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Network analysis among HIV-infected young black men who have sex with men demonstrates high connectedness around few venues

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Abstract

Background—Network analysis is useful for understanding sexual transmission of HIV and other sexually transmitted infections. We conducted egocentric and affiliation network analysis among HIV-infected young black men who have sex with men (MSM) in the Jackson, Mississippi, area to understand networks and connectedness of this population.

Methods—We interviewed 22 black MSM aged 17–25 years diagnosed with HIV during 2006–2008. Participants provided demographic and geographic information about each sex partner during the 12 months before diagnosis and identified venues where they met these partners. We created affiliation network diagrams to understand connectedness of this population and identify venues that linked participants.

Results—The median number of partners reported was four (range 1–16); a total of 97 partners (88 of whom were male) were reported. All but one participant were connected through a network of venues where they had met partners during the 12 months before diagnosis. Three venues were named as places for meeting partners by 13 of 22 participants. Participants reported having partners from all regions of Mississippi and five other states.

Conclusions—HIV-infected young black MSM in this analysis were linked by a small number of venues. These venues should be targeted for testing and prevention interventions. The pattern of meeting sex partners in a small number of venues suggests densely connected networks that propagate infection. This pattern, in combination with sexual partnerships with persons from outside Jackson, may contribute to spread of HIV and other STIs into or out of the Jackson area.

Short summary

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A network study of HIV-infected young black MSM in Jackson, Mississippi, found all were linked by few Jackson venues but that partners were from locations that were widely distributed geographically.

Key Words

HIV; sexual networks; young black men who have sex with men

Introduction

Men who have sex with men (MSM), and particularly black MSM, are disproportionately affected by HIV. In 2008, HIV prevalence among black and white MSM who participated in the National HIV Behavioral Surveillance System (NHBS) was 28% and 16%, respectively.¹ The Centers for Disease Control and Prevention (CDC) estimates that, during 2006-2009, HIV incidence increased 34% among young MSM and 48% among young black MSM.²

These HIV surveillance data underscore the importance of characterizing the HIV transmission dynamics among young minority MSM. Individual risk behaviors do not adequately explain racial disparities in HIV infection, as black MSM are not more likely than other MSM to report sexual risk behavior or substance use.³⁻⁵

However, differences in social and sexual networks likely have a substantial impact on racial disparities in HIV infection. Distribution of HIV and other STIs across social and sexual networks may contribute more to the risk for HIV infection than individual risk behaviors.⁵⁻⁷ Additionally, there is evidence that black MSM who prefer same-race partners and whose partners have substantial overlap in their sexual networks are at increased risk for exposure to HIV.^{5,8,9}

Network analyses assessing connections between people can inform our understanding of transmission of HIV and other STIs.¹⁰ HIV transmission is structured by sexual relationships between infected and susceptible persons, which determine exposure and transmission, and the social context of risk and protective behaviors.¹¹ There are three primary types of network analysis data used to describe transmission dynamics: sociometric, which evaluate complete networks; egocentric, which assess personal networks; and affiliation, which measure mutual membership or participation. Sociometric network analysis consists of interviewing all members of a network and describing both direct and indirect linkages among persons at risk in the network.¹² Although the gold standard, sociometric network analysis is expensive and resource intensive. Egocentric analysis requires that respondents provide descriptive data about their social and sexual contacts;¹³ this type of analysis does not allow direct observation of complete population-level structures of networks, but allows assessment of age-mixing, spatial bridging, and concurrency.^{13,14} Affiliation network analyses, which describe links between individuals and venues, can be used to maximize information obtained by egocentric analyses by identifying venues that link groups of people and, consequently, the potential for social or sexual connections.^{15,16}

During fall 2007, the Mississippi State Department of Health (MSDH) notified CDC about an increase in HIV diagnoses among young black MSM. During February-April 2008, CDC and MSDH conducted a multi-method investigation that included a case-control study,^{17,18} a qualitative study,¹⁹ a phylogenetic analysis,²⁰ and an egocentric and affiliation network analysis study. Formative interviews with community members and stakeholders indicated that the Internet was playing a large role in finding sex partners and that travel was prominent in social and sexual networks; therefore, these issues were explored in the network analysis. We analyzed data from the egocentric and affiliation network component of this investigation to identify the sexual networks of young black MSM with new HIV diagnoses and to describe their social and sexual mixing patterns and risk behaviors.

