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Perceptions of Prevalence and Risk Perception Among Sexual and Gender Minorities in Urban and Rural Areas in the Southern United States

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An abstract of
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Abstract

Perceptions of Prevalence and Risk Perception Among Sexual and Gender Minorities in Urban and Rural Areas in the Southern United States

By Megan Henry

There is limited data on how perceptions of risk and attitudes towards HIV and HIV prevention vary between rural and urban/metropolitan areas. This study sought to assess the accuracy of estimates of HIV prevalence by urbanicity (urban vs. rural) and HIV risk perception/fatalism among sexual and gender minority (SGM) populations in the southern US. We conducted a cross-sectional study of minority SGM individuals in rural and non-rural areas of the southern United States to characterize the experiences of rural SGM populations. The study's primary outcome of interest was awareness of HIV prevalence among gay or bisexual men in an individual's county and state of residence. Individuals reported their best guess of the percent of the MSM population living with HIV in their state of residence and county of residence. True prevalence proportion values were estimated for comparison to participant estimation. The study's primary independent variable of interest was the rurality of where an individual lived. Other variables of interest included demographics such as race, income, age, and education, as well as behavioral/social factors like HIV testing habits, perception of HIV risk and general attitudes regarding HIV/HIV prevention, and disclosure of sexuality to healthcare providers. Binary logistic regression was performed and unadjusted and adjusted odds ratios and 95% confidence intervals were estimated to assess the association between rurality and awareness. Results of the study showed a weak positive association between rurality of a participant's county and awareness of HIV prevalence among gay and bisexual men in a participant's state (Adjusted OR = 1.64, 95% CI 0.89, 3.01 as well as a positive association between rurality of a participant's county and awareness of HIV prevalence among gay and bisexual men in a participant's county (Adjusted OR = 2.10, 95% CI 1.22, 3.64). The result implies that there might be a higher awareness of HIV prevalence among rural populations, despite urban populations having higher perceptions of their individual risk. This could mean that urban populations have a better understanding of individual risk but need programming that educates on HIV prevalence in local areas. Rural participants may have a higher awareness of HIV prevalence in their communities but need programming that focuses on individual risk. This is consistent with the unique challenges that rural areas face when approaching HIV care and prevention compared to urban and metropolitan areas. Interventions for rural and urban areas in the South should be unique to each individual area and consider the awareness and risk perception of their target population so that they are able to make informed decisions regarding HIV prevention.

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Introduction

There were an estimated 1.2 million individuals living with HIV in the United States as of 2019.[1] HIV disproportionately affects men who have sex with men (MSM), Black and Hispanic/Latine individuals, and individuals living in the southern United States.[1] In 2019 there were 36,740 new HIV diagnoses among adults and adolescents in the United States[1]and 65% of all new diagnoses were attributed solely to male-to-male sexual contact (MMSC).[1]

Prevalence of HIV among MSM within the United States is estimated to be around 12%, based on data collected from 2010-2015.[3] Transgender and nonbinary individuals made up only 1% of new HIV infections in 2019, but the rate of infection has risen significantly since 2015.[1] A meta-analysis using data from 2006-2017 estimated that 14.1% of transgender women and 3.2% of transgender men are living with HIV, and that Black and Hispanic/Latine trans populations were disproportionately affected.[4]

The diagnosis rate in 2019 in the southern United States was 15.2 per 100,000 individuals, which is higher than the national average.[1] Individuals living in the South made up 52% of new diagnoses in 2019 despite only making up 38% of the US population.[1,5,6] The South has a higher burden of HIV in small metropolitan (less than 500,000 individuals) and non-metropolitan (less than 50,000) areas than the rest of the country.[7] The proportion of diagnoses attributed to male-to-male sexual contact (MMSC) does not differ significantly between large metropolitan, small metropolitan, and nonmetropolitan areas.[7]

Risk perception is a measure of an individual's beliefs about their own behavior, regardless of the true circumstances.[8] Risk perception is an important factor in health outcomes, as risk perception is known to influence behavior and impact how an individual perceives

situations.[8] A study conducted in France and Canada with HIV-negative MSM and transgender women who had unprotected sex at least twice in the previous six months found that those who perceived their HIV risk to be high were less likely to use condoms regularly, but were more likely to be consistently adherent to PrEP.[8] A study conducted in seven different countries measuring perceptions of risk and seriousness showed that HIV-negative MSM in the United States tended to view HIV (once contracted) as very serious, but tended to view the risk of actually contracting HIV as only moderately serious.[9] In a study examining perceptions of HIV risk among HIV-negative MSM in the United States who use the internet to find sex partners for unprotected sex, the results showed that over half the men perceived themselves as having little-to-no risk of contracting HIV; lower perceived risk was associated with the following factors: older age, little-to-no substance use during sex, frequent condom use, consistently being the insertive partner, and lower frequency of using partner-finding websites.[10]

There is limited data on how perceptions of risk and attitudes towards HIV, HIV prevention vary between rural and urban or metropolitan areas. Urban or metropolitan areas are often the most targeted areas for HIV prevention and studies done in metropolitan areas have helped inform public health officials' design for metropolitan HIV programs. The unique HIV care continuum challenges faced in rural areas require unique programming and understanding how SGM (sexual & gender minority) populations are affected in rural areas is imperative to implementing effective rural HIV programming. We sought to assess the accuracy of estimates of HIV prevalence by urbanicity (urban vs. rural) HIV risk perception and fatalism among SGM populations in the southern US.

