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Respondent driven sampling is an effective method for engaging methamphetamine users in HIV prevention research in South Africa

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Abstract

Background—South Africa, in the midst of the world's largest HIV epidemic, has a growing methamphetamine problem. Respondent driven sampling (RDS) is a useful tool for recruiting hard-to-reach populations in HIV prevention research, but its use with methamphetamine smokers in South Africa has not been described. This study examined the effectiveness of RDS as a method for engaging methamphetamine users in a Cape Town township into HIV behavioral research.

Methods—Standard RDS procedures were used to recruit active methamphetamine smokers from a racially diverse peri-urban township in Cape Town. Effectiveness of RDS was determined by examining social network characteristics (network size, homophily, and equilibrium) of recruited participants.

Results—Beginning with 8 seeds, 345 methamphetamine users were enrolled over 6 months, with a coupon return rate of 67%. The sample included 197 men and 148 women who were

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AUTHOR DISCLOSURES

Contributors

Meade, Watt, and Skinner designed the original project and secured grant funding; Kimani, Merli, Meade and Watt conceptualized the current study; Kimani wrote the first draft and conducted most of the analyses; Watt and Meade wrote sections of the final manuscript; Pieterse provided oversight and conducted data collection; and all authors contributed to and have approved the final manuscript.

Conflict of Interest

No conflict declared.

racially diverse (73% Coloured, 27% Black African) and had a mean age of 28.8 years (SD=7.2). Social networks were adequate (mean network size >5) and mainly comprised of close social ties. Equilibrium on race was reached after 11 waves of recruitment, and after 3 waves for all other variables of interest. There was little to moderate preference for either in- or out-group recruiting in all subgroups.

Conclusions—Results suggest that RDS is an effective method for engaging methamphetamine users into HIV prevention research in South Africa. Additionally, RDS may be a useful strategy for seeking high-risk methamphetamine users for HIV testing and linkage to HIV care in this and other low resource settings.

Keywords

methamphetamine; drug abuse; respondent driven sampling (RDS); HIV/AIDS; HIV prevention; South Africa

1. INTRODUCTION

South Africa is home to the largest HIV epidemic in the world, with an estimated 6.4 million residents living with HIV in 2012 (Shisana et al., 2014), and is experiencing an emerging epidemic of non-injection methamphetamine use. In the Western Cape Province, where the methamphetamine epidemic is concentrated, the proportion of admissions to drug treatment facilities for methamphetamine increased from 0.8% in 2002 to 52% in 2011 (Dada et al., 2012). Community-based surveys in Cape Town confirm the high prevalence of methamphetamine use, particularly in densely populated township communities. For example, in a sample of >3000 individuals recruited from alcohol serving venues in one township, 6.4% of participants reported methamphetamine use within the past 4 months, with rates three times higher among persons who were Coloured (a recognized group of mixed ethnicities) compared to Black African (Meade et al., 2012). It is feared that this increase in methamphetamine use may contribute to a new wave of HIV infections in the Western Cape (Parry et al., 2008).

Methamphetamine is mainly smoked in South Africa, so HIV risks associated with injection use remain low (Dada et al., 2012). However, as a stimulant, methamphetamine increases sexual desire and is associated with increased prevalence of risky sexual behavior and HIV infection (Carey et al., 2009; Freeman et al., 2011; Lorvick et al., 2012; Mimiaga et al., 2010; Rawson et al., 2008). Data from Cape Town confirms that methamphetamine smokers in this region are more likely to engage in risky sexual behaviors compared to non-smokers, and that methamphetamine is commonly used with sex to augment the sexual experience (Meade et al., 2012; Parry et al., 2011; Simbayi et al., 2006; Wechsberg et al., 2012). Given that methamphetamine smoking is most prevalent in Coloured communities, while HIV continues to disproportionately affect Black Africans, there is concern that a dual epidemic of methamphetamine and HIV may increase HIV incidence (Kapp, 2008). This has led to a call to prioritize strategies that promote engagement of methamphetamine smokers in research necessary for tracking the HIV epidemic and planning effective responses (Morris and Parry, 2006). Identifying and engaging methamphetamine smokers in targeted HIV research and prevention programs in South Africa remains difficult because

methamphetamine-related stigma leads users to hide their addiction for fear of prosecution and rejection from family and friends (Myers et al., 2009; Watt et al., 2013).