Materials and Methods

Inclusion Criteria

Black men aged 17–25 years who had been diagnosed and reported to the Mississippi HIV/AIDS Reporting System with HIV infection and lived in (or were diagnosed in) the Jackson, MS, area (Hinds, Rankin, and Madison counties) during January 2006 – April 2008 were considered potential participants. Because a substantial number of persons meeting these criteria did not have complete information regarding transmission category, we did not limit recruitment to persons who were believed to have a transmission category of male-male sex. However, we later excluded from analysis those persons who did not report any male anal sex partners during the 12 months before HIV diagnosis.

We identified men using the Mississippi HIV/AIDS Reporting System and attempted to recruit all men who met eligibility criteria by phone, mail, or in person for participation in the overall investigation. Those who agreed to participate in the investigation were invited to participate in the case-control study,^{17,18} and those who participated in the case-control study after the network analysis study had begun were also invited to participate in the network analysis study. Men who consented to participate in the network analysis study received a \$25 gift card. Because this study was conducted in the context of a public health epidemiologic investigation, it was determined by the National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention at the CDC that this investigation did not constitute research and therefore did not require approval from CDC or local institutional review boards.

Measures

Trained interviewers conducted a standardized interview. The questionnaire, designed using input from formative interviews, focused on partners and venues from the 12 months before HIV diagnosis. Domains included demographic and geographic information about each partner, behaviors with each partner, strength of relationship with each partner (scale: 1–10, where 10 is a best friend), venues (including the Internet) where participants met each sex partner, and venues where participants socialized (“places where you went to socialize, hang out, or meet people”). Although participants were assured that partners would not be contacted and were asked to provide the full name of each partner, nearly all were willing or able to provide only a partial name, a nickname, or initials.

Analysis

We described characteristics of participants and their male sex partners, stratified by whether the participant considered the partner a main partner (“partners that you have an emotional bond with and with whom you have regular sex, such as a boyfriend, girlfriend, spouse, significant other, or life partner”) or casual partner (“people you have sex with every now and then and one-night-stands”). Sample sizes are small and this is intended as a descriptive analysis; therefore, no statistical tests were performed. We created egocentric network diagrams showing links between participants and their partners. These diagrams depict the type of partnership (main or casual), gender of partner, and HIV status of partner, all as reported by the participant. We considered named partners to be the same person if they had 1) the same first and last name or 2) the same first name, race/ethnicity, gender, city of residence, and age (+/- 2y).

We also created affiliation network diagrams showing links between participants and Jackson-area public venues (gay bars and clubs, shopping malls, cruising areas, and colleges) where they met sex partners or socialized. We did not include locations that were reported by only one person unless the location was a gay bar or cruising area. Network diagrams were created using NetDraw version 2.099 (Analytic Technologies, Lexington, Kentucky).²¹

Finally, we created a map showing the locations of residence of participants’ sex partners, overlaid on the HIV prevalence rate by county (for Mississippi counties).²²

Results

Between January 2006 and April 2008, 86 HIV infections among individuals who met criteria as potential participants were reported to MSDH. Forty of these men participated in the investigation, of whom 30 had male-male sex during the 12 months before diagnosis. Of these, 22 completed the network analysis interview. Those not included were not significantly different from those included with respect to age, year of diagnosis, reported risk category, or residency or HIV diagnosis in the Jackson area versus elsewhere in Mississippi.

Among the 22 men interviewed, median age was 22 years (range: 18–24). Fifteen identified as gay or homosexual, 4 as bisexual, 2 as heterosexual, and 1 as questioning. The median number of sex partners named was 4 (range: 1–16), and 20 men reported having only male partners in the 12 months prior to HIV diagnosis. Nearly half (n=9) reported using marijuana during the 12 months before diagnosis, but only 2 participants reported use of any other drugs (ecstasy, cocaine, and crack). Two participants reported buying or selling sex.