Methods

Study Design and Population

We conducted a cross-sectional study of gender and sexual minority (SGM) individuals in rural and non-rural areas of the southern United States to characterize the experiences of rural SGM populations. Participants were eligible if they were assigned male at birth or assigned female at birth and did not identify as cisgender female, reported a history of sex with men, and were between the ages 18-34, were an English speaker, were an Android or iOS smartphone user, and were willing to download a health-related smartphone app. The smartphone-related eligibility criteria were in place because the overall study was designed to assess preferences for HIV prevention smartphone apps among rural SGM individuals. Data were collected from April 2021 – January 2022.

Recruitment for the survey was conducted mostly online, using apps such as Jack'd and Instagram to advertise to adults in the rural southern US. Instagram ads were targeted to adults in the target age range whose social media activity indicated they might identify with at least one SGM group. Offline recruiting was minimal but was conducted through flyers and community partners promoting the survey. Finally, individuals who had previously taken part in the American Men's Internet Survey[11] and had consented to be contacted for further research opportunities were recruited via email. All recruitment methods led individuals to an online consent and screener for eligibility. Data collected from screening and the subsequent survey was stored in secure, HIPAA-compliant servers of Alchemer located in Boulder, Colorado. There was initially no compensation for taking part in the study; however, a weekly raffle for a $50 electronic gift card was implemented in October 2021.

Measures and Variables

The study's primary outcome of interest was awareness of HIV prevalence among gay or bisexual men in an individual's county and state of residence. Individuals reported their best guess of the percent of MSM population living with HIV in their state of residence and county of residence. Separate variables describing awareness of HIV prevalence were calculated for the county and state level prevalence.

True prevalence proportion values were estimated for comparison to participant estimation. Cases are often reported in context of how HIV was transmitted to the individual living with HIV. Sexually active gay and bisexual men are captured in two categories: MSM (individuals living with HIV who are men who have sex with men), and MSM + IDU (individuals living with HIV who are men who have sex with men and are also injection drug users, so the exact method of transmission isn't known). The prevalent case counts for both MSM and MSM + IDU transmission categories reported for each county in the southern U.S. were used as a proxy for HIV case counts for gay and bisexual men and were used as each county's numerator. Data for case counts at the state and county levels were retrieved from AIDSVu, a HIV visualization and dissemination database that uses data from the CDC and local health departments to provide easily accessible and widely available HIV data.[12] Using each state's MSM population percentage estimate as a proxy for a county's proportion of gay and bisexual men, the gay and bisexual male population was estimated for each county by multiplying the U.S. Census County population by the percentage of MSM estimated to be in the state, and this value was used as the denominator value.[13,14] The result was a percentage estimate (0-100%) of the proportion of gay and bisexual men living with HIV in each county. The same

process was repeated with southern U.S. states but instead used state-wide prevalent HIV case counts of MSM and MSM + IDU and state-wide Census populations. The result for the second procedure was a percentage estimate (0-100%) of the proportion of gay and bisexual men living with HIV in each state. . It should be noted that there were 2 participant entries where the number of MSM + MSM + IDU case counts in their counties were higher than the anticipated gay and bisexual male population in their counties; in these cases, prevalence was set to 100% to keep the percentage scale from exceeding 100%.

Participants' estimated HIV prevalence at the county and state levels were compared to the surveillance-based estimates we generated. If an individual was within 2.5 percentage points of the correct prevalence in either direction, then they were considered "aware" of HIV prevalence in their community. If their guess was more than 2.5 percentage points different from the correct prevalence, they were considered "unaware" of HIV prevalence in their community.

