings and populations. Additionally, we were unable to ascertain reasons or motivations for taking PrEP, particularly among participants who reported being in a monogamous relationship as circumstances such as

being in a relationship with a partner living with HIV may provide greater insight into contributing factors of YMSM's PrEP beliefs and behaviors. By addressing these limitations, future research should aim to capture a broader sample of YMSM in regions with less access to PrEP, including those with little knowledge of PrEP and those with negative attitudes towards PrEP. These strategies may better identify demographic characteristics that distinguish those who possess negative attitudes toward PrEP from those who do not. Finally, our ability to make causal inferences is limited due to the cross-sectional nature of this study. PrEP stereotypes, stigma, gay community attachment, and PrEP use were measured at a single point in time, making it difficult to assess the directionality of the effects seen in our results. Future studies should employ time-series analyses to assess how changing attitudes and network characteristics might be related to engagement across the PrEP continuum, spanning awareness, intention, and willingness to seek PrEP, accessing PrEP-related medical care, initiating PrEP medications, and sustained PrEP adherence.

## Conclusions

The successful rollout of PrEP to communities at high risk for HIV like YMSM remains a high priority HIV prevention strategy for ending the HIV epidemic in the United States. As structural interventions to facilitate the availability and accessibility of PrEP continue to emerge, these efforts must be paired with strategies that minimize intra-individual and interpersonal barriers to adopting PrEP. The development of negative attitudes about PrEP among YMSM is a persisting barrier associated with less progression along the PrEP continuum. To our knowledge, our study is one of the first to explore how gay community attachment contextualized with parallel community stigmas (e.g., community homophobia and HIV stigma) were associated with the endorsement of negative PrEP stereotypes and lifetime PrEP use. We conclude that the capacity for HIV prevention programs to leverage positive qualities of social networks and undermine negative PrEP stereotypes demands ongoing and additional support to reduce incident cases of HIV among YMSM.

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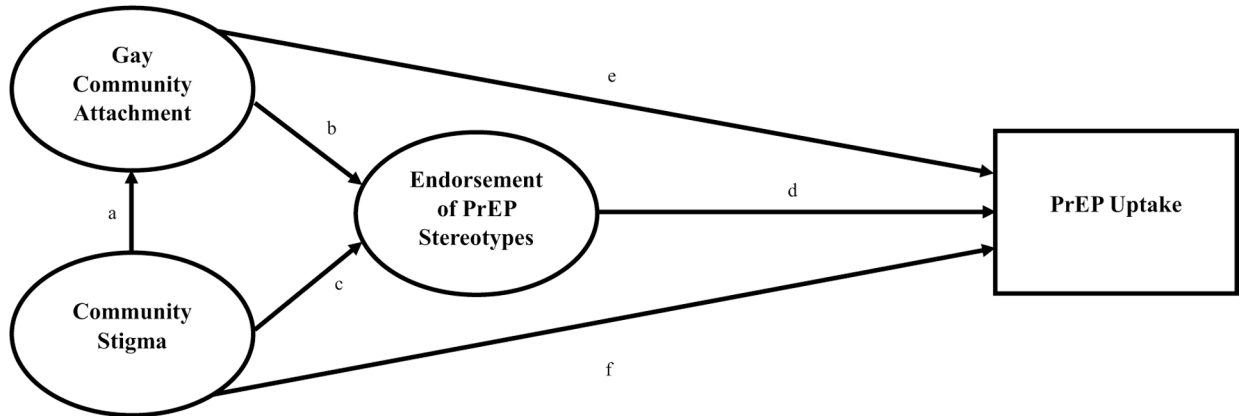


