



Network Properties Among Gay, Bisexual and Other Men Who Have Sex with Men Vary by Race

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Abstract

The HIV burden among gay, bisexual, and other men who have sex with men (GBM) may be related to variations in network characteristics of the individual's social and sexual network. This study investigates variations in network properties among 188 Black and 295 White GBM recruited in New Orleans during the National HIV Behavioral Surveillance in 2014. Participants described up to five people who provided social support and five sex partners in the past 3 months. Network properties and network dissimilarity indicators were aggregated to the participant level as means or proportions and examined using PROC GLM. White participants reported larger networks ($p=0.0027$), had known network members longer ($p=0.0033$), and reported more substance use ($p<0.0001$) within networks. Black participants reported networks with fewer men ($p=0.0056$) and younger members ($p=0.0110$) than those of White GBM. Network properties among GBM differ by race in New Orleans which may inform prevention interventions.

Keywords National HIV Behavioral Surveillance · Gay, bisexual, and other men who have sex with men · Social and sexual networks · HIV prevention

Introduction

New HIV infections in the United States are increasingly concentrated among young, urban gay and bisexual men who have sex with men (GBM) who represent a small proportion of the population. Should these racial disparities persist, the CDC predicts one in two Black GBM will become infected with HIV during their lifetime [1]. In 2016, Louisiana ranked third in the nation for new HIV case rates, and eighth for the estimated number of HIV cases [2, 3]. That same year, 63% of all new diagnoses in New Orleans were among men who reported having sex with men, 69% were Black and 60% were among individuals younger than age 35 [2, 3]. The HIV prevalence among Black GBM in New

Orleans is comparable to some of the most severely affected populations globally.

A number of social determinants of health including poverty, access to health care, poor education, stigma, homelessness, and racism disproportionately likely affect individual risk for acquiring HIV, particularly in the south where the burden of disease is highest [4]. The explanation for disproportionate rates of HIV and other STIs among Black GBM who report lower or comparable risk behaviors to White GBM may be partially attributed to their social and sexual network properties [5]. Sexual and social network connections regulate individual health behaviors through diffusion of innovation, social support, norms, and access to resources and by exposure to people living with infectious disease [5–12]. A number of studies have investigated social and sexual network environments including the structure and types of relationships that promote or constrain HIV risk behaviors such as the behaviors and HIV status of sexual partners [13–15], aspects of network structure including concurrent sexual partners [16], drug use networks [17, 18], and the intersection of sexual and social networks [16, 19–22].

Previous research has shown that social network characteristics such as the density of a network, size, composition,

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norms, communication patterns, and the closeness of network members are associated with unprotected anal sexual intercourse [20]. The number, quality, and type of social support ties an individual maintains may foster healthy or risky behaviors and variations in network attributes such as an alters age, race, gender or sexual identity may ultimately impact individual risk. Social networks may also restrict access to resources or promote social norms surrounding sexual risk behaviors [23]. Dense networks, in which many people are connected to each other, may restrict the number of sex partners [24].

Studies have also demonstrated that the HIV status of sexual partners may partially explain racial and ethnic disparities in HIV [25, 26]. Sexual partners of the same race increase the probability of becoming infected with HIV due to higher prevalence rates within minority populations [27]. These network differences may be related to structural conditions like poverty and racism. Homophily among sexual partners, the tendency for people to secure ties with people similar to themselves, could in part be due to stigma Black GBM may experience leading to sexual partner selection and support from other people of color [28]. Relatedly, the age of sexual partners could increase HIV risk as older people are more likely to have HIV, although recent studies have not supported this theory [29].