The 22 men named a total of 97 sex partners, 88 (91%) of whom were male. Full names were provided for only 2 male partners. Table 1 presents characteristics of the 88 male sex partners stratified by type of partner. The vast majority (98%) of partners were black, and 30% were older than 25 years. HIV status was unknown for 59% of partners. Main partners were most commonly described as “boyfriends” (68%), whereas casual partners were most commonly described as “acquaintances” (52%). Relationships with main partners were

stronger (median 9/10 vs. 2.5/10) and of longer duration (median 8 months vs. 1 month) than relationships with casual partners. However, the duration of more than one-third of main partnerships was less than 6 months.

Over half of main partners and three-quarters of casual partners resided in the Jackson area. Participants met similar proportions of main and casual partners at work or school (24% for each); 24% of main and 16% of casual partners were met online. The most common places for meeting casual partners were public social events such as clubs and circuit parties (32% of casual partners vs. 13% of main partners).

Participants reported greater risk with casual than main partners. Participants were more likely to report not knowing the HIV status of a casual than a main partner (69% vs. 45%). While common with both main and casual partners, concurrent relationships were more common among casual partners (85% vs. 63%). Condom use at last anal sex was less common with casual partners than main partners (39% vs. 58%).

Figure 1 shows the egocentric sexual networks of the 22 participants during the 12 months before HIV diagnosis. There is large variation in the number of sex partners reported. Thirteen of the 15 men who reported more than one sex partner in the 12-month period had both main and casual partners. Additionally, 12 men reported more than one main partnership in the 12-month period; we do not have data to indicate whether these main partnerships were serial or concurrent. Seventeen participants had at least one sex partner of unknown HIV status. Only 2 participants had female or transgender sex partners; both reported having multiple male and female partners. Few connections between cases were identified—only one sex partner was reported by more than one participant, and one participant was reported by another participant.

The affiliation network diagram (Figure 2) connects participants to venues where they socialized and met sex partners (solid black lines), met sex partners only (dashed blue lines), or socialized but did not meet sex partners (dashed red lines). This diagram is densely connected; all participants were connected through a network of where they had met sex partners or socialized, and all but one participant were connected through a network of where they had met sex partners during the 12 months prior to diagnosis. Three venues (two gay bars and one college) were named as places for meeting sex partners by 13 of the 22 participants. In contrast, less than half of participants reported meeting sex partners online. Of the 17 partners who were met online, 7 were first met in person at a physical venue included in Figure 2 (3 at a gay bar, 3 at a college, and 1 at a mall).

Figure 3 demonstrates the locations of residence of participants' sex partners. Although the largest proportion of partners resided in Jackson, partners resided in all regions of Mississippi and 5 other states, and there are numerous partners from the Mississippi Delta region, which has the highest HIV prevalence rates in the state outside of the Jackson area.

Discussion

Affiliation network analysis demonstrated that the HIV-infected young black MSM interviewed were linked by a small number of venues. The pattern of meeting sex partners in

a limited number of venues suggests densely connected networks that propagate infection. This, in combination with sexual partnerships with persons from outside of Jackson, many from large urban areas, may contribute to spread of HIV and other STIs into or out of the Jackson area.

The fact that there were few venues frequented may be a result of homophobia and stigma which is widely present, particularly in the black community²³ and the South.²⁴ The qualitative component of this investigation previously found that young black MSM felt that there were few venues in Jackson where they could be open about their sexuality.¹⁹ The personal security gained by socializing in these venues may be offset by increased HIV risk, as these venues provide increased opportunity for intersection of sexual networks of infected and susceptible persons.

While many young black MSM interviewed reported frequenting Internet websites, our results suggest that public venues played a more prominent role in meeting sex partners, especially casual partners. A network study of black MSM in Baltimore, Maryland, also found that black MSM more commonly met partners at bars than on the Internet, and data from NHBS indicate that, in 2008, only 17% of MSM interviewed reported meeting their last partner on the Internet or a chat line.^{25,26} However, it will be important to monitor potential changes in the use of the Internet to meet sex partners over time.