Respondent driven sampling (RDS) has been used to engage members of hard-to-reach populations characterized by involvement in stigmatized and/or illegal behaviors (Heckathorn, 1997; Magnani et al., 2005). It is a variant of chain referral sampling that relies on peers to recruit diverse samples from the target population (Heckathorn, 1997; Salganik and Heckathorn, 2004). The primary advantage of RDS over other chain referral sampling strategies is that it employs statistical estimation methods to limit biases that may arise from peer-driven recruitment (Heckathorn, 1997). In theory, RDS can generate unbiased and accurate point-prevalence estimates for the population of interest (Heckathorn, 2002). While some recent evaluations of RDS have suggested that prevalence estimates can be biased with large design effects (Gile and Handcock, 2010; Goel and Salganik, 2010; Mouw and Verdery, 2012; Yamanis et al., 2013), others have concluded that RDS is an effective sampling method for HIV surveillance of hard-to-reach populations when appropriately designed and implemented (Johnston et al., 2008b; McCreesh et al., 2012; Platt et al., 2006; Robinson et al., 2006; Townsend et al., 2010, 2012). RDS has been successfully used in diverse settings internationally with numerous socially marginalized groups, including undocumented immigrants, sex workers, men who have sex with men (MSM), and illicit drug users (Johnston and Sabin, 2010; Malekinejad et al., 2008; Montealegre et al., 2013; Robinson et al., 2006; Wang et al., 2005).

RDS recruitment begins with purposive sampling of initial respondents (“seeds”) from the target population. Once a seed completes the study assessment, he/she is compensated for participation (“primary incentive”) and then asked to recruit a predetermined number of peers (usually 2 to 3) using recruitment coupons. The seed is rewarded with a “secondary incentive” if their recruit is eligible and enrolls in the study. Enrolled participants then serve as recruiters and are offered the same primary and secondary incentives. This procedure creates an expanding system of chain referrals characterized by “waves” of recruitment until the target community is saturated or the desired sample size is reached (Heckathorn, 1997; Johnston, 2008).

In many parts of the world, hard-to-reach and socially marginalized groups play a central role in the rising incidence of HIV infections (Beyrer and Abdool Karim, 2013). RDS has been utilized extensively in HIV research among injection drug users (Burt et al., 2010; Lansky et al., 2012; Malekinejad et al., 2008). However, non-injection drug use is also driving the epidemic, contributing to HIV transmission via risky sexual behaviors, and strategies for HIV prevention among injectors do not translate well to non-injectors (Freeman et al., 2011; Shoptaw et al., 2013; Volkow et al., 2007). Therefore, linking non-injection drug users to HIV prevention efforts remains paramount, particularly in high prevalence settings (Degenhardt et al., 2010). By utilizing social networks and providing financial incentives for recruitment, RDS has the potential to successfully identify and engage methamphetamine smokers. This study describes the effectiveness of RDS as a method for engaging a cross-section of methamphetamine smokers into an HIV behavioral research study in a racially diverse township in South Africa. Additionally, it explores the effectiveness of RDS in reaching various sub-groups of methamphetamine smokers

stratified by HIV risk profile (self-reported HIV status, HIV testing history, perceived HIV risk, and willingness to test) and substance use characteristics (frequency of methamphetamine smoking and concurrent other drug use).

2. METHODS

Approval was obtained from the ethical review board at Duke University Health System and Stellenbosch University's Health Research Ethics Committee.

2.1. Setting and participants

This study was conducted during a 6 month period (May-October 2013) in Delft, a township located 15 miles outside the Cape Town city center. Delft was established in the early 1990s as a racially integrated township, with Black African and Coloured residents. The majority of its 150,000 residents are unemployed and living in poverty (Lehohla, 2012). The target population was adult methamphetamine smokers. Eligibility criteria were: 18 years of age, residence in Delft, and current methamphetamine use (verified by urine drug screen). Exclusion criteria were: acute intoxication, impaired mental status, and/or inability to provide informed consent. Except for seeds, participants were required to present a valid recruitment coupon. The study office was located inside the Delft South Public library and was open weekdays from 9am to 5pm. The field staff comprised of four fulltime staff (3 interviewers and 1 project manager).