Social networks among gay and bisexual men may additionally include social group affiliations within the LGBTQ community that are not homogenous [30]. For example, studies have documented chosen or constructed families comprised of persons who are biologically or legally unrelated but refer to chosen friends as family (i.e. parents and children). These chosen friends-as-family relationships may form in part due to rejection from families of origin and include the house ball community and gay families [30–38]. Houses provide a foundation of support to LGBTQ people of color through new kinship ties and friendships in large cities [39, 40]. House families are referred to by adopted surnames that are often names of well-known fashion designers or icons [41, 42]. Alternatively, gay families also have parents who act as mentors and parents, but these families are not affiliated with ball culture [34, 36, 38–40, 42–46]. Members of gay families also often adopt family names which may act to further legitimize family membership and status, although gay families are not always associated with a family name.

Additional social ties among GBM include, but are not limited to, the Bear and Leather communities. Bears often exhibit masculine appearance and physical traits including facial and body hair and larger body size [47–50]. In comparison, the leather subculture is organized around leather clothing, dominant masculine sexuality, and sexual behavior preferences such as bondage/discipline, dominance/submission and sado/masochism practices [47, 51]. In addition to the aforementioned social organizations, various other

social organizations and ties also exist within LGBTQ communities.

The extent to which men belong to certain subcultures and their relative HIV risk may be indicative of variations in risk behaviors and HIV status [52]. One study investigated risk-related behaviors among men in the leather community and found higher rates of HIV and unprotected sex with sero-discordant partners [53]. A literature review of health risks in the bear community found that this subgroup is continually found to have higher body mass, lower self-esteem and engage in risky sexual behaviors compared to other groups of gay and bisexual men [54, 55]. More recent research suggests that chosen family networks, such as gay families, may regulate healthy behaviors among GBM such as practicing safe sex [38]. Other studies have provided ample evidence that membership in house ball networks may increase HIV risk and that the social network structure of the house and ball community can effectively disseminate HIV prevention messages [30, 39, 56–60]. Previous studies have also investigated the social-structural properties among young Black GBM in the ballroom and gay family communities [61], finding that members of house and family communities were more likely than non-members to report protective traits like awareness of PrEP, health insurance, and a primary care doctor. These findings could be partially attributed to the instrumental support provided by chosen families that may be more important, but more fragile, among vulnerable groups such as Black GBM. Moreover, these differences highlight the need for culturally tailored interventions that harness or build upon social capital that exists within chosen families.

Due to marginalization and discrimination as a result of multiple stigmatized identities including race, gender and sexuality for GBM [62–65], it is important to consider racial differences in group memberships and the composition of networks affiliated with particular subgroups. Egocentric network measures that combine social and sexual network ties at the individual level allow us to focus on the function and structure of networks that potentially overlap and provide valuable information on social ties. Egocentric networks are depicted from the perspective of one individual, known as *ego*. Thus, one person (centrally located ego) may be approached and asked to describe 10 members, known as *network alters*, of their network. This study investigates variations in network properties among Black and White GBM in New Orleans, a metropolitan statistical area with high rates of new HIV infections. This study addresses the following research question: What are the variations in social and sexual network properties of White and Black GBM?

Methods

During the New Orleans arm of the National HIV Behavioral Surveillance (NHBS) in 2014, 553 GBM were recruited using venue-based time–space sampling (VBTS) to complete the core survey and locally developed egocentric network interview. HIV tests were provided to consenting participants upon completion of the 45-min interview. This study was submitted and approved through the LSU Health Sciences Center and Louisiana Department of Health’s Institutional Review Boards.

Participants

This analysis is restricted to the 483 respondents who identified as either Black (39%) or White (61%). Eligible participants were English speaking, 18 years of age or older, New Orleans residents, who were born and self-identified as male and reported ever having sex with a man.

Recruitment

Participants were recruited by VBTS which uses formative research to identify venues and to establish daytime periods for recruitment of participants. Recruitment events were scheduled on a monthly calendar in a two-stage sampling design with specific days and times identified for each venue such as bars, sex clubs, and dance clubs. At each event, men were systematically approached, screened for eligibility, and asked to participate in an anonymous survey and HIV testing. Reimbursement for time spent participating included a \$25 cash-value gift card for the survey and an additional \$25 cash-value gift card for HIV testing. All study participants received prevention materials, information about prevention and testing, and referrals to relevant services or programs in New Orleans.