Egocentric network analysis revealed important information regarding relationship dynamics and concurrency. We found that concurrency was prevalent in both main and casual partnerships and that relationship duration was less than 6 months for most casual partnerships and over one-third of main partnerships. These findings may have important implications for transmission of HIV and other STIs, especially at the network level.²⁷⁻²⁹

Public Health Implications

Our egocentric and affiliation network analysis identified several network factors that may promote HIV transmission. These factors are potential behavioral targets for prevention campaigns. The men interviewed identified a small number of venues; these venues, especially those with many patrons, should be targeted for testing and prevention interventions. Previous research has demonstrated the importance of understanding venues where people meet sex partners for prevention efforts for HIV and other STIs.^{30,31} Finally, the fact that partnerships often crossed jurisdictional boundaries indicates that coordination between public health agencies is critical to reduce transmission.

Limitations

All data are limited by recall bias and social desirability bias, which may affect reliability and accuracy of the analysis. We had data for less than half of eligible cases, limiting generalizability. The fact that we had full names for only 2 of 88 male partners severely limited our ability to determine when more than one participant had a common partner; therefore, we likely overestimated the total number of unique partners and underestimated the number of connections in the network. Egocentric network analysis is also limited by the fact that partners are not interviewed. Interviewing the partners may have identified additional links among network members. Thus, Figure 1 may under-represent the

connectedness of the sexual network. A prominent limitation of affiliation networks is that they measure opportunities for social connection, but not direct social connections. The true level of connectedness likely lies somewhere between that displayed in Figure 1 and Figure 2.

Conclusion

Using egocentric and affiliation network analysis, we identified networks that were densely connected by a small number of venues within the Jackson, Mississippi, area but bridged to other communities both inside and outside of Mississippi. These data are relatively easy and inexpensive to collect, and they provided insights and targets for intervention not obtained from other investigation methods. When used in public health investigations, egocentric network analysis can be a valuable tool to understand sexual network structure and partner-level risk behavior, and affiliation network analysis can help identify targets for interventions for HIV and other STIs. Moreover, data from network analysis can be triangulated with other surveillance and behavioral data from public health investigations; in doing so, multi-method investigations such as this one provide a more complete picture of acquisition and transmission dynamics within a community.

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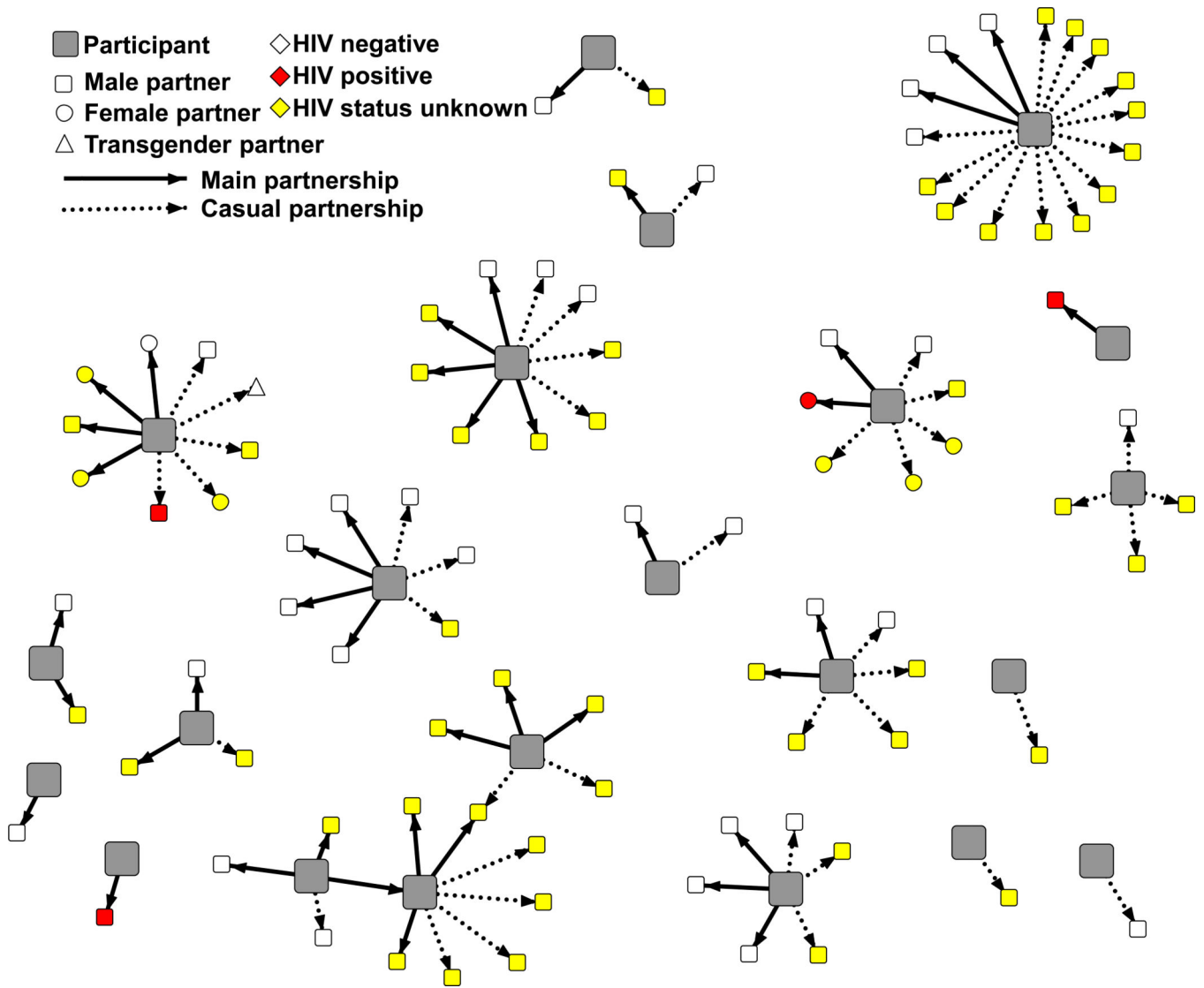