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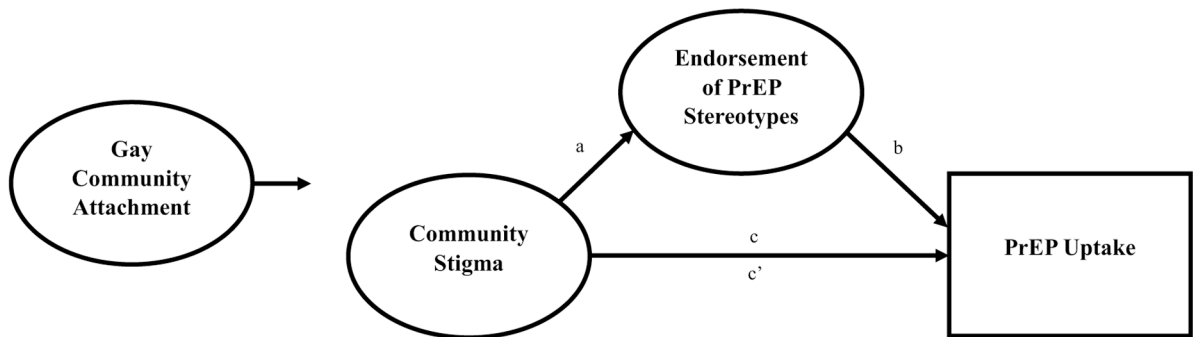
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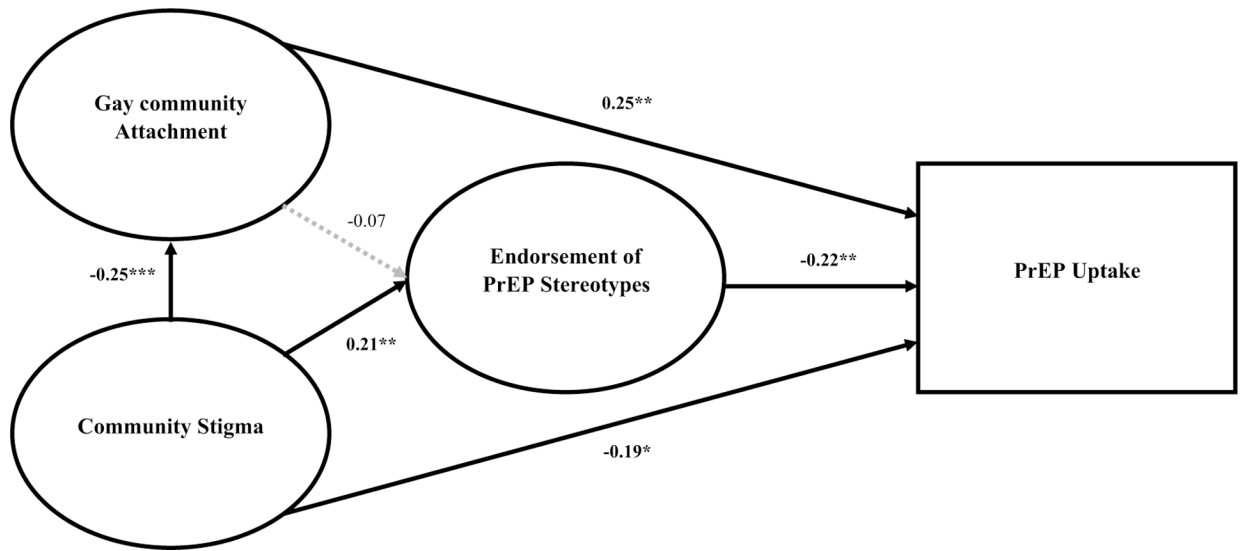
*Model A* – Gay community attachment as a mediator between community stigma and PrEP uptake among YMSM



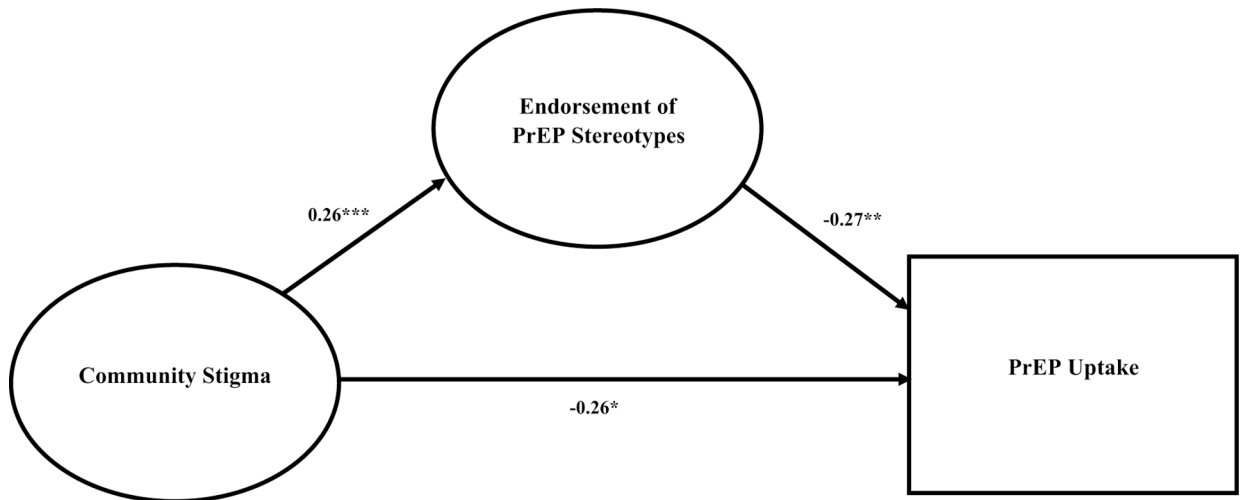
*Model B* – Gay community attachment moderates the association between community stigma and PrEP uptake through PrEP stereotypes