The study's primary independent variable of interest was the rurality of where an individual lived. Participant ZIP code was used to categorize their residence as rural or non-rural using the index of relative rurality (IRR), a continuous measure of rurality based on population size, population density, and proximity to urban centers.[15,16] IRR scores of 0.4 or higher were categorized as rural, per the suggestions of the authors and previous evidence that this dichotomization effectively identifies rurality-based disparities in HIV outcomes.[15–17]

Other variables of interest included demographics such as race, income, age, and education, as well as behavioral and social factors like HIV testing habits, perception of HIV risk and general attitudes regarding HIV prevention, and disclosure of sexuality to healthcare providers. Age (in years) was divided into three groups: 18-24, 25-29, and 30-34). Race and ethnicity were divided into four categories: Hispanic, non-Hispanic White, non-Hispanic Black,

and non-Hispanic other or multiracial. Annual household income was separated into 4 brackets: Less than $20,000, $20,000 - $39,999, $40,000 - $74,999, and $75,000+. Questions asked to participants included “Have you ever been tested for HIV?,” “Have you ever been tested for a sexually transmitted infection like gonorrhea, chlamydia, or syphilis?,” " Have you ever taken PrEP?,” “Would you be willing to take anti-HIV medicines every day to lower your chances of getting HIV?,” “Are you currently taking PrEP?,” and “Have you ever tried to obtain or use PrEP but have not been able to?.” Disclosure of sexuality to healthcare provider was measured with the question, “Have you ever told a healthcare provider that you are attracted to or have sex with men?.”

Participants were also asked to read a variety of statements and choose their level of agreement with each. Options included “Strongly Agree”, “Agree”, “Neutral”, “Disagree”, and “Strongly Disagree”. Statements included “If one is destined to become infected with HIV, there's nothing you can do about it,” “Most of my friends think that getting HIV sooner or later is unavoidable,” “Most of my friends believe they can do something to prevent HIV transmission,” “Concerns about HIV make me anxious about having sex,” “Becoming HIV infected would make my life harder,” “I am concerned about high rates of HIV infection among people like me,” “I would be willing to make a change in my daily life to prevent HIV,” and “Having a sexually transmitted infection (e.g. gonorrhea, chlamydia, syphilis) can increase my risk of getting HIV.” Participants also finished the statement, “I think my chances of getting infected with HIV are:” with either “Almost zero,” “Small,” “Moderate,” “Large,” or “Very large,” and the statement “Getting HIV is something I am:” with either “Not concerned about,” “A little concerned about,” “Moderately concerned about,” “Concerned about a lot,” or “Extremely concerned about.” Perception of fatalism (inevitability of HIV infection) was measured by participants’ level of

agreement with the statement, “If one is destined to become infected with HIV, there’s nothing you can do about it,” and was categorized as Agreement (an aggregate of Agree and Strongly Agree) or Non-Agreement (an aggregate of Neutral, Disagree, and Strongly Disagree).

Statistical Analysis

Data cleaning was done in SAS 9.4 and R Studio 2022.12.0+353. All statistical analyses were done using SAS 9.4. Binary logistic regression was used to determine if there was an association between a participant’s awareness of HIV prevalence among MSM in their community and the level of rurality of their community. Awareness of HIV prevalence among MSM in a participant’s community was defined as a participant’s estimate of prevalence being within +/- 2.5% of the true estimated prevalence. Separate regression analyses were run for participant awareness of state and county prevalence. Confounders included in the model were determined using a directed acyclic graph and included age, income, education, fatalism towards HIV infection, and sexual identity disclosure to healthcare professionals in a participant’s lifetime. Parameter estimates for unadjusted and adjusted (controlling for confounders) odds ratios were estimated to assess the impact of rurality on awareness, along with 95% confidence intervals. A sensitivity analysis at +/- 5% accuracy was also done and is presented in Appendix A.

Results

Of the 5,598 potential participants who clicked on the link to the online eligibility screener, 3,339 (59.6%) consented to screen, 3,055 (54.6%) completed the screener, and 1,169 (20.9%) were eligible. 583 (10.4%) participants completed the survey, and 543 (10.3%) participants were included in the analysis; 40 participants were excluded for being under 18 (n=4) or missing data on county (n = 23), state (n = 7), or rurality (n = 6).

Table 1 describes the demographics of the 543 participants included in analysis. The results are stratified by urbanicity. Of the participants included in analysis, 31.1% were between the ages of 18-24, 29.6% were between the ages of 25-29, and 29.3% were between the ages of 30-34. Half (49.8%) of participants were non-Hispanic White; 22.6% of participants were non-Hispanic Black, 18.9% were Hispanic, and 8.7% were another non-Hispanic racial identity or multiracial. In urban areas, 44.9% of participants were non-Hispanic White, which was lower than rural areas where 60.8% of the participants were non-Hispanic White. The majority (52.1%) of urban participants had graduated college, while only 37.0% of rural participants were a college graduate. The majority among all groups identified as cisgender male (84.6% total, 86.7% urban, 79.9% rural). Most participants identified as homosexual, gay, or lesbian (69.5%). Most (83.5%) participants had been tested for a STI in the past, and 90.1% of participants had been tested for HIV. Most (76.9%) of participants reported that they were willing to take daily PrEP to prevent HIV, but only 37.2% of participants had ever taken PrEP in their lives. 23.3% of participants reported currently being on PrEP, and 23.9% of participants reported having an unsuccessful attempt to obtain or use PrEP in the past. Most (75.7%) participants reported ever

having told a healthcare provider that they are attracted to or have sex with men (78.3% in the urban group vs. 69.5% in the rural group).