Figure 1. Sexual networks of HIV-infected young black MSM from the Jackson, MS, area. Figure includes participants and sex partners they reported from the 12 months before HIV diagnosis.

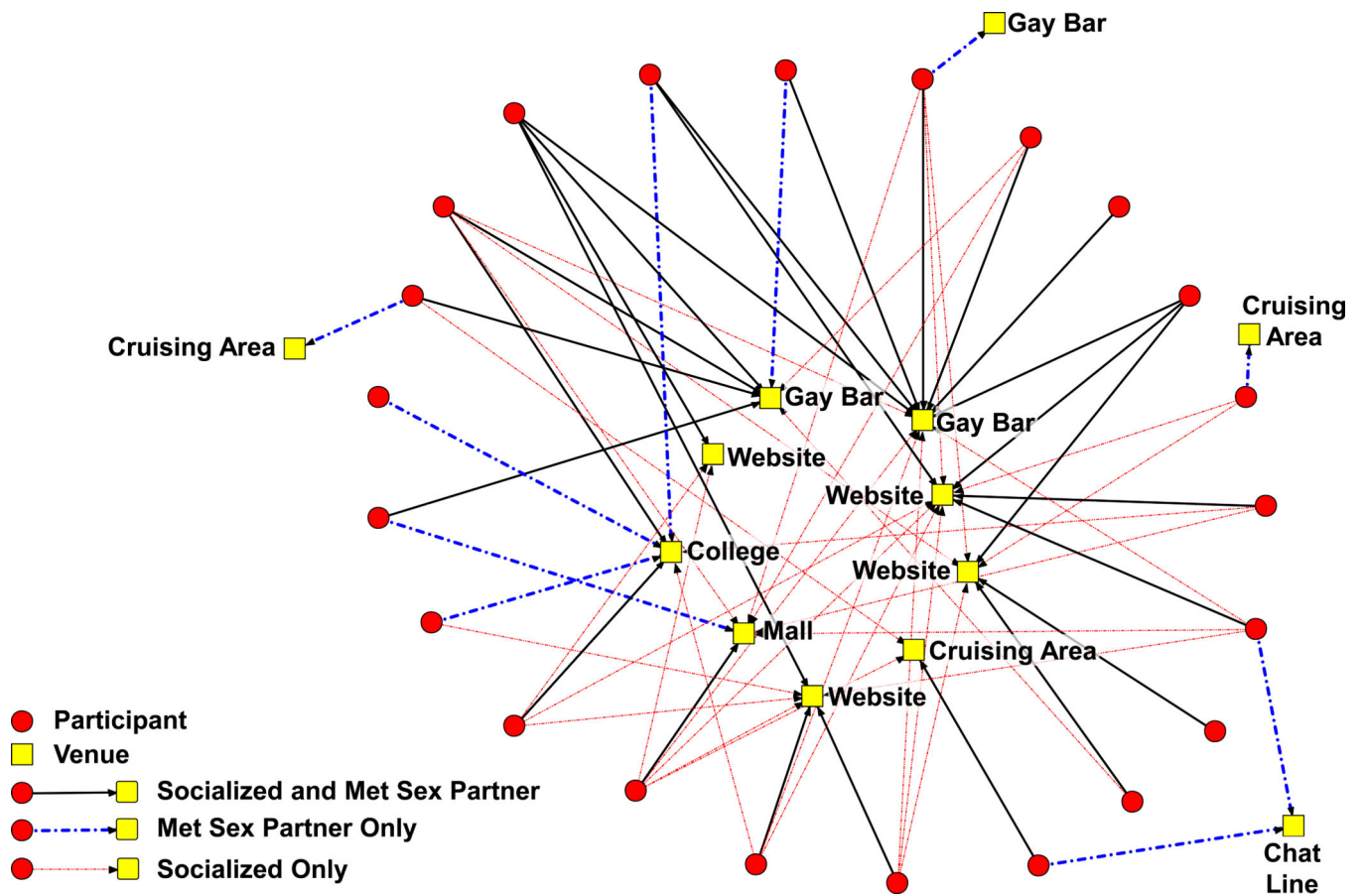


Figure 2.
Affiliation network diagram showing links between HIV-infected young black MSM in the Jackson, MS, area and public venues where they met sex partners and where they socialized.