2.2. Formative research

Formative research was used to adapt the RDS strategy for methamphetamine smokers living in a township community (Johnston et al., 2010). We assessed feasibility by evaluating characteristics of the social network (size, sociometric depth and composition); acceptability of proposed incentives; and survey logistics such as study office location, hours of operation, and duration for the study visit. Four focus groups with members of the target population, stratified by race and gender, were conducted (N=31, 7–8 per group). Participants were recruited using convenience sampling based on relationships established during prior research in Delft. Findings revealed that methamphetamine smokers: (1) are from all race, gender, and age groups; (2) often smoke methamphetamine daily; and (3) have well-established social networks with other methamphetamine smokers (i.e., they socialize and smoke together, with reported network sizes ranging from 2 to 60). We did not identify any group that existed in isolation or without existing “bridges” to other methamphetamine users. All participants reported that they would be willing to invite at least two peers from their social network. These results provided confidence that RDS procedures would be feasible to implement.

2.3. RDS procedures

Recruitment started with eight seeds stratified by race and gender who were identified by our field staff during the formative phase. After completing the study visit, each seed was given coupons to recruit two peers. The coupons listed the address, telephone number, and operating hours of the study office.

Recruited peers came to the study site with their coupons. Those who met preliminary eligibility provided written informed consent and completed a urine drug test. Only those who tested positive for methamphetamine were eligible to proceed. Participants completed an audio computer assisted structured interview (ACASI) on sexual risk behavior and mental health, a clinical interview on drug addiction, and additional face-to-face questions about their social network and relationship to their recruiter. The full study visit took approximately 2 hours and each participant was given two coupons and instructed how to recruit new peers. All participants received the primary incentive of a grocery voucher worth ZAR 70 (~US\$7), and had the potential to receive the secondary incentive of a ZAR 20 (~US\$2) voucher for each of a maximum of two recruits. Each recruitment coupon had a unique serial number to track the relationships among participants. Participants received referral information for local support groups and treatment facilities for HIV and substance use. We aimed to enroll at least 160 methamphetamine smokers to address our primary goal of assessing the effectiveness of RDS, but allowed the recruitment process to proceed until study resources were exhausted.

To manage participant flow, seed enrollment was staggered throughout the study period and initiated one at a time. For seeds 1–7, we used systemized reduction of recruitment coupons (Johnston et al., 2008a): participants in waves 9–11 received only one coupon, and those in wave 12 received zero. Seed 8 was unique because he was initiated at the end of the study period when resources were limited. All participants recruited from seed 8 received only one coupon with no systemized reduction of coupons to ensure that characteristics of his recruits reached equilibrium distribution. The principal network theories underlying RDS are based upon a linear recruitment process, which is best achieved through the use of only one recruitment coupon (Heckathorn, 1997).

2.4. Measures

All study activities were conducted in the language of the participant's choosing (Afrikaans, isiXhosa or English).

2.4.1. Demographics—Participants reported their age, gender, race, marital status, employment status, and level of education.

2.4.2. Social network characteristics—Three questions were used to assess network size: “1) Think about the people in Delft, who you know by name and they know you by name. Of these people, think about the ones who use methamphetamine. How many people are these? 2) Of these people, how many are 18 years or older? 3) Of these people, how many have you seen in the last 1 month?” The answer to the third question was used as the measure of network size. Recruits described their relationship to their recruiter (friend, romantic partner, family member/relative, or other) and the perceived strength of the relationship (very close, somewhat close or not close). Participants were also asked: “Where did this person first ask you to join the study?” and “Did you give this person anything in exchange for the coupon?” Participants who answered affirmatively to the second question described in an open-ended format what was exchanged.