**Fig. 1.** Competing conceptual models. *Model A* gay community attachment as a mediator between community stigma and PrEP uptake among YMSM. *Model B* gay community attachment moderates the association between community stigma and PrEP uptake through PrEP stereotypes



**Fig. 2.** Structural equation model with gay community attachment as a mediator adjusted for age, race/ethnicity, sexual identity, employment status, relationship status, and condomless anal intercourse



**Fig. 3.** Structural equation model for YMSM with high gay community attachment adjusted for age, race/ethnicity, sexual identity, employment status, relationship status, and condomless anal intercourse

Table 1

Participant characteristics,  $N = 285$ 

Variable	$n$ (%)	$m$ (sd)
Age, range 18–25		22.20 (2.13)
Race/ethnicity		
Non-Hispanic White	185 (64.9)	
Non-Hispanic Black	23 (8.1)	
Hispanic/Latino all races	40 (14.0)	
Other race or multiracial	37 (13.0)	
Sexual identity		
Gay, queer, same-gender loving, or homosexual	230 (80.7)	
Other MSM identity	55 (19.3)	
HIV status		
Negative	255 (89.5)	
Unknown or unaware	30 (10.5)	
Relationship status		
Single	185 (64.9)	
In a relationship, monogamous	51 (17.9)	
In a relationship, non-monogamous	49 (17.2)	
Education level		
Less than college degree	119 (41.8)	
A college degree or higher	166 (58.2)	
Employment status		
Unemployed	74 (26.0)	
Part-time	78 (27.4)	
Full-time	133 (46.6)	
Metropolitan area		
Baltimore	51 (17.9)	
Philadelphia	110 (38.6)	
Washington, DC	124 (43.5)	
Recent condomless anal intercourse		

Variable	n (%)	m (sd)
None	76 (26.7)	
Any	209 (73.3)	
Gay community attachment, range 1–4		2.76 (0.73)
Stigma: perceived community homophobia, range 1–4		1.90 (0.58)
Stigma: perceived community HIV stigma, range 1–4		2.44 (0.55)
Endorsement of PrEP stereotypes, range 1–4		1.93 (0.60)
Lifetime PrEP use		
None	182 (63.9)	
Any	103 (36.1)	

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**Table 2**

Endorsement of PrEP stereotypes and PrEP uptake by sample characteristics among YMSM, *N* = 285