Measures

The core NHBS survey includes questions about individual demographic characteristics, recent sexual and substance use behaviors, and recent HIV prevention activities such as testing and treatment. A locally developed network questionnaire was adapted from the African American Young Men’s Study [41, 44] and asked participants to list up to 10 individuals from their network with whom they interacted in the past 3 months.

Respondent Characteristics

Age was calculated from birth date and categorized into the following age groups: 18–29, 30–39, 40–49, and 50+. Household income in the past 12 months was organized into four categories ranging from less than \$15,000 to more than \$50,000. Education level was operationalized as less than high school, high school equivalent, some college, and college graduate. Sexual identity included three response options: gay/homosexual, bisexual, or heterosexual/straight. HIV and insurance status were self-reported by participants and dichotomized. The sexual risk measure ‘*Condomless anal sex*’ refers to condom use during anal sex at last sex. GBM who reported having either receptive or insertive anal sex at last sex and who did not use a condom were given a “1”; otherwise, they were coded “0”.

Social Group Type

Formative research findings from current and previous NHBS cycles identified several distinct classifications of social groups and organizations of GBM. This was used to create an additional local survey item referring to social groups and organizations: “Please tell me whether you belong to any of the following groups. You can choose more than one option (Check all that apply).” Response options included: gay family, pageant family, house ball community, faerie community, gay fraternity, bear community, leather community, other, and none. Any participant who reported belonging to any of the three chosen family categories (gay, pageant, or house ball) were additionally asked if their chosen family had a name. Based on these responses, the final operationalization of group type recoded participants into four social group types: named and non-named chosen families, other social groups, and no social group membership.

Network Properties

A series of locally developed questions explored network characteristics for each respondent (ego) in reference to “living members of your family, friends, sex partners, coworkers, classmates or other people in your life who are important to you”. To help participants keep track of their network alters, respondents were provided with a network card upon which they could write down the initials or nickname of up to five people who provided them social support and up to 5 people with whom they had had sex in the past 3 months. Participants were asked to enumerate the number of people in their life who offer them social support defined as “you could talk to them about things that are very personal and private, go to them for advice, or borrow some money or something valuable if you needed it”. The social support network members were written on lines 1–5 of the card. On

lines 6–10, participants were instructed to “write the initials of anyone you’ve had sex with in the last 3 months on lines 6–10.” Participants were instructed not to repeat any person on their network card. However, two questions accounted for potential network overlap: “Is there anyone on lines 1–5 who you have had sex with in the past 3 months? If so, please tell me the number next to their nickname.” and “Is there anyone on lines 6–10 that offers you social support?” To ensure confidentiality, interviewers did not look at the cards but asked participants questions about each person they listed for each number. Thus, the network cards were not retained for analysis purposes and each network card was shredded immediately following the interview.

Participants were asked to describe each person on their network card in terms of: demographic characteristics, relationship, social support, risk behavior, and social group affiliation. The majority of the network series questions used check all that apply options to refer to each person listed on a respondent’s network card: (i.e. “Which of them are male?” and “Which of them could you ask for advice or help about your health in general”). A series of questions also asked about each individual network member (i.e. “What is the age of person 1”). Respondent characteristics, egocentric network characteristics and social group memberships are presented as means. Indicators for dissimilarity of the network to ego were operationalized as the proportion of network members who were different than the respondent by age, race, gender or HIV status.

Analyses

Data were analyzed using SAS 9.3. Chi square tests were performed using PROC FREQ to test for bivariate associations between respondent characteristics and race. Egocentric network properties and network similarity indicators were aggregated to the participant level as means or proportions. Associations between network measures and race were examined using PROC GLM.