2.4.3. Addiction Severity Index-Lite (ASI-L)—This structured clinical interview provides details of lifetime and recent substance use, including severity of use and associated impairments (McLellan et al., 1992). For this study, participants reported the number of days in the past 30 on which they used methamphetamine (“tik”) or other amphetamines, marijuana (“dagga”), and methaqualone (“buttons”). They also reported how many years they had regularly used each of these substances and the most typical route of administration.

2.4.4. HIV testing and behavioral risk factors—The ACASI asked about HIV testing history, HIV status, and willingness to test for HIV. The following item measured perceived HIV risk: “Based on your behavior over the past 3 months, how much do you think you are at risk for getting HIV?” Response options were “not at risk”, “a little bit at risk”, “somewhat at risk”, and “very much at risk”. For analyses, responses were dichotomized into either “no risk” or “any risk.” Participants were also asked about number of sex partners in the past 3 months and participation in any transactional sex involving methamphetamine in the past 3 months.

2.5. Data Analysis

Effectiveness of RDS recruitment was determined based on the following outcomes: adequacy of social network ties, recruitment tendencies (network homophily), and attainment of “equilibrium” for our key demographic variables of race and gender. We defined adequate social ties as mean network sizes ≥ 3 . Network homophily values range from -1 (exclusive “out-group” recruitment, or tendency to recruit from outside their own groups) to $+1$ (exclusive “in-group” recruitment). Values close to 0 suggest that social ties among participants cross networks, overcoming biases introduced by preferential in- or out-group recruitment (Heckathorn, 1997, 2002). Equilibrium refers to the state in which distribution of sample population estimates converge and does not change during subsequent waves (Heckathorn, 1997). For this study, sample population proportions were considered at equilibrium when the change in population proportions between waves was $<2\%$.

We computed adjusted proportion estimates with 95% confidence intervals and adjusted mean network size. The RDS-adjusted confidence intervals were computed using enhanced data smoothing algorithm for bootstrapping with 15,000 bootstrap samples per interval estimate. We report the standard RDS-1 estimator that accounts for network size and recruitment pattern between subgroups (Heckathorn, 2002; Salganik and Heckathorn, 2004). Respondent Driven Sampling Analysis Tool (RDSAT) version 7.1.38 (Cornell University, Ithaca, NY, USA) was used to calculate these measures (Volz et al., 2012). Recruitment diagrams were created using NetDraw 2.136 (Analytic Technologies, Harvard, MA). Stata version 12.1 (Stata Corporation, College Station, TX) was used to prepare the dataset for analysis and compute descriptive statistics.

3. RESULTS

3.1. Sample characteristics

Figure 1 illustrates the recruitment characteristics of seeds. The seeds included 5 women and 3 men, ages 18–41 years, with a mean network size of 21. The most productive seed, seed 6 resulted in 11 recruitment waves and 146 participants. Seeds 1 and 2 recruited >50 peers. Only seed 5 did not recruit any participants. In total, 555 coupons were distributed, with 374 coupons returned (return rate of 67.4%). Of the 374 individuals who presented with a coupon, 29 were not eligible, leaving a final sample of 345. Reasons for ineligibility were: no reported methamphetamine use in the past week or negative drug screen ($n=26$), <18 years old ($n=1$), impaired mental status ($n=1$), and refusal to complete the assessment ($n=1$). Table 1 shows the crude sample characteristics. The sample was 73% Coloured and 57% male with a mean age of 28.8 years ($SD=7.2$). Coloured participants used methamphetamine more frequently and had been using regularly for more years. Black African participants were younger and more likely to be male, employed, and unmarried. The majority of the participants used other drugs concurrently (64% methaqualone use; 78% marijuana use), with no differences by race.

3.2. Social network characteristics

Table 2 summarizes adjusted population proportions and network sizes, network homophily, and number of waves required to reach equilibrium. With the exception of race, equilibrium on all variables was reached in 3 waves, well below the maximum number of waves in each group. Equilibrium proportion for race was reached in 9 waves for Coloured participants and 11 waves for Black African participants. With the exception of race, network homophily indices ranged from -0.23 to $+0.32$, indicating minimal preference for either in- or out-group recruiting. In contrast, there was moderate preference for in-group recruiting among Black African and Coloured participants (homophily indices $=0.69$ and 0.50 , respectively). After adjusting for over-sampling of participants with large networks and differential recruitment by network size, participants had an average of 5 social ties to peers across various demographic, HIV risk, and drug use sub-groups.