Table 2 describes the distribution of each group's estimates of HIV prevalence among different groups within their communities, as well as the differences between participants' estimates and the true prevalence values estimated for each county. As not all participants answered every question, the total number is also given for each group for each question. The mean value of participants' estimates of the percentage of gay and bisexual men with HIV in their county was 27.9% (29.2% in the urban group vs. 25.1% in the rural group), and the mean value of participants' estimates of the percentage of gay and bisexual men with HIV in their state was 31.5% (32.7% in the urban group vs. 29.0% in the rural group). The mean value of participants' estimates of the percentage of their friends with HIV was 10.7% (11.5% in the urban group vs. 8.9% in the rural group). The mean value of participants' estimates of the percentage of their sex partners with HIV was 10.2% (11.2% in the urban group vs. 7.9% in the rural group).

Table 3 describes the perceptions of risk and attitudes surrounding HIV among each group. For the statement, "If one is destined to become infected with HIV, there's nothing you can do about it", a minority of participants chose "Agree" or "Strongly Agree" (8.8% total, 10.6% urban, 4.8% rural). Most participants agreed with the statement "Most of my friends believe they can do something to prevent HIV transmission" (93.5% total, 93.6% urban, 93.3% rural). When asked to complete the statement "I think my chances of getting infected with HIV are:", 7.2% of the total participants answered "Large" or "Very Large" (8.8% urban vs. 3.6% rural).

Table 4 describes the results of the adjusted and unadjusted nominal regression models. There is a weak positive association between rurality of a participant's home location and awareness of HIV prevalence among gay and bisexual men in a participant's state, both in a bivariate analysis (Unadjusted OR = 1.63, 95% CI 0.95, 2.81) and in a multivariable analysis controlling for age, race, education, income, disclosure of sexuality to healthcare provider, and fatalism towards HIV (Adjusted OR = 1.64, 95% CI 0.89, 3.01). There is a positive association between rurality of a participant's home location and awareness of HIV prevalence among gay and bisexual men in a participant's county in a bivariate analysis (Unadjusted OR = 1.96, 95% CI 1.18, 2.24), and a strong positive correlation in a multivariable analysis controlling for age, race, education, income, disclosure of sexuality to healthcare provider, and fatalism towards HIV (Adjusted OR = 2.10, 95% CI 1.22, 3.64).

Discussion

This study shines a light on the overall low level of awareness of HIV prevalence in the southern United States, as well as a multitude of opportunities for surveillance, education, interventions, and other public health work targeting SGM populations. While results showed that rural participants had a higher proportion of correctly estimated (within 2.5%) HIV prevalence among gay and bisexual men in their county, the true county population estimates were estimated with relatively low confidence due to lack of county-level data on MSM populations, and most participants in both rural and urban groups estimated incorrectly (> 2.5%). This highlights further opportunities for interventions and education as well as the need for better surveillance systems that cater specifically to the SGM community. Almost a quarter of participants denied ever telling a healthcare provider their sexuality, which shows opportunities for providers to create a safer environment, especially in rural areas, and could possibly indicate missed opportunities for healthcare providers to educate SGM patients on HIV risk and prevalence. Increasing HIV risk and prevalence awareness could also be an opportunity to increase PrEP adherence and uptake, based on the number of participants who are not currently on PrEP but are willing to start. Although there is a certain level of fatalism among participants in both urban and rural areas, most participants answered questions about perceptions of risk in a manner that demonstrated they viewed HIV as a risk that they took seriously and considered themselves capable of preventing an HIV infection, highlighting opportunities to reach individuals who already seem to be well-educated on HIV risk and prevention methods.

Although most participants reported their sexuality when asked during the survey, many (24.4%) also reported never having told a healthcare provider their sexuality . Appendix B shows

that among the participants who reported never having disclosed their sexuality to a provider, a majority reported that they had never felt excluded from family activities because of their sexuality (67.3%), and a majority also reported never having experienced discriminatory remarks about their sexuality from family members (52.5%). This brings up a possibility that many of the individuals who have not disclosed their sexuality to their provider feel a certain level of safety among their family, and yet they are still unwilling to come out to their provider; previous literature has suggested that there is both anticipated and experienced stigma among sexual and gender minorities in healthcare settings.[18] Previous studies have demonstrated the barriers that stigma creates in the HIV care continuum, especially for sexual and gender minorities in the southern United States.[18–25] The added context of the wide range of prevalence estimates given by participants shows an opportunity for healthcare providers to educate their patients on HIV risk and prevalence in their area. If there are not safe environments for SGM individuals to disclose their identity to their provider, these opportunities will be more limited.