Results

Respondent Characteristics

Respondent demographic characteristics are shown in Table 1. Significant differences in the composition of the sample were found by race. Compared to White participants, Black participants were younger: 59% were under the age of 30 in comparison to only 23% of White participants (Chi square 71.20, $p < 0.0001$). Black participants also reported lower educational attainment (Chi square 49.25, $p < 0.0001$) and income levels (Chi square 27.29, $p < 0.0001$), were more likely to identify as bisexual (Chi square 15.03, $p = 0.0005$),

and belong to families with a family name (Chi square 45.74, $p < 0.0001$). Black respondents were more likely to self-report being HIV positive (Chi square 5.76, $p = 0.0164$) and less likely to report condomless anal sex at last sexual intercourse (Chi square 9.96, $p = 0.0016$). Twelve of the men were unaware of their HIV status (not shown). Black participants were less likely to list their last sexual partner as a person who provides them with social support (Chi square 8.22, $p = 0.0042$).

Network Properties

Additional respondent characteristics are shown at the top of Table 2. Social support varied by race. On average, Black participants reported around 8.44 people in their lives who offer them social support compared to 11.71 people among White participants ($F = 3.88$, $p = 0.0494$). Compared to White GBM, Black men reported fewer sex partners in the past 12 months ($F = 8.02$, $p = 0.0048$), less frequent attendance at venues to meet other men ($F = 39.48$, $p \leq 0.0001$), and were significantly younger ($F = 80.14$, $p \leq 0.0001$) with younger last sexual partners ($F = 41.48$, $p \leq 0.0001$).

Significant variations in network properties were also found. White participants reported larger overall networks ($F = 9.11$, $p = 0.0027$), listed more social support connections ($F = 5.29$, $p = 0.0219$) and sexual partners ($F = 5.49$, $p = 0.0195$), and were more likely to list their last male partners as a social support connection ($F = 4.73$, $p = 0.0367$). White respondents reportedly knew members longer (approximately 15 years vs. 12 years) ($F = 8.75$, $p = 0.0033$). In addition, White participants also reported more drug ($F = 11.52$, $p = 0.0110$) and alcohol use ($F = 30.49$, $p < 0.0007$) within their network. Black participants reported networks with fewer men ($F = 7.74$, $p = 0.0056$) and their networks were comprised of younger members. The average age of White participants’ network was 40 compared to 29 for Black respondents ($F = 7.35$, $p = 0.0110$). Social group memberships among respondents’ networks also varied by race: White men reported larger proportions of network members who belonged to the leather ($F = 12.43$, $p = 0.0005$), bear ($F = 21.89$, $p < 0.0001$), and radical faerie ($F = 10.61$, $p = 0.0012$) communities compared to Black respondents. Significant network dissimilarity indicators included age ($F = 9.60$, $p = 0.0002$), such that White GBM reported a greater proportion of network members of a different age compared to Black GBM.

Discussion

This study emphasizes the importance of social and sexual network variations among Black and White gay and bisexual men in New Orleans where rates of HIV infection continue