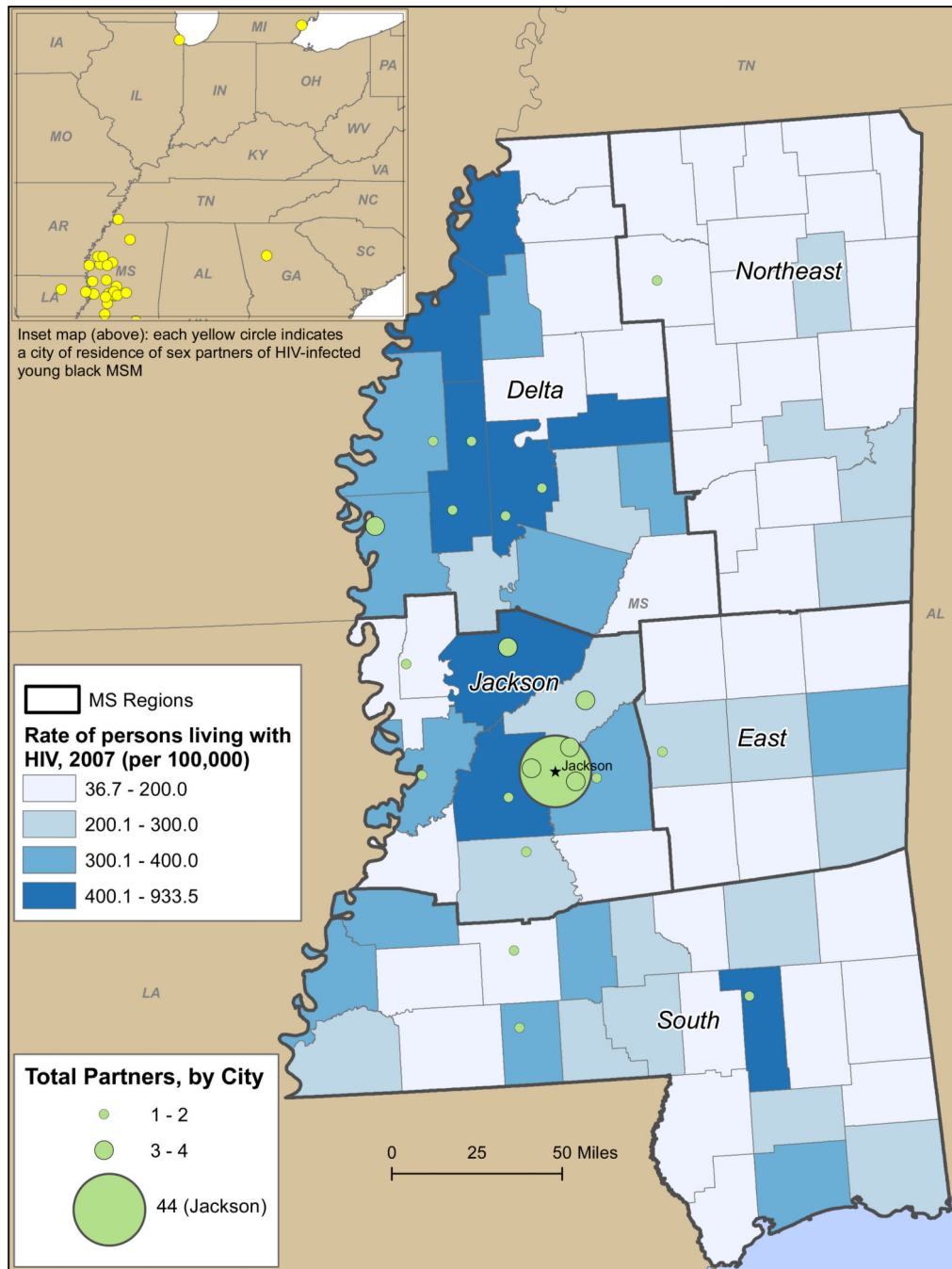


Figure 3. Locations of residence of sex partners of HIV-infected young black MSM in the Jackson, MS, area. Mississippi counties are shaded according to the rate of persons living with HIV.

Table 1

Characteristics of male sex partners of HIV-infected young black men who have sex with men, Jackson, Mississippi

	All Partners (n=88) %	Main Partners (n=38) %	Casual Partners (n=50) %
Characteristics of partner			
Age			
<18 years	2	3	2
18–25 years	68	66	70
26–30 years	18	16	20
31–40 years	10	16	6
>40 years	1	0	2
Race/ethnicity			
Black	98	97	98
Other	2	3	2
Partner residence			
Mississippi -- Jackson area	69	58	78
Mississippi -- Delta	10	13	8
Mississippi -- South	5	5	4
Mississippi -- Northeast	2	3	2
Mississippi -- East	1	0	2
Out of state	13	21	6
Partner HIV status			
Negative	36	50	27
Positive	3	5	2
Unknown	59	45	69
Characteristics of Relationship and Behaviors			
Relationship to respondent			
Spouse/Long-term partner	1	3	0
Boyfriend	32	68	4
Friend	32	26	36
Acquaintance	30	0	52
Other	5	3	8
Where respondent first met partner			
Public social event (night club/dance club/circuit party)	24	13	32
Work/school	24	24	24
Internet	19	24	16