There is also an opportunity to increase PrEP access and adherence. Only 23.2% of participants in this study reported currently taking PrEP, but over a third (37.2%) of participants reported having a past experience where they attempted to obtain or use PrEP but were unable to. Of the 66 individuals living in rural areas who reported having an unsuccessful attempt in the past to use or obtain PrEP, 59 (89.4%) reported that they would still be willing to take daily PrEP. In context of the wide range of HIV prevalence estimates, programming that targets rural MSM and gender-diverse individuals can focus on educating individuals on the HIV risk in their area, the effectiveness of PrEP, and the difference in HIV risk among those on PrEP and those not on PrEP. Risk mitigation behaviors are linked to risk perception, and awareness of HIV

prevalence in an individual's area could strengthen an individual's perceptions of PrEP efficacy.[11,18,27,28]

The wide range of estimates regarding the HIV prevalence among gay and bisexual men in a participant's county and state demonstrate that there is heterogeneity of perception of HIV among SGM communities, but also a lack of reliable data to begin correcting awareness. The limitations of the true prevalence estimates for HIV prevalence among SGM men in each county and state are discussed in detail below, but it is notable that in some counties, the MSM case counts exceeded the expected population of SGM men in that county. This is likely due to the lack of county-level population data, as data published on SGM populations in the United States are often done at the state-level and don't give insight into the heterogeneity that is likely to occur between counties in each state. Better surveillance methods for MSM and SGM populations would greatly benefit estimates of HIV prevalence among MSM and SGM groups. Some interventions are already beginning to occur, such as the U.S. Census starting to capture sexuality data in some of their surveys, but this data has yet to be published and county-level population data is badly needed.[14,29]

This study suggests that while there is a certain level of fatalism towards HIV, the results of the risk and attitude questions suggest that most participants took HIV seriously and were conscious of the ways risk is increased and decreased, and that they felt they could take an active role in preventing themselves from getting infected . Contrasting these results with the proportion of participants that reported currently being on PrEP (23.3%), and the number of participants that experienced trouble accessing PrEP in the past (23.9%), these results demonstrate an opportunity to reach those who are already educated on HIV and willing to

employ prevention methods, as well as casting a light on the number of MSM and gender diverse individuals who are currently not being reached in the healthcare system.

The results of the logistic regression analysis showed that rural participants were more likely to correctly estimate the HIV prevalence among gay and bisexual men in their county (OR = 2.1, 95% CI 1.22, 3.64). A boxplot of the difference in estimate and true prevalence among rural and urban groups shows that rural participants were overestimating by a wider margin than their margin of underestimating, whereas urban participants had a wide margin of error on both sides. Among the counties in which participants in this study lived, true HIV prevalence estimates tended to be higher than rural areas, giving urban participants a larger range of error when underestimating. Urban participants had a slightly higher perception of prevalence than rural participants. The result of the logistic regression should be interpreted cautiously, as estimates of true prevalence did not account for heterogeneity among counties nor potential underestimates of gay and bisexual populations in areas where stigma prevents individuals from coming out. The result implies that there might be a higher awareness of HIV prevalence among rural populations, despite urban populations having higher perceptions of their individual risk. This could mean that urban populations have a better understanding of individual risk but need programming that educates on HIV prevalence in local areas. Rural participants may have a higher awareness of HIV prevalence in their communities but need programming that focuses on individual risk. This is consistent with the unique challenges that rural areas face when approaching HIV care and prevention compared to urban and metropolitan areas. In a study assessing rural barriers and geographic accessibility to HIV care, 671 HIV care sites were found throughout the United States, and 95% of those were in urban areas.[20] MSM in rural areas are less likely than MSM in urban areas to tell their healthcare provider their sexual identity and

avoid healthcare more often in general.[30,31] In a study assessing barriers to care among individuals living with HIV in urban and rural areas, both groups reported lack of HIV awareness in their communities, financial cost of HIV care, lack of employment opportunities, and lack of supportive work and home environments, but rural participants reported long distances from care facilities, inadequately trained mental and medical health providers, lack of transportation (both public and private), and a higher level of community stigma surrounding HIV.[23] In a 2018 study on HIV care in rural areas of the U.S., rural participants were found to be less likely to be retained in care than their urban counterparts.[22]

Limitations of this study include possible reporting bias, lack of concrete prevalence data among SGM populations, small sample sizes of transgender and nonbinary people, lack of coverage across all southern United States counties, and the difficulty of measuring stigma and "outness". The bulk of the measures in this analysis were self-reported, and social desirability bias cannot be ruled out. In addition, the sample used in this study had to meet the inclusion criteria and most completed the survey without compensation; this could cause selection bias by having a larger representation of health-conscious individuals and individuals who are willing to be surveyed with no compensation than would be found in the full scope of the population. The estimates of true prevalence should be regarded with caution as the population of SGM men on a county-level is not currently available. While the best effort was made to create an approximation of the number of MSM living with HIV and the total number of MSM in each county, the data relied on state-wide data that did not account for heterogeneity within states. This sample also had a very small sample size of transgender and nonbinary individuals necessitating aggregating these groups into a single "gender diverse" group that gives no insight into the heterogeneity among different gender identities. Although transgender and nonbinary

individuals make up a small portion of the United States population, it is important to have a large enough sample of individuals with gender-diverse identities in order to identify trends and patterns that are specific to each group. The limitations of this study are numerous but also highlight the lack of concrete data available on MSM populations at the county level, lack of state-level and county-level data on transgender and nonbinary individuals, stigma affecting MSM in rural areas in the Southern United States, and inconsistent case reporting among states.