Table 1 Demographic characteristics of respondents by race

	Total		Black		White		χ^2	<i>p</i> value
	N	%	N	%	N	%		
Age							71.20	< 0.0001
18–29	178	37	111	59	67	23		
30–39	118	24	40	21	78	26		
40–49	78	16	15	8	63	21		
50+	109	23	22	12	87	29		
Education							49.25	< 0.0001
Less than high school	10	2	6	3	4	1		
High school	103	21	66	35	37	13		
Some college	149	31	62	33	87	29		
College graduate	221	46	54	29	167	57		
Income							27.29	< 0.0001
Less than \$15,000	100	21	58	32	42	14		
\$15,000–\$29,999	90	19	37	20	53	18		
\$30,000–\$49,999	107	22	41	22	66	23		
\$50,000+	181	38	48	26	133	45		
Sexual identity							15.03	0.0005
Gay	383	80	134	72	249	85		
Bisexual	81	17	47	25	34	11		
Straight	17	3	6	3	11	4		
Health insurance							0.00	0.9878
Yes	365	76	142	76	223	76		
No	118	24	46	24	72	24		
Social group							45.74	< .0001
Named chosen family	60	13	43	24	17	6		
Chosen family (no name)	55	12	16	9	39	13		
Other social group	67	14	10	5	57	20		
None	288	61	111	61	177	61		
Arrested, past 12 months							10.32	0.0013
Yes	36	26	26	39	10	14		
No	100	74	41	61	59	86		
HIV status							5.76	0.0164
Negative	356	78	124	72	232	82		
Positive	100	22	48	28	52	18		
Condomless anal sex							9.96	0.0016
Yes	159	33	46	24	113	38		
No	324	67	142	76	182	62		
Substance use, last sex							2.85	0.0913
Yes	208	43	72	38	136	46		
No	275	57	116	62	159	54		
Last partner as social support							8.22	0.0042
Yes	144	30	42	22	102	35		
No	339	70	146	78	193	65		

Bold values represent *p* < 0.05

to disproportionately affect younger Black men. This study found that specific aspects of an individual’s social and sexual networks differed among White and Black men. For example, Black participants described networks with fewer members who they could talk to about their health in

general, that were younger on average, and reported fewer risk behaviors compared to White participants. The number of people providing social support among Black participants was significantly fewer than those of White men in the study. In addition, Black men were less likely to frequent

Table 2 Respondent characteristics and network properties by race

	Total Prop or mean	Black Prop or mean	White Prop or mean	F value	β	<i>p</i> value
Respondent characteristics (means)						
Social support (base number)	10.43	8.44	11.71	3.88	−3.27	0.0494
Number of sex partners ^a	7.07	3.97	9.04	8.02	−5.07	0.0048
Frequent gay venues ^a	4.13	3.59	4.46	39.48	−0.87	<0.0001
Average age, respondent	37.57	31.14	41.66	80.14	−10.52	<0.0001
Average age, last partner	39.10	33.43	43.77	41.48	−10.35	<0.0001
Network properties (means)						
Total network size (up to 10)	5.62	5.22	5.87	9.11	−0.65	0.0027
Total social (persons 1–5)	4.19	4.02	4.31	5.29	−0.29	0.0219
Total sexual (persons 6–10)	1.43	1.21	1.57	5.49	−0.35	0.0195
Social support and sex partner	0.53	0.49	0.55	0.57	−0.06	0.4524
Sex partner as social support	0.37	0.29	0.42	4.73	−0.13	0.0301
Average time known (years)	14.14	12.39	15.25	8.75	−2.86	0.0033
Can ask about general health	2.92	2.62	3.11	5.30	−0.49	0.0217
Can ask about sexual health	2.38	2.40	2.37	0.02	0.03	0.8832
Male members	3.89	3.55	4.11	7.74	−0.56	0.0056
Female members	1.67	1.60	1.71	0.65	−0.11	0.4188
Transgender members	0.05	0.06	0.04	1.09	0.03	0.2979
Black members	2.27	4.71	0.71	699.68	4.01	<0.0001
White members	3.35	0.52	5.16	638.68	−4.64	<0.0001
Average age of members	38.13	29.42	40.14	7.36	−10.72	0.0110
Used drugs with	0.61	0.37	0.77	11.52	−0.41	0.0007
Got drunk with	1.95	1.31	2.35	30.49	−1.04	<0.0001
Social group membership (means)						
Gay fraternity	0.33	0.28	0.36	0.73	−0.08	0.3928
Leather community	0.21	0.07	0.30	12.43	−0.22	0.0005
Bear community	0.25	0.05	0.38	21.89	−0.33	<0.0001
Fairy community	0.18	0.03	0.27	10.61	−0.24	0.0012
Chosen family	0.75	0.85	0.69	1.04	0.15	0.3073
Dissimilarity to ego (proportions)						
Age	0.32	0.27	0.35	9.60	−0.08	0.0002
Race	0.11	0.09	0.12	1.89	−0.03	0.1700
Gender	0.31	0.32	0.30	0.66	0.02	0.4177
HIV Status	0.22	0.25	0.20	2.69	0.05	0.1015