Public place (mall/restaurant/park)	14	13	14
Private place (someone's house/health club/private party)	7	13	2
Chat line	3	5	2
Sex-related place (adult bookstore, sex party, sex club, bathhouse)	1	3	0

	All Partners (n=88) %	Main Partners (n=38) %	Casual Partners (n=50) %
Other	8	5	10
Strength of relationship (1 is weakest, 10 is strongest)			
1-2	28	0	50
3-4	10	0	18
5-6	15	16	14
7-8	17	26	10
9-10	30	58	8
Duration of sexual relationship			
1 day	25	3	43
1-3 weeks	3	3	4
1-5 months	28	32	27
6-11 months	20	32	12
12-24 months	13	13	12
>24 months	9	18	2
Respondent or partner had concurrent relationships			
Yes	74	63	85
No	17	29	8
Don't know	7	8	6
Had anal sex with this partner in 12 months before diagnosis			
Yes	88	97	80
No, oral sex only	13	3	20
Used condom at last anal sex			
Yes	47	58	39
No	52	42	61

Percentages may not add to 100% due to missing responses or rounding.

* Recall period for all questions about partners was 12 months before diagnosis

** Main partners: "partners that you have an emotional bond with and with whom you have regular sex, such as a boyfriend, girlfriend, spouse, significant other, or life partner;" casual partners: "people you have sex with every now and then and one-night-stands."