This study demonstrated that SGM people in rural areas have lower perception of individual risk and higher awareness of HIV prevalence among gay and bisexual men in their area compared to non-rural SGM. Although the urban group seemed to report a modestly higher proportion of access to care, education about HIV, and lack of stigma, both groups still had a notable proportion of participants facing these barriers. Interventions for rural and urban areas in the South should be unique to each individual area and consider the awareness and risk perception of their target population so that they are able to make informed decisions regarding HIV prevention.

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Tables

Table 1: Baseline Characteristics of Sexual and Gender Minorities in the Southern United States			
	Total n (%)	Urban n (%)	Rural n (%)
Age			
18-24	169 (31.1%)	108 (28.7%)	61 (36.8%)
25-34	374 (68.9%)	269 (71.4%)	105 (70.5%)
Race			
Hispanic	102 (18.9%)	77 (20.6%)	25 (15.1%)
Non-Hispanic Black	122 (22.6%)	92 (24.6%)	30 (18.1%)
Non-Hispanic White	269 (49.8%)	168 (44.9%)	101 (60.8%)
Other Race or Multiracial	47 (8.7%)	37 (9.9%)	10 (6.0%)
Education			
High School or Lower	101 (18.67%)	62 (16.5%)	39 (23.6%)
Some College	183 (33.8%)	118 (31.4%)	65 (39.4%)
College Graduate or More	257 (47.5%)	196 (52.1%)	61 (37.0%)
Gender Identity			
Cisgender Male	457 (84.6%)	326 (86.7%)	131 (79.9%)
Other	83 (15.37%)	50 (13.3%)	33 (20.1%)
Insurance			
Private	350 (64.9%)	250 (66.8%)	100 (60.6%)
Public	42 (7.8%)	22 (5.9%)	20 (12.1%)
Private/Public Combo or Other	23 (4.3%)	15 (4.0%)	8 (4.9%)
None	124 (23.0%)	87 (23.3%)	37 (22.4%)
Income			
Less than $20,000	123 (24.3%)	83 (23.4%)	40 (26.5%)
$20,000 - $39,000	138 (27.3%)	98 (27.6%)	40 (26.5%)
$40,000 - $74,999	135 (26.7%)	95 (26.8%)	40 (26.5%)
$75,000+	110 (21.7%)	79 (22.3%)	31 (20.5%)
Sexual Identity			
Homosexual, Gay, or Lesbian	373 (69.5%)	270 (72.4%)	103 (62.8%)
Heterosexual or Straight	9 (1.7%)	6 (1.6%)	3 (1.8%)
Bisexual	118 (22.0%)	72 (19.3%)	46 (28.1%)
Not Listed	37 (6.9%)	25 (6.7%)	12 (7.32%)
Ever Been Tested for STI			
Yes	439 (83.5%)	315 (85.6%)	124 (78.5%)
No	87 (16.5%)	53 (14.4%)	34 (21.5%)
Ever Been Tested for HIV			
Yes	484 (90.1%)	342 (91.9%)	142 (86.1%)
No	53 (9.9%)	30 (8.1%)	23 (13.9%)
PreP Use			
Not on Daily PreP but Willing to Start	283	196	87
Ever Taken PreP	200 (37.2%)	157 (42.1%)	43 (26.1%)
Currently Taking PreP	125 (23.2%)	99 (26.5%)	26 (15.8%)
Unable to Access PreP in the Past	129 (23.9%)	92 (24.6%)	37 (22.3%)
Disclosed Sexuality to Healthcare Provider			
Yes	407 (75.7%)	293 (78.3%)	114 (69.5%)
No	131 (24.4%)	81 (21.7%)	50 (30.5%)

Table 2: Perceptions of Prevalence of HIV Among Sexual and Gender Minorities in the Southern United States