Participants were mostly recruited by friends (89%), with relatively few recruited by family members (8%) and romantic partners (3%). Very few of the recruiter-recruitee relationships were sexual (8%). Most participants reported having smoked methamphetamine with their recruiter (80%), and about half felt very close to their recruiter (52%). While a majority of the recruitees had known their recruiters for >2 years (67%) and saw them daily (68%), there was a notable number of recent relationships (10% were <6 months old). Twelve participants reported that they had exchanged something for the recruitment coupon, most commonly the secondary incentive. Most participants (64%) reported being recruited from their homes, which was also where 42% of participants smoked methamphetamine, indicating that recruiters actively sought out participants. Only 10% reported that they were recruited on the streets.

4. DISCUSSION

Responding to the emerging methamphetamine epidemic in South Africa, this study found that RDS is an effective strategy for engaging a large and diverse sample of active methamphetamine smokers, including those at high risk for HIV transmission, into an HIV behavioral research study. To date, studies in this setting have either surveyed broad cross-sections of the community or used admission data from treatment facilities to describe methamphetamine users (Meade et al., 2012; Pluddemann et al., 2013, 2008; Simbayi et al., 2006; Wechsberg et al., 2010). Yet, the vast majority of drug users remain hidden from the public and do not access drug treatment, limiting representativeness of study findings (Myers et al., 2010). While RDS has been previously used to recruit high-risk populations in Cape Town, including MSM and heterosexual males and females with multiple partners (Chopra et al., 2009; Lane et al., 2011; Townsend et al., 2010, 2012), it had not been used to recruit methamphetamine users or other illicit drug users in South Africa, populations central to the evolving HIV epidemic. Results of this study suggest that RDS can effectively recruit active methamphetamine smokers living in a low-income township community with a high prevalence of drug abuse.

From just 8 seeds, we recruited 345 eligible participants in 6 months. Only one seed did not recruit any participants while 91% of the respondents originated from three seeds. This is consistent with observations that only a small percentage of seeds are highly productive in most RDS studies (Malekinejad et al., 2008). In a review of 128 studies that utilized RDS to engage high-risk populations internationally, including South Africa, the median sample size using RDS recruitment was 225 with an interquartile range of 152–360 (Johnston et al., 2008b). Our sample size falls in the upper margin of this range, indicating that RDS was similarly effective in engaging methamphetamine smokers in a racially diverse township in Cape Town. Specific strategies were used to ensure the diversity of our sample. First, based on findings from our formative research, we purposively selected seeds who were representative of the racial composition in the township. Second, because seeds were staggered, we observed recruitment patterns in real time and were able to make adjustments. We quickly realized that, despite being established as a racially integrated community, there were neighborhoods within Delft that were racially homogenous. In addition, given that previous research has found that participants are more likely to refer peers who live near them (McCreesh et al., 2011), we selected subsequent seeds from geographically dispersed neighborhoods. Our staggered and adaptive implementation strategy resulted in a manageable flow of participants, while still efficiently reaching our target sample size.

Acceptance of RDS by the target population was high, as reflected in the high coupon return rate. As a result, half of the seeds resulted in >8 waves of recruitment, and all variables of interest reached equilibrium before the final wave. Theoretically, recruitment proceeding beyond wave 6 eliminates bias related to non-random selection of seeds (Heckathorn, 1997). The long recruitment waves indicate that we reached deeper connections within the sampled networks, representing sufficient sociometric depth (Abdul-Quader et al., 2006). Given the context of poverty, we verified self-reports of methamphetamine use with a urine drug screen. The vast majority of recruits who presented to the study tested positive, indicating

that this is a viable strategy that should be used to ensure enrollment of active methamphetamine users.