Bold values represent $p < 0.05$

^aPast 12 months

gay venues to meet other sexual partners and form network connections. While Black participants reported fewer HIV risk behaviors and sexual partners in their networks, these findings provide insight into characteristics of the social connections in the lives of Black gay, bisexual and other men who have sex with men that may directly impact HIV prevention.

This study contributes to existing scientific literature on the promise of prevention activities that access social and sexual networks of gay and bisexual men to promote pre-exposure prophylaxis (PrEP) and treatment as prevention

(TasP). Reaching this population with interventions to curb HIV infection requires acknowledging differences among networks by race, particularly those with higher HIV prevalence and those specifically among Black GBM [66]. Prior research has demonstrated that members of social networks have successfully recruited peers as volunteers for HIV counseling and testing, and are demonstratively effective in identifying new HIV cases in comparison to the historical partner services approach [67, 68]. Social network based interventions have historically disseminated information through networks to promote the adoption of HIV education

and prevention messages or increase condom use via peers or opinion leaders [69]. Studies have also accessed online social network communities to encourage HIV testing among GBM [70]. The interpersonal communication lines made available by opinion leaders in a network may be just as important as the prevention message itself for effective interventions [19, 25, 69, 71].

Therefore, this study calls for interventions addressing HIV disparities to account for network characteristics among Black GBM, particularly in New Orleans. For example, local community-based organizations or health departments with programs designed to deliver interventions in community settings could assess network composition, memberships to particular social groups, and other network characteristics of potential study participants to better tailor interventions within networks of young Black men. Such interventions could include increased HIV/STI screening, promotion of PrEP uptake, retention, and adherence, and address additional social determinants and related health outcomes including substance use and mental/behavioral health.

Because specific differences in network properties among Black and White GBM have been rarely considered in public health research, our finding of smaller, younger networks with predominately Black members with less social support could potentially contribute to the disproportionate HIV burden among Black GBM. For example, these network characteristics may impact stigma, social perceptions and norms, dissemination of information, and access to resources including HIV testing, PrEP awareness, willingness and uptake, and the success of TasP strategies. Moreover, this speaks to prior work which suggests that the HIV status, age, or race of sexual partners may partially explain racial and ethnic disparities in HIV [25, 26]. For social and sexual network prevention interventions to be equally effective, it is potentially valuable to consider whether differences in network structure may influence the efficacy of combination approaches tailored to address disparities among younger sexual minority men of color. Our findings justify studies that consider potential interactions with other identities and egocentric network properties. For example, future studies should consider whether racial or ethnic identity moderates the relationship between network properties and PrEP outcomes including awareness and uptake of PrEP. Such studies should consider the extent to which HIV positive GBM are networked with HIV negative GBM by race or other factors within social, sexual, drug use and other networks that are integral to and appropriate for interventions in other geographic contexts.

Our research additionally supports the identification of social connections that are more commonly associated with White or Black men in the gay community, that may be harnessed in cities like New Orleans as unique intervention points. One potential example of such work is research