	Overall					Urban					Rural				
Estimate percent with HIV:	n	$\hat{\mu}$	σ	Mdn	IQR	n	$\hat{\mu}$	σ	Mdn	IQR	n	$\hat{\mu}$	σ	Mdn	IQR
Gay and bisexual men in the largest city near your home	538	32.3	22.4	25.0	30.0	374	32.9	23.2	26.0	31.0	164	30.9	20.5	25.0	28.5
Gay and bisexual men in your county	542	27.9	20.4	24.0	29.0	376	29.2	20.4	25.0	26.0	166	25.1	20.3	20.0	23.0
Gay and bisexual men in your state	540	31.5	21.8	27.0	27.0	376	32.7	22.9	28.0	28.0	164	29.0	19.0	25.0	25.0
Friends	503	10.7	17.3	5.0	15.0	353	11.5	17.9	5.0	15.0	150	8.9	15.5	2.0	11.0
Your sex partners	466	10.2	18.5	2.0	10.0	327	11.2	19.2	3.0	11.0	139	7.9	16.7	1.0	10.0
Transgender men in the largest city near your home	518	22.4	20.2	16.0	22.0	365	23.2	20.1	18.0	21.0	153	20.4	20.2	15.0	24.0
Transgender men in your county	516	20.6	19.6	15.0	23.0	364	21.7	19.4	16.0	23.0	152	18.1	19.8	10.5	22.0
Transgender men in your state	518	21.1	18.7	15.0	23.0	364	22.0	18.9	17.0	21.0	154	19.1	18.4	11.0	24.0
Transgender women in the largest city near your home	525	27.3	21.6	22.0	30.0	369	28.4	21.8	23.0	31.0	156	24.8	21.0	21.0	27.5
Transgender women in your county	522	25.6	21.0	20.5	25.0	370	26.5	21.0	21.5	28.0	152	23.5	21.1	18.0	28.0
Transgender women in your state	524	26.6	21.1	22.0	29.0	369	27.9	21.5	24.0	30.0	155	23.6	19.8	20.0	26.0
Accuracy* of Participants' Estimates**															
Absolute Value of Difference***:	n	$\hat{\mu}$	σ	Mdn	IQR	n	$\hat{\mu}$	σ	Mdn	IQR	n	$\hat{\mu}$	σ	Mdn	IQR
Gay and bisexual men in your county	535	18.8	16.9	14.5	19.8	375	19.6	16.8	15.8	20.0	160	17.0	17.2	12.2	17.5
Gay and bisexual men in your state	538	20.4	19.2	14.7	22.7	375	21.5	20.1	15.7	23.0	163	17.8	16.7	13.0	21.1
Relative Value of Difference****:	n	$\hat{\mu}$	σ	Mdn	IQR	n	$\hat{\mu}$	σ	Mdn	IQR	n	$\hat{\mu}$	σ	Mdn	IQR
Gay and bisexual men in your county	535	5.5	24.7	4.7	26.3	375	2.2	25.7	2.2	29.8	160	13.2	20.3	8.5	22.1
Gay and bisexual men in your state	538	17.8	21.6	13.8	27.0	375	18.9	22.6	15.0	27.1	163	15.3	19.0	12.5	25.5

n - number of participants who answered the question
$\hat{\mu}$ - mean (average) value of responses
σ - standard deviation of responses
Mdn - median value of responses
IQR - Inter-quartile range
*Accurate estimates are quantified as being within 2.5% of either side of the true prevalence estimate of HIV among MSM in participants' county or state.
**HIV Prevalence Estimates were measured by asking participants, "Estimate percent with HIV: Gay and bisexual men in your state" and "Estimate percent with HIV: Gay and bisexual men in your county".
***Absolute Value of Difference is quantified as the absolute value of the difference between a participant's estimate and the true prevalence estimate.
****Relative Value of Difference is quantified as the value of the true prevalence subtracted from the participant's estimate.

Table 3: Perceptions of Risk and Attitudes Surrounding HIV Among Sexual and Gender Minorities in the Southern United States

	Overall	Urban	Rural
How much do you agree or disagree?	Agree or Strongly Agree		
If one is destined to become infected with HIV, there's nothing you can do about it:	48 (8.8%)	40 (10.6%)	8 (4.8%)
Most of my friends think that getting HIV sooner or later is unavoidable:	45 (8.3%)	35 (9.3%)	10 (6.1%)
Most of my friends believe they can do something to prevent HIV transmission:	507 (93.5%)	353 (93.6%)	154 (93.3%)
Concerns about HIV make me anxious about having sex:	320 (58.9%)	224 (59.4%)	96 (57.8%)
Becoming HIV infected would make my life harder:	433 (79.7%)	309 (82.0%)	124 (74.7%)
I am concerned about high rates of HIV infection among people like me.:	375 (69.1%)	272 (72.2%)	103 (62.1%)
I would be willing to make a change in my daily life to prevent HIV:	445 (82.0%)	317 (84.1%)	128 (77.1%)
Having a sexually transmitted infection (e.g. gonorrhea, chlamydia, syphilis) can increase my risk of getting HIV:	356 (65.6%)	249 (66.1%)	107 (64.5%)
	Large or Very Large		
I think my chances of getting infected with HIV are:	39 (7.2%)	33 (8.8%)	6 (3.6%)
	Concerned or Extremely Concerned About		
Getting HIV is something I am:	176 (32.4%)	123 (32.6%)	53 (31.9%)