This study is the first to implement RDS in a racially diverse township in South Africa. While participants tended to recruit peers from within their own racial group, our moderate homophily score for race implies that social ties crossed racial groups and that a single RDS sample is suitable (Johnston et al., 2010; Schonlau and Liebau, 2012). However, given potential selection bias by race, large samples are recommended when implementing RDS in racially diverse settings. Additionally, because equilibrium for race was reached in wave 11 for Black African participants, we recommend that future studies in racially diverse communities in South Africa continue recruitment beyond wave 12 when possible.

Differences in recruitment by gender were also evident. While Coloured participants recruited equally from both genders, Black Africans were more likely to recruit males. Having observed this in real time, we subsequently sampled more female seeds from the Black African community. This practice of “steering” recruitment has been described in previous studies (Heckathorn, 1997; Johnston et al., 2008a). While the small number of Black African females in our final sample may suggest that we were unable to access this sub-group, it more likely reflects the fact that methamphetamine use is relatively less common among Black African women (Meade et al., 2012; Myers et al., 2013). However, given the high HIV prevalence rate among Black African women in South Africa, concerted efforts to engage this group of methamphetamine users, even if small in population size, are warranted. Additional focus groups with Black African women could help to identify potential barriers to participation in this sub-group.

RDS yielded a sample of heavy methamphetamine users, the majority of whom smoked methamphetamine daily and combined it with other substances. Moreover, these users were diverse in their HIV status, risk behaviors, and testing experiences. While many had undergone HIV testing at some point in their lives, a quarter had never tested, 20% of whom were unwilling to test. A third of participants reported having multiple partners and nearly half had exchanged sex for methamphetamine. In South Africa, recreational drug users have been identified as a key population urgently in need of targeted HIV prevention interventions (Shisana et al., 2014), and RDS may be a useful strategy for enrolling members of this key population into HIV prospective longitudinal studies and prevention trials.

Several limitations of the study should be noted. First, it is impossible to know how well our sample represents the population of methamphetamine users living in Cape Town townships. However, the demographic characteristics of our sample are very similar to that reported in other studies, suggesting that RDS was able to capture a representative cross section of this population (Meade et al., 2012; Pluddemann et al., 2013). Nevertheless, additional research is needed to determine if results generalize beyond the study community. Second, since we did not offer HIV testing, future studies are needed to estimate HIV seroprevalence in this population. Third, we are unable to estimate the impact of preferential recruitment on our sample. Future studies should collect robust social network data on the “alters,” eligible individuals who refused study participation (Yamanis et al., 2013). Finally,

seed 8 and his recruits received only one coupon and recruitment was allowed to proceed beyond wave 12. The long and narrow chain produced is known to reduce homophily biases related to clustering, resulting in low variance around the RDS estimator, even with a smaller sample size (Goel and Salganik, 2009). Therefore, it is unlikely that this modification to the RDS process affected our findings. Moreover, our analysis of the data showed that equilibrium distribution for our key variables was attained after the same number of waves, with or without the 22 recruits from seed 8.

While critical to the evolving HIV epidemic, methamphetamine users have not been adequately reached for HIV prevention and treatment in South Africa. This study demonstrates that RDS is an effective way to engage methamphetamine smokers into research aimed at understanding HIV risk behaviors. In addition, it highlights novel opportunities for harnessing established peer connections through RDS for the delivery of interventions to seek, test, and link to treatment even the most at-risk methamphetamine smokers. Future implementation studies should examine the potential of RDS to deliver tailored interventions that integrate addiction treatment and HIV prevention, thus addressing intersecting public health epidemics in South Africa.

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Research highlights

- We used respondent driven sampling (RDS) among South African methamphetamine users.
- Methamphetamine users in a township community had well-established social networks.
- The network characteristics of methamphetamine users permitted the use of RDS.
- There was minimal preference for in- or out-group recruiting in all subgroups.
- RDS is effective for recruiting methamphetamine users for HIV prevention research.