that connects gay and bisexual men to social networks that promote behavior change by augmenting social capital—the exchange of information, assets, and resources by virtue of social connections [72]. Our previous research has demonstrated that memberships to specific LGBTQ social groups are associated with decreased HIV risk behaviors [38]. In addition, we found that network level properties within chosen families (more common among GBM of color) can be used to measure social capital among GBM [73] and that membership in social groups specific to GBM are one potential indicator of social capital that is associated with PrEP awareness and willingness [74]. Aspects of young Black men’s networks, such as lack of affiliation in any LGBTQ social groups or membership in particular social groups could be targeted for tailored interventions designed to increase social capital, resilience, and potentially improve myriad health outcomes, including HIV prevention and treatment among GBM of color. A recent group-level intervention designed to improve engagement in care for young Black GBM living with HIV in the South successfully demonstrated that exploring interactive strategies for navigating social relationships can facilitate new social network connections and augment social capital within intervention groups [75]. Future research should therefore investigate whether network properties are associated with high impact prevention activities among Black GBM that can be leveraged for social capital and network-based interventions. Certain features of Black GBM’s network structure could inform effective network-level HIV prevention intervention design. Essential network properties for such efforts may include the number of individuals within networks who are willing to discuss health behavior and change, connections who provide various forms of support, and those who promote social norms including destigmatizing TasP strategies among young GBM of color.

Limitations

Several limitations are important to note. First, the self-reported data presented is cross-sectional and is subject to recall and social desirability bias. Due to the reliance upon respondents to describe their relationships, it is not possible to corroborate the nature or directionality of relationships from the perspective of network alters who were not interviewed [40]. Nonetheless, the meaningfulness of the relationships perceived by GBM with their network alters may be important irrespective to whether or not the alter validates or reciprocates those perceptions [76–78]. In addition, we cannot take into account changes within respondents’ social networks over time. Previous studies have found that individuals are likely to report upon individuals with whom they have recently been in contact [79, 80]. The locally developed

egocentric network survey accounted for this possibility by asking about interactions GBM had with in the past 3 months. Therefore, changes in the size or composition of participant's network may be minimal. Relatedly, we operationalized social networks by including up to 10 network alters participants listed as social support and sexual connections within the past 3 months. This operationalization may not fully capture the social and sexual networks of GBM. Lastly, this data is limited due to the VBTS sampling strategy: the results may not be generalizable to GBM otherwise eligible to participate in the NHBS survey who do not attend the venues.

Despite these limitations, the use of egocentric network survey questionnaire embedded within the NHBS survey environment was a practical way to report on networks of GBM who attend venues in New Orleans. Egocentric data remain a feasible way to collect network-level data in resource limited settings, particularly when the boundary of networks is difficult to define as is the case for populations not easily enumerated such as GBM [81]. Furthermore, the respondent level data supports previous research indicating that Black GBM engage in fewer risk behaviors than White GBM.

Conclusions

Network characteristics that relate to health outcomes and health behaviors can improve our understanding of HIV transmission and inform the design of healthcare interventions and the evaluation of existing services. This study provides nuance to further public health understanding of variations in social and sexual network structures and relationships among gay, bisexual, and other men who have sex with men that differ by race and HIV status in New Orleans. We believe it is possible to capitalize on extant networks as part of future interventions among GBM. Furthermore, this study promotes employing a formative phase of HIV intervention development to actively assess network characteristics before selecting participants and developing an intervention. These approaches may increase the efficacy of intervention efforts. Formative research should also investigate peer effects on reporting risk and protective behaviors which may be influenced by social or sexual network properties. Other potentially important lines of inquiry may include measuring network factors, such as strength of ties, that were not measured here. Furthermore, studies should investigate social capital within social and sexual networks of other gender and sexual minority populations, including transgender or non-binary individuals, to understand their influence on overall health and HIV risk. The identification of network-level factors may be important for ongoing research and HIV prevention interventions among racial, gender, and sexual

minority populations in the south where the disease burden is highest. Prevention interventions that prioritize younger Black GBM, especially those that capitalize on network strategies or peer-driven approaches, should take variations in network composition into account.

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Compliance with ethical standards

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Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval The authors declare that the findings reported have not been previously published and that the manuscript is not being simultaneously submitted elsewhere. This study was submitted and approved through the Louisiana State University Health Sciences Center's and Louisiana Department of Health's Institutional Review Board. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

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