Table 4: Binary Logistic Regression Model Comparing Accuracy* of HIV Prevalence Estimates** by Urbanicity*** Among Sexual and Gender Minorities in the Southern United States

	Odds Ratios****		95% Confidence Intervals	Model*****
	Urban (Ref)	Rural		
State Estimate	1.0	1.63	0.95 - 2.81	Unadjusted
	1.0	1.64	0.89 - 3.01	Adjusted
County Estimate	1.0	1.96	1.18 - 2.24	Unadjusted
	1.0	2.10	1.22 - 3.64	Adjusted

*Accurate estimates are quantified as being within 2.5% of either side of the true prevalence estimate of HIV among MSM in participants' county or state.

**HIV Prevalence Estimates were measured by asking participants, "Estimate percent with HIV: Gay and bisexual men in your state" and "Estimate percent with HIV: Gay and bisexual men in your county".

***Urbanicity measured on the IRR Scale from 0-1, with counties scoring 0.4 or higher being categorized as "Urban" and counties scoring lower than 0.4 being categorized as "Rural".[16,17]

****Odds Ratio refers to the odds of participants accurately estimating the prevalence of HIV among MSM in their county or state.

*****Adjusted models control for age, race, education, income, disclosure of sexuality to healthcare provider, and fatalism towards HIV.

Appendix

Appendix A: Sensitivity Test at 5% Level for Binary Logistic Regression Model Comparing Accuracy* of HIV Prevalence Estimates** by Urbanicity*** Among Sexual and Gender Minorities in the Southern United States

	Odds Ratios****		95% Confidence Intervals	Model*****
	Urban (Ref)	Rural		
State Estimate	1.0	1.36	0.89 - 2.10	Unadjusted
	1.0	1.35	0.83 - 2.18	Adjusted
County Estimate	1.0	1.54	1.01 - 2.34	Unadjusted
	1.0	1.58	0.99 - 2.51	Adjusted

*Accurate estimates are quantified as being within 2.5% of either side of the true prevalence estimate of HIV among MSM in participants' county or state.

**HIV Prevalence Estimates were measured by asking participants, "Estimate percent with HIV: Gay and bisexual men in your state" and "Estimate percent with HIV: Gay and bisexual men in your county".

***Urbanicity measured on the IRR Scale from 0-1, with counties scoring 0.4 or higher being categorized as "Urban" and counties scoring lower than 0.4 being categorized as "Rural".

****Odds Ratio refers to the odds of participants accurately estimating the prevalence of HIV among MSM in their county or state.

*****Adjusted models control for age, race, education, income, disclosure of sexuality to healthcare provider, and fatalism towards HIV.

Appendix B: Stigma Experiences Among Sexual and Gender Minorities in the Southern United States Who Have Never Disclosed Sexuality to a Healthcare Provider			
Question 1: Have you ever felt excluded from family activities because you have sex with men?			
	Overall	Urban	Rural
No	70 (67.3%)	44 (66.7%)	26 (68.4%)
Yes, in the last 6 months	17 (25.3%)	10 (15.2%)	7 (18.4%)
Yes, but not in the last 6 months	17 (25.3%)	12 (18.2%)	5 (13.2%)
Question 2: Have you ever felt that family members have made discriminatory remarks or gossiped about you because you have sex with men?			
	Overall	Urban	Rural
No	52 (52.5%)	34 (54.0%)	18 (50%)
Yes, in the last 6 months	26 (26.3%)	18 (28.6%)	8 (22.2%)
Yes, but not in the last 6 months	21 (21.2%)	11 (17.4%)	10 (27.8%)

Appendix C: Measuring Willingness to Take PrEP and Past Experiences Among Participants Not Currently Taking PrEP			
	Overall	Urban	Rural
Willingness to Take PrEP			
Willing	283 (69.5%)	196 (72.6%)	87 (63.5%)
Unsure	67 (16.5%)	42 (15.6%)	25 (18.25%)
Unwilling	57 (14.0%)	32 (11.9%)	25 (18.25%)
Ever Tried to Obtain or Use PrEP but Were Unable To			
Yes	321 (77.7%)	208 (75.9%)	113 (81.3%)
No	92 (22.3%)	66 (24.1%)	26 (18.7%)
Tried to Obtain or Use PrEP but Were Unable To Stratified vs. Willingness			
Willing and Had Past Unsuccessful PrEP Experience	83 (90.2%)	59 (89.4%)	24 (92.3%)
Unsure and Had Past Unsuccessful PrEP Experience	5 (5.4%)	4 (6.1%)	1 (3.9%)
Unwilling and Had Past Unsuccessful PrEP Experience	3 (3.3%)	2 (3.0%)	1 (3.9%)
Unknown but Had Past Unsuccessful PrEP Experience	1 (1.1%)	1 (1.5%)	0 (0.0%)