Figure 1.
Recruitment network diagrams showing recruitment characteristics of seeds (highlighted with bold rim)

Table 1

Crude sample characteristics of recruited participants by race and gender (N=345, seeds are excluded)

	Total (N = 345)	Coloured (n = 252)	Black (n = 93)	Pearson's χ^2 or t statistic
Age in years, M (SD)	28.8 (7.2)	30.2 (7.2)	25.3 (5.6)	5.9106***
Male, n %	200 (57.1)	124 (48.8)	76 (79.5)	25.6322***
Completed primary school education, n (%)	168 (48.7)	126 (50.0)	42 (45.2)	0.6366
Employed (part- or full-time), n (%)	61 (17.7)	34 (13.5)	27 (29.0)	11.2711***
Married, n (%)	47 (13.6)	40 (15.9)	7 (7.5)	4.0212**
Days of methamphetamine use in past 30, M (SD)	23.5 (8.9)	24.7 (8.3)	20.2 (9.9)	4.2224***
Years of regular methamphetamine use, M (SD)	7.1 (3.6)	7.8 (3.6)	5.3 (3.2)	5.8224***
Concurrent other use in past 30 days, n %				
Methaqualone	221 (64.1)	164 (65.8)	57 (61.3)	0.4236
Marijuana	269 (78.0)	192 (76.2)	77 (82.8)	1.7255

*
p < 0.05,**
p < 0.01,***
p < 0.001

Table 2

Adjusted demographic, HIV risk, and substance use sample characteristics (N=345)

	n	Adjusted population proportion (95% CI)	Mean Network Size	Homophily	Waves
Race					
Black	93	18.3 (10.1, 28.3)	8.8	0.69	11
Coloured	252	81.7 (71.7, 89.9)	5.5	0.50	9
Gender					
Female	148	32.3 (24.9, 40.7)	7.8	0.31	2
Male	197	67.7 (59.3, 75.1)	5.3	-0.01	2
Age					
Young (<30 years)	234	64.1 (55.8, 72.8)	6.5	0.22	1
Old (≥ 30 years)	111	35.9 (27.2, 44.2)	5.4	0.05	2
Education					
Grade 9	177	51.5 (42.6, 59.7)	5.8	-0.01	1
Grade 10	168	48.5 (40.3, 57.5)	6.5	0.10	1
Marital status					
Unmarried	298	85.8 (80.0, 91.2)	6.2	0.11	1
Married	47	14.2 (8.8, 20.0)	5.8	0.05	1
Any employment					
No	284	85.1 (78.8, 90.6)	5.9	0.03	2
Yes	61	14.9 (9.4, 21.2)	7.2	0.20	3
Ever tested for HIV					
No	70	27.2 (19.1, 35.6)	4.5	0.01	2
Yes	275	72.8 (64.4, 80.9)	6.7	0.33	1
Self-reported HIV status					
Negative/Unknown	205	93.2 (87.7, 97.3)	6.7	0.01	1
Positive	16	6.8 (2.7, 12.3)	7.2	0.08	2
Willing to test for HIV					
No	60	19.1 (13.1, 26.8)	6.0	0.09	2
Yes	255	80.9 (73.2, 86.9)	6.1	0.11	1
At risk for HIV (Perceived)					

	n	Adjusted population proportion (95% CI)	Mean Network Size	Homophily	Waves
No	172	54.8 (45.6, 64.5)	6.0	0.15	2
Yes	142	45.2 (35.5, 54.4)	6.1	0.17	2
Multiple sexual partners					
No	237	70.3 (62.9, 77.2)	6.0	-0.02	0
Yes	108	29.7 (22.8, 37.1)	6.4	0.03	0
Any transactional sex					
No	197	54.5 (46.3, 63.1)	6.4	0.16	1
Yes	148	45.5 (36.9, 53.7)	5.8	0.08	1
Daily methamphetamine use					
No	139	22.6 (17.3, 28.7)	10.9	0.23	0
Yes	206	77.4 (71.3, 82.7)	4.7	-0.23	0
Concurrent Mandrax use					
No	124	38.0 (29.6, 46.2)	5.8	0.01	1
Yes	221	62.0 (53.8, 70.4)	6.3	0.10	1
Concurrent marijuana use					
No	76	17.9 (12.3, 23.9)	7.5	0.05	0
Yes	269	82.1 (76.1, 87.7)	5.8	-0.05	0