Variable	Endorsement of negative PrEP stereotypes				PrEP uptake (0: Never [n = 182, 63.9%], 1: Any [n = 103, 36.1%])							
	<i>m</i> ( <i>sd</i> )	<i>t</i>	<i>F</i>	<i>r</i>	<i>p</i>	Uptake = 0 <i>n</i> (%)	Uptake = 1 <i>n</i> (%)	Uptake = 0 <i>m</i> ( <i>sd</i> )	Uptake = 1 <i>m</i> ( <i>sd</i> )	$\chi^2$	<i>t</i>	<i>p</i>
Age				-0.16	0.008			21.69 (2.09)	23.10 (1.91)		-5.63	< 0.001
Race/ethnicity												
Non-Hispanic White	1.87 (0.61)	-2.11			0.036	110 (59.5)	75 (40.5)			4.42		0.035
Racial minority	2.03 (0.59)					72 (72.0)	28 (28.0)					
Sexual identity												
Gay, queer or homosexual	1.90 (0.60)	-1.66			0.098	138 (60.0)	92 (40.0)			7.69		0.006
Other MSM identity	2.05 (0.62)					44 (80.0)	11 (20.0)					
HIV status												
Negative	1.92 (0.60)	-0.98			0.327	154 (60.4)	101 (39.6)			12.62		< 0.001
Unknown or unaware	2.03 (0.65)					28 (93.3)	28 (93.3)					
Relationship status												
Single	1.91 (0.61)		0.48		0.621	118 (63.8)	67 (36.2)			12.12		0.002
In a relationship, monogamous	2.01 (0.53)					41 (80.4)	10 (19.6)					
In a relationship, non-monogamous	1.92 (0.67)					23 (46.9)	26 (53.1)					
Education level												
Less than college degree	1.99 (0.62)	1.47			0.143	93 (78.2)	26 (21.8)			18.08		< 0.001
A college degree or higher	1.89 (0.59)					89 (53.6)	77 (46.4)					
Employment status												
Unemployed	1.97 (0.70)		1.61		0.202	52 (70.3)	22 (29.7)			24.18		< 0.001
Part-time	2.01 (0.54)					64 (82.1)	14 (17.9)					
Full-time	1.86 (0.58)					66 (49.6)	67 (50.4)					
Metropolitan area												
Baltimore	2.01 (0.66)		0.68		0.508	68 (54.8)	56 (45.2)			8.94		0.011
Philadelphia	1.90 (0.60)					81 (73.6)	29 (26.4)					
Washington, DC	1.92 (0.59)					33 (64.7)	18 (35.3)					
Recent condomless anal intercourse												

Variable	Endorsement of negative PrEP stereotypes										PrEP uptake (0: Never [ <i>n</i> = 182, 63.9%], 1: Any [ <i>n</i> = 103, 36.1%])			
	Uptake = 0					Uptake = 1					Uptake = 0		Uptake = 1	
	<i>m</i> ( <i>sd</i> )	<i>t</i>	<i>F</i>	<i>r</i>	<i>p</i>	<i>n</i> (%)	<i>n</i> (%)	<i>m</i> ( <i>sd</i> )	<i>m</i> ( <i>sd</i> )	<i>χ</i> <sup>2</sup>	<i>t</i>	<i>p</i>		
None	2.10 (0.65)	2.72			0.007	61 (80.3)	15 (19.7)			12.08		0.001		
Any	1.88 (0.58)					121 (57.9)	88 (42.1)							
Gay community attachment				-0.08	0.175			2.63 (0.69)	2.99 (0.75)		-4.09	< 0.001		
Stigma: perceived comm. homophobia				0.19	0.002			2.00 (0.59)	1.72 (0.51)		4.08	< 0.001		
Stigma: perceived comm. HIV stigma				0.09	0.129			2.49 (0.57)	2.36 (0.52)		1.94	0.053		
Endorsement of PrEP stereotypes								1.99 (0.61)	1.82 (0.58)		2.38	0.018		
Lifetime PrEP uptake														
None	1.99 (0.61)	2.38			0.018									
Any	1.82 (0.58)													

**Table 3**

Parameter estimates for final mediation model

Path	Estimates	95% CI
Model with gay community attachment as a mediator <sup>a</sup>		
Perceived community stigma → stereotype endorsement		
Direct effect (c)	0.21 *	0.08, 0.34
Indirect effect (a * b)	0.02	-0.02, 0.05
Gay community attachment → PrEP uptake		
Direct effect (e)	0.25 *	0.11, 0.40
Indirect effect (b * d)	0.02	-0.01, 0.04
Perceived community stigma → PrEP uptake		
Direct effect (f)	-0.19 *	-0.36, -0.02
Total indirect effect	-0.11 *	-0.17, -0.05
Indirect effect (c * d)	-0.05 *	-0.09, -0.01
Indirect effect (a * e)	-0.06 *	-0.11, -0.02
Indirect effect (a * b * d)	-0.004	-0.01, 0.004
Model with gay community attachment as a moderator <sup>b</sup> —low gay community attachment		
Perceived community stigma → stereotype endorsement		
Direct effect (c)	-0.11	-0.38, 0.16
Total indirect effect (a * b)	-0.03	-0.09, 0.02
Model with gay community attachment as a moderator <sup>b</sup> —high gay community attachment		
Perceived community stigma → stereotype endorsement		
Direct effect (c)	-0.26 *	-0.47, -0.06
Total indirect effect (a * b)	-0.07 *	-0.13, -0.01

\*  $p < 0.05$

<sup>a</sup> Letters correspond to paths outlined in Fig. 1 Model A

<sup>b</sup> Letters correspond to paths outlined in Fig. 1